सत्यमेव जयते

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

सेवा में / To

संलग्न सूची के अनुसार
As per list enclosed

विषय : दक्षिण क्षेत्र विद्युत समिति (परेक्षण योजना) की 2nd बैठक का कार्यवृत।
Subject: Minutes of 2nd meeting of Southern Regional Power Committee (Transmission Planning) [SRPC(TP)].

महोदय (Sir)/महोदया (Madam),

दक्षिण क्षेत्रीय विद्युत समिति (परेक्षण योजना) की 2nd बैठक 01.10.2020 को आयोजित की गयी थी। बैठक का कार्यवृत संलग्न है।

The 2nd meeting of Southern Regional Power Committee (Transmission Planning) [SRPC(TP)] was held on 01.10.2020 through VC. Minutes of the meeting is enclosed for kind information.

भवदीय/Yours faithfully,
Signature Not Verified
Digitally signed by ISHAN SHARAN
Date: 2020.12.03 15:24:43 IST
(ईशान शरण/ Ishan Sharan)
निदेशक/ Director

Copy for kind information to:
1) PPS to Member PS, CEA

List of addressee:

1. The Member Secretary, Southern Regional Power Committee, 29, Race Course Cross Road, Bengaluru 560 009. FAX : 080-22259343	2. Chief Operating Officer (CTU-Plg), Central Transmission Utility, Power Grid Corporation of India "Saudamini" Plot No. 2, Sector-29, Gurugram-122001 Tel. No. 0124-2571816
3. Director (System Operations), POSOCO B-9, Qutub Institutional Area, Katwaria Sarai, New Delhi-110016 Tel. No. 26852843 Fax No. 2626524525, 26536901	4. Managing Director Karnataka Power Transmission Corp. Ltd., Cauvery Bhawan, Bengaluru - 560 009. FAX : 080 -22228367
5.Chairman and Managing Director, Transmission Corp. of Andhra Pradesh Ltd., (APTRANSCO) Gunadala, Eluru Road, Vijayawada, Andhra Pradesh	6. Chairman-cum-Managing Director Transmission Corp. of Telangana Ltd., (TSTRANSCO) Vidyut Soudha, Khairatabad Hyderabad – 500 082.
7. Chairman-cum-Managing Director, Kerala State Electricity Board, Vidyuthi Bhawanam, Pattom, Thiruvananthapuram - 695 004. Fax : 0471-2444738	8. Managing Director, Tamil Nadu Transmission Corporation Ltd (TANTRANSCO), 6th Floor, Eastern Wing, 800 Anna Salai, Chennai - 600002. Fax : 044-28516362
9. The Superintending Engineer –I, First Floor, Electricity Department, Gingy Salai, Puducherry – 605 001. Fax: 0413-2334277/2331556	10. Executive Engineer, Divisional Office, Lakshadweep Electricity Department, Kavaratti Island, UT of Lakshadweep
11. Chairman & Managing Director, NTPC Limited, NTPC Bhawan, SCOPE Complex, Institutional Area, Lodhi Road,New Delhi – 110003	12. Chairman & Managing Director, NHPC Limited, N.H.P.C. Office Complex, Sector-33, Faridabad - 121003 (Haryana)
13. Chairman, Solar Energy Corporation of India Limited, 1st Floor, D-3, A Wing, Primus Platinum Building, District Centre, Saket, New Delhi – 110017	

Other invitees:

Director (Operations), NPCIL, Mumbai dschoudhary@npcil.co.in	Director (Power), NLC India Limited Neyveli, Tamil Nadu dir.power@nlcindia.in	Director (Planning & Projects) NLC India Limited Neyveli, Tamil Nadu dpp.co@nlcindia.in

Minutes of 2nd meeting of Southern Regional Power Committee (Transmission Planning)

Date: 01.10.2020 **Time: 11:00 A.M**

List of participants is at **Annex-I**.

Chairperson, CEA [with additional charge of Member (Power System), CEA], welcomed the participants.

Chief Engineer (PSPA-I), CEA, also welcomed the participants. He informed that the 1st Southern Regional Power Committee (Transmission Planning) [SRPC(TP)] meeting was held on 16.12.2019. RPC(TP) meeting is to be held once in every quarter. However, due to COVID-19 pandemic, the 2nd SRPC(TP) meeting has been delayed. Further, if the meetings are held every quarter, agenda items would be less and few presentations on technical aspects of power system planning could be arranged in each meeting. Thereafter he requested Director (PSPA-I), CEA, to take up the agenda points.

1.0 Minutes of 1st Meeting of Southern Regional Power Committee (Transmission Planning) [SRPC(TP)]

1.1 Director (PSPA-I), CEA, informed that minutes of 1st SRPC (TP) meeting held on 16.12.2019 at Hyderabad, was circulated vide letter No. CEA-PS-12-14(12)/1/2018-PSPA –II/I/9079/2020 dated: 12.02.2020. Comments/observations on the minutes have not been received.

The minutes of 1st SRPC (TP) meeting as circulated was confirmed.

Follow up issues of previous meetings of Southern Region Standing Committee on Transmission (SRSCT)/ Southern Regional Power Committee (Transmission Planning) [SRPC(TP)]

2.0 Modifications in 220 kV transmission system proposed by KPTCL at Yalwar (associated transmission lines of 400/220 kV Yalwar Substation.)

2.1 Director (PSPA-I), CEA, stated that the KPTCL had requested for the modifications in the associated 220 kV transmission system of 400/220 kV Yalwar S/S. This system, as agreed in the 2nd SRSCT meeting held on 10.06.2019 is given below:

i. LILO of both circuits of existing B. Bagewadi – Lingasugur 220 kV D/C line at Yalwar.
ii. LILO of both circuits of Bijapur- Sindagi 220 kV D/C line at Yalwar sub-station.
iii. B. Bagewadi -Yalwar 220 kV D/C line.

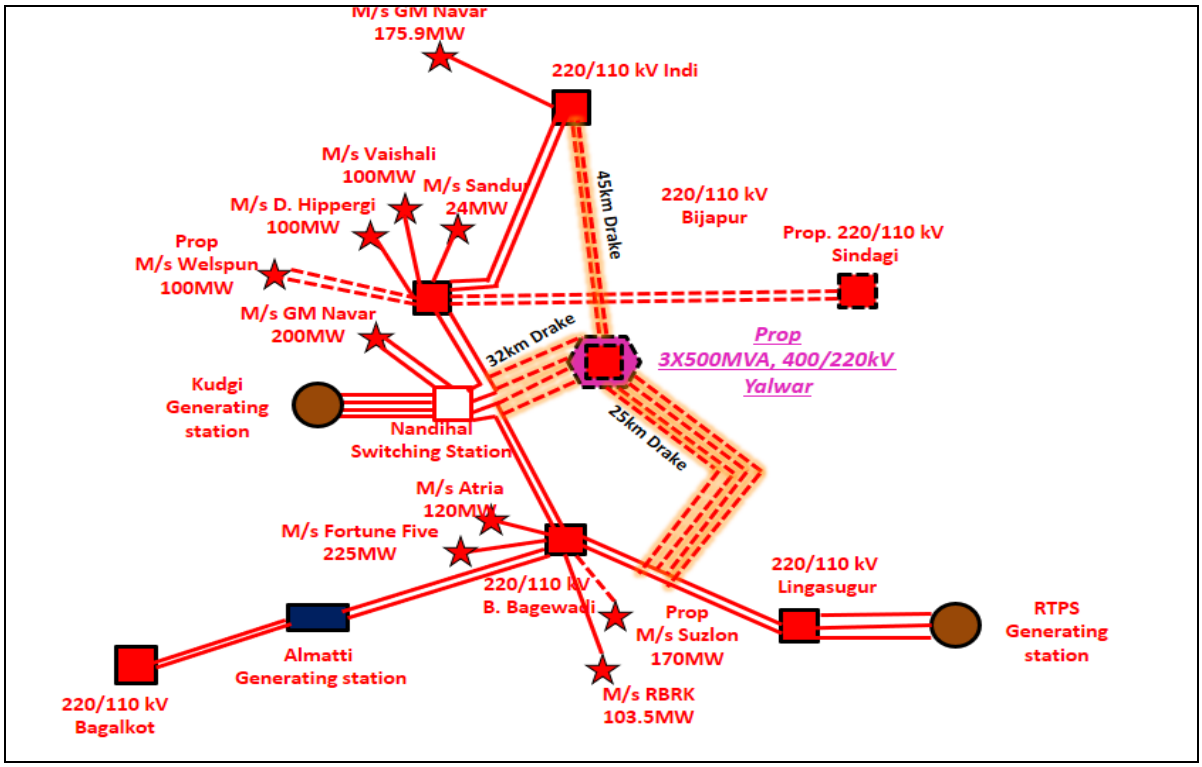
2.2 Modifications in 220 kV transmission system proposed by KPTCL, as given below was discussed in the 1st SRPC(TP) meeting held on 16.12.2019.

i. D/C LILO of existing B.Bagewadi – Lingasugur 220 kV D/C line to the proposed 400/220 kV Yalwar sub-station.

ii. 220 kV D/C line from proposed 400/220 kV Yalawar (Shivanagi) sub-station to 220 kV Indi substation.

iii. 220 kV multi-circuit line to the LILO point of 220 kV DC Basavana Bagewadi-Vijayapur line near 220 kV Nandihal switching station.

The transmission line at Sl. No. (i) was already agreed in the 2nd SRSCT meeting. Changes have been suggested in Sl. No. (ii) and (iii).



2.3 In the 1st SRPC(TP) meeting, Chief Engineer (PSPA-II), CEA, had stated that with the proposed connectivity, there would be unequal loading between B. Bagewadi –Yalwar. KPTCL representative had informed that in order to solve the problem of unequal loading, they were planning to use series capacitors for matching the impedance of transmission lines between B. Bagewadi –Yalwar. COO(CTU) had opined that Kudgi generating station being nearby, use of series capacitors in the transmission line may cause the problem of sub-synchronous resonance. As such, it was decided in the 1st SRPC(TP) meeting that KPTCL will carry out detailed study with the planned series capacitors and submit the study results to CEA.

2.4 Chief Engineer (PSPA-I), CEA, inquired about the results of detailed technical study with the planned series capacitors.

2.5 Representative of KPTCL informed that detailed survey is being carried out to finalize the route length of the proposed LILO line (4 nos. of 220 kV circuits) from proposed 400/220 kV Yalwar sub-station to LILO the existing 220 kV B.Bagewadi - Lingasugur DC line. Detailed technical study shall be carried out after the line length is finalized. Results of the detailed technical study would be submitted before the next SRPC(TP) meeting.

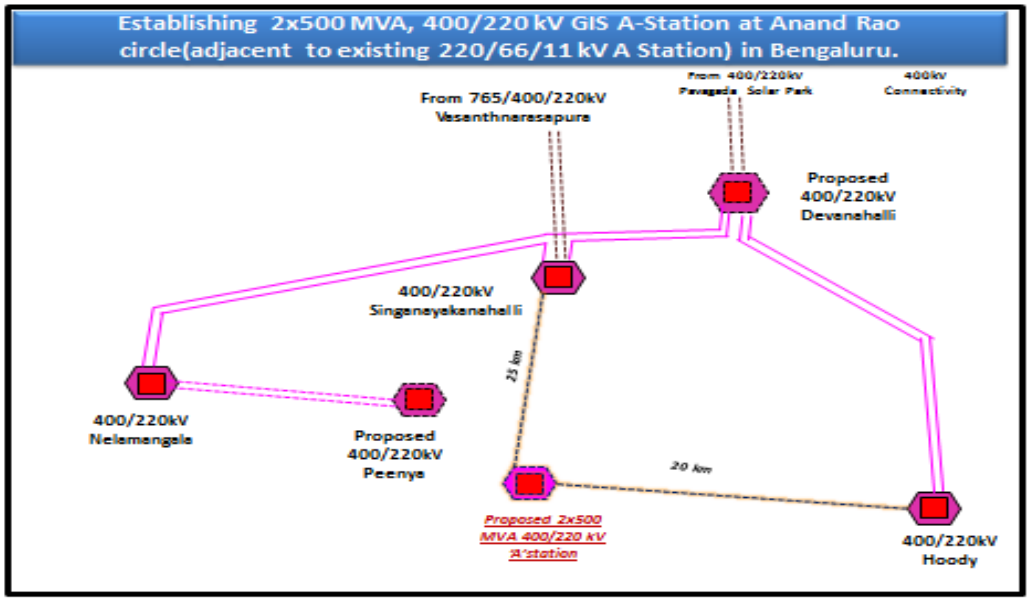
Members noted the same.

3.0 Establishing 2x500 MVA, 400/220 kV GIS A-Station at Anand Rao circle (adjacent to existing 220/66/11 kV A Station) in Bengaluru

3.1 Director (PSPA-I), CEA, stated that KPTCL has proposed the establishment of 2x500 MVA, 400/220 kV GIS A-Station at Anand Rao circle (adjacent to existing 220/66/11 kV A Station) in Bengaluru with following connectivity:

400 kV Connectivity:

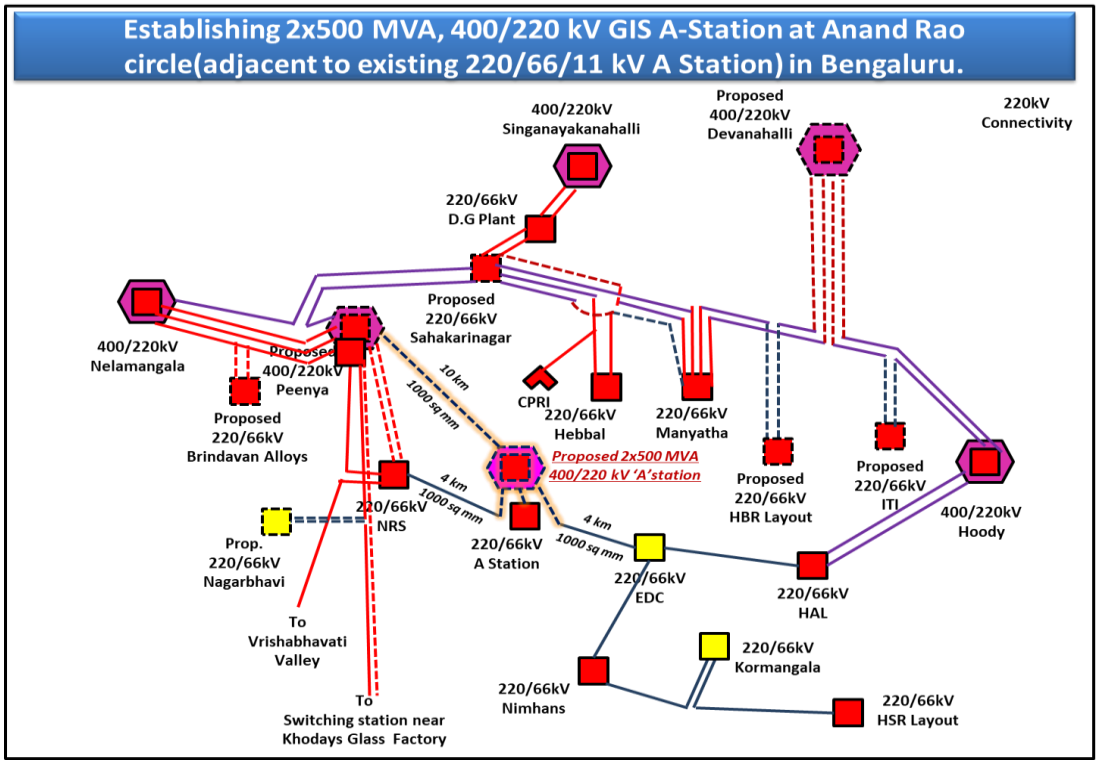
i. 400 kV connectivity from 400/220 kV Singanayakanahalli PGCIL substation which is at a distance of 25 km from the proposed substation.
ii. 400 kV connectivity from 400/220 kV Hoody substation which is at a distance of about 20 km from the proposed substation.



220 kV connectivity:

i. The existing 220 kV 'A' station will be connected to the 220 kV bus of proposed 400 kV 'A' station.
ii. The existing 220 kV UG cable between NRS and "A" station and existing 220 kV UG cable between EDC and "A" station will be terminated to 220 kV bus of 400 kV substation proposed at 'A' station.

iii. The proposed 220 kV UG cable between Peenya and "A" station (proposed in 400 kV Peenya scheme) will be terminated to 220 kV bus of 400 kV substation proposed at 'A' station.



3.2 The proposal was discussed in the 1st SRPC(TP) meeting held on 16.12.2019. In the meeting, KPTCL had informed that looking into the severe RoW issues involved in Bengaluru area, underground AC transmission cables of 400 kV and 220 kV levels shall be used for connectivity of the proposed substation. It was also informed by KPTCL that presently at 400 kV level, about 19 km long UG AC cable is in operation in Saudi Arabia only. Representative of CTU had opined that 25 km long AC cable at 400 kV level shall generate huge amount of reactive power and losses/temperature rise in the cable would also be very high. This may pose problem in operation of the cable. KPTCL had been requested to present operational experience of such long cable at 400 kV level along with suitable reactive compensation scheme. Accordingly, it had been decided that KPTCL shall submit the detailed technical feasibility report of the scheme and the same would be discussed in the next SRPC(TP) meeting.

3.3 Chief Engineer (PSPA-I), CEA, inquired about the detailed technical feasibility report for using 25 km long UG cable at 400 kV level.

3.4 Representative of KPTCL informed that they were looking at other alternatives viz. overhead line along with cable and the length of 400 kV UG cable would be reduced to 4 - 5 km in place of 25 km. KPTCL further informed that they will be submitting the study/firm proposal before the next SRPC (TP) meeting.

Members noted the same.

4.0 Proposal for grant of connectivity to NLC India Ltd for TPS-II 2nd Expansion (2x660 MW) in Cuddalore, Tamil Nadu, and to control high short circuit fault level in Neyveli Generation complex.

4.1. Proposal for grant of connectivity to M/s NLC India Ltd for Neyveli TPS-II 2nd Expansion (2x660 MW) had been discussed and agreed in the 2nd SRSCT meeting held on 10.06.2019 and subsequently in the 1st SRPC (TP) meeting held on 16.12.2019. In view of connectivity requirement of Neyveli TPS-II 2nd Expn. from April, 2021, and expected commissioning of Manalmedu (TANTRANSCO) substation by December, 2021, it was agreed in 1st SRPC(TP) meeting that LILO of 2nd circuit of Neyveli TS-II / Neyveli TS-I Expn - Trichy 400 kV D/c line at Nagapattinam, shall be by-passed only after commissioning of Manalmedu S/s, Neyveli TPS II 2nd Expn – Manalmedu 400 kV D/c (Quad) line and Manalmedu – Ariyalur 400 kV D/c line by TANTRANSCO.

4.2. Accordingly, following was agreed in the 2nd SRSCT/ 1st SRPC(TP) meeting(s):

Transmission System for providing connectivity to Neyveli TPS-II 2nd Expn (2x660 MW):

i. Re-storation of Neyveli TS-II/Neyveli TS-I Expn - Trichy 400 kV D/c lines through suitable arrangement of bypassing the LILOs at Nagapattinam– to be implemented under ISTS.
ii. Utilization of LILO sections for making Neyveli TPS-II 2nd Expn – Nagapattinam 400 kV, 2xD/c lines upto Neyveli TPS-II 2nd Expn swithchyard - to be implemented under ISTS.
iii. 2nd circuit of Neyveli TS-II / Neyveli TS-I Expn – Trichy 400 kV D/c line shall be restored i.e. LILO of 2nd circuit at Nagapattinam to be bypassed only after commissioning of Manalmedu S/s, Neyveli TPS II 2nd Expn – Manalmedu 400 kV D/c (Quad) line and Manalmedu – Ariyalur 400 kV D/c line by TANTRANSCO.
iv. 2x125 MVAr bus reactors at generation switchyard (Neyveli TPS-II 2nd Expn) – by NLC India Ltd.
v. The line bays at generation switchyard would be implemented by NLC India Ltd.
vi. Generation switchyard to be designed with 50 kA short circuit level.

4.3. Additional system strengthening was agreed in the above meetings for control of short circuit levels in Neyveli generation complex and re-arrangement of network configuration to control overloading of ICTs / 230 kV lines from Neyveli generation complex:

i. Neyveli TS-II – Cuddalore 400 kV D/c (Quad) line – under the scope of TANGEDCO as agreed in 1st SRSCT.

ii. Manalmedu – Neyveli TPS-II 2nd Expn 400 kV D/c (Quad) line (in place of Cuddalore – Manalmedu 400 kV D/c line agreed in 1st SRSCT) – under the scope of TANGEDCO.

iii. Bypassing of one ckt. of Neyveli TS-II - Salem 400 kV D/c line of PGCIL and Neyveli TS-II- NNTPS 400 kV S/c line of PGCIL at Neyveli TS-II, to form NNTPS-Salem 400 kV S/c line (agreed in 42nd SCPSPSR) – to be implemented under ISTS.

4.4. Subsequently, CTU vide email dated 12.03.2020 had sought confirmation on start date of connectivity and expected commissioning schedule of both the units of Neyveli TPS-II 2nd

Expn. In reply to the email, M/s NLC India Ltd. had furnished the following information towards start date of connectivity and expected commissioning schedule:

- Date from which connectivity is required: year 2024-25 (Tentative)
- Date of commissioning of Unit 1: year 2025-26 (Tentative)
- Date of commissioning of Unit 2: year 2025-26 (Tentative)

4.5. CTU informed that in view of above mentioned tentative commissioning schedule of Neyveli TPS-II 2nd Expn, implementation of the associated transmission scheme may be required to be phased by TANTRANSCO.

4.6. NLC representative informed that start date of connectivity for Neyveli TPS-II 2nd Expn may be considered as 2025-26 (tentative). He further informed that the firm start date of connectivity can be confirmed only after award of the project, which is expected by February/March, 2021.

4.7. TANTRANSCO representative informed that works for Manalmedu S/s is likely to start by January/February, 2021, and the substation is expected to be commissioned by 2022-23. TANTRANSCO further informed that estimated line length for proposed Manalmedu – Ariyalur 400 kV D/c line is about 145 km. In view of uncertainty in commissioning schedule of Neyveli TPS-II 2nd Expn and keeping in view the long line length, TANTRANSCO proposed that instead of Manalmedu – Ariyalur 400 kV D/c line, LILO of NNTPS – Neyveli TS-II 400 kV S/c line at Manalmedu S/S may be considered.

4.8. SRLDC representative stated that the 400 kV Neyveli TS II – NNTPS S/C line is heavily loaded during high wind season and less generation in Chennai area and hence the proposed re-arrangement of 400 kV NNTPS – Neyveli TS II & 400 kV Neyveli TS II – Salem line as 400 kV NNTPS – Salem S/C line would relieve the line loading and the same may be expedited and delinked from transmission system for Neyveli TPS II 2nd Expn. The proposed re-arrangement work may be carried out before the next high wind season. SRLDC representative also stated that the 230 kV network in NLC/NNTPS area is heavily loaded. This re-arrangement may not relieve loadings in downstream network, however, commissioning of 400 kV Manalmedu S/S and 400 kV Ariyalur S/S and its downstream network would relieve the congestion and the same may be expedited.

4.9. CTU representative informed that the ICTs of 2x250 MVA at Neyveli TS-II needs to be upgraded to 2x500 MVA. NLC representative informed that upgradation of ICT's may not be possible due to unavailability of adequate space.

4.10. Chief Engineer (PSPA-I), CEA, opined that since the tentative start date of connectivity of Neyveli TPS II 2nd Expn is 2025-26, whereas the Manalmedu S/s is expected to be commissioned by 2022-23, phasing of transmission system is required. TANTRANSCO has also proposed change in connectivity for Manalmedu S/s. In view of this, it was decided that CEA, SRPC, CTU, POSOCO/SRLDC, NLC and TANTRANSCO may jointly study the proposal and also work out phasing of the transmission scheme. The same would be discussed in next SRPC(TP) meeting.

5.0 Overloading of 400 kV NP Kunta-Kolar S/C line

5.1. Director (PSPA-I), CEA, informed that overloading of N.P. Kunta-Kolar 400 kV S/c line was discussed in the 2nd SRSCT meeting and subsequently in the 1st SRPC(TP) meeting. In the 1st SRPC(TP) meeting held on 16.12.2019, representative of POSOCO had informed that the NP Kunta-Kolar line was heavily loaded in the months of February to May. This happened even when import of power in Southern Region from NEW grid was as low as 4,000 MW. Hence, it was proposed that the 400 kV Cuddapah - NP Kunta - Kolar line may be by-passed at NP Kunta and restored as 400 kV Cuddapah - Kolar line. Other alternative like strengthening, including re-conductoring of NP Kunta-Kolar section may also be explored. It was also informed that the high loading also constrained the operator to reduce the import at Kolar or whenever there was outage of a pole at Kolar HVDC terminal. It had been decided in the 1st SRPC(TP) meeting that CEA, CTU and SRLDC/POSOCO may jointly study the matter and the same would be discussed in the next SRPC(TP) meeting.

5.2. CTU representative informed that based on the inputs from NLDC/RTAMC, detailed studies were carried out. From the studies, it was observed that high loading on NP Kunta – Kolar 400 kV S/c line can be addressed with bypassing of Cudappah – NP Kunta 400 kV S/c line and NP Kunta – Kolar 400 kV S/c line at NP Kunta through suitable arrangement at NP Kunta sub-station to form Cudappah – Kolar 400 kV S/c line. CTU further proposed that initially the Cudappah – NP Kunta and NP Kunta – Kolar 400 kV S/c lines can be bypassed at NP Kunta sub-station and re-conductoring of NP Kunta – Kolar 400 kV line may be carried out with higher capacity conductor (like twin HTLS equivalent to Quad Moose). Upon completion of re-conductoring work, the LILO may again be restored to form Cuddapah – NP Kunta 400 kV S/c line and NP Kunta – Kolar 400 kV S/c line. This arrangement of LILO would provide additional path from NP Kunta and would enhance reliability in evacuation of power from NP Kunta solar park.

5.3. SRLDC informed that they agree with the proposal of CTU, as re-conductoring of the NP Kunta – Kolar 400 kV line and the LILO arrangement will provide more flexibility to grid operator and will help in better management of the grid. Representative of KPTCL and APTRANSCO also agreed to the proposal.

5.4. APTRANSCO enquired about the commercial implication of re-conductoring of the NP Kunta-Kolar 400 kV line. It was informed that re-conductoring of the line is to be carried out to address the operational constraints and the same shall be implemented as regional system strengthening scheme.

5.5. COO(CTU) opined that for re-conductoring of NP Kunta - Kolar 400 kV S/C line, rating of bay equipments at both ends would need to be examined and the same may need to be upgraded, if required.

5.6. After detailed deliberations, following was agreed for implementation as Regional System Strengthening scheme:

i. Cudappah – NP Kunta 400 kV S/c line and NP Kunta – Kolar 400 kV S/c line shall be temporarily bypassed with suitable arrangement at NP Kunta sub-station to form Cudappah – Kolar 400 kV S/c line
ii. Re-conductoring of the NP Kunta – Kolar 400 kV S/c line (twin Moose) section with high capacity conductors (like twin HTLS equivalent to Quad Moose).
iii. Upgradation of 400 kV bays equipment at NP Kunta and Kolar for NP Kunta – Kolar 400 kV line section (if required).
iv. Restoration of LILO arrangement to form Cuddapah – NP Kunta 400 kV S/c line and NP Kunta – Kolar 400 kV S/c line upon completion of re-conductoring works of NP Kunta – Kolar line.

Members agreed for the same.

6.0 Short Circuit studies and Over/Under Voltage studies for Southern Region

6.1. **Over/Under Voltages:** CTU informed that in the 1st SRSCT meeting held on 07.09.2018, implementation of 27 nos. of bus reactors were agreed at different ISTS and STU substations in Southern Region. The reactors are under different stages of implementation.

6.1.1 SRLDC representative informed that high voltage is being observed at a number of substations in Southern Region during off-peak load conditions. In some instances, voltage in Telangana was observed to be as high as 440 kV and as many as 60 lines had to be opened to control the voltage. SRLDC stressed that opening of transmission lines to control voltage would reduce the system reliability and requested to expedite the commissioning of planned bus reactors. The bus reactors planned in a transmission scheme should be available before the charging of first transmission line emanating from the substation.

6.1.2 It was also opined that line reactors may be converted to switchable line reactors, wherever feasible, so that same may be utilized as bus reactors to control the high voltage situations.

6.1.3 Chief Engineer (PSPA-I), CEA, opined that space availability at some of the existing sub-stations may be a problem for converting existing line reactors to switchable line reactors for their utilization as bus reactors.

6.1.4 CTU informed that reactive power planning is a continuous process and adequate reactive compensation is being planned at the inception of transmission projects. Further, based on the feedback received from grid operator, reactive compensation requirements of the entire Southern Region is assessed on a regular basis and suitable reactive compensation devices, wherever required, are being identified through detailed system studies. Accordingly, 27 nos. of bus reactors were finalized at different substations in Southern Region. In case the high voltage conditions persists even after considering above planned/under implementation bus reactors, comprehensive reactive compensation studies may be carried out considering high RE integration in Southern Region.

6.1.5 TANTRANSCO representative stated that it has been observed that in certain cases of delay in the commissioning of transmission lines awarded through TBCB, the line reactors are being

commissioned and utilized as bus reactors which is leading to excess tariff/ transmission charges on DICs.

6.1.6 Chief Engineer (PSPA-I), CEA, opined that grid stability and reliability should be of utmost importance and in case there is a possibility of utilizing an available reactor to control high voltage situation in the grid, the same may be availed in consultation with stakeholders including the grid operator.

6.1.7 Member Secretary, SRPC, informed that earlier PSDF funding was available for installation of reactors. However, now PSDF funding is not being provided for installation of reactors. Some reactors in Southern Region are held up due to non-availability of PDSF funding. COO(CTU) informed that installation of reactors does not qualify for funding through PSDF.

6.1.8 It was also informed that a committee has been constituted in CEA to look after the high/low voltage issues and reactive power planning. Suggestions of the committee would also be kept in view while carrying out reactive power planning exercise in Southern Region.

6.1.9 After detailed deliberations, it was decided that respective states shall expedite the implementation of already approved reactors and SRPC may closely monitor the implementation of the same as the reactors are critical in controlling the high voltage conditions in the SR grid.

6.1.10 Details of the reactors and their present implementation status as informed during the meeting are as given below.

Sl. No.	Bus Name	Voltage (kV)	ISTS / State	Existing / UC Bus Reactor (MVAr)	Type	Shunt Reactor Agreed (MVAr)	Updated Status
1	HOSUR	400	ISTS	63	Bus	125	Awarded, SCOD – July 2021
2	MADHUGIRI	400	ISTS	63	Bus	125	
3	DHARAMPURI	400	ISTS	-	Bus	125	
4	HIRIYUR	400	ISTS	-	Bus	125	
5	PUGALUR	400	ISTS	-	Bus	125	
6	PUGALUR HVDC STN	400	ISTS	-	Bus	2x125	
7	RACHAGUNNERI	400	AP	-	Bus	125	Expected to be commissioned by December 2020.
8	HINDUPUR	400	AP	80	Bus	125	80 MVAR Bus Reactor is expected to be commissioned by December 2020. Works are to be awarded for 125 MVAr reactor.
9	YERAMARUS	400	KAR	-	Bus	125	KPTCL informed that they would obtain the status from PCKL and inform accordingly.
10	BELLARY PS	400	KAR	-	Bus	2x125	Commissioned
11	CN HALLI	400	KAR	-	Bus	2x125	Expected to commissioning by 2022-23
12	JAGALUR	400	KAR	-	Bus	2x125	Instead of 2x125MVAR, 2x80 MVAR bus reactor commissioned.
13	WAYANAD	400	KER	-	Bus	125	Wayanad S/s is under approval. Reactor to be planned along with sub-station.

Sl. No.	Bus Name	Voltage (kV)	ISTS / State	Existing / UC Bus Reactor (MVAr)	Type	Shunt Reactor Agreed (MVAr)	Updated Status
14	VELALIVIDU	400	TN	-	Bus	125	Instead of 125MVAR reactor (as approved), 1x80 MVAR is under implementation & expected to be commission by March, 2021.
15	UDDANDAPUR	400	TEL		Bus	125	Preparation of technical sanction is under progress.
16	KTPP SS	400	TEL		Bus	125	Works awarded for construction of 400/220/132 kV KTPP SS along with 1x125 MVAR reactor vide PO dated : 22.05.2020 and works are under progress
17	RAIDURG	400	TEL	-	Bus	125	Works have been taken up against the ongoing contract of Rayadurg GIS sub-station and are under progress.
18	NARLAPUR	400	TEL		Bus	125	Contract has been awarded for the erection pf 400 kV LI SS at Narlapur, Vattem, Yedula along with supply & erection of 1x125 MVAr reactor at each substation. The work is likely to be completed in 2021-22.
19	YEDULA	400	TEL		Bus	125	
20	VATTEM	400	TEL		Bus	125	
21	NARSAPUR	400	TEL	-	Bus	125	Works will be taken up after sanction of grant from PSDF.
22	KETHIREDDYPALLI	400	TEL	-	Bus	125	
23	KAMALAPURAM	400	TEL	-	Bus	125	Works have been taken up against the ongoing contract of Kamalapuram LI sub-station and are under progress.
24	TIPPAPUR	400	TEL	-	Bus	125	Executing agency was requested to procure and erect 125 MVAr Reactor Bay each at 400 kV Tippapur & Sundilla (Yellampally) and work is under progress.
25	SUNDILLA (YELLAMPALLI)	400	TEL		Bus	125	
26	CHANDULAPUR	400	TEL		Bus	125	All works are completed and the date of commissioning of Reactor Bay is 06.09.2019.
27	CHOUTTUPPAL	400	TEL	-	Bus	125	Works awarded for construction of 400/220/132 kV Choutuppal SS along with 1x125 MVAR Bus Reactor vide LOI dated: 06.08.2020 and are under progress.
28	DINDI	400	TEL		Bus	2x125	Administrative approval was accorded by TSTRANSCO for installation of Bus/Line Reactors in phased manner at various sub-stations. Accordingly, tenders were invited and finalized for execution of Reactors bays at these substations in first phase. However, procurement of reactors and awarding of contract for reactor bays is pending due to delay in sanction of PSDF.
29	JANAGAON	400	TEL		Bus	125	
30	SURYAPET	400	TEL		Bus	125	
31	MAHESHWARAM-TS	400	TEL		Bus	125	
32	ASUPAKA	400	TEL		Bus	80	
		400	TEL		Line	63	

6.2. **Short Circuit Level:** In the 1st SRPC(TP) meeting held on 16.12.2019, CTU had informed about the likely locations where high short circuit level could be experienced in 2023-24 time frame. It had been decided in the 1st SRPC(TP) meeting that STUs may also carry out detailed

studies for identification of locations where fault levels were expected to cross the design limits and suggest necessary measures for control of fault level. Details of short circuit current and switchyard rating of ISTS and STU substations as informed are tabulated below.

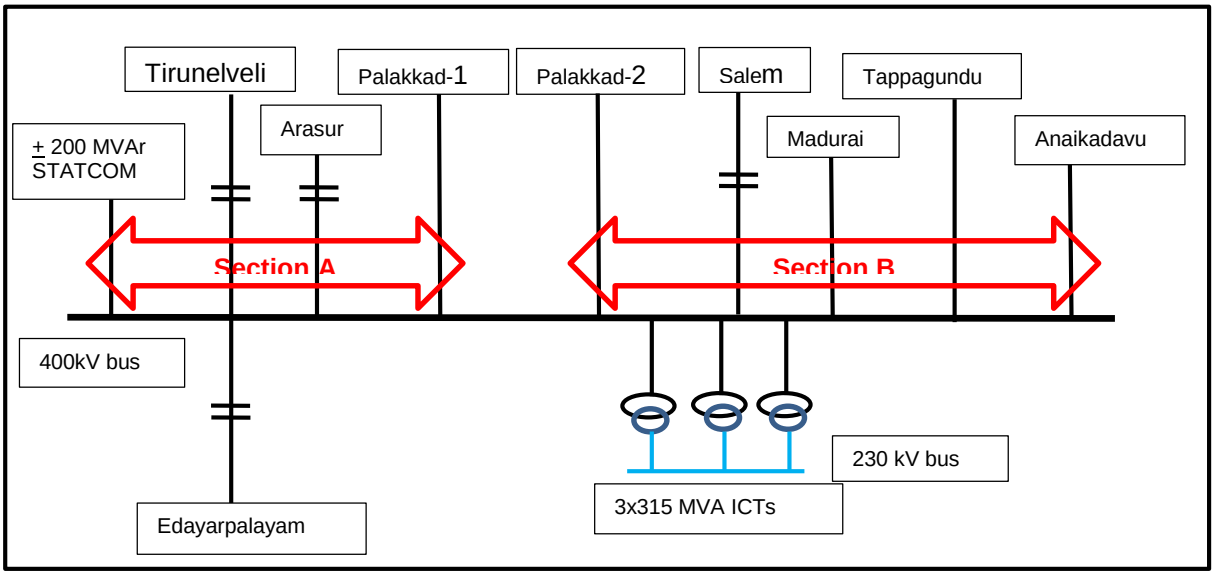
Sl. No.	Substation	Voltage level (kv)	3-Ph SC (kA)	1-Ph SC (kA)	Ownership	Switchyard rating (kA) / Remarks
1.	MAHESHWARAM-TS	400	63.7	45.5	TSTRANSCO	50
2.	MAHESHWARAM	400	63.5	45.6	POWERGRID	63
3.	UDUMALPET	400	51.8	37.1	POWERGRID	40
4.	YADADRI	400	49.3	49.9	TSTRANSCO	50
5.	CHITTOR	400	47.4	33.5	APTRANSCO	Fault level are expected to remain within design limits with implementation of ***scheme to control fault level at Thiruvalam S/s***
6.	DINDI	400	46.9	33.2	TSTRANSCO	50
7.	EDAYARPALAYAM	400	46.7	33.3	TANTRANSCO	63
8.	TIRUNELVELI	400	45.7	35.0	POWERGRID	40
9.	HYDERABAD-TS	400	45.5	31.0	TSTRANSCO	40
10.	KURNOOL	400	45.1	33.3	APTRANSCO	
11.	KURNOOL	765	40.5	27.5	POWERGRID	40

6.2.1 Use of fault limiting reactors for limiting the fault current was brought out. Member Secretary, SRPC, opined that the existing sub-stations may not have sufficient space for installation of fault limiting reactors. He opined that the upcoming sub-stations must have adequate space for installation of reactors to limit the fault current.

6.2.2 Chief Engineer (PSPA-I), CEA, opined that study needs to be carried out to evolve schemes to control the fault level in entire southern region.

6.2.3 TSTRANSCO sought the views of CEA/CTU to control the fault level at Maheshwaram-TS sub-station. It was decided that the scheme to control the fault level at Maheshwaram-TS may be evolved through joint system study with participation from CEA, SRPC, CTU, TSTRANSCO and POSOCO/SRLDC. It was also decided that scheme for controlling fault level at Kurnool (APTRANSCO), Hyderabad-TS (TSTRANSCO), Tirunelveli (POWERGRID) may be put-up for discussions in subsequent SRPC(TP) meetings.

6.2.4 For controlling the fault level at Udumalpet S/s, CTU informed that from the system studies carried out for 2023-24-time frame, the 3-phase short circuit levels at 400 kV bus of Udumalpet S/s is expected to be of the order of about 49 kA, whereas the substation is designed for 40 kA fault level. Accordingly, the Udumalpet substation is proposed to be splitted into two buses for putting-up the 12Ω, 420 kV fault limiting bus series reactors. Schematic diagram of the scheme is as given below:



6.2.5 The study results are tabulated below.

Alt.	Scheme	Connectivity Details	3-Ph Fault current (kA)	
			Section-A	Section-B
	Base case	Palakkad D/c line, Arasur D/c line, Edayarpalayam(quad) D/c line, Tirunelveli D/c line, Salem D/c line, Madurai S/c line, Tappagundu S/c line, Anaikadevu S/c line and 3x315 MVA, 400/230kV ICTs	49.1	-
1	12Ω, 420kV fault limiting bus series reactors between Bus Section-A & Bus Section-B	**Bus section-A:** One ckt. of Palakkad D/c line, Arasur D/c line, Edayarpalayam (quad) D/c line, Tirunelveli D/c line **Bus section-B:** 2nd ckt. of Palakkad D/c line, Salem D/c line, Madurai S/c line, Tappagundu S/c line, Anaikadevu S/c line and 3x315 MVA, 400/230 kV ICTs	38.2	38.3
2	12Ω, 420kV fault limiting bus series reactors between Bus Section-A & Bus Section-B 12Ω, 420 kV fault limiting series line reactor in Udumalpet – Anaikadevu 400kV S/c line at Udumalpet	**Bus section-A:** One ckt. of Palakkad D/c line, Arasur D/c line, Edayarpalayam (quad) D/c line, Tirunelveli D/c line **Bus section-B:** 2nd ckt. of Palakkad D/c line, Salem D/c line, Madurai S/c line, Tappagundu S/c line, Anaikadevu S/c line and 3x315 MVA, 400/230 kV ICTs	38.2	36.2

Alt.	Scheme	Connectivity Details	3-Ph Fault current (kA)	
			Section-A	Section-B
3	12Ω, 420 kV fault limiting bus series reactors between Bus Section-A & Bus Section-B Bypass of one ckt of Udumalpet – Arasur and Udumalpet – Anikadevu at Udumalpet to form Anikadev – Arasur 400kV S/c line	**Bus section-A:** One ckt. of Palakkad D/c line, Arasur S/c line, Edayarpalayam (quad) D/c line, Tirunelveli D/c line. **Bus section-B:** 2nd ckt. of Palakkad D/c line, Salem D/c line, Madurai S/c line, Tappagundu S/c line and 3x315 MVA, 400/230kV ICTs	35.7	32.5

6.2.6 From the above study results, it is observed that in case of Altenative-3, the fault level in both sections of the Udumalpet 400 kV bus remains well within 40 kA limit, the designed fault level of the bus.

6.2.7 SRLDC representative opined that during bypassing of any lines at 400 kV Udumalpet SS for addressing high short circuit level problem, the possibility of terminating at the same dia to be explored, providing flexibility to the grid operator.

6.2.8 TANTRANSCO proposed that bypass of Udumalpet – Anikadevu and one ckt of Udumalpet - Edayarpalyam may be carried out instead of bypass of Udumalpet – Anikadevu and one ckt of Udumalpet – Arasur line. CTU suggested that the proposed rearrangement requires further detailed system study in order to keep the fault current levels within the design limits.

6.2.9 After detailed deliberations it was decided that CEA, SRPC, CTU, TANTRANSCO and SRLDC/ POSOCO may jointly study the scheme for controlling fault level at Udumalpet S/s. The same would be discussed in the next SRPC(TP) meeting.

7.0 Augmentation of Transformer capacity in Southern Region (including augmentation of transformation capacity with 1x500 MVA, 400/220 kV ICT each at Kochi and Hiriyur 400 kV substations)

7.1 Director (PSPA-I), CEA, informed that in the 1st SRPC(TP) meeting held on 16.12.2019, it was brought out that the present peak demand of the Southern Region is about 49,000 MW (March, 2019), which is likely to increase to about 70,000 MW by 2023-24 (as per 19th EPS). To meet the growing power demand and to facilitate the constituents to draw their allocated power from the ISTS network, adequate transformation capacity needs to be provided. Further, POSOCO in operational feedback had mentioned that the requirement of transformation capacity augmentation may be identified for 765 kV and 400 kV substations under ISTS as well as Intra-STS substations.

7.2 Matter was discussed in 1st SRPC(TP) meeting, wherein CTU informed that based on the inputs from constituents, loading profile, and expected growth in electricity demand, augmentation of

transformation capacity required at various substations is identified from time-to time. System studies were carried out for 2023-24 time-frame, wherein ICT loadings at the certain substations were observed to exceed more than 80% of the transformer ratings. In the 1st SRPC(TP) meeting, it had also been decided that states may go through the proposal and review the requirement of augmentation of transformers at respective locations. The proposal from respective states for augmentation of transformation capacity shall be discussed in the next SRPC(TP) meeting.

7.3 CTU informed that in view of the observations received during the meeting and modifications/updation received from SR constituents on circulated all-India system study file, the network was updated and the studies were revised, wherein ICT loadings at the following substations is likely to exceed 80% of the ICT rating:

Sl. No.	Substation	voltage level (kV)	Ownership	Per ICT flow (MVA)	ICT ratings (MVA)	% loading	STU response/suggestion
1.	Kurnool	400/220	AP	264	3x315	84	With the proposed solar power projects in Prakasam, YSR Kadapa and Ananthapuram, it is expected that loading on ICTs at Kurnool will be reduced.
2.	Edayarpalayam	400/110	TN	244	2x200	122	400/110 kV substation with 3x200 MVA ICTs is under implementation and expected to be commissioned by 2022.
3.	Ottapidaram	400/110	TN	83	2x100	83	400/110 kV substation with 2x200 MVA ICTs is under implementation and expected to be commissioned by March, 2022.
4.	Salem	400/230	TN	262	2x315	83	Replacement of 2x315 MVA ICT (existing) by 2x500 MVA ICT had been approved in 41st SCPSPSR. TANTRANSCO is planning to add 3rd 1x315 MVA ICT, instead of replacing the existing 2x315 MVA ICTs by 2x500 MVA ICTs. Likely by December, 2021.
5.	Salem	400/110	TN	222	2x200	112	2x200 MVA ICTs are already existing. Additional 1x200 MVA ICT expected to be commissioned by December,2021.
6.	Manalmedu	400/110	TN	182	2x200	90	400/110 kV substation with 3x200 MVA ICT is yet to be awarded and is expected to be commissioned by 2022-23.

7.4 With regard to APTRANSCO's observation regarding ICT loading at Kurnool, CTU representative stated that with expected increased injection of solar power, ICT loadings are expected to further increase and adequate system strengthening, including ICT augmentation needs to be planned.

7.5 **Augmentation of transformation capacity at Hiriyur**: CTU representative informed that the matter of non-compliance of N-1 criteria of 2x315 MVA, 400/220 kV ICTs at Hiriyur S/S was discussed in 1st SRSCT meeting held on 07.09.2018, 2nd SRSCT meeting held on 10.06.2019

and 1st SRPC(TP) meeting held on 16.12.2019. In the 1st SRPC(TP) meeting, KPTCL had requested to consider augmentation of transformation capacity at Hiriyur substation. In addition, POSOCO in the operational feedback had also mentioned the issue of overloading of 2x315 MVA, 400/220 kV ICTs at Hiriyur. Accordingly, augmentation of transformation capacity at Hiriyur substation by 1x500 MVA, 400/220 kV was proposed as Regional System strengthening scheme.

7.6 After deliberations, proposal for augmentation of 1x500 MVA, 400/220 kV 3rd ICT at Hiriyur substation was agreed for implementation as Regional System strengthening scheme.

7.7 **Augmentation of transformation capacity at Kochi:** CTU informed that with the commissioning of Tirunelveli - Kochi 400 kV (quad) D/c line, loadings on 2x315 MVA, 400/220 kV ICTs at Kochi S/s has increased significantly. Presently both ICTs are loaded to about 80-90 % of their transformation capacity and are not complying N-1 criteria. CTU proposed augmentation of transformation capacity by 1x500 MVA, 400/220 kV ICT at Kochi substation as Regional System strengthening scheme. KSEB representative informed that the proposal may be agreed, however, decision shall be intimated after their management approval.

7.8 SE(Operation), SRPC, informed that as per studies carried out by SRLDC, it was observed that ICTs at Kochi are highly loaded and the loadings are expected to further increase with the commissioning of 2000 MW, ±320 kV Pugalur – Trichur VSC based HVDC system. Therefore, augmentation of transformation capacity at Kochi is required on urgent basis.

7.9 POSOCO representative also informed that additional ICT at 400/220 kV Cochin S/S is required urgently. The limiting constraint for S3 import TTC is N-1 of ICTs at 400/220 kV Cochin S/s for current network condition and for future network condition also i.e. after commissioning of 2000 MW, ±320 kV Pugalur –Trichur VSC based HVDC line. It was also informed that S3 TTC would be getting reduced from present level after commissioning of ±320 kV Pugalur – Trichur VSC based HVDC system due to increase of flow on Cochin ICTs.

7.10 After deliberations, proposal for augmentation of 1x500 MVA, 400/220 kV 3rd ICT at Kochi substation was agreed for implementation as Regional System strengthening scheme.

8.0 Evacuation of power from Telangana Ph-I (2x800 MW) Power Project of NTPC – provision of adequate margin in transmission system for evacuation of 15% unallocated quota (transmission system already agreed in 41st SCPSPSR meeting as intra-state system).

8.1 Director(PSPA-I), CEA, informed that NTPC had requested CTU to keep the margins in the ISTS Grid for evacuation and supply of 15% unallocated quota power from Telangana Ph-I TPS. CTU had stated that the generation project is a state embedded generation and its transmission system is being implemented by TSTRANSCO. Therefore, to keep the margin for 15% unallocated quota from the generation project in ISTS Grid, NTPC may apply for LTA under the Connectivity Regulations, 2009. In the 1st SRPC(TP) meeting, TSTRANSCO had informed that they were in discussions with NTPC for allocation of 100% power from the generation project.

8.2 TSTRANSCO representative informed that they have requested MoP for allocation of 100% power from Stage –I (2x800 MW) of 4000 MW Telangana STPP of NTPC. However, reply from MoP is awaited.

Members noted the same.

Transmission planning proposals by Andhra Pradesh

9.0 Provision of 4th ICT of 500 MVA capacity at existing 400/220 kV Vemagiri substation

9.1 Director (PSPA-I), CEA, informed that APTRANSCO vide letter dated 08.01.2020 has requested for augmentation of ICT capacity from 3x315 MVA to 3x315 + 1x500 MVA at existing 400/220 kV Vemagiri substation in order to overcome the ICT constraints, satisfy N-1 condition and for reliable power supply in the area.

9.2 POSOCO in its operational feedback for January-March, 2020, had also brought out that for the 400/220 kV, 3x315 MVA ICTs at Vemagiri, N-1 condition was not satisfied for 12% of the time in the month of March, 2020.

9.3 DGM (CTU) suggested that augmentation of ICT capacity from 3x315 MVA to 3x315 + 1x500 MVA at the existing 400/220 kV Vemagiri substation would also facilitate import of power from NEW grid to SR grid.

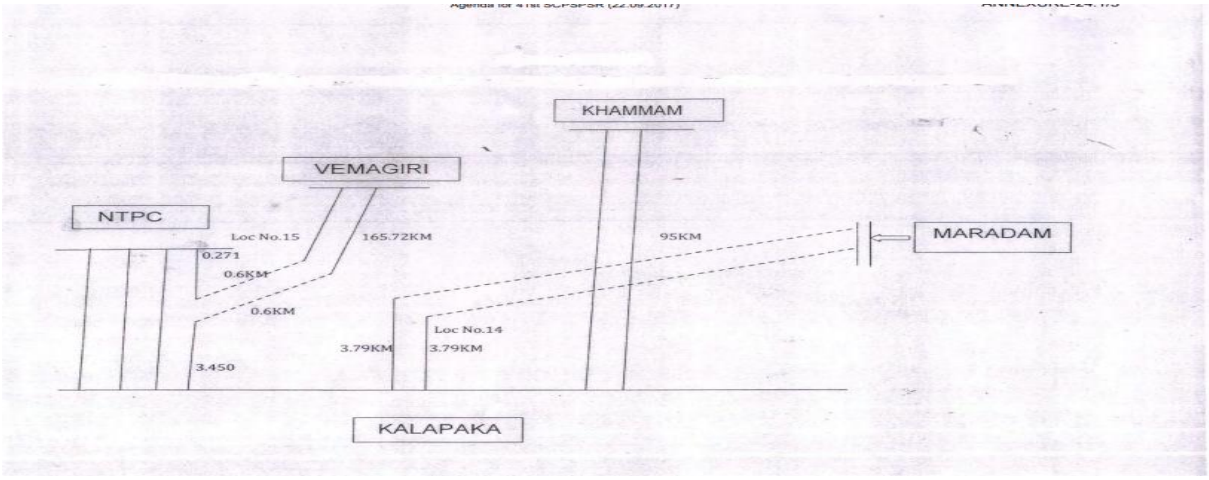
9.4 Representative from APTRANSCO inquired whether the cost of 4th ICT (500 MVA) would be charged to Regional pool or at state level. DGM (CTU) stated that existing 400/220 kV Vemagiri substation belongs to APTRANSCO, so the cost of additional ICT would have to be borne by the state.

9.5 After deliberations, the proposal of 4th ICT of 500 MVA at existing 400/220 kV Vemagiri S/S was agreed.

10.0 Erection of 400 kV Quad Moose DC line from 400 kV Kalpaka SS to 400 kV Garividi (Mardam) SS- replacement of existing Twin Moose Conductor with Twin Moose Invar conductor from location No. 1 to location No. 14.

10.1 Director (PSPA-I), CEA, stated that re-arrangement of Kalpaka-Garividi (Mardam) 400 kV Quad Moose D/C line was discussed in the 41st Meeting of Standing Committee on Power System Planning for Southern Region (SCPSPSR) held on 22nd September, 2017 at Chennai.

10.2 APTRANSCO vide letter dated 20.02.2020 had mentioned that APTRANSCO proposed to take up the 400 kV Quad Moose line from 400 kV Kalpaka SS to the proposed 400 kV Garividi (Mardam) SS by replacing the existing Twin Moose conductor with Twin Moose equivalent Invar conductor from location No. 1 to location No. 14 of 400 kV Kalpaka-Garividi (Mardam) D/C line. However, the same has not been mentioned in the minutes of the meeting of 41st SCPSPSR and APTRANCO had requested to issue necessary clarification/approval in this regard.



10.3 CEA vide letter dated 08.05.2020 had conveyed 'in-principle' approval for the following and recommended that modification would be formalized in the next meeting of SRPC(TP) and accordingly scope of the scheme that was agreed in the 41st SCPSPSR (para 24.4 of the minutes) would get partly modified.

The Kalpaka-Garividi (Mardam) 400 kV Quad Moose D/C line may be implemented as:

(i) The portion of line from Kalpaka SS end (location No. 1) to location No. 14, which comprises of Twin Moose conductor (existing Kalpaka-Vemagiri line), would be re-conductored with HTLS conductor equivalent to Quad Moose capacity, so as to match the capacity of the remaining portion of Kalpaka-Garividi (Mardam) Quad Moose line.

(ii) The transmission line from location No. 14 (of Kalpaka-Vemagiri line) to Garividi (Mardam) would be Quad Moose D/C line.

Members agreed for the same.

11.0 Evacuation of 6,100 MW (AC) of Solar Power proposed by Andhra Pradesh Green Energy Corporation Limited (APGECL) from various Pooling Stations under Phase-I out of 10,000 MW (AC) of Solar power

11.1 Director (PSPA-1), CEA, stated that APTRANSCO vide letter dated 24.09.2020 informed that Andhra Pradesh Green Energy Corporation Limited (APGECL) has proposed 6,100 MW (AC) of solar power to be set by them under Phase-I in Prakasam, YSR Kadapa and Ananthapur districts of Andhra Pradesh.

11.2 The locations of Solar Power Parks along with capacities are tabulated below. As per APTRANSCO, power generated from the solar parks would be used for meeting the nine hours Agricultural Supply in the state during day time.

Sl. No.	Location of Solar Park	Capacity proposed under Phase-I (MW)
1	C.S. Puram, Prakasam Dist.	600
2	Rudrasamudram, Prakasam Dist.	600
3	Pendlimarri, YSR Kadapa Dist.	500

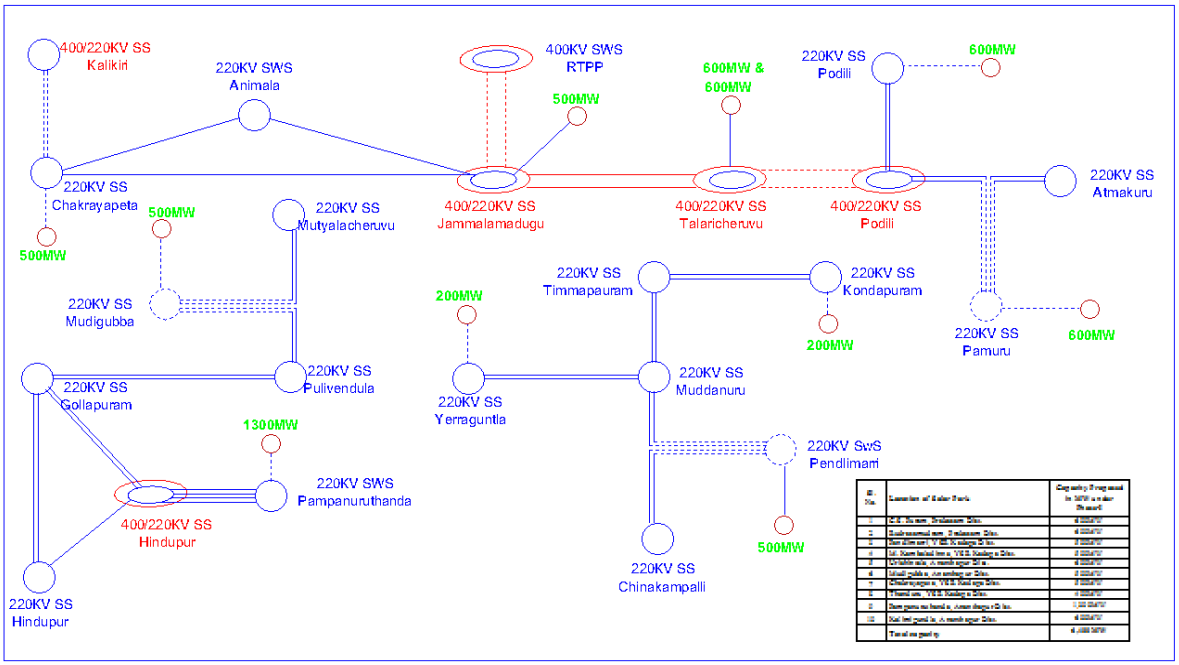
Sl. No.	Location of Solar Park	Capacity proposed under Phase-I (MW)
4	M. Kambaladinne, YSR Kadapa Dist.	500
5	Urichintala, Ananthapur Dist.	600
6	Mudigubba, Ananthapur Dist.	500
7	Chakrayapeta, YSR Kadapa Dist.	500
8	Thonduru, YSR Kadapa Dist.	400
9	Pampanuruthanda, Ananthapur Dist.	1,300
10	Kolimigundla, Ananthapur Dist.	600
	Total capacity	**6,100**

The already approved transmission schemes in AP and changes proposed by APTRANSCO are given below:

Sl. No.	Schemes approved earlier	Revised Proposals/Remarks
1	400 kV Jammalamadugu (Kondapuram) - Ghani QMDC line as per 38th SCPSPSR	**Dropped.** Proposed Lines: a) 400 kV QMDC line from Takaricheruvu to Podili b) 400 kV TMDC Line from Jammalamadugu (Kondapuram) to RTPP
	400KV SS Uravakonda: a) 2x315 + 2x500 MVA ICTs b) 220 kV DC line from 220 kV Vajrakarur SS to 220 kV Ananthapur SS as per 40th Standing Committee Meeting.	a) Proposed 4x500 MVA ICT to meet the N-1 contingency. b) **Dropped.**
3	400kV Talarichervu SS: 3x315 MVA ICT as per 40th Standing Committee Meeting.	Proposed 1x315 + 3x500 MVA ICTs
4	400/220kV SS at Mylavaram 3x315 MVA ICTs and 1x125 MVAR Bus reactor and 400kV QMDC line from 400kV Jammalmadugu–Mylavaram SS (2 km) for evacuation of 1000 MW of Solar Power at Mylavaram (1000MW Solar Power of Kadapa Ultra Mega Solar Park of APSPCL) as per 40th Standing Committee Meeting.	**Dropped.** **1000MW will be evacuated to 400 kV Jammalamadugu (Kondapuram) Substation:** a) PS-1 to Jammalamadugu SS: 220kV TMDC/SC line: 12.5 km b) PS-2 to Jammalamadugu SS: 220kV TMDC/SC line: 10.0 km c) PS-3 to Jammalamadugu SS: 220kV SMDC line: 8.0 km

Sl. No.	Schemes approved earlier	Revised Proposals/Remarks
		d) PS-4 to Jammalamadugu SS: 220kV SMDC Line: 9.8 km **(Already commissioned)**
5	400 kV Jammalamadugu SS (Kondapuram): 3x315 MVA ICTs as per 40th Standing Committee Meeting.	Proposed 2x500 +2x315 MVA ICTs
6	220 kV Single Moose DC line from 400/220 kV Hindupur SS to 220 kV Pampanur Tanda SS as per 40th Standing Committee Meeting.	Proposed 220 kV Twin Moose DC line from 400/220 kV Hindupur SS to 220 kV Pampanur Tanda SS.

11.3 The following transmission system has been proposed by APTRANSCO for evacuation of 6100 MW solar power:



11.4 APTRANSCO has carried out system studies for the following scenarios considering an annual peak electricity demand of 14,611 MW by the year 2022-23. A maximum capacity factor of 75% has been taken for wind and solar power as per Transmission Planning Criteria.

