भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

सेवा में / To,

उ.क्षे.वि.स. एवं टीसीसी के सभी सदस्य एवं विशेष आमंत्रित (संलग्न सूचीनुसार)

Members of NRPC & TCC and Special Invitees (As per List)

विषय: 52 वीं तकनीकी समन्वय समिति (टीसीसी) और 77 वीं उत्तरी क्षेत्रीय विद्युत समिति (एनआरपीसी) बैठक की कार्यसूची।

Subject: Agenda for 52nd Technical Co-ordination Committee (TCC) & 77th Northern Regional Power Committee (NRPC) -reg.

महोदय / महोदया,

उत्तरी क्षेत्रीय विद्युत समिति (एनआरपीसी) की **तकनीकी समन्वय समिति (टीसीसी) की 52 वीं बैठक 27.12.2024 (सुबह 09:00 बजे) गुवाहाटी, असम में होगी।**

यह उल्लेख करना उचित है कि एनआरपीसी के व्यवसाय संचालन नियमों के अनुसार, टीसीसी में प्रतिनिधित्व, राज्य उपयोगिताओं में तकनीकी प्रमुखों, पीएसयू में कार्यकारी निदेशकों / मुख्य महाप्रबंधकों या समकक्ष तथा वितरण कंपनी/ ट्रेडर/ आईपीपी में तकनीकी प्रमुखों एवं सीईए में मुख्य अभियंता के स्तर पर होगा।

उत्तरी क्षेत्रीय विद्युत समिति (एनआरपीसी) की **77 वीं बैठक 28.12.2024 (सुबह 09:00 बजे)** को उसी स्थान पर आयोजित की जाएगी।

यह उल्लेख करना उचित है कि एमओपी गजट संकल्प दिनांक 03.12.2021 के अनुसार, संबंधित संगठनों से एनआरपीसी में प्रतिनिधि या तो संगठन का प्रमुख होना चाहिए या कम से कम कंपनी के बोर्ड में निदेशक के पद से

नीचे का व्यक्ति नहीं होना चाहिए। केंद्रीय सार्वजनिक क्षेत्र उपक्रमों (सीपीएसयू) में प्रतिनिधि कार्यकारी निदेशक के स्तर पर भी हो सकते हैं।

बैठक की कार्यसूची संलग्न है । **कृपया इसमें भाग लेना सुविधाजनक बनाएं या अपनी ओर से प्रत्येक बैठक में भाग लेने के लिए उपयुक्त प्रतिनिधि (उपरोक्त समकक्षता के अनुसार) नियुक्त करें । नियुक्त प्रतिनिधि अपने संगठन से संबंधित एजेंडा आइटम पर इनपुट प्रदान करने में सक्षम हों।** बैठक की मेजबानी एनटीपीसी विद्युत व्यापार निगम लिमिटेड द्वारा की जा रही है। नोडल अधिकारियों का विवरण इस प्रकार है:

श्री रणदीप सिंह, एजीम; +91-9415243583; randeepsingh@ntpc.co.in श्री विकास कुमार, एसएम; +91-7781007668; vikaskumar04@ntpc.co.in

यह अनुरोध किया जाता है कि प्रतिभागी एनआरपीसी सचिवालय को अपनी यात्रा का विवरण (नाम, मोबाइल नंबर, यात्रा की रीति सहित) **seo-nrpc@nic.in** पर दिनाँक **22.12.2024** तक सूचित कर सकते हैं।

The 52nd meeting of Technical Co-ordination Committee (TCC) will be held on **27.12.2024 (09:00 AM) at Guwahati, Assam.**
It is pertinent to mention that as per Conduct of Business Rules of NRPC, the representation in TCC shall be at the level of Technical Heads in State Utilities, Executive Directors / Chief General Managers or equivalent in PSUs / Technical Heads of Distribution company / Traders / IPPs and Chief Engineer in CEA.

The 77th meeting of Northern Regional Power Committee (NRPC) will be held on **28.12.2024 (09:00 AM) at same place.**
It is pertinent to mention that as per MoP gazette resolution dated 03.12.2021, the representative in NRPC from respective organizations should be either the head of the organization or at least a person not below the rank of a Director on the Board of the company/corporate entity except for Central Public Sector Undertakings (CPSUs) where representative could also be at the level of Executive Director.

Agenda for the above meetings is attached. **Kindly make it convenient to attend the same or depute suitable representative (as per above equivalency) for each**

meeting on your behalf. Deputed representative shall be able to provide input on agenda items related to their organization.

The meetings are being hosted by NTPC Vidyut Vyapar Nigam Limited. Details of nodal officials are as below:

Sh. Randeep Singh, AGM; +91-9415243583; randeepsingh@ntpc.co.in
Sh. Vikash Kumar, SM; +91-7781007668; vikaskumar04@ntpc.co.in

It is requested that participants may intimate their travel details (Name, Mobile No., Travel Mode etc.) to NRPC Secretariat at **seo-nrpc@nic.in latest by 22.12.2024.**

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भवदीय

Yours faithfully

Signed by Vijay Kumar Singh
Date: 20-12-2024 10:03:03

(वी.के. सिंह)

(V.K. Singh)

सदस्य सचिव

Member Secretary

Copy to:

Chairperson, NRPC & MD, HPPTCL (md.tcl@hpmail.in)

सत्यमेव जयते

उत्तर क्षेत्रीय विद्युत समिति
NORTHERN REGIONAL POWER COMMITTEE

Agenda of

52nd meeting of

Technical Coordination Committee

&

77th meeting of

Northern Regional Power Committee

Date: 27-28 December 2024

Time: 09:00 AM

Venue- Guwahati, Assam

Contents

Agenda for TCC meeting

A.1 Approval of MoM of the 51st TCC & 76th NRPC meeting

A.1.1 The minutes of the 51st TCC & 76th NRPC meeting (held on 25.10.2024) were issued vide letter dtd. 19.11.2024. No comment has been received as of now.

Decision required from Forum:

Forum may consider to approve the issued MoM.

A.2 Status of action taken on decisions of 51st TCC & 76th NRPC meeting (agenda NRPC Secretariat)

A.2.1 Status on decisions of 51st TCC & 76th NRPC meeting is attached as **Annexure-I.**

Decision required from Forum:

Status of action taken may be discussed in meeting.

A.3 Extension of AMC of existing AMR System along with upgradation of existing AMR System (agenda by POWERGRID)

A.3.1 The Automatic meter reading (AMR) system for collection of SEM data centrally at NRLDC was implemented by POWERGRID. The purchase order for installation and commissioning of AMR system for Northern Region was awarded by POWERGRID to M/s Kalki Communication Technologies Ltd. vide Reference PO: N1/C&M/11-12/AMR/193(A) dated 15.02.2012 (Supply Portion) and N1/C&M/11-12/AMR/193(B) dated 15.02.2012 (Service Portion). The initial purchase order was placed for integration of **1250 SEMs at 220 locations** of the Northern Region at a total cost of **Rs. 1.87 Cr**.

A.3.2 With the expanding power network in NR, over **1900 SEMs have been integrated in AMR at 300 locations** till now under this contract. The total amended value of the contract has gone over **2.86 Cr** (i.e. 52% variation from original contract).

A.3.3 The annual maintenance contract (AMC) period under the original contract was 04 years after the warranty period of 01 year, which was extended from time to time for smooth operation of AMR services and facilitation of SEM data to NRLDC for commercial settlement.

A.3.4 The original AMC contract expired in June'23 since there was no provision for further extension in the contract.

A.3.5 Furter, to keep the existing AMR system in operation to provide SEM data to NRLDC, another AMC contract was awarded to M/s Kalkitech for two years valid till 25.06.2025.

A.3.6 It is pertinent to mention that as per the minutes of 74th NRPC, the Forum has approved the scheme of Supply & Installation of AMR Compatible with 5 min ISTS Interface Energy Meters along with AMR (Automatic Meter Reading) System with mode of funding and implementation mode to be deliberated in the NCT meeting. The relevant pages of the same is attached herewith at **Annexure-II**. The supply & installation of AMR compatible with 5 min IEMs/ SEMs will take considerable time.

A.3.7 The matter of extension of AMC for existing AMR system was discussed in 50th Commercial sub-committee meeting of NRPC wherein, it was decided that until the new AMR system is fully implemented, the existing AMC contract should be extended. The relevant pages of the same is attached herewith at **Annexure-III.**

A.3.8 Accordingly, matter was taken up with M/s Kalkitech to extend the AMC. However, M/s Kalkitech expressed the need for upgradation of existing AMR system (which is in operation since 2012) due to the following reasons:

i) AMR for energy meter, installed in 2012, has become outdated due to advancement in technology, necessitating both hardware and software upgrades.

ii) Many automation systems which are deployed beyond 5 years are now found to be more vulnerable to cybersecurity threat as both applications and the edge devices then used are not designed to protect from the cyber threats.

iii) With the increasing number of substations under the Northern region and the number of IEM (Interface energy meter)/ SEM (Special energy meter) meters are increasing every year, which cannot be handled by present AMR system (which was originally designed for 1250 meters). Further approximately 500 SECURE make meters are also planned to be integrated in AMR system by Mar’25, taking the total meter integration status to approximately 2400.

iv) The Application needs support of the advanced security suite defined in the DLMS protocol as and when the IS adapt the same for IEM (Interface energy meter)/ SEM (Special energy meter) Meters.

A.3.9 In view of the above, M/s Kalkitech has submitted a techno-commercial offer of Rs 2.4 Cr for upgradation of software and licenses. Additionally, 2 nos. server and DNS license is in POWERGRID scope which amounts to approximately 20 lacs. The AMC charges for 2 years shall be approximately 50 lacs Therefore, the total approximate cost of upgradation comes out to be **Rs. 3.1 Cr**. The technical proposal & price schedule submitted by M/s Kalkitech is attached herewith at **Annexure-IV** & **Annexure-V** respectively.

A.3.10 In view of above, POWERGRID has requested to deliberate upon the need for upgradation of the existing AMR system for NR for extension of existing AMC contract without further capacity augmentation till new AMR system is implemented.

Decision required from Forum:

Forum may deliberate on the need for upgradation of the existing AMR system as per submission of M/s Kalki Communication Technologies Ltd and consider to accord on the same with extension of existing AMC contract without further capacity augmentation till new AMR system is implemented.