Scenario 1: Full Solar Full Wind (75% Solar, 75% wind)
Scenario 2: Full Solar Full Wind (75% Solar, 75% wind, RTPP NIL)
Scenario 3: Full Solar Less wind (75% Solar, 40% wind)
Scenario 4: Full Solar, No wind (75% Solar, 0% wind)
Scenario 5: Less Solar, Full wind (40% Solar, 75% wind)
Scenario 6: No Solar, Full wind (0% Solar, 75% wind)
Scenario 7: Less Solar, Less wind (40% Solar, 40% wind)
Scenario 8: No Solar, No wind (0% Solar, 0% wind)

11.5 Based on the system studies for the 6,100 MW Solar Power, the following evacuation lines are proposed for evacuation of 6,100 MW of Solar Power in Prakasam, YSR Kadapa and Ananthapur Districts under Phase-1.

Sl. No.	Description	Revised Solar Power Capacity	Revised Network for evacuation and Deletion of earlier proposed Lines
1	C.S. Puram Pooling Stations-1&2 to Pamur Substation Prakasam Dist.	600 MW	1) 220 kV TMSC Line (4 km) from PS-1 to Common Tower, 220 kV TMSC Line (4 km) from PS-2 to Common Tower and 220 kV TMDC Line (15 km) from common Tower to Pamur SS. 2) Upgradation of existing 132 kV SS/Pamur into 220 kV SS. 3) Double LILO of existing 220 kV SMDC Line from 400 kV SS/Podili to Atmakur to Pamur SS (13.5 km).
2	Rudrasamudram Pooling Stations-1&2 to 220KV SS/Podili, Prakasam Dist.	600 MW	220 kV TMSC Line (8 km) from PS-1 to Common Tower, 220 kV TMSC Line (4 km) from PS-2 to Common Tower and 220 kV TMDC Line (38 km) from common Tower to 220 kV SS/Podili.
3	Pendlimarri Pooling Stations-1&2 to proposed Pendlimarri Sw. Station, YSR Kadapa Dist.	500 MW	1) 220 kV TMSC Line (3 km) from PS-1 to Common Tower, 220 kV TMSC Line (4 km) from PS-2 to Common Tower and 220 kV TMDC Line (6 km) from common Tower to proposed 220 kV Sw. Station at Pendlimarri. 2) Double LILO of existing 220 kV RTPP-Chinakampalli SMDC Line to Pendlimarri Sw. Station duly converting it as TMDC. Towers are suitable for Twin Moose DC.
4	M. Kambaladinne Pooling Stations-1&2 to 400KV SS/Jammalamadugu, YSR Kadapa Dist.	500 MW	220 kV TMSC Line (2 km) from PS-1 to Common Tower, 220 kV TMSC Line (5 km) from PS-2 to Common Tower and 220 kV TMDC Line (20 km) from common Tower to the existing 400 kV/SS Jammalamadugu.
5	Urichinthala Pooling Stations-1&2 to 400KV SS/Talaricheruvu, Anantapur Dist.	600 MW	220 kV TMSC Line (4 km) from PS-1 to Common Tower, 220 kV TMSC Line (1 km) from PS-2 to Common Tower and 220 kV TMDC Line (6 km) from common Tower to the existing 400 kV/SS Talaricheruvu.
6	Mudigubba Pooling Stations-1&2 to the proposed Sw. Station at Mudigubba, Anantapur Dist.	500 MW	1) 220 kV TMSC Line (4 km) from PS-1 to Common Tower, 220 kV TMSC Line (3 km) from PS-2 to Common Tower and 220 kV TMDC Line (7 km) from common Tower to the proposed Sw. Station at Mudigubba 2) Making Double LILO of 220 kV Pulivendula-Mutyalacheruvu SMDC Line (5 km) which is (under construction) to the proposed Mudigubba Sw. Station.

Sl. No.	Description	Revised Solar Power Capacity	Revised Network for evacuation and Deletion of earlier proposed Lines
7	Chakrayapeta Pooling Stations-1&2 to the existing 220KV SS/ Chakrayapeta, YSR Kadapa Dist.	500 MW	1) 220 kV TMSC Line (2 km) from PS-1 to Common Tower, 220 kV TMSC Line (2 km) from PS-2 to Common Tower and 220 kV TMDC Line (8 km) from common Tower to the existing 220 kV SS/Chakrayapeta 2)220 kV TMDC line from the existing 220 kV SS/ Chakrayapeta to the existing 400 kV SS/ Kalikiri (80 km).
8	Thonduru Pooling Station-1 to the existing 220KV SS/Kondapuram & Pooling Station-2 to the existing 220KV SS/ Yerraguntla, YSR Kadapa Dist.	400 MW	1) 220 kV SMDC line (30 km) from PS-1 to the existing 220 kV SS/Kondapuram 2) 220 kV SMDC line (35 km) from PS-2 to the existing 220 kV SS/Yerraguntla
9	Pampanur Tanda Pooling Stations-1,2,3&4 to proposed Sw. Station at Pampanur Tanda, Anantapur Dist.	1300 MW	1) 220 kV TMSC Line (3 km) from PS-1 to Common Tower, 220KV TMSC Line (3KM) from PS-2 to Common Tower and 220KV TMDC Line (4KM) from common Tower to the proposed Sw. Station at Pampanur Tanda. 2) 220 kV TMSC Line (3 km) from PS-3 to Common Tower, 220KV TMSC Line (3KM) from PS-4 to Common Tower and 220KV TMDC Line (4KM) from common Tower to the proposed Sw. Station at Pampanur Tanda.
10	Kolimigundla Pooling Stations-1&2 to 400KV SS/Talaricheruvu, Anantapur Dist.	600 MW	220 kV TMSC Line (2KM) from PS-1 to Common Tower, 220KV TMSC Line (2KM) from PS-2 to Common Tower and 220KV TMDC Line (15 km) from common Tower to the existing 400 kV SS at Talaricheruvu
	Total Capacity	6100 MW	

11.6 In addition, the following transmission scheme have also been proposed by APTRANSCO.

1	Proposal for extension of Power Supply for a CMD of 400 MVA to the proposed Industrial Park at Guttapadu by APIIC: i. laying 220 kV TMDC Line from 400 kV Ghani SS to the proposed Switching Station at Guttapadu,(14 km length) and ii. Making Double LILO of the 220 kV Narnur-Somayajulu Palli DC line at the proposed Switching Station at Guttapadu (7 km)

11.7 APTRANSCO informed that tentative commissioning date of proposed transmission system would be 12 to 15 months from the date of approval by SRPC(TP).

11.8 SRLDC representative enquired whether the system studies conducted by APTRANSCO were on the PSS/E case of CTU with other networks and load-generation balance updated. Further, it was also pointed out that there is no mention of reactive compensation.

11.9 SRLDC representative also mentioned that most of the RE generation are being injected at Jammalamadugu, Hinudupur, and Uravakonda area and no additional 400 kV transmission system has been planned by APTRANSCO and hence the same needed to be reviewed. It was also mentioned that 400 kV Kurnool (PG) – Gooty and 400 kV Narnoor – Gooty lines are heavily loaded during High Wind and Solar generation in the Jammalamadugu, Hindupur, and Uravakonda complex.

11.10 Director (PSPA-I), CEA, informed that with the existing and planned networks by APTRANSCO, overloading is observed in the 220 kV network of AP with the injection of power from 6,100 MW solar power projects. Further about 2,000 MW power would be injected in the ISTS grid in the high RE generation scenario.

11.11 Chief Engineer (PSPA-I), CEA, suggested that as the modified proposal of APTRANSCO had been received only 2-3 days prior to the meeting, it could not be studied in detail and the same could be finalized only after detailed study.

11.12 After further deliberations it was decided that the transmission scheme proposed by APTRANSCO would be studied in detail in a joint meeting of CEA, SRPC, CTU, POSOCO/SRLDC and APTRANSCO and the scheme would be put up in the next SRPC(TP) meeting for discussion.

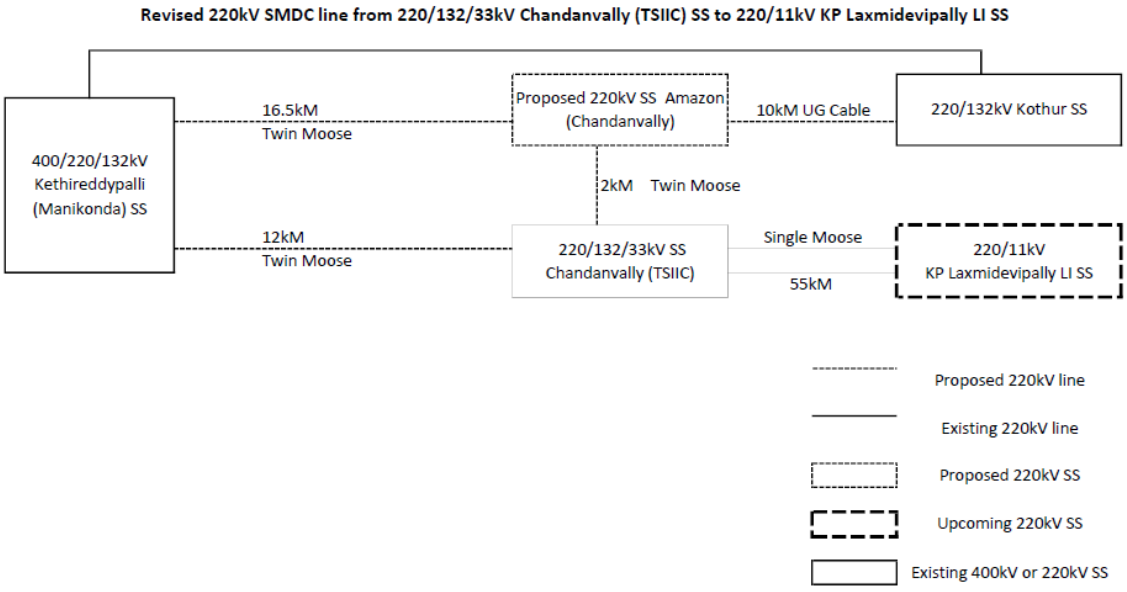
Transmission Planning proposals by Telangana

12.0 Proposal for new 220 kV substation at Chandanvally along with modification in earlier approved 220 kV D/C line from 400/220/132 kV Kethireddypalli (Manikonda) SS to proposed 220 kV KP Laxmidevipally LI SS.

12.1 Director (PSPA-I), CEA, informed that TSTRANSCO vide letter dated 28.05.2020 had proposed the following transmission system for establishing 220 kV substation at Chandanvally for meeting the load of Amazon data services and TSIIC:

i. Proposed 220/132/33 kV Chandanvally (TSIIC) S/S with 2x100 MVA PTR capacity (70 MW load).
ii. Proposed 220 kV S/S for M/s. Amazon Data Services India Private Limited, Chandanvally (100 MW load).
iii. Proposed 220 kV Twin Moose S/C line from 400/220/132 kV Kethireddypalli SS to proposed 220 kV Amazon (Chandanvally) SS* - 16.5 km.
iv. Proposed 220 kV Twin Moose S/C line from 400/220/132 kV Kethireddypalli SS to proposed 220 kV Chandanvally (TSIIC) SS* – 12 km
* For common corridor portion both S/C lines share common D/C tower
v. Proposed 220 kV Twin Moose SC line from 220 kV Chandanvally (TSIIC) SS to 220 kV Amazon (Chandanvally) SS - 2 km
vi. Proposed 220 kV S/C line (1200 sq.mm. UG Cable) from 220/132 kV Kothur SS to proposed 220 kV Amazon (Chandanvally) SS - 10 km
vii. Proposed 220 kV Single Moose D/C line from 220/132/33 kV Chandanvally (TSIIC) SS to proposed 220 kV KP Laxmidevipally LI SS (236 MW load) – 55 km [instead of

220 kV DC line from 400/220/132 kV Kethireddypalli (Manikonda) SS to proposed 220 kV KP Laxmidevipally LI SS as agreed in 1st SRPC(TP) meeting].



12.2 Representative of TSTRANSCO informed that the data centres (Amazon and TSIIC) are to be provided connectivity from two independent sources.

12.3 SRLDC representative opined that Telangana is a high voltage zone and the under-ground cable being planned from 220 kV Amazon (Chandanavally) SS to 220/132 kV Kothur SS may lead to further high voltage during off-peak periods. Hence, TSTRANSCO should plan enough reactive compensation at 400/220 kV Kethireddypalli S/S.

12.4 TSTRANSCO representative informed that 1x125 MVAr (400 kV) reactor had already been agreed to be installed at Manikonda (Kethireddypalli) 400/220 kV SS in the 1st SRSCT meeting held on 07.09.2018. TSTRANSCO was requested to expedite the installation of the bus reactor.

12.5 After deliberations, the transmission scheme proposed by TSTRANSCO as mentioned at para 12.1 was agreed.

13.0 Proposal for extending power supply to meet the load requirement for lifting additional 1 TMC of water from Godavari Basin in Link-I, Link-II & Link-IV of Kaleshwaram Lift Irrigation Scheme

13.1 Director (PSPA-I), CEA, stated that TSTRANSCO vide letter dated 10.06.2020 has informed that Irrigation & CAD (I&CAD) Department of Telangana has requested to extend power supply for lifting the additional 1 TMC water from Godavari Basin in Link-I, Link-II & Link-IV of Kaleshwaram Lift Irrigation Scheme. The additional load for lifting of additional 1 TMC water is as follows:

LINK	Sl.No.	PUMP House/ Load Centre	Existing Loads (MW)	New/ Additional Loads (MW)	Total Load (MW)
LINK-I	1	Medigadda	11x40MW=440 MW	6x40MW=240 MW	680
	2	Annaram	8x40 MW=320 MW	4x40 MW=160 MW	480

LINK	Sl.No.	PUMP House/ Load Centre	Existing Loads (MW)	New/ Additional Loads (MW)	Total Load (MW)
	3	Sundilla	9x40 MW=360 MW	5x40 MW=200 MW	560
	TOTAL		**1120**	**600**	**1720**
LINK-II	1	Medaram	7x124.4 MW=870.8 MW	0	870.80
	2	Ramadugu	7x139 MW=973 MW	0	973
	3	Velgatoor Reach-I	0	5x135 MW=675 MW	675
	4	Pegadapally (Namapur) Reach-II	0	4x135 MW=540 MW	540
	TOTAL		**1843.8**	**1215**	**3058.80**
LINK-IV	1	Near Tippapur (Reach-I) (Veljipur (V))	4x106 MW=424 MW	4x125 MW=500 MW	924
	2	Near Chandulapur (Reach-II) Chinagundavelli(V)	4x134.8 MW=539.2 MW	6x125 MW=750 MW	1289.2
	3	Near Tukkapur (Reach-III)	8x43 MW=344 MW	4x90 MW=360 MW	704
	TOTAL		**1307.2**	**1610**	**2917.2**

13.2 TSTRANSCO has proposed the following transmission system to meet the load requirement for lifting additional 1 TMC of water from Godavari Basin in Link-I, Link-II & Link-IV of Kaleshwaram Lift Irrigation Scheme:

(I) Link – I for additional load of 600 MW at Medigadda, Annaram and Sundilla pumping stations

a) Proposed 400/220 kV Annaram SS with 3x500 MVA Transformers.

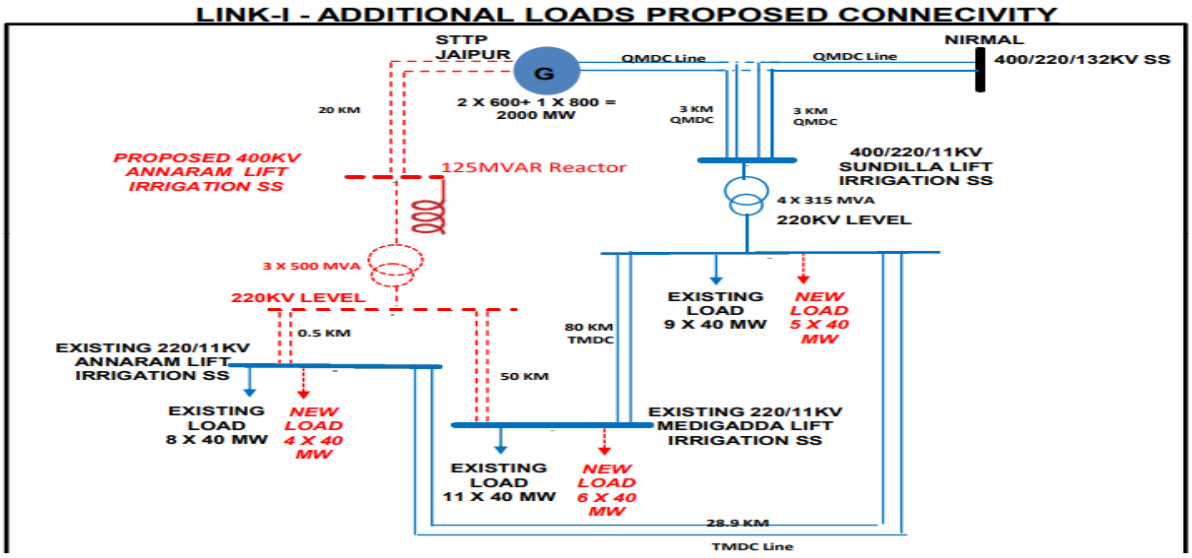
b) Proposed 400 kV QMDC line from STPP Jaipur (Singareni STPP) to proposed 400/220 kV Annaram SS - 20 km.

c) Proposed 220 kV TMDC line from 400/220 kV Annaram SS to existing 220/11 kV Annaram SS – 0.5 km.

d) Proposed 220 kV TMDC Line from 400/220 kV Annaram SS to existing 220/11 kV Medigadda SS – 50 km.

13.3 1x125 MVAR reactor at the proposed 400/220 kV Annaram SS. Representative of TSTRANSCO informed that additional load of 600 MW is proposed to be met from upcoming 1x800 MW unit at STTP Jaipur (Singareni TPP) which is expected to be commissioned by 2023-24.

13.4 Director (PSPA-I), CEA, stated that the 1x800 MW unit at STPP Jaipur is yet to be taken up for construction and it will take minimum 5 years to be commissioned. Also, based on the load generation scenario, the power deficit in Telangana is expected to be about 6,000 MW by 2022-23, the time frame in which the Lift irrigation schemes would be commissioned.



13.5 Chief Engineer (PSPA-I), CEA, inquired about the Power Purchase Agreement (PPA) between Telangana and STPP Jaipur and how the 6,000 MW power deficit by 2022-23 is proposed to be met.

13.6 Director, TSTRANSCO, stated that they have not signed any PPA with STPP Jaipur to purchase power from 1x800 MW unit and the 6,000 MW power deficit (likely in 2022-23) would be met through short term power purchase from ISTS grid. He further informed that additional load on account of lift irrigation schemes is a seasonal load for a period of about 3 months (24x7) in a year. Also the additional load of 600 MW for LINK-I has been proposed after considering 20% overload capacity of pumps. So the proposed network augmentation has been designed considering 20% overload capacity.

13.7 Chief Engineer (PSPA-I), CEA, stated that there are no issues in network augmentation proposed for LINK-I, but regarding short term power purchase from ISTS grid, TSTRANSCO should take advice from SRLDC.

13.8 DGM (CTU) informed that load growth which TSTRANSCO is considering is higher than 19th EPS projections. Since TSTRANSCO has not informed from where they will be purchasing power on short term basis, its impact on ISTS transmission system cannot be analysed.

13.9 SRLDC representative suggested that the proposed 1x125 MVAR bus reactor at Annaram s/s should be commissioned before the commissioning of new transmission lines at 400/220 kV Annaram LISS.

13.10 After deliberations, the transmission system for Link-I as proposed by TSTRANSCO was agreed by the members.

(II) Link-II for additional load of 1,215 MW at Vegaltoor (Reach-I of Load 675 MW) and Namapur/Pegadapally (Reach-II of Load 540 MW)

a) Proposed 400 kV Vadkapur switching station.

b) Proposed 400/11 kV Pegadapally SS.

c) Proposed 400/11 kV Velgatoor SS.

d) LILO of 400 kV QMDC line from STPP Jaipur (Singareni STPP) – Gajwel 400/220/132 kV SS to proposed 400 kV Vadkapur Switching station – 5 km LILO length instead of already existing LILO of 400 kV QMDC line from STPP Jaipur – Gajwel 400/220/132 kV SS at 400/220 kV Ramadugu SS.

e) LILO of 400 kV QMDC line from Telangana STPP (2x800 MW) - 400/220/32 kV Narsapur SS to proposed 400 kV Vadkapur Switching station – 5 km LILO length.

f) Proposed 400 kV QMDC Line from 400 kV Vadkapur Switching Station to 400/220 kV Ramadugu SS – 18 km.

g) Proposed 400 kV QMDC line from 400 kV Vadkapur switching station to 400/11 kV Velgatoor SS – 35 km.

h) Proposed 400 kV QMDC line from 400 kV Vadkapur switching station to 400/11kV Pegadapally SS in - 32 km.

i) Proposed 400 kV QMDC line from 400/11 kV Pegadapally SS to 400/11 kV Velgatoor SS – 29 km.

j) LILO of 400 kV NTPC-Dichpally TMSC to proposed 400/11 kV Velgatoor SS - 15 km LILO length.

k) Re-conductoring of proposed 400 kV NTPC - Velgatoor single circuit line with higher current carrying capacity conductor (i.e. 400 kV NTPC - Velgatoor portion pertaining to LILO of 400 kV NTPC - Dichpally to Velgatoor SS)

l) 1x125 MVAR Reactor at proposed 400 kV Vadkapur SWS.

m) 1x125 MVAR Reactor at proposed 400/11 kV Pegadapally SS.

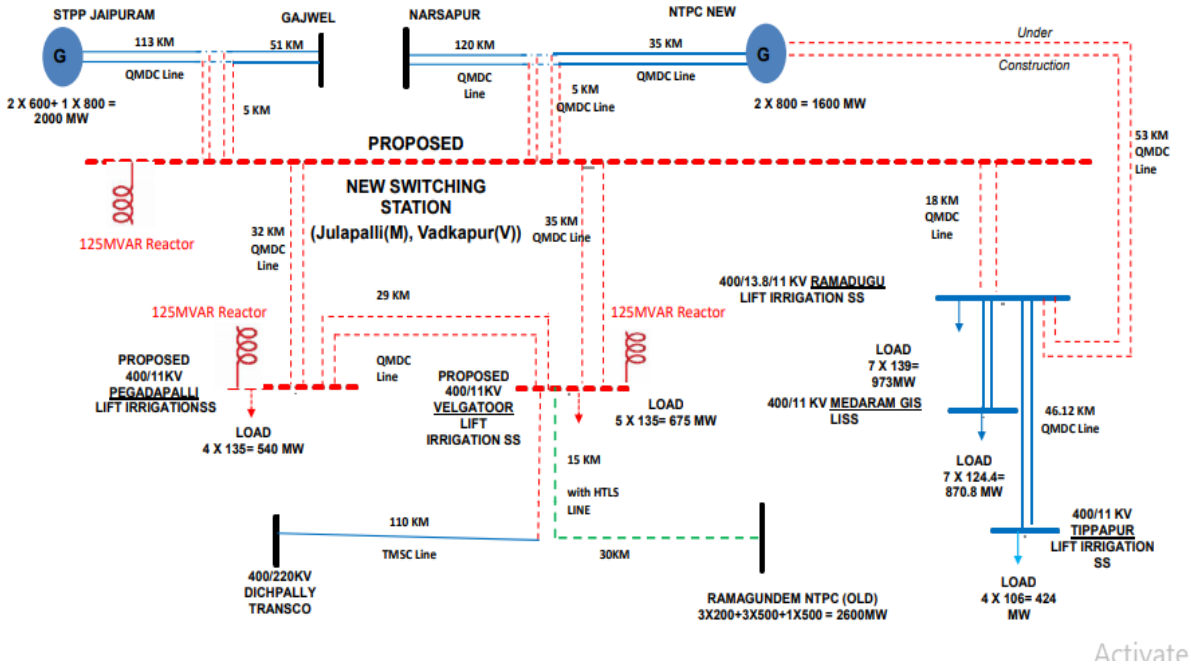
n) 1x125 MVAR Reactor at proposed 400/11 kV Velgatoor SS.

13.11 Director (PSPA-I), CEA, informed that in a meeting between CEA, CTU and TSTRANSCO held through VC, TSTRANSCO had been advised to drop the LILO of 400 kV NTPC (Ramagundam) - Dichpally TMSC to proposed 400/11 kV Velgatoor SS, as maximum load at proposed 400/11 kV Pegadapally SS and proposed 400/11 kV Velgatoor SS would be met through this line due to its close proximity. To maintain reliability, splitting of 400 kV bus at Vadkapur switching station using a bus sectionalizer had been suggested so that in case of fault in one section, load could be supplied from another section.

13.12 SRLDC representative opined that the LILO of 400 kV Ramagundam – Dichipally line to proposed Velgatoor S/s may be reviewed.

13.13 TSTRANSCO representative agreed to use a bus sectionalizer at proposed 400 kV Vadkapur switching station with one and half breaker scheme and agreed to drop the proposed LILO of 400 kV NTPC (Ramagundem)-Dichpally SC line to 400/11 kV Velgatoor SS.

LINK-II - ADDITIONAL LOADS PROPOSED CONNECIVITY



13.14 Chief Engineer (PSPA-I), CEA, inquired about the circulating currents in the loop formed by Vadkapur SS, Pegadapally SS and Velgatoor SS. DGM (CTU) stated that circulating currents will be minimum due to heavy loads connected at Pegadapally SS and Velgatoor SS.

13.15 Member Secretary, SRPC, opined that motors (load) at all the substations in this scheme will contribute to the bus bar fault at 400 kV Vadkapur SS. He advised TSTRANSCO to consider this aspect in load flow analysis and design the switching equipments accordingly.

13.16 SRLDC representative suggested that the 1x125 MVAR Bus Reactors to be commissioned before the commissioning of new transmission lines at 400/220 kV Pegedapalli, 400 kV Velgatoor, and 400 kV Vadkapur S/S.

13.17 After deliberations the following transmission scheme was agreed for Link-II for additional load of 1,215 MW at Vegaltoor (Reach-I of load 675 MW) and Namapur/Pegadapally (Reach-II of load 540 MW):

a) Proposed 400 kV Vadkapur switching station with bus sectionaliser.

b) Proposed 400/11 kV Pegadapally SS.

c) Proposed 400/11 kV Velgatoor SS.

d) LILO of 400 kV QMDC line from STPP Jaipur (Singareni STPP) – Gajwel 400/220/132 kV SS to proposed 400 kV Vadkapur Switching station – 5 km LILO length instead of already existing LILO of 400 kV QMDC line from STPP Jaipur – Gajwel 400/220/132 kV SS at 400/220 kV Ramadugu SS.

e) LILO of Telangana STPP (2x800 MW) - Narsapur SS 400 kV QMDC line to proposed 400 kV Vadkapur Switching station – 5 km LILO length.

f) Proposed 400 kV QMDC line from 400 kV Vadkapur Switching Station to 400/220 kV Ramadugu SS – 18 km.

g) Proposed 400 kV QMDC line from 400 kV Vadkapur switching station to 400/11 kV Velgatoor SS – 35 km.

h) Proposed 400 kV QMDC line from 400 kV Vadkapur switching station to 400/11 kV Pegadapally SS in - 32 km.

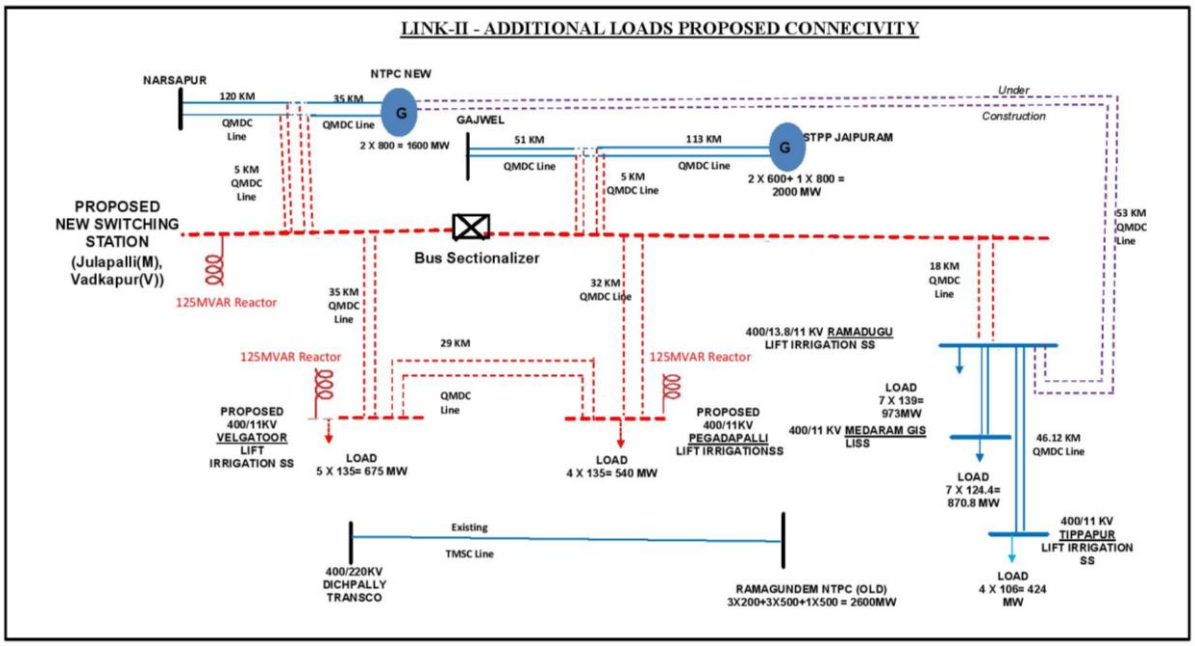
i) Proposed 400 kV QMDC line from 400/11 kV Pegadapally SS to 400/11 kV Velgatoor SS – 29 km.

j) 1x125 MVAR reactor at proposed 400 kV Vadkapur SWS.

k) 1x125 MVAR reactor at proposed 400/11 kV Pegadapally SS.

l) 1x125 MVAR reactor at proposed 400/11 kV Velgatoor SS.

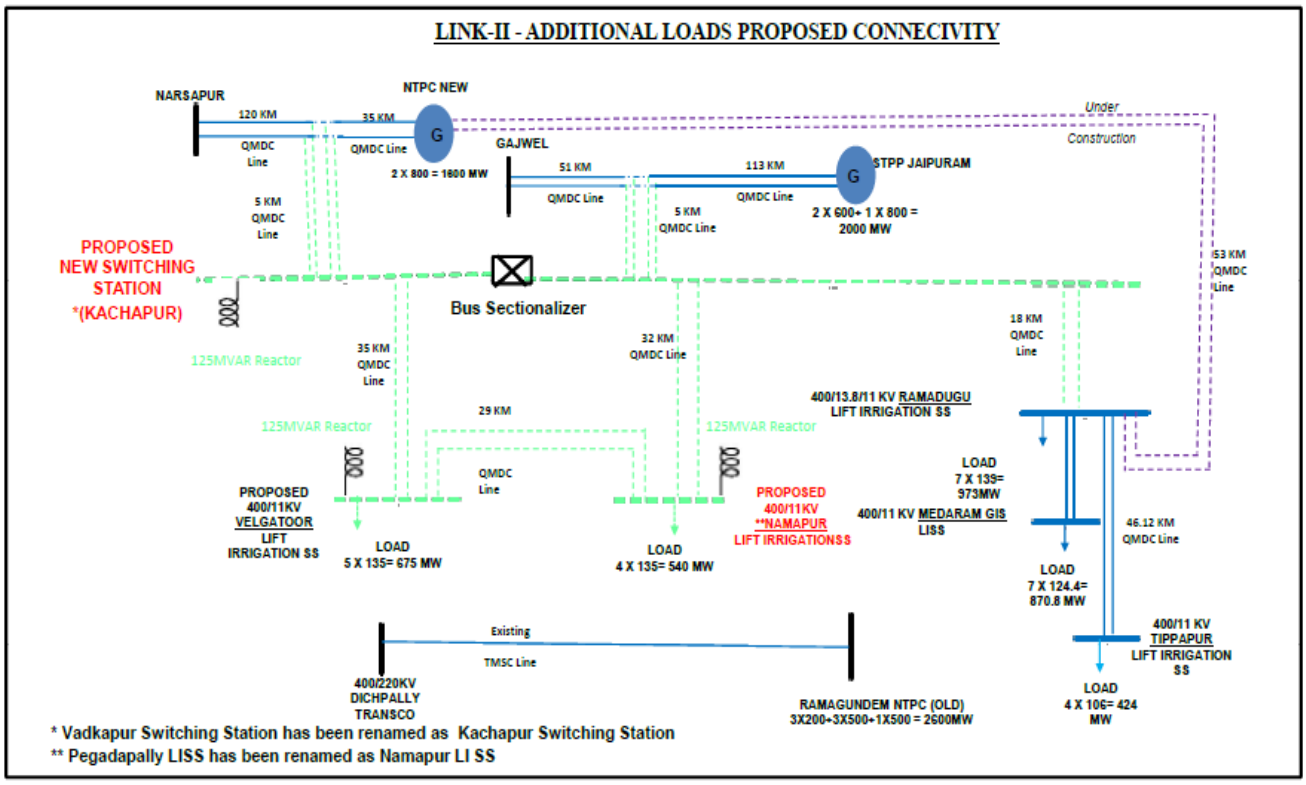
Schematic diagram of the transmission system agreed in the meeting is given below:



13.18 TSTRANSCO vide letter No. Lr. No. CE(PS)/SE(PS)/DE(SS II)/ADE/AE/F. /D.No. 57 dated 03.11.2020 has informed that some of the substations in the above scheme have been renamed according to the village limits and boundaries in which the substation land comes under. Name of the following substations in Link-II have been changed:

S.No.	Initial Name of Proposed Substations	Revised name of Substations	Link Name of the Scheme
1	400kV Vadkapur Switching Station	400kV Kachapur Switching Station	LINK-II
2	400/11kV Pegadapally SS	400/11 kV Namapur SS	

TSTRANSCO has requested to incorporate the above changes in the names of substations in the minutes. Accordingly, the schematic of transmission scheme with new name of sub-stations is given below:



(III) Link-IV of Kaleshwaram Scheme for additional load of 1,610 MW at Reach – I (near Tippapur: 500 MW), Reach - II (near Chandlapur: 750 MW) and Reach – III (Tukkapur: 360 MW) Pumping Stations

a) Proposed 400 kV QMDC Line from 765/400 kV Nizamabad substation (PGCIL) to existing 400/13.8/11 kV Chandlapur substation – 120 km.

b) Proposed 400 kV switchyard (Reach-I) at Veljipur (V).

c) Proposed 400 kV QMDC line from existing 400/11 kV Tippapur SS to proposed additional load (4x125 MW=500 MW) Pumping Station (Reach-I) at Veljipur (V)- 5 km.

d) Proposed 400 kV Switchyard (Reach-II) at Chinagundavelli (V).

e) Proposed 400 kV QMDC line from existing 400/13.8/11 kV Chandlapur substation to proposed additional load (6x125 MW = 750 MW) pumping station (Reach-II) at Chinagundavelli (V) – 5 km.

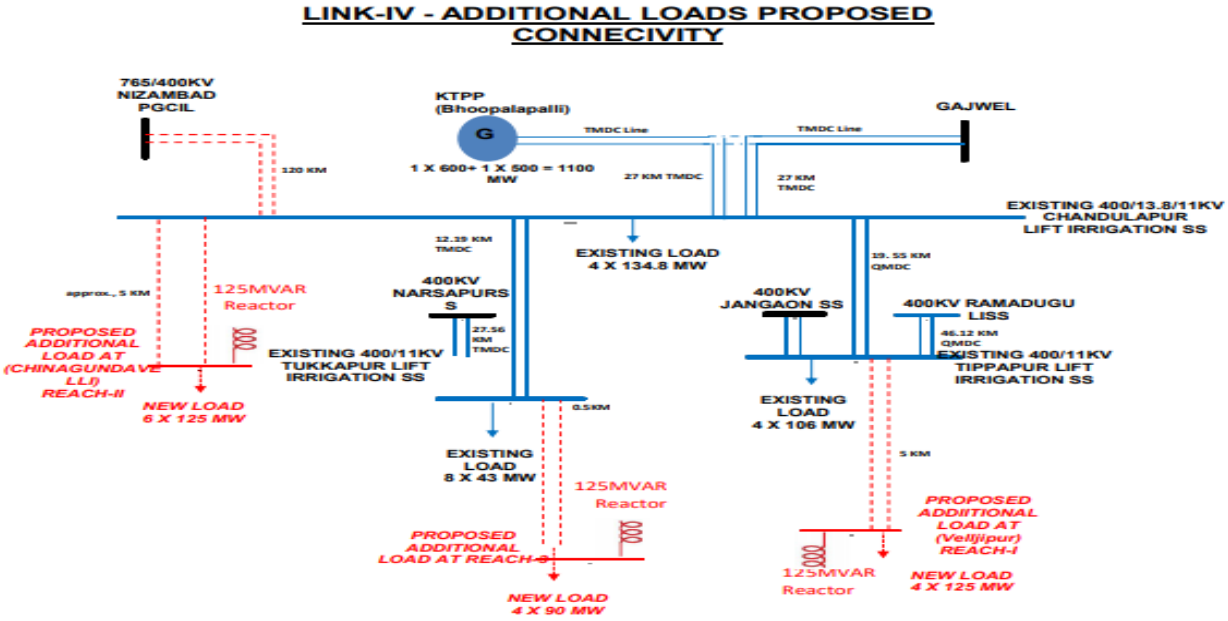
f) Proposed 400 kV switchyard (Reach-III)

g) Proposed 400 kV TMDC line from existing 400/11 kV Tukkapur SS to proposed additional load (4x90 MW = 360 MW) Pumping Station (Reach-III) - 0.5 km

h) 1x125 MVAR reactor at proposed 400 kV Reach-I Switchyard Veljipur (V)

i) 1x125 MVAR reactor at proposed 400 kV Reach-II Switchyard Chinagundavelli (V)

j) 1x125 MVAR reactor at proposed 400 kV Reach-III Switchyard.



13.19 TSTRANSCO representative stated that the proposed additional loads of 1,610 MW are radially connected to existing 400/13.8/11 kV Chandulapur Lift Irrrigation SS.

13.20 Chief Engineer (PSPA-I), CEA, inquired about the connectivity of existing 400/13.8/11 kV Chandulapur Lift Irrrigation SS to 765/400 kV Nizambad (PGCIL) substation.

13.21 TSTRANSCO representative stated that POWERGRID has agreed to allocate 2 nos. of bays at 765/400 kV Nizamabad (PGCIL) substation for connectivity with existing Chandulapur LISS.

13.22 CTU representative informed that there are 2x1500 MVA ICTs at 765/400 kV Nizamabad (PGCIL) substation. In case of outage of one ICT at Nizamabad (PGCIL) substation, other ICT may get overloaded due to the additional load proposed by TSTRANSCO. Further, since TSTRANSCO has not informed about the tie-up of generation capacity, contingency analysis at Nizamabad (PGCIL) substation cannot be carried out.

13.23 TSTRANSCO informed that as per load flow studies carried out by them considering the additional load, flow in each ICT at Nizamabad (PGCIL) substation would be 965 MW.

13.24 Chief Engineer (PSPA-I), CEA, stated that POSOCO/SRLDC should suggest TSTRANSCO about the maximum drawl from Nizamabad (PGCIL) substation.

13.25 SRLDC representative informed that with the drawl of additional power from the 765 kV Nizamabad S/S through the proposed 400 kV Nizamabad – Chandulapur D/C line, the ICTs at Nizamabad maybe loaded beyond N-1 limit and network augmentation may be required.

13.26 DGM (CTU) informed that based on the feedback from POSOCO regarding maximum drawl from Nizamabad (PGCIL) substation and information regarding tie up of power by TSTRANSCO for meeting the additional load of 1,610 MW, augmentation of transformer capacity at Nizamabad (PGCIL) substation may be planned. The matter would be reviewed upon receipt of LTA/MToA application from TSTRANSCO.

13.27 However, TSTRANSCO reiterated that they would be purchasing power under short term for meeting their additional load. Chief Engineer (PSPA-I), CEA, advised TSTRANSCO to tie up

power in Long Term/Medium Term, as the lift Irrigation loads are critical loads and the total deficit expected by the year 2023-24 in Telangana would likely be about 6,000 MW.

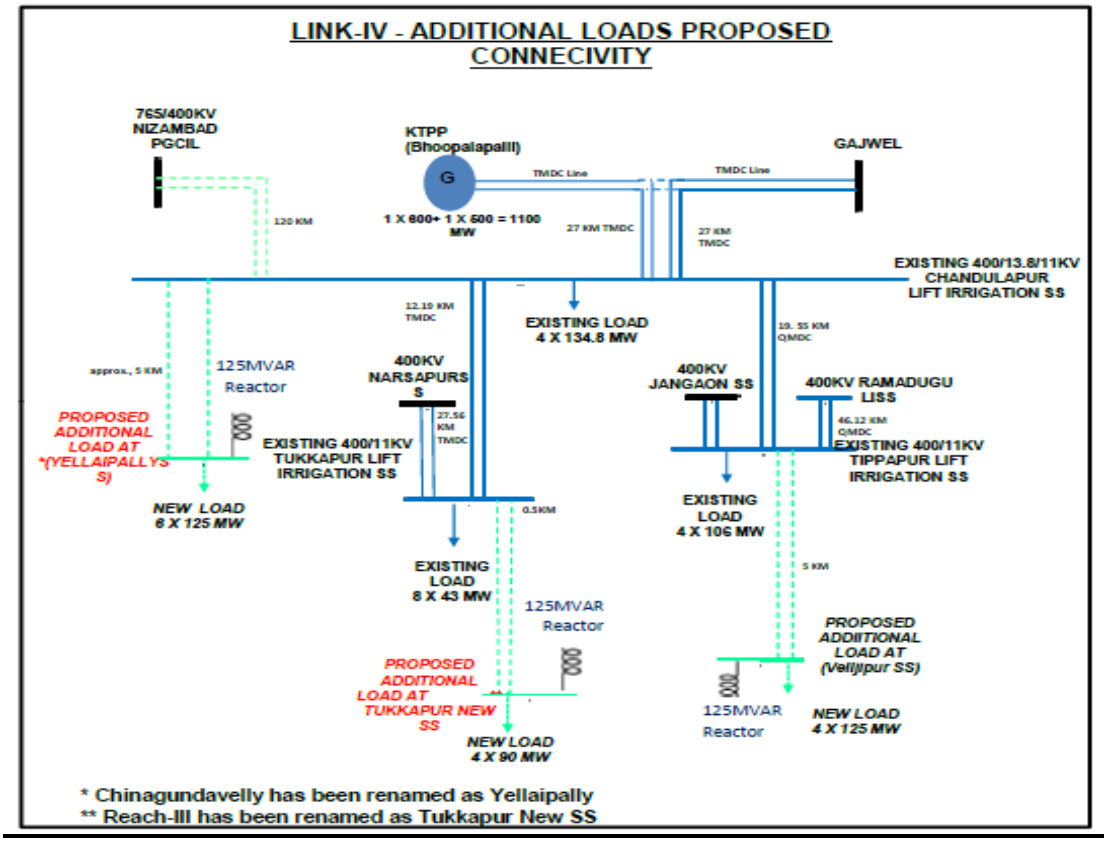
13.28 SRLDC representative suggested that the 125 MVAR Bus Reactor be commissioned before the commissioning of new transmission lines at 400/220 kV Chinagundavelli S/s, 400 kV Reach - 3 S/S and 400 kV Veljipur S/S.

13.29 After deliberations, the transmission system for Link-IV as proposed by TSTRANSCO was agreed by the members.

13.30 TSTRANSCO vide letter No. Lr. No. CE(PS)/SE(PS)/DE (SS II)/ADE/AE/F./D.No.57 dated: 03.11.2020 has informed that some of the substations in the above scheme have been renamed according to the village limits and boundaries in which the substation land comes under. Name of the following substations in Link-IV have been changed:

Sl. No.	Initial name of Proposed substations	Revised name of substations	Link
1	400/11kV Chinagundavelli SS	400/11 kV Yellaipally SS	LINK-IV
2	400/11kV Reach -III	400/11 kV Tukkapur New SS	

TSTRANSCO has requested to incorporate the above changes in the names of substations in the minutes. Accordingly, the schematic of transmission scheme with new name of sub-stations is given below:



Transmission Planning proposals by TANTRANSCO

14.0 Establishment of S. P. Koil 400/230-110 kV SS by upgrading the existing S. P. Koil 230/110 kV SS

14.1 Director (PSPA-I), CEA, stated that TANTRANSCO had informed that considering the future load growth in and around Chennai South area, the establishment of S.P. Koil 400/230-110 kV S/S has been envisaged by upgrading the existing S.P. Koil 230/110 kV SS, with the following connectivity.

400 kV transmission lines:

Erection of 400 kV DC line on DC tower for making LILO of one circuit of Thiruvalam - Kalivanthapattu 400 kV DC Twin Moose line at S.P. Koil 400/230 kV SS.

ICTs:

- 2x500 MVA, 400/230 kV ICT

Bus Reactor:

- 1x125 MVAr, 400 kV

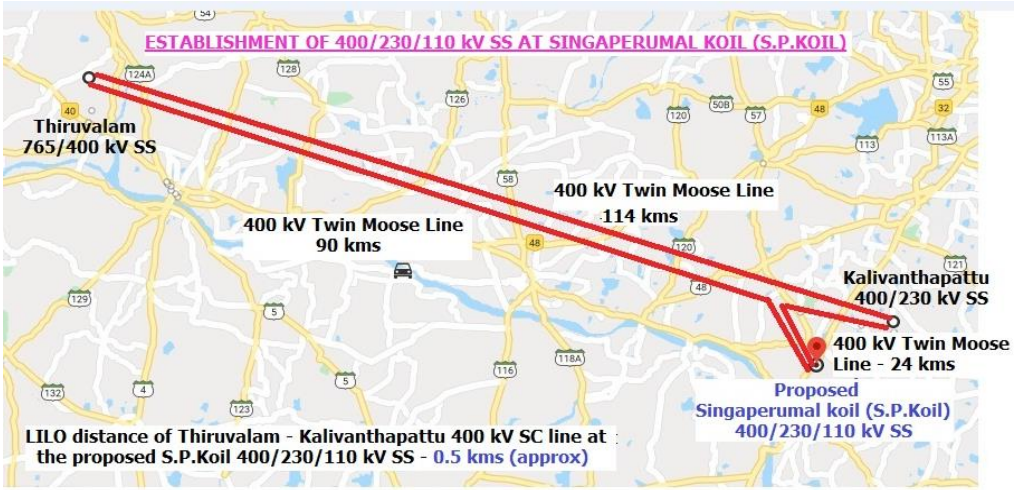
230 kV transmission lines:

i. The existing 230 kV transmission lines at S.P. Koil, 230/110 kV SS, would be retained and in addition to this 230 kV S/C line is planned to Kadapperi 230 kV SS from the S.P. Koil 400/230-110 kV SS.

ii. Replacement of existing S.P. Koil - Veerapuram 230 kV S/C feeder conductor by equivalent HTLS conductor.

110 kV transmission lines:

Existing 110 kV transmission lines at S.P. Koil 230/110 kV SS would be retained.



14.2 In the meeting, representative of TANTRANSCO stated that they wanted to defer the above proposal and would present the revised proposal in next SRPC(TP) meeting.

Members noted the same.

15.0 Revised ATS for Mangalapuram 400/230 kV S/S

15.1 Director (PSPA-I), CEA, informed that establishment of Mangalapuram 400/230 kV S/S was approved in the 37th meeting of SCPSPSR held on 31.07.2014 with the following transmission system:

400 kV transmission lines:

LILO of both circuits of Pugalur-Ariyalur 400 kV D/C quad line at Mangalapuram 400/230 kV S/S.

230 kV transmission lines:

i. LILO of Salem –Singapuram 230 kV feeder.
ii. LILO of Deviyakurichi - Valayapatty 230 kV feeder.
iii. 230 kV SC line to the proposed Thammampatty 230 kV SS.
iv. 230 kV SC line to the proposed Udayapatty 230 kV SS.

ICT:

2 x 315 MVA, 400/230 kV ICT.

15.2 TANTRANSCO has proposed revised ATS with increase in the ICT capacity for Mangalapuram 400/230 kV substation as given below:

400 kV transmission lines:

LILO of one of the circuit of Pugalur-Kalivanthapattu 400 kV D/C Quad line.

230 kV transmission lines:

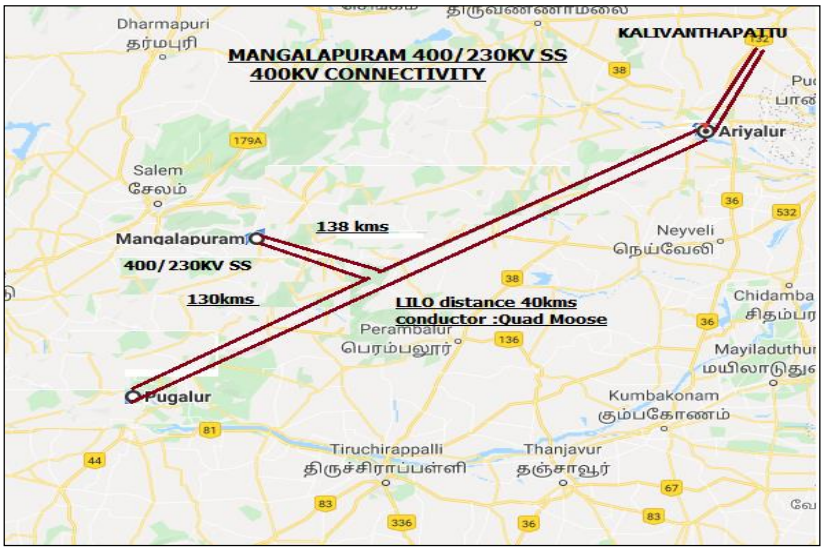
i. LILO of Salem –Singapuram 230 kV feeder.
ii. LILO of Deviyakurichi - Valayapatty 230kV feeder.
iii. Erection of a new 230 kV feeder by stringing on the existing free arm from Pudhanchandai to Deviyakurichy 230 kV substations and making LILO at the proposed Mangalapuram 400/230 kV SS.
iv. 230 kV DC line to the proposed Udayapatty 230 kV SS.

ICT:

2 x 500 MVA, 400/230 kV ICT.

Bus Reactors:

400 kV, 2 x125 MVAr bus reactors.



15.3 The already approved transmission scheme and revised scheme are given below:

Scheme approved in 37th SCPSPSR held on 31.07.2014	**Proposed revised scheme**
400 kV Connectivity	**400 kV Connectivity**
LILO of both circuits of Pugalur-Ariyalur 400 kV D/C quad line.	LILO of one of the circuit of Pugalur-Kalivanthapattu 400 kV D/C Quad line.
ICT	**ICT**
2 x 315 MVA, 400/230 kV ICT.	2 x 500 MVA, 400/230 kV ICT
Bus Reactor	**Bus Reactor**
	400 kV, 2 x125 MVAr bus reactors
220 kV connectivity	**220 kV connectivity**
LILO of Salem –Singapuram 230 kV feeder	LILO of Salem –Singapuram 230 kV feeder.
LILO of Deviyakurichi - Valayapatty 230 kV feeder.	LILO of Deviyakurichi - Valayapatty 230kV feeder
230 kV SC line to the proposed Thammampatty 230 kV SS	

Scheme approved in 37th SCPSPSR held on 31.07.2014	Proposed revised scheme
230 kV SC line to the proposed Udayapatty 230 kV SS	230 kV DC line to the proposed Udayapatty 230 kV SS.
	Erection of a new 230 kV feeder by stringing on the existing free arm from Pudhanchandai to Deviyakurichy 230 kV substations and making LILO at the proposed Mangalapuram 400/230 kV SS.

15.4 Chief Engineer (PSPA-I), CEA, inquired about the loading on ICT's at 400/230 kV Mangalapuram SS and the likely commissioning date of the proposed substation. Representative of TANTRANSCO informed that loading will be around 300 MW on each ICT at Mangalapuram SS and the sub-station is likely to be commissioned by October, 2022.

15.5 SRLDC representative opined that the 2x125 MVAR Bus Reactors should be commissioned before commissioning of new-lines at the 400/230 kV Managalapuram S/S.

15.6 DGM(CTU) stated that the proposal was approved in the year 2014 and it is already delayed by 6 years which may impact the transmission planning process. TANTRANSCO representative informed that the substation had been delayed due to land acquisition and budget allocation issues.

15.7 Chief Engineer (PSPA-I), CEA, suggested that SRPC should monitor the proposals as agreed in SCPSPSR/SRSCT/SRPC(TP) meetings and make sure that the proposals agreed in the meetings are implemented as per schedule.

15.8 After deliberations, the revised transmission scheme for Mangalapuram 400/230 kV S/S as mentioned in para 15.2 was agreed by the members.

16.0 Establishment of Kalvadagam 400/110 kV substation

16.1 Director (PSPA-I), CEA, stated that TANTRANSCO has proposed to establish 400/110 kV substation at Kalvadagam, Erode Region, instead of Kolapalur 400/230-110 kV S/S approved in 37th meeting of SCPSPSR held on 31.07.2020, due to land availability issue at Kolapalur.

16.2 Transmission system for Kolapalur 400/230-110 kV substation as approved in 37th meeting of SCPSPSR is given below:

400 kV transmission lines:

i. Single circuit LILO of 400 kV MTPS Stage III - Karamadai D/c line at Kolapalur

ii. 400 kV D/C line from Rasipalayam 400 kV Substation.

ICT

2x 315MVA, 400/230kV ICTs and 2x200 MVA, 400/110 kV ICTs

230 kV transmission lines:

i. 230 kV S/C line to Thingalur 230 kV SS

ii. 230 kV S/C line to Anthiyur 230kV SS

iii. 230 kV S/C line to Shenbagapudur 230 kV SS

iv. LILO of Gobi – Pallakapalayam 230kV feeder

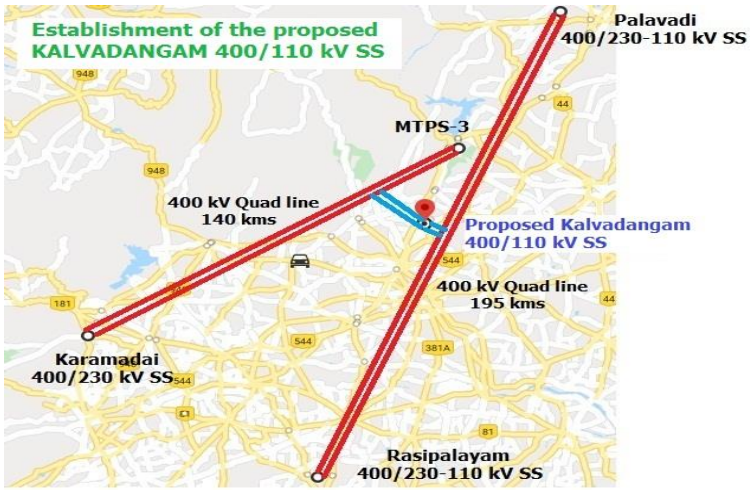
v. LILO of Karamadai – Ingur 230kV line

16.3 Transmission system for 400/110 kV substation at Kalvadagam, Erode Region, as proposed by TANTRANSCO (instead of substation at Kolapalur) is given below:

400 kV transmission lines:

i. LILO of one circuit of Rasipalayam - Palavadi 400 kV D/C quad line at Kalvadagam.

ii. LILO of one circuit of MTPS III - Karamadai 400 kV D/C quad line at Kalvadagam.



LILO Details:

LILO distance of 400 kV Rasipalayam - Dharmapuri Quad SC line - 7 kms.

LILO distance of 400 kV MTPS (Mettur) - Karamadai Quad SC line - 10 kms.

Distance between Substations:

1. Rasipalayam - Kalvadagam - 107 kms.
2. Palavadi - Kalvadagam - 102 kms.
3. MTPS (Mettur) - Kalvadagam - 35 kms.
4. Karamadai - Kalvadagam - 120 kms.

ICT

3x200 MVA, 400/110 kV ICT

Bus Reactor:

400 kV, 1x125 MVAr Bus reactor

110 kV transmission lines:

i. LILO of Pallipalyam - Barrage II 110 kV feeder.

ii. LILO of Barrage III - Anthiyur 110 kV feeder (in between Barrage-III & Chennampatty 110 kV S/S).

iii. LILO of K.R.Thoppur-Vembadithalam- IVELI 110 kV feeder (in between Vembadithalam & IVELI 110 kV S/S).

iv. D/C feeder to Edapadi 110 kV S/S.

16.4 Representative from TANGEDCO informed that voltage level is changed from 230 kV to 110 kV because of change in location from Kolapur to Kalvadagam, Erode Region, as 110 kV voltage level is predominant in Kalvadagam, Erode Region.

16.5 Representative of SRLDC suggested that the 1x125 MVAr Bus reactor at 400/110 kV Kalvadagam substation should be commissioned before commissioning of new lines at the 400/110 kV Kalvadagam substation.

16.6 After deliberations the proposal of TANTRANSCO for establishment of 400/110 kV Kalvadagam substation and associated transmission lines as mentioned in para 16.3 was agreed by the members.

17.0 Neyveli TS-II to Neyveli (TANTRANSCO) 230 kV substation-230 kV line 1 & 2 - Ratification for the usage of Twin Moose conductor instead of the approved HTLS conductor:

17.1 Director (PSPA-I), CEA, stated that TANTRANSCO has informed that in the 36th SCPSPSR meeting held on 4th September, 2013, the proposal of Neyveli TS-II - Neyveli (TANTRANSCO 230 kV substation), 230 kV DC line with HTLS conductor was approved as additional transmission system for evacuation of power from 2x500 MW Neyveli Lignite Corporation Ltd. TS-I (Replacement), NNTPS.

17.2 During the execution of work, the 230 kV D/C line between Neyveli TS-II - Neyveli (TANTRANSCO 230 kV substation) was erected with 230 kV twin moose conductor instead of the already approved HTLS conductor. The transmission line has been subsequently commissioned on 26.12.2019.

17.3 Accordingly, TANTRANSCO has requested that necessary ratification may be issued for the change in the type of 230 kV conductor from HTLS to twin moose between Neyveli TS-II and Neyveli (TANTRANSCO 230 kV substation).

17.4 Chief Engineer (PSPA-I), CEA, inquired about the loading on 230 kV D/C line between Neyveli TS-II - Neyveli (TANTRANSCO 230 kV substation). Representative from SRLDC informed that loading is about 180 MW.

17.5 After deliberations members agreed for the change in the type of 230 kV conductor from HTLS to twin moose

18.0 Proposal to drop the 230 kV connectivity to NTPL for power evacuation during contingent conditions

18.1 Director (PSPA-I), CEA, stated that as per the minutes of the 24th meeting of SCPSPSR held on 18.06.2007, following transmission system had been agreed as the evacuation system for Tuticorin TPS JV (2x500 MW) (NTPL):

i) Tuticorin JV TPS – Madurai 400 kV D/c quad line

ii) 2x315 MVA 400/220 kV ICT at Tuticorin TPS JV

iii) LILO of 2 nos. of 230 kV circuits at Tuticorin TPS JV

18.2 In the 1st SRPC(TP) meeting, TANTRANSCO had stated that the 230 kV lines should not be utilized for the evacuation of power from Tuticorin JV (2x500 MW) TPP as the same leads to congestion in the downstream network and some of the state's generation may have to be backed down.

18.3 The matter had been discussed in the 1st SRPC(TP) meeting and it had been agreed that the 230 kV NTPL-TTP Auto & 230 kV NTPL-TTPS lines will be restored and normally kept bypassed with suitable switching arrangement at NTPL switchyard. However, whenever requirement arises, these lines would be closed on the instruction of SRLDC after taking into account the concerns of TANTRANSCO.

18.4 Director (PSPA-I), CEA, informed that TANTRANSCO vide letter dated 18.07.2020 has again requested to drop the 230 kV connectivity of NTPL power plant (LILO of TTPS – Tuticorin 230 kV). TANTRANSCO has stated that evacuation of NTPL power through this 230 kV feeder results in overloading of the 230 kV feeder due to which the TTPS generation has to be backed down. Hence, TANTRANSCO has requested to drop the proposal of utilizing TTPS – TTN Auto 230 kV S/C line connectivity for power evacuation from NTPL station.

18.5 Representative of SRLDC informed that as agreed in 1st SRPC(TP) meeting, 230 kV NTPL-TTP Auto & 230 kV NTPL-TTPS lines will be restored and normally kept bypassed and when there is a need to provide start up power at 230 kV level to NTPL or in the event of outage of 400 kV D/C lines from NTPL, the 230 kV line would be closed. Further, SRLDC also informed that during the closing of the said 230 kV transmission line, TN (SLDC) would be consulted.

18.6 SRLDC also shared the difficulty in extending start-up supply to NTECL Vallur (1500 MW) and North Chennai Stage 2 (1200 MW) during inclement weather conditions, and the experience during the recent cyclone in the Chennai area. In view of this, SRLDC suggested that the 230 kV connectivity is essential for providing startup power to NTPL and hence it is not advisable to drop 230 kV connectivity to NTPL. This would provide more flexibility to the system operator.

18.7 Member Secretary, SRPC, also stated that the above lines will be normally kept bypassed and will be available for TANTRANSCO for evacuation of power. However, whenever need arises, the line would be closed after consulting TN(SLDC).

18.8 Chief Engineer (PSPA-I), CEA, stated that it is a fair assessment on part of SRPC & SRLDC that the above mentioned 230 kV lines will be restored and normally kept bypassed, however, whenever need arises, these could be used for providing start-up power to NTPL or for evacuation of power from NTPL, duly taking into account the concerns of TANTRANSCO.

18.9 After further discussions, the proposal to drop the 230 kV connectivity to NPTL was not agreed as the 230 kV connectivity is a part of transmission system of NTPL, as agreed in 24th SCPSPSR meeting.

19.0 Manalmedu 400/230-110 kV substation

19.1 Director (PSPA-I), CEA, stated that establishment of Manalmedu 400/230-110 kV substation was agreed in the 41st meeting of SCPSPSR (held on 22.09.2017) with the following transmission schemes:

400 kV transmission lines:

i. Ariyalur (proposed 765/400 kV SS) - Manalmedu 400 kV D/C link
ii. Neyveli (TNEB)-Manalmedu 400 kV D/C link.

230 kV transmission lines:

i. LILO of Neyveli TS-II - Kadalangudi 230 kV SC line at Manalmedu.
ii. Kumbakonam- Manalmedu 230 kV S/C line
iii. Narimanam- Manalmedu 230 kV S/C line.

ICTs:

i. 2x500MVA, 400/230 kV ICT
ii. 2x200MVA, 400/110 kV ICT

Bus reactor:

2x80 MVAr Bus reactors.

19.2 Due to constraints in land acquisition for the establishment of 400 kV SS at Neyveli, upgradation of the existing Cuddalore 230/110 kV substation into 400/230-110 kV SS instead of the already approved Neyveli 400/230 kV substation had been approved in the 1st SRSCT meeting held on 07.09.2018 with the following connectivity:

(i) Neyveli TS II - Cuddalore 400 kV D/C line.
(ii) Manalmedu - Cuddalore 400 kV D/C line.
(iii) 2x500 MVA, 400/230 kV ICTs
(iv) 2x200 MVA, 400/110 kV ICTs
(v) 2x125 MVAr, 400 kV bus Reactors

Thus the 400 kV connectivity for Manalmedu SS was modified as given below:

(i) Ariyalur 765/400 kV SS - Manalmedu 400 kV DC line.
(ii) Cuddalore - Manalmedu 400 kV D/C line.

19.3 Further, in the 2nd SRSCT meeting held on 10.06.2019, as an additional system strengthening scheme for control of short circuit levels in Neyveli generation complex and rearrangement of network configuration to control overloading of ICTs/230 kV lines from Neyveli generation complex, transmission schemes of the already proposed Manalmedu & Cuddalore 400 kV substations were modified as follows:

(i) Neyveli TS II - Cuddalore 400 kV D/c (Quad) line - under the scope of TANGEDCO as agreed in 1st SRSCT meeting.
(ii) Manalmedu - Neyveli TPS II 2nd Expansion 400 kV D/c (Quad) line (in place of Cuddalore – Manalmedu 400kV D/c line as agreed in 1st SRSCT) – under the scope of TANGEDCO

19.4 TANTRANSCO vide letter dated 18.07.2020 has proposed to revise the transmission scheme for the establishment of 400/230-110 kV Manalmedu substation as given below:

Manalmedu 400/230-110 kV SS – proposed revised connectivity:

400 kV transmission lines:

i. Erection of 400 kV DC line from Ariyalur 765/400 kV SS to Manalmedu 400 kV SS.
ii. Erection of 400 kV DC line from the proposed Neyveli TS II 2nd Expansion TPP to Manalmedu 400 kV SS.

ICT

i. 2x500 MVA, 400/230 kV ICTs
ii. 3x200 MVA, 400/110 kV ICTs

Bus reactor

2x125 MVAr Bus Reactors

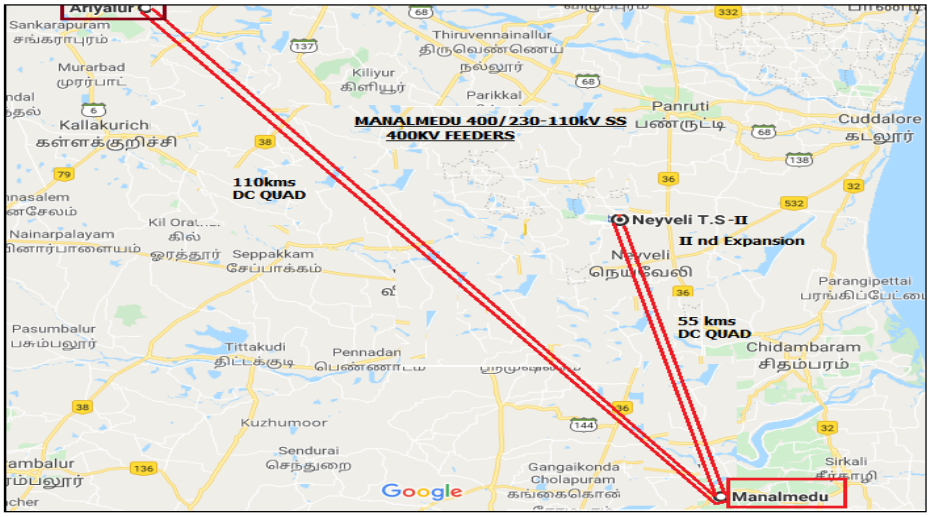
230 kV transmission lines:

i. Erection of DC line to make LILO of Neyveli TS-II to Kadalangudi 230 kV feeder at Manalmedu 400 kV SS.
ii. Erection of SC line to Kumbakonam 230 kV SS from Manalmedu 400 kV SS
iii. Erection of SC line to Poyyur 230 kV SS from Manalmedu 400 kV SS.
iv. Erection of DC line to the proposed Chidambaram 230 kV SS from Manalmedu 400 kV SS.
v. Erection of DC line to the proposed Virudhachalam 230 kV SS from Manalmedu 400 kV SS.

110 kV transmission lines

i. LILO of existing Kadalangudy-LTPCL-Manalmedu 110 kV feeder between LTPCL and Manalmedu substation.
ii. SC line to Kattumannar Koil 110 kV SS.
iii. SC line to Sethiyathoppu 110 kV SS.

iv. DC line to Pappakudi 110 kV SS.
v. SC line to the sanctioned Naduvalur 110 kV SS.



19.5 TANTRANSCO representative informed that works of Manalmedu S/s will start by January/February, 2021 and the substation is expected to be commissioned by 2022-23. However, Neyveli TPS II 2nd Expansion TPP (2x660 MW) is delayed and is likely to be commissioned by 2025-26. In view of uncertainty in commissioning schedule of Neyveli TPS-II 2nd Expn, instead of Manalmedu – Ariyalur 400 kV D/c line, LILO of NNTPS – Neyveli TS-II 400 kV S/c line at Manalmedu may be considered.

19.6 Chief Engineer (PSPA-I), CEA, stated that the tentative start date of connectivity for Neyveli TPS-II 2nd Expn is 2025-26 whereas Manalmedu S/s is expected by 2022-23, therefore phasing of transmission system is required. TANTRANSCO has also proposed change in connectivity for Manalmedu S/s. In view of the same, it was decided that CEA, SRPC, CTU,

SRLDC/POSOCO, NLC & TANTRANSCO may jointly study the scheme and also work out phasing of the transmission scheme. Thereafter, the same would be discussed in next SRPC(TP) meeting.

Transmission Planning proposals by KSEB

20.0 Green Corridor Projects (GC) in Kerala

20.1 Director (PSPA-I), CEA, stated that KSEB vide letter dated 17.07.2020 has informed that in the 40th meeting of SCPSPSR held on 19.11.2016, the following intra-State Green Power Corridor schemes had been agreed:

Wayanad – Kasargode Green Power Corridor Project

i. Construction of a 400 kV Substation at Wayanad (Kattikulam)
ii. Construction of a 2x500MVA 400/220kV, 2 x 200MVA 220/110kV, substation at Kasargode (Cheemeni)
iii. Interconnectivity of 400 kV Switching Station Wayanad (Kattikulam) to 400 kV Kasargode (Cheemeni) substation.
iv. 220 kV connectivity to existing 220 kV substations at Kanhirode, Thaliparamba, Ambalathara and Mylatty.

Attapaddy Green Power Corridor Project

i. 33/220 kV step up substation at Kottathara.
ii. Construction of 220 /110 kV Substation at Vettathur by LILO of 220 kV Madakathara – Areakode.
iii. 220/110 kV Multi circuit / Multi Voltage line on Multi circuit towers from the proposed 220 kV Vettathur Substation up to the existing 110 kV Mannarkkad Substation and then extending the 220 kV D/c line to 220 kV Substation Kottathara. (The 110 kV D/c line will be between the proposed 220 kV Vettathur Substation and existing 110 kV Mannarkkad Substation)

220 kV Ramakkalmedu Green Power Corridor

i. Construction of a 2x50 MVA, 33/110 kV step up substation at Anakkaramettu.
ii. Construction of 110kV D/c line from Anakkaramettu (near Ramakkalmedu) to 110 kV Substation Nedumkandam.
iii. Construction of 2 nos 110 kV feeder bays at 110 kV Nedumkandam Substation.
iv. Construction of 110 kV D/c line from Kattappana to Kuyilimala along the right of way of existing 66 kV S/c line.

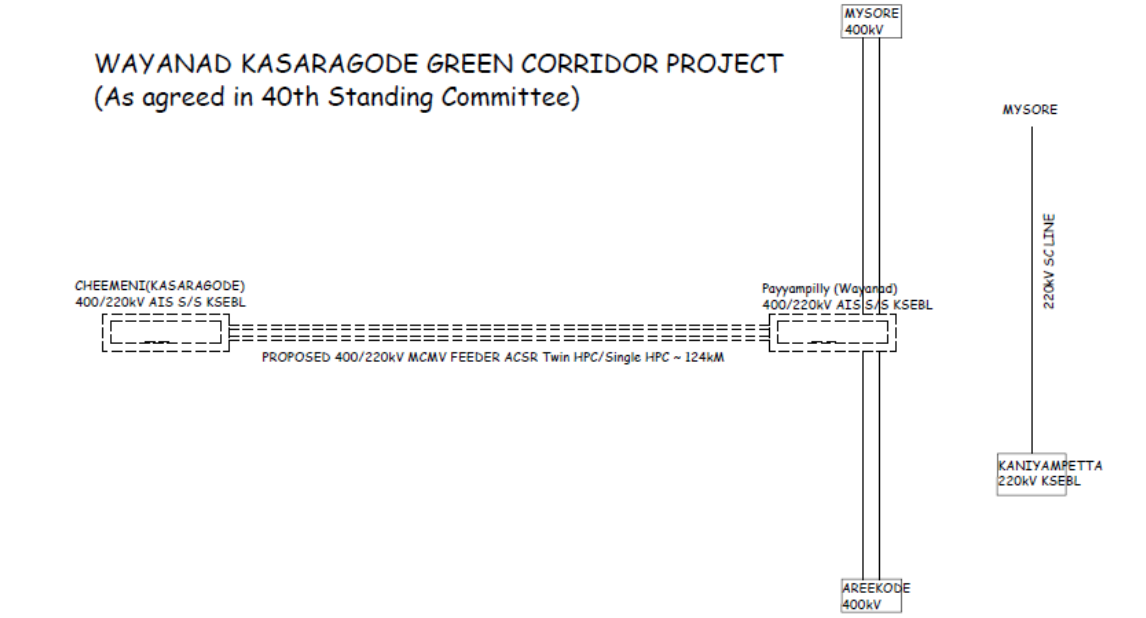
v. Construction of a 220/110 kV substation with 2nos 220/110 kV, 50 MVA transformers and 2 nos 220 kV feeder bays at Kuyilimala. LILO of 220 kV Udumalpet – Idukki S/c feeder at 220 kV Kuyilimala Substation.

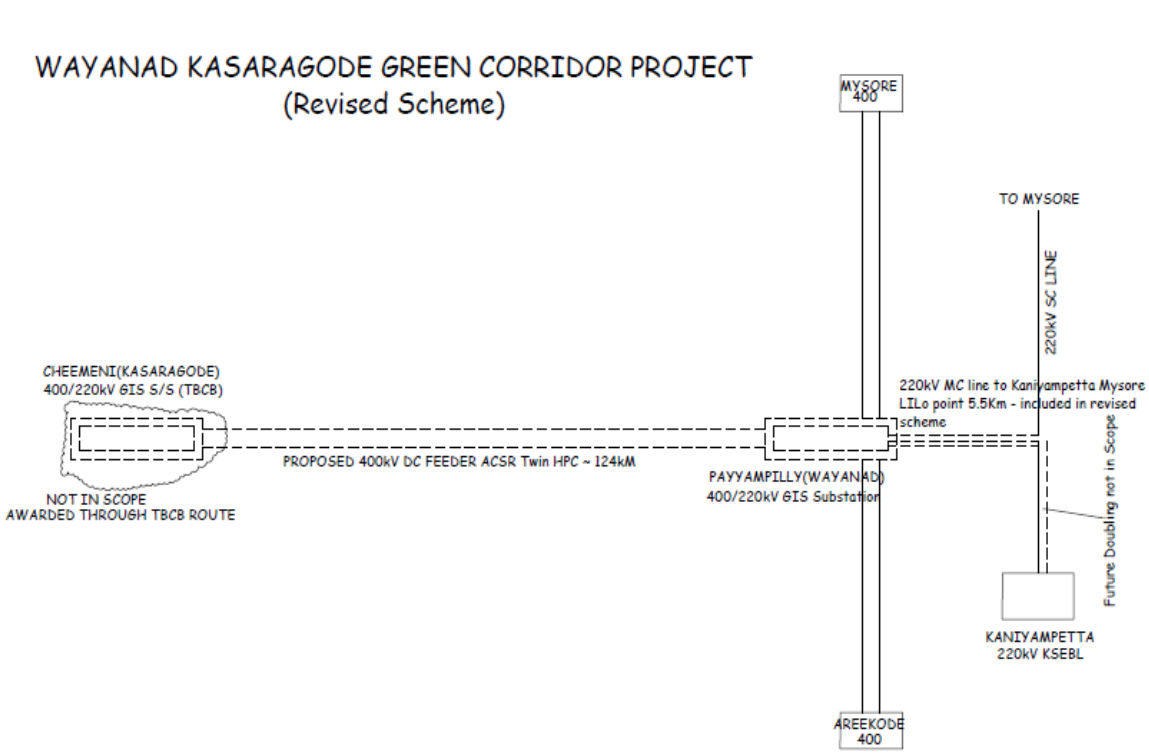
20.2 However, subsequently these schemes underwent some modifications consequent to change in the project elements, change in locations, reconfiguration of the scheme owing to introduction of additional renewable resources etc. Accordingly, KSEB has requested for revision in the transmission schemes. The proposed revised schemes are as follows:

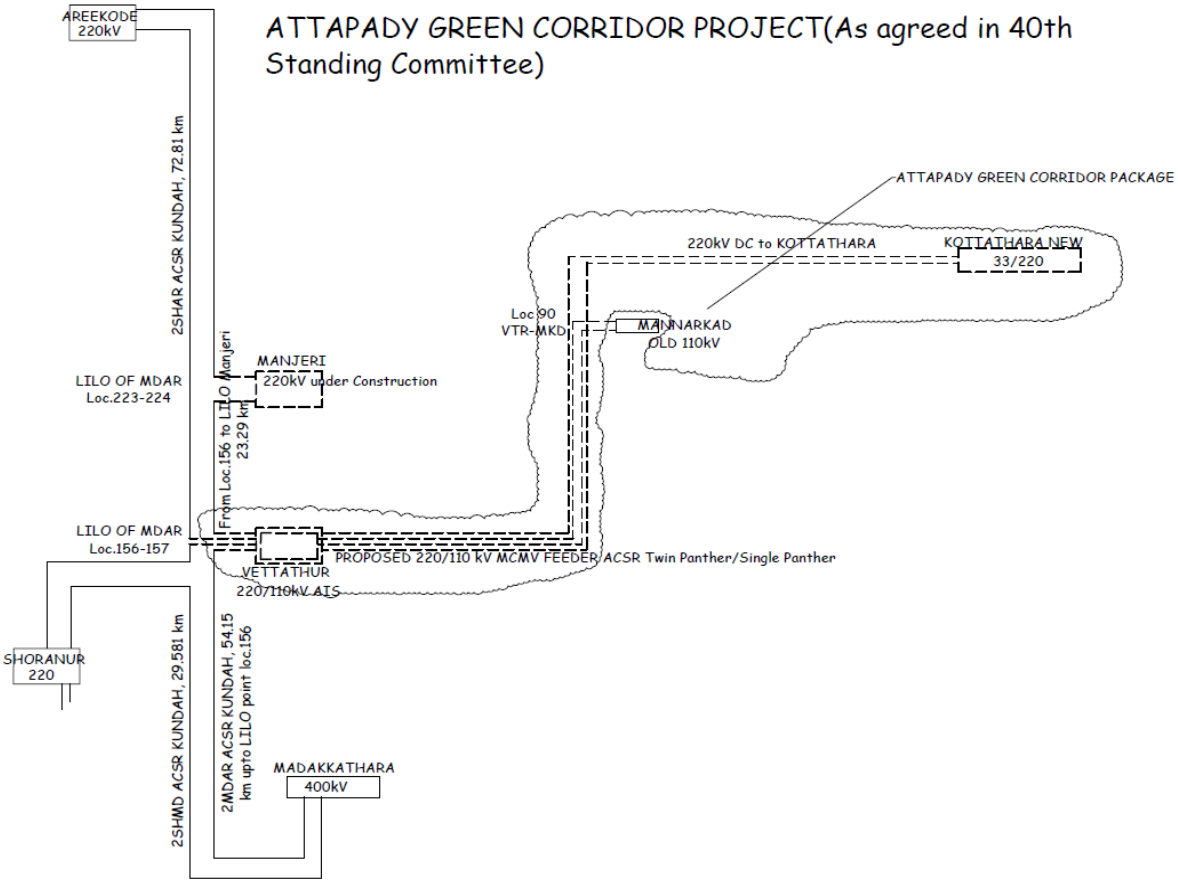
WAYANAD KASARAGODE GREEN POWER CORRIDOR PROJECT	
Scheme as agreed in the 40th SCPSPSR meeting held on 19.11.2016	**Proposed revised scheme**
Construction of 400 kV Substation at Wayanad (Kattikulam)	Construction of 400/220 kV GIS Substation at Wayanad (Payyampally). (Note: the switching station at Wayanad would be connected to Mysore-Areacode 400 kV D/C line by LILO of both the circuits)
Construction of a 2x500 MVA 400/220kV, 2x200 MVA 220/11 kV Substation at Kasaragode (Cheemeni)	Deleted (as the scheme is being developed as ISTS scheme through TBCB route)
Interconnectivity of 400 kV Switching Station Wayand (Kattikulam) to 400 kV Substation Kasaragode (Cheemeni)	400 kV DC line from Wayanad (Payyampalli) S/S to Kasaragode (Cheemeni) 400/220 kV substation.
220 kV connectivity to existing 220 kV substation at Kanhirode, Thaliparamba, Ambalathara and Mylatty.	LILO of 220 kV Kadakola (Mysore)-Kaniyampetta S/C line to 400/220 kV Wayanad (Payyampally) Substation (LILO length 5.25 km)

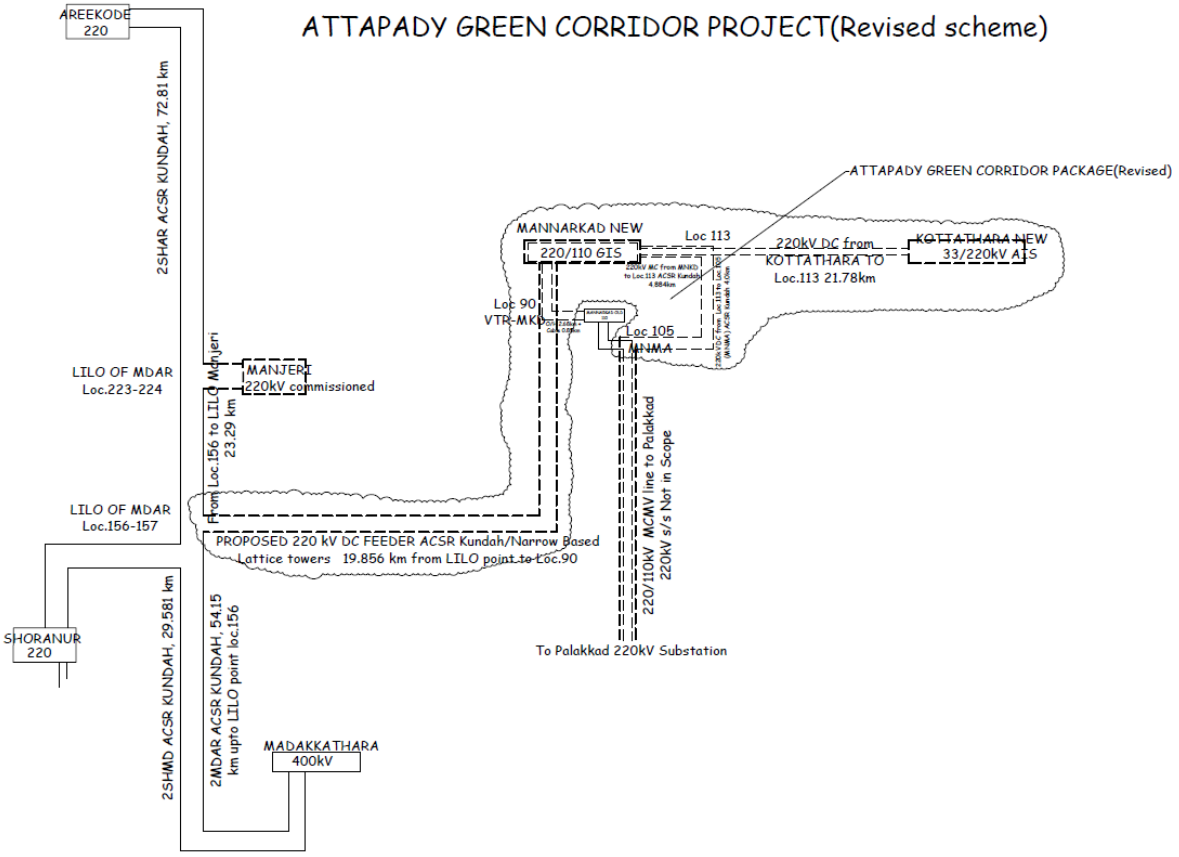
ATTAPADDY GREEN POWER CORRIDOR PROJECT	
Scheme as agreed in the 40th SCPSPSR meeting held on 19.11.2016	**Proposed revised scheme**
33/220 kV step up susbtation at Kottathara	Construction of 33/220 kV Kottathara AIS substation
Construction of 220/110 kV substation at Vettathur by LILO of 220 kV Madakkathara- Areekode line	Construction of 220/110 kV Mannarkad GIS substation. (Note: location has been changed to the land available with KSEB near to existing Mannarkkad 110 kV S/S)
220/110 kV Multi Circuit/Multi Voltage line on Multi circuit towers from the proposed 220 kV substation Vettathur upto the the existing 110 kV Substation Mannarkkad and then extending the 220kV D/c line to 220kV Substation Kottathara. (The 110kV line will be between the proposed 220kV Vettathur Susbtation and existing 110 kV Substation Mannarkkad)	220 kV DC line from Vettathur tap (location) to Mannarkad. (Note: As the substation site has been changed to Mannarkkad, only 220 kV DC line needs to be constructed by LILO of Madakkathara Areekode 220 kV feeder. The connectivity at 110 kV level to the existing 110 kV Mannarkkad Substation is included in this part)
	220 kV DC line from Mannarkad to Kottathara

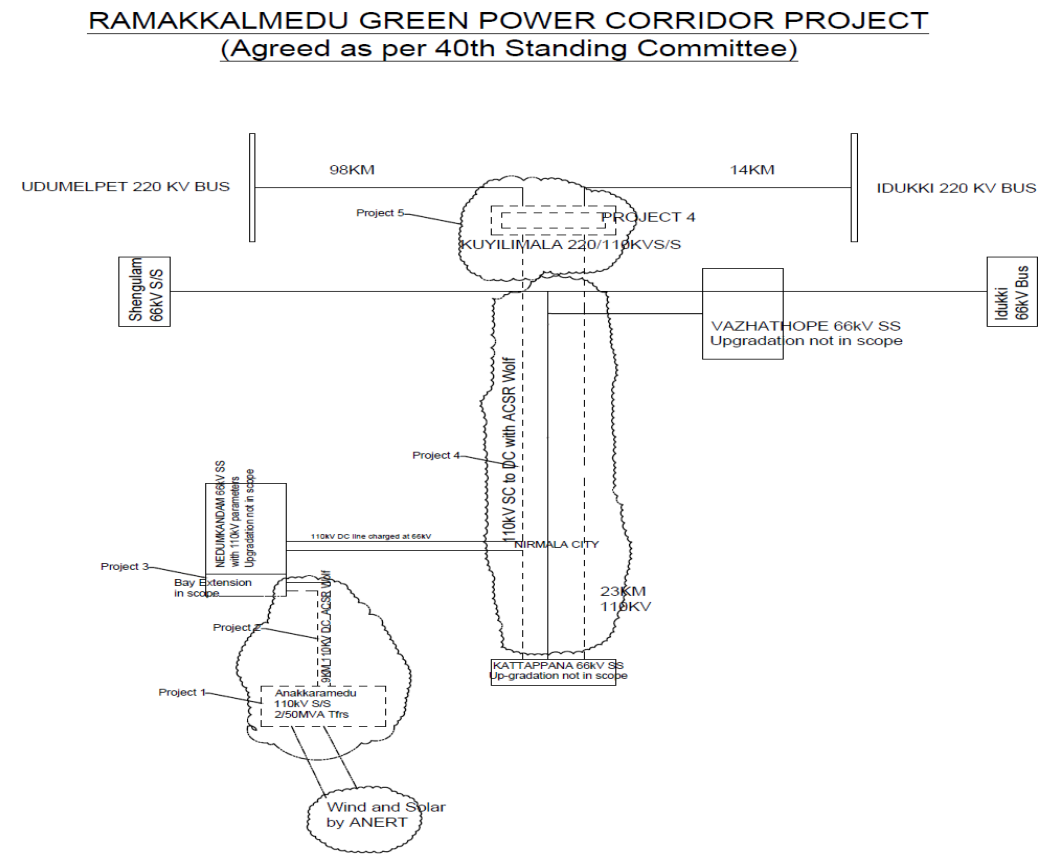
220 kV RAMAKKALMEDU GREEN POWER CORRIDOR	
Scheme as agreed in the 40th SCPSPSR meeting held on 19.11.2016	**Proposed revised scheme**
Construction of 2x50 MVA, 33/110 kV step up substation at Anakkaramedu	Construction of 2x60 MVA, 33/110 kV step up substation at Anakkaramedu. (Note: the transformer capacity has been enhanced to 2x60 MVA due to increased wind generation proposed in the area)
Construction of 110 kV D/c line from Anakkaramedu (near Ramakkalmedu) to 110 kV substation Nedunkandam	Construction of 110 kV D/c line from Anakkaramedu (near Ramakkalmedu) to 110 kV Nedunkandam substation.
Construction of 2 nos 110 kV feeder bays at Nedunkandam Substation	Construction of 2 nos. 110 kV feeder bays at Nedunkandam Substation.
Construction of 110 kV D/c line from Kattappana to Kuyilimala along the right of way of existing 66 kV S/c line	Construction of 20 km 220/110 kV MCMV Line from Nirmala City (Near Kattappana) to Kuyilimala (location) and 5 km 110 kV DC line from Nirmala city to Kattappana along ROW of existing 66 kV SC line.
Construction of a 220/110 kV substation with 2 nos 220/110 kV 50 MVA transformers and 2 nos 220 kV feeder bays at Kuyilimala. LILO of 220 kV Udumalpet I Idukki S/c feeder at 220 kV Substation, Kuyilimala	Construction of 220/110 kV GIS substation with 1 no. 100 MVA transformer and 4 nos. 220 kV feeder bays and 6 no. 110 kV feeders bays at Nirmala City (Near Kattappana) (Note: Substation site has been changed to Nirmala City where land is available)
	Construction of 2 nos 110 kV feeder bays at Vazhathope Substation. (Note: The pooling station for 50 MW of floating solar power, out of total capacity of 300 MW, is proposed near Vazhathope. The evacuation is proposed at 110 kV level to the nearby Vazhathope SS. Hence additional two nos feeder bays is required at Vazhathope SS).


WAYANAD KASARAGODE GREEN CORRIDOR PROJECT
(As agreed in 40th Standing Committee)
MYSORE
400kV
MYSORE
220kV SC LINE
CHEEMENI(KASARAGODE)
400/220kV AIS S/S KSEBL
Payyampilly (Wayanad)
400/220kV AIS S/S KSEBL
PROPOSED 400/220kV MCMV FEEDER ACSR Twin HPC/Single HPC ~ 124kM
KANIYAMPETTA
220kV KSEBL
AREEKODE
400kV

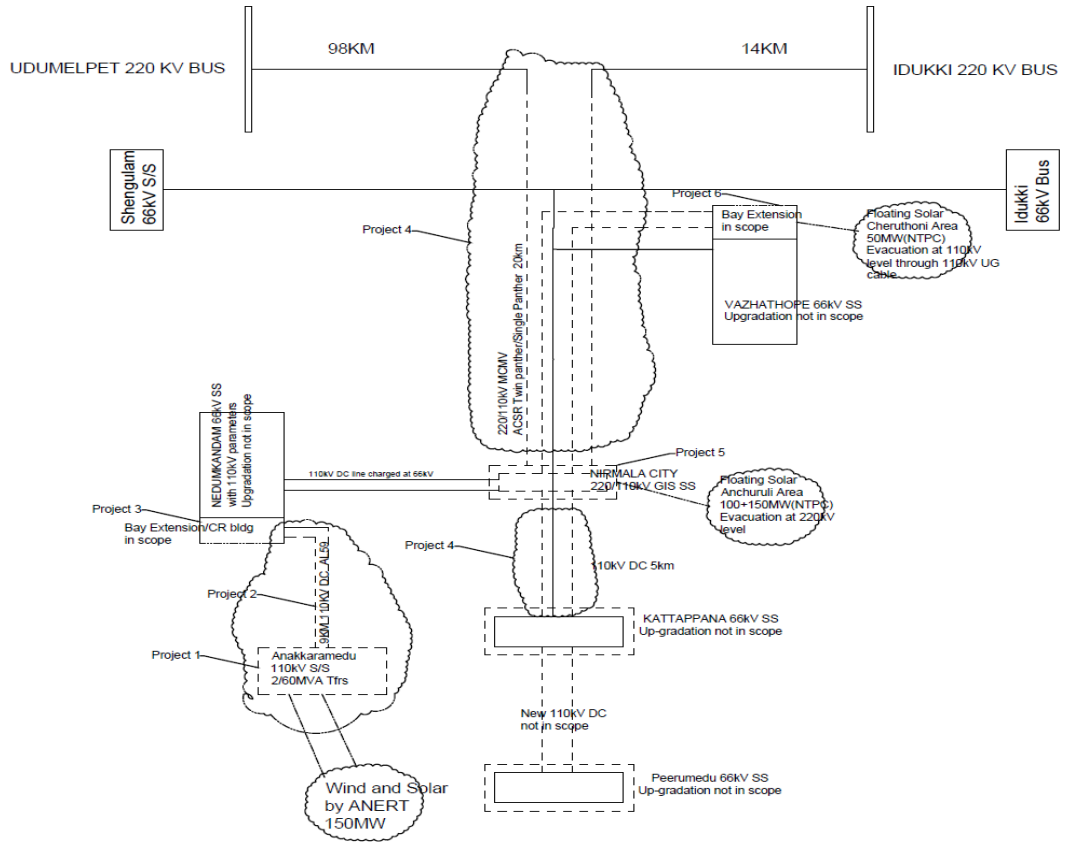

WAYANAD KASARAGODE GREEN CORRIDOR PROJECT
(Revised Scheme)
MYSORE
400
TO MYSORE
220kV SC LINE
CHEEMENI(KASARAGODE)
400/220kV GIS S/S (TBCB)
220kV MC line to Kaniyampetta Mysore
LILo point 5.5Km - included in revised
scheme
PROPOSED 400kV DC FEEDER ACSR Twin HPC ~ 124kM
PAYYAMPILLY(WAYANAD)
400/220kV GIS Substation
Future Doubling not in Scope
NOT IN SCOPE
AWARDED THROUGH TBCB ROUTE
KANIYAMPETTA
220kV KSEBL
AREEKODE
400


ATTAPADY GREEN CORRIDOR PROJECT(As agreed in 40th Standing Committee)
AREEKODE 220kV
25HAR ACSR KUNDAH, 72.81 km
ATTAPADY GREEN CORRIDOR PACKAGE
220kV DC to KOTTATHARA
KOTTATHARA NEW 33/220
Loc 90 VTR-MKD
MANNARKAD OLD 110kV
MANJERI 220kV under Construction
LILO OF MDAR Loc.223-224
From Loc.156 to LILO Manjeri 23.29 km
LILO OF MDAR Loc.156-157
PROPOSED 220/110 kV MCMV FEEDER/ACSR Twin Panther/Single Panther
VETTATHUR 220/110kV AIS
SHORANUR 220
2SHMD ACSR KUNDAH, 29.581 km
2MDAR ACSR KUNDAH, 54.15 km upto LILO point loc.156
MADAKKATHARA 400kV


ATTAPADY GREEN CORRIDOR PROJECT(Revised scheme)
AREEKODE 220
2SHAR ACSR KUNDAH, 72.81 km
ATTAPADY GREEN CORRIDOR PACKAGE(Revised)
MANNARKAD NEW 220/110 GIS
Loc 113
220kV DC from KOTTATHARA TO Loc.113 21.78km
KOTTATHARA NEW 33/220kV AIS
Loc 90 VTR-MKD
Loc 105 MNMA
LILO OF MDAR Loc.223-224
MANJERI 220kV commissioned
From Loc.156 to LILO Manjeri 23.29 km
LILO OF MDAR Loc.156-157
PROPOSED 220 kV DC FEEDER ACSR Kundah/Narrow Based Lattice towers 19.856 km from LILO point to Loc.90
220/110kV MCMV line to Palakkad 220kV s/s Not in Scope
To Palakkad 220kV Substation
SHORANUR 220
2SHMD ACSR KUNDAH, 29.581 km
2MDAR ACSR KUNDAH, 54.15 km upto LILO point loc.156
MADAKKATHARA 400kV


RAMAKKALMEDU GREEN POWER CORRIDOR PROJECT
(Agreed as per 40th Standing Committee)
UDUMELPET 220 KV BUS
98KM
14KM
IDUKKI 220 KV BUS
Project 5
PROJECT 4
KUYILIMALA 220/110KVS/S
Shengulam 66kV S/S
Idukki 66kV Bus
VAZHATHOPE 66kV SS
Upgradation not in scope
Project 4
110kV SC to DC with ACSR Wolf
NEDUMKANDAM 66kV SS with 110kV parameters Upgradation not in scope
110kV DC line charged at 66kV
NIRMALA CITY
Project 3
Bay Extension in scope
23KM 110kV
Project 2
Project 1
Anakkaramedu 110kV S/S 2/50MVA Tfrs
KATTAPPANA 66kV SS Up-gradation not in scope
Wind and Solar by ANERT

RAMAKKALMEDU GREEN POWER CORRIDOR PROJECT
(Revised Scheme)



20.3 KSEB further informed that ICT's at Wayanad substation would be 2x315 MVA, 400/220 kV ICT's.

20.4 Director (PSPA-I), CEA, informed that DPR of the above schemes have been received in CEA for appraisal and subsequent recommendation to MNRE for funding under GEC-II schemes. However, from the DPR of Kasargode- Wayanad Green Power Corridor Project, it is not clear about how much MW of green power is to be injected/evacuated through the 400 kV Kasargode- Wayanad D/c line.

20.5 Director (Transmission), KSEB, informed that solar power will be injected at Kasargode (Cheemeni) and Kaniyampetta substation. He further stated that around 300 MW solar power will be evacuated from Ambalathara, Mylatty and Kanhirode and it will be injected at Kasargode (Cheemeni) substation. Also around 100 MW of floating solar at Kaniyampetta will be evacuated at Wayanad substation. He further informed that MNRE has already agreed to fund the scheme in GEC-II. Director, KSEB, informed that details regarding RE capacity planned to be evacuated through Kasargode- Wayanad 400 kV line, would be subsequently furnished to CEA.

20.6 Representative of KPTCL enquired about how the Wayanad- Kasargode link could be considered as Green Power Corridor Project (Intra-State) as the above link is to be connected

to Mysore-Areacode ISTS line at Wayanad and hence the power will be flowing through ISTS network. Representative of KSEB informed that with the injection of green power from Ambalathara and Myatty at Kasargode substation and flow of this power towards Wayanad, power flow in Kerala from Mysore would be reduced.

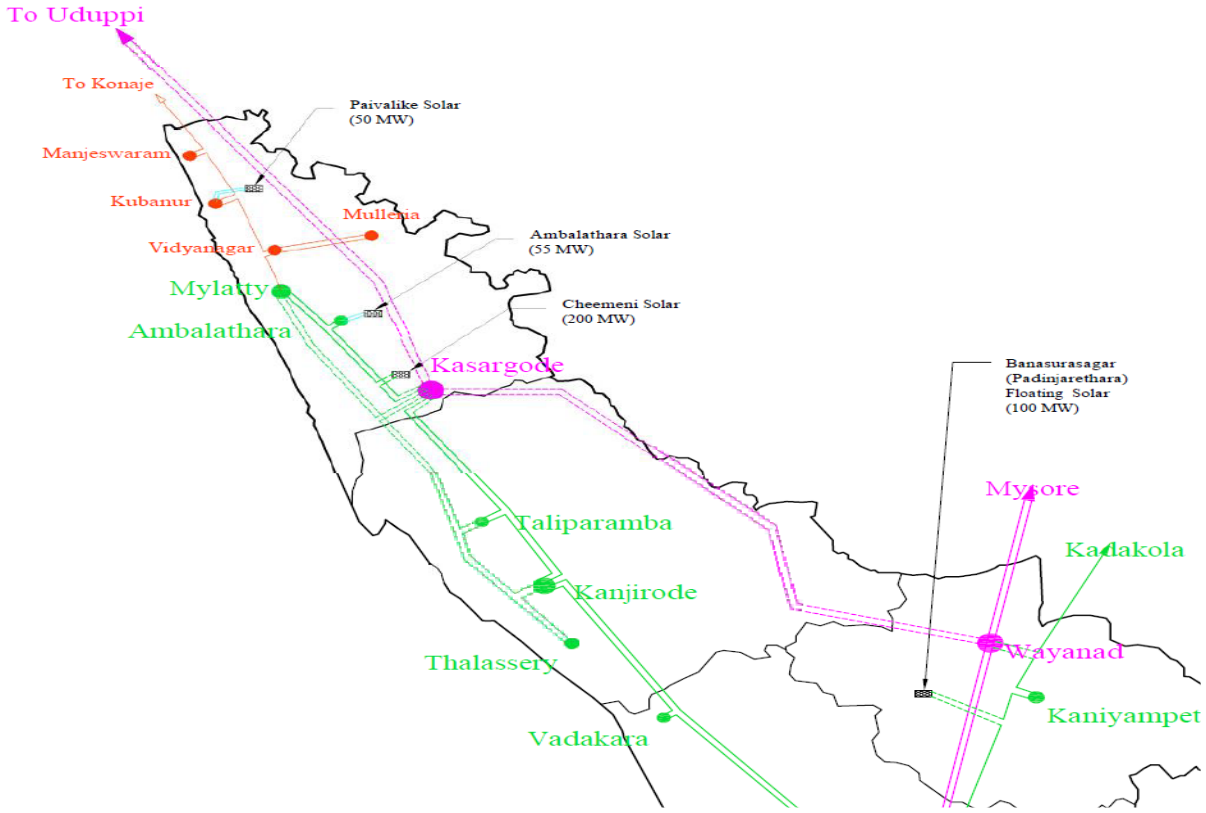
20.7 DGM (CTU) stated that for utilization of 400 kV Uduppi - Kasargode ISTS link, which is planned to be commissioned by November 2022, the Kasargode - Wayanad link is required. So KSEB should expedite the Kasargode - Wayanad link.

20.8 KSEB vide letter dated 14.10.2020 has submitted following details regarding RE power to be evacuated through the Kasargode - Wayanad Green Power Corridor project:

Sl. No.	Name of scheme	Name of Project	RE Injection Point	Solar (MW)		Floating Solar (MW)		Solar Total (MW)
				Existing	Future	Existing	Future	
1	Kasargode -Wayanad NGEC	Ambalathara	Ambalathara-220 kV S/S	50	5*	0	0	55
2		Paivelikae	Mayatti 220 kV S/S	0	50*	0	0	50
3		Cheemni	Kasargode 220 kV S/S	0	200**	0	0	200
4		Banasurasagar	Kaniyampetta 220 kV S/S	0	0	0	100	100
							Total	405

**Project Under Construction*

*** Land received from GoK for 100MW and land identified for another 100MW*



20.9 KSEB vide letter dated 14.10.2020 has further mentioned that Kasargod-Wayand 400 kV line will be a multipurpose transmission line for transferring solar power generated at Kasargode and Wayanad during day time and rest of the time for transferring power to North Kerala for meeting demand.

20.10 The Kasargode - Wayanad 400 kV Quad D/C line is a crucial link for Kerala and it will help in relieving the transmission congestion within Kerala, improve the S1-S2 ATC and help in evacuating the renewable energy generated in Northern Kerala. The scheme is technically justified. The Kasargod-Wayand 400 kV quad moose D/C line can easily transfer about 3500 MW power, however, the scheme is being justified by KSEB for funding through GEC-II scheme for evacuation of just 305 MW solar power. As such, whether the scheme qualifies for funding through GEC-II scheme, needs to be discussed with MNRE.

20.11 Regarding Attapaddy Green Power Corridor Project, Director (KSEB) stated that due to land acquisition issues, 220/110 kV Mannarkad GIS substation is proposed. RE projects in Attapaddy Green Power Corridor Project is given below (as informed by KSEB vide letter dated 14.10.2020)

Name of scheme	Wind (MW)		
	Existing	Future	Total
Attappady	18.6	72	90.6

20.12 Regarding 220 kV Ramakkalmedu Green Power Corridor Project, Director (KSEB) informed that NTPC will install 250 MW of floating solar near Nirmala city, so KSEB has decided to change the location of sub-station from Kuyilimala to Nirmala City. RE projects in Ramakkalmedu Green Power Corridor Project is given below (as informed by KSEB vide letter dated 14.10.2020)

Name of scheme	Wind (MW)			Solar (MW)		Floating Solar (MW)		Solar Total (MW)
	Existing	Future	Total	Existing	Future	Existing	Future	
Ramakkalmedu	14.25	80	94.25	0	50	0	250	300

20.13 DGM (CTU) suggested that, considering the future load growth, new substations proposed should be planned with 500 MVA ICT instead of 315 MVA ICT as there is not much difference in cost.

20.14 Director (PSPA-I), CEA, inquired about the change in DPR cost estimation with the change of 4x167 MVA transformer to 2x315 MVA transformer at Wayanad substation. Director (KSEB) informed that there would not be any significant change in DPR cost with the change in transformer configuration.

20.15 After deliberations, the revised transmission system in Wayanad – Kasargode Green Power Corridor Project, Attapaddy Green Power Corridor Project and Ramakkalmedu Green Power Corridor Project as mentioned in para 20.2 was agreed. However, regarding funding of Wayanad – Kasargode Green Power Corridor Project under GEC-II scheme, the matter needs to be discussed with MNRE.

21.0 Installation of Shunt Reactor at the proposed 400 kV Kottayam substation

21.1 Director (PSPA-I), CEA, stated that 400 kV substation at Kottayam was agreed in the 39th SCPSPSR held on 28-29 December, 2015, with the following connectivity:

- 400 kV substation at Kottayam with 2x315 MVA, 400/220 kV interconnection transformers by LILO of 400 kV Thirunelveli- Kochin East PGCIL DC line.
- 220 kV connectivity (as per 41st meeting of SCPSPSR held on 22nd September, 2017)
  - Ettumanoor – Kottayam 220 kV D/c line.
  - Thuravoor (Eramalloor) – Kottayam 220 kV D/c line.
  - 220 kV connectivity to existing 220 kV substations at Poovanthuruthu and Ambalamughal by LILO of existing 220 kV Pallom - Ambalamughal feeder to 400 kV Kottayam substation.

21.2 KSEB vide letter dated 17.07.2020 has proposed installation of one 125 MVAR shunt reactor in the 400 kV bus at Kottayam to control voltage during lightly loaded conditions.

21.3 CTU and SRLDC welcomed the proposal of 1x125 MVAR shunt reactor in the 400 kV bus at Kottayam to control voltage during lightly loaded conditions.

21.4 After deliberations, the proposal of KSEB regarding installation of 1x125 MVAR Shunt Reactor at the proposed 400 kV Kottayam substation was agreed.

22.0 Modification in 400 kV Edamon substation

22.1 Director (PSPA-I), CEA, stated that 400 kV substation at Edamon was agreed at 39th SCPSPSR held on 28-29 December, 2015. The following scheme was agreed upon:

- Six 400 kV line bays
- Four spare 400 kV line bays
- Two transformer bays with 2x315 MVA 400/220 kV ICT's.
- The 400 kV connectivity would be established by charging existing 220 kV Tirunelveli – Edamon Twin Moose D/c feeder, constructed in 400 kV parameters, at 400 kV, and by LILO-ing both circuits of under construction 400 kV Tirunelveli – Cochin East Quad Moose D/c feeder.
- Additional connectivity to 400 kV substation, Trivandrum North is planned later by LILO of existing 400 kV Tirunelveli – Trivandrum (North) Twin Moose D/c feeder.

- Downstream 220 kV connectivity:
  a. 220 kV connectivity will be directly to existing 220 kV switchyard of Edamon and further to following stations
  b. 220 kV D/c feeder to Pothencode
  c. 220 kV D/c and 220 kV S/c feeders to Sabarigiri
  d. 220 kV feeders to Kundara and Edappon.

22.2 KSEB vide letter dated has informed that at the identified location for 400/220 kV substation, Tirunelveli - Edamon I & II Twin Moose feeders, Tirunelveli - Cochin East I & II Quad Moose feeders and Tirunelveli - Trivandrum I & II Quad Moose feeders are crossing so that the 400 kV lines can be directly terminated.

22.3 As per studies carried out by KSEB, only six circuits need to be connected to the new 400/220 kV substation at Edamon, Nagamala Estate. The following revised transmission scheme has been proposed by KSEB:

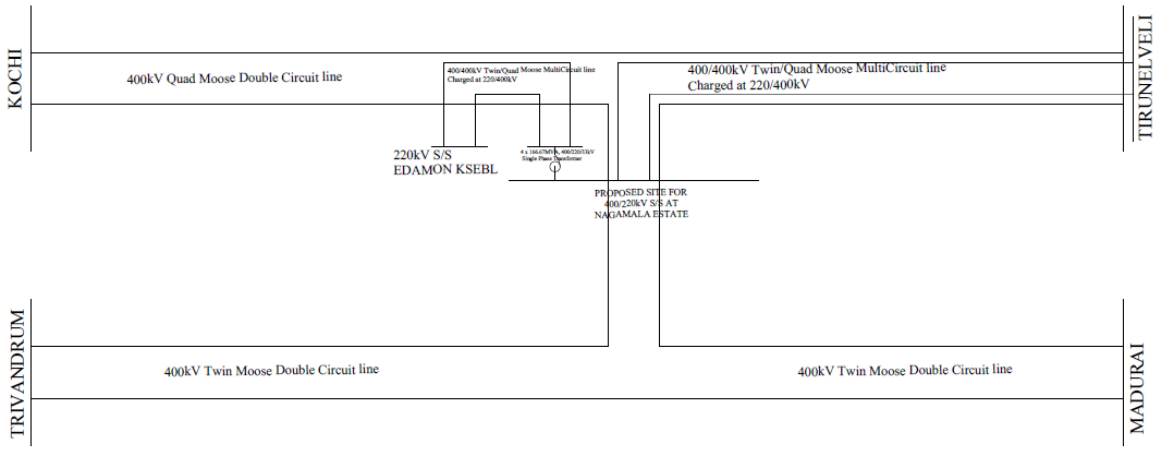
i. Tirunelveli - Edamon I & II Twin Moose feeders constructed in 400 kV parameters and now charged at 220 kV level will be terminated at 400 kV Edamon substation.
ii. One of the 400 kV Quad Moose Tirunelveli- Cochin East I & II feeders will be LILO'ed at 400 kV Edamon substation.
iii. One of the 400 kV Twin Moose Tirunelveli - Trivandrum I & II feeders will be LILO'ed at 400 kV Edamon substation.
iv. The 220 kV connectivity to 220 kV Edamon (KSEBL) existing substation will be established by using the balance portion of Twin Moose feeder to Edamon (KSEB) substation.
v. 3 Nos. + 1 No.(spare) 166.67 MVA, 400/220/33 kV single phase auto transformer banks at 400 kV Edamon substation.

22.4 KSEB informed that 2x315 MVA, 400/220 kV ICTs have been planned at Edamon.

22.5 Further, KSEB has proposed the following downstream connectivity at Edamon (Nagamala Estate):

- 220 kV connectivity to existing 220 kV switchyard of Edamon
- 220 kV D/c feeder to Pothencode
- 220 kV D/c feeder to Sabarigiri
- 220 kV feeder to Pathanamthitta
- 220 kV feeders to Kundara and Edappon.

400/220kV SUBSTATION EDAMON (NAGAMALA ESTATE
NETWORK DIAGRAM



22.6 DGM(CTU) opined that LILO of Tirunelveli-Trivandrum D/c line at Edamon would not be required as Edamon S/s would be having sufficient connectivity even in the absence of this LILO. Further, the 400/220 kV ICT's may need to be reviewed in view of large number of 220 kV transmission lines planned from Edamon S/s.

22.7 After deliberations, it was decided that the transmission system for Edamon would be studied in a joint meeting of CEA, SRPC, CTU, SRLDC/POSOCO and KSEB and the same would be discussed in the next SRPC(TP) meeting.

23.0 Change in location of 220 kV Eramallur substation

23.1 Director (PSPA-I), CEA, stated that establishment of 220 kV Eramallur sub station was approved in the 39th SCPSPSR held on 28-29 December 2015.

23.2 KSEB vide letter dated 04.09.2020 has proposed change in location of 220 kV Eramallur substation to Thuravoor (due to land availability issue) with the following connectivity:

220 kV connectivity

Connectivity to 220 kV Thuravoor S/S has been planned through Kottayam – Thuravoor 220 kV D/c line from 400/220 kV Kottayam S/s

(The same connectivity had been agreed for Eramallur 220 kV substation in 41st SCPSPSR meeting held on 06.12.2017).

110 kV connectivity at Thuravoor Substation

- 110 kV D/c feeder to 110 kV Thykattussery S/s.
- 110 kV feeder to 110 kV Cherthala S/s
- 110 kV feeder to 110 kV Mattancherry S/s

- 110 kV feeder to 110 kV Eramalloor S/s
- 110 kV D/c feeder to 110 kV SL Puram S/s
- 110 kV feeder to 110 kV Aroor S/s
- 110 kV feeder to 110 kV Vaikkom S/s
- 110 kV feeder to 110 kV Thykattussery S/s

23.3 Director (PSPA-I), CEA, further stated that the change in location from 220 kV Eramallur substation to Thuravoor (due to land availability issue) and its connectivity had already been agreed in 41st SCPSPSR meeting held on 06.12.2017.

23.4 Director, KSEB mentioned that details of 110 kV connectivity had not been mentioned in the minutes of 41st SCPSPSR and the same needed to be discussed.

23.5 After deliberations, the transmission system mentioned in para 23.2 was agreed.

Transmission planning proposals by CTU

24.0 Alternate arrangement of transmission system for evacuation of power from 2nd Unit of NNTPS (2x500 MW) in Tamil Nadu

24.1. Director (PSPA-I), CEA, informed that CTU vide letter dated 02.03.2020 had communicated that the Ariyalur sub-station (being executed by TANTRANSCO and was scheduled for commissioning in 2017-18) has been delayed and now expected to be commissioned by June, 2020 (under best effort scenario) as intimated by TANTRANSCO. The 2nd Unit of NNTPS (being implemented by NLC), and the NNPTS – Ariyalur 400 kV D/c line, being implemented by POWERGRID, is likely to be commissioned by March, 2020. Hence, as an interim arrangement, the NNTPS – Ariyalur line may be connected with one circuit of LILO section of Pugalur – Kalivandapattu 400 kV D/c line at Ariyalur, to form NNTPS – Pugalur 400 kV circuit and NNTPS – Kalivandapattu 400 kV circuit.

24.2. A meeting was held on 09.03.2020 at CEA, New Delhi, to deliberate on the matter, wherein it was agreed that NNTPS - Ariyalur 400 kV D/c line can be connected with one circuit of LILO section of Pugalur – Kalivandapattu 400 kV D/c line at Ariyalur, to form NNTPS – Pugalur 400 kV circuit and NNTPS – Kalivandapattu 400 kV circuit, as an interim arrangement. This interim arrangement would help in evacuation of power from NNTPS. TANTRANSCO was advised to commission the Ariyalur S/S by June 2020. As agreed during the meeting, in-principle approval was conveyed vide CEA letter dated 18.03.2020 for the interim arrangement.

24.3. CTU informed that interim arrangement has already been completed and the balance quantity of LTA has already been made effective from July, 2020.

24.4. TANTRANSCO informed that Ariyalur S/s is expected by June, 2021. TANTRANSCO was requested to expedite the implementation of same.

Members noted the above.

25.0 Restoring of one circuit of Kudankulam – Tuticorin PS 400 kV (quad) D/c line at Tirunelveli to control loadings/un-balancing on Kudankulam – Tirunelveli 400 kV (quad) lines

25.1. In the 41st Southern Region constituents meeting regarding connectivity/LTA applications held on 13.04.2020, SRLDC informed that in real time operation with full generation of Coastal Energen, Tuticorin JV and high wind generation at Tuticorin-II GIS, the tendency of power flow is from Tuticorin PS to Kudankulam in place of Kudankulam to Tuticorin PS. Due to this, entire power of Kudankulam Unit 1&2 and power coming from Tuticorin PS is flowing through Kudankulam – Tirunelveli 400 kV (quad) D/c line and results in high loading in case of outage of one circuit of Kudankulam – Tirunelveli 400 kV (quad) D/c line. However, as per the feedback of SRLDC, with the increase in RE generation at Tuticorin-II, the un-balancing of loading on the quad lines may further increase.

25.2. CTU informed that to address the high/unbalance loading on Kudankulam – Tirunelveli 400 kV (quad) D/c line, re-arrangement of circuits at Tirunelveli has been proposed. Restoration of one circuit of Kudankulam – Tuticorin PS 400 kV D/c line at Tirunelveli substation, would provide one additional 400 kV quad circuit and is expected to address the above issues. With this re-arrangement, there will be three 400 kV (quad) circuits from Kudankulam to Tirunelveli, one 400 kV (quad) circuit from Kudankulam to Tuticorin PS and one 400 kV (quad) circuit between Tirunelveli and Tuticorin PS. From the study results, it was also observed that the arrangement addresses issue of high loading under N-1 contingency conditions. Diagram of the proposed re-arrangement is below:

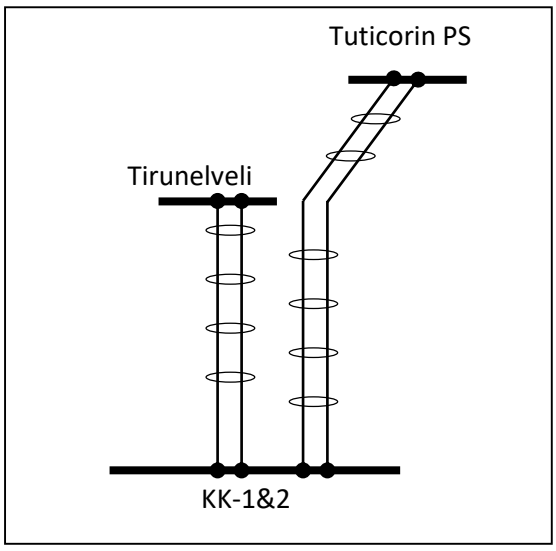


Fig: Existing arrangement

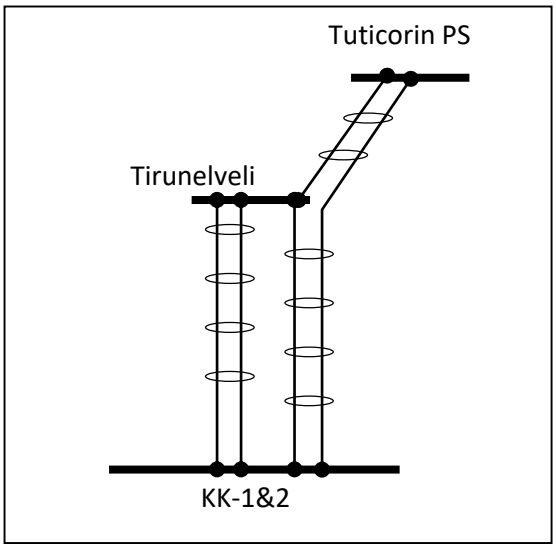


Fig: Proposed re – arrangement

25.3. SRLDC representative stated that major portion of the power from Kudankulam NPP is flowing through 400 kV KKNPP-Tirunelveli lines and outage of one of the circuit of 400 kV Kudankulam – Tirunelveli line results in over loading of the other circuit. In addition to this, there is power injection from Tuticorin to KKNPP bus, which further increases the line

loadings. Thus, restoring of one circuit of Kudankulam – Turicotin PS line at Tirunelveli would strengthen the 400 kV Kudankulam – Tirunelveli corridor.

25.4. Representative of NPCIL also agreed to the proposal.

25.5. After detailed deliberations, the proposal for re-arrangement of one circuit of Kudankulam – Tuticorin PS 400 kV D/c line via Tirunelveli S/s was agreed by the members.

26.0 Transmission system for grant of Connectivity to NPCIL for expansion of Kudankulam NPP Unit 3&4 (2x1000 MW)

26.1. CTU informed that transmission system for grant of connectivity to NPCIL for expansion of Kudankulam NPP Unit 3&4 (2x1000 MW) was discussed in the 1st SRPC(TP) meeting held on 16.12.2019 wherein following transmission system was agreed:

i. Restoration of Kudankulam – Tirunelveli 400 kV D/c (Quad) line by terminating it at Tirunelveli substation [presently this line is connected to Tirunelveli – Tuticorin PS 400 kVD/c (Quad) line and thus form Kudankulam (Unit-1&2) – Tuticorin PS 400kV D/c(Quad) line]– **Under ISTS**

ii. Kudankulam NPP (Unit-3&4) - Tuticorin PS 400 kV D/c (Quad) line [by implementing Kudankulam-Tirunelveli section and extending this upto Tuticorin PS, using the Tirunelveli-Tuticorin PS –400 kV D/c (Quad) existing line as mentioned in (a) above]– **Under ISTS**

iii. Termination of one circuit of each of Kudankulam Unit-1&2 – Tirunelveli 400 kV 2xD/c (Quad) line at Kudankulam Unit-3&4 and one circuit of Kudankulam Unit-3&4 - Tuticorin PS 400 kV D/c (Quad) line at Kudankulam Unit-1&2. This arrangement shall result into 3 nos. of 400 kV quad circuits from Kudankulam Unit-1&2 and Kudankulam Unit-3&4 generating stations – transmission line works under ISTS and re-arrangement works alongwith 400kV bays at generation switchyard – **by NPCIL**.

iv. 2x125 MVAR, 420kV bus reactor at Kudankulam (Unit-3&4) – **by NPCIL**

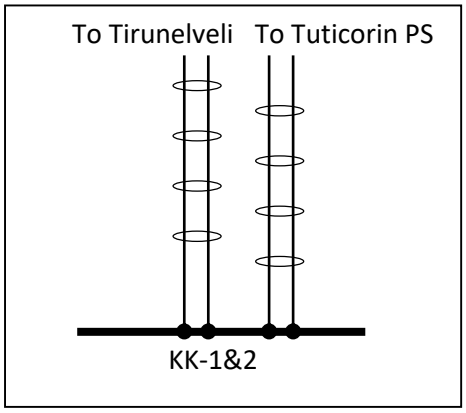


Fig : Connectivity arrangement at KKNPP for Unit-1&2

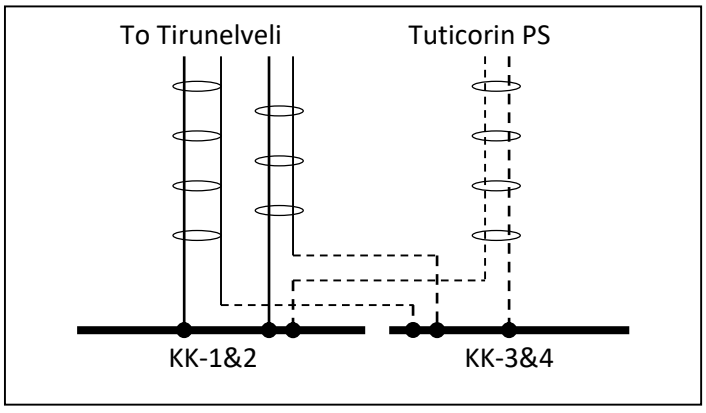


Fig : Proposed Connectivity arrangement at KKNPP generation complex with proposed U-3&4

26.2. NPCIL vide letter dated 21.08.2019 and email dated 04.09.2019 & 06.09.2019 had conveyed that commissioning schedule of Kudankulam Unit - 3&4 has been confirmed as October 2023 & April 2024 respectively. NPCIL is seeking connectivity for Unit-3&4 from March, 2023.