A.4 O&M Tariff of 765kV D/c Sikar-II-Aligarh Line Bays at Aligarh substation under NRSS-38 (agenda by POWERGRID)

A.4.1 ICTs and Bays associated with Northern Region System Strengthening Scheme (NRSS-XXXVIII)" with the following elements have been commissioned at GIS Aligarh Sub-station in NR-III. Copy of Investment approval of NRSS-XXXVIII is attached herewith at **Annexure-VI**.

"ICTs & Bays associated with Northern Region System Strengthening Scheme (NRSS – XXXVIII)"

Broad scope of work is as follows:

Substation

i) Creation of 400kV level at Aligarh(PG) 765kV GIS switching Station – Extn

a. Provision of 2x1500MVA 765/400kV ICTs along with associated bays

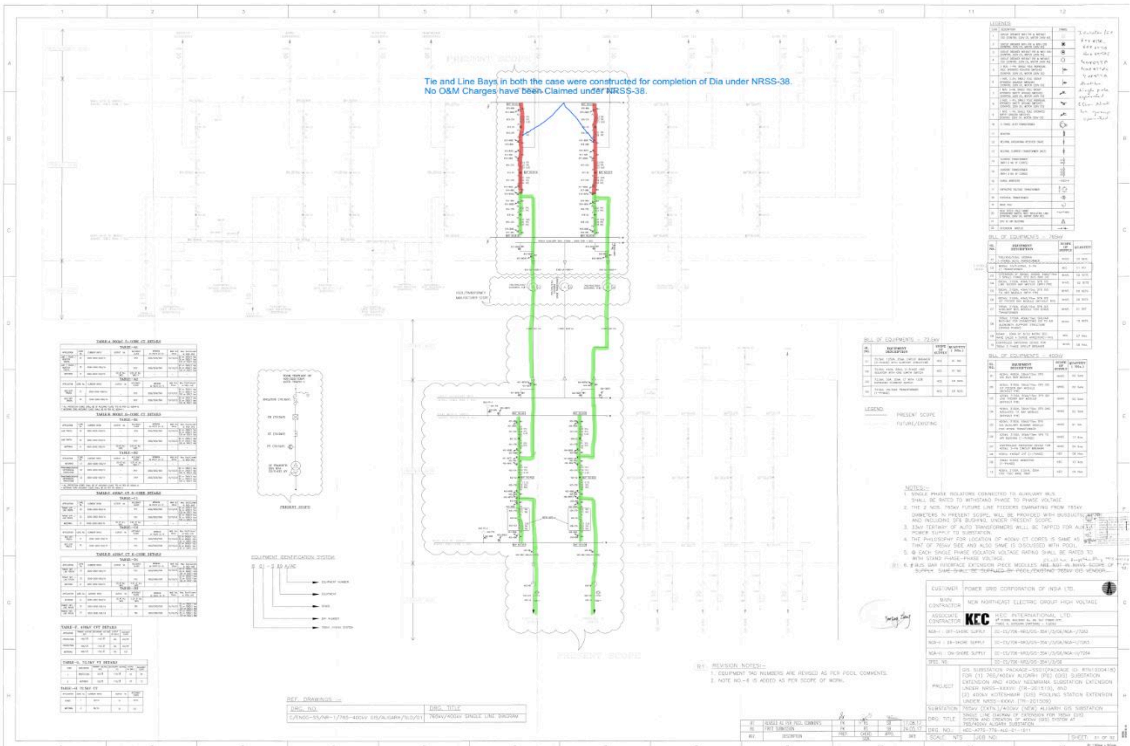
b. Provision of 2 Nos. of 400kV line bays for termination of Aligarh Prithla 400kV D/c line under TBCB

ii) Extension of 400kV Neemrana(PG) substation

a) Provision of 2 Nos. of 400kV line bays for termination of Neemrana-Dhanonda 400kV D/c line under TBCB

A.4.2 As per the above scheme only 02 Nos 765kV GIS Bays associated with 02 Nos 765kV ICTs were provisioned with the scheme. However, to complete the dia, Tie and spare line bays were constructed along with the associated ICT bays and same was approved by CERC vide Petition No 649/TT/2020 on 02.08.2024 (Copy attached at **Annexure-VII**). SLD of the NRSS-XXXVIII is given hereunder:

NRSS-38 SCOPE Drawing



A.4.3 Later on, 765kV Sikar-II- Aligarh D/C Line (under TBCB) connected at GIS Aligarh substation was agreed, however, as per the minutes of 2nd meeting of NRPCTP held on 01.09.2020, the provision for 02 nos. bays at Aligarh substation for Sikar-II was deleted in view of availability of 02 nos. 765kV GIS line bay modules at Aligarh GIS Substation (relevant pages attached at **Annexure-VIII**), it is mentioned as below:

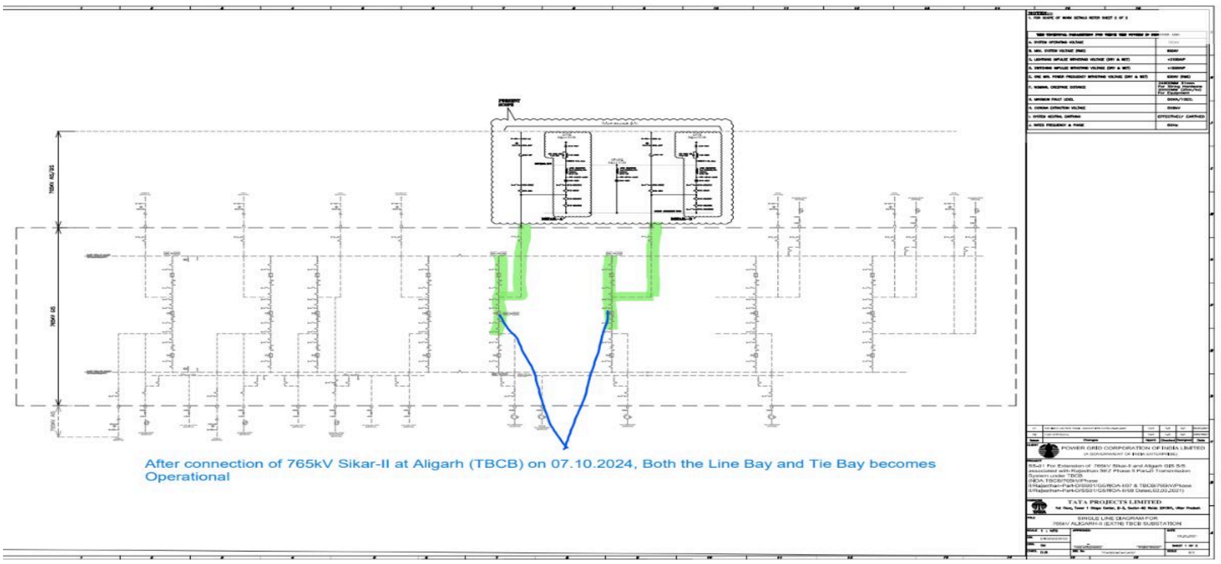
16.0 2 nos. of 765kV GIS line bays Modules at Aligarh S/s

16.1 CEA stated that the transmission system strengthening scheme for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase-II was agreed in the 5th meeting of Northern Region Standing Committee on Transmission (NRSCT) held on 13.09.2019. The scheme also included Sikar-II – Aligarh 765kV D/c line along with 765kV line bays & line reactors at each end. However, it is to inform that 2 nos. of 765kV GIS line bay modules are already available at Aligarh S/s. Accordingly, it is proposed that above GIS line bay modules available at Aligarh S/s may be utilized for termination of Sikar-II – Aligarh 765kV D/c line and the provision for 2 nos. of bays at Aligarh S/s would be deleted from the scope.

16.2 Members noted the same.

A.4.4 Accordingly, Sikar-II-Aligarh 765kV D/c line (Under TBCB) connected at GIS Aligarh Sub-station with the spare line bays on 07.10.2024. Copy of the SLD is given hereunder:

765kV D/C Sikar-II-Aligarh (Under TBCB) SCOPE Drawing



A.4.5 Since there was no provision of the spare bays in NRSS-XXXVIII, and these bays were constructed only to complete the ICTs dia, hence, there was no provision of O&M Tariff of these 02 bays.

A.4.6 Presently, these bays have been commissioned with Sikar-II-Aligarh 765kV D/c line therefore, POWERGRID has requested that, Operation and Maintenance Tariff of 02 nos. GIS bays at Aligarh GIS substation may be agreed for inclusion with the NRSS-XXXVIII Scheme.

Decision required from Forum:

Forum may deliberate and approve the inclusion of Operation and Maintenance Tariff of 02 nos. GIS bays at Aligarh GIS substation with NRSS-XXXVIII Scheme.

A.5 Condoning of outage of 400/220/33KV, 315MVA ICT 1 of Kaithal Substation due to sudden failure during through fault in 220kV Lines (Agenda by POWERGRID)

A.5.1 Sudden failure of 400/220/33kV 315 MVA ICT-1 at 400/220kV Kaithal substation of POWERGRID happed due to external faults in 220kV lines of HVPN. The issue was deliberated in the 220th OCC meeting held in June 2024, 51st PSC meeting held in July'2024 and further deliberated in special meeting held on 20.11.2024. The MOMs are attached herewith at **Annexure-IX, Annexure-X & Annexure-XI** respectively for reference.

A.5.2 Based on decision of the Forum in above meetings, POWERGRID has requested to condone outage of 400/220/33KV 315MVA ICT 1 at Kaithal Substation from 00:51 Hrs of 11.05.2024 to 21:26 Hrs of 11.06.2024. Total outage period is 764:35 Hrs. i.e. 31.84 Days.

A.5.3 As per CERC regulations 2024, Appendix-IV, outage period beyond one month and up to three months to be certified after the decision at RPC.

A.5.4 During the meeting dated 20.11.2024, it was decided that POWERGRID may submit the agenda to NRPC Secretariate for discussion in NRPC. The excerpt of the meeting is given below:

QUOTE

"Since, total verified outage period is more than 30 days (and less than 3 months), deemed availability can be granted by NRPC Forum only. Accordingly,

POWERGRID, may submit the agenda to NRPC Secretariate for discussion in NRPC"

UNQOTE

A.5.5 In view of the above, POWERGRID has requested Forum to condone the outage of 400/220/33kV 315MVA ICT-1 at Kaithal substation.

Decision required from Forum:

Forum may deliberate and consider to condone the outage of 400/220/33kV 315MVA ICT-1 at Kaithal substation from 00:51 Hrs of 11.05.2024 to 21:26 Hrs of 11.06.2024

A.6 Recovery of shortfall/deficit amount in Deviation & Ancillary Services Pool Account (agenda by HPSLDC)

A.6.1 HPSLDC has submitted that NRLDC has forwarded Deviation & Ancillary Services Pool Account Deficit Recovery Statement/Bill for the period prior to 16.09.2024 (Statement for Legacy Dues) in respect of State/ Drawee DICs including HP State vide their letter no. NRLDC/MO/DSM-2024/538 Dated: 11.11.2024. Total amount due shown is Rs. 3142 crores in respect of State/ Drawee DICs which is to be paid in 20 equal instalments by the State/ Drawee DICs.

A.6.2 This bill has been raised under Hon'ble CERC DSM and related matters Regulations, 2024 and the payment is requested to be made within the due date failing which it attracts simple interest @ 0.04 % for each day of delay. To avoid late payment surcharge installments of Rs. 1.3572220 Crore are being paid before due date under protest.

A.6.3 Although, this bill has been issued as per the procedure for "Recovery of charges in case of deficit in the Deviation and Ancillary Service Pool Account" approved by Hon'ble CERC, HPSLDC has following observations: -

1. **Lack of consultation from the States:** The methodology used for the recovery of the above-mentioned shortfall/deficit amount in Deviation & Ancillary Services Pool Account has been implemented without soliciting feedback/comments from the States which are the effected parties in this case. Such consultation would have been important because its impact is on the consumers, and ideally,

provisions for such recovery should have been embedded within the regulations itself and not through the procedure.

2. **Non-Uniform Billing Across Regional Entities:** The shortfall/deficit amount appears to have been billed only to certain drawee entities based on GNA (General Network Access) and drawl of the States, despite all regional entities bearing some responsibility for this shortfall in the Deviation & Ancillary Services Pool Account. The regional entities registered with the RLDCs such as Regional Open Access Generators & Consumers etc. are excluded from these charges. A uniform approach across all entities would have ensured fairness and transparency, resultantly impact on particular State would have been reduced.

3. **Utilization of PSDF Surplus:** Prior to 16.09.2024 for which this bill has been raised, RLDCs/NLDC may have transferred certain surplus amount from Deviation and Ancillary Services Pool account to PSDF (Power System Development Fund) being maintained by RLDC/NLDC and the same could have been used to offset the shortfall, thus reducing the financial burden on States and the consumers.

4. **Consolidated Account for Shortfall Recovery:** All accounts viz. Deviation Charges, Reactive Energy Charges, Ancillary services and Congestion Charges have been merged into a single account for determining the shortfall /deficit amount in the Deviation and Ancillary Services Pool account and its recovery from constituents. However, only certain drawee entities are being billed for this consolidated shortfall, despite it is a shared responsibility. HPSLDC suggests that the shortfall/deficit should be recovered directly from the specific entities responsible in each category i.e. Deviation Charges, Reactive Energy Charges, Ancillary services and Congestion Charges.

A.6.4 In view of above facts, HPSLDC vide letter no. HPLDS/SLDC/DSM/Regulation-18/2024-25-7604-05 Dated: 21.11.2024 has already requested the NRLDC, with a copy to NLDC to defer the recovery of the shortfall/ deficit amount and suggested that wide consultation be made with States for recovery of this shortfall/deficit amount in Deviation & Ancillary Services Pool Account. However, any positive response in the matter is still awaited.

A.6.5 HPSLDC has desired Forum to request NLDC to review the methodology/procedure for Deviation & Ancillary Services Pool Account Deficit Recovery.

Decision required from Forum:

Members may kindly discuss and direct NLDC to review the methodology/procedure for Deviation & Ancillary Services Pool Account Deficit Recovery, if required.

A.7 Surrendering/utilization of spare 2 No. bays at 400/220 kV Hamirpur Sub-Station of PGCIL allotted to HPSEBL (agenda by HPSEBL)

A.7.1 The 400/220 kV Sub-station at Hamirpur was planned and executed in view of decision taken vide Agenda Item No: 1 entitled " Evacuation System for Chamera-III HEPs in 16th Meeting of Standing Committee held on 24/03/2004. The MoM of this meeting are annexed at **Annexure- XII** (Annexure- (A(1)). In the MoM, it is amply clear that 400/220 kV Sub-Station at Hamirpur was created for evacuation of power at 220 kV level from Power projects like Chamera-II (231 MW), Kutehar (260 MW), Bharmour (45 MW), Kugti (45 MW), Budhil (70 MW).

A.7.2 In this meeting out of the three alternatives as per agenda item annexed at **Annexure- XII** (Annexure-A (2)), alternative III was approved because of the following reasons:

i). Difficulty in locating of adequate/suitable land for construction of pooling point in hilly region.

ii). Interconnection of Chamera III with the existing stages of Chamera would create deloading of the existing Kishenpur Moga 765 kV line operated at 400 kV.

iii). Considering the number of projects envisaged in Ravi basin a 400/220 kV pooling point was required to be established which would serve the purpose of evacuation of power from Ravi as well as Beas basin projects.

iv). Evacuation at 400 kV from pooling point in hills to the load center would create an over voltage/stability problem due to long line length and less load absorption capacity in the nearby area.

v). With 220 kV evacuation option as per alternative II, the requirements for future projects of HP would call for additional network, leading to sub- optimal development.

A.7.3 In the MoM, it was stated that considering the above facts a 400/220 kV pooling point near Hamirpur had been envisaged, the location of which was to be finalised depending on the alignment of the line crossing of Chamera to Jullundhar viz-a-viz Parbati III to Amritsar line. It was further stated that with the commissioning of other upstream Ravi basin hydro projects, Kutehar would be interconnected with Chamera III by SC line and 220 kV D/C line from Kutehar would be taken to Hamirpur pooling point. The Hamirpur Jullundhar section charged at 220 kV with Chamera III would then be charged at 400 kV.

A.7.4 Subsequently Director (SP&PA) issued corrigendum in respect of Item No. 1 and Item No. 2 of 16th Meeting of Standing Committee vide letter No: 1/9/03- SP&PA dated 13/5/2004 **Annexure- XII** (Annexure-B). In this corrigendum instead of specifying location as Hamirpur for 400/220 kV Pooling station, the location close to the alignment of Chamera- Jullundhar and Parbati-Amritsar lines was indicated. Further, in the MoM, it has also been recorded that in the Chamera- III time frame, this pooling station would be initially 220 kV Switching station which would be upgraded to 400 kV in future. However, in the 17th Meeting of Standing Committee held on 10/8/2004 **Annexure- XII** (Annexure-C), it was given to understand that this 400/220 kV Pooling station shall be created at suitable location near Hamirpur.

A.7.5 In 23rd meeting of Standing Committee held on 16th Feb, 2008, norms for providing 220 kV bays with 400/220 kV Transformers were revised as per Item No. 6.1 of the MoM annexed at **Annexure- XII** (Annexure-D (1)). Vide Item No 6.7, it was decided to construct Hamirpur 400/220 kV, 2x315 MVA Sub-Station and LILO of one circuit of Parbati PS-Amritsar 400 kV D/C to create new 400 kV Sub-Station Hamirpur under system Strengthening Scheme NRSS-XX. As per these revised norms, 6 Nos. 220 kV bays were mandated to be provided at 400/220 kV Sub-Station Hamirpur and this fact was already agreed to by the representative of PGCIL as per Agenda Item No. 6 of the 30th Meeting of Standing Committee the MoM of which was circulated by CEA vide letter no: 1/9/SP&PA-12/ dated 20/1/12 **Annexure- XII** (Annexure-D(2)). In this meeting it was also apprised that 4 Nos. bays stand utilized and 2 no. bays could be provided for interconnection of Kangoo Sub-Station. As no time limit for utilization of these 220 kV bays was specified as these were meant for future use.

A.7.6 HPSEBL knowing that 400/220 kV Sub-Station is being created by PGCIL and 6 No. 220 kV bays are to be provided as per norms and home State can lodge its claim for their use, apprised PGCIL vide letter HPSEB/ESCHWW- 57/2011-5106-07 dated 21/10/2011 **Annexure- XII** (Annexure-E) that HPSEBL will be using these 6 bays by

(i) Constructing 220 kV D/C line to existing 220/132 kV Sub-Station Mattansidh (Hamirpur) which is already being fed on 220 kV line from Jullundhar,

(ii) Interface 220 kV Sub-Station Kangoo and Patti (Palampur).

A.7.7 It is pertinent to mention here that proposal for connectivity to 220 kV Kangoo and Patti (Palampur) was planned by HPSEBL long back even before the inception of PGCIL Sub-Station at Hamirpur, from existing 220/132 kV Sub-Station of HPSEBL at Mattansidh (Hamirpur) where sufficient space is available. It was only the location of 400/220 kV Sub-Station of PGCIL at Hamirpur which prompted HPSEBL to envisage connectivity to this Sub-Station for delivery of power as per above letter dated 21/10/2011 **Annexure- XII** (Annexure-E) as it would have benefitted grid in terms of less energy losses in comparison to drawl on 220 kV line from Jullundhar. Furthermore, length of proposed 220 kV line to Kangoo shall reduce about by 6 kM if connected at 400/220 kV Sub-Station of PGCIL.

A.7.8 In the 30th Meeting of Standing Committee held on 19/12/2011, vide Item No. 6, it was stated that HPSEBL has proposed to connect their 220/132 kV Sub-Station Hamirpur with PGCIL 400/220 kV Sub-Station by constructing 220 kV D/C line about 4.0 KM. In the meeting representative of PGCIL stated that connectivity of 220 kV at the PGCIL Sub-Station is urgently required for stable/reliable operation of the Parbati Pooling-Hamirpur-Amritsar 400 kV line as well as for effective utilization of Hamirpur 400/220 kV Sub-Station. Thus, it was decided that existing 220 kV line from Jullundhar to Hamirpur catering power to HPSEBL at Mattansidh (Hamirpur) be LILOed and thus 4 Nos. bays were utilized for the downstream system at Hamirpur and at Jullundhar. The remaining 2 no. bays were proposed to be utilized form connecting 220/132 kV Sub-Station Kangoo of HPSEBL with 400/220 kV Sub-Station of PGCIL at Hamirpur.