26.3. CTU further informed that NPCIL is yet to submit Long Term Access (LTA) application for Kudankulam Unit – 3&4 as per CERC Connectivity Regulations, 2009. In view of the above, it is proposed that connectivity for Kudankulam NPP Unit-3&4 may be provided through bus extension of Kudankulam NPP Unit-1&2 generation switchyard with the suitable bus section arrangement. Further the Kudankulam NPP (Unit-3&4) - Tuticorin PS 400 kV D/c (Quad) line and other re-arrangement of evacuation transmission lines at Kudankulam generation switchyard, as approved in the 1st SRPC(TP) meeting may be included in the transmission system required for LTA.

26.4. NPCIL representative requested to retain the system for connectivity of KKNPP Unit 3 & 4 as agreed in 1st SRPC(TP) meeting. NPCIL informed that they will apply for LTA at the earliest and requested to take up the transmission system for implementation. NPCIL representative also informed that they would be intimating the firm commissioning schedule of Kudankulam NPP U3&4 shortly.

26.5. CTU informed that in case the transmission system is taken up for implementation and is completed prior to the commissioning of the generation project, the transmission system may not get utilized. Accordingly, it was proposed that connectivity for KNPP Unit - 3&4 may be granted through bus extension and the transmission system may be taken-up as part of LTA only.

26.6. After detailed deliberations, it was agreed that that the connectivity for Kudankulam NPP Unit-3&4 may be provided through bus extension of Kudankulam NPP Unit-1&2 generation switchyard with suitable bus sectionalise arrangement under the scope of NPCIL. The transmission system agreed in 1st SRPC(TP) meeting would be taken up upon receipt of LTA application from NPCIL.

26.7. Subsequently, NPCIL vide letter No. NPCIL/Trans/2020/M/33 dated 30.10.2020, has informed that the connectivity requirement of KKNPP- 3&4 will be in February, 2024.

27.0 Assessment of online Dynamic Line Rating

27.1. As per the directions of CERC regarding implementation of assessment of Dynamic Line Loadings in real time / day ahead for optimal utilization of transmission lines, the matter was discussed in 37th SRPC and 167th OCC meetings held on 01.02.2020 and 13.03.2020 respectively. In the OCC meeting it was decided that SRPC may take up the matter with POSOCO/CTU to have a pilot project on any critical line in Southern Region. Member Secretary, SRPC, vide letter dated 16.03.2020 addressed to CTU/POSOCO, had requested to have a pilot project on any critical line in Southern Region. KSEB vide letter dated 29.02.2020 has proposed installation of the system for dynamic loadings on Udumalpet–Palakad 400 kV D/c line.

27.2. A presentation was made in the meeting on the basics of Dynamic Line Rating. Copy of presentation is at Annex-III. Due to paucity of time, the matter could not be discussed in detail and it was decided that the matter would be discussed in next SRPC(TP) meeting.

28.0 Requirement of 765 kV spare (1-Ph) Reactors units:

28.1 765 kV transmission system forms backbone of the power transmission network. Outage of single 765/400 kV ICT or 765 kV line reactor / bus reactor impacts the grid much more than that the outage of single unit of ICT and line reactor/bus reactor of 400 kV systems. Hence, reliability of the 765 kV transmission system is of utmost importance.

28.2 765 kV ICTs and reactors are high MVA/MVAR rating equipments and are large in size. Transportation of 765 kV equipments takes much more time than 400 kV units. Therefore, 765 kV S/s are generally planned with one spare unit (1-Ph) of 765/400 kV ICT, 240 MVAR/330 MVAR bus reactors and line reactors so that reliability of 765 kV grid can be maintained.

28.3 One spare unit (1-Ph) of 80 MVAR reactor has not been considered for 765 kV Warangal New and Chilkaluripeta TBCB substations. Therefore, it is proposed to provide one spare unit (1-Ph) of 80 MVAR reactor at each 765 kV Warangal New and Chilkaluripeta TBCB substations along with necessary arrangement to take spare reactor units into service as per requirement.

28.4 Due to shortage of time, the matter could not be discussed and it was decided that the matter would be discussed in next SRPC(TP) meeting

29.0 Connectivity transmission system agreed in connectivity/LTA meetings of Southern Region

Grant of connectivity and LTA to following applicants was agreed in various connectivity/LTA meetings of Southern Region held after 1st SRPC(TP) meeting held on 16.12.2019.

29.1 **Connectivity and LTA agreed in 40th connectivity/LTA meeting held on 28.02.2020**

Connectivity application:

Sl. No.	Application No.	Applicant	Location	Stage-II Connectivity (MW)	Start Date of Stage-II connectivity	Proposed location for grant of Stage-II Connectivity	Dedicated Transmission System
1	1200002448	Renew Power Pvt. Ltd. (RPPL)	Davangere, Karnataka	300	15-March, 2021	Hiriyur	Renew Power Pvt Ltd – Hiriyur 220kV S/c line strung on D/c tower along with bays at both ends*
***RPPL has been granted connectivity with the same bay subsequent to withdrawal of earlier granted Connectivity at Hiriyur*							

LTA application:

Sl. No.	Application No.	Applicant	Location	LTA quantum (MW)	Beneficiaries (MW)	Start date of LTA	Remarks
1	1200002343	Renew Power Pvt. Ltd. (RPPL)	Davangere, Karnataka	300	ER (target)	15-Mar-21	LTA has been agreed with the availability of 3rd 400/220 kV ICT at Hiriyur.

29.2 **Connectivity agreed 41st Connectivity/LTA meeting held on 13.04.2020**

Connectivity application:

Sl. No.	Application No.	Applicant	Location	Stage-II Connectivity (MW)	Start Date of Stage-II connectivity	Proposed location for grant of Stage-II Connectivity	Dedicated Transmission System
1	1200002503	NTPC Ltd.	Tuticorin, Tamil Nadu	230	01-Sept-21	Tuticorin-II GIS	NTPC Limited (Tuticorin) – Tuticorin-II 230 kV S/c line (high capacity conductor enabling at least 380 MW power transfer at nominal voltage) along with bay at NTPC end.

As per the Detailed Procedure for "Grant of Connectivity to projects based on Renewable Sources to Inter-State Transmission System" under para 5.3.1 provides that "For the connectivity transmission system, the dedicated transmission line including line bays at generation pooling station shall be under the scope of the applicant and the terminal bays at the ISTS sub-station shall be under the scope of transmission licensee owning the ISTS sub-station subject to compliance of relevant provision of tariff policy."

Accordingly, under above provisions of the detailed procedure, NTPC has requested that the implementation of 230 kV bay at ISTS substation may kept under the scope of ISTS licensee. In view of the above, it is proposed that 1 no. of 230 kV bay at Tuticorin-II GIS PS may be implemented under ISTS for termination of dedicated/connectivity transmission line from NTPC Ltd. for its Tuticorin Solar generation project.

29.3 **Connectivity agreed in 42nd Connectivity/LTA meeting held on 06.05.2020**

Sl. No.	Application No.	Applicant	Location	Stage-II Connectivity (MW)	Start Date of Stage-II connectivity	Proposed location for grant of Stage-II Connectivity	Dedicated Transmission System
1	1200002536	ReNew Surya Ojas Private Limited	Koppal, Karnataka	300	15.01.2022 or availability of Koppal PS & associated transmission system, whichever is later	Koppal PS	ReNew Surya Ojas Private Limited Koppal generation switchyard – Koppal 220 kV S/c line on D/C towers

29.4 **Connectivity and LTA agreed in 43rd Connectivity/LTA meeting held on 29.05.2020**

Connectivity application:

Sl. No.	Application No.	Applicant	Location	Stage-II Connectivity (MW)	Start date of Stage-II connectivity	Proposed location for grant of Stage-II connectivity	Dedicated Transmission System
1	1200002562	Boreas Renewable Energy Pvt Ltd	Bellary, Karnataka	175	15-Aug-20	Hiriyur	Boreas Renewable Energy Pvt Ltd – Hiriyur 220kV S/c line along with bays at both ends

LTA application:

Sl. No.	Application No.	Applicant	Location	LTA quantum (MW)	Beneficiaries (MW)	Start date of LTA	Remarks
1	1200002585	Boreas Renewable Energy Pvt Ltd	Bellary, Karnataka	175	ER (target)	15-Aug-20	LTA has been agreed with the availability of 3rd 400/220 kV ICT at Hiriyur

Members noted the above.

30.0 Status of Implementation of downstream network by State utilities associated with ISTS substation of POWERGRID

30.1 CTU informed that augmentation of transformation capacity in various existing substations as well as addition of new substations along with line bays for downstream network are under implementation at various locations in Southern Region. For utilization of these transformation

capacities, downstream 220kV system needs to be commissioned. The status of downstream system as informed by respective states in the 2nd SRPC(TP) meeting, is as follows:

Sl. No.	Name of Existing Substation	MVA Capacity	Total 220 kV Bays	Total Un-utilized bays (under ISTS)	Remarks	Deliberations in 2nd SRPC(TP) meeting
1.	Tumkur (Vasantnar sapur)	3x500 MVA	6	2	• Construction of downstream T/L for 2 Nos 220 kV bays to be expedited by KPTCL. • Construction of downstream T/L for 8 Nos (4 bays under ISTS) 220 kV bays to be expedited by KPTCL.	• 220 kV D/c line Tumkur-Antrasanahalli **Commissioned.** • 220 kV DC line Tumkur-Madhugiri **Commissioned.** • 2 Nos 220 kV circuits to Vasanthanarsapur industrial area of KIADB **– by March, 2022.**
2.	Yelahanka	2x500 MVA	10	4	Construction of downstream T/L for 8 Nos (4 bays under ISTS) 220 kV bays to be expedited by KPTCL.	• 220 kV Yelahanka – DG Plant 2000 sq mm UG cable 2 runs – **Commissioned**
3.	Bidadi	2x500 MVA	6	4	Construction of downstream T/L for 4 Nos 220 kV bays to be expedited by KPTCL.	• 220 kV D/c line between Bidadi (PG)- Bidadi (KPTCL) – **Commissioned** • 220 kV D/c line Bidadi – Magadi line -Under Execution.**Target** – March, 2021 • 220 kV Bidadi – Kumbalgod Status:- Under Execution. **Target** –To be confirmed by KPTCL • 220 kV S/c line identified to Kampagada layout
4.	Hiriyur	2x315 MVA	6	2	Construction of downstream T/L for 2 Nos 220 kV bays to be expedited by KPTCL.	• 220 kV Hiriyur – Chitradurga via Thallak to Hiriyur – **Commissioned**. • 220 kV D/c Hiriyur – Gowribidnur- **Commissioned.** • 220kV Hiriyur (PGCIL) – Hiriyur (KPTCL) Status: under execution Target – November, 2020 • 220 kV Hiriyur (PGCIL) – Chitradurga Status: under execution Target – November, 2020
5.	Hassan	2x315 MVA	6	2	Construction of downstream T/L for 2 Nos 220 kV bays to be expedited by KPTCL.	• LILO of B4 circuit of Shimoga – Bangalore 220 kV line at Hassan **Status**: Under Execution Target – December, 2020
6.	Kolar	2x500 MVA	6	2	Construction of downstream T/L for 2 Nos 220 kV bays to be expedited by KPTCL.	• 220 kV D/c line Kolar(PG) – Kolar (KPTCL) **Commissioned.** • 220 kV D/c line Kolar – Chintamani- **Commissioned.** • 2 Nos 220 kV downstream T/L to Gollahalli

						Status: Under Execution **Target** – December, 2020
7.	Kozhikode	2×315 + 1x500 MVA	4	1	Construction of downstream T/L for 1 Nos 220 kV bay to be expedited by KSEB.	• KSEB is enhancing the capacity of existing three numbers of 220 kV feeders from 400 kV Kozhikode (PGCIL) S/S to 220 kV Areekode (KSEB) S/S by changing from Single Moose conductors to Double Moose conductors. With the upgradation of existing 3 nos. of feeders, the power transfer capacity between the sub-stations will increase and the existing transformation capacity at 400 kV Kozhikode substation would be fully utilised. Accordingly, KSEBL is not planning to construct the fourth 220 kV feeder between the sub-stations at present. The work of upgrading the existing 220kV feeders is in progress and is tentatively scheduled for commissioning by January, 2021.

31.0 Phase-I & Phase-II Solar & Wind Energy Zone Transmission Schemes

31.1 SECI/MNRE have identified Potential Solar Energy Zones (SEZ) and Wind Energy Zones (WEZ) in various districts of six RE rich states for 66.5 GW quantum. Subsequently, based on bidding timeline, SECI provided phasing details of prioritized SEZs (50,000 MW) and WEZs (16,500 MW) in two phases i.e. 2020 & 2021. The details of prioritized SEZs and WEZs in Southern region (totaling to 18,500 MW) are as under:

	Solar		**Wind**		**Total**
State/District	**Ph-1 (GW)**	**Ph-2 (GW)**	**Ph-1 (GW)**	**Ph-2 (GW)**	**(GW)**
	2020	**2021**	**2020**	**2021**	
Andhra Pradesh					
Kurnool	2.5		2	1	5.5
Ananthpuram		2.5			2.5
Karnataka					
Koppal			2.5		2.5
Gadag		2.5			2.5
Bidar		2.5			2.5
Tamil Nadu					
Karur			1.5	1	2.5
Tirunelvelli				0.5	0.5
Total	**2.5**	**7.5**	**6**	**2.5**	**18.5**

31.2 Out of the 18.5 GW of identified SEZs and WEZs in Southern Region, transmission system for evacuation of 8.5 GW of power from Phase-I and Phase-II Wind Energy Zone and 1.5 GW of Phase-I Solar Energy Zone (in Kurnool area), totaling to Renewable Energy Zone power of 10 GW, was agreed in 1st SRSCT meeting held on 07.09.2018, and it was decided that the schemes would be taken up for implementation as ISTS, consequent to grant of LTA by CTU. The transmission system discussed and agreed in 1st SRSCT is given below:

a) Tirunelveli and Tuticorin Wind Energy Zone (Tamil Nadu) (500 MW):

(i) Addition of 1x500 MVA, 400/230kV ICTs (4th) at Tuticorin-II GIS sub-station.

***Operation of Tuticorin Pooling Station – Dharmapuri (Salem) 765kV D/C line (presently operating at 400kV) at its rated voltage. (i. e. 765kV) & 5th ICT (500 MVA) at Tuticorin-II PS would be reviewed for dispersal of more than 2000MW RE generation*

b) Karur / Tiruppur Wind Energy Zone (Tamil Nadu) (2500 MW):

(i) Establishment of 5x500 MVA, 400/230 kV Karur Pooling Station (at a location in between Karur Wind zone and Tiruppur wind zone)

(ii) LILO of both circuits of Pugalur – Pugalur (HVDC) 400 kV D/c line (with Quad Moose ACSR Conductor) at Karur PS

(iii) 9 nos. of 230 kV line bays for interconnection of wind projects

(iv) 2x125 MVAr, 400 kV Bus reactors at Karur PS

c) Koppal Wind Energy Zone (Karnataka) (2500 MW):

(i) Establishment of 5x500 MVA, 400/220 kV pooling station near Munirabad /suitable location in Koppal distt.

(ii) Pooling station (near Munirabad /suitable location in Koppal distt.) - Narendra (New) 400 kV D/c Line (with Quad Moose ACSR conductor)

(iii) 9 Nos of 220 kV line bays for interconnection of wind projects

(iv) 2x125 MVAr, 400 kV bus reactor at Pooling station (near Munirabad /suitable location in Koppal Distt.)

(v) Adequate space provision for future expansion

[Note: Pooling station (near Munirabad /suitable location in Koppal distt.) - Munirabad 400 kV D/c Line (with Quad Moose ACSR conductor), agreed in the 1st SRSCT was dropped as per the request of KPTCL in 2nd SRSCT meeting.]

d) Kurnool Wind Energy Zone (3000 MW) /Solar Energy Zone (AP) (1500 MW):

(i) Establishment of 765/400/220 kV 3x1500 MVA, 9x500 MVA Pooling station at suitable location in Kurnool Distt. (Kurnool-III)

(ii) Kurnool-III Pooling station - Kurnool(new) 765 kV D/c Line

(iii) Kurnool –III PS-Maheshwaram(PG) 765 kV D/c Line

(iv) 220 kV line bays for interconnection of wind projects (15 nos.)

(v) 1x330 MVAr (765kV) & 1x125 MVAr (400 kV) bus reactor at Kurnool-III PS

(vi) 240 MVAr Switchable line reactors at both ends of Kurnool-III PS – Maheshwaram (PG) 765 kV D/c Line

It was agreed in the 1st SRSCT meeting that the transmission schemes would be implemented as ISTS, consequent to grant of LTA by the CTU. The transformation capacity at various stations and certain elements could be required to be reviewed based on LTA applications. Accordingly, this broad master plan would be implemented in stages to serve RE integration.

31.3 Transmission system for immediate connectivity for balance 8.5 GW of RE potential in Southern Region and integration of 18.5 GW of Solar and Wind Energy Zones in Southern Region was discussed and agreed in the 2nd SRSCT meeting held on 10.06.2019. The transmission schemes discussed and agreed in 2nd SRSCT for Phase-I and Phase-II RE zones in Southern Region are given below:

a) Ananthpuram (Ananthapur) SEZ (AP) (2500 MW) and Kurnool SEZ (AP) (Kurnool-1000 MW)

(i) Establishment of 400/220 kV, 7x500 MVA pooling station at suitable border location between Ananthpuram & Kurnool Distt.

(ii) Ananthpuram PS-Kurnool-III PS 400 kV (High capacity equivalent to quad moose) D/c Line

(iii) Ananthpuram PS-Cuddapah 400 kV (High capacity equivalent to quad moose) D/c Line with suitable line reactors

(iv) 220 kV line bays for interconnection of wind/solar projects (12 nos.)

(v) 2x125 MVAr (400 kV) bus reactors at Ananthpuram PS

b) Gadag SEZ (Karnataka) (2500 MW)

(i) Establishment of 400/220 kV, 5x500 MVA Gadag Pooling Station.

(ii) Gadag PS-Koppal PS 400 kV (high capacity equivalent to quad moose) D/C Line.

(iii) Gadag PS-Narendra (New) PS 400 kV (high capacity equivalent to quad moose) D/C line.

(iv) 220 kV line bays for interconnection of solar projects (8 nos.)

(v) 1x125 MVAr (400 kV) bus reactor at Gadag PS.

(vi) Upgradation of Narendra (New) to its rated voltage of 765 kV level alongwith 2x1500 MVA transformer and 1x330 MVAr Bus Reactor.

(vii) Upgradation of Kolhapur (PG) to its rated voltage of 765 kV level alongwith 2x1500 MVA transformer and 1x330 MVAr Bus Reactor.

(viii) Upgradation/charging of Narendra new - Kolhapur (PG) 765 kV D/c line (initially charged at 400 kV) to its rated voltage of 765 kV along with 1x330 MVAr switchable Line Reactor on Kolhapur (PG) end of each circuit.

c) Bidar SEZ (Karnataka) (2500 MW)

(i) Establishment of 765/400/220 kV, 3x1500 MVA, 5x500 MVA pooling station at suitable border location near Bidar.

(ii) Bidar PS – Maheshwaram (PG) 765 kV D/C line along with 1x240 MVAr switchable Line Reactor on Bidar PS end of each circuit.

(iii) 220 kV line bays for interconnection of solar projects (8 nos).

(iv) 1x240 MVAr (765 kV) & 1x125 MVAr (400 kV) bus reactor at Bidar PS.

d) Common transmission system strengthening in Southern Region for enabling evacuation and export of power from Solar & Wind Energy Zones in Southern Region

(i) Upgradation of Tuticorin PS to its rated voltage of 765 kV level alongwith 2x1500 MVA transformer and 1x330 MVAr Bus Reactor.

(ii) Upgradation of Dharmapuri (Salem New) to its rated voltage of 765 kV level alongwith 2x1500 MVA transformer and 1x240 MVAr Bus Reactor.

(iii) Upgradation of Madhugiri (Tumkur) to its rated voltage of 765 kV level alongwith 2x1500 MVA transformer and 1x240 MVAr Bus Reactor.

(iv) Upgradation/charging of Tuticorin PS - Dharmapuri (Salem New) 765 kV D/c line (initially charged at 400 kV) to its rated voltage of 765 kV along with 1x330 MVAr switchable line reactor on both end of each circuit.

(v) Upgradation/charging of Dharmapuri (Salem New) - Madhugiri (Tumkur) 765 kV 2xS/c line (initially charged at 400 kV) to its rated voltage of 765 kV along with 1x330 MVAr switchable Line Reactor on Dharmapuri (Salem New) end of each circuit.

(vi) Upgradation/charging of Madhugiri (Tumkur) - Narendra New 765 kV D/c line (initially charged at 400 kV) to its rated voltage of 765 kV along with 1x330 MVAr switchable line reactor on both end of each circuit.

(vii) Conversion of 400 kV line reactors installed on 765 kV circuits/ lines (initially charged at 400 kV) mentioned at sl no. iv, v and vi into 400 kV bus Reactor with suitable arrangements at respective substations.

- As per discussions in 2nd SRSCT meeting, the above transmission system is a broad master plan to serve integration of RE generation potential assessed in Tamil Nadu, Karnataka and

Andhra Pradesh for period upto 2021-22. As such, it was agreed that the scheme would be implemented as ISTS, consequent to grant of LTA by CTU. The transformation capacity at various sub-stations and certain elements may be required to be reviewed based on LTA applications. Accordingly, this broad master plan would be implemented in stages to serve RE integration.

31.4 As per information furnished by SECI, status of land availability for setting up of RE generation projects (18.5 GW) in Southern Region is detailed below:

- Land is available in Gadag (2500 MW SEZ) and Koppal (2500 MW WEZ) and Government of Karnataka has already identified the land. However, Koppal was originally envisaged as Wind Energy Zone but SECI has now proposed to develop Koppal as a SEZ.
- Regarding Bidar (2500 MW SEZ), Karnataka, land location is yet to be firmed up.
- Land is available in Ananthpuram (2,500 MW SEZ) and Kurnool (2,500 MW SEZ, 3,000 MW WEZ) Andhra Pradesh.
- Regarding Karur WEZ (2,500 MW), Tamil Nadu Government has raised specific concerns about the availability of land for the identified potential of 2500 MW. Regarding Tirunelveli WEZ (500 MW), Tamil Nadu Government has not confirmed the availability of land.

31.5 Further, the following were also decided in the 1st SRPC(TP):

i. SECI would share the RE potential assessment study/report for 18.5 GW of envisaged RE potential in states of Andhra Pradesh, Karnataka and Tamil Nadu with CEA/CTU/SRPC and with STU's of SR

ii. SRPC would co-ordinate with states to find out the RE potential already developed and the balance RE potential which could be developed in different locations (connected to ISTS as well as intra-state network), based on availability of land and other infrastructure within two months and forward their findings to CEA.

iii. SECI/MNRE to confirm whether the assessed RE potential at different locations in Southern Region includes the potential being developed in intra-state system or excludes the same. For example, whether the RE potential (2.5 GW) at Koppal, Karnataka, is the total potential of Koppal area and includes the RE potential (of about 1 GW) being developed by KPTCL in Koppal or is over and above the potential being developed by KPTCL.

iv. SECI was requested to expedite the bidding process of planned RE capacity in Southern region so as to avoid mismatch between commissioning of RE capacity and associated transmission system.

v. Accordingly, CEA/CTU may review the transmission plans/schemes based on the above.

31.6 SECI along with NIWE, made a presentation on assessment of 18.5 GW RE Potential in states of Andhra Pradesh, Karnataka and Tamil Nadu, at TNEB Headquarters Chennai on 11th February 2020.The meeting was attended by SR constituents.

31.7 Director (PSPA-I), CEA, stated that out of 18.5 GW of RE potential, land availability corresponding to 5.5 GW of RE (Karur - 2.5 GW, Tirunelveli – 0.5 GW and Bidar – 2.5 GW) is yet to be finalized.

31.8 Chief Engineer (PSPA-I), CEA, requested SECI to furnish the details of land availability in Koppal, Gadag, Kurnool and Ananthapuram.

31.9 Representative of SECI stated that land has been finalized by A.P. government for setting up RE generation projects in Ananthpuram and Kurnool and the same will be formalized within two months. He also informed that SECI has invited bidders to set up solar park of 2,500 MW capacity in Koppal. He further clarified that SECI has not identified Koppal as SEZ only, Koppal may be developed as a hybrid zone and has the potential for both solar and wind power. Regarding Gadag, land is available corresponding to 2,100 MW of solar power.

31.10 DGM (CTU) informed that at Gadag, one connectivity application has been revoked whereas at Koppal, Stage –II connectivity of 300 MW had been granted but it may be revoked due to non-submission of Construction phase Bank Guarantee for implementation of Common Transmission System for connectivity.

31.11 Representative from TANGEDCO stated that as per the directions of CERC, SECI has been asked to file an affidavit for the following for each RE location in Southern Region:

- Firm availability of land.
- Status of bidding.
- Status of LTA application.
- Whether RE power can be evacuated through existing transmission system or augmentation is required.
- Whether the proposed transmission network for evacuation of RE power can be taken up independently and in phased manner

Subsequently, SECI has filed an affidavit informing that land is available in Koppal to develop 2.5 GW of solar park. However, as per TANGEDCO, SECI, has not provided any document related to land availability. Therefore, TANGEDCO requested to defer the scheme till land availability issue is resolved.

31.12 SECI representative informed that SECI has submitted all the documents in respect of land availability which has been made available either by Karnataka Government or A.P Government.

Members noted the same. Due to paucity of time this agenda could not be discussed completely and the same would be discussed in the next SRPC(TP) meeting.

32.0 Upgradation of Narendra New to its rated voltage of 765 kV level under the scheme Gadag Solar Energy Zone, Karnataka (2500 MW) Part – B

32.1. CTU informed that upgradation of Narendra New to its rated voltage of 765 kV along with installation of 2x1500 MVA, 765/400 kV ICTs and 1x330 MVAr Bus Reactor under the scheme Gadag Solar Energy Zone, Karnataka (2500 MW) was agreed in the 2nd SRSCT meeting held on 10.06.2019.

32.2. Presently, Narendra New GIS substation is operating at 400 kV level and proposed upgradation to 765 kV was also agreed to be GIS. However, after survey at site, it has been found that land adjacent to 400 kV GIS switchyard is available and can be acquired for establishment of 765 kV AIS switchyard instead of 765kV GIS.

32.3. Accordingly, considering the techno-economic aspects, it was proposed that the upgradation of Narendra New may be carried out as 765 kV AIS instead of 765 kV GIS. With the proposed change of configuration from GIS to AIS, additional land required is about 350x530 Sqm approx. However, the overall cost of upgradation to 765 kV AIS is lesser than that of 765 kV GIS.

32.4. SRLDC suggested commissioning of 1 x 330 MVAr Bus reactor before commissioning of transmission lines.

32.5. After deliberations, members agreed to the proposal of upgradation of Narendra New as 765 kV AIS instead of 765 kV GIS.

33.0 All-India studies for evolution of additional transmission scheme for export of power from Southern grid to rest of all-India grid

33.1 It was decided in the 2nd SRSCT meeting that all-India studies would be carried out with the participation of CEA, CTU, POSOCO and concerned beneficiaries/STUs for evolution of additional (over and above the above proposed transmission scheme) transmission scheme for export of power from Southern grid to rest of all-India grid.

33.2 Accordingly, Load-Generation balance was prepared by CEA and CTU to carry out system studies for integration of 175 GW RE by the year 2022 and the load generation balance along with PSSE file for one scenario (August 2021-22 Afternoon Peak) had been circulated to SR constituents and POSOCO on 19.11.2019. The same was also discussed with the SR constituents and POSOCO in the joint study meeting on 21-22 November, 2019, at New Delhi and subsequently in the 1st SRPC(TP) meeting held on 16.12.2019 at Hyderabad.

33.3 In the 1st SRPC(TP) meeting, it was decided to prepare total nine scenarios for the month of June, 2021, August, 2021 and February, 2022, for afternoon peak, evening peak and night off-peak scenarios (three scenarios for each month viz. June, August and February). It was further decided that the same shall be circulated to SR constituents for their comments / observations / suggestions. Further, SR Constituents were again requested to forward their

comments/observations on the already circulated Load-Generation balance and PSSE file, so that the nine number of scenarios could be formulated.

33.4 In view of the above, LGB for 9 nos. of scenarios and system studies file for one scenario (June 2021-22 Afternoon Peak) was prepared. Load generation scenarios, results of the system studies, study assumptions & inputs considered were uploaded on CTU website and were also circulated to all the regional constituents for their comments/observations vide emails dated 20.05.2020 (SR), 08.06.2020 (WR) and 11.06.2020 (NR, ER & NER).

33.5 Comments were received from POSOCO vide letter dated 25.06.2020. Further, observations pertaining to certain transmission network data updation of STU network and generation dispatches were also received from TANTRANSCO vide email dated 02.06.2020 and KPTCL vide email dated 08.06.2020. KPTCL has stated that the 9 nos. of load generation balance scenarios and assumptions considered for study pertaining to Karnataka is in line with the historical pattern. No comments were received from any other constituents. Accordingly, the system studies file was updated incorporating the above observations of the constituents and system studies were carried out for all the 9 nos. of scenarios. The system studies along with observations received from POSOCO/constituents were also discussed with CEA and POSOCO in meeting held on 23.07.2020.

33.6 The Load generation scenarios, study assumptions & inputs considered, system studies and the detailed study analysis was uploaded on CTU website on 03.08.2020 and the same was also circulated to constituents for their comments and observations.

33.7 Due to paucity of time this agenda could not be discussed and the same would be discussed in the next SRPC(TP) meeting.

Additional proposal by KPTCL

34.0 Establishing of 3x500 MVA, 400/220kV Devanahalli substation in Bengaluru

34.1 Director (PSPA-I), CEA, stated that KPTCL vide letter dated 14.09.2020 has informed that the proposal of establishing 400/220 kV Devanahalli substation had been approved in the 39th meeting of SCPSPSR under "Transmission scheme for 2000MW Tumkur (Pavagada) Ultra Mega Solar Park" with the following Inter-State transmission system.

Phase-1 (1000 MW)

i. LILO of 400 kV Gooty - Tumkur (Vasanthnarasapura) D/C at Tumkur (Pavagada) Pooling station.
ii. Tumkur (Pavagada) Pooling station - Hiriyur 400 kV D/C (as part of Tumkur (Pavagada) Pooling station - Mysore D/C line.
iii. LILO of 400 kV Bellary Pool - Tumkur (Vasanthnarasapura) D/C (Quad) (both Circuits) [KPTCL line] at Tumkur (Pavagada) Pooling station*.
iv. Establishment of 3x500 MVA, 400/220 kV Pooling station at Tumkur.

v. 1x125 MVAR bus reactor at 400/220 kV Pooling station at Tumkur.
vi. 8 nos. 220 kV bays at 400/220 kV Tumkur (Pavagada) Pooling station for interconnection with solar project.

*KPTCL would complete Bellary Pooling Station -Tumkur (Vasanthnarasapura) D/C (Quad) by December-2016.

Phase-II (1000 MW)

i. Hiriyur-Mysore 400 kV D/C line*
ii. Tumkur (Pavagada) Pooling station – Devanahalli (KPTCL) 400 kV D/C (Quad)**
iii. Augmentation of 2x500 MVA, 400/220 kV transformer at Tumkur (Pavagada) Pooling station.
iv. 1x125 MVAR bus reactor at Tumkur (Pavagada) Pooling station.
v. Third 400/220 kV, lx500 MVA transformer at Tumkur (Vasanthnarasapura).
vi. 1x80 MVAR switchable line reactor at Mysore end of Hiriyur-Mysore DC for each circuit.
vii. 8 nos. 220 kV line bays at 400/220 kV Tumkur Pooling Station for Solar Interconnection.

*With the completion of this line, it would be connected with Tumkur (Pavagada) Pooling station - Hiriyur 400 kV DC line to form Tumkur (Pavagada) - Mysore DC line.

****KPTCL would complete establishment of 400/220 kV sub-station at Devanahalli including inter-linking 400 kV and 220 kV line before Phase-II at Ultra Mega Solar Power Park.**

34.2 Further, in the agenda of 40th meeting of SCPSPSR, it is mentioned that (para 10.1):

"During 39th SCPSPSR, Tumkur (Pavagada) Pooling Station - Devanahalli (KPTCL) 400 kV D/C Quad line was agreed as a part of transmission system for Tumkur (Pavagada) Ultra Mega Solar Park (2000 MW) Phase II. LILO of Nelamangala-Hoody line at 400 kV Devanahalli was also agreed."

34.3 However, ICT details and reactors have not been mentioned the minutes of 39th meeting of SCPSPSR.

34.4 In this context, KPTCL had informed that the work of 400/220 kV Devanahalli substation along with LILO of 400 kV Hoody-Nelamangala D/C line at Devanahalli S/S is completed and needs to be charged. KPTCL had requested for ratification of the following:

- LILO of 400 kV Yelahanka (Singanayakanhalli) - Hoody and LILO of 400 kV Nelamanagala- Hoody line at 400/220 kV Devanahalli Sub-Station
- 3 x 500 MVA, 400/220 kV transformers
- 1 x 125 MVAR bus reactor

34.5 To discuss the matter, a meeting was held on 17.09.2020 (through VC) with representatives from CEA, CTU, SRLDC and KPTCL. In the meeting, it was agreed that since the 2x500 MVA, 400/220 kV transformers and 1x125 MVAR reactor at Devanahalli substation have already been installed and are ready for charging, in-principle approval may be accorded for the following:

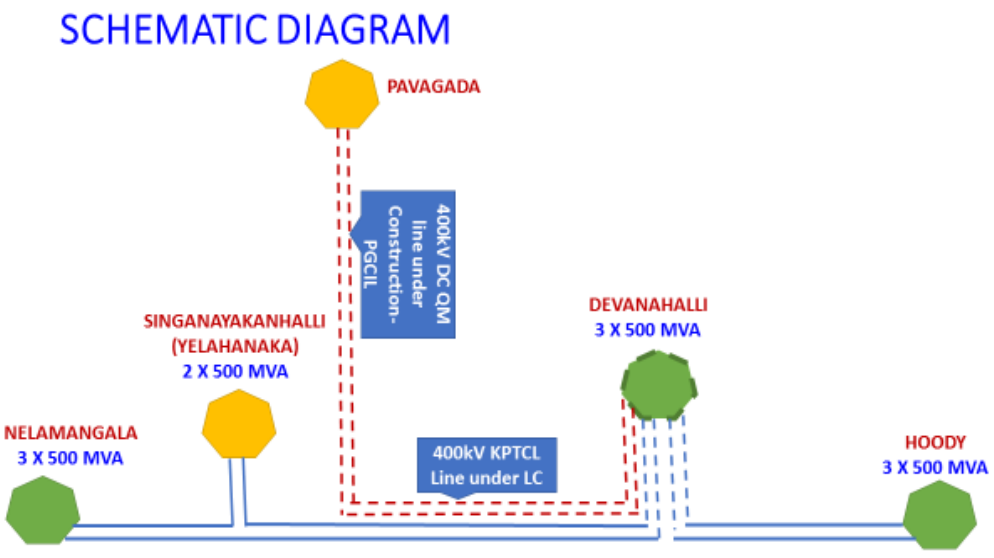
- LILO of 400 kV Yelahanka (Singanayakanhalli) - Hoody and LILO of 400 kV Nelamanagala- Hoody line at 400/220 kV Devanahalli Sub-Station
- 3 x 500 MVA, 400/220 kV transformers
- 1 x 125 MVAR bus reactor

It was also decided in the meeting that the matter would be put up in the forthcoming SRPC(TP) meeting for ratification.

34.6 Chief Engineer (PSPA-I), CEA, stated that in-principle approval was accorded in the meeting held on 17.09.2020 for the following and requested the members to note the same:

- LILO of 400 kV Yelahanka (Singanayakanhalli) - Hoody and LILO of 400 kV Nelamanagala- Hoody line at 400/220 kV Devanahalli SS
- 3 x 500 MVA, 400/220 kV transformers
- 1 x 125 MVAR bus reactor.

Members noted the same.



35.0 Operational feedback from POSOCO (Quarter 3: Oct'19 to Dec'19)

35.1 Transmission Line Constraints

Sl. No.	Corridor	Description of the constraints	CTU comments	STU's comments
1	400 kV Hiriyur-Nelamangala D/c line	With less generation at UPCL and high wind and solar generation, the flow on 400 kV Hiriyur-Neelamangala D/c line is severely high and flow will further increase if Yeramarus TPS & BTPS generation is full. **Remarks:** 400 kV Hiriyur – Mysore D/C line and 400 kV Bellary Pooling station – Jagalur - C N Halli D/C line would relive the line loading of 400 kV Hiriyur – Neelamangala D/c line. The same may be commissioned at the earliest.	With the commissioning of Hiriyur – Mysore 400 kV D/c line (one circuit bypassed at Hiriyur forming Pavagada – Mysore 400 kV S/c line), the loading on Hiriyur– Nelamangala line has been reduced. In the 2nd SRSCT meeting, KPTCL informed that with the commissioning of 400 kV Vasanthnarasapura – Singanayakanahalli D/c line and commissioning of the associated 400 kV transmission scheme of Yeramarus, the line loading on Hiriyur – Nelamangala line may get reduced. KPTCL to expedite the implementation of the line.	With the commissioning of Hiriyur – Mysore 400 kV D/c line (one circuit bypassed at Hiriyur forming Pavagada – Mysore 400 kV S/c line), the loading on Hiriyur– Nelamangala line has been reduced. Jagalur - C N Halli D/C line Status: CN Halli- land acquisition under progress.
2	Constraints in Nagjhari PH evacuation	The 220 kV Nagjheri – Ambewadi DC line, 220 kV Ambewadi – Narendra DC line, 220 kV Kodasalli – Nagjheri D/C line, 220 kV Kaiga – Kodasally SC & 220 kV Kadra – Kodasally SC lines are severely over-loaded. In 1st meeting of SRSCT, committee recommended for re-conductoring of the lines with HTLS conductor. KPTCL has to expedite the same.	KPTCL has to expedite the re-conductoring work.	Survey work under progress.
3	Tamil Nadu 230 kV System	The following lines are heavily loaded: 230 kV NLCTS2 – Kadalangudi S/C line	TANTRANSCO may update	Additional 230 kV Neyveli - Kadalangudi S/c line already commissioned.

Sl. No.	Corridor	Description of the constraints	CTU comments	STU's comments
		230 kV Kalivendapattu – Tharamani S/C line		After upgradation of Tharamani SS from 230 kV to 400 kV, present constraints will be relieved.
		230 kV Anaikaduvu-Othakalmandapam D/C line (during wind season)		After commissioning of Edayarpalayam 400 kV SS and with commissioning of LILO of 230 kV Thudialur - Othakkalmandabam S/c line at Edayarpalayam SS, the constraints would be relieved.
		230 kV Othakalmandapam-Coimbatoor S/C line		(1) With commissioning of LILO of 230 kV Othakkalmandabam - Coimbatore S/c line at New Selvapuram 230 kV SS and 2) with commissioning of LILO of 230 kV Thudialur-Edayarpalayam 400 kV SS at Selvapuram 230 kV SS, the constraints would be relieved.
		230 kV Othakalmandapam - Thudialur S/c line		After commissioning of Edayarpalayam 400 kV SS, with commissioning of LILO of 230 kV Thudialur - Othakkalmandabam S/c line at Edayarpalayam SS, the constraints would be relieved.
		230 kV Madurai - Sembatty S/c line		After commissioning of 230 kV (Madurai) Checkanoorani - Sembatty S/c line (2nd circuit), constraints would be relieved.
		230 kV Pugalur - Mywadi S/c line		After making LILO of Pugalur - Mywadi 230 kV S/C line at Kurkathi 230 kV SS, present constraints will be relieved.
		230 kV Pudanchandai-Pugalur line		(1) After commissioning of LILO of 230 kV Alundur - Pugalur S/c line at Valayapatti SS and (2) after commissioning of Mangalapuram 400 kV SS with 230 kV connectivity to Pudansandai, the constraints would be relieved.

Sl. No.	Corridor	Description of the constraints	CTU comments	STU's comments
		230 kV TTPS-TSIPCOT S/c line		Proposal of 230 kV TTPS - Tsipcot S/C line to be LILOed at Ottapidaram 400 kV SS will relieve the present constraints
		230 kV Pugalur – Karukathi S/c line		After making LILO of Pugalur - Mywadi 230 kV S/C line at Kurkathi 230 kV SS, present constraints will be relieved.
4	220 kV Bangalore Metro Network	Most of the 220 kV network in Bengaluru is radialised during peak season to prevent overloading of lines. The radialisation of lines decreases the reliability of supply, thus resulting in low voltage situation during peak period and high voltage during off-peak period of the day, thus making it an ideal station for STATCOM. There is no sufficient Capacitor Compensation at distribution level in BESCOM area.	KPTCL may update	The 220 kV sub-stations planned under Bengaluru improvement works at Koramangala, ITI, Brindavan Alloys have been commissioned. Further, following additional works are planned in Bangalore Metropolitan Area to relieve existing congestion. • Establishing 3x500 MVA, 400/220kV Devanahalli sub-station- Commissioned. • Establishing 2x500 MVA, 400/220kV Peenya sub-station. Status: DPR under preparation. • Establishing 3x500 MVA, 400/220 kV Mylasandra sub-station. Status: GIS Module equipment testing, HV testing completed. C&R panel testing under progress. Minor finishing works under progress 400 kV line: Target – December, 2020. • Establishing 2x500 MVA, 400/220 kV Dommasandra sub-station. Status: Estimate under preparation. • Establishing 2x150 MVA, 220/66 kV Kumbalagodu sub-station: Status: All major works completed, minor finishing

Sl. No.	Corridor	Description of the constraints	CTU comments	STU's comments
				works under progress. Target – March, 21. • Establishing 2x150 MVA, 220/66 kV Exora sub-station. Status: Work Awarded. • Establishing 2x150 MVA, 220/66 kV HBR Layout sub-station. Status: Work under Progress. Dismantling the existing 66 kV tower in the proposed 220 kV station switch yard and re-routing the existing 66 kV line with the UG cable and CTT. CTT & D+6 stub concreting completed. 220 kV and 66 kV cable check survey completed, agency has to submit the drawing for approval. • Establishing 2x150 MVA, 220/66 kV Sahakari Nagar sub-station. Status: Work under progress. Site levelling, Earth mat, foundation for transformers & Control room building works under progress. Line: work to be commenced • 2x150 MVA, 220/66 kV GIS sub-station at Sobha Dreams in Bengaluru East Taluk, Bengaluru Urban district. Status: Work under Progress. LOI issued on 10th June, 2020. Land leveling under progress. Drawings to be submitted for approval to CEE(P&C). • 2x 150 MVA, 220/66 kV GIS sub-station at Hagadur in Bengaluru East taluk, Bengaluru Urban district. Status: DPR under preparation. • Establishing 2x150 MVA, 220/66 kV Nagarbhavi sub-station. Status: DPR under preparation.

Sl. No.	Corridor	Description of the constraints	CTU comments	STU's comments
				• Establishing 2x100 MVA, 220/66 kV Nelamangala sub-station. Status: To be tendered. • Establishing 2x150 MVA, 220/66 kV GIS in the premises of existing 66/11 kV Keonics (Electronic City) substation Status: Estimate under preparation. • Establishing 2x150 MVA, 220/66 kV GIS near 66/11 kV Mathikere substation in Mathikere, Bengaluru. Status: To be tendered. • Construction of 220 kV Multi Circuit (4 ckts) line with High Performance Conductor (HPC) ACCC DRAKE conductor and partially 220 kV UG cable from existing 400/220 kV Nelamangala Station to strengthen the 220 kV transmission line connecting the 220 kV SRS Peenya, 220 kV NRS Rajajinagara, ongoing 220 kV Brindavana Sub-station and Proposed 220 kV Sahakarinagra Sub-stations by utilizing 13 km of idle 110 kV SBT corridor. • Strengthening of existing 220 kV Kolar HVDC-Kolar DC line by replacing Drake to Drake equivalent HTLS conductor. • Strengthening of existing 220 kV Bidadi PGCIL-Bidadi DC line by replacing AAAC to equivalent HTLS conductor. • Running 220 kV 1200 sqmm UG Cable from 400 kV Hoody to EDC sub-station for a length of 13.5 km. • Running 220 kV 1200 sqmm UG Cable from 220 kV

Sl. No.	Corridor	Description of the constraints	CTU comments	STU's comments
				Koramangala to EDC sub-station for a length of 4.5 km. • Construction of 220 kV GIS switching station with double bus bar arrangement in the vacant land of BWSSB adjacent to existing 220 kV Vrishabhavathi Valley sub-station along with strengthening of 220 kV Somanahalli-Tataguni-VV Valley SC overhead transmission line. The proposal of providing STATCOMs at 400/220 kV Nelamangala & Hoody stations was proposed in the 1st SRPCTP meeting held on 16.12.2019. It was decided it had been decided to explore feasibility of both use of Solar Inverter and STATCOM for containing voltage within limits in the SR grid. 191.4 MVAR Shunt capacitors at various 66/11 kV sub-stations in BESCOM area are approved.

35.2 ICT Constraints

Sl. No.	ICT	Description of the constraints	CTU comments	Present Status
1	400/220 kV 2x315 MVA ICTs at Maradam SS	N-1 condition not satisfied for considerable time. N-1 of this ICTs will overload ICTs at Gazuwaka and Kalpakka SS.	Augmentation of ICT capacity from 2 x 315 MVA to 2 x 315 MVA + 1x 500 MVA ICTs at 400/220 kV Maradam (Garividi) S/S had already been agreed in the 1st SRSCT. APTRANSCO may expedite the implementation of 3rd ICT at Maradam.	Works are nearer to completion and expected to be commissioned by November, 2020

Sl. No.	ICT	Description of the constraints	CTU comments	Present Status
2	400/220 kV 3X500 MVA ICTs at Somanhalli	N-1 condition not satisfied for 10 % of time in Dec 2019.		Commissioning of 400 kV Mylasandra and its associated lines will relieve the overloading of ICTs at 400 kV Somanahalli. Status: GIS Module equipment testing, HV testing completed. C&R panel testing under progress. Minor finishing works under progress, 400 kV line: Under construction. Target – December, 2020.
3	400/220 kV 2x315 MVA ICTs at Kochi	N-1 condition not satisfied for 23 % of time in Dec 2019.	Loading on 2x315 MVA ICTs at Kochi has been increased with the commissioning of Tirunelveli – Cochin 400kV (Quad) D/c line. With the commissioning of 2000 MW Pugalur – North Trichur VSC based HVDC, the loadings are expected to reduce. 1x500 MVA ICT has been planned by CTU at Kochi, subject to approval of SRPC(TP).	With the commissioning of 400 kV Kochi-Tirunelveli DC line, the loadings on Kochi ICTs have increased. In a joint meeting with SRPC, SRLDC and KSEB held on the 15th of September, SRLDC has observed that with the commissioning of HVDC Pugalur-Trichur Poles, the loading on Kochi ICTs will further increase. It was decided in the meeting that KSEB will take measures for installation of an additional 500 MVA ICT at Kochi SS with approval from SRPC (TP). KSEB would also expedite the commissioning of 220 kV transmission lines from HVDC Trichur sub-station and construction of 400 kV Kottayam SS, which will relieve the loadings on Kochi ICTs.

Sl. No.	ICT	Description of the constraints	CTU comments	Present Status
				Subsequently, KSEB has taken up the issue in the 2nd SRPC (TP) meeting held on 1st October, 2020, for the installation of 500 MVA ICT at Kochi.

35.3 Nodes Experiencing High Voltage / Low Voltage

During the 1st SRPC(TP) meeting held on 16.12.2019, it was informed that detailed study of reactive power compensation had been carried out and the same had been discussed in 1st meeting of SRSCT, wherein 27 nos. of 125 MVAR bus reactors were agreed to be installed at different locations and with the commissioning of planned/ under implementation bus reactors at various ISTS & STU substations, the issue of high voltage would be addressed. It was decided in the meeting that states may expedite the implementation of bus reactors and may update the status. Status of implementation of bus reactors in Southern Region is give at para 6.1.10.

In case the high voltage conditions persists with the commissioning of above planned / under implementation bus reactors, comprehensive reactive compensation studies may be carried out subsequently, considering the high RE integration in Southern Region.

35.4 Delay in transmission lines affecting grid operation adversely

Sl. No.	Transmission Corridor	Proposed Commissioning Date/ Original Target date	Actual/ Likely Commissioning Date	Transmission Constraint Caused	CTU comments
1.	400 kV Thrissur – Kozhikode DC line	---	RoW issues	Low voltages in North Kerala & 220 kV North - South corridor of Kerala	Line is proposed to be commissioned by December, 2020.
2.	400 kV Hiriyur-Mysore DC line	July-19	RoW issues	High loading on 400 kV Hiryur-Neelamangala DC line	Line already commissioned and date of commercial operation is 01.05.2020.
3.	400 kV Bellary PS - Chikkanayakanahalli DC line	--	Tendering stage	High loading on 400 kV Hiriyur-Neelamangala DC line	Line from BPS to Jagalur already commissioned. Status of 400 kV C.N Halli S/s: Land acquisition under process.

36.0 Operational feedback from POSOCO (Quarter 4: January 20 to March 20)

36.1 Transmission Line Constraints

Sl. No.	Corridor	Description of the constraints	CTU comments	STU comments
1	400 kV Hiriyur-Nelamangala D/c line	With less generation at UPCL and high wind and solar generation, the flow on 400 kV Hiriyur-Nelamangala D/c line is severely high and flow will further increase if Yeramarus TPS & BTPS generation is full. **Remarks:** 400 kV Hiriyur – Mysore D/C line and 400 kV Bellary Pooling Station – Jagalur - C N Halli D/C line would relive the line loading of 400 kV Hiriyur – Nelamangala D/c line. The same may be commissioned at the earliest.	With commissioning of Hiriyur – Mysore 400 kV D/c line (one circuit bypassed at Hiriyur forming Pavagada – Mysore 400kV S/c line), the loading on Hiriyur – Nelamangala line has been reduced. In the 2nd SRSCT meeting, KPTCL informed that with the commissioning of 400 kV Vasanthnarasapura – Singanayakanahalli D/c line and commissioning of the associated 400 kV transmission scheme of Yeramarus, the line loading on Hiriyur – Nelamangala line may get reduced. KPTCL to expedite the implementation of the line.	With the commissioning of Hiriyur – Mysore 400 kV D/c line (one circuit bypassed at Hiriyur forming Pavagada – Mysore 400 kV S/c line), the loading on Hiriyur–Nelamangala line has been reduced. Jagalur – CN Halli D/C line status: CN Halli-land acquisition under process.
2	400 kV NLC TS2-NNTPS line	This line loading is high when there is no generation at NNTPS and wind generation is high in Tamil Nadu area.	With the commissioning of NNTPS – Ariyalur line, the line loading is expected to be reduced.	TSTRANSCO stated the following: (i) NNTPS- Pugalur and NNTPS-Kalivanthapattu line was commissioned on 07.07.2020. After commissioning of both the lines, the loading of 400 kV NLC TS2-NNTPS line got reduced momentarily but when there is no generation at NNTPS, this line loading is increasing above the limit even after charging of NNTPS-Pugalur and NNTPS-Kalivanthapattu Line. (ii) One more case was also observed that when NNTPS-Kalivanthapattu line is in service, the line loading 400 kV NLC TS2-NNTPS line loading is increasing above the limit. So as per instruction

Sl. No.	Corridor	Description of the constraints	CTU comments	STU comments
				from SRLDC, most of the time NNTPS-Kalivanthapattu Line is kept in switched off condition only. (iii) At present only Unit 1 is in service. As per observation, 400 kV NNTPS-TPS2 line loading has to be thoroughly studied further. TANTRANSCO stated that as per the SRSCT approval, the following transmission line works may be carried out: 400 kV NLC TS2 - Salem D/c line to be modified to 400 kV NNTPS - Salem S/c line.
3	400 kV Kanarapatty - Tirunelvelli S/C line	With solar generation in Kamuthi area and high wind generation Karaikudi & Kayathar area, the line loading is high. **Remarks:** Commissioning of 400 kV Kanarpatty - Tirunelvelli second circuit will relieve the loading.	TANTRANSCO may update. The 2nd circuit of Kanarpatty – Tirunelveli was agreed for reliability purpose only and not for regular injection of power.	Commissioning of 2nd circuit 400 kV Kanarpatti - Tirunelveli S/c line would relieve the present constraint condition.
4	Constraints in Nagjheri PH evacuation	The 220 kV Nagjheri – Ambewadi DC line, 220 kV Ambewadi – Narendra DC line, 220 kV Kodasalli – Nagjheri D/C line, 220 kV Kaiga – Kodasally SC & 220 kV Kadra – Kodasally SC lines are severely over-loaded. In 1st meeting of SRSCT, committee recommended for re-conductoring of the lines with HTLS conductor. KPTCL has to expedite the same.	KPTCL may update	Status: Survey work under progress.
5	Tamil Nadu 230kV System	The following lines are heavily loaded		
		230 kV NLC TS2 – Kadalangudi S/C line		Additional 230 kV Neyveli - Kadalangudi S/c line commissioned.

Sl. No.	Corridor	Description of the constraints	CTU comments	STU comments
		230 kV Kalivendapattu – Tharamani S/C line	TANTRANSCO may update	After upgradation of Tharamani 400 kV SS from 230 kV SS, present constraints will be relieved.
		230 kV Anaikaduvu-Othakalmandapam D/C line (during wind season)		After commissioning of Edayarpalayam 400 kV SS and with commissioning of LILO of 230 kV Thudialur - Othakkalmandabam S/c line at Edayarpalayam SS, constraints would be relieved.
		230 kV Othakalmandapam-Coimbatoor S/C line		(1) With commissioning of LILO of 230 kV Othakkalmandabam - Coimbatore S/c line at New Selvapuram 230 kV SS and 2) with commissioning of LILO of 230 kV Thudialur-Edayarpalayam 400 kV SS at Selvapuram 230 kV SS, constraints would be relieved.
		230 kV Othakalmandapam - Thudialur S/c line		After commissioning of Edayarpalayam 400 kV SS and with commissioning of LILO of 230 kV Thudialur - Othakkalmandabam S/c line at Edayarpalayam SS, constraints would be relieved.
		230 kV Madurai - Sembatty S/c line		After commissioning of 230 kV (Madurai) Checkanoorani - Sembatty S/c line (2nd circuit), present constraints will be relieved.
		230 kV Pugalur - Mywadi S/c line		After making LILO of Pugalur - Mywadi 230 kV S/C line at Kurkathi 230 kV SS, present constraints will be relieved.
		230 kV Pudanchandai-Pugalur line		(1) After commissioning of LILO of 230 kV Alundur - Pugalur S/c line at Valayapatti SS and (2) After commissioning of Mangalapuram 400 kV SS with 230 kV connectivity to Pudansandai, constraints would be relieved.

Sl. No.	Corridor	Description of the constraints	CTU comments	STU comments
		230 kV TTPS-TSIPCOT S/c line		Proposal of LILO of 230 kV TTPS - Tsipcot S/C line at Ottapidaram 400 kV SS will relieve the present constraints
		230 kV Pugalur – Karukathi S/c line		After making LILO of Pugalur - Mywadi 230 kV S/C line at Kurkathi 230 kV SS, present constraints will be relieved.
6	220 kV Bangalore Metro Network	Most of the 220 kV network in Bengaluru is radialised during peak season to prevent overloading of lines. The radialisation of lines decreases the reliability of supply & thus resulting in low voltage situation during peak period and high voltage during off-peak period of the day, thus making it an ideal station for STATCOM. There is no sufficient Capacitor Compensation at distribution level in BESCOM area.	KPTCL may update	Please see para 35.1 Sl. No. 4.
7.	Andhra Pradesh 220 kV network	The following lines are heavily loaded:		
		220 kV Lower Sileru – Bommuru S/C line		Works for revival of 220 kV Lower Sileru – Bommuru DC abandoned line is under progress. It is expected to be commissioned by December 2022.
		220 kV Maradam-Garividi D/C line		Works for construction of 220/132 kV Pydi Bhimavaram SS in the same scheme area is under progress. Once, it is commissioned, loading on these feeders will be reduced. It is expected to be commissioned by November, 2020.
		220 kV Maradam-Bobbili D/C line		
		220 kV Kalpaka-Brandix D/C line		400/220 kV Atchutapuram SS was proposed and furnished to CEA for approval wherein Brandix-Atchutapuram(GIS) was proposed to make LILO at 400/220 kV Atchutapuram SS. Firm date of commissioning yet to be confirmed.

Sl. No.	Corridor	Description of the constraints	CTU comments	STU comments
		220 kV Upper Sileru-Pendurthi S/C line		Works for revival of 220 kV Lower Sileru – Bommuru DC abandoned line is under progress. It is expected to be commissioned by December 2022.
		220 kV Lower Sileru-KTS V S/C line		
		220 kV Gazuwaka-Parawada line		220 kV Gajuwaka (VSS)-Kakinada line is proposed for LILO arrangements at 220 kV Parawada SS. It is expected to be commissioned by December 2022.
		220 kV Vemagiri-Bommuru D/C line		Restringing with HTLS conductor will be proposed. Firm date of commissioning yet to be confirmed
		220 kV Gudivada-Nunna D/C line		It was proposed to make LILO of the line at proposed 400/220 kV Gudiwada SS. Firm date of commissioning yet to be confirmed.
		220 kV Gunadala-Nunna S/C line		220 kV Nunna-Gunadala DC line work is under progress. It is expected to be commissioned by March 2021.
		220 kV VTPS-Tadikonda D/C line		220 kV Prathipadu (Guntur) SS was charged hence overloading can be avoided. 132 kV feeders at 220 kV Prathipadu SS were charged in June-2020. Now, loads on 220 kV VTST-Tadikonda Feeders have been reduced.
		220 kV Sattenapalli-Narasaraopet D/C Line	.	Charging of 2nd & 3rd ICTs of 315 MVA at 400 kV Podili SS and making LILO of 220 kV Podili-Atmakur line at 400/220 kV Podili SS is nearing completion. With the completion of these lines, overloading on 220 kV lines emanating from 400 kV Sattenapalli will be reduced. It is expected to be commissioned by December, 2020.
		220 kV Sattenapalli-Parchur D/C Line		

Sl. No.	Corridor	Description of the constraints	CTU comments	STU comments
		220 kV Chinakampalli-Rajampet S/C line		220 kV Chinakampalli Renigunta is D/C Line. One circuit was made LILO at Rajampet & Kodur. Now, the 2nd circuit is also proposed for LILO arrangements at 220 kV Rajampet SS. Expected to be commissioned by March, 2022.
		220 kV Ghani-Somayajulapalli D/C line		Restringing with HTLS conductor will be proposed. It is expected to be commissioned by March, 2022.

36.2 ICT Constraints

Sl. No.	ICT	Description of the constraints	CTU comments	STU comments
1.	400/220 kV 2x315 MVA ICTs at Maradam SS	N-1 condition not satisfied for considerable time. N-1 of these ICTs will overload ICTs at Gazuwaka and Kalpakka SS.	Augmentation of ICT capacity from 2 x 315 MVA to 2 x 315 MVA + 1x 500 MVA ICTs at 400/220 kV Maradam (Garividi) S/S had already been agreed in the 1st SRSCT. APTRANSCO may expedite the implementation of 3rd ICT at Maradam.	3rd ICT of 500 MVA- works are nearing completion and expected to be commissioned by November, 2020.
2.	400/220 kV, 3x315 MVA ICTs at Vemagiri	N-1 not satisfied for 12% of the time in March	APTRANSCO may update. Proposal has been received from APTRANSCO for additional 1x500 MVA ICT at Vemagiri 400/220 kV substation.	4th ICT of 500 MVA- works were awarded and work is going on war footing basis. Expected to be commissioned by January, 2021.
3.	400/220 kV 3x315 MVA ICTs at Nellore	N-1 not satisfied for few instants	1x500 MVA, 4th ICT at Nellore S/s (Manubolu) had already been agreed in 1st SRPC(TP) meeting. APTRANSCO may update.	4th ICT of 500 MVA works are under progress and expected to be commissioned by February, 2021
4.	400/220 kV 2x500 MVA ICTs at Kolar	N-1 not satisfied for 25 % of the time in February and March		With commissioning of 400 kV Dommasandra S/S and its associated lines, the ICT loadings are expected to reduce. Status: Estimate under preparation

Sl. No.	ICT	Description of the constraints	CTU comments	STU comments
5.	400/220 kV 2x315 MVA ICTs at Kaiga	N-1 not satisfied for 23 % of the time	KPTCL may update	KPTCL would obtain the details from NPCIL.
6.	400/220 kV 2x315 MVA ICTs at UPCL	N-1 not satisfied 17 % of the time in March	KPTCL may update	Proposed 400 kV Arasapadavu sub-station is intended to share loads of 220 kV MSEZ and Kavoor sub-stations, resulting in reduction of load on 2x315 MVA, 400/220 kV UPCL transformers. Status: KIADB land being allotted.
7.	400/220 kV 2x315 MVA ICTs at Guttur	N-1 not satisfied for few instants	KPTCL may update	With the commissioning of 400 kV Jagalur S/s and its associated line, loads of 220 kV Chitradurga is being fed from 400 kV Jagalur. Hence, the ICT issues of 2x315 MVA, 400/220kV Guttur will be solved. The 220 kV Jagalur-Chitradurga line is likely by December, 2020.
8.	400/220 kV 2x315 MVA ICTs at Kochi	N-1 not satisfied for few instants	Loading on 2x315 MVA ICTs at Kochi has been increased with the commissioning of Tirunelveli – Cochin 400 kV (Quad) D/c line. With the commissioning of 2000 MW Pugalur – North Trichur VSC based HVDC, the loadings are expected to reduce. 1x500 MVA ICT has been planned by CTU at Kochi, subject to approval of SRPC(TP).	With the commissioning of 400 kV Kochi-Tirunelveli DC line, the loadings on Kochi ICTs have increased. In a joint meeting with SRPC, SRLDC and KSEB held on the 15th of September, SRLDC has observed that with the commissioning of HVDC Pugalur-Trichur Poles, the loading on Kochi ICTs will further increase. It was decided in the meeting that KSEBL will take measures for installation of an additional 500 MVA ICT at Kochi SS with approval from SRPC(TP). KSEB would also expedite the commissioning of evacuating 220 kV transmission lines from Trichur HVDC sub-station and construction of 400 kV Kottayam SS, which will relieve the loadings on Kochi ICTs. Subsequently, KSEB has taken up the issue in the 2nd SRPC (TP) meeting held on 1st October for

Sl. No.	ICT	Description of the constraints	CTU comments	STU comments
				the installation of 500 MVA ICT at Kochi.
9.	400/230 kV 2x315 MVA ICTs at Thiruvalam	N-1 not satisfied for few instants	1x500 MVA 3rd ICT has been planned by TANTRANSCO. TANTRANSCO may update	After commissioning of 1x500 MVA, 400/230 kV ICT, present constraint condition to be relieved.
10.	400/220 kV 2x315 +1x500 MVA ICTs at Mysore	N-1 not satisfied for 40 % of the time in February and March	With the commissioning of 400 kV Kadakola S/S and its associated lines, the ICT loadings are expected to reduce.	With commissioning of 400 kV Kadakola S/S and its associated lines, the ICT loadings are expected to reduce. Status: Survey work under progress.
11.	400/220 kV 3x500 MVA ICTs at Nelamangala	N-1 not satisfied for 30 % of the time in February.	KPTCL may update	Commissioning of 400/220 kV Devanahalli, Peenya and its associated lines would relieve the situation. Devanahalli hardware park substation commissioned on 24th September, 2020 with 400 kV line.
12.	400/220 kV 3x500 MVA ICTs at Hoody	N-1 not satisfied for 25 % of the time	KPTCL may update	Commissioning of 400/220 kV Devanahalli, Mylasandra and its associated lines would relieve the situation. Devanahalli hardware park substation commissioned on 24th September, 2020 with 400 kV line. Mylasandra:Target-Dec 2020.