A.7.9 At later stage connectivity of 220/132 kV Sub-Station Kangoo of HPSEBL with 400/220 kV Sub-Station of PGCIL at Hamirpur was deferred due to following reasons:-

(i) After LILO of 220 kV Hamirpur-Jullundhar Line at 400/220 kV Sub-Station Hamirpur, HPSEBL is drawing power to the tune of 250-300 MW through its 220/132 kV Sub-Station at Hamirpur. This drawl of power shall remain almost same even if the proposed 220 kV bay proposed to be utilized for Kangoo is also used because the load of this area is already being fed from existing 220/132 kV Sub-Station Hamirpur of HPSEBL at 132 kV level.

(ii) On the request of HPSEBL, BBMB has allowed drawl of additional Power from Dehar Power and further proposal for stringing of 2nd Circuit on 220 kV Dehar (BBMB)-Kangoo (HPSEBL) S/C Line was on D/C Towers for integrated operation at 220/132 kV Kangoo Sub-Station in District Mandi of Himachal Pradesh was also approved.

(iii) With the above arrangement, sufficient power is available to 220/132 kV Sub-Station at Kangoo at 220 kV level and there is no proposal of HPSEBL/HPPTCL to connect the Kangoo Sub-Station with 400/220 kV Sub-Station of PGCIL at Hamirpur by utilizing the remaining 2 no. 220 kV Bays.

A.7.10 Due to Non-utilization of remaining 2 no. 220 kV Bays, HPSEBL is paying transmission charges to the tune of Rs. 68 Lakhs per annum.

A.7.11 From the above, it is evident that

(i) 400/220kV Sub-Station Hamirpur was exclusively created for evacuation of Power from various power houses in Ravi and Beas Basin.

(ii) HPSEBL has never requested for creation of this Sub-station for which the construction of downstream system was precedent condition for its commissioning PGCIL has to connect the HPSEBL's system by LILO of 220kV Jullundhar Hamirpur line to address the issue of over voltage and ensure safe and reliable operation of the 400 kV Parbati- Hamirpur-Amritsar line.

(iii) At present or in near future there is no plan of HPSEBL/HPPTCL for utilizing the remaining 2 no. 220 kV Bays at 400/220 kV Sub-Station of PGCIL at Hamirpur.

A.7.12 In view of above, HPSEBL has requested that the remaining 2 no. 220 kV bays at 400/220 kV Sub-Station of PGCIL at Hamirpur allotted to HPSEBL may be surrendered and levy of Transmission charges to the tune of Rs. 68 Lakhs per annum may be waived off.

Decision required from Forum:

Members may deliberate and take decision accordingly on the submission of HPSEBL.

A.8 Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh (agenda by CTUIL)

A.8.1 CTUIL has informed that after deliberations and receipt of connectivity application of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh, transmission system for evacuation of power from Pumped Storage Projects was agreed in 34th CMETS-NR meeting (held on 20.09.2024) & 36th CMETS-ER meeting (held on 29.10.2024).

A.8.2 The estimated cost is **Rs. 4141 Cr.**

A.8.3 CTUIL has submitted the detailed scheme of transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh enclosed as **Annexure- XIII.**

Decision required from Forum:

Forum may deliberate on above proposal of CTU and may approve accordingly.

A.9 Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line (agenda by CTUIL)

A.9.1 CTUIL has informed that the above scheme was discussed and agreed in the 34th CMETS-NR meeting (held on 20.09.2024) and 32nd CMETS-WR meeting (held on 24.09.2024).

A.9.2 The estimated cost is Rs. 1876 Cr.

A.9.3 CTUIL has submitted the detailed scheme of Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line enclosed as **Annexure-XIV.**

Decision required from Forum:

Forum may deliberate on above proposal of CTU and may approve accordingly.

A.10 OPGW installation on existing 765kV Fatehpur-Varanasi S/c & 765kV Fatehpur-Sasaram S/c Lines which are proposed to be LILOed at New Prayagraj (ISTS) S/s (agenda by CTUIL)

A.10.1 In the 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 20.09.2024 (MoM attached at **Annexure-XV**) transmission scheme "Transmission system for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh" was deliberated. In the scheme LILO of existing 765kV Fatehpur-Varanasi S/c Line & 765kV Fatehpur-Sasaram S/c Line are proposed at the new Prayagraj S/s (ISTS). As per the inputs received from POWERGRID, OPGW is not available on both lines.

A.10.2 To meet data, voice & protection requirement between Fatehpur, Varanasi, Sasaram & Prayagraj Substations, OPGW needs to be installed over the 765kV Fatehpur-Varanasi S/c Line (223 Km) and 765kV Fatehpur-Sasaram S/c Line (356 km) which are proposed to be LILOed on New Prayagraj S/s. Further as per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, "The primary path for tele-protection shall be on point-to-point Optical Ground Wire".

A.10.3 This scheme was deliberated in the 26th NRPC TeST meeting held on 19.11.24 (MoM awaited) where the requirement of FOTE at Fatehpur, Varanasi & Sasaram was deliberated and POWERGRID was requested to submit the inputs to CTUIL regarding FOTE.

A.10.4 As per the inputs received from POWERGRID vide email dtd. 12.12.2024, FOTE shall be required at Fatehpur & one FOTE for Fatehpur-Sasaram line section repeater is required, Total cost of FOTE, Optical interfaces, amplifiers etc. at all locations will be INR **1.4 Cr.**

A.10.5 Scheme has been prepared and attached at **Annexure-XVI**.

A.10.6 Subsequently CEA PCD division vide letter Ref. CEA-PS-17-24/1/2024-PCD Division dtd. 22.11.2024 informed that in line with letter addressed to MoP from DoT, Ministry of Communication CTU, POWERGRID, STUs and all TSPs are requested to incorporate at least 48 Fiber OPGW in place of 24 Fiber in all upcoming schemes for utilization of additional fibers for Telecom licensees on leasing basis. (Letter attached at **Annexure-XVII**) based on this 48 Fiber OPGW has been proposed for this scheme.

A.10.7 This scheme is being taken up in NRPC Meeting alongwith transmission scheme of “Transmission system for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh”.

A.10.8 The estimated cost of the scheme is approx. **Rs. 33.24 Crores**.

A.10.9 The Implementation time frame is 24 months from date of allocation with best effort to match time frame with transmission scheme of “Transmission system for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh”. After Review in NRPC, the Scheme shall be put up in NCT for approval in RTM mode to POWERGRID.

Decision required from Forum:

Members may please deliberate and accord approval for the proposed scheme.

A.11 Establishment of Samba- Jallandhar link for strengthening of ISTS communication system and ring protection to important ISTS nodes in NR by utilization of OPGW on 400kV D/c Samba (PG) – Jalandhar (PG) line (owned by M/s Indigrid) (agenda by CTUIL)

A.11.1 Redundant communication for Samba by utilization of OPGW on 400kV D/c Samba (PG) – Jalandhar (PG) line (owned by M/s Indigrid) was deliberated in the 22nd, 23rd & 26th TeST Meeting of NRPC held on 24.05.2023 & 21.09.2023, 19.11.2024 respectively.

A.11.2 Utilization of this OPGW on 400kV D/c Samba (PG)-Jalandhar (PG) shall also provide ring protection to the following stations:

Samba (PG), Kishenpur (PG), Chamera-II (NHPC), Chamera-I (NHPC) & Jalandhar (PG)

A.11.3 In the above meetings, M/s Indigird informed that OPGW on 400kV D/c Samba (PG) – Jalandhar (PG) line was not originally in their scope as per TSA, however installation has been carried out for commercial utilization at their own cost.

A.11.4 After deliberations in the 26th NRPC TeST Meeting, it was finalised that in line with 50th WRPC meeting held on 24.08.2024 (Minutes attached at **Annexure-XVIII**) following were agreed however MoM of 26th TesT meeting is awaited:

a. Indigrid shall provide six nos. of dark fibers for ISTS communication purpose and also maintain healthiness of the same, for commercial issues if any Indigrid may approach to CERC.
b. FOTE at both end at Samba & Jallandhar end to be installed under ISTS scheme. The same shall be prepared by CTUIL.

A.11.5 POWERGRID has provided the input vide email dtd. 12.12.2024 that Optical Interfaces/ Amplifiers at the existing FOTE of Samba S/s (PG) & Jallandhar S/s (PG) are required and there is no need of additional FOTE. Cost of Optical Interfaces/ Amplifiers shall be **20 lakhs (Approx)**.

A.11.6 Scheme for Establishment of Samba- Jallandhar link for strengthening of ISTS communication system has been prepared by CTU and attached at **Annexure-XIX.**

A.11.7 The Implementation time frame of the scheme shall be 12 months from date of allocation. After Review in NRPC, the Scheme shall be put up in NCT for approval under RTM mode to POWERGRID

A.11.8 CTUIL has also suggested that since the cost of the scheme is very nominal, same may be carried out under O&M by POWERGRID or may be clubbed with any ongoing project.

Decision required from Forum:

Members may please deliberate and accord approval for the proposed scheme

A.12 Year-wise demand estimation and planned capacity for Resource Adequacy (agenda by CEA)

A.12.1 Ministry of Power had notified Electricity (Amendment) Rules in December, 2022. As per Rule 16 of the Electricity (Amendment) Rules, Ministry of Power has to issue guidelines for assessment of resource adequacy during the generation planning stage and operational planning stage. Accordingly, the Resource Adequacy guidelines have been notified by the Ministry of Power in June 2023.

A.12.2 Distribution Utility needs to carry out LTDRAP (Long term Distribution Licensee Resource Adequacy Plan) to meet the utility peak and energy requirement reliably. CEA will guide & hand hold the states in data collection, power system modelling and analysis of result for carrying out state specific resource adequacy studies in order to prepare the respective LT-DRAP within stipulated time frame.

A.12.3 During the Review, Planning & Monitoring Meeting held on 11th April 2023 under the chairmanship of the Honorable Minister of Power & NRE, Central Electricity Authority was instructed to handhold the States and help them to prepare Resource Adequacy plan for them.

A.12.4 Accordingly, state-resource adequacy studies for all the States of the Northern Region have already been carried out, and respective reports have been shared with the states.

A.12.5 The success of the Resource Adequacy studies and the subsequent power procurement hinges on active state participation. The results of the completed states, various assumptions taken and methodology adopted while carrying out studies need to be discussed with state officials so that states can prepare their power procurement plan based on the studies.

A.12.6 The LT-DRAP studies, being carried out for a period of 10 years on a rolling basis, require urgent revision. The states whose studies have been carried out till 2029-30 or 2031-32 need to be revised till 2034-35. To revise studies, the contracted capacity of states till March 2024, the Demand profile for the year 2023-24, year-wise demand estimation and planned capacity are required till 2034-35.

A.12.7 As per the Resource Adequacy (RA) Guidelines, the Central Electricity Authority is entrusted to prepare a Long Term-National Resource Adequacy Plan (LT-NRAP) RA study for the period of 10 years (up to 2034-35) and to revise annually on a rolling basis. Therefore, year-wise demand estimation and planned capacity are required till 2034-35.

Decision required from Forum:

Members may please deliberate and sensitize the utilities regarding the above requirements.

A.13 Progress of transmission augmentation in RVPN control area (agenda by NRLDC)

A.13.1 Serious concerns have been raised by NRLDC on the transmission related issues being observed in RVPN control area in various forums including NRPC and OCC forum (recently discussed in detail in 224th & 225th OCC meeting). Apart from this, separate meeting was organized on 19.11.2024 in Rajasthan wherein members from NRPC, RRVPNL, RRVUNL, Rajasthan SLDC, DISCOM & NRLDC were present. For majority of the issues highlighted by NRLDC, it is observed that although actions have been initiated by Rajasthan, their actual implementation will take some time even more than two years for some cases. Situation with present transmission network is expected to remain worse during this winter season.

A.13.2 The major issues which have already been highlighted by NRLDC side along with present status as discussed in sub-committee meetings of NRPC are listed below:

a) Nearly all 400/220kV substations, both intrastate and interstate, in Rajasthan are operating beyond their N-1 contingency limits during the day due to considerable shift of load during daytime as compared to previous years. This overloading has not only led to localized load losses in areas with N-1 non-compliance but also poses risks of major grid disturbances within the Rajasthan control area. There is considerable non-compliance during daytime, with a noticeable shift of load to daytime hours.

The matter was also discussed in 73rd NRPC meeting, wherein earlier Communication from MoP was also discussed with specific mention to following point:

"It is requested that the shifting agricultural load to solar hours be implemented by end of March, 2024. Some states have reported constraints in transmission / distribution because of which the shift could be delayed. In such cases, the shift can be in phases. The Transmission and distribution bottlenecks can be addressed by using fund from the RDSS to separate agriculture feeder."

During 225th OCC meeting held on 12.11.2024, Rajasthan SLDC provided following update:

- Agricultural load has been shifted to morning 5am for some of the substations where there are severe transmission constraints.
- SE (T&C) are taking up with respective officers of DISCOMs to shift the load especially of the areas having transmission constraints.
- However, as two block supply is govt policy decision, DISCOMs are somewhat apprehensive to shift major load to non-solar hours and shifting only in case of severe transmission constraints.

As Rajasthan transmission grid is facing severe transmission constraints and challenges during day-time, it is once again suggested that RVPN reconsider on its strategy of shifting agricultural load to day time till transmission/distribution constraints including issues of low voltages are addressed.

b) Continuous N-1 non-compliance issues at ICT level in most of the RVPN and POWERGRID substations are often leading to major trippings (sometimes cascade trippings) resulting in substantial load loss in major load centres. There were number of such events in Dec-Jan last winter as a consequence of N-1 non-compliance.

Name of Substation	MVA Capacity	Total Loading (MW) (variations throughout day during first week of Dec'2024)	SPS Status as available with NRLDC
Bhiwadi(PG)	3*315=945	300-700	Not implemented
Neemrana(PG)	315+500=815	300-470	Not implemented
Bassi(PG)	2*315+500=1130	400-900	Not implemented
Sikar(PG)	2*315+500=1130	200-800	Not implemented
Jaipur South(PG)	2*500=1000	250-600	Not implemented

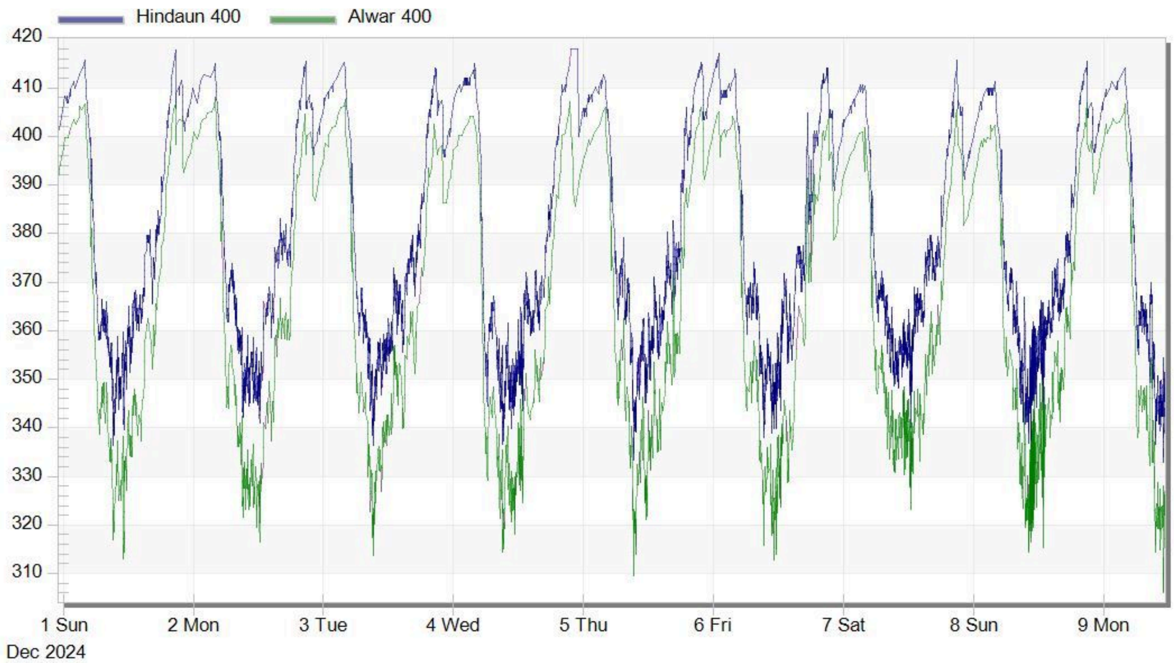
Kankroli(PG)	3*315=945	200-600	Not implemented
Kotputli(PG)	2*315=630	200-500	Not implemented
Hindaun (RVPN)	2*315 =630	200-500	Implemented
Chittorgarh (RVPN)	3*315 =945	100-700	Implemented
Ajmer (RVPN)	2*315 =630	300-600	Implemented
Merta (RVPN)	2*315 =630	250-500	Implemented
Bikaner (RVPN)	2*315 =630	100-550	Implemented
Jodhpur (RVPN)	2*315 =630	300-500	Implemented
Heerapura(RVPN)	3*250+315=1065	400-850	Not implemented
Bhilwara (RVPN)	1*500+1*315 =815	300-550	Under Implementation
Ratangarh(RVPN)	3*315=945	300-650	Implemented
Deedwana(RVPN)	2*315=630	200-500	Not implemented
Suratgarh(RVPN)	2*315=630	100-450	Implemented

As per latest status shared by RVPN, only new 500MVA ICT is expected at 400/220kV Hindaun during this winter, whereas other transmission constraints are expected to persist and system is likely to be n-1 non-compliant with present demand pattern.

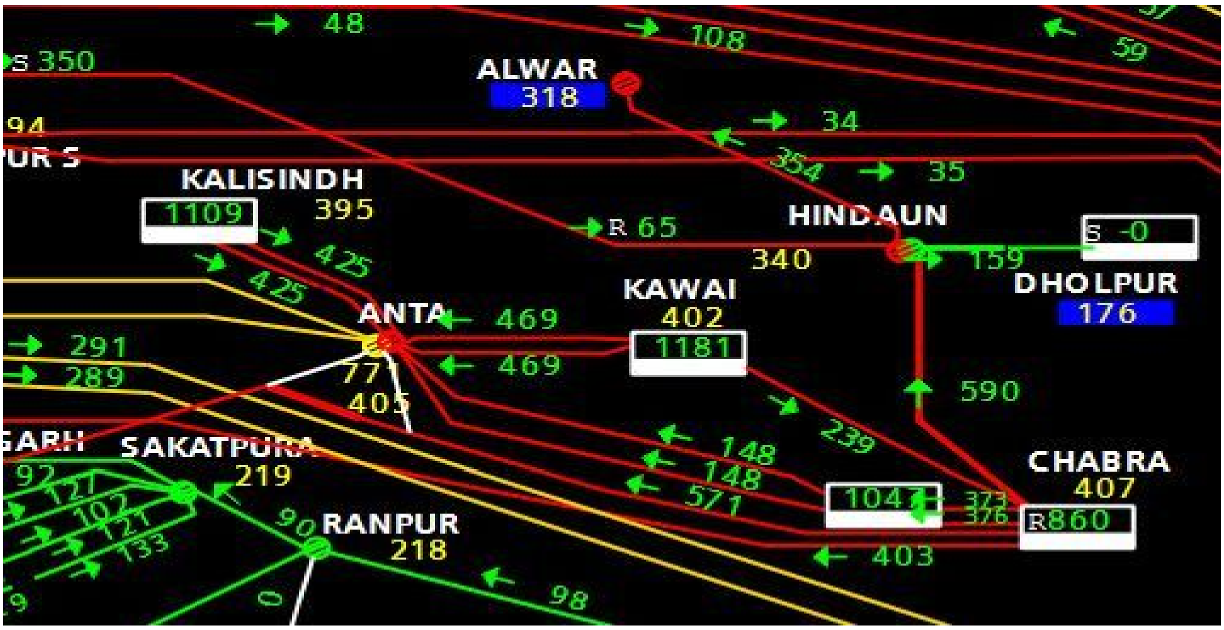
Under such circumstances, there is always possibility of major grid disturbance/grid event in the Rajasthan state grid with the present load requirement and demand pattern in the state.

c) Sustained low voltage operations in several Rajasthan system pockets, like voltage dropping to 340 & 330 kV level at the 400kV Hindaun & Alwar substations respectively, are leading to risky & vulnerable grid operation, apart from the more serious concerns in the down-stream distribution sector.