36.3 Node Experiencing High Voltage / Low Voltage

During the 1st SRPC(TP) meeting held on 16.12.2019, it was informed that detailed study of reactive power compensation had been carried out and the same had been discussed in 1st meeting of SRSCT, wherein 27 nos. of 125 MVAR bus reactors were agreed to be installed at different locations and with the commissioning of planned/ under implementation bus reactors at various ISTS & STU substations, the issue of high voltage would be addressed. It was decided in the meeting that states may expedite the implementation of bus reactors and may update the status. Status of implementation of bus reactors in Southern Region is give at para 6.1.10.

In case the high voltage conditions persists with the commissioning of above planned / under implementation bus reactors, comprehensive reactive compensation studies may be carried out subsequently, considering the high RE integration in Southern Region.

36.4 Delay in transmission lines affecting grid operation adversely

Sl. No.	Transmission Corridor	Proposed Commissioning Date/ Original Target date	Actual/Likely Commissioning Date	Transmission constraint	CTU comments
1.	400 kV Thrissur – Kozhikode DC line	---	RoW issues	Low voltages in North Kerala & 220 kV North - South corridor of Kerala	Line is likely to be commissioned by December, 2020.
2.	400 kV Bellary PS - Chikkanayakanahalli DC line	--	Tendering stage	High loading on 400 kV Hiriyur-Nelamangala DC line	Line from BPS to Jagalur commissioned. Status of 400kV C.N. Halli: Land acquisition under process.
3.	400 kV Ariyalur-NNTPS D/C line	February, 2020	RoW issues	Constraint in evacuation of NNTPS generation	NNTPS – Ariyalur line expected by June, 2020. In view of delay in readiness of Ariyalur S/s (TANTRANSCO), interim arrangement done to connect this line to one ckt of LILO section of Pugalur-Kalivandapattu 400 kV D/c line to evacuate power from NNTPS.

37.0 Presentations on technical aspects

37.1 Presentation on Composite Insulated Cross Arm solution for the Transmission Line Towers by Shemar Power Engineering (India) Pvt. Ltd.-Presentation at **Annex-II.**

37.2 Presentation on Dynamic Line Rating by Ampacimon- Presentation at **Annex –III**.

Annex-I

List of Participants

Sl. No.	Name	Designation
Central Electricity Authority		
1	P. S. Mhaske	Chairperson
2	Goutam Roy	Chief Engineer (PSPA-I)
3	Ishan Sharan	Director (PSPA-I)
4	Kanchan Chauhan	Assistant Director (PSPA-I)
5	Mayank Wadhwa	Assistant Director (PSPA-I)
SRPC		
6	A. Balan	Member Secretary
7	Asit Singh	SE (Operation)
CTU		
8	Dr. Subir Sen	COO
9	Ashok Pal	CGM
10	Anil Kumar Meena	DGM
11	Ajay Dahiya	Chief Manager
12	Ankush Patel	Manager
13	Venkatesh Gorli	Manager
NPCIL		
14	Sandeep Sarwate	Addl. Chief Engineer (Transmission)
NLC		
15	K. Ganesan	CGM
16	R. Senthil Kumar	DGM
POSOCO		
17	Abhimanyu Gartia	ED (SRLDC)
18	S. P. Kumar	CGM (SRLDC)
19	R. K. Porwal	Sr. GM (NLDC)
20	T. Muthu Kumar	DGM (SRLDC)
21	Madhukar G.	Chief Manager (SRLDC)
22	Pradeep Reddy	Manager (SRLDC)
23	L. Sharath Chand	Manager (SRLDC)
SECI		
24	R. K. Agarwal	Consultant
NTPC		
25	S. S. Mishra	GM
26	Subhash Thakur	Addl. GM (PE-Elect)
NHPC		
27	J. R. Chaudhary	ED
28	J. C. Sarkar	GM
TSTRANSCO		
29	J. Surya Prakash	Director/ Lift Irrigation Schemes

Sl. No.	Name	Designation
30	G. Sampath Kumar	Chief Engineer/Lift Irrigation Schemes
31	K. Prasanna Lakshmi	Chief Engineer/Power Systems
32	M. Sheshagiri	Divisional Engineer/ System Studies-II
33	J. Ajay Kumar	Divisional Engineer/ System Studies-I
34	Ajay Jilla	Divisional Engineer
TANTRANSCO		
35	T. Senthilvelan	Director/Transmission Projects
36	T. Subbarayan	Superintending Engineer/LD&GO
37	K. Kamaraju	Executive Engineer/SLDC
38	S. Senthilkumar	Assistant Executive Engineer/SLDC
TANGEDCO		
39	N. Balaji	Chief Engineer/Planning & R.C
40	R. Ramalakshmi	Superintending Engineer/CERC
41	M. Sudarsan	Superintending Engineer/System Studies
42	T. Sumathi	Executive Engineer-II/System Studies
43	G. RameshKumar	Executive Engineer-I/System Studies
44	Porselvan	Executive Engineer/CERC
45	J. Kalaiselvi	Asst. Exe. Engineer/System Studies
46	L. Porchelvi	Asst. Exe. Engineer/System Studies
47	R. Kathiravan	Asst. Exe. Engineer/CERC
48	D. Narendran	Assistant Engineer/System Studies
KSEB		
49	Dr. P. Rajan	Director(T&SO)
50	Pradeep K.P.	Chief Engineer (Transmission System Operation)
51	Radhakrishnan V.	Chief Engineer
52	Biju S.S.	Executive Engineer
KPTCL		
53	Siddaraju. K.	Director (Transmission)
54	M. Shanti	Chief Engineer (Planning & Co-ordination)
55	V. S. Raghavendra	Superintending Engineer (Electy), Planning
56	Chethan. D.	Executive Engineer(Elec) (PSS-S)
57	Divya Prabha. H.	Assistant Executive Engineer(E), (PSS)
58	Meetha C. Jadav	Assistant Engineer (E), PSS
APTRANSCO		
59	K. Praveen Kumar	Director/Grid, Transmission & Management
60	P. Surya Chandram	Chief Engineer (PS, Planning & Design)
61	A. K.V. Bhaskar	Chief Engineer, SLDC
62	C. Sreenivasa Rao	Executive Engineer/System Studies-I
63	R.N. Parasar Kesari	Deputy Executive Engineer/System Studies
64	Goriparthi Rama Mohan Rao	Assistant Executive Engineer/System Studies

SMAREPC

CICA

Compact Transmission Line

Shemar Power Engineering (India) Pvt. Ltd.

2020/10/01

ABOUT US

BEING VALUABLE BY CREATING VALUE

ABOUT SHEMAR

Shemar Power Engineering (India) Pvt. Ltd. is the provider of overall solution for power transmission, substation and distribution.

Vision: Provide more economical electricity

Mission: Through innovation, advance power industry

Strategy: Build new generation of power system through new materials & technologies

Value: Being valuable by creating value

Compact Line Solution

SMAREPC

01

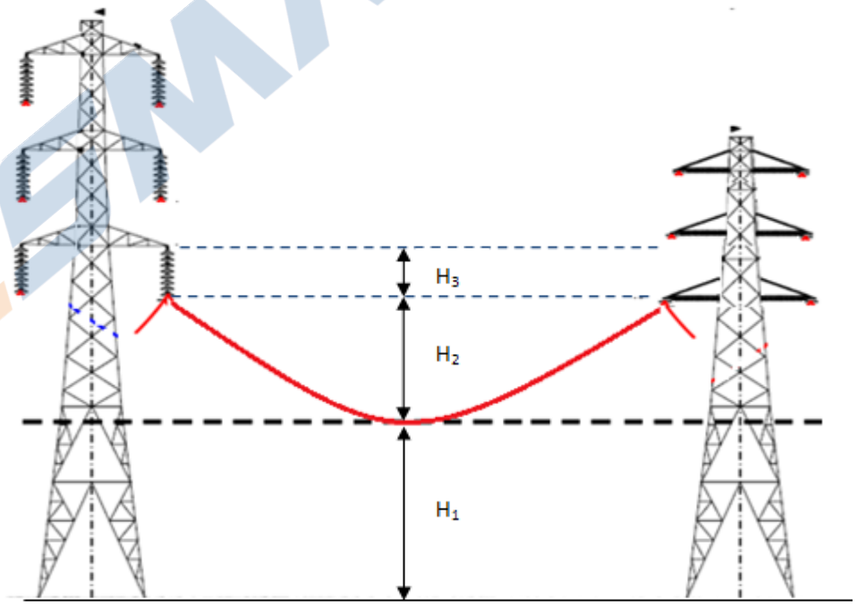
Introduction of CICA

Advantage of Composite Insulated Cross-Arm (CICA)
Application and uses of CICA

1.1 Introduction of CICA

Shemar Power Engineering (India) Pvt. Ltd. has developed the Composite Insulated Cross-Arm (CICA) solution for the Transmission Line Towers. The CICA based towers are providing the following solutions.

- Resolve ROW problem due to less tower width
- Corridor width reduction
- Resolve Clearance Issues
  - ✓ Additional ground clearances available by using small length of insulator string fittings
  - ✓ Additional Electrical clearances available by using small length of insulator string fittings
- Reducing the Tower Height
  - ✓ Tower weight reduction
  - ✓ Saving of Foundation Volume
  - ✓ Overall savings of tower & foundation quantity
- Saving Total numbers of tower
  - ✓ Span between the towers can be increased by maintaining the ground clearance
- No Additional Insulator Strings
  - ✓ CICA it self a composite insulator with small length of suspension fittings
- Savings in Overall Project input cost including transportation and Installation



1.1 Introduction of CICA

- CICA can provide 30 years of life cycle and hence no maintenance is required. Effectively resulted to zero maintenance of life cycle cost.

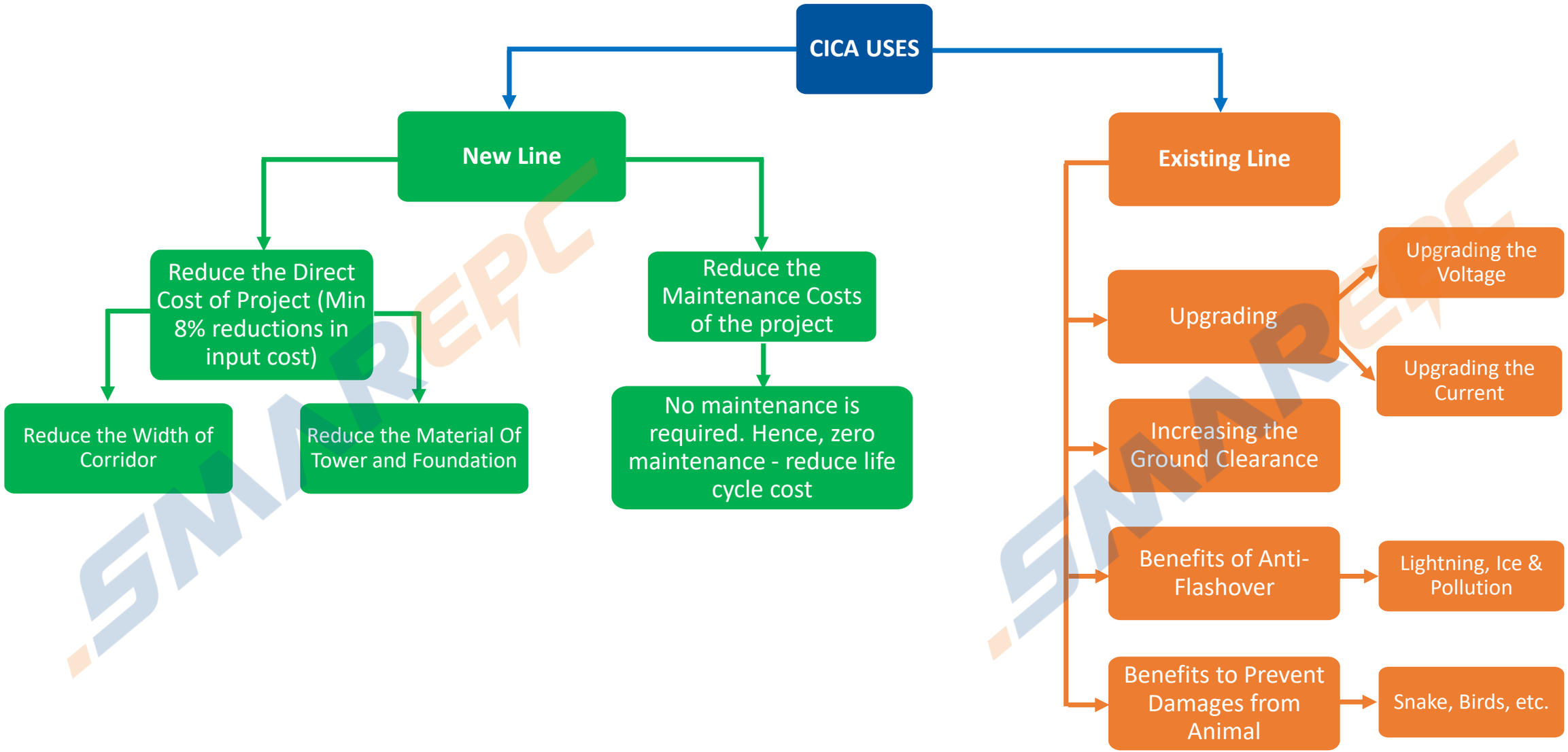
- CICA can effectively reduce wind flashover, pollution flashover, rain and Ice flash, and greatly reduce the accident rate of lightning trip.

- CICA based tower greatly reduces the consumption of traditional materials, saves resources and reduces the cost of dismantling after the project is scrapped or the life cycle is completed.

- The composite insulated cross-arm (CICA) based tower saves land resources and reduces damage to ecological environment. Hence an Eco-Friendly Product.

All the principles and CICA applications are even applicable for Pole Structures in all voltage up to 765kV level.

1.2 Application and uses of CICA



02

Solution for Suspension Tower

Present RFP/Tech. Spec. Requirements
CICA Arrangement for Suspension Towers
Requirements as per Standards
Applicability to Clearances Working
Comparison of required live metal clearances

2.1 Present RFP/Tech. Spec. Requirements

1. RFP Requirement for 400kV Traditional/Conventional Towers,

- The required phase to phase spacing and horizontal spacing for 400kV line shall be governed by the tower design as well as minimum live metal clearances for respective voltage levels under different insulator swing angles.

- The minimum live metal clearances for 400 kV D/C transmission lines shall be considered as follows:

  (i) Under stationary conditions From tower body: 3.05m
  (ii) Under swing conditions

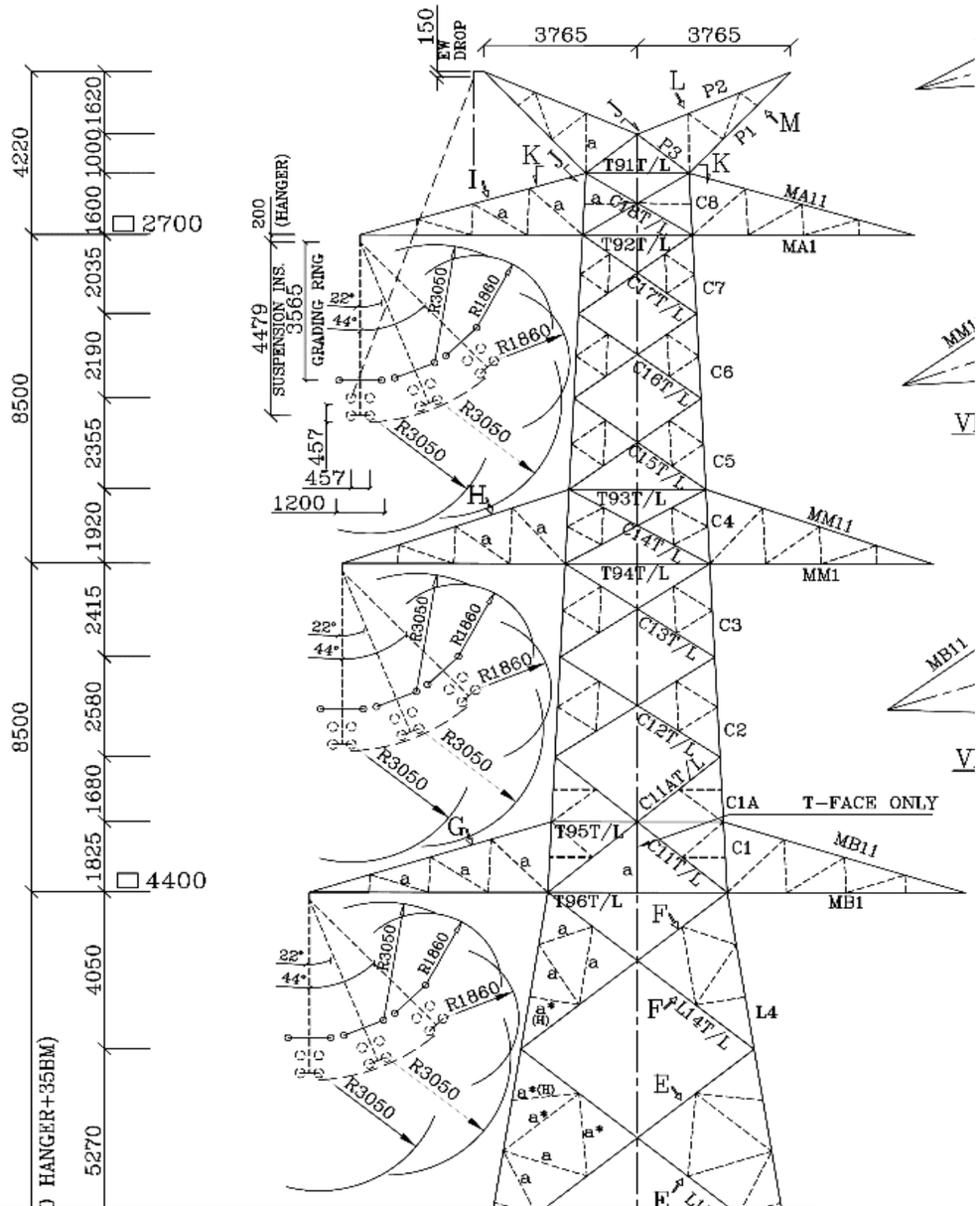
Wind pressure Condition	Minimum electrical clearance
a) Swing angle (22º)	3.05 mtrs
b) Swing angle (44º)	1.86 mtrs

However, the phase to phase spacing for 400 kV D/C Line shall not be less than 8m.

- The minimum ground clearance for 400kV D/C transmission lines shall be 8.84m so that maximum electric field does not exceed 10kV/m within the ROW and does not exceed 5kV/m at the edge of the ROW as per international guidelines.

- The minimum mid span separation between earth wire and conductor shall be 9.0 m for 400 kV D/C transmission lines. Shielding angle shall not exceed 20 deg for 400 kV D/C line.

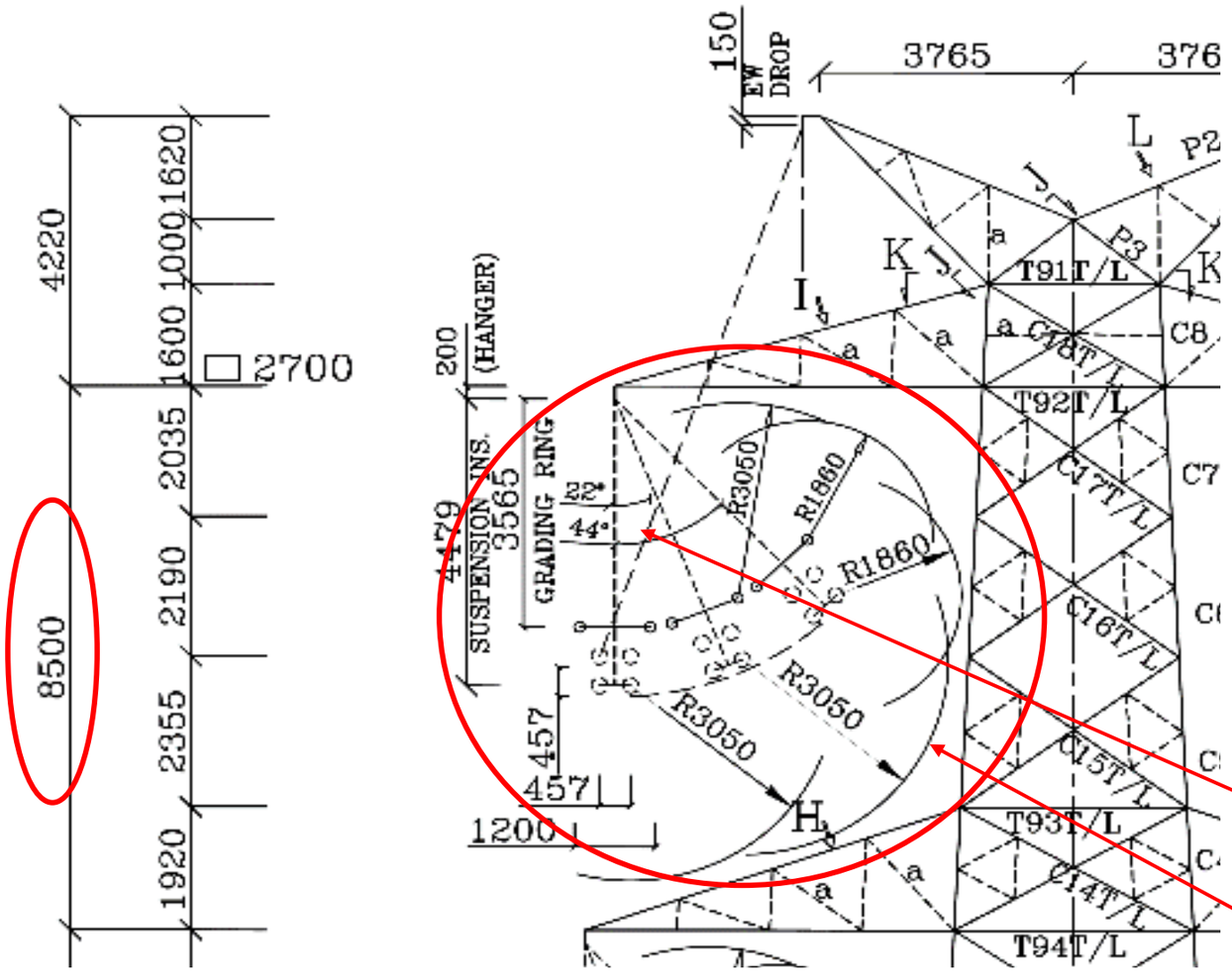
Traditional Tower



Hence, the traditional tower geometry have been configured based on suspension insulator/jumper swing & other clearance as per present RFP/Tech Specification requirement

2.2 Requirements: Traditional Tower (DA)

Traditional Tower - Phase to phase distance requirement for 400kV line



Hence, for Traditional Designs, it is maintained 8 to 8.5m due to Insulator length and its Swing/Jumper Swing

Considering the actual live metal clearances to the tower body and cross-arm as per IS:5613, the minimum required distance for traditional towers are ranging 8 to 8.5m.

Table 1 Swing Angles and Minimum Clearances from Live Parts to Tower Body/Cross-Arm Members

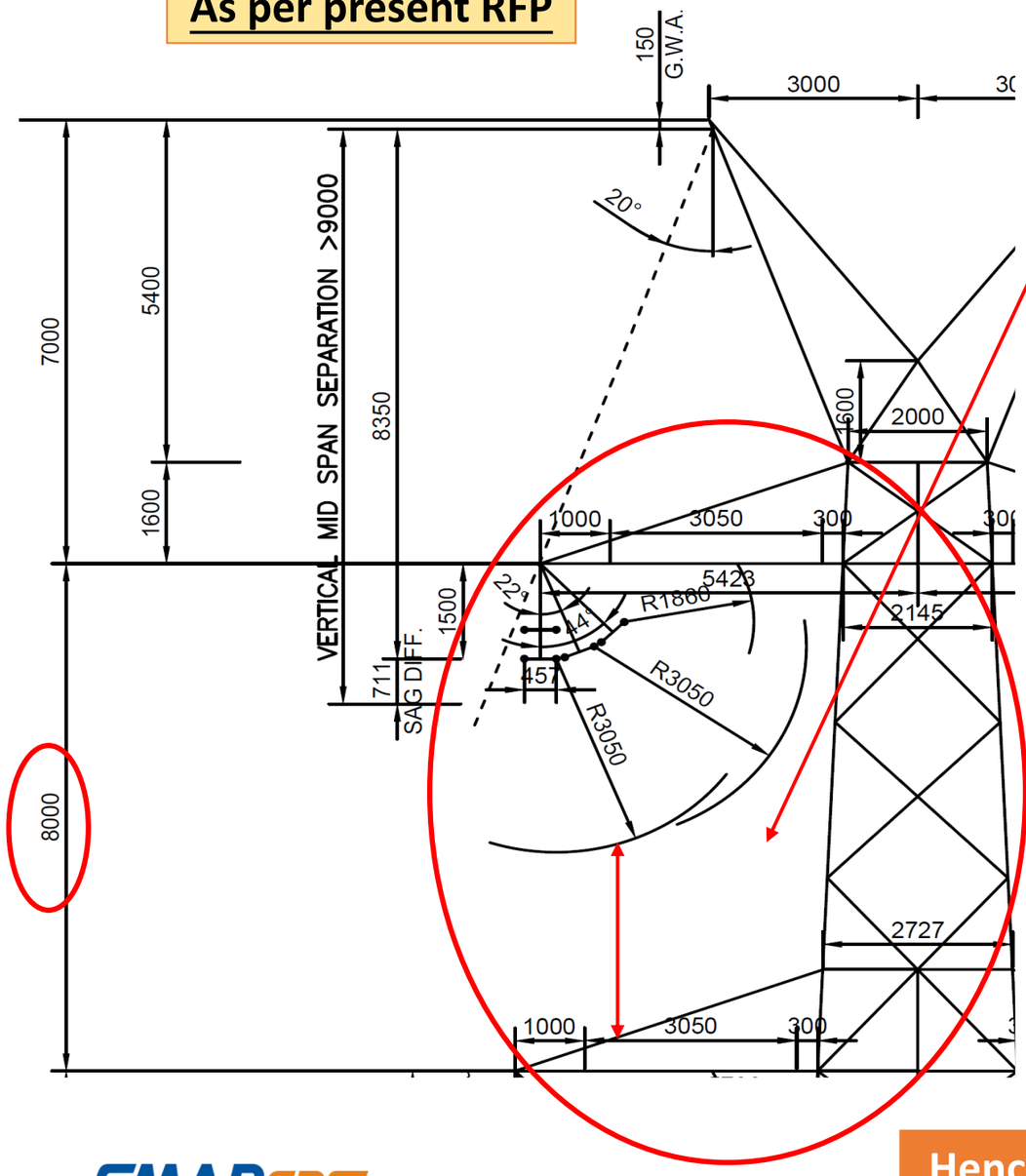
(*Clauses* 14.1.4 *and* B-6.2)

Wind Pressure kg/m²	Angle of Swing				
	Insulator String		Jumper Swing		
			Switching Surge Over-Voltage		Power Frequency Over Voltages
	Normal Swing	Maximum Swing	Normal Swing	Maximum Swing	Maximum Swing
(1)	(2)	(3)	(4)	(5)	(6)
43	21°(15°)	42°(30°)	26°(20°)	(40°)	(52°)
45	22°(15°)	44°(30°)	31°(20°)	(40°)	(62°)
52	24°(15°)	48°(30°)	34°(20°)	(40°)	(68°)
Clearances mm	3 050	1 860	3 050	(1 860)	(3 050)

NOTE — The values given in the brackets are the revised values. It is proposed to ultimately retain the revised values only and delete the old values.

2.3 Requirements: Tower with CICA (DA)

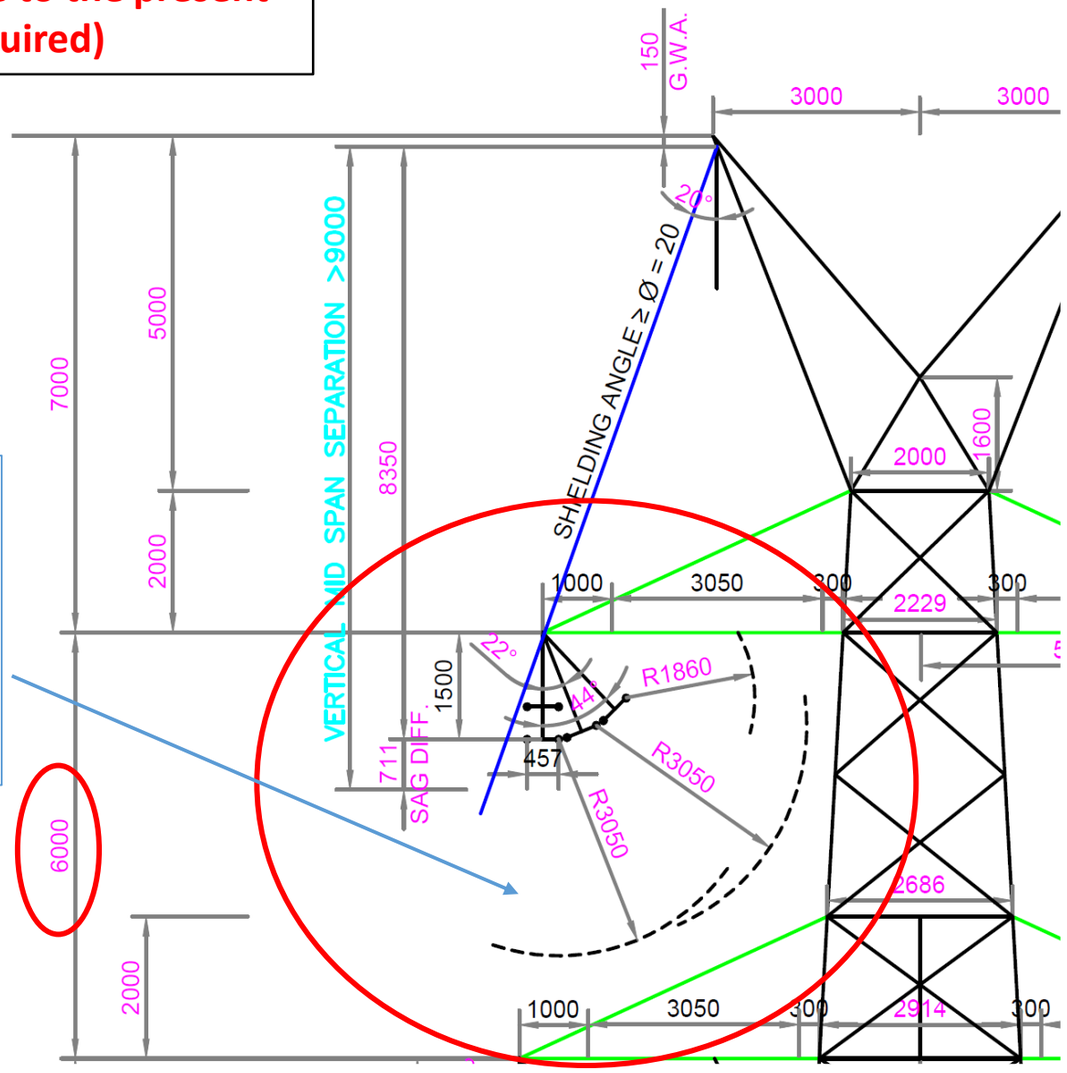
As per present RFP



Unnecessary 2m of additional clearance due to the present spec (Not required)

Required Clearances Achieved to the tower body & between phase.

Tower with CICA



Hence, the actual clearances can be achieved with 6m distance and extra 2m space can be optimized

2.4 Requirements as per IS & Int. Standards

1. Tower Internal/Electrical Clearances for 400kV Lines

Indian Standards (IS:5613 (Part-3/Sec-1) : 1989)

Minimum clearance from line parts to tower body and cross-arm members in the case of 400 kV lines shall be in accordance with Table 1. of IS:5613 (Part-3/Sec-1)

Normal Swing at 22 deg. – 3.050m

Maximum Swing at 44 deg. – 1.860m

European Practice (EN 50341-1)

BIL = 1425 kV ; Del = 2.66 m

BSL = 1050 kV ; Del = 3.02 m (governing)

UK Practice (SSE Scotland Functional Specifications)

Phase-to earth wire clearance (at the support) = 3.14 m

Phase-to earth wire clearance (within span) = 2.96 m

US Practice (NESC – national Electric Safety Code)

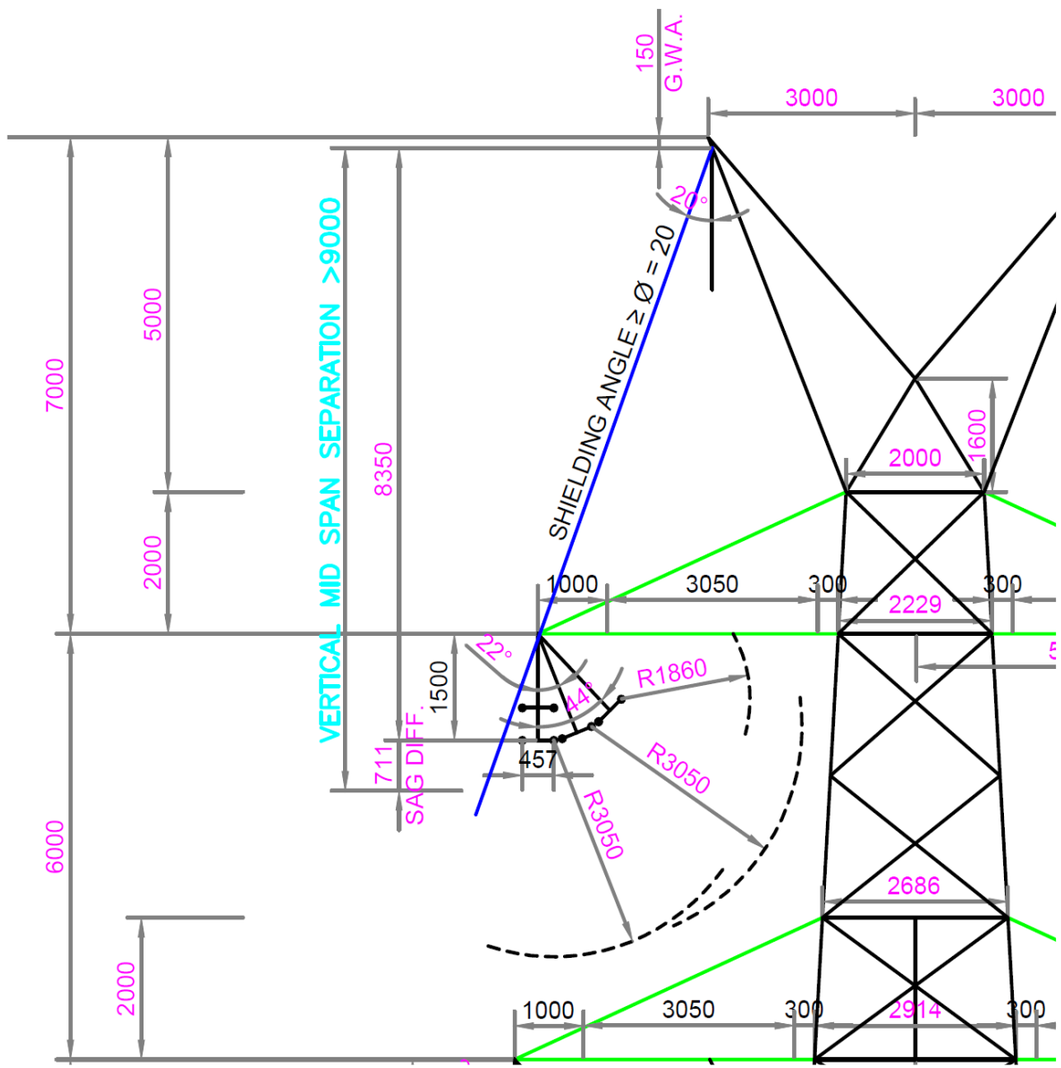
Mid Span Clearance = Reference Height (of relevant object) + Electrical Clearance

For open land, 4.3 m + 3.04 m = 7.34 m

Middle East Practice (SEC – Standards)

At the support: Clearance of conductor from its own support earth wires = 3.5 m

Tower with CICA



Mandatory Clearance is required based on the Insulator length and its Swing/Jumper Swing values

2.5 Compact Design-Suspension Tower with CICA

Benefits,

- **Tower Height**
  – 5.345m (10%↓)
- **Base Width**
  – 2.546m (17%↓)
- **Phase to Phase**
  – 2.5m (30%↓)
- **Phase to Earth**
  + 2.78m (65% ↑)
- **Weight**
  – 4.69MT (28.41%↓)

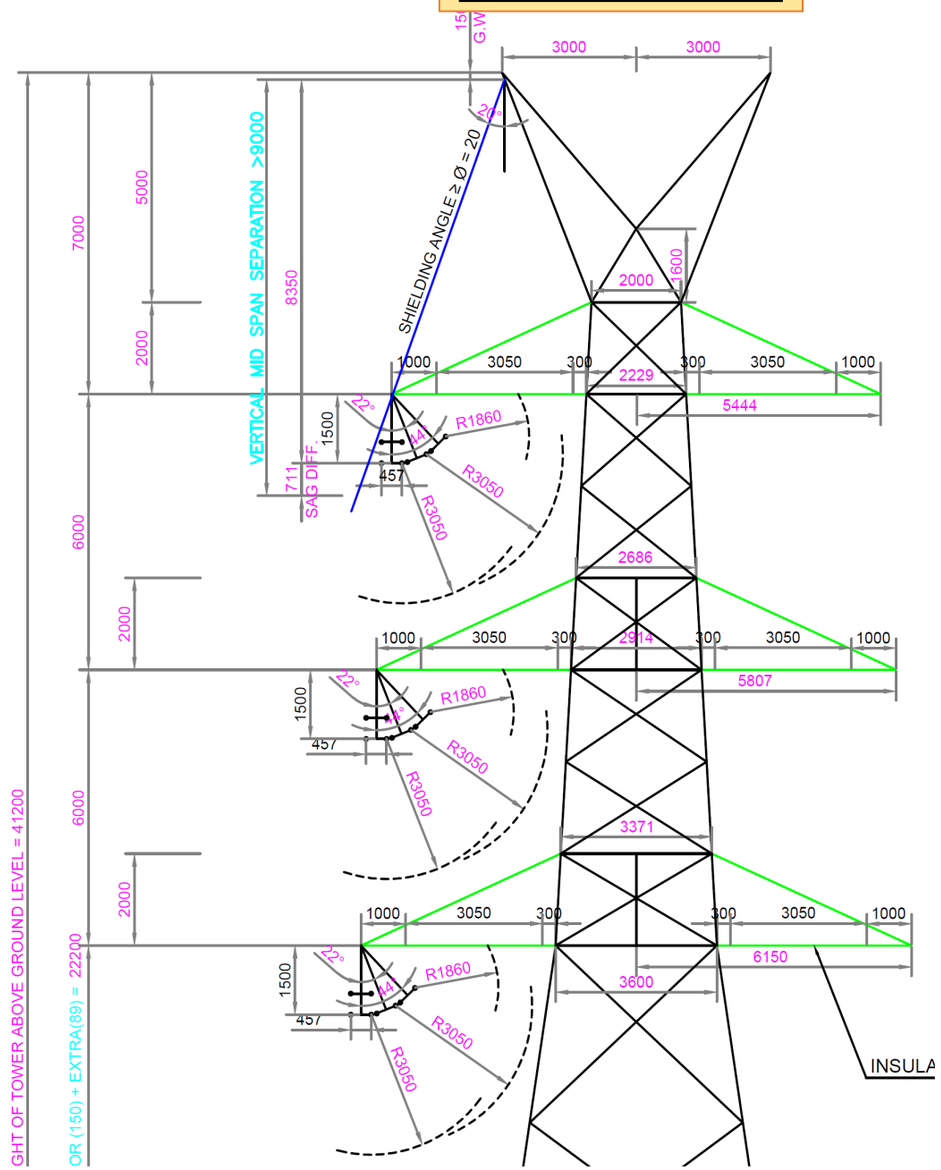
CICA Tower (+9m BE),

- Tower Height – 50.2m
- Base Width – 13.0m
- Phase to Phase – 6m
- Phase to Earth – 7m
- Weight – 11.82MT

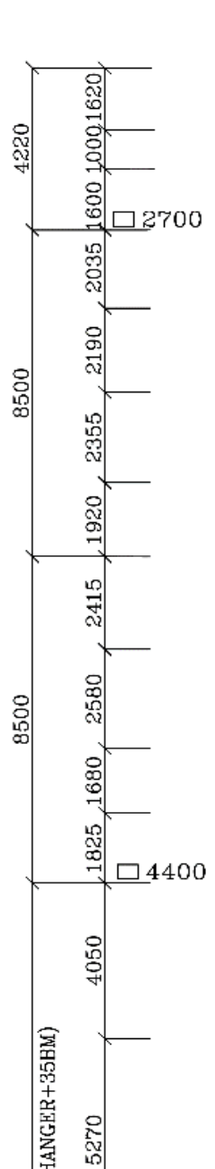
Trad. Tower (+9m BE),

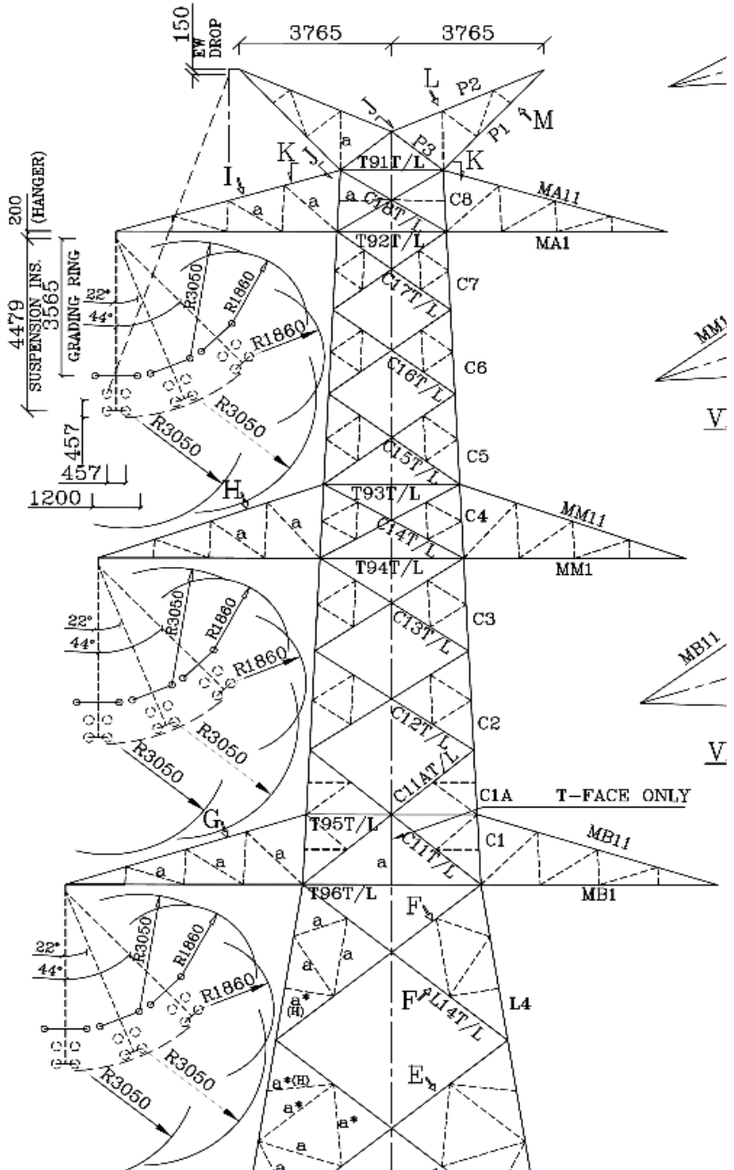
- Tower Height – 55.545m
- Base Width – 15.546m
- Phase to Phase – 8.5m
- Phase to Earth – 4.22m
- Weight – 16.51MT

Tower with CICA



Traditional Tower





Most optimized design of DA type Tower due to explanation of previous slides & it can provide 4.69MT less weight than traditional tower

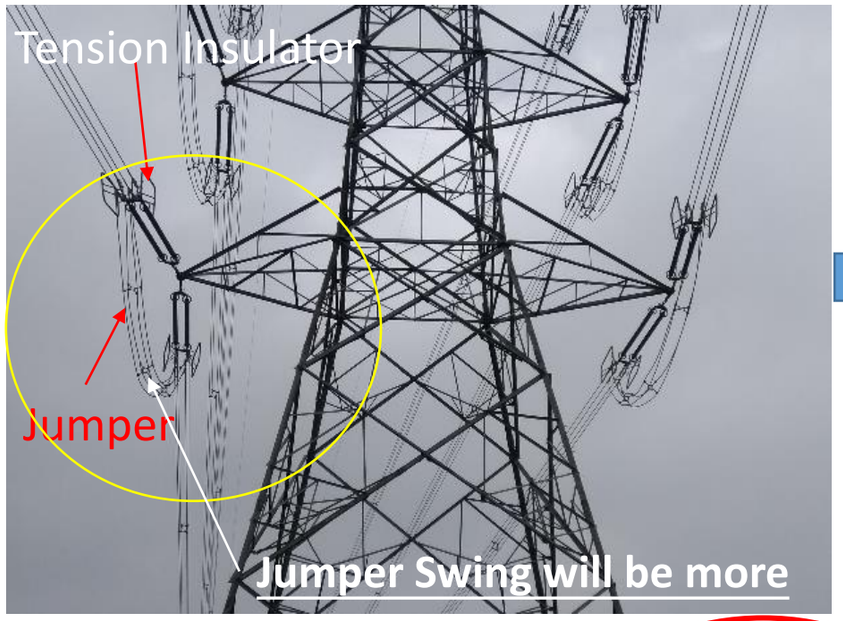
03

Solution for Tension Towers

Comparison of required live metal clearances
CICA Arrangement for Tension Towers

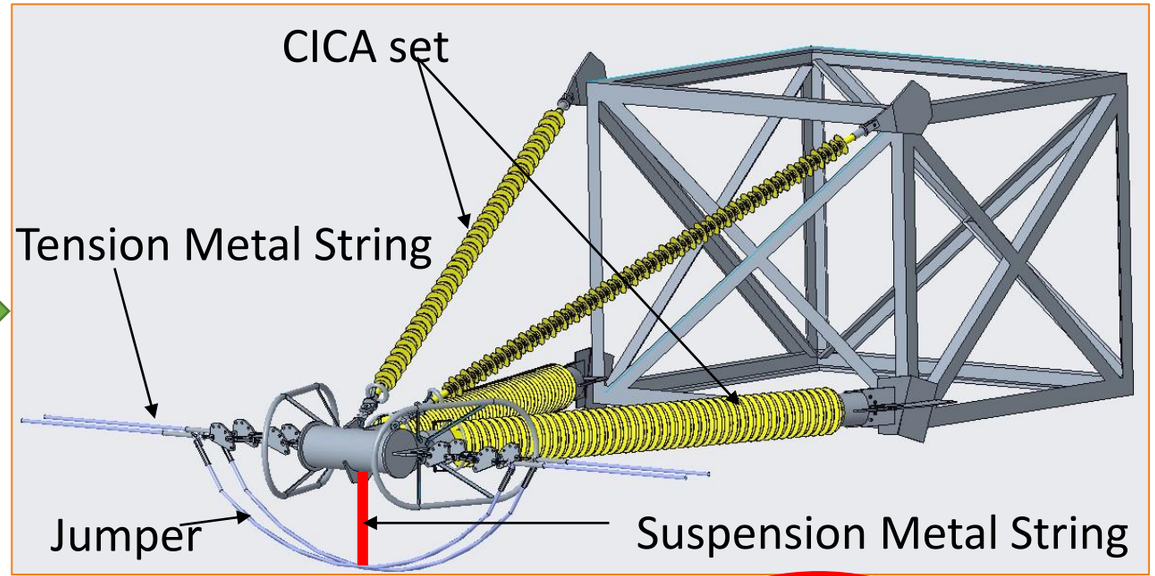
3.1 Solution for Tension Towers

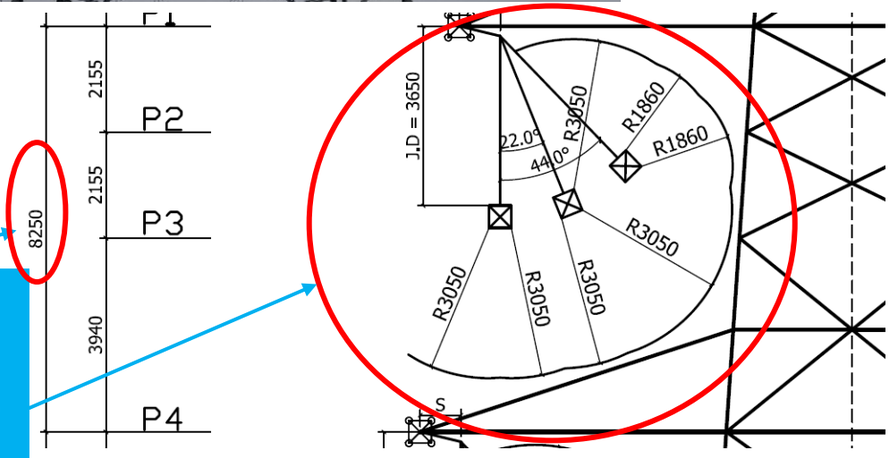
Traditional Tower-DB



We have solution for Tension Towers

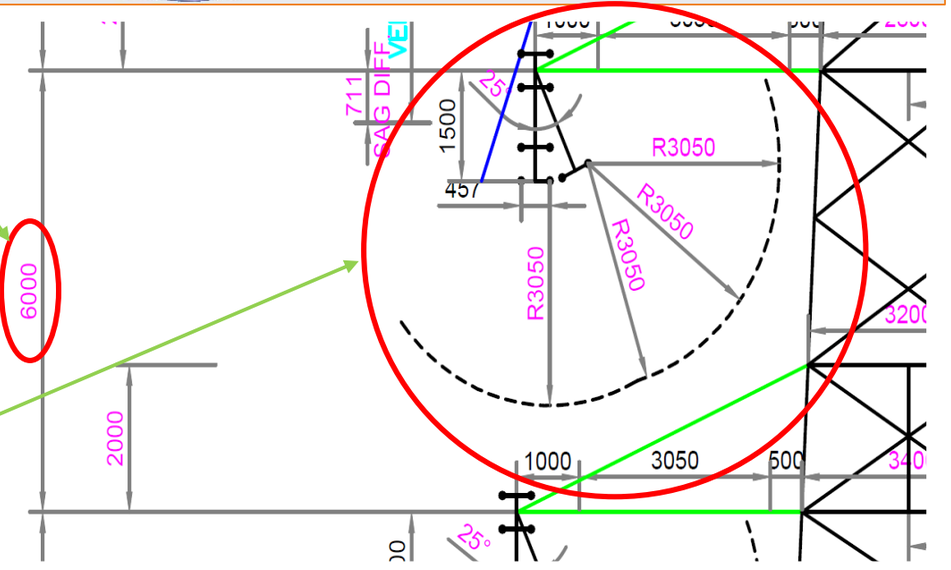
CICA Tower-DB





Traditional Tower needs more distance b/w phase & long cross-arm

CICA Tower needs less distance b/w phase & cross-arm shorter



Based on CICA Arrangement, Jumper Swing shall be restricted and Hence, Phase to Phase distance shall be optimized to 6m from 8/8.5m

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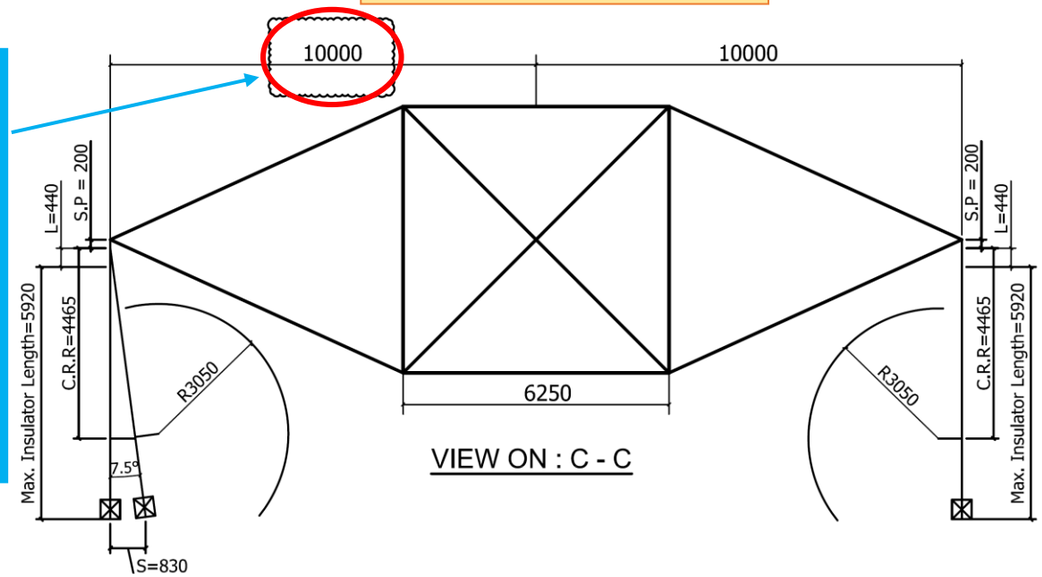
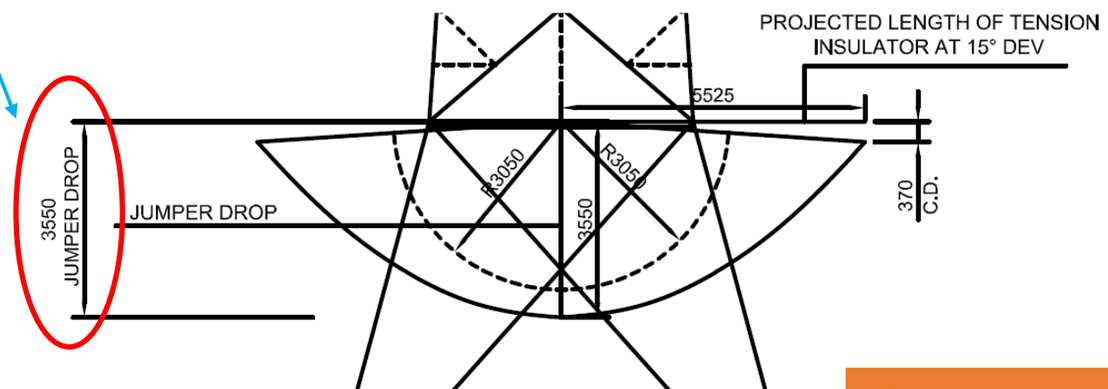
3.1 Solution for Tension Towers

1. Electrical Clearances Checking for 400kV Line Tension Tower

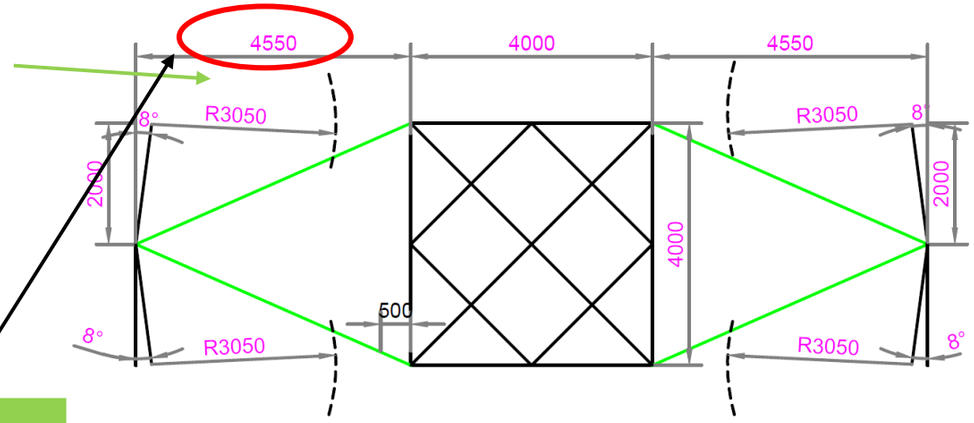
Traditional Tower

Traditional Tower needs more distance b/w phase & resulted to longer cross-arm

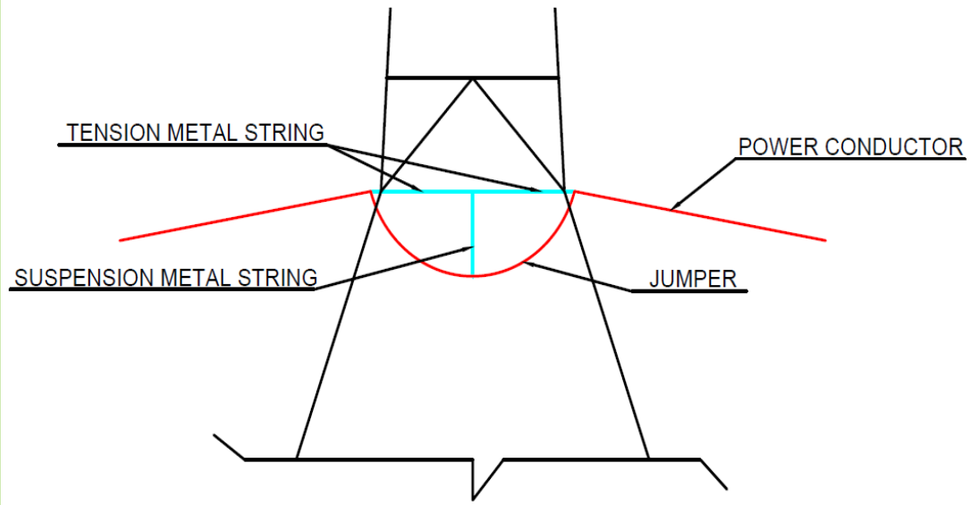




Tower with CICA



CICA Tower needs less distance b/w phase & required shorter insulated cross-arm



The required live metal clearances are well within limit based on CICA arrangement. Hence, the Cross-Arm length and Phase to Phase distance shall be reduced and further total tower weight shall be optimized.