Voltage profile for first week of Dec’2024 is shown below:



Network snapshot for 09.12.2024 is shown below:



As discussed on previous many occasions, sufficient generation at Dholpur TPS needs to be ensured so that the voltages in Hindaun/Alwar area remain within the IEGC band limit.

d) Huge MVar drawl by RVPN network leading to very poor power factor at number of substations like Bikaner, Merta, Bhinmal(PG) etc. have resulted in the Rajasthan grid (in pockets) operating without any margin or reliability. Very often the reactive energy drawal from 400/220kV ICTs at some stations such as Bikaner

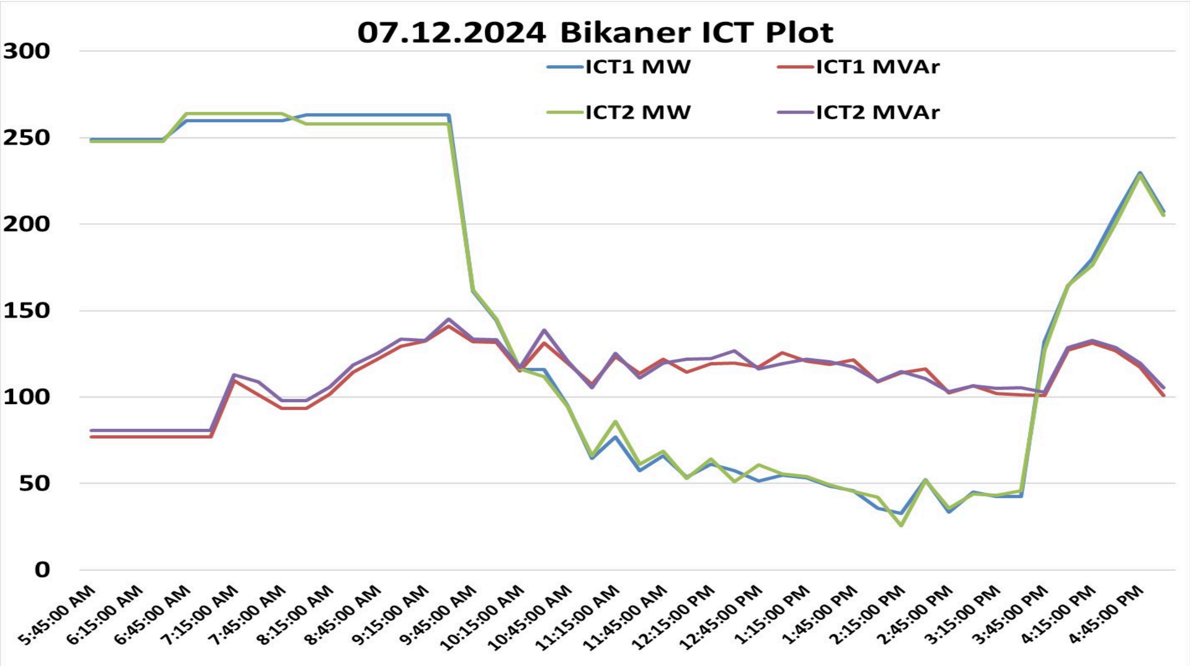
(RVPN) in Rajasthan is more than the corresponding active energy drawal, leading to grid reliability issue in EHV transmission system.

Typical Active/Reactive power loading at 400/220kV substations in Rajasthan during high demand period of the day are tabulated below:

ICTs MW drawl, MVAr drawl, Power factor and S/s voltage for Solar hours (10:00-14:00hrs) for Rajasthan Control area (01-08 Dec 2024)					
400/220 Sub-Station ICTs	ICTs Capacity (MVA)	MW Drawl	MVAr Drawl	Power factor	Voltage(kV)
Bikaner(RVPN)	2*315	100-300	150-300	0.40-0.65	375-390
Jodhpur	315	400-500	200-300	0.85-0.90	375-385
Kankani	(315+500)	500-700	200-300	0.87-0.90	370-385
Merta	2*315	400-500	200-250	0.85-0.89	380-395
Bhinmal(Powergrid)	2*315	500-600	200-300	0.87-0.90	360-370

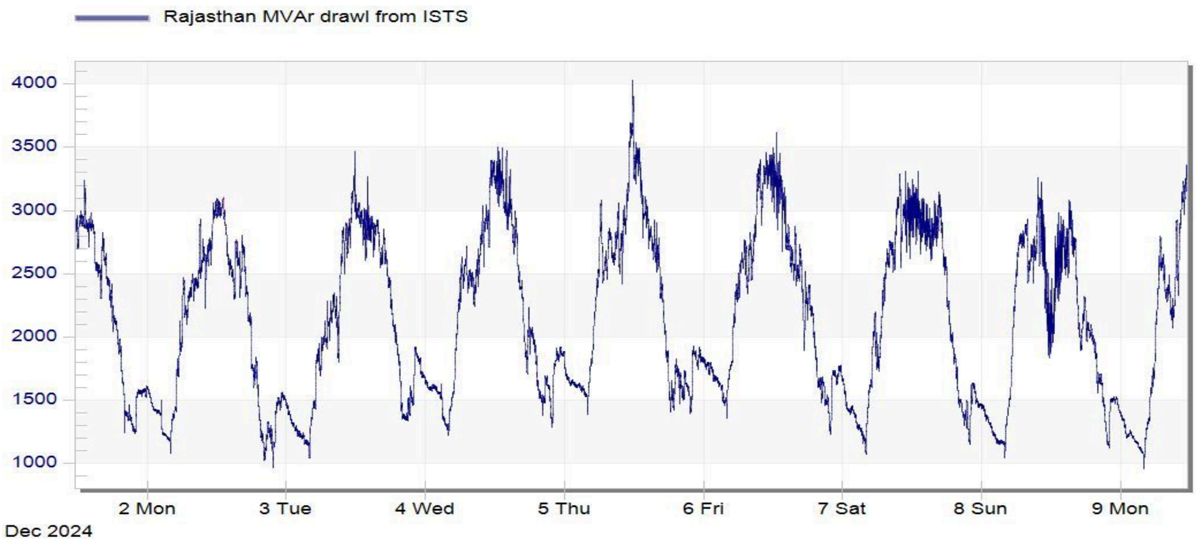
Poor power factor is resulting in low voltages in the system and therefore expeditious commissioning of network elements and shunt capacitor both at transmission and distribution level is required.

Daily trend of MW/MVAR drawl by 400/220kV Bikaner (RVPN) ICTs is shown below:



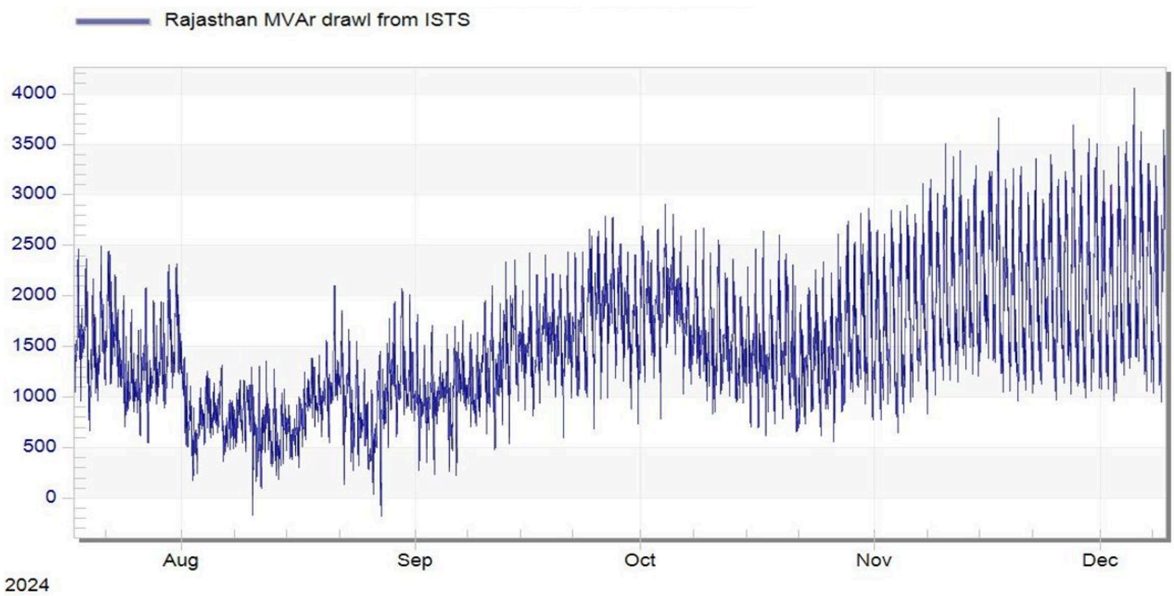
It can be clearly seen that there is huge MVAR drawl by Rajasthan intra-state network which is also degrading the voltage profile in the ISTS network.

NRLDC is also monitoring reactive power drawl by Rajasthan network from the interstate transmission system. As shown below, it can be seen that there is considerable increase in reactive energy drawl by Rajasthan from ISTS grid during the day-time.



It is utmost essential that load MVAR drawl management including identification of nodes at 220kV and 132kV level which are drawing huge MVAR from the grid and remedial actions for the same is carried out on priority.

It is also to be noted that this reactive drawl from ISTS increases in winter months when there is high agricultural load in Rajasthan state control area as shown below:



During 225 OCC meeting held in Nov'2024, Rajasthan SLDC updated that Capacitor banks are expected to be commissioned before next winter season and it is expected that installation of capacitor banks would begin from Mar'2025 onwards.

Furthermore, severe oscillations were observed in the grid when high wind generation was observed in Rajasthan state control area. It is gathered from earlier discussions that these old intrastate wind generators are not providing reactive power support, instead drawing reactive power from the grid. On 08.12.2024, number of thermal generators in NR also reported hunting. This was only taken care when around 1000MW of RE (solar and wind) was curtailed in the RE complex.

As the old wind turbines are drawing reactive power from the grid and hampering grid voltage profile during peak solar generation, RVPN in coordination with wind developers is requested to install suitable reactive compensation devices or restrict generation from wind plants which are drawing reactive power from the grid, incase wind generation is present during period of solar generation i.e. 10:00hrs to 14:00hrs to maintain grid voltages within limit.

A.13.3 The systemic shortcomings highlighted above are threat to safe grid operation during the ongoing winter season, when the severe transmission related constraints in state grid would compromise safe & reliable operations. Following corrective measures by RVPN may moderate the looming crisis situation in grid operations to a large extent until more long-term corrective measures come into action:

1) More meticulous planning for & close monitoring of the load management & voltage profile management in the Rajasthan grid till above long-term measures are implemented. Rajasthan SLDC to operate the intrastate grid without compromising on secure grid operation and take measures to improve the state grid profile including shifting of some load to night time till transmission related issues are resolved **(Short-term)**
2) As Dholpur Gas plant has also been run in the recent past and significant improvement in Voltages and grid parameters have been observed, RVUNL to ensure the running of Dholpur units as ultimate solution in present condition. **(Short-term)**
3) Rajasthan SLDC to conduct meeting with intrastate thermal generators (to provide reactive power support to minimize low voltages), DISCOMs and RE

generators so that action plan is prepared and submitted in OCC forum **(Short-term)**

4) Enforcing the CEA technical standards on the intra-state RE generators in respect of their participation in reactive energy management at point-of-connection level, as is being practiced in case of ISGS RE generators. Their participation is expected to bolster the voltage profile in Bikaner/Bhadla areas **(Short-term)**
5) Minimizing forced outage of intrastate thermal generating units during high demand season to avoid possibility of power shortages/ excessive drawl from the grid **(Short-term)**
6) Expediting commissioning of new ICTs at 400/220kV substations having serious N-1 violations, in line with the decision in the earlier TCC/ NRPC meetings. Prioritizing transformation capacities augmentation in critical stations like 400/220kV Ajmer, Merta, Heerapura, Jodhpur and Bikaner may be a prudent approach to face the challenge **(Long-term)**
7) Expediting commissioning of capacitor banks at various substations of RVPN and DISCOMs, in line with the decision in the 68th NRPC meeting held on 18.08.2023. The Hindaun/Alwar/Gangapur City/ Dholpur pocket loads (in Jaipur Discom area) fed from 400/220kV Hindaun & Alwar EHV Stations may be considered on priority to safeguard the transmission system reliability **(Long-term)**
8) In line with the discussion in the 64th NRPC meeting held on 24.03.2023, expediting the commissioning of planned STATCOMs at RVPN substations (for improvement in voltage in Western Rajasthan) & 400/220kV Dholpur GSS(for improvement in voltage in Hindaun/Alwar area) **(Long-term)**
9) As simulation studies done by NRLDC and Rajasthan SLDC concluded that there is requirement of around 3000-4000 MVAr additional capacitor banks in the RVPN transmission & distribution network. Same may be expeditiously awarded and commissioned to resolve the low voltage issues **(Long-term)**
10) Explore fund from RDSS to separate agricultural feeder as discussed in TCC/NRPC meetings and communication received from MoP. **(Long-term)**

Decision required from Forum:

Members may please deliberate.

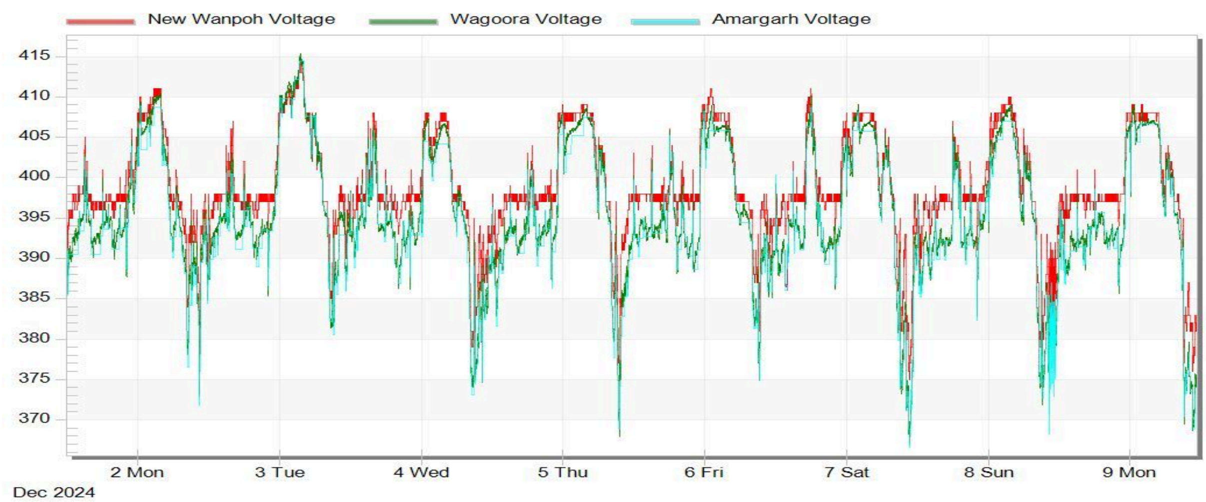
A.14 Low voltage related issues in J&K control area (agenda by NRLDC)

A.14.1 J&K grid being weakly connected from the rest of the grid and due to its isolated location suffers from issues of severe low voltage when internal generation is not available. During winter months when hydro generation is not available and demand in J&K control area is high due to heating load requirements, the issue of low voltage gets aggravated. J&K also has to pay large amounts as reactive energy charges to pool due to high MVAr drawl from ISTS grid at the time of low voltage.

A.14.2 It has been discussed and suggested to J&K to plan & expedite commissioning of reactive power devices especially capacitors at lower voltage level to improve the voltage profile in valley area and also avoid large sums payable as reactive energy charges.

A.14.3 Low voltage related issues of J&K and Ladakh (UT) has been regularly shared by NRLDC with CEA and CTUIL in Grid-India's quarterly operational feedback report. The issue has been continuously raised in NRPC as well as OCC meetings still the issues of low voltage persist in J&K especially Kashmir valley.

A.14.4 As can be seen from recent trends, 400kV voltages are reaching 370kV at Amargarh, Wagoora and Wanpoh substations. Even the SVC at New Wanpoh is being fully utilized and no margin is available for dynamic support. Situation is likely to worsen with decrease in temperature and increase in demand of J&K state. Plots of 400kV bus voltages of Amargarh, Wagoora and Wanpoh substations for first week of Dec 2024 are shown below:



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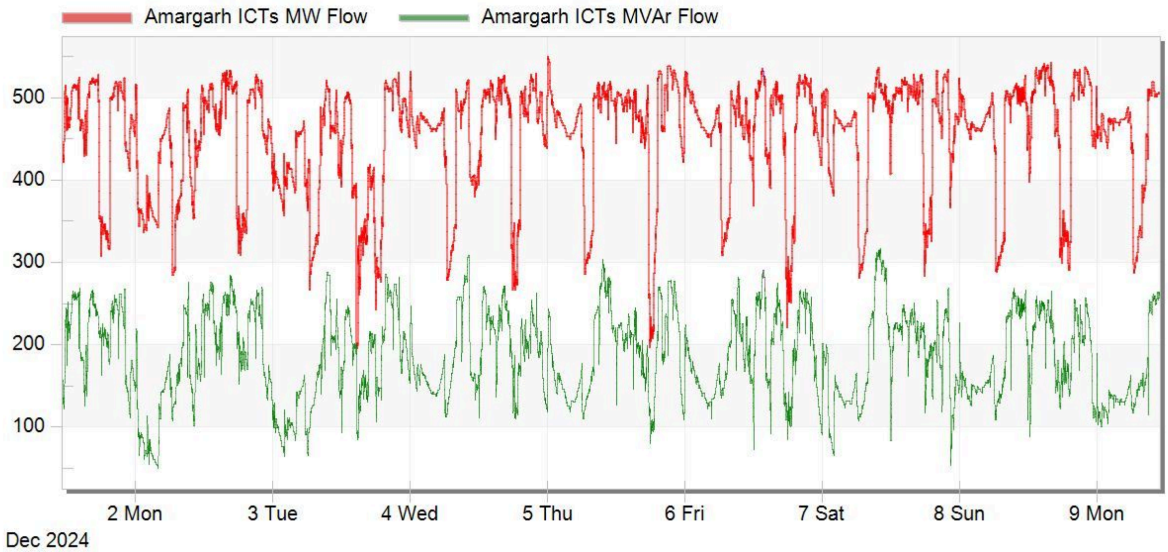
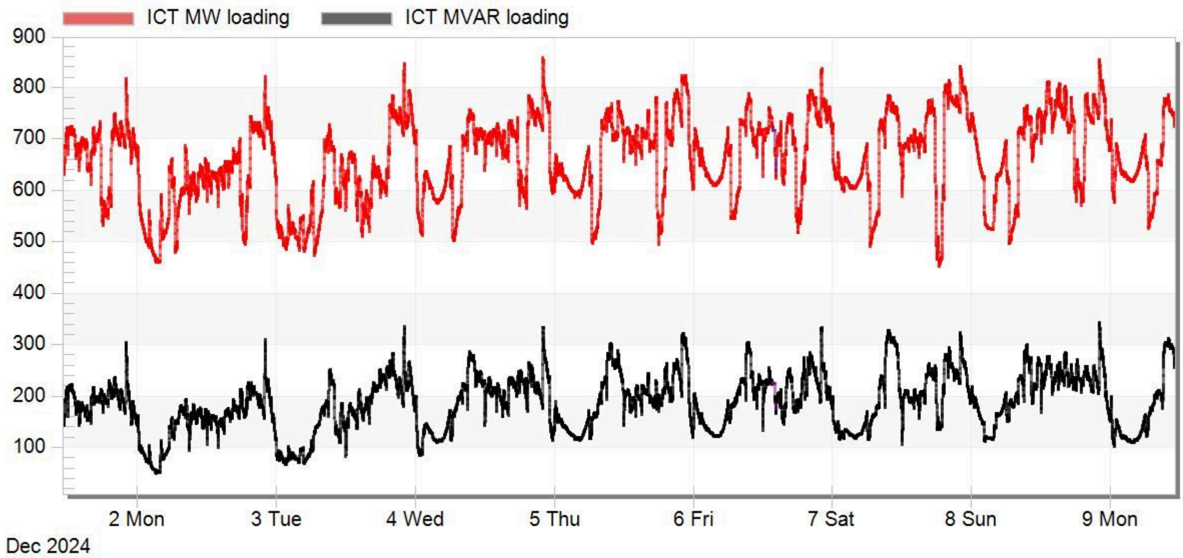
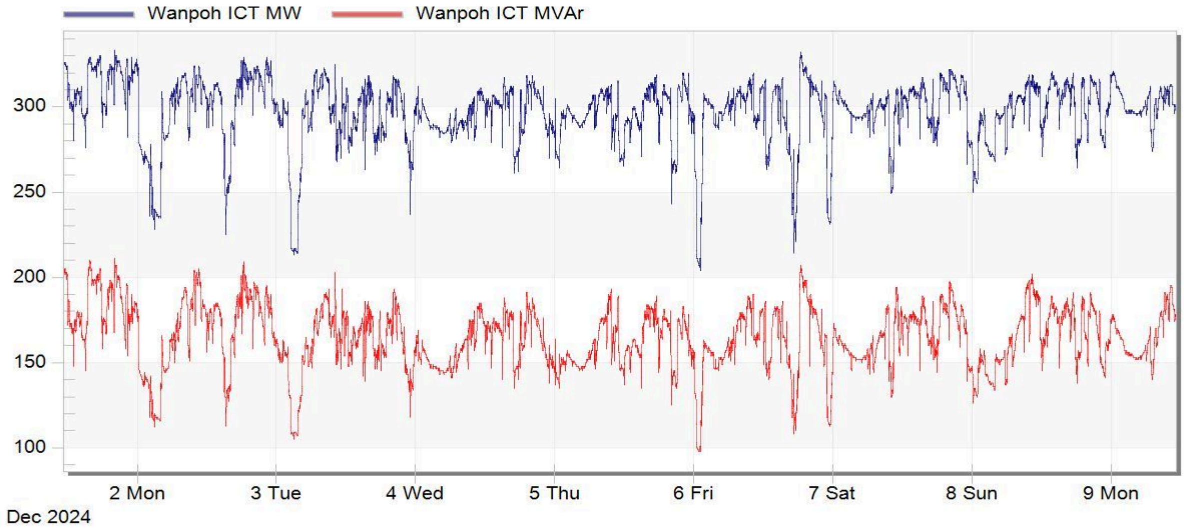
A.14.5 Pattern of MW and MVAR drawl by 400/220kV ICTs at ISTS substations such as Amargarh, Wagoora and New Wanpoh suggest, there is urgent requirement of reactive compensation in intrastate network. From the plots, it is clear that the reactive drawl is at least half of the MW drawl of 400/220kV ICTs. This increases % loading of transmission elements and also leads to low voltages in the grid. The power factor at 400/220kV ISTS substations is in range of 0.8-0.9.