3.2 Compact Design-Tension Tower-DB

Benefits,

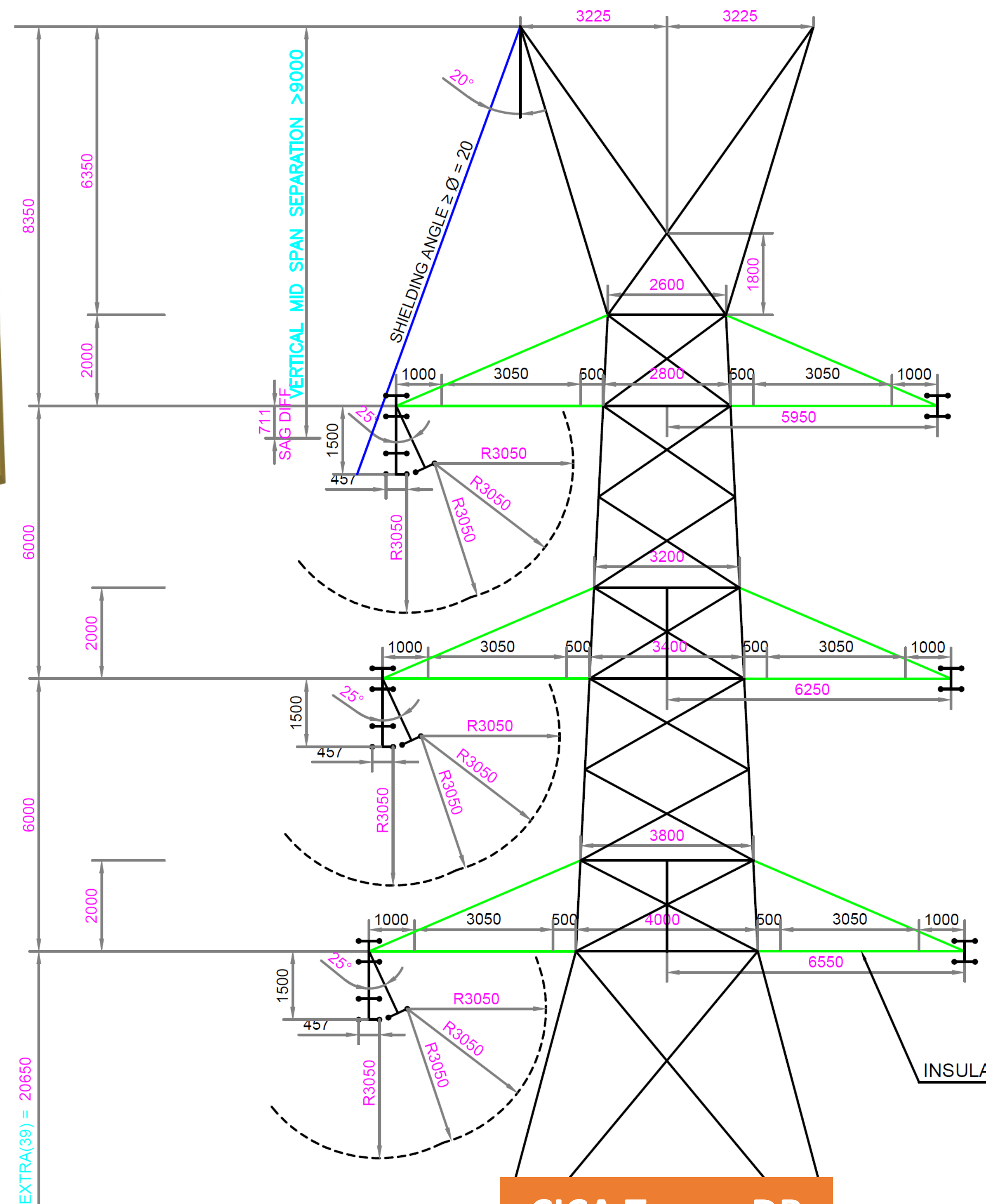
- **Tower Height**
  – 6.02m (12.80%↓)
- **Base Width**
  – 2.75m (15.50%↓)
- **Phase to Phase**
  – 2m (25%↓)
- **Phase to Earth**
  – 0.05m (0.6% ↑)
- **Weight**
  – 5MT (28.41%↓)

CICA Tower (+0m BE),

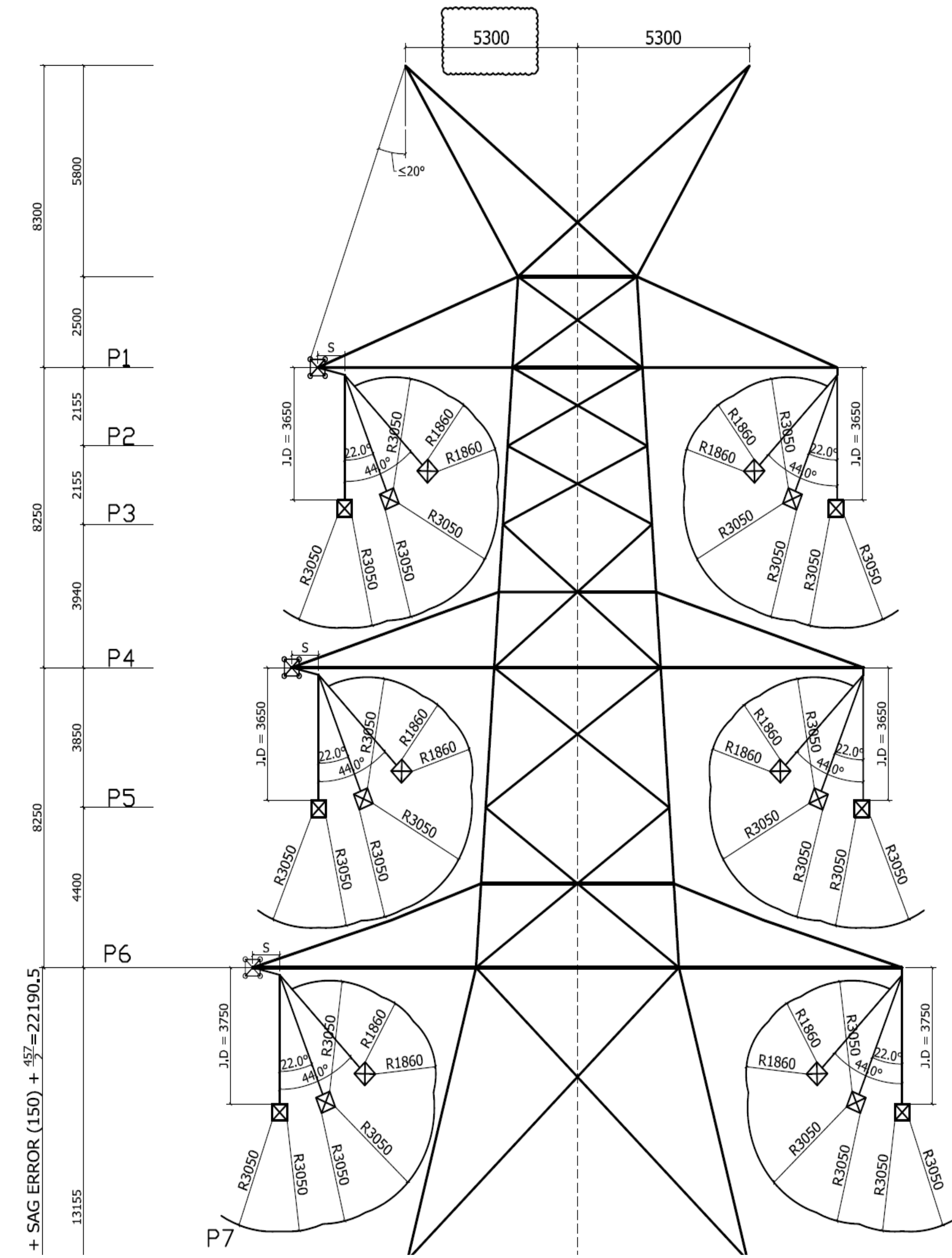
- Tower Height – 41m
- Base Width – 15m
- Phase to Phase – 6m
- Phase to Earth – 8.35m
- Weight – 20MT

Trad. Tower (+0m BE),

- Tower Height – 47.02m
- Base Width – 17.75m
- Phase to Phase – 8.25m
- Phase to Earth – 8.3m
- Weight – 25MT



CICA Tower-DB



Traditional Tower-DB

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3.3 Compact Design-Tension Tower-DC

Benefits,

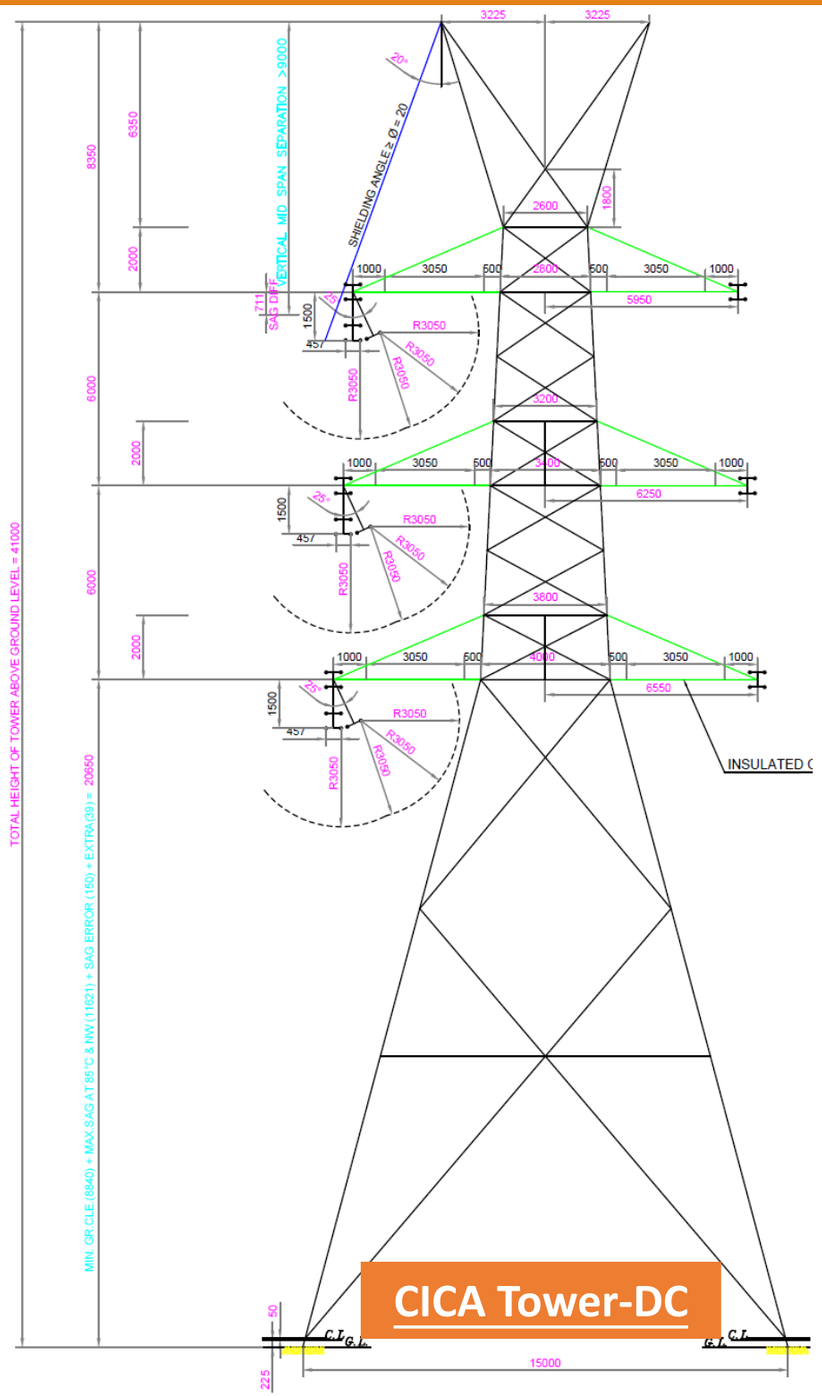
- **Tower Height**
  – 6.53m (13.74%↓)
- **Base Width**
  – 3.75m (20%↓)
- **Phase to Phase**
  – 2m (30.23%)
- **Phase to Earth**
  – 0.05m (0.6% ↓)
- **Weight**
  – 5MT (14.30%↓)

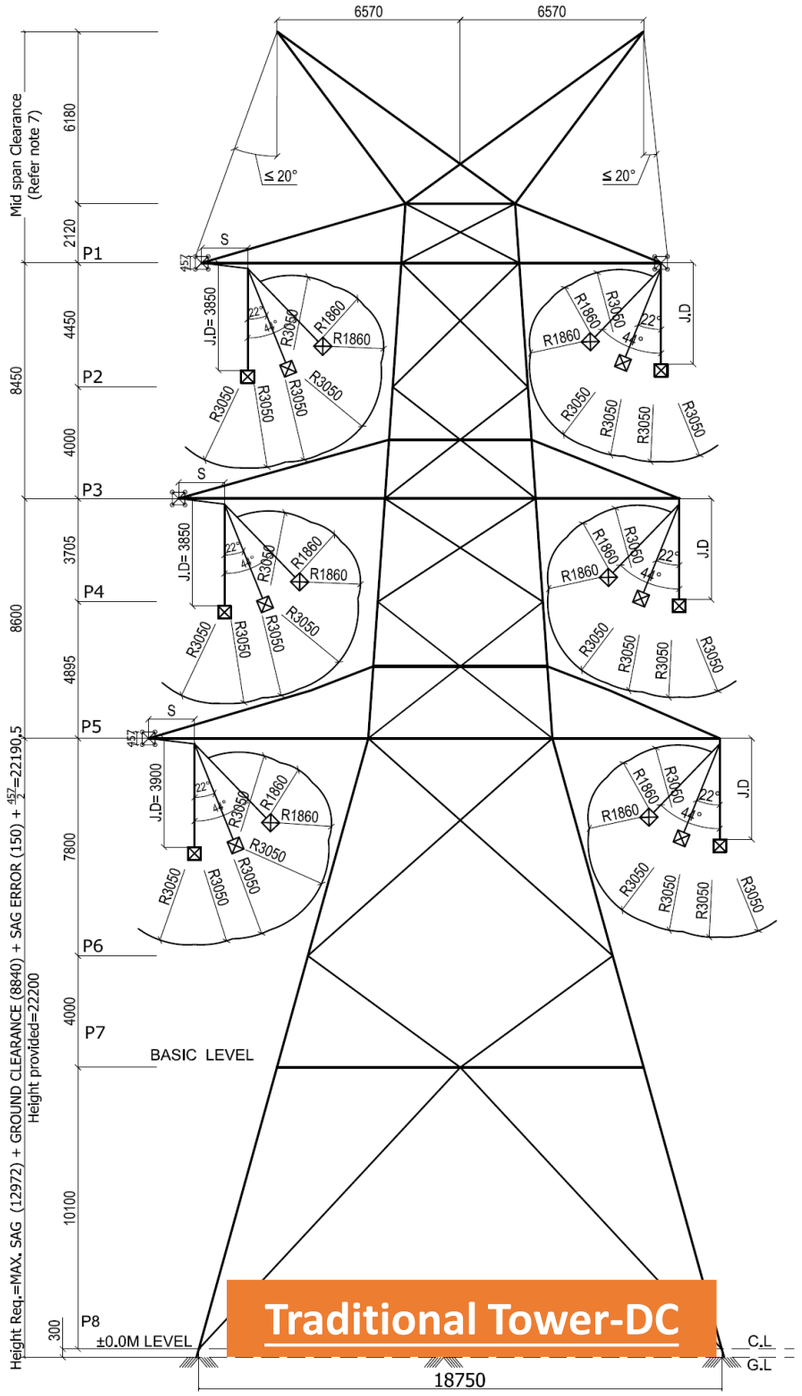
CICA Tower (+0m BE),

- Tower Height – 41m
- Base Width – 15m
- Phase to Phase – 6m
- Phase to Earth – 8.35m
- Weight – 30MT

Trad. Tower (+0m BE),

- Tower Height – 47.53m
- Base Width – 18.75m
- Phase to Phase – 8.6m
- Phase to Earth – 8.3m
- Weight – 35MT





3.4 Compact Design-Tension Tower-DD/DE

Benefits,

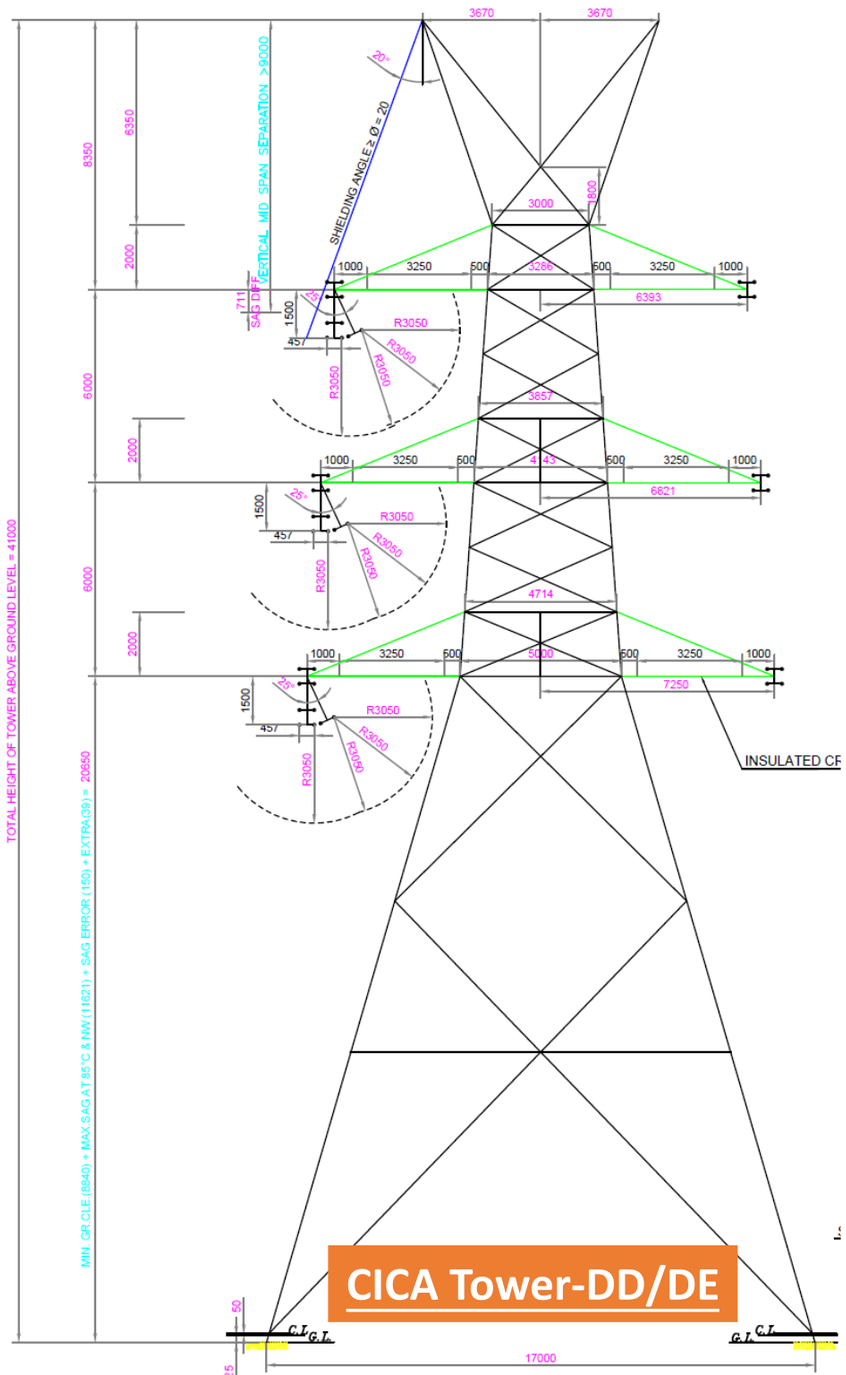
- **Tower Height**
  – 7.25m (15%↓)
- **Base Width**
  – 3.612m (17.52%↓)
- **Phase to Phase**
  – 3m (33%↓)
- **Phase to Earth**
  – 0.05m (0.6% ↑)
- **Weight**
  – 5MT 10%↓)

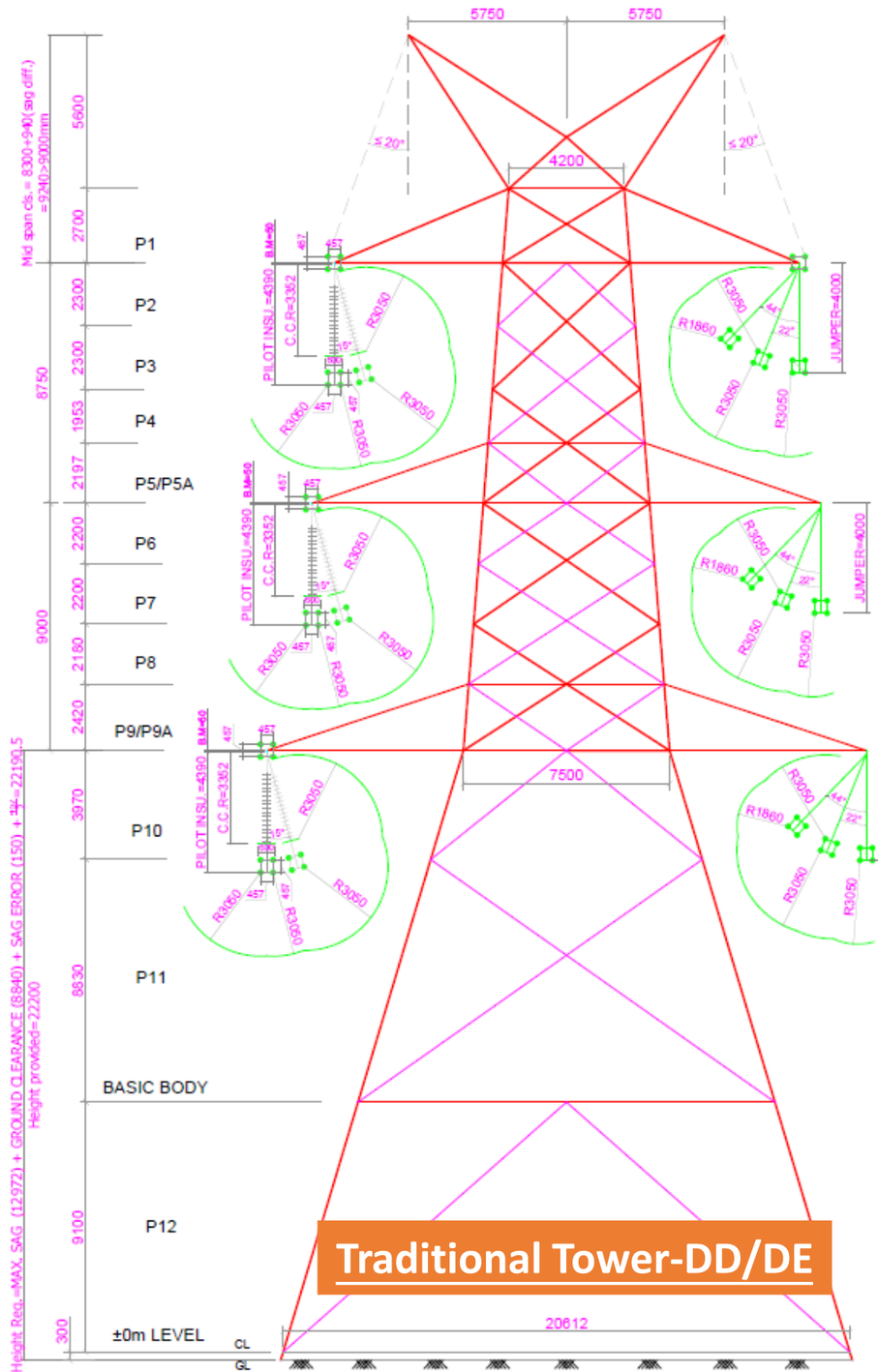
CICA Tower (+0m BE),

- Tower Height – 41m
- Base Width – 17m
- Phase to Phase – 6m
- Phase to Earth – 8.35m
- Weight – 45MT

Trad. Tower (+0m BE),

- Tower Height – 48.25m
- Base Width – 20.612m
- Phase to Phase – 8.3m
- Phase to Earth – 9m
- Weight – 50MT





04

ROW Requirements for CICA Towers/Line

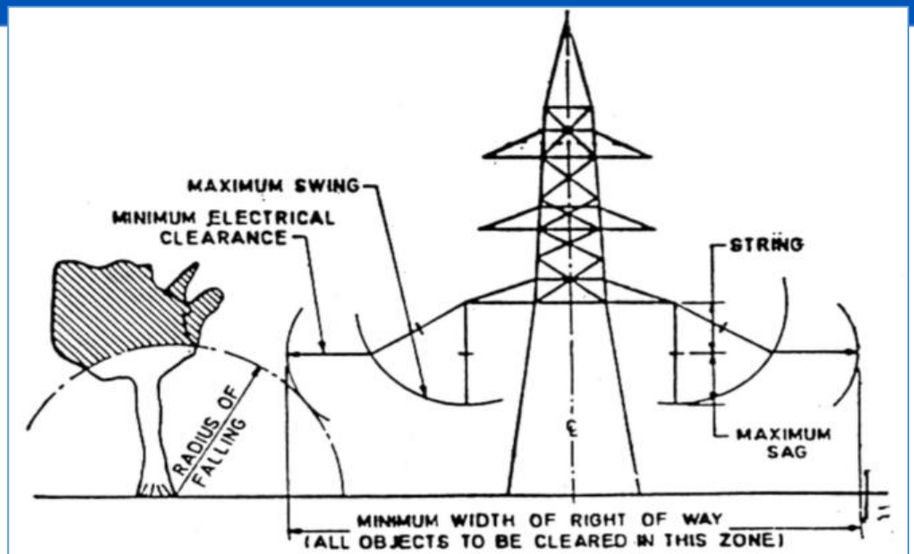
Requirements based on factors and as per IS code
Detailed Calculation & Comparison

SMAREPC

4.1 ROW Requirements as per IS code

1. Requirements of ROW for Transmission Lines as per Indian Standards (IS:5613 (Part-3/Sec-2) : 1989) & CEA/CBIP:

- ✓ Configuration of Tower [S/C (Horizontal / Delta / Vertical) or D/C (Vertical)]
- ✓ Span length
- ✓ Sag of Conductor, which depends on type of conductor used, maximum operating temperature of the conductor and Span length Wind velocity and angle of swing
- ✓ Projection of Cross arm or distance of conductor attachment point from centre line of tower, which depends on wind velocity, swing angle, metal clearance, cage width or tower body width at bottom conductor level
- ✓ Minimum horizontal & Vertical safety clearance as per CEA (Measures relating to safety and Electric supply) Regulations, 2010
- ✓ Configuration of insulators [I / V / Y configuration] and Length of insulator string)
- ✓ Electric field limits below bottom most conductor and at edge of RoW



Note: Portion of tree falling with in clearance zone to be lopped or trimmed

Fig. 1 : Line clearance (Right-of-way) requirement

Voltage Level	Corridor Requirement (m)
66kV AC	18
110kV AC	22
132kV AC	27
220kV/230 kV AC	35
400kV AC Single Circuit (Horizontal configuration)	52
400kV AC Double Circuit / 400kV S/C (Vertical / delta configuration)	46
765kV AC Single Circuit (Horizontal configuration)	85
765kV AC Single Circuit (Delta / Vertical configuration)	64
765kV AC Double Circuit	67
1200kV AC	89
+/- 500kV HVDC	52
+/- 800kV HVDC	69

It is important to define that the required ROW is mainly depends on Tower Configuration & Suspension Insulator Length

4.2 Detailed Calculation of ROW Requirements

2. Detailed Calculation & Comparison of ROW Requirement:

Voltage level (A)	Confi-guration	Conductor type (B)	Ruling Span in M (C)	String Type (I)	Horizontal clearance in M (2.0m+0.3 M for each additional 33 kV) (D)	Insulator Length (Considered for Swing) in M (E)	Max Sag at Max Deg. C in M (F)	Max Swing angle In Deg (G)	Horizontal displacement from Conductor attachment point due to swing. (H)	Horizontal distance of Conductor attachment point from centre of tower in M (X)	Tower width at Bottom Cross-Arm Level (Wd)	Actual Width of Right of Way (ROW) in M (R)
765kV D/C	Vertical	Hexa Zebra	400	'I' String	8.65	7.635	13.35	35	12.04	12.5	5.8	66
				CICA	8.65	1.8	13.35	35	8.69	10	4.8	55
400kV D/C	Vertical	Quad MOOSE	400	'I' String	5.34	4.479	11.621	35	9.23	8.05	4.4	45
				CICA	5.34	1.5	11.621	35	7.53	6.15	3.6	38
220kV D/C	Vertical	ACSR Zebra	350	'I' String	3.70	2.8	10.8	35	7.80	5	2.7	33
				CICA	3.70	0.64	10.8	35	6.56	3.605	1.75	28
132kV D/C	Vertical	ACSR Panther	320	'I' String	2.90	2.6	7.8	35	5.97	3.6	1.75	25
				CICA	2.90	0.5	7.8	35	4.76	2.68	1.5	21
110kV D/C	Vertical	ACSR Wolf	320	'I' String	2.70	1.8	7.11	35	5.11	3	2	22
				CICA	2.70	0.3	7.11	35	4.25	2.27	1.3	18
66kV D/C	Vertical	ACSR Wolf	250	'I' String	2.30	1.2	5.11	35	3.62	2.5	1	17
				CICA	2.30	0.2	5.11	35	3.05	1.615	1	14

Sr.No.	Voltage	Configuration	Span (m)	**ROW for CICA line (m)**	ROW for Traditional line (m)	Difference	
1.	765kV D/C	Vertical	400	**55**	67	-12m	-18%
2.	400kV D/C	Vertical	400	**38**	46	-8m	-17%
3.	220kV D/C	Vertical	350	**28**	35	-7m	-20%
4.	132kV D/C	Vertical	320	**22**	27	-5m	-19%
5.	110V D/C	Vertical	320	**18**	22	-4m	-18%
6.	66kV D/C	Vertical	250	**14**	18	-4m	-22%

Formula used:

$H = (E+F)*\sin(35)$ $\quad R = 2(D+H)+2X$

Hence, CICA based Tower/Line required less ROW than the Traditional/Conventional Scheme. The difference ranging from 17 % to 22%

05

Solution for Existing Lines

Ground Clearance Improvement
Voltage upgradation with existing towers/foundation
A case study on upgradation of existing line

SMARTEPC

5.1 Solution for Existing Transmission Lines

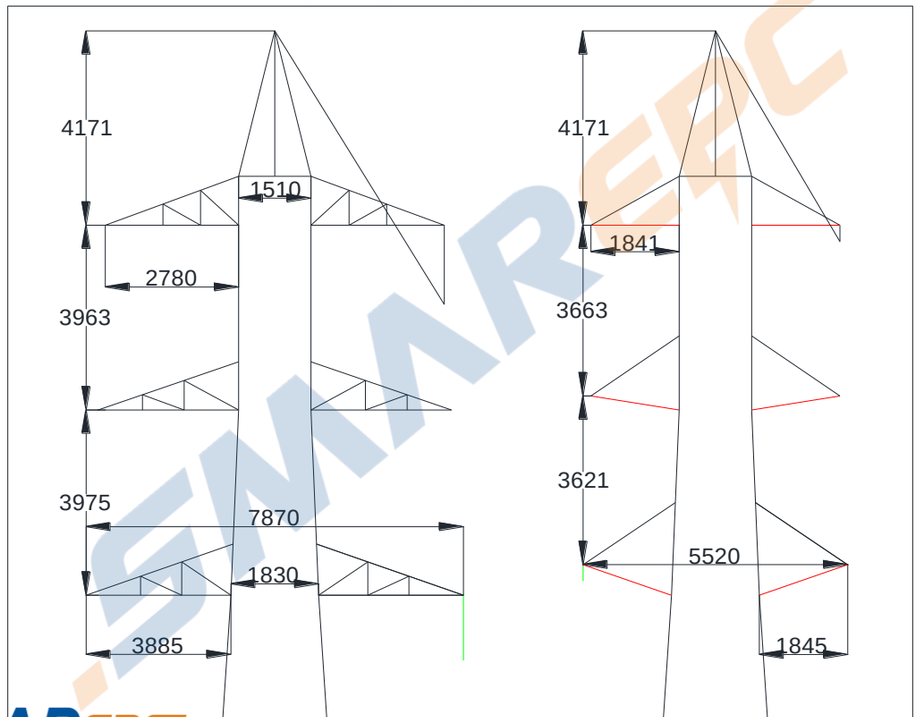
1. Installation in INDIA - Hyderabad Project (2019): Increasing the Ground Clearance

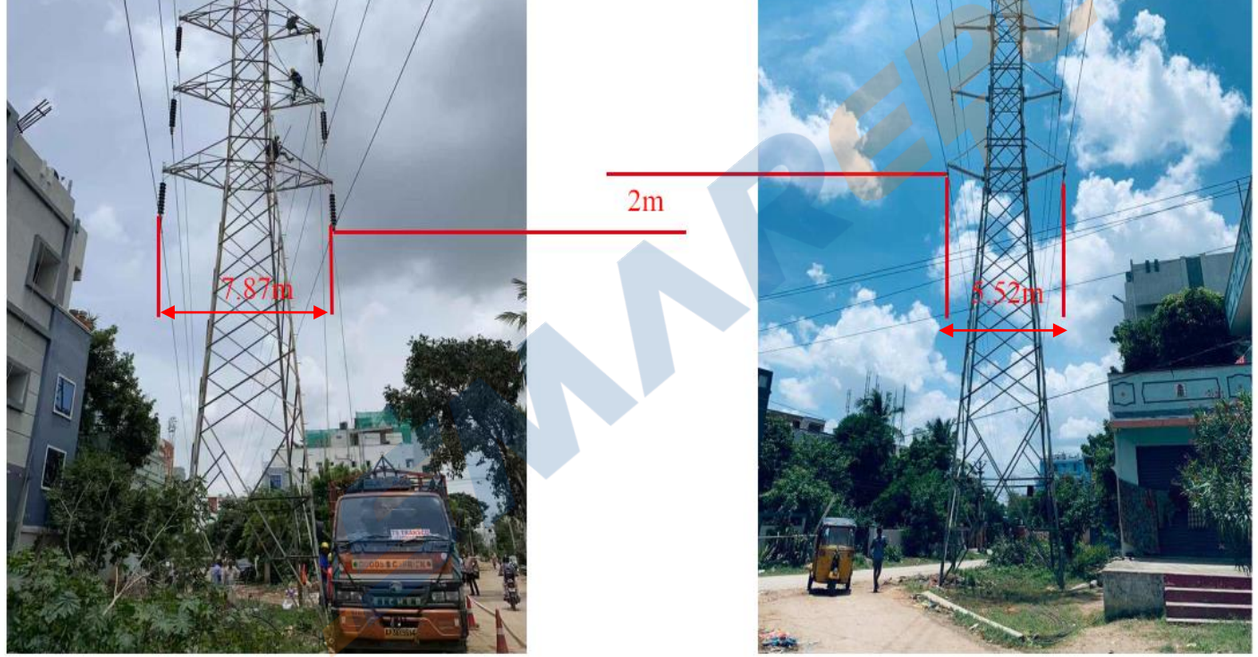
- A typical problem in Indian is urban area (such as dense buildings, insufficient ground distance, and flashover trips, etc.).
- **SHEMAR** have done 132kV D/C line Ground clearance improvement work in TSTRANSCO, Hyderabad in 2019. Achieved additional 2m of Ground Clearance on the same cross-arm level by replacing the existing steel cross-arm to CICA.

Project Name: 132KV D/C Chandrayanagutta Existing Transmission Line (Imlibun – Bandlaguda)

Achievement:

- *ROW decreased by 4.1m*
- *Conductor to Ground Clearance increased by 2m*
- *The lowest point of sag to ground increased by 2.6m*





Before replacing the CICA

After replacing the CICA

5.2 Solution for Existing Transmission Lines

2. Upgrading the voltage capacity of the existing line by replacing existing steel cross-arm to CICA

- Transmission capacity often fails to meet the needs of regional economic development. In order to meet the downstream capacity increased over the longer network the voltage upgradation will provide benefit to state utilities.

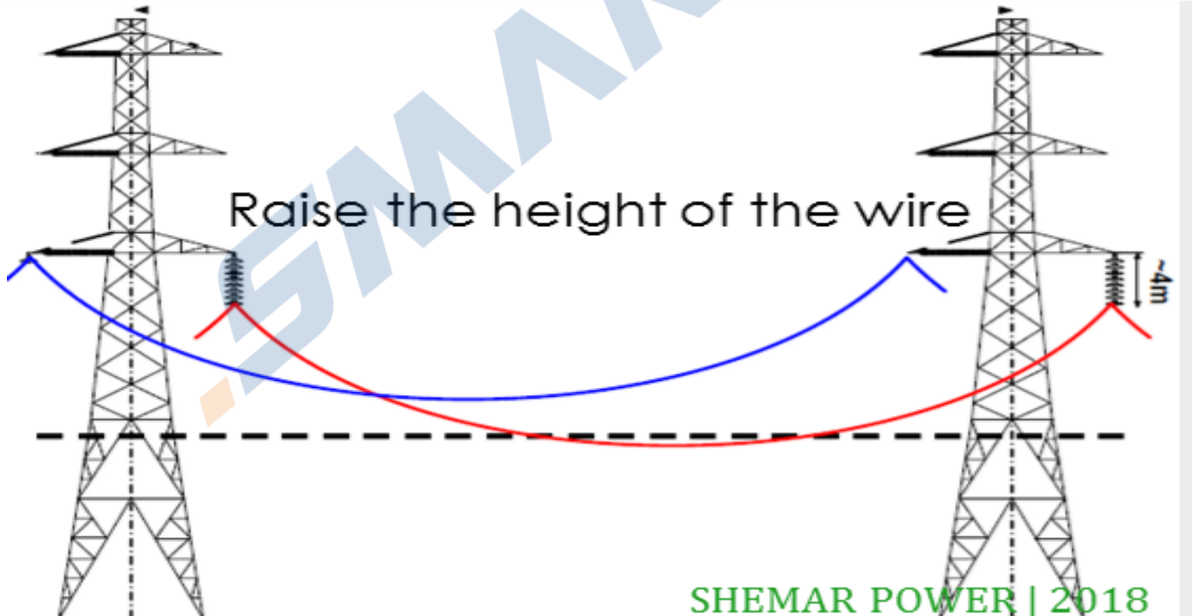
- The commonly problem is long shutdown requirement and ROW issue associated in building the new tower in the same corridor.

- But, our CICA solution can enable the existing towers to upgrade to the next higher voltage using same towers by maintaining required clarences (Ground & Electrical live metal clearances) thereby reducing time of upgradation cost.

- Without changing the cross-arm level, the required voltage can be achieved by using Equivalent or HTLS/AL59 type conductors.

While upgrading the voltage level, it is important to achieve the required clearances. Hence, using CICA by simply replacing the existing steel cross-arm with an equivalent conductor can be easily achieved

Sl.No.	Activities	Traditional System	CICA Method	Remarks
1.	**Review of Existing line for upgrade**	Not Required	Required	Simple Survey Needed
2.	**Selection of Required conductor**	Required	Required	-
3.	**Using existing towers**	Not Required	Required	Saving in overall Project Cost and Time
5.	**Planning time for New line**	High	Very Low	Simply to validate the requirements
6.	**Utilising same corridor to avoid additional RoW issues**	Corridor width & row required to increase	Same corridor width & row only required	Insulated Cross-Arm provides less corridor width
7.	**Construction/Erection Time & Cost**	High	Very Low	Only cross-arm portion required to change
8.	**Foundation Replacement**	New foundation required	No Need	Only some places demand for strengthening



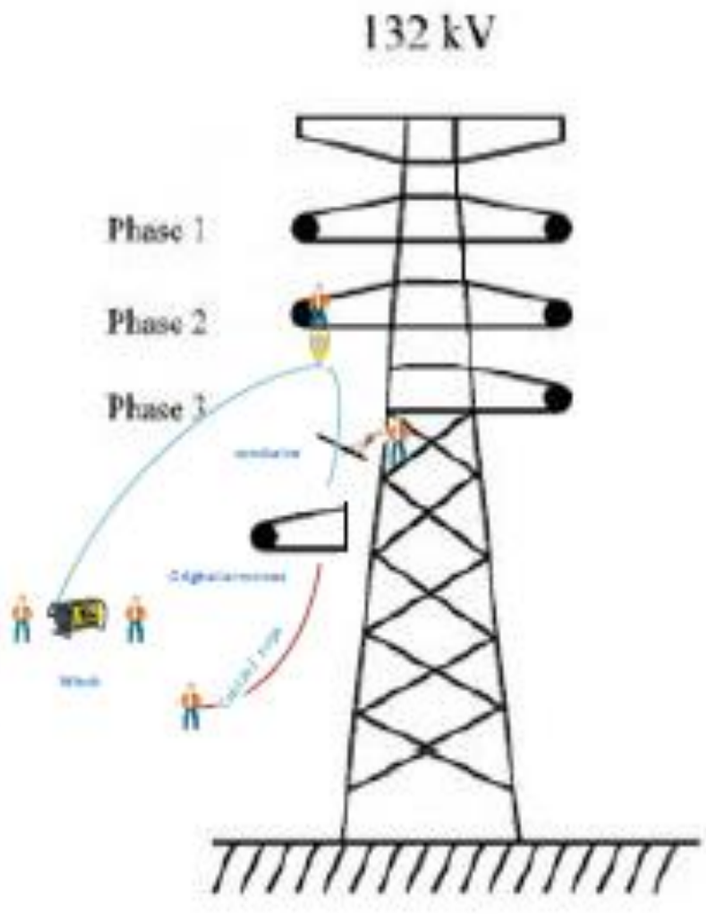
5.3 Solution for Existing Transmission Lines

3. Voltage upgradation with existing towers/foundation and line by using CICA

- SHEMAR's composite insulated cross-arm benefited to install easily on the existing tower without changing tower geometry on cross-arm level to provide a compact and reliable solution.

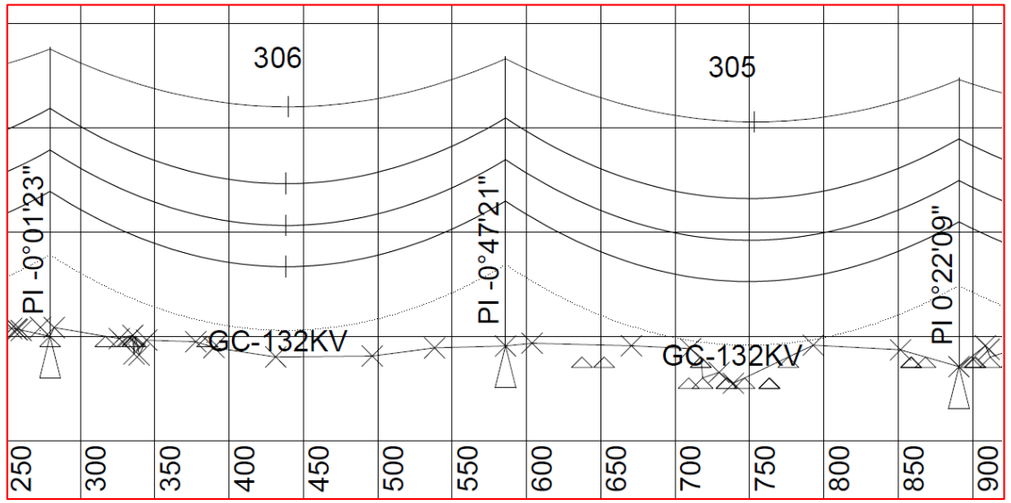
- Also, to maintain the safety of existing tower, foundation, and complete line.

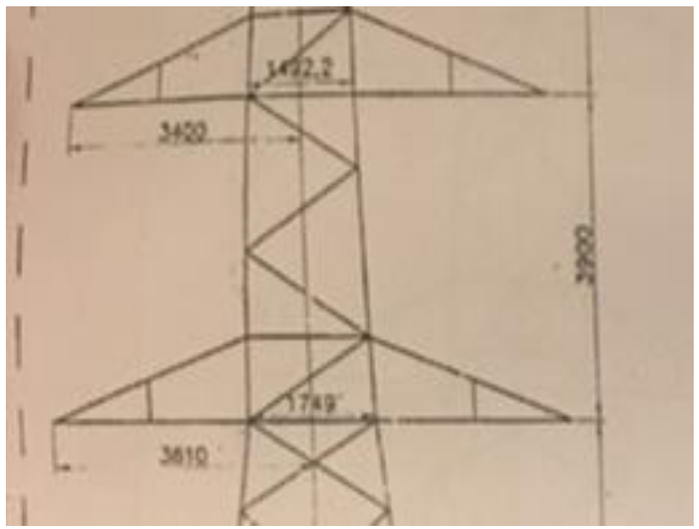
- Easy Installation of Composite Insulated Cross-Arm any EPC can do it.



5.4 Solution for Existing Transmission Lines

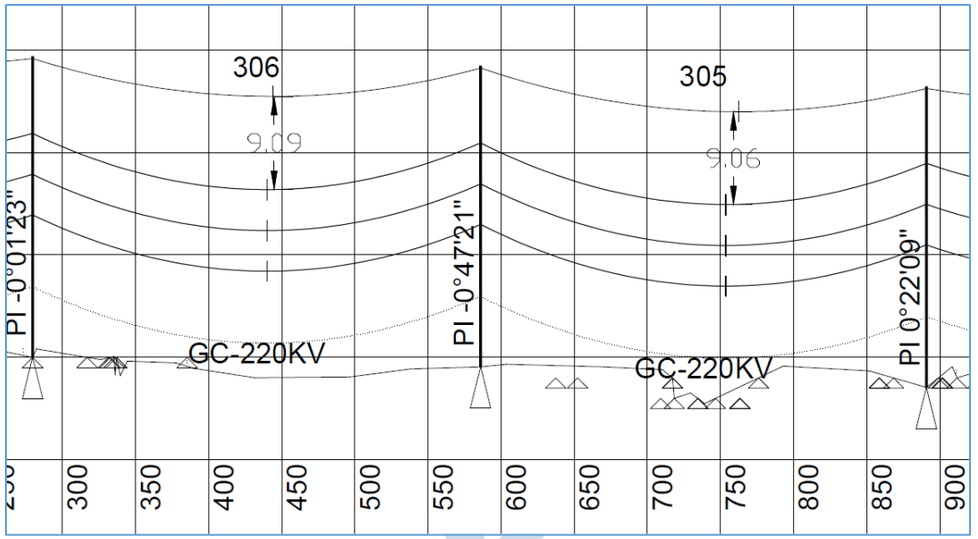
4. A case study on upgradation of existing 132kV D/C to 220kV D/C line

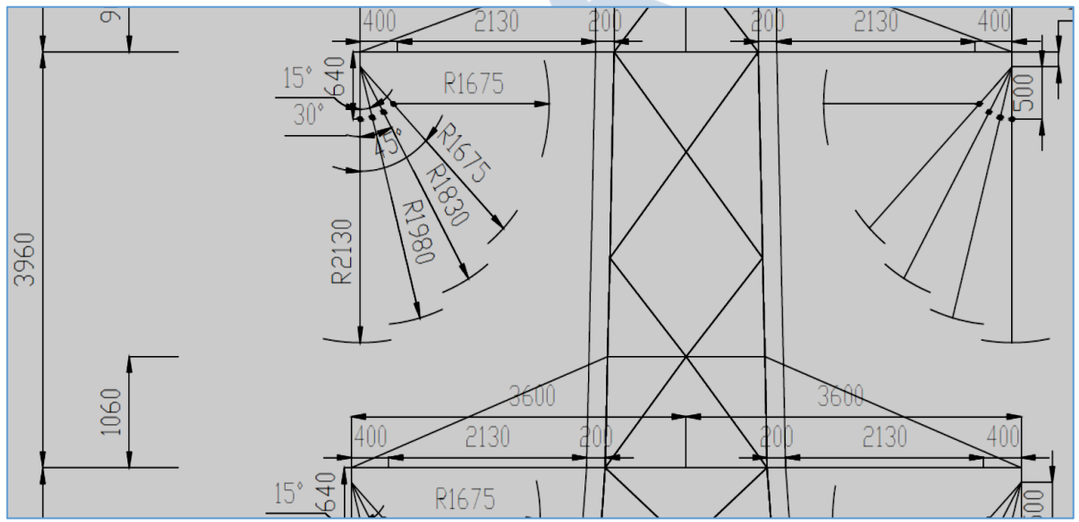




Existing 132kV D/C Towers

- ✓ Required ground clearances after the upgradation of existing line can be achieved with the help of CICA and an equivalent conductors.
- ✓ Required Electrical/Live metal clearances after the upgradation of existing line can be achieved with the help of CICA by using same tower & geometry.





Upgraded to 220kV D/C by using CICA on Existing 132kV D/C Towers

SMAREPC

5.4 Solution for Existing Transmission Lines

5. A case study on upgradation of existing 66kV D/C to 110kV D/C & 132kV D/C to 220kV D/C line

- ✓ As per the case study it is understood that the upgradation of line is possible with CICA and an equal diameter of exiting conductor such as using normal ACSR, AL59 & HTLS type conductors.

Sr. No.	Particulars	Existing 66kV	66kV Upgrade to 110kV		Existing 132kV	132kV Upgrade to 220kV	
1.	Conductor Type	ACSR Dog	ACSR Wolf	ACSR Coyote	ACSR Panther	AL59	ACCC Casablanca
2.	Cross Section (mm2)	118.5	195.032	151.6	261.5	261.5	313.3
3.	Diameter (mm)	14.15	18.14	15.86	21.00	21.00	20.50
4.	Unit Weight (kg/km)	394	714	521	974	720	834.7
5.	Ultimate Tensile Strength (kg)	3299	7303	4638	9704	6661	10316
6.	Design Tension at Everyday Temperature (32°C) with full wind (kg)	2275	3609	2814	4552	4123	3923
7.	Maximum Sag at Max temp. (m)	8.3	7.11	7.75	7.15	7.97	5.95
8.	Ground Clearance (m)	6.1	6.1	6.1	6.1	7.015	7.015
9.	DC Resistance at 20°C (Ω/km)	0.2792	0.1871	0.2214	0.139	0.11	0.1024
10.	Maximum Operating temperature (°C)	75	75	90	75	95	180
11.	**Current in Amp. at maximum temp. (I)**	**291**	**405**	**430**	**482**	**654**	**1167**
12.	**Power Flow Capacity (MVA)**	**66**	**154**	**164**	**220**	**500**	**890**

A case study comparison of existing line upgradation to next higher voltage shows that the power flow capacity can be achieved by using an equivalent conductors

5.5 Solution for Existing Transmission Lines

6. Upgrading the voltage capacity of the existing line by replacing steel cross-arm to CICA or New Line with CICA

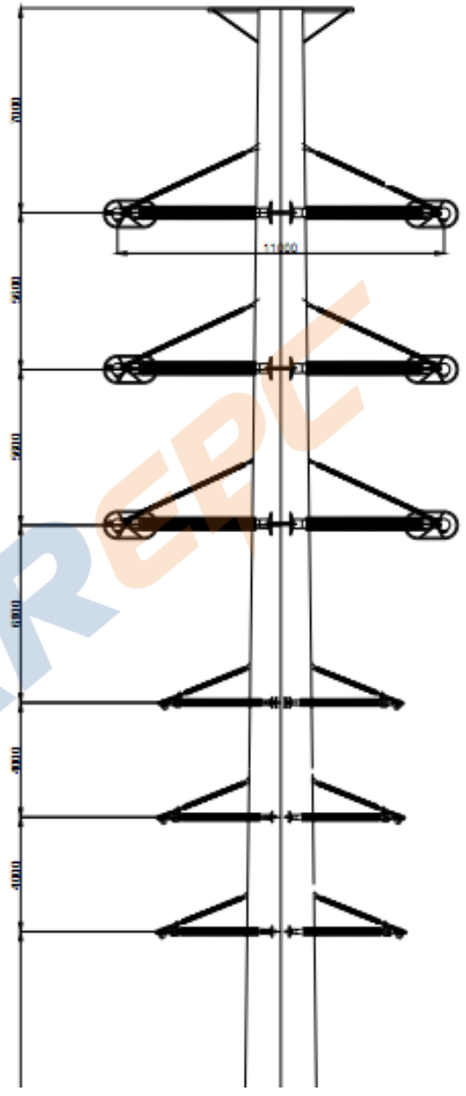
CICA uses in Pole Structures

- If the power capacity demands more and where the uses of same corridor occurs severe ROW problems for the existing line upgradation, normally pole structures are recommended.

- CICA can be provided with the Pole Structures considering the required voltage level by using same corridor is more feasible and benefitable to the utilities and to the project company.

- Uses of less footprint and additional ground clearances are an advantage while using pole structures with CICA.

CICA solution is capable to provide solutions for Pole Structures up to 765kV level



06

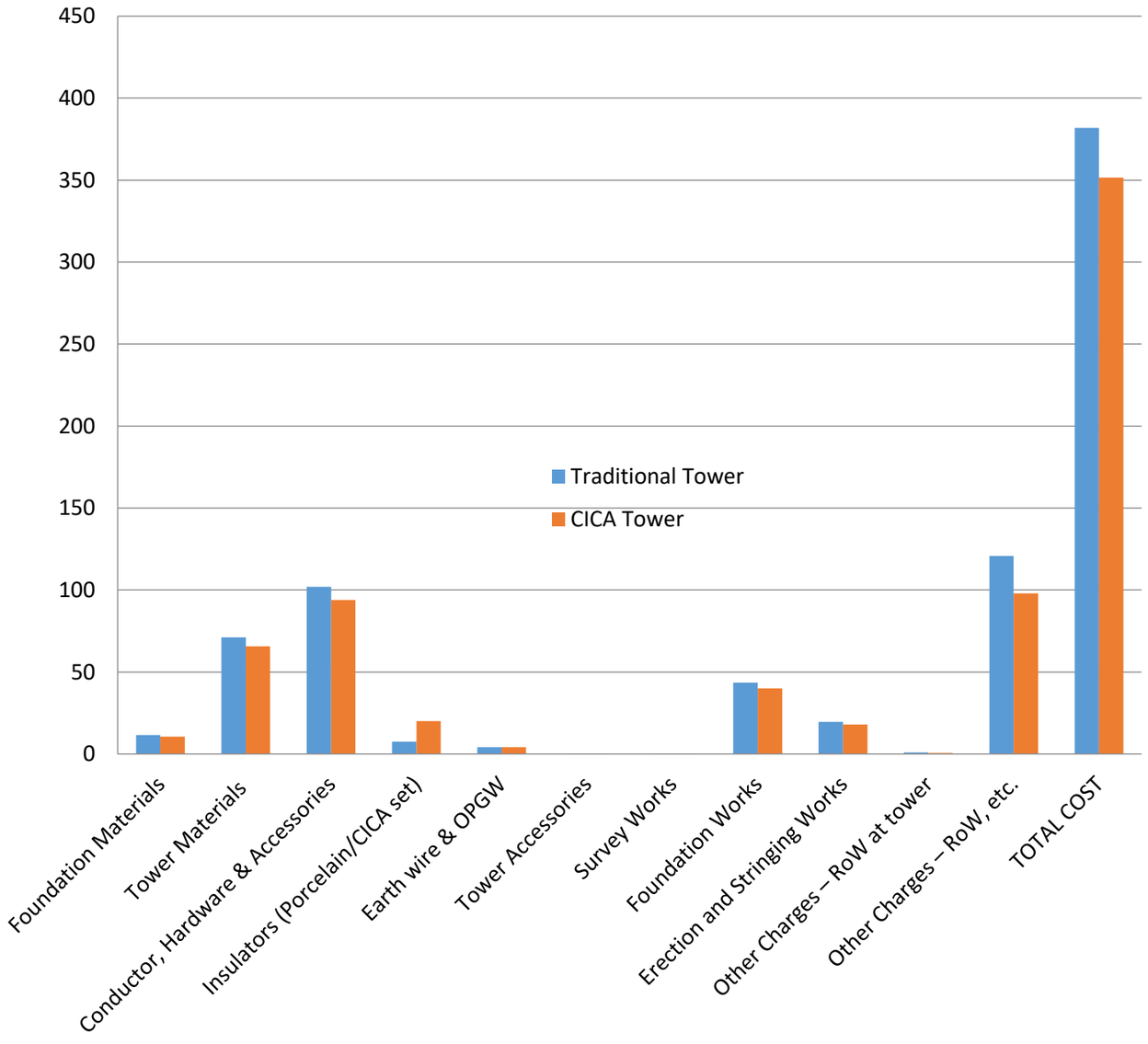
Cost Benefits & Analysis

Comparison of 400kV D/C Quad Moose line in India
Life Cost Comparison of 400kV D/C Quad Moose line

6.1 Cost Comparison

Comparison made based on 120km Quad Moose type conductor in Wind Zone-2 under Reliability-1 & Terrain Category-2

1. Comparison of 400kV D/C Quad Moose line in India



Particulars	Traditional tower (Cr.)	Tower with CICA (Cr.)	Difference (Cr.)	
Foundation Materials	11.52	10.6	-0.92	-8 %
Tower Materials	71.16	65.6	-5.56	-8 %
Conductor, Hardware & Accessories	102	94	-8	-8 %
Insulators (Porcelain/CICA set)	7.54	20	+12.46	+165 %
Earth wire+OPGW and Hardware's for Earth wire & OPGW	4.13	4.13	-	-
Tower Accessories	0.28	0.28	-	-
Survey Works	0.37	0.34	-0.03	-8 %
Foundation Works	43.52	40	-3.52	-8 %
Erection and Stringing Works	19.55	18	-1.55	-8 %
Other Charges – RoW Compensation for tower base land area	1	0.65	-0.35	-35 %
Other Charges – RoW Compensation, Transportation, Statutory and Approval Charges, etc. for corridor	120.84	98	-22.84	-19 %
TOTAL COST	**381.91**	**351.6**	**-30.31**	**-8%**

Traditional Method Cost = 318 lakh per km

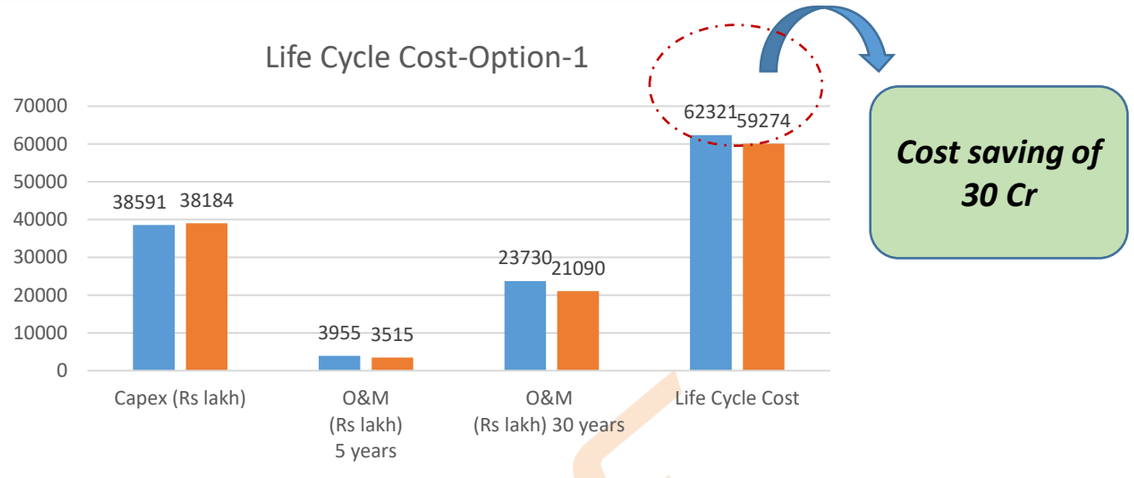
CICA Method Cost = 293 lakh per km

About 8% of minimum overall savings in Input cost considering CICA Technology

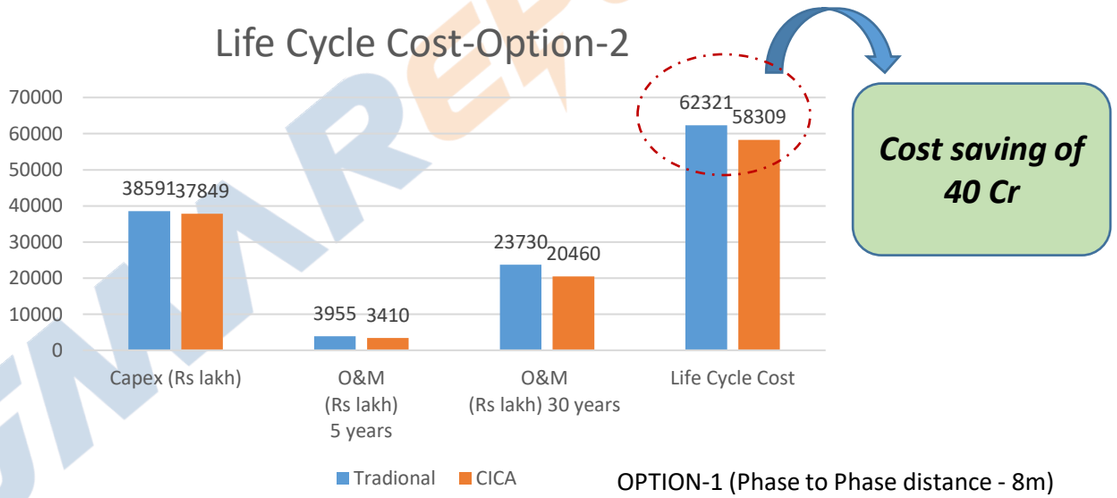
6.2 Better Life Cycle Cost Management

2. Life Cost Comparison of 400kV D/C Quad Moose line

Comparison made based on Quad Moose type conductor in Wind Zone-2 under Reliability-1 & Terrain Category-2 for 120kM line length



Cost saving of 30 Cr



Cost saving of 40 Cr

OPTION-1 (Phase to Phase distance - 8m)

OPTION-2 (Phase to Phase distance - 6m)

- Tradional transmission line required regular O&M including washing of insulator string and periodic replacement of insulator.
- Annual O&M expense is roughly **2.04 %** of Capex expenditure for traditional line
- Over a life time of 30 years, OPEX would be roughly 20% of that of Capital expenditure.
- CICA have 30+ years lifetime warranty.
- Compact and light weight line design would further reduce inspection cost.
- Annual O&M cost will be only **1.8%** of capex cost with CICA based design line
- CICA based design will ensure better life cycle cost of the asset.

07

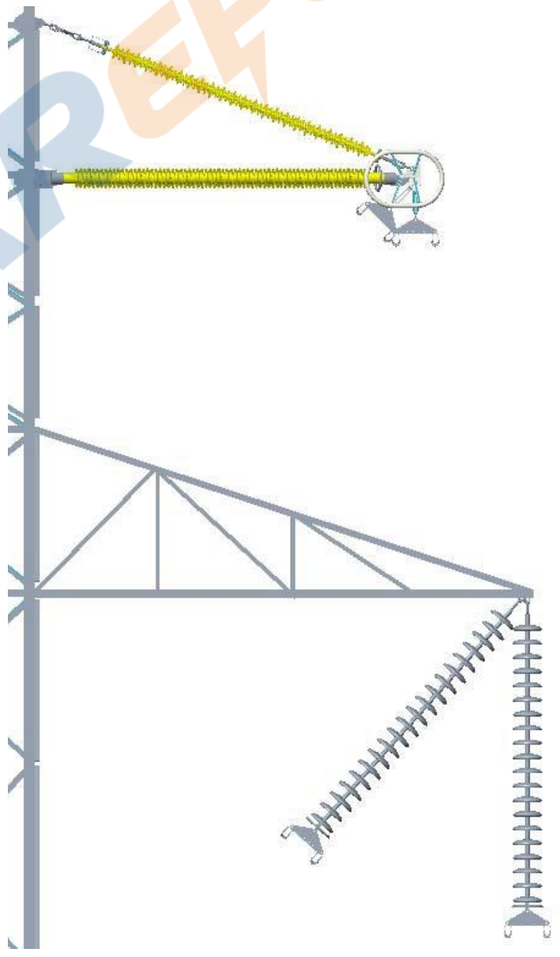
Effect & Advantages of Compact Line

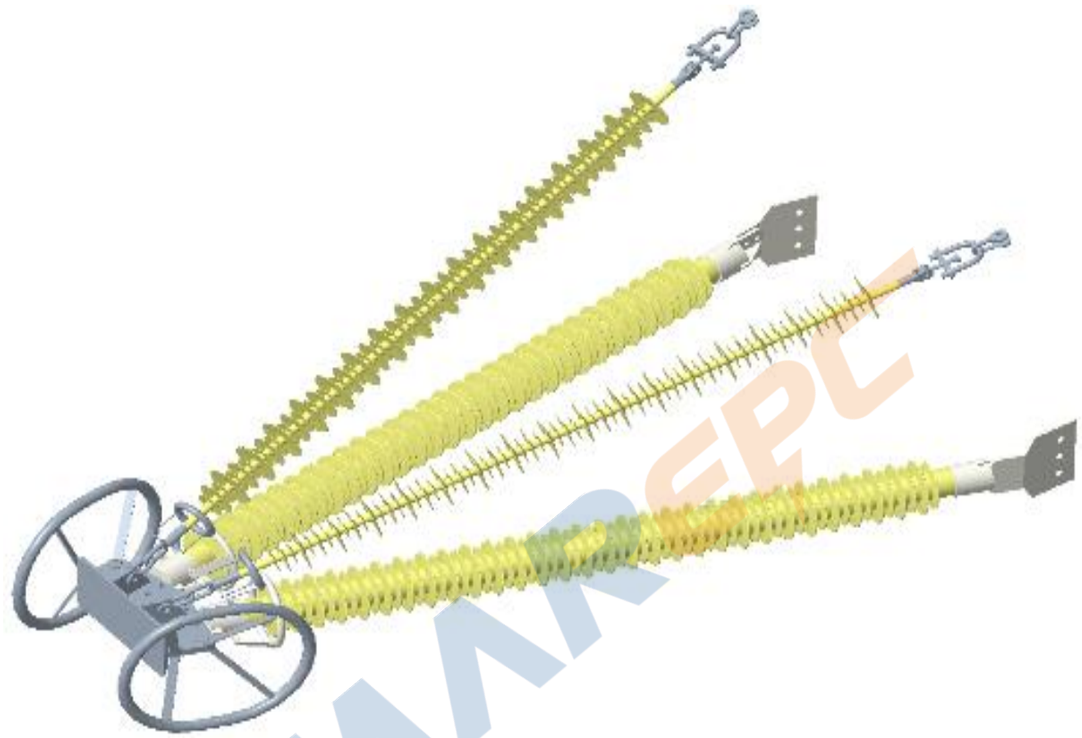
Reduced Swing & Line Compaction
Increase in Power Transfer Capacity/SIL
Higher Reliability and Electrical Performance

7.1 Line Compaction

1. Advantages of Composite Insulated Cross-Arm (CICA)

CICA eliminates the wind induced swings and long overhang lengths of suspension insulator strings, enabling a compact tower geometry with a smaller foot-print that is more aesthetic and easier to integrate into the existing natural landscape.





2. Reduced Swing and Compaction

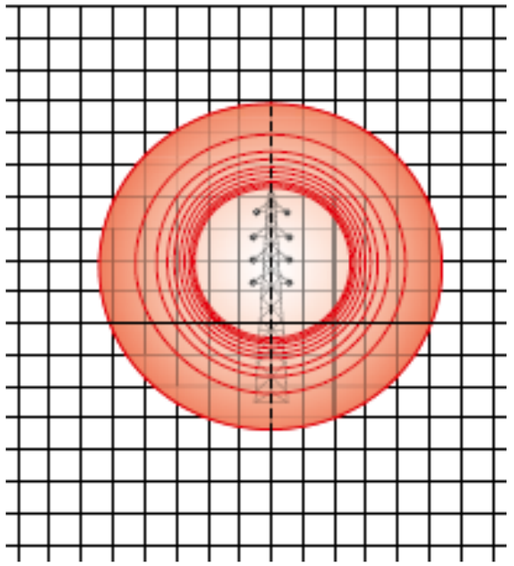
Due to climatic changes, wind swinging accidents caused by strong wind has become more frequent- leading to safety of power system.

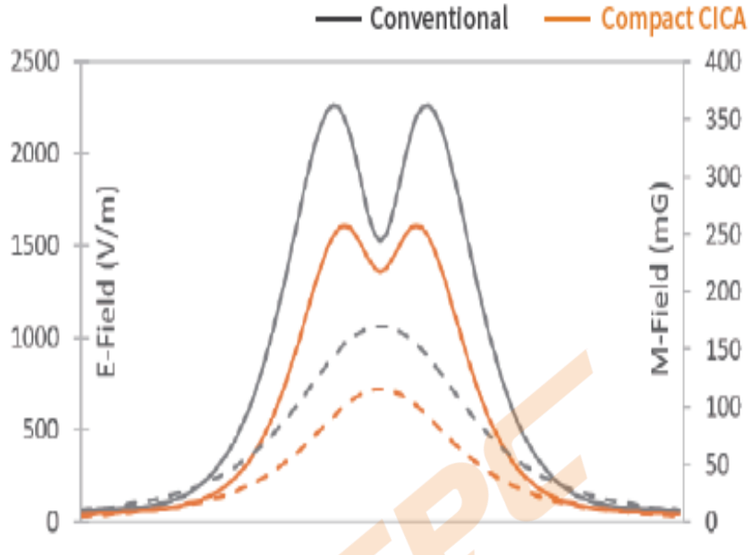
CICA based tower can eliminate the risk of windage yaw flashover due absence of long-standing insulator.

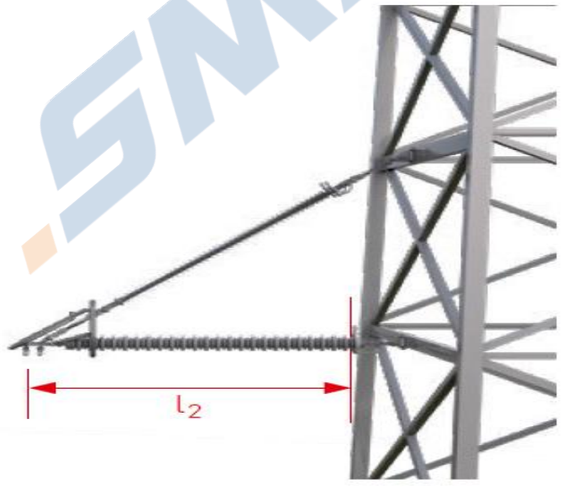
7.2 Benefits of Compaction Line

1. Compact lines have a lower level of radiation

- ✓ Overhead lines are predominantly operated as three phase AC systems, in which the electromagnetic fields of the parallel conductors compensate each other out up to a certain extent.
- ✓ The degree to which they do so is determined by the distance between the conductors:
- ✓ The further apart they are, the weaker the effect, and vice versa.
- ✓ In compact lines, the conductors are substantially closer together causing electromagnetic field exposure around the overhead line becoming considerably lower.







2. Compact lines are more efficient

A crucial factor for the transmission capacity of long overhead lines is the surge impedance. The lower this impedance, the higher the so-called natural transmission capacity. Due to the smaller spacing of the conductors, the surge impedance in compact lines is significantly lower than in comparable standard lines.
As a result, compact lines can achieve transmission capacities that are 15 to 20 % higher.

3. Compact lines are more reliable

Conductors are secured to crossarms with insulators. Conventional overhead lines have often one insulator per conductor, whereas compact lines use two insulators. This has a direct impact on supply reliability: If an insulator should break, a standard line will immediately fail. However, in a compact line, the second insulator holds the conductor in place, thereby maintaining the power supply.
Hence, no more power loss due to the insulator damages.

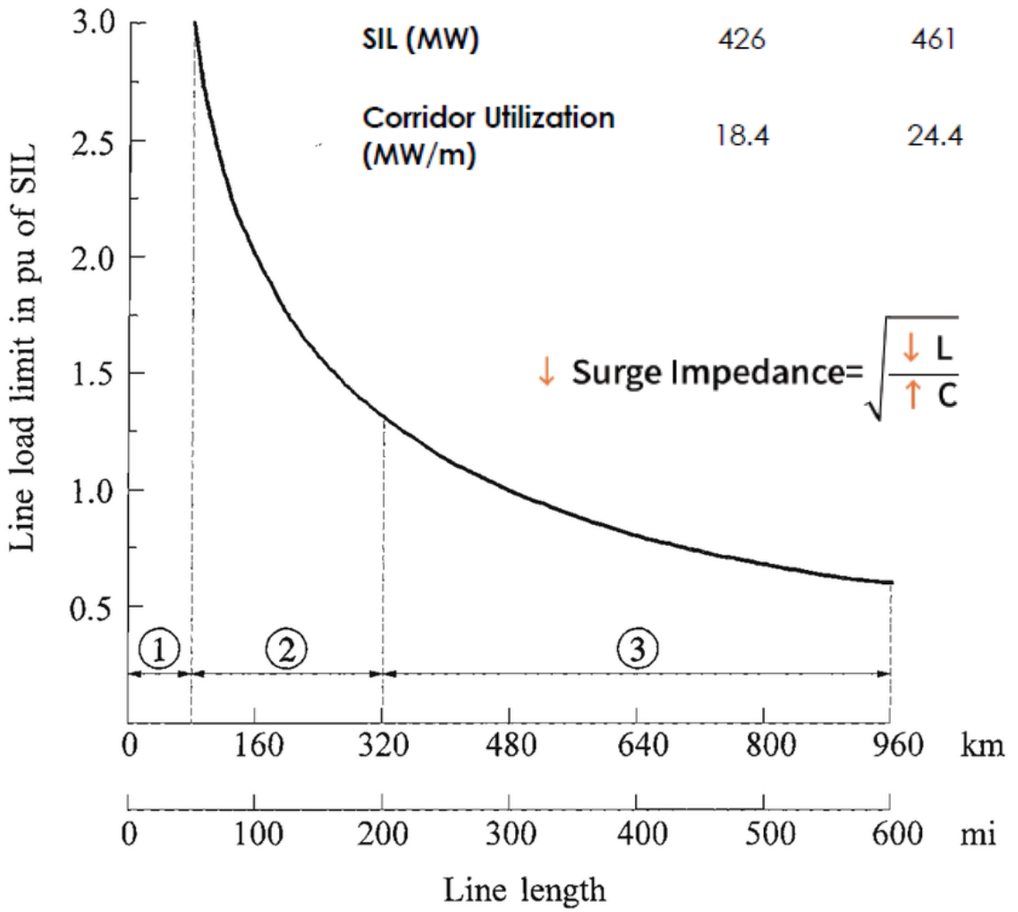
7.3 Increase in Power Transfer Capacity/SIL

1. Higher Reliability and Electrical Performance

- The amount of power that can transmitted on long (> 80 km) TL lines is dictated by surge impedance loading (SIL).
- Compaction increases the circuit's SIL.

Parameters	Traditional	Option-1	Option-2
Positive sequence impedance(Ω/km)	0.01519+j0.249538	0.014582+j0.239557	0.013367+j0.219594
Negative sequence impedance(Ω/km)	0.01519+j0.249538	0.014582+j0.239557	0.013367+j0.219594
Zero sequence impedance(Ω/km)	0.260584+j1.017151	0.255169+j1.039129	0.251628+j1.070833
Positive sequence capacitance(F/km)	1.48E-08	1.58825E-08	1.71209E-08
Negative sequence capacitance (F/km)	1.48E-08	1.58825E-08	1.71209E-08
Zero sequence capacitance(F/km)	8.46E-09	9.10603E-09	8.60038E-09
Surge impedance(Ω)	231.348	216.87	200.714
Surge impedance loading(MW)	**1383.176**	**1475.542**	**1594.306**
Corridor Utilization (MW/m)	**25.149**	**30.740**	**33.215**

	Conventional	Compact
Surge Impedance (Ω)	280	258
SIL (MW)	426	461
Corridor Utilization (MW/m)	18.4	24.4



① 0–80 km: Region of thermal limitation
② 80–320 km: Region of voltage drop limitation
③ 320–960 km: Region of small-signal (steady-state) stability limitation

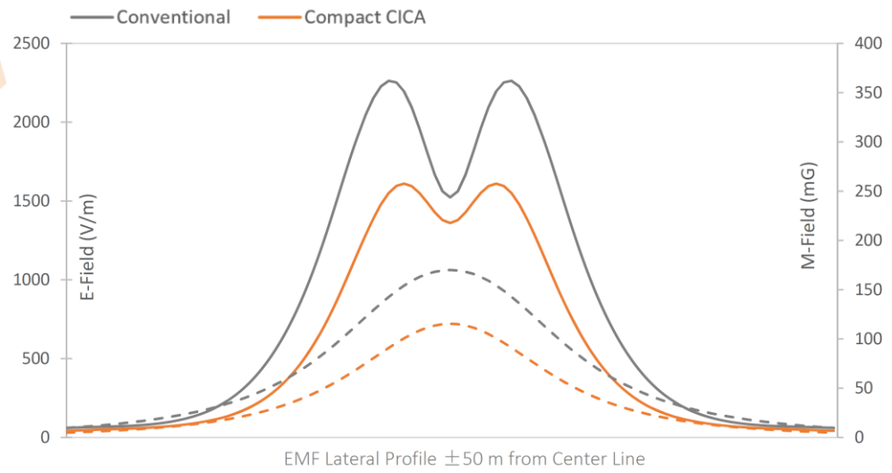
Surge impedance can reduce with CICA Technology. Hence, further Improvement in the SIL with 6m phase to phase distance

7.4 Improved Reliability & Electrical performances

1. Actual electro-magnetic effects verification for UKTL project

Particulars	OPTION:1 - CICA (8m phase distance)	OPTION:2 - CICA (6m phase distance)
Max. Electrical Field	*0.56 kV/m < 5kV/m at the edge of ROW*	*0.44 kV/m < 5kV/m at the edge of ROW*
Max. Radio Inference	*36.25 dB < 50 dB*	*43.07 dB < 50 dB*
Max. Audible Noise	*35.42 dB (A) < 55 dB (A)*	*40.69 dB (A) < 55 dB (A)*

EMF lower for CICA Tower



2. Comparison of electro-magnetic effects with traditional towers/line

- Electric Field (E-field) ↓ Tower with CICA provide less
- Magnetic Field (M-field) ↓ Tower with CICA provide less
- Radio Interference (RI) ↑
- Audible Noise (AN) ↑

5 dB higher
However, within limit

Switching Overvoltage's

- Same performance

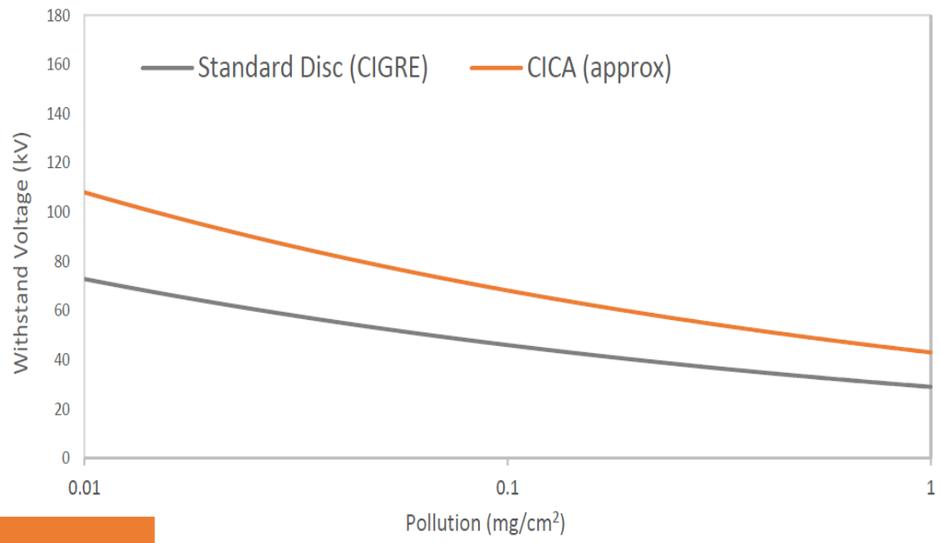
Lightning

- Shielding Failure Flashover ↓ Tower with CICA provide less
- Back Flashover ↓ Tower with CICA provide less

Pollution

- Hydrophobicity and orientation ↓ Tower with CICA provide less

Tower with CICA provides good performance under polluted zone as well



Contamination Withstand Performance

Tower with CICA can provide much better Electrical performances than Traditional towers/line

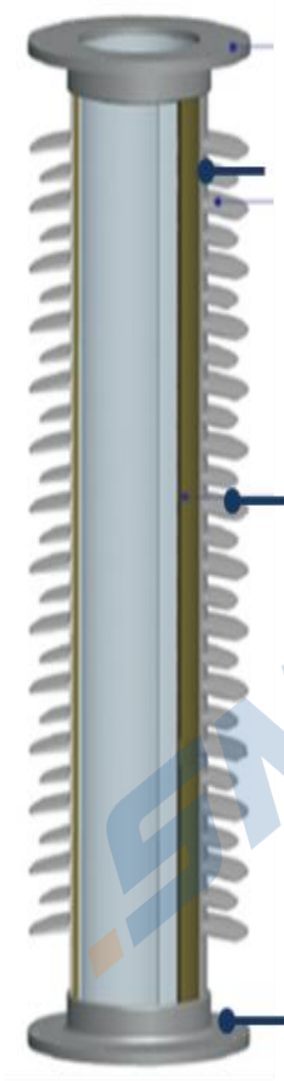
08

Additional Benefits

Lifetime Assurance-30Years
Aging Analysis
Life Cycle & Cost Comparison
Benefits of Zero Maintenance

8.1 Lifetime Quality Assurance: 30 Years

1. Quality Assurance of 30 years - The significance of sheds - Silicone Rubber determines the aging of Insulators



- increase the creepage distance along the surface, improve the resistance of pollution and wet flash
- obstruct the intrusion of external environmental factors and act as an absolute barrier for the internal insulation (withstands the influence of external environmental factors, like force, heat, light, electricity, chemicals, etc. as an external insulation)
- Risk of aging exist in climate and electrical stress
- Silicone rubber is an important factor to cause of insulator failure (According to many practical experience)

Aging type	Aging time	Life prediction
Thermal oxygen aging	5000h	51years
Ultraviolet aging	5000h	＞40 years
Damp heat aging	5000h	Much more than 40 years
Acid aging	1224h	＞45 years

Benefits:

✓ **Shemar HTV SiR Shed with Anti-Radiation, Anti- Aging Property: Providing Life Guarantee >30 year**

Category	LSR	RTV	Shemar HTV
Molecular weight of silicon rubber	(1~10) thousand	(1~10) thousand	(40~80) thousand
Optimize formula	/	/	Anti-radiation, anti-oxidant, anti-aging, etc.
Mechanical properties	Lower hardness (≤60AH)	Normal (elongation at rupture around 200%)	Totally improvement (elongation at rupture 300%~400%)
Reinforced filler	NO	NO	YES (lower particle size, surface treatment)
Mixing process	Mix well	Mix well	Excellent mixing and dispersion
Molding process	Infusion	Spraying、painting	Vacuum infusion

8.1 Lifetime Quality Assurance: 30 Years

2. Recommended technical conditions for silicone rubber shed

No.	Particulars	Index			
		Shemar	DL/T 376	National Grid	IEC/TR 62039
1	Hardness, ShA	65±5	≥50	≥50	-
2	Creak strength, MPa	≥4	≥4	≥4	-
3	Elongation at rupture, %	≥280	≥150	≥200	-
4	Tear strength, kN/m	≥12	≥10	≥10	≥6
5	Volume resistivity, Ω-cm	$\geq 1\times10^{14}$	$\geq 1\times10^{14}$	$\geq 1\times10^{14}$	$\geq 1\times10^{10}$
6	Surface resistivity, Ω	$\geq 1\times10^{12}$	$\geq 1\times10^{12}$	$\geq 1\times10^{12}$	-
7	Resistance to tracking and electrical damage	1A4.5	1A4.5	1A4.5	1A3.5
8	Breakdown field strength (Alternating current), kV/mm	≥20	≥20	≥20	≥20
9	Service life, year	≥30	-	-	-

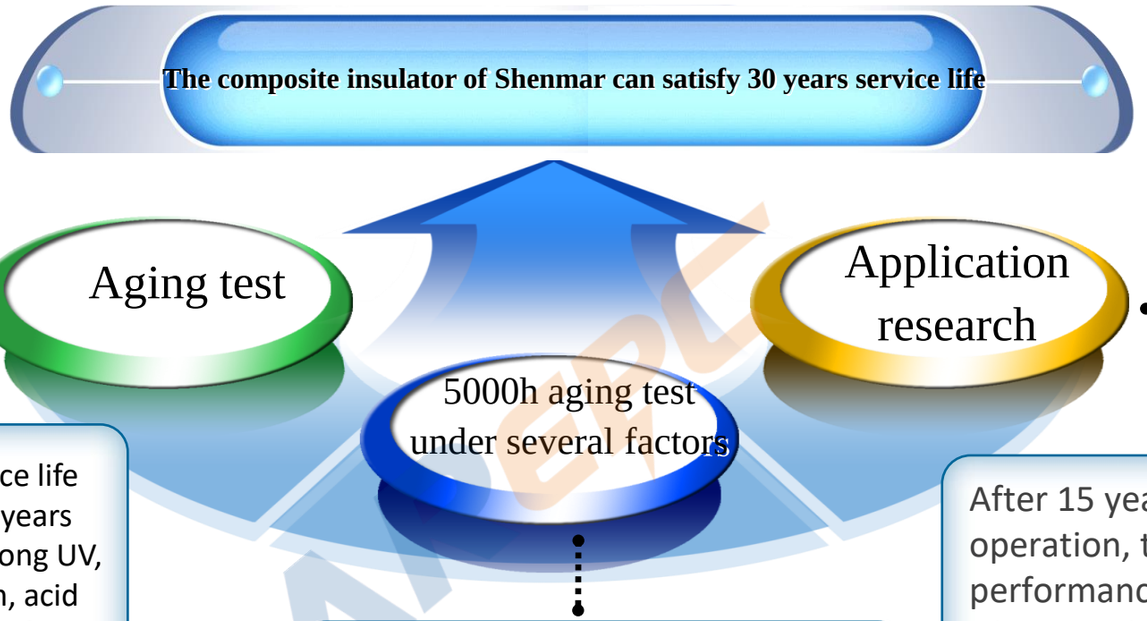
Only Shemar's Composite Insulators can provide 30 years of life

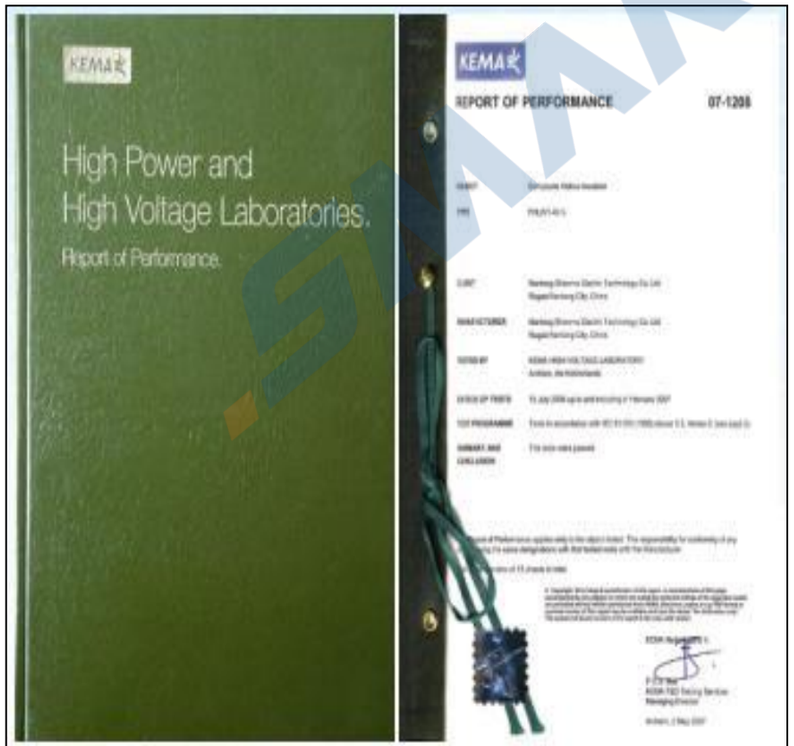
8.1 Lifetime Quality Assurance: 30 Years

3. Quality Assurance Tests

Shemar's composite insulators have passed rigorous and comprehensive external insulation test projects:

- ✓ KEMA test report (5000h multi-factor aging test, IEC 61109).
- ✓ Tsinghua University test report (5000h multi-factor aging test IEC 62217).
- ✓ DARMSTADT test report (1000h AC salt spray test, IEC 60099).
- ✓ Swedish ABB test report (South Africa seashore aging Test).
- ✓ French Alstom test report (limit extreme high and low temperature test).
- ✓ French Alstom test report (long-term thermal aging).





Fachgebiet Hochspannungstechnik
TECHNISCHE UNIVERSITÄT DARMSTADT

TEST REPORT No. 208 E

Weather Aging Test, Series A according to standard IEC 60099-4, Ed. 2.1, Clause 10.8.14.2.1

(1000-h-salt-fog-test)

Device under test:

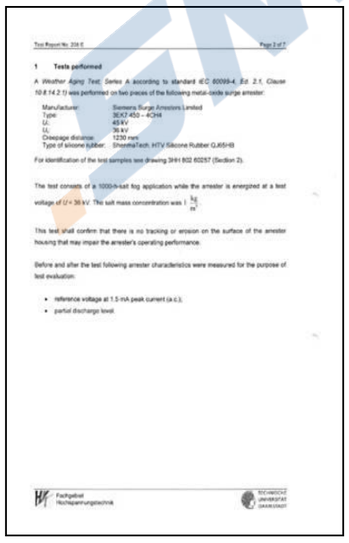
Metal-oxide surge arrester type **3EK7 450-4CH4** manufactured by Siemens Surge Arresters Limited

Test result: The metal-oxide surge arrester 3EK7 450-4CH4 has passed the test without any objections.

Customer: Siemens AG, PTD H51, Berlin/Germany
Test period: March to May, 2007
Test Engineer: Dipl.-Ing. Stefan Schäfer (TU Darmstadt)

Darmstadt, June 13, 2007

Stefan Schäfer — Dipl.-Ing. Stefan Schäfer
Prof. Dr.-Ing. Volker Hinrichsen



1 Tests performed

A Weather Aging Test, Series A according to standard IEC 60099-4, Ed. 2.1, Clause 10.8.14.2.1) was performed on two pieces of the following metal-oxide surge arrester:

Manufacturer: Siemens Surge Arresters Limited
Type: 3EK7 450 – 4CH4
U_r: 45 kV
U_c: 36 kV
Creepage distance: 1230 mm
Type of silicone rubber: Shanghai Tech. HTV Silicone Rubber GJ65HB

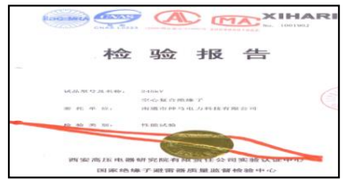
For identification of the test samples see drawing 3HH 802 60257 (Section 2).

The test consists of a 1000-h-salt fog application while the arrester is energized at a test voltage of U_c = 36 kV. The salt mass concentration was i $\frac{kg}{m^3}$.

This test shall confirm that there is no tracking or erosion on the surface of the arrester housing that may impair the arrester's operating performance.

Before and after the test following arrester characteristics were measured for the purpose of test evaluation:

- reference voltage at 1.5 mA peak current (a.c.),
- partial discharge level.

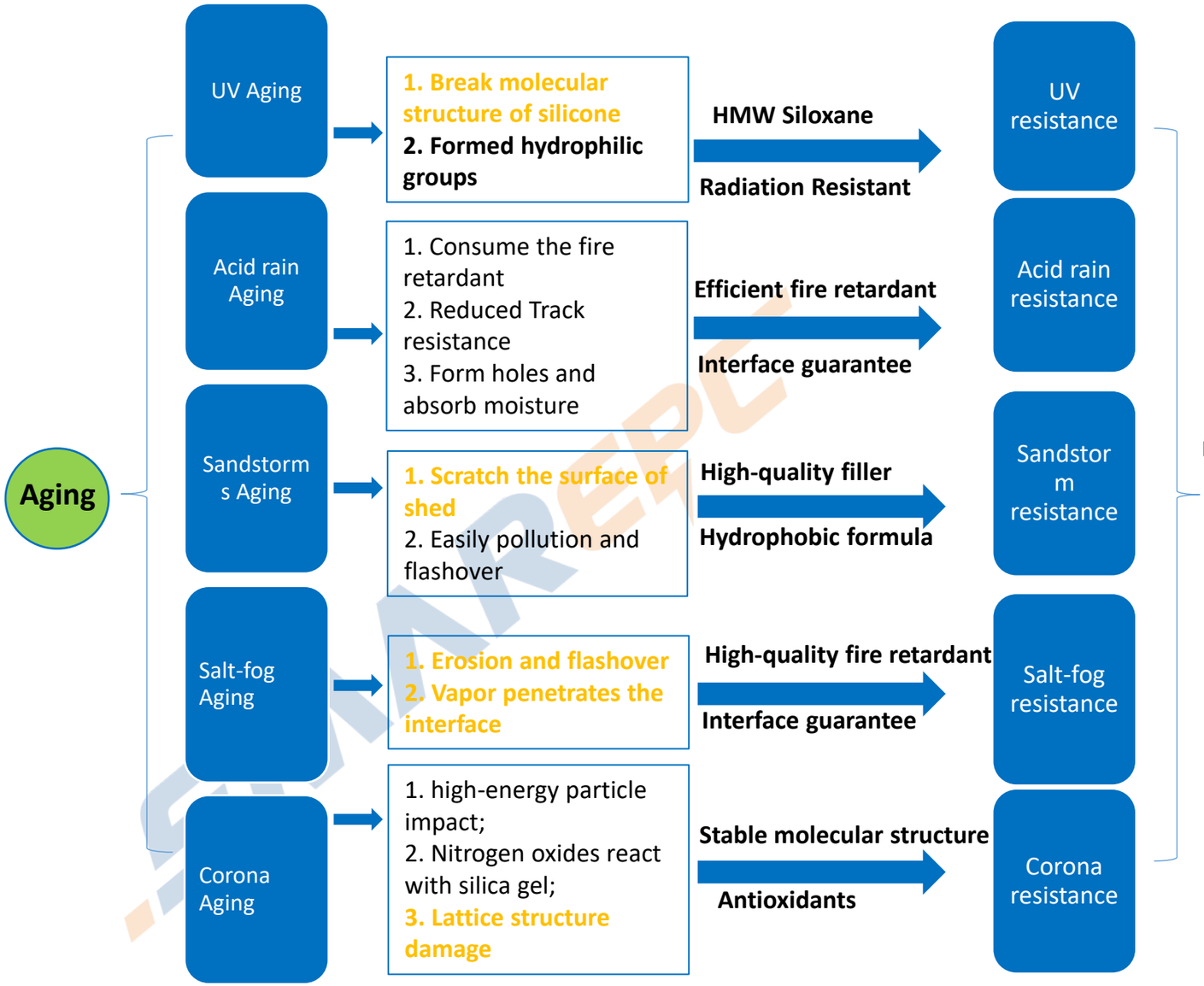


Benefits:

- ✓ **Aging test**
- ✓ **5000h aging test**
- ✓ **Salt spray resistance aging test**
- ✓ **artificial pollution test**
- ✓ **low temperature retraction test**
- ✓ **Aeolian sand test**

8.2 Resistance to Different Agents of Aging

1. Aging mechanism of composite external insulation

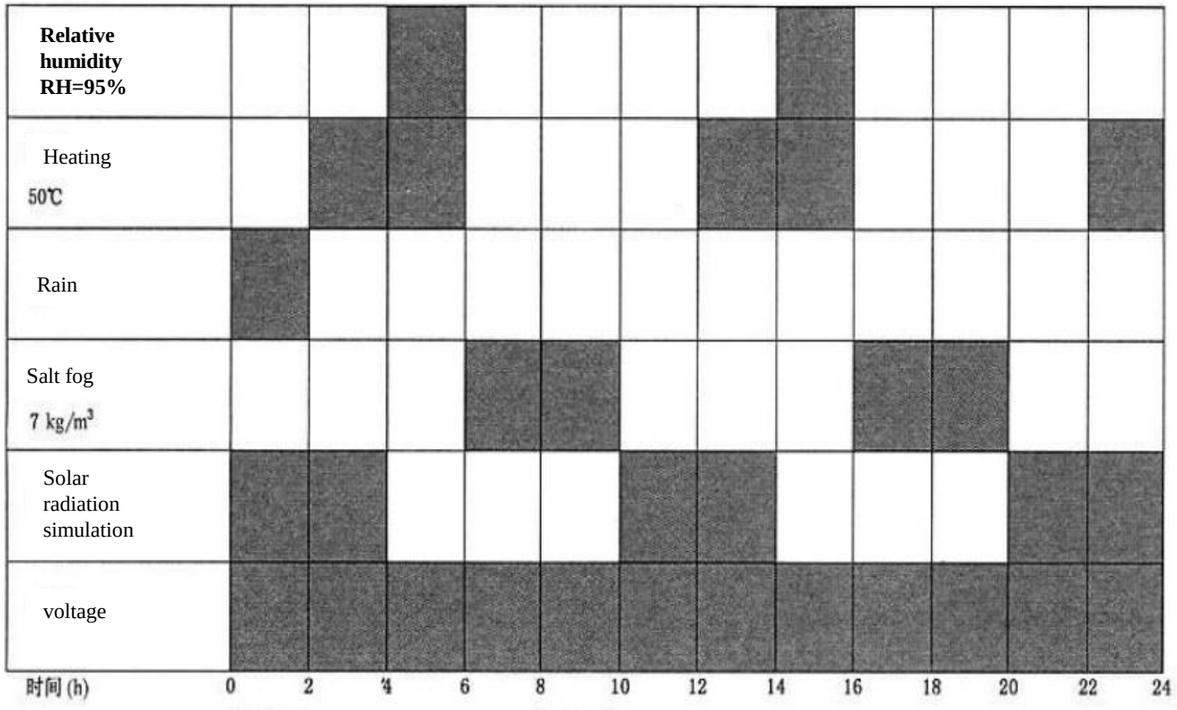


Based on the aging mechanism, there are several basic requirements for long-life composite external insulation

- **Silicone rubber property**
  - HMW siloxane
  - Stable molecular structure
- **Enhanced performance**
  - Reinforced filler
  - Low particle size
- **Flame retardation**
  - flame retardant
- **Special formula**
  - Radiation Resistant
  - Antioxidants
  - Anti-aging, etc.

Shemar composite insulators have passed rigorous and comprehensive external insulation test and have proved that it can satisfy Maintenance free 30+ year life cycle

8.3 Multi-Factor Aging Test



The HTV silicone rubber composite hollow insulator was subjected to a 5000-hour multi-factor aging test. The test included six aging factors: high humidity, high temperature, rainfall, salt spray, solar radiation, and voltage. According to the procedure, each cycle lasted 24 hours, and a test condition was changed every two hours. Reference standard: IEC62217.

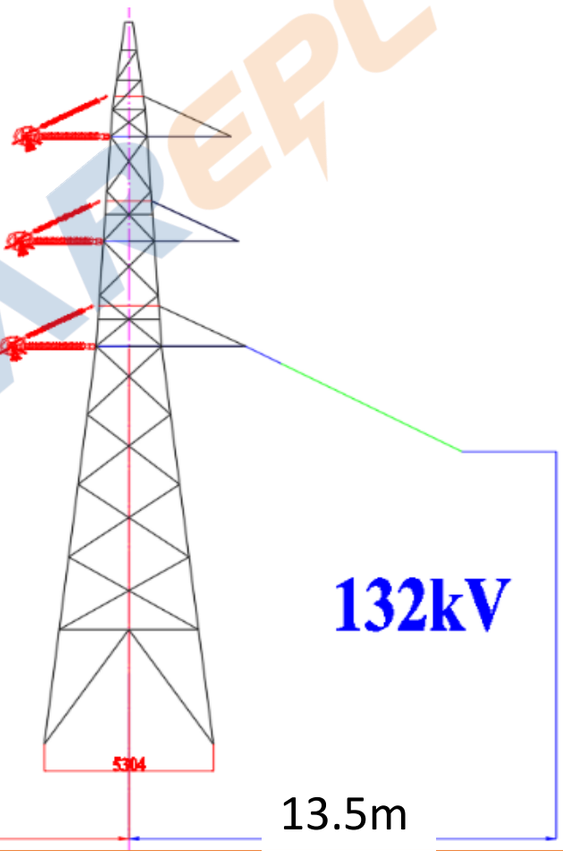
High temperature ℃	High humidity %	Rainfall	Salt spray	UV radiation intensity	Voltage	Time
50	95 % ±3 %	Reference IEC62217	7 kg NaCl/m^3	Almost 90Mw/cm^2	21.4kV	**5000h**

This test successfully carried out a 5000h multi-factor aging test on the test insulator. During the test, the protection device did not break down, flash down or trip, and the insulation material did not deteriorate seriously. According to the Japan Electric Power Research Institute, the service life of composite insulators that passed the 5000h multi-factor aging test is more than 30 years.

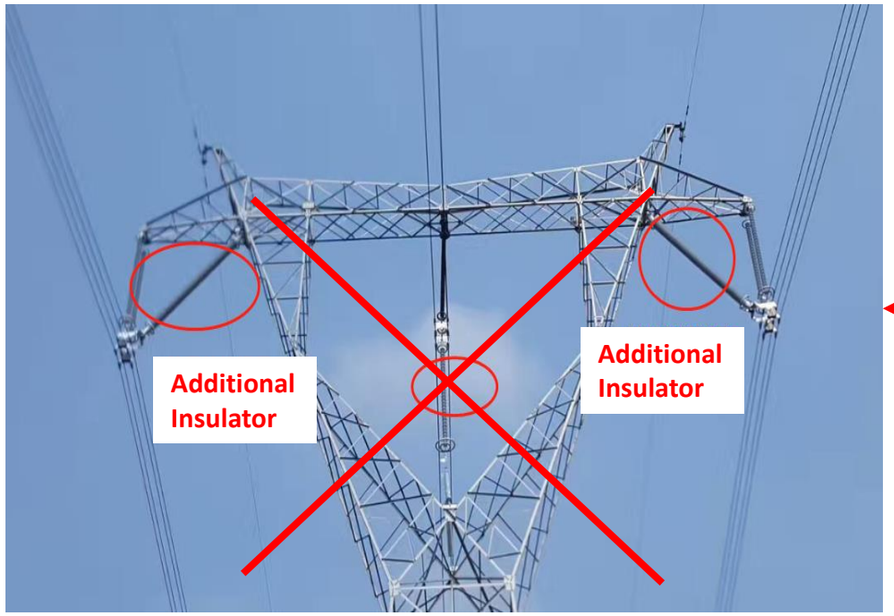
8.4 Additional Benefits of CICA

1. Additional Benefits of using CICA Towers – Reduced ROW & Swing restriction

- Right-of-Way (ROW) Problem
- Land acquisition
- Selection of route
- Construction & Erection time
- Approval from other authorities, etc.,



CICA Towers Required less corridor width and existing corridor is enough for line upgradation



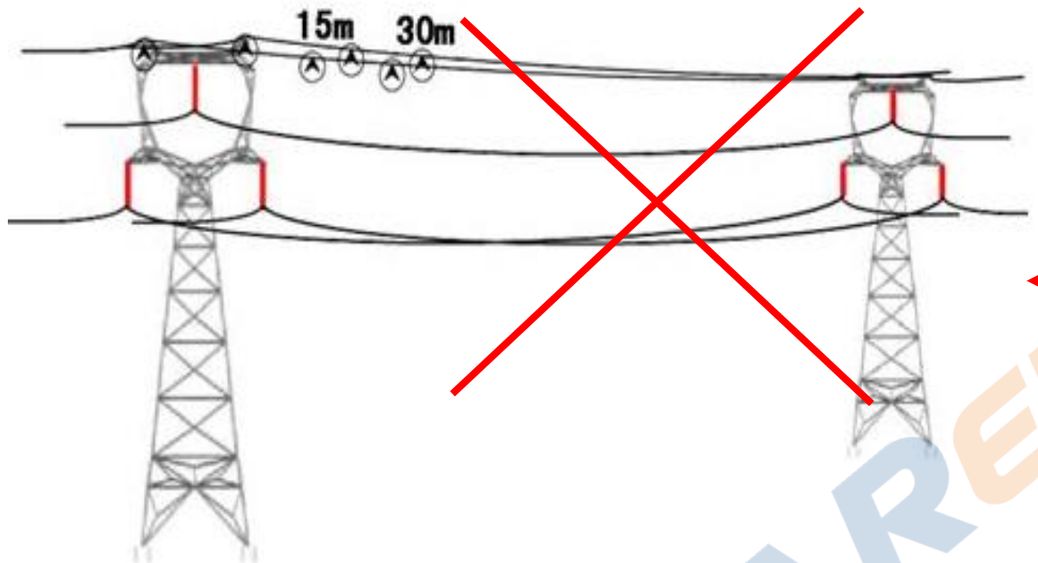
Avoid wind swing of insulators without additional provision

No Need of
-Decontamination
-Adjust Creepage
-Spray RTV
-Add sheds

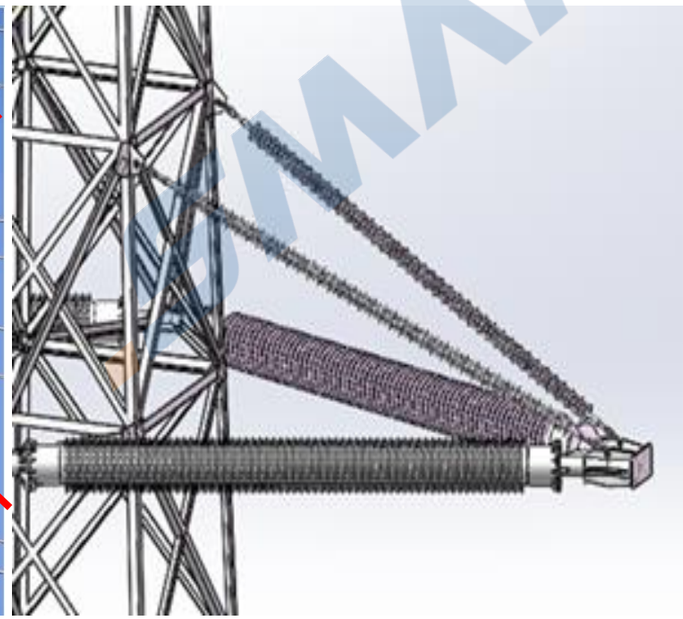
8.5 Additional Benefits of CICA

2. Additional Benefits of using CICA Towers – Resolves Flashover & Prevention from natural formation

Avoid Re-construction of Rain proof and Ice proof Flashover



Avoid Lightning trips and flashover



It is difficult to build nest due to larger insulation distance and it is also better for anti-snake performance

8.6 Benefits of Zero Maintenance (CICA)

Benefits:

- ✓ **Shemar's Composite Insulated Cross-Arm (CICA) shall offered barely need any maintenance due to their advantage of material properties over its lifetime and hence nearly zero maintenance.**

No need of Cleaning, Spraying to remove the dust particulars & Ice formation

Composite Insulated Cross-Arm (CICA) shall have sheds of the "open aerodynamic profile without any under ribs" with good self-cleaning properties.

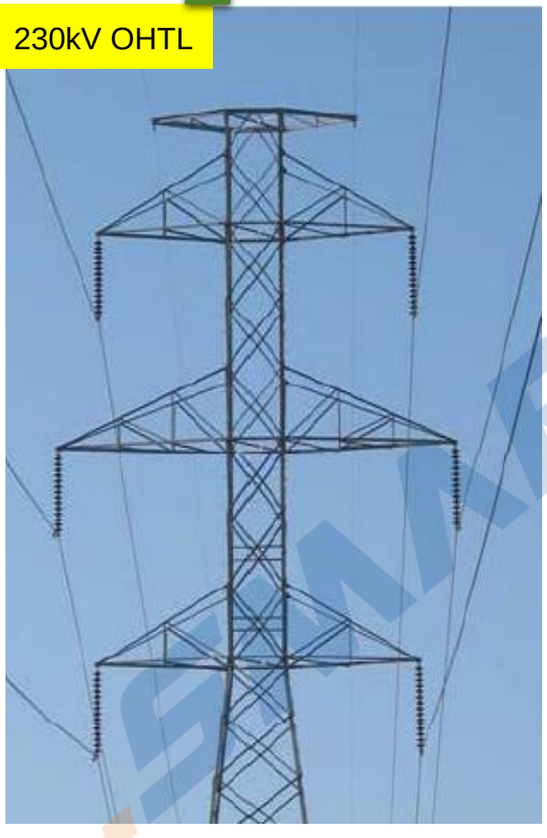
09

Reference Projects

Projects in USA
Projects in China
Projects in Europe
Similar Reference – CPRI 66kV Testing
CICA for Distribution Line

9.1 Reference Projects-USA

230kV OHTL



345kV OHTL

220kV OHTL

380kV OHTL

Existing 230/220kV OHTL upgrading to 345/380kV with CICA in USA Utility (PacifiCorp – Utah)

9.2 Reference Projects-China

Location: China

End-user: State Grid

Project: 750kV UHV Interconnection Project (Channel II) of Northwest Main Power Grid

COD: 2013

CICA used in 765kV transmission line in China

CICA used in UHV AC 1000kV transmission line in China

Location: China

End-user: State Grid

Project: DC ±800kV T/L (Lingzhou-Shaoxing)

COD: 2015

9.3 Reference Projects-Europe

European AC highest voltage:

- 420kV "diamond-type" composite insulators in Pole structures, applied to the British Hinkley nuclear power transmission project (the entire line involves a variety of tower shapes such as straight lines, corners, and tensile strength.

- SHEMAR’s composite insulators in Pole structures, the only supplier that has passed the mechanical and electrical experiments of the British National Grid, becoming the sole supplier of "diamond" composite insulators pole.

Composite insulators in pole structures used in AC 420kV line in Europe

9.4 Similar Reference in India

The 2015 World Congress on
Advances in Structural Engineering and Mechanics (ASEM15)
Incheon, Korea, August 25-29, 2015

Structural Assessment of a 66 kV Overhead Power Transmission line tower built with Polymer Composite Material

*Munusamy Selvaraj[1)]

Central Power Research Institute (CPRI), Bangalore 560080, India

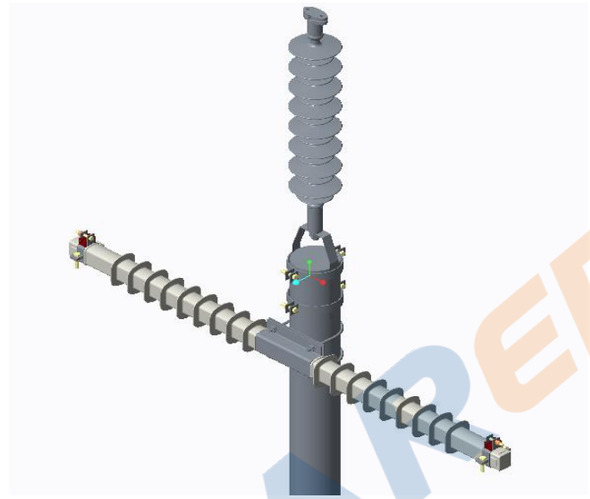
केन्द्रीय विद्युत अनुसंधान संस्थान
(विद्युत मंत्रालय भारत सरकार के अधीन स्वायत्त सोसाइटी)
Central Power Research Institute
(An autonomous society under Ministry of Power, Govt. of India)

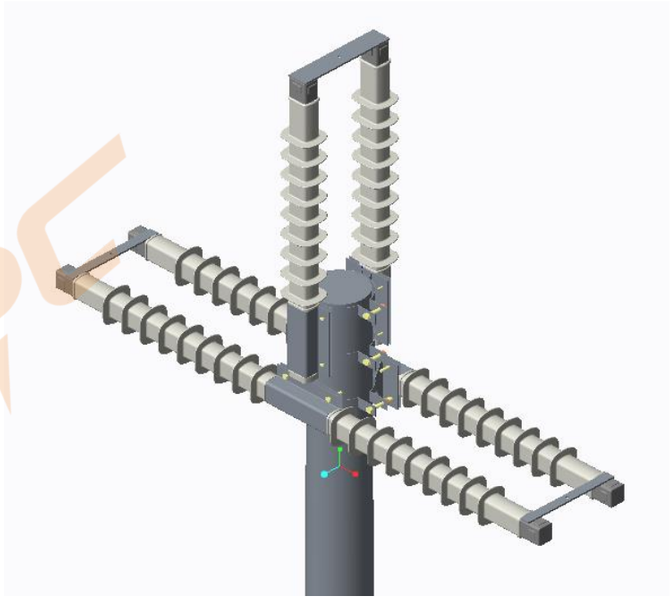
66kV tower with similar type of insulated cross-arm during proto-type test in CPRI, INDIA

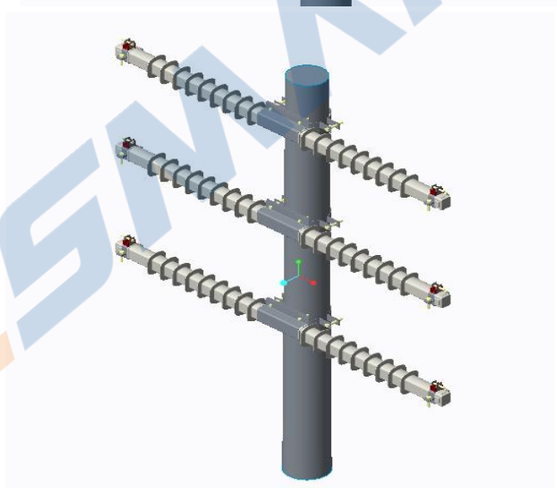
9.5 Same Applications for Distribution Line

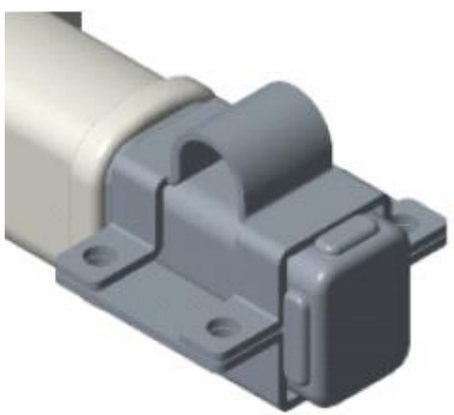
Shemar's Composite Insulators are used for Distribution Line and shall provide the following benefits,

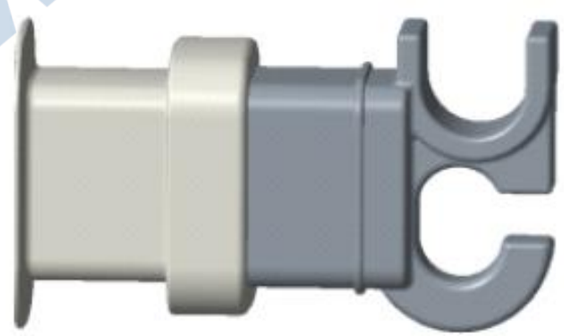
- ✓ **Lightning Protection:** greatly improved (arcing distance greatly increased)
- ✓ **Anti-Flashover**: Greatly improved (creepage distance largely increased, silicone rubber is hydrophobic material)
- ✓ **Maintenance free:** Quality of material and its advantage











Different types of Shemar's CICA for Distribution Line

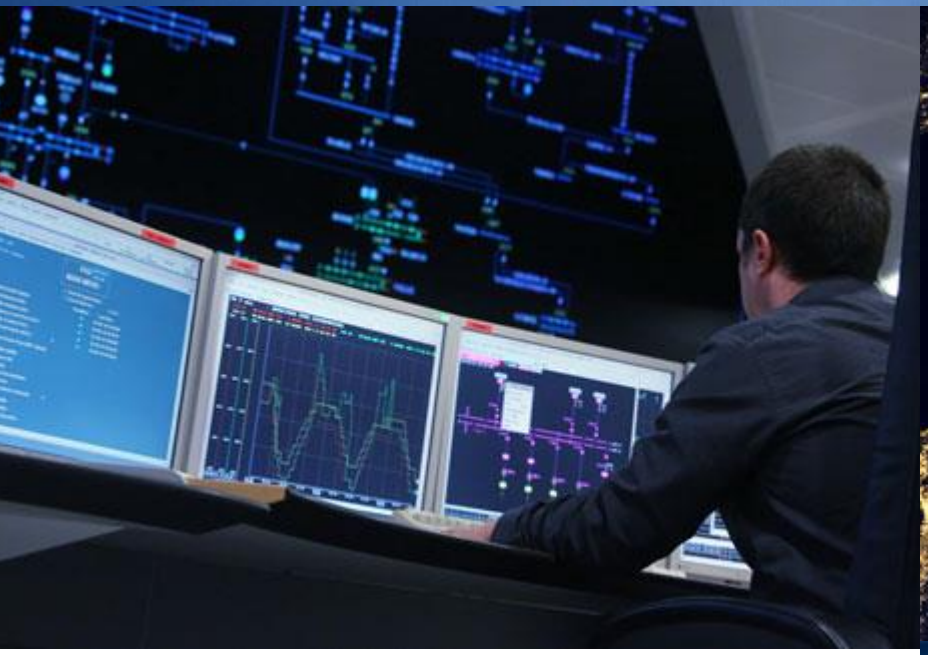
10

Discussion

- Q&A

THANK YOU

Shemar Power Engineering (India) Pvt. Ltd.
Platina Tower, Mehrauli-Gurgaon Road,
Gurugram, Haryana 122002, India.
http://en.smarepc.com/



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Ampacimon s.a.
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www.ampacimon.com

Ramaswamy K V
Head- India Région

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DYNAMIC LINE RATING

- smart solution towards managing a Dynamic Grid

Presentation to

SRPC (TP)

Oct.1st 2020.

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Topics

- Principles of DLR
- Significance of DLR
- Criticality of RT Wind Speed
- Benefits of DLR deployment
- RT Demo of an installation in India
- Relevance to Indian context
- Regulatory Impetus

DLR Principles

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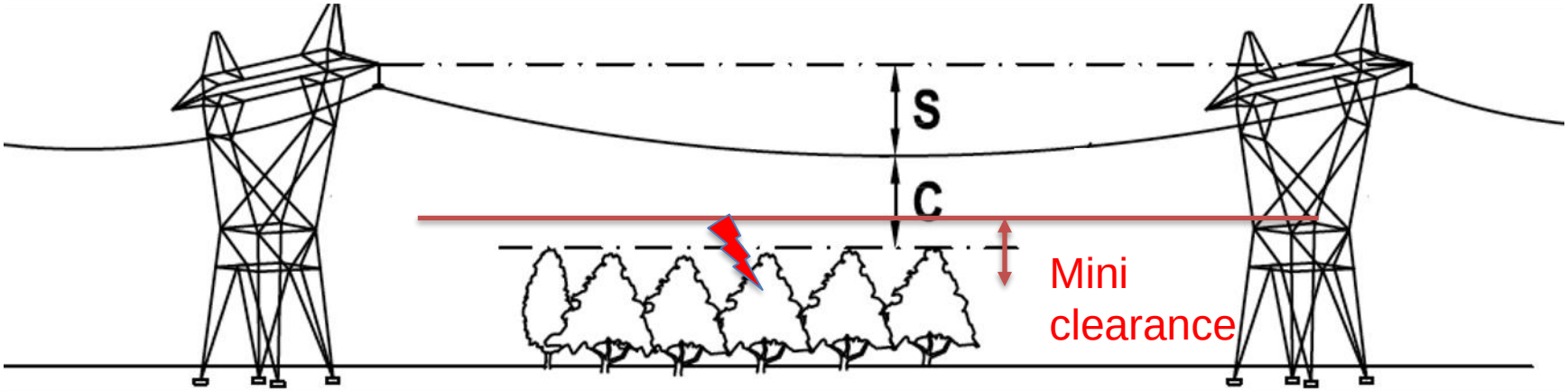

- Sag is the **ultimate consequence** of line load
- **Sag** (Clearance) & Conductor temperature are the limits for operation of an overhead line
- **Designs done on worst case scenario – which aren't there most of the time**
- In the absence of a way to monitor RT conditions, the designed limits or Static rating was the accepted norm till recently.

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DLR Principles

- Sag of OHL - the ultimate consequence determining actual transmission capacity, itself measured in Real Time
- No safety feature is compromised at any time.
- OHL are monitored in Real Time to assess the reserves in Actual Capacity that may still be available
- Its sheer unlocking of the hidden capacity
- Also have Ice detection – as a feature; if required.

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Significance of DLR

- DLR unlocks the hidden reserves in Capacity.
- Reinforces security framework ; due to RT visibility
- Enables relief almost immediately & at a fraction of Cost – compared to conventional solutions
- Helps financially – allowing postponing / deployment of Capex – only where necessary.
- Concept of DLR shouldn't be misunderstood.
- DLR is not a substitute to extensions – but will be a great facilitator

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Significance of DLR- contd.

- Facilitates enhanced Renewable Energy integration in the Grid (reducing curtailment, accelerating connection)
- **Accurate prediction of capacity** in Transient, Short term (30 mts.- 6 Hrs) & Day ahead / D2 forecasts.
- Scaling up of Energy Security – due to RT Monitoring
- RT Market for Electricity – Will be a great Enabler
- Reduced Cost of Transmission – benefits everyone !

- **Contributes towards Clean Energy & Sustainability**

Line capacity is designed for the worst case

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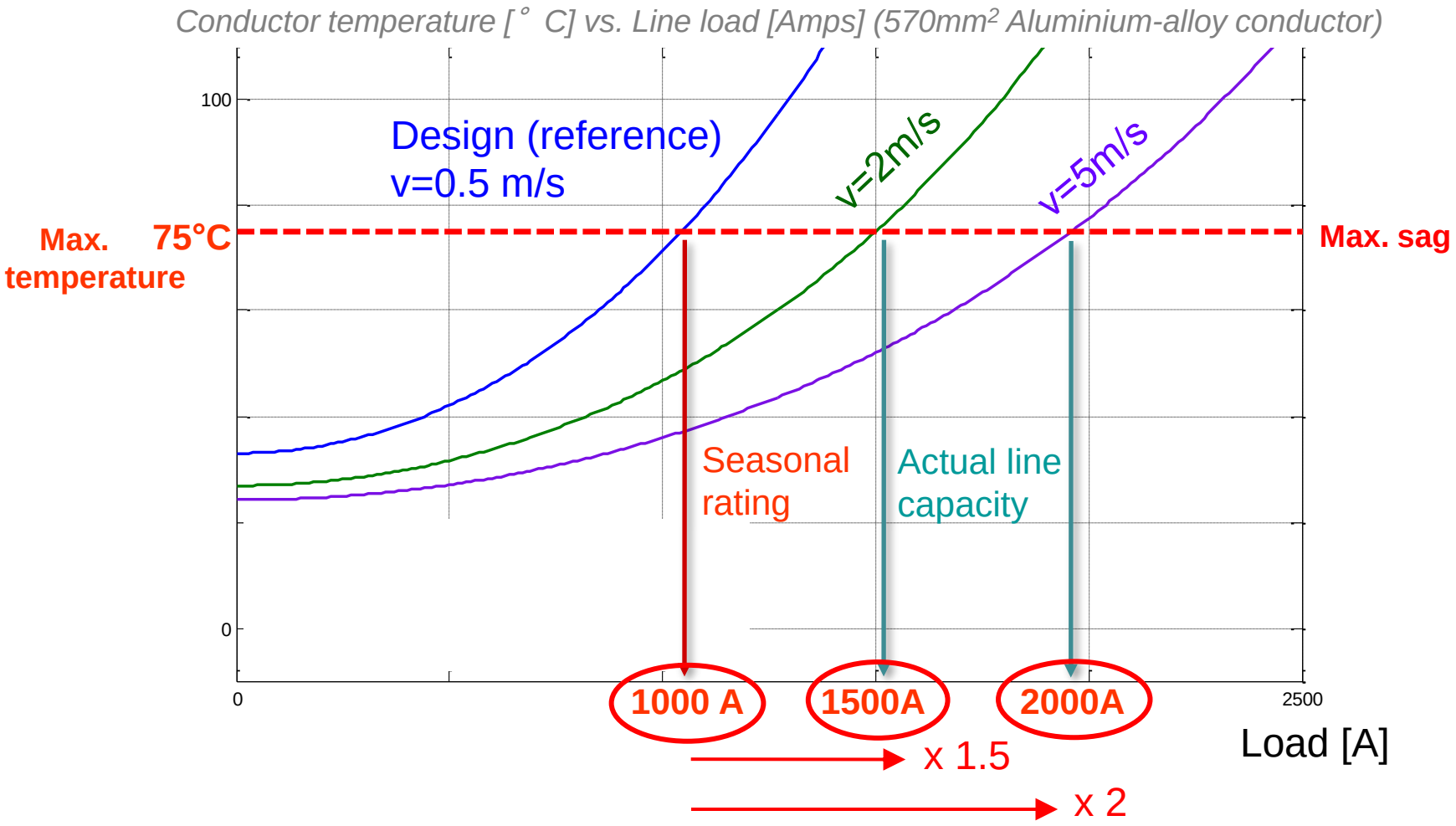
… Wind is the most critical factor (and varies a lot with time and location)



DER connection to grid *(end)*

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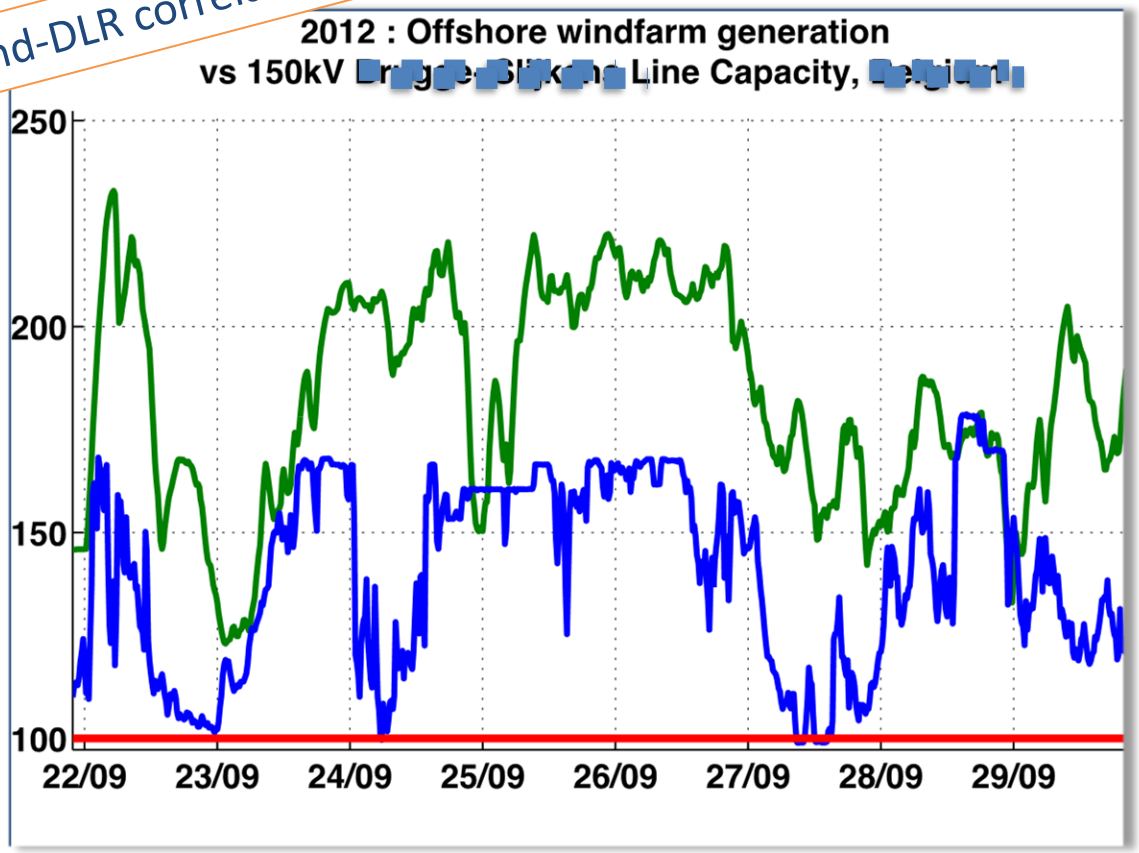
Wind-DLR correlation



Real-time rating

Wind power output

Static rating

- **Positive, strong correlation with windpower output**
- **Reduces wind-farms curtailments → drastically improves windfarm project economics**
- **Increases used capacity on windfarm corridors**
- **Reduces required grid re-inforcements invesments to reach REN integration targets**

Predictable, Reliable
Increased security of supply

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Line		RT Ampacity average gain	RT Ampacity gain 90% of the time	D-2 Forecast P98 90% of the time
380.11.V	Herderen-Van Eyck	+ 38%	+ 30%	12%
380.23	Meerhout-Van Eyck	+ 36%	+ 26%	9%
380.25	Doel-Zandvliet	+ 56%	+ 42%	13%
380.80	Avelgem-Avelin	+ 32%	+ 21%	8%
380.19	Achene-Lonny	+ 43%	+ 30%	8%

Source: Elia

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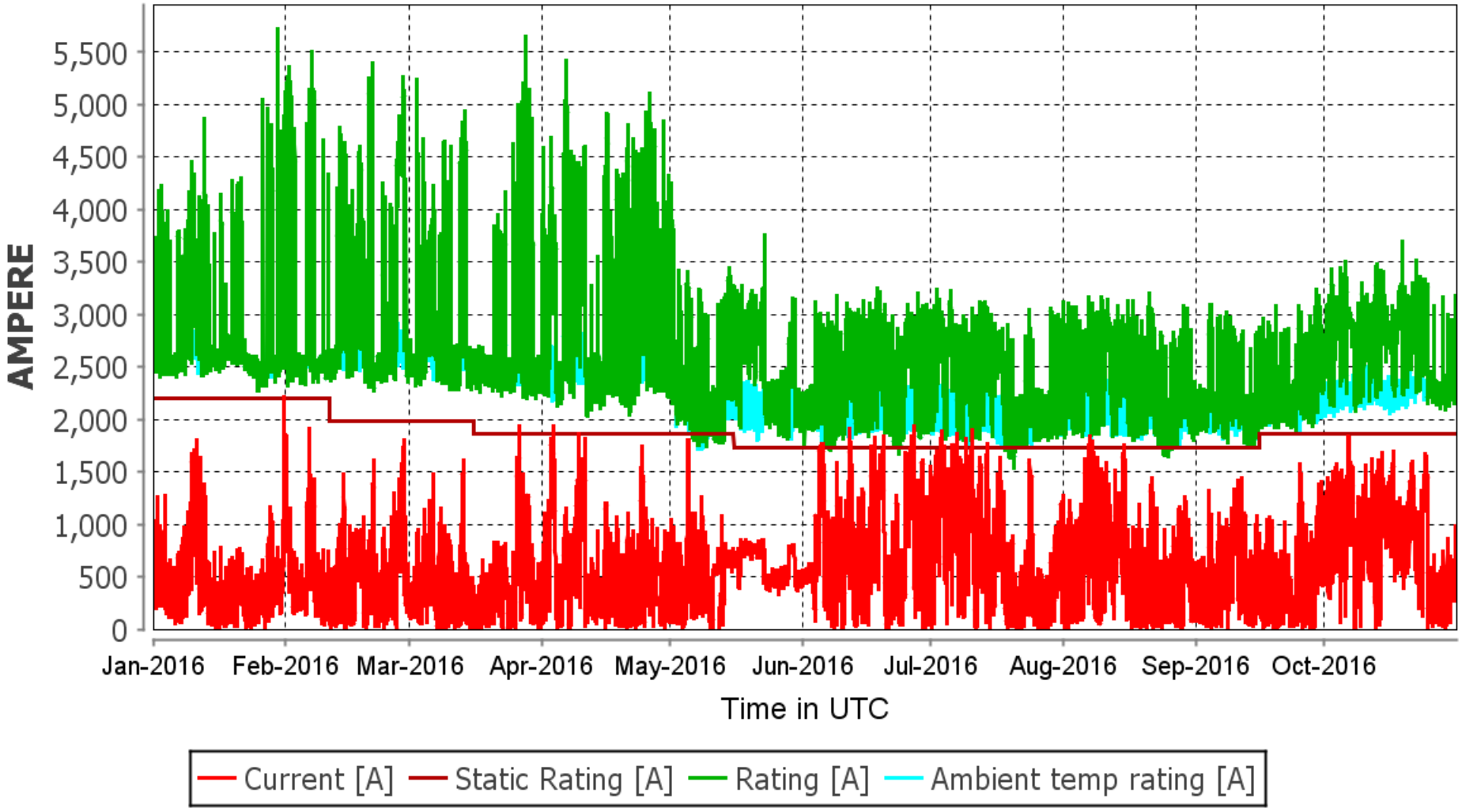
Line ampacity - line [redacted]

Period: from 2016-01-1 to 2016-11-1



ADR Ampacímon HORIZON D-1

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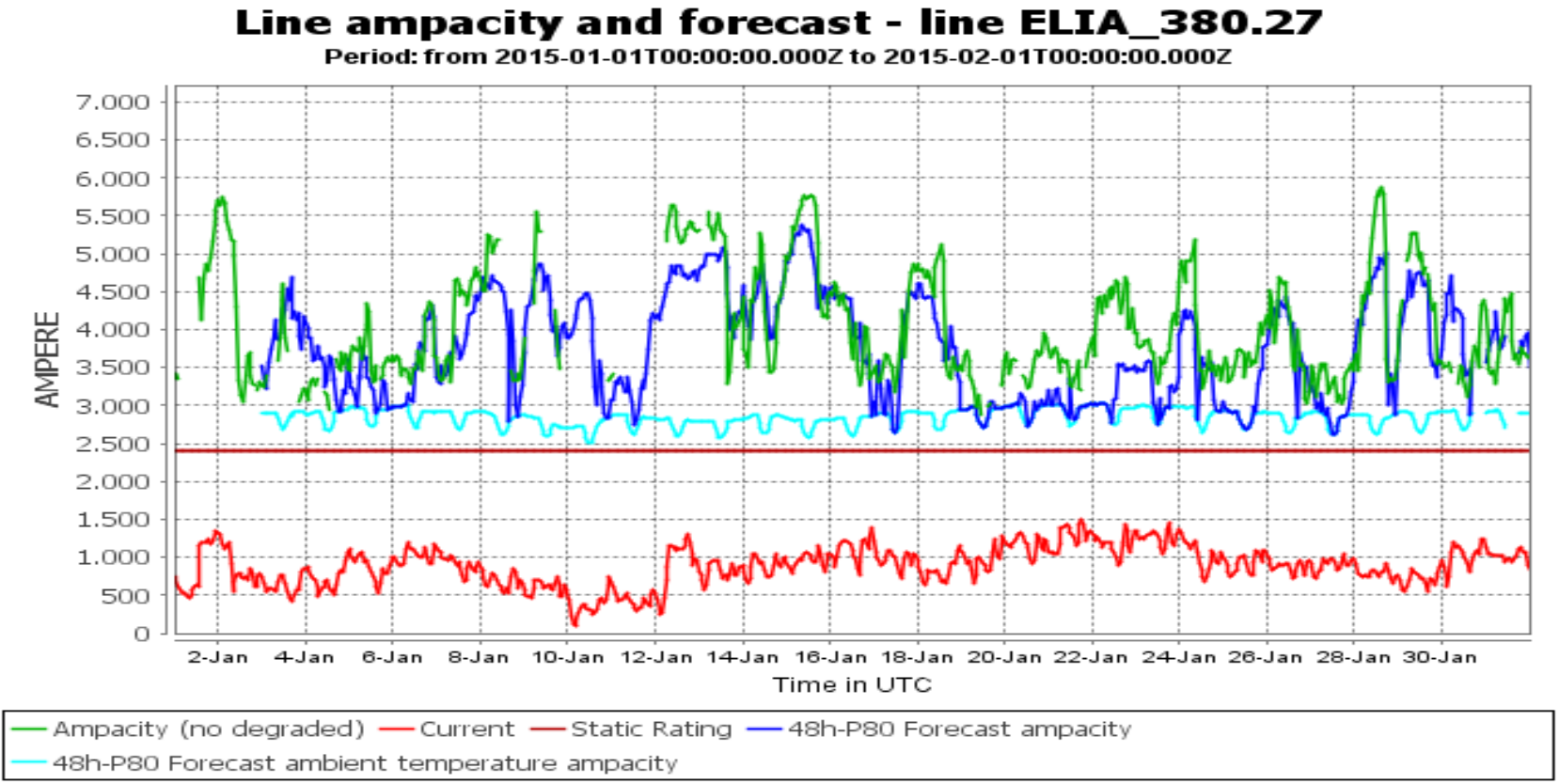


- **Up to 60h-ahead ampacity forecast**
- **Uses weather-based models, correlated with historical Real-Time ampacity measurements**
- **Statistically reliable, Percentiles can be set**
- **Used for inter-market operations and day-ahead dispatching plans**

Dynamic Line Rating

Field	HV & EHV Electricity Transmission
Country	France
Year	2017-2018
Budget	500 k€
Beneficiary	Transmission operator, Consumers, Community

DESCRIPTION

- **Issues:** allow for more renewable energies, augment line transit,
- **Project goal:** for the transmission operator: increase the capacity and service of existing infrastructure without investments on the grid.

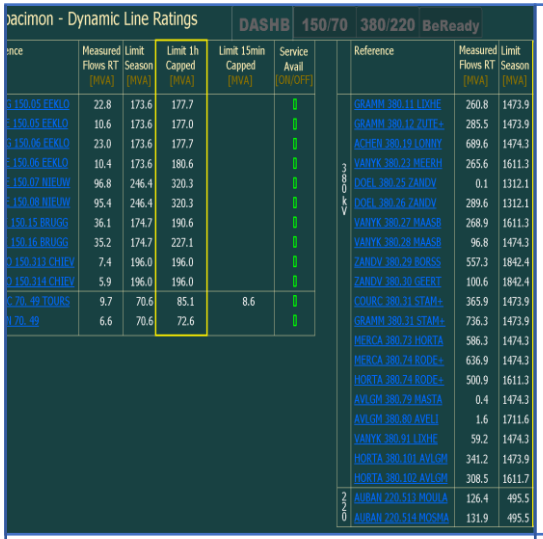
IMPLEMENTATION

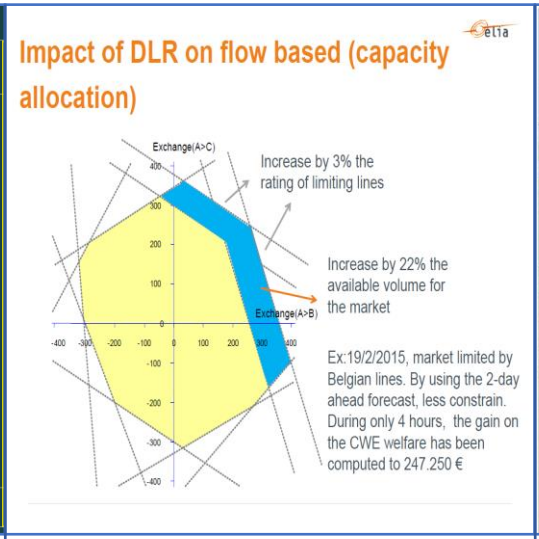
- Installation without interruption (live working) of ampacity controlling devices on the lines.
- Coupling with regional network control & operation system with integration of specially developed functions and software tools + data collection from environment (weather, ...) and grid
- 3 lines equipped in France to date.
- Success factors: quick implementation. Immediate results.

IMPACTS

- +30% of transmission capacity at crucial moments of constraints.
- Time of return on investment of 8 month,
- Reduction of call to expensive peak generation, thus reducing tafiff costs. Less fossil fuel consumed. More capacity for renewables. No additional infrastructure.
- Future objectives: weather based allocation for transformers and high voltage lines,

How’s DLR used in Europe?





Real-time data in SCADA	Forecast data in market trading	Statistics data for grid planning

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Products and service offering

ADR Ampacímon Dynamic Rating

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ADR Ampacimon VIEW	DLR planning software, performing rating estimations based on prevailing weather parameters. Typically identifies 5-15% ratings gains, no direct on-line measurements
ADR Ampacimon SENSE	ADR-Sense and Sense-D: The OHL vibrations sensors (patented)
ADR Ampacimon OPERATE	Real-time data acquisition, sag and ampacity computation software
ADR Ampacimon TREND 1h 4h	Short term (1-4h) ampacity forecast software
ADR Ampacimon HORIZON D-1	24-48h ampacity forecast software, using predicitive algorithms based on weather modeling combined with historical ampacity real-time acquisition

A full suite of products
enabling TSO's / ISO's to maximize use of grid capacity,
fully integrated within their SCADA/EMS

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Relevance in Indian Context

Actual Study reports

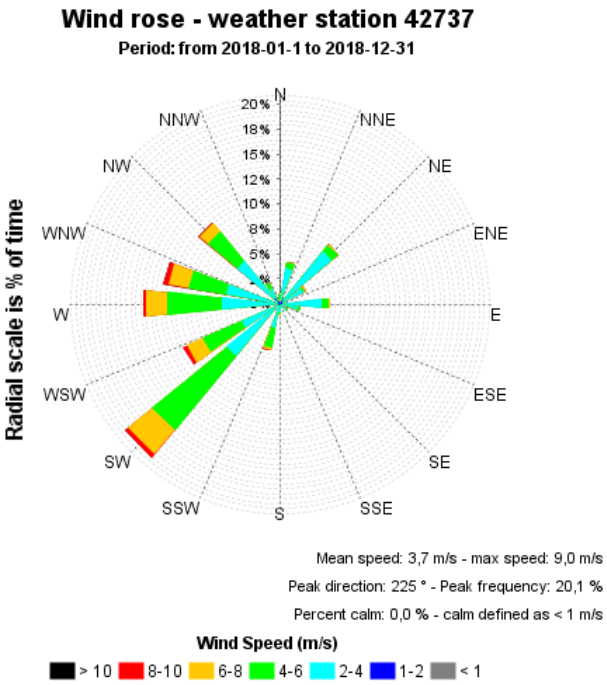
What is the potential for DLR in India?

Why? Because there is always wind

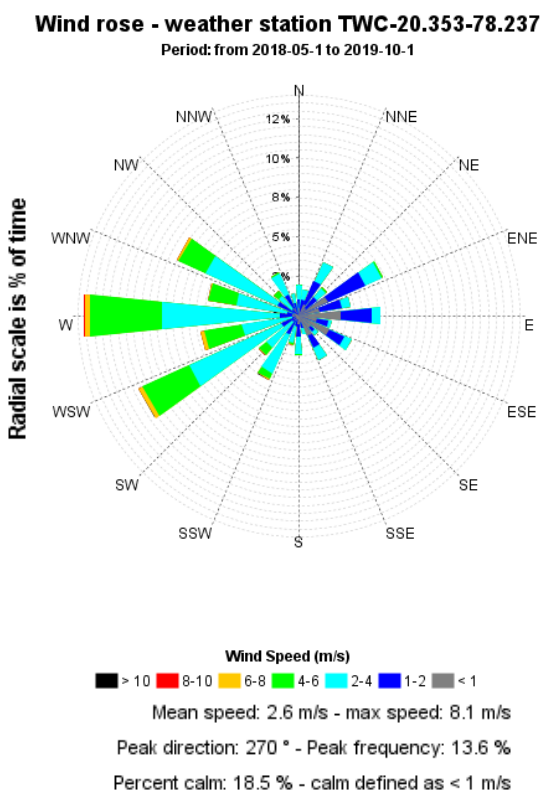
Ampacimon analysed +1yr measurements at three regions / locations

India's geography is favourable for DLR

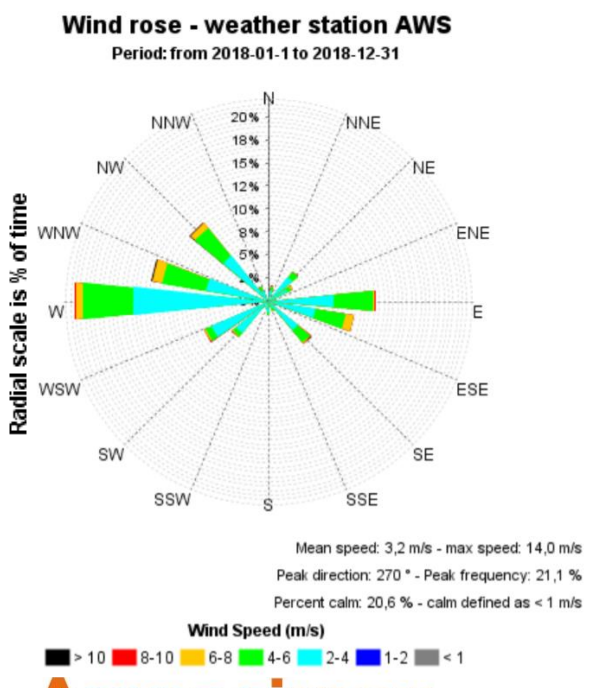
Wind region



Non-Wind- Central



Non-Wind -North



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Possible gains over existing limit 220kv Zebra { Non Wind Zone} ambient temp.38.7C Design limit 691 A; Existing limit 630A

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Name	Average value	90% of the time value	95% of the time value	98% of the time value
Relative rating [%]	161.6%	140.7%	135.8%	131.7%
Relative ambient temperature rating [%]	152.2%	130.2%	126.5%	122.1%

The following table shows the gain of the dynamic rating for each season over the whole simulation period.

Name	Average value	90% of the time value	95% of the time value	98% of the time value
Rating ALL [A]	1022A	891A	859A	833A

Possible gains over existing limit 220kv-Zebra { Wind Zone} ambient temp.40.6C Design limit 500A; Existing limit 600A

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Name	Average value	90% of the time value	95% of the time value	98% of the time value
Relative rating [%]	153.2%	135.6%	131.6%	127.9%
Relative ambient temperature rating [%]	139.2%	121%	117.9%	115.2%

The following table shows the gain of the dynamic rating for each season over the whole simulatio period.

Name	Average value	90% of the time value	95% of the time value	98% of the time value
Rating ALL [A]	919A	813A	790A	767A

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Latent wind speed seem to exist across our geography

Good reserves in capacity appear certain across the country.

DLR a 'Reliable concept'

Enables 'well informed' network planning

The Regulatory intervention

ACER
Agency for the Cooperation of Energy Regulators

DECISION No 02/2019
OF THE AGENCY FOR THE COOPERATION OF ENERGY REGULATORS

of 21 February 2019

on the Core CCR TSOs' proposals for the regional design of the day-ahead and intraday common capacity calculation methodologies

THE AGENCY FOR THE COOPERATION OF ENERGY REGULATORS,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators[1], and, in particular, Articles 8(1) thereof,

(68) When defining I_{max}, the Agency limited possible options to calculate it only to three, and grouped the approaches associated to a fixed limit in the Amended Proposals into one category to which only those elements that are both not sensitive to ambient conditions and installed in the primary power circuit are eligible. The Agency excluded secondary equipment from this category. As a principle, secondary equipment should not limit I_{max}, as the costs of replacing such equipment are low, in particular in comparison with the expected gain from replacing them.

(69) The Agency further clarified that, as a consequence of a temporary limit applied to a CNE, various CNECs associated with the same CNE may have different values for I_{max}. The Agency also rephrased and clarified the assumption on the power factor $\cos(\varphi)$.

(70) In order to maximise the available capacity on the CNECs, the Agency reinforced the obligation for the Core TSOs gradually to replace the seasonal limits to calculate I_{max} with a dynamic limit, which ensures that I_{max} represents the maximum current under expected ambient conditions for a given market time unit. In order to ensure an efficient implementation of this requirement and to fulfil the objectives set in Articles 3(b) and 3(d) of the CACM Regulation, (i.e. respectively ensuring an optimal use of the transmission infrastructure and optimising the calculation and allocation of cross-zonal capacity), TSOs should focus on the most limiting CNEs and compare the costs and benefits of installing the equipment needed to implement dynamic limit on those CNEs. When benefits outweigh costs, TSOs should install such equipment within three years.

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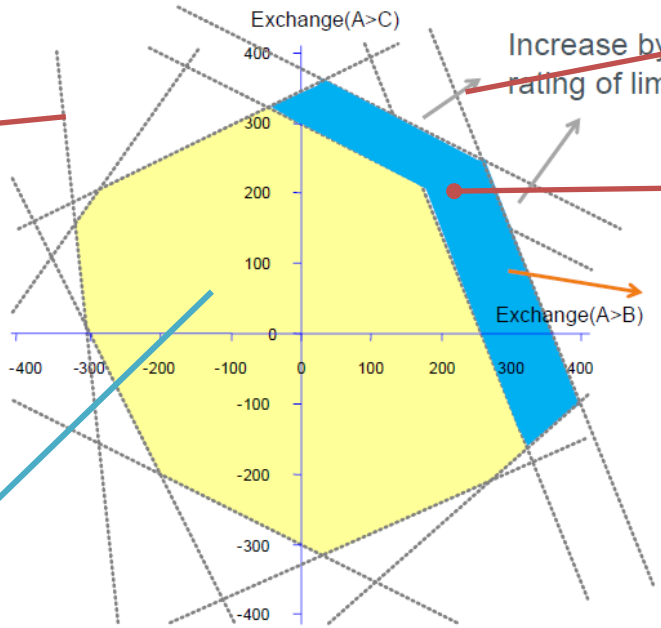
RT Market for Electricity

DLR increase of 3% on CNE leveraged 22% trade volume increase worth quarter million EUR in 4 hours of trade

Impact of DLR on flow based (capacity allocation)



Constraints by CNEs

Increase by 3% the rating of limiting lines

Constraints by CNEs relieved by DLR

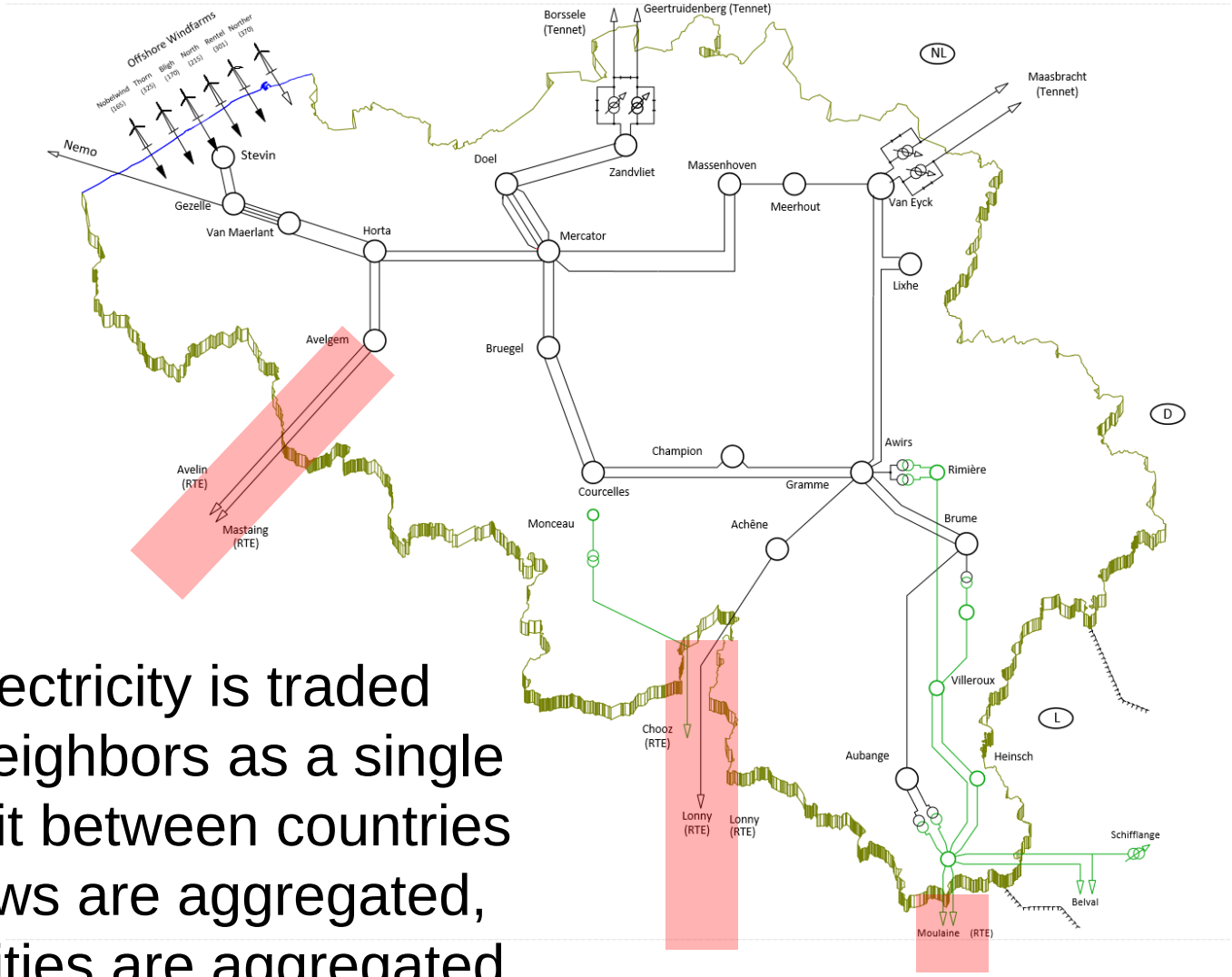
Increase in safe trade capacity due to DLR

Increase by 22% the available volume for the market

Ex:19/2/2015, market limited by Belgian lines. By using the 2-day ahead forecast, less constrain. During only 4 hours, the gain on the CWE welfare has been computed to 247.250 €

Portion of Fmax for traders

Flows on lines are not equal, nor capacity



Yet, electricity is traded with neighbors as a single conduit between countries
→ Flows are aggregated, capacities are aggregated

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How is it done ?

Patented vibration method

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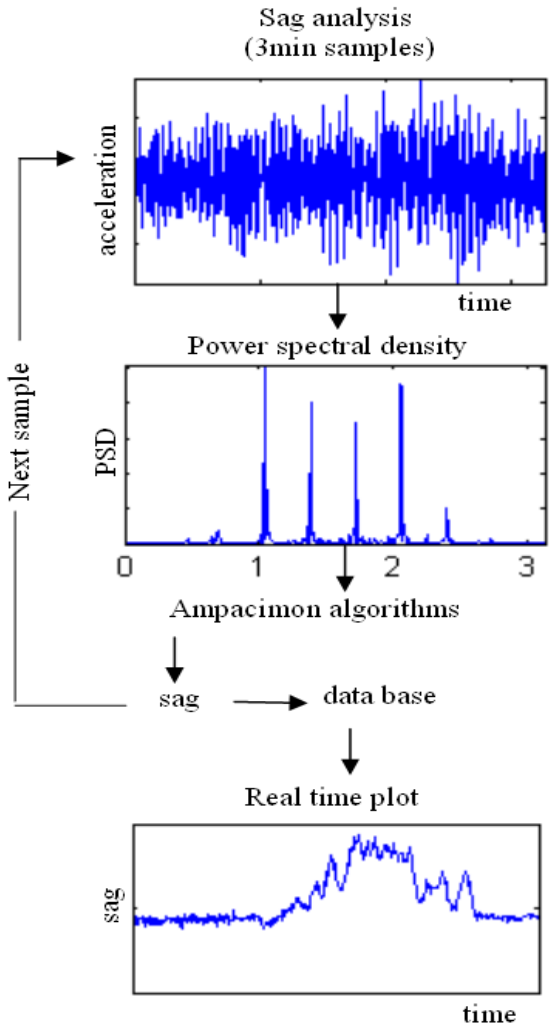
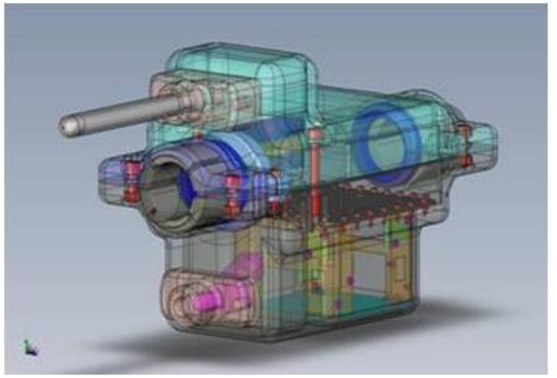


Fréquence [Hz]	Indice [-]
0.274 ± 0.002	2
0.412 ±0.003	3
0.545 ± 0.002	4
0.686 ± 0.003	5
0.817 ± 0.004	6
1.09 ± 0.005	8
1.238 ± 0.002	9
1.370 ± 0.008	10
1.510 ± 0.008	11
1.771 ± 0.002	13
2.045 ± 0.004	15

Fundamental Frequency [Hz]	Sag [m]
$0.1367 \pm 4\ 10^{-4}$	16.40 ± 0.1

$$\left.\begin{aligned} f_k &= \frac{k}{2L}\sqrt{\frac{T}{m}} \\ s &= \frac{mgL^2}{8T} \end{aligned}\right\} \quad s = \frac{g}{32\, f_1^{\,2}}$$



Validated and accurate

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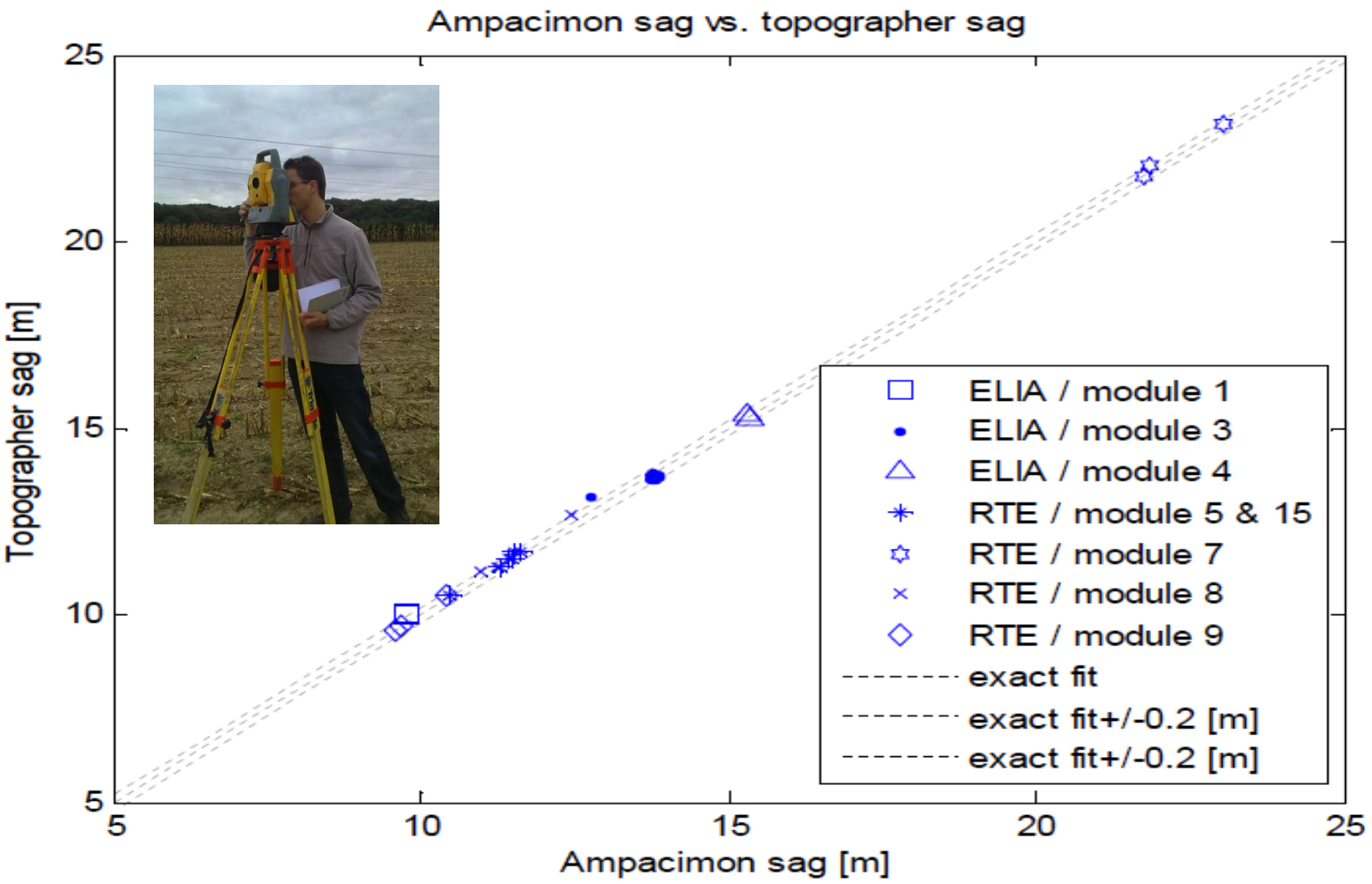
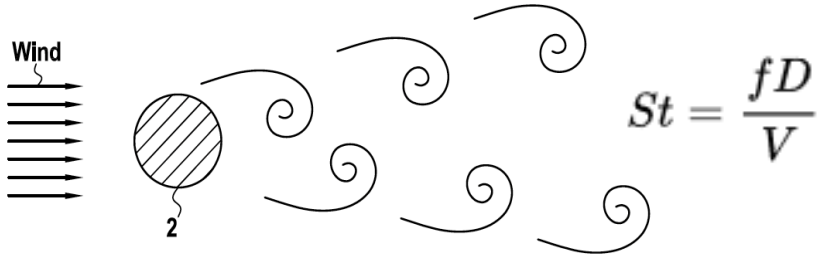
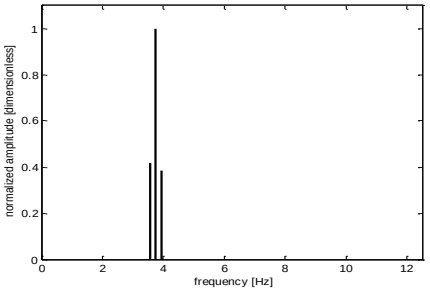
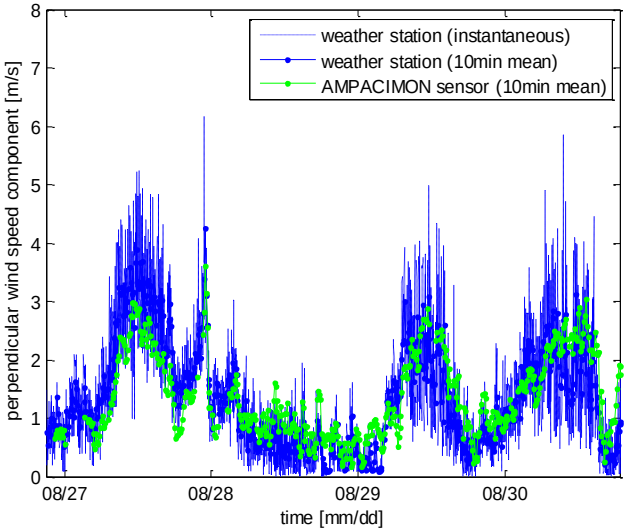
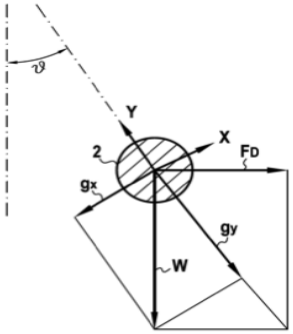


Wind Speed measurement (patented)









- High Accuracy even at **low speeds**
- Measured exactly at the **right spot, right height**
- No maintenance, no calibration

Simple and Robust

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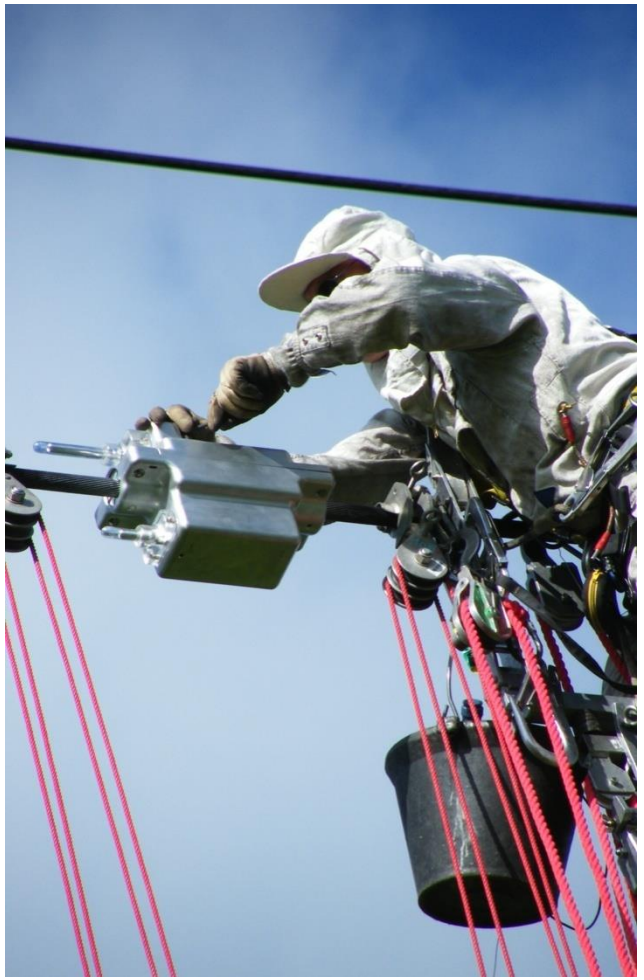

- Simple & quick to install **(typically 30 mn, live or dead line)**
- **Self-powered**
- **No calibration**
- **No maintenance**

End-to-end solution

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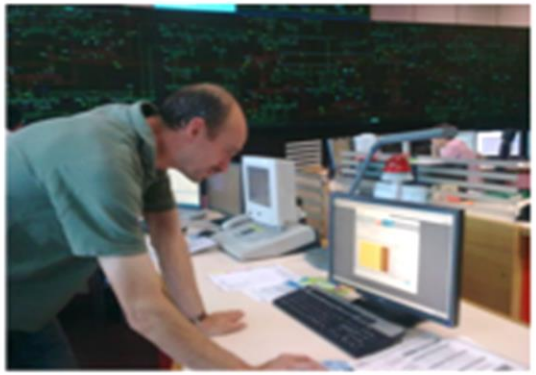
« data »

Ampacity

RT

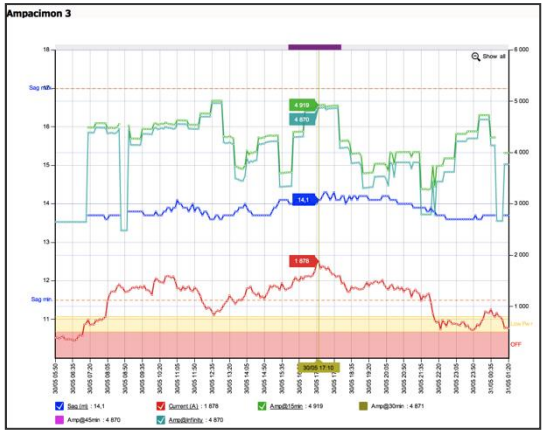
Current

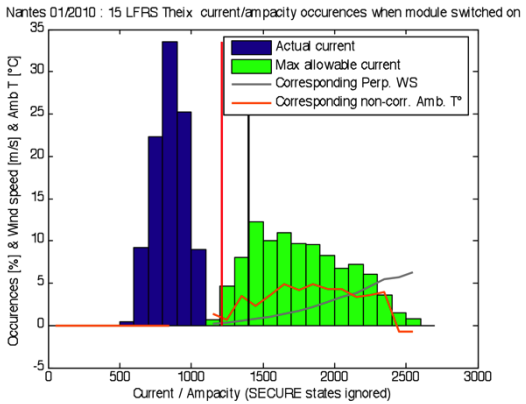


Vibration Monitors on Critical Spans

Central Server

Ampacity Screen at TSO Dispatching





ADR Ampacímon SENSE

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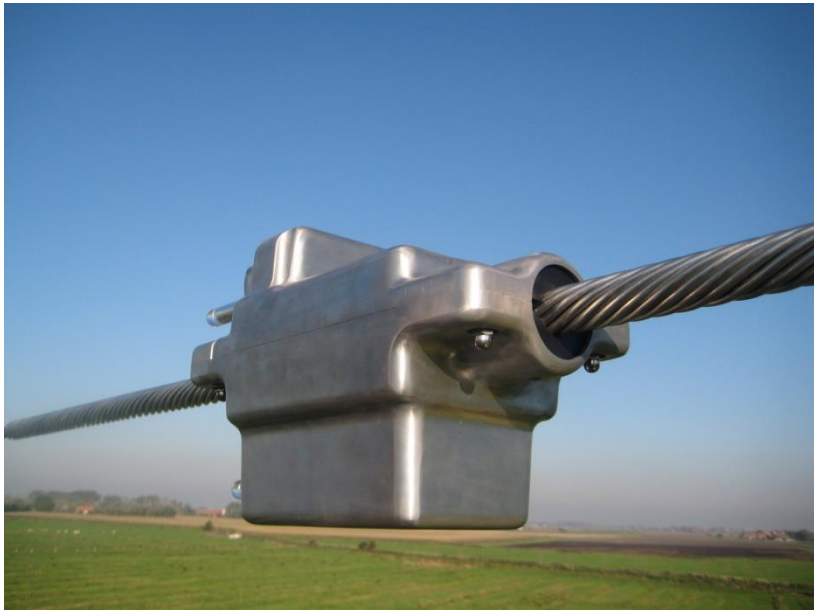

- Tested by certified labs up to 400 kV
- Lightning
  - (1475 KV peak with cutted wave)
- Short circuit
  - (63 kA rms, 150 kA peak)
- Corona free
  - Corona Test under heavy rain shower,
  - IEC 600060-1 testing in 420 kV hall at Renardières (RTE, France), January 2009
  - 750 kV testing in Brussels, September 2015

- **Sag sensor**
- **Measures line vibrations**
- **Transmits data through GPRS/GSM**
- **On-board current, temperature and wind measurement (patented)**
- **Self-powered**
- **Up to EHV**
- **No calibration, maintenance-free**
- **On average, one sensor every 3-5km (more if more complex terrain….less if flat !)**

ADR Ampacímon TREND 1h 4h

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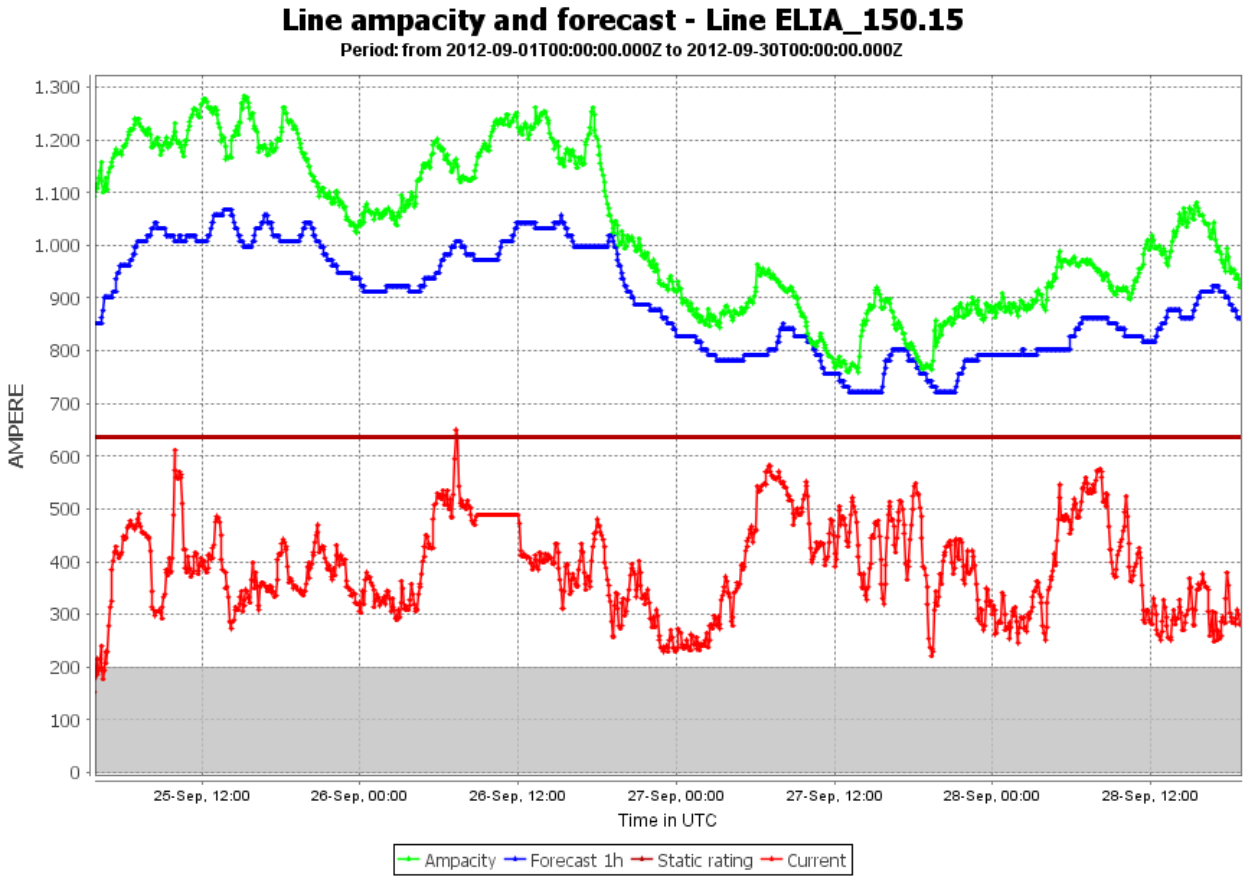

- Computes a time-series based “forecast” ampacity over a 1-4h horizon
- Eliminates very short-term RT ampacity fluctuations
- Provides dispatch center operators with a more practical information which can be fed directly into N-1 flow simulators. Used for hours-ahead congestion management

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CASE STUDIES/ APPLICATIONS

DLR Use Cases

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RENEWABLES integration
- Accelerates wind farms integration (no need for new lines)
- Less curtailment

Infrastructure deployment and optimization
- Quick, significant, easy to deploy extra capacity until new infrastructure is in place or while maintenance is performed

Security of supply
- Visibility and transparency on available capacity on critical lines
- Increases security of supply
- Ability to plan DLR capacity up to 2 days in advance

Typical REN integration

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- Maximizing usage of existing OHL
- Particularly interesting for wind farms thanks to the strong DLR/Wind generation correlation

A TSO needs to connect 9 MW extra wind farm capacity on a 63 kV line (static rating 430 A)

➢ New OHL would require 24m$ investment, 5 years plan

ADR Ampacimon SENSE **deployed in 3 months**

➢ **Gains up to 50% in RT** sufficient to debottleneck the line

Off-shore Wind power integration

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Challenge

- Around 900 MW off-shore windpower (North Sea)
- Risks of congestions on sub-transmission grid

Solution outline (map next page)

- DLR deployment on 3 lines (150 kV) ADR Ampacimon SENSE
- Real-time ampacity with ADR Ampacimon OPERATE

Customer benefits

- Congestions due to windpower relaxed
- Grid extension deferred / minimized (Stevin – 7 years, 200 mEur)
- Massive integration of renewables enabled by DLR

Take away

- Earlier connection to grid
- Significant investment savings
- Impact on energy prices / social welfare

Off-shore Wind power integration *(end)*

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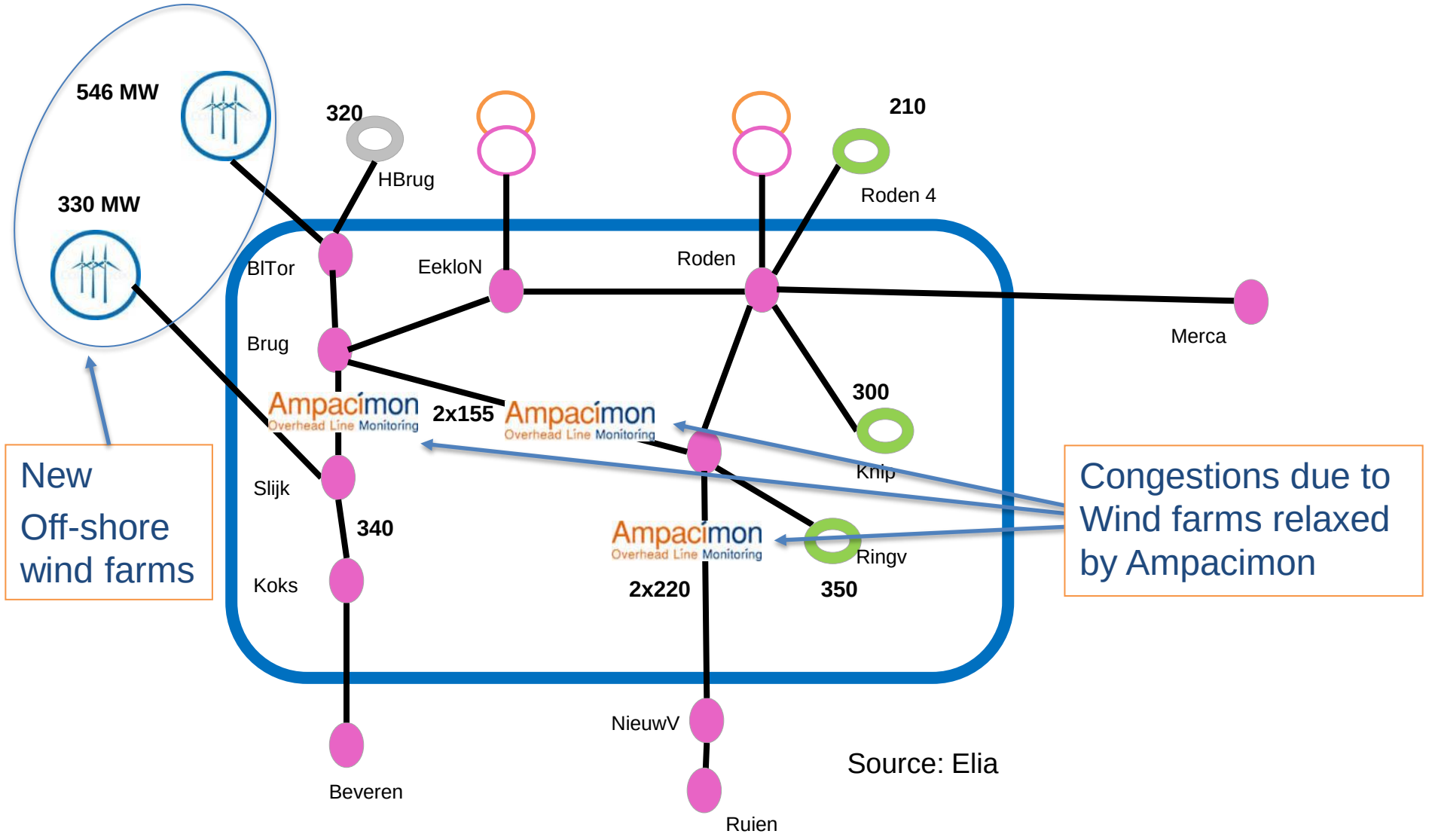

Asset optimisation

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Challenge

- Scheduled outage on a 220kV line
- Due to last several months
- Costly plan

Solution outline

- Adjacent line equipped with 4 devices ADR Ampacimon SENSE
- Ampacity is monitored with ADR Ampacimon OPERATE
- This line carries the extra load for 3 months, average +40% capacity

Customer benefits

- Safety is never compromised
- Maintenance schedule is optimized

Take away

- Increases system availability and reliability during long scheduled outages
- System can be re-deployed on other lines

Conformance checks

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Challenge

- Ski resort area sees load increase in winter over the years
- Fed by a 150kV line
- Costly uprating in mountainous area
- Public safety issue

Solution outline

- Critical spans monitored with ADR Ampacimon SENSE
- Ampacity/Sag is monitored with ADR Ampacimon OPERATE
- In winter, up to 40% gain above nominal rating
- Sufficient to cope with this seasonal variability

Customer benefits

- Increased safety within “true limits”
- Strong design + Monitoring = More value

Take away

- Payback after the first winter

Markets integration / RT Market for Electricity

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Challenge

- Potential generation shortage looming in Belgium
- Interconnectors (France and the Netherlands) capped at 3000 MW
- Urgent (next winter)

Solution outline

- Agreement to increase cross-border transit
- 8 lines (380 kV) equipped in 2 months with ADR Ampacimon SENSE
- Real-time Ampacity is monitored with ADR Ampacimon OPERATE
- Day-ahead forecast with ADR Ampacimon HORIZON D-2

Customer benefits

- Gains up to 40% in Real-time (1200 MW) → Pay-back = a few weeks
- D-2 forecast allows to increase total import capacity by 10-15% (extra 450MW)

Take away

- Step-by-step implementation < surveys – real-time – forecast >
- Sections outside of Belgium have become the limiting ones

Markets integration *(continued)*

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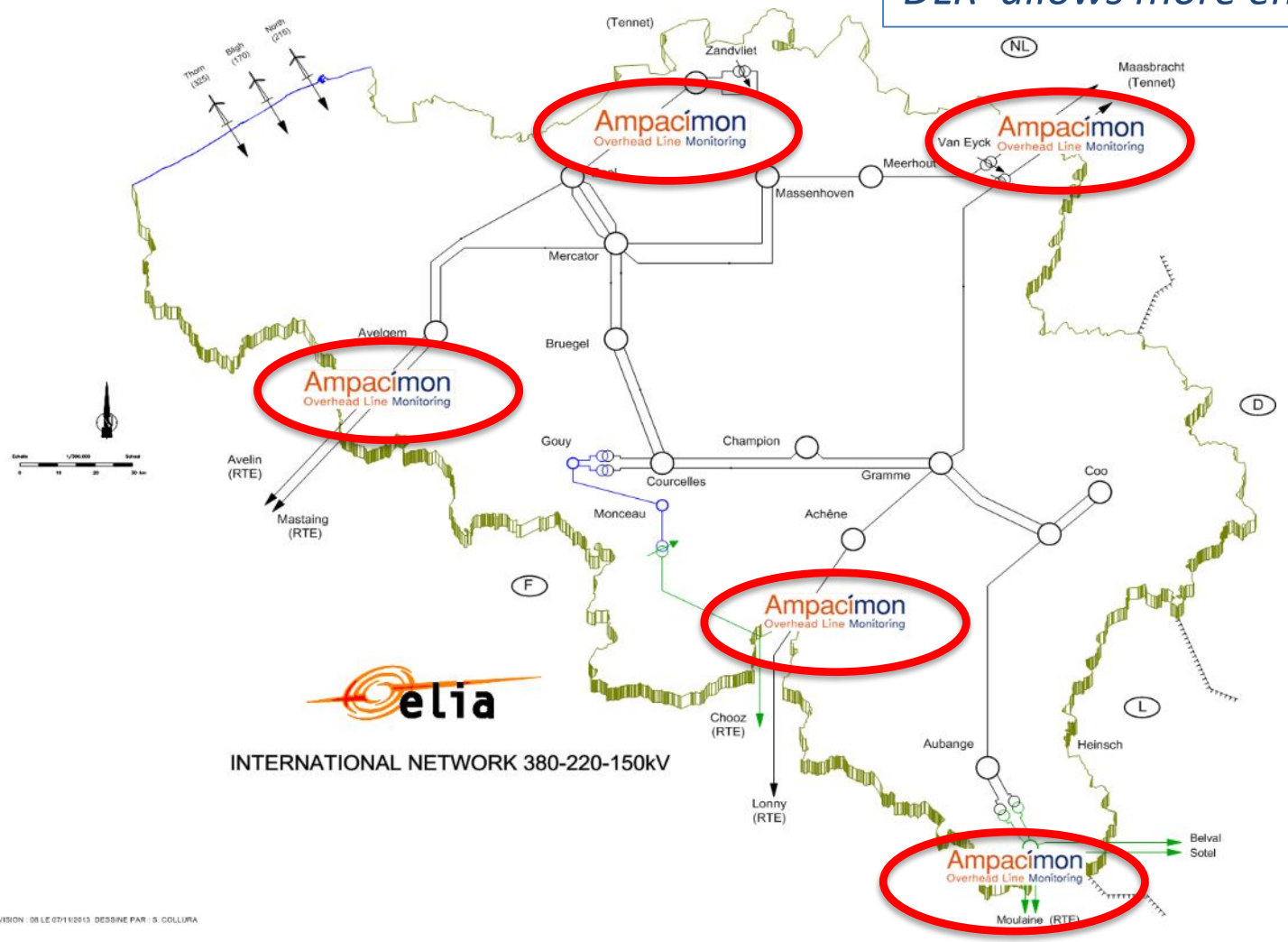
Belgian interconnectors
DLR allows more energy import



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Proven

Case studies
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TenneT
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New York Power Authority
elia
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creos
amprion
Ameren
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