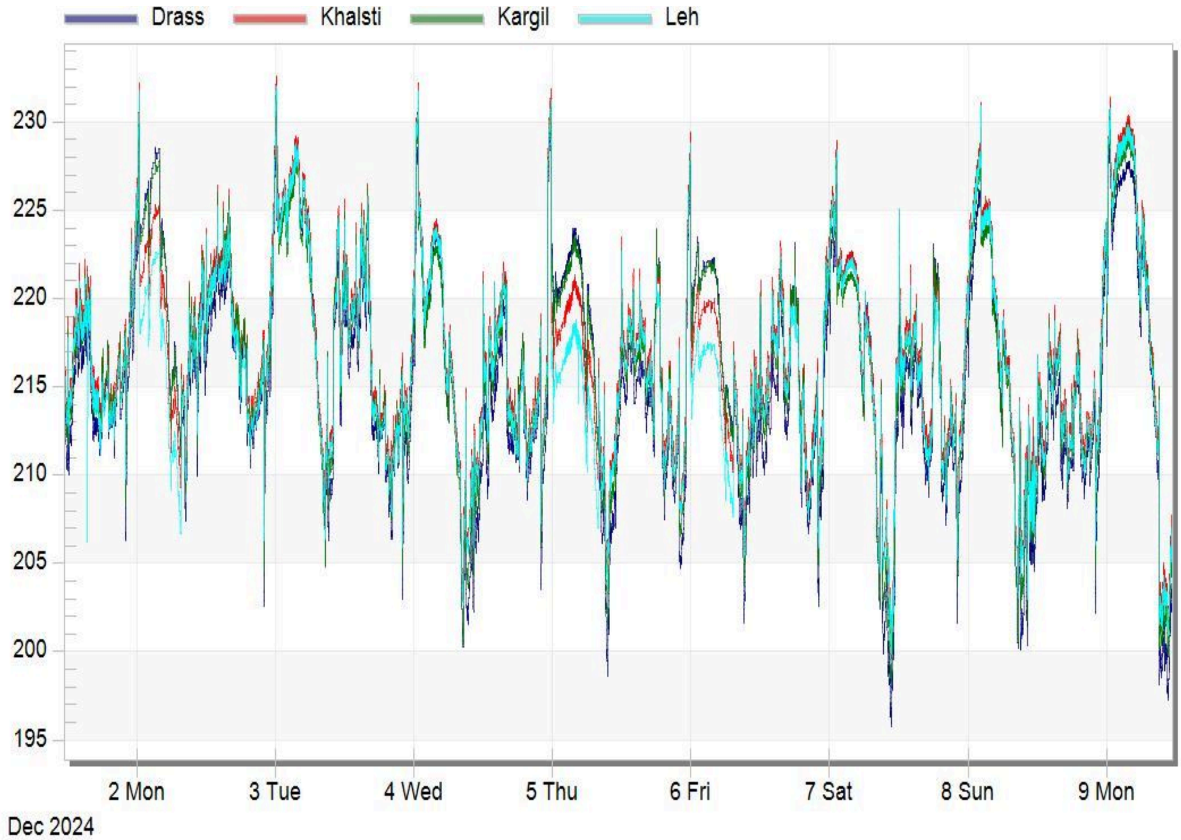


Wagoora ICTs

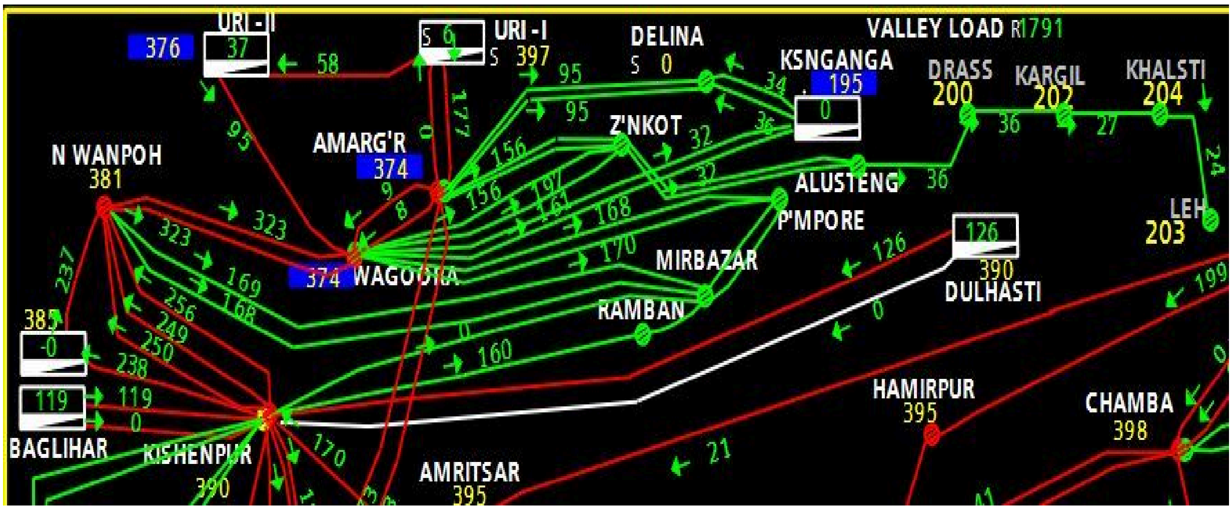




A.14.6 Further, low voltages are also being observed in Ladakh area also during winter months:



A.14.7 Network snapshot for 09.12.2024 @ 10:30hrs is shown below, where low voltages in J&K area can be clearly seen:



A.14.8 In special meeting taken by NRPC with J&K on 12.10.2023, following was discussed w.r.t. low voltage J&K control area:

A.14.9 NRLDC representative requested that following may be shared by J&K:

- List of nodes & node wise capacitor bank requirement (as finalised by JPDCL, KPDCL & JKPTCL)
- Tentative timeline for tendering and commissioning of capacitor banks
- List of nodes in J&K and Ladakh facing low voltage issues along with the voltage profile
- Status of 350MVAr capacitor bank at 11 kV under progress.

A.14.10 JPDCL representative informed that at present 392MVAr capacitor is functional. Further, 720 MVAr capacitors are also under proposal/implementation as per RDSS (Revamped Distribution Sector Scheme) scheme.

A.14.11 JKPTCL representative informed that at present 323MVAR is commissioned in transmission level out of which 240MVAR is functional. The faulty capacitors would be readied by end of this year. Further, new capacitors have been proposed under capital expenditure.

A.14.12 MS NRPC expressed concern on the issue highlighted by NRLDC and asked J&K to expedite their actions. It was also informed that if required, PSDF proposal may also be submitted by J&K.

A.14.13 In 71 NRPC meeting, NHPC representative stated that the voltages are also remaining low in Uri & Uri-II hydro stations. Low voltage at these stations also is stressing hydro units at these stations.

A.14.14 In 71 NRPC meeting, it was discussed that capacitors and supply of reactive power at local level is the only solution.

A.14.15 J&K representative stated that only 78MVAr capacitors are functional as on date in Kashmir area. They shall submit plan to improve the voltage profile in the area. It was further informed that 220kV Alusteng-Mirabzar is under commissioning and 50km line works are pending and expected to be charged before next winter.

A.14.16 NRLDC representative also asked JKPTCL, JPDCL and KPDCL to expedite the commissioning of number of transmission elements are being implemented in J&K control area including those funded by PMDP-2015 & PMRP-2004. It is important that these already approved transmission elements along with capacitors for reactive power support are commissioned at the earliest to improve the transmission network in J&K control area.

A.14.17 Further, in a meeting organized by CEA on 04.10.2023 to deliberate the issue of Charging of 220 kV Wagoora- Zainakote Transmission line after re-conductoring, J&K was asked to remove the tapping of 220kV Wagoora-Ziankote line and NRPC/OCC was asked to follow up the same at RPC level. Extract of MoM of the meeting are quoted below:

“JKPTCL was requested to complete the 2nd D/c line between Wagoora- Zainakote with LILO at Budgam, at the earliest and subsequently remove the tapping of existing circuit at Budgam at the earliest.”

“NRPC to be apprised about the issue, so that the same could be deliberated in NRPC/OCC forum so as to ensure that the tapping is removed at the earliest.”

A.14.18 In 71 NRPC meeting, J&K representative stated that land acquisition is in progress for one pending tower location & it is expected that the line would be charged very soon. MS NRPC stated that the line may also be included in list of follow up agenda of OCC meeting. But due to infrequent participation from J&K in OCC meeting, status is not getting updated.

A.14.19 In this Meeting, NRLDC has requested J&K to provide update on the following points:

a) Actions being taken to avoid low voltage issues in the Kashmir valley area during winter months and also minimise reactive energy charges payable to pool account
b) Status of removal of T-point of 220kV Wagoora-Ziankote at Budgam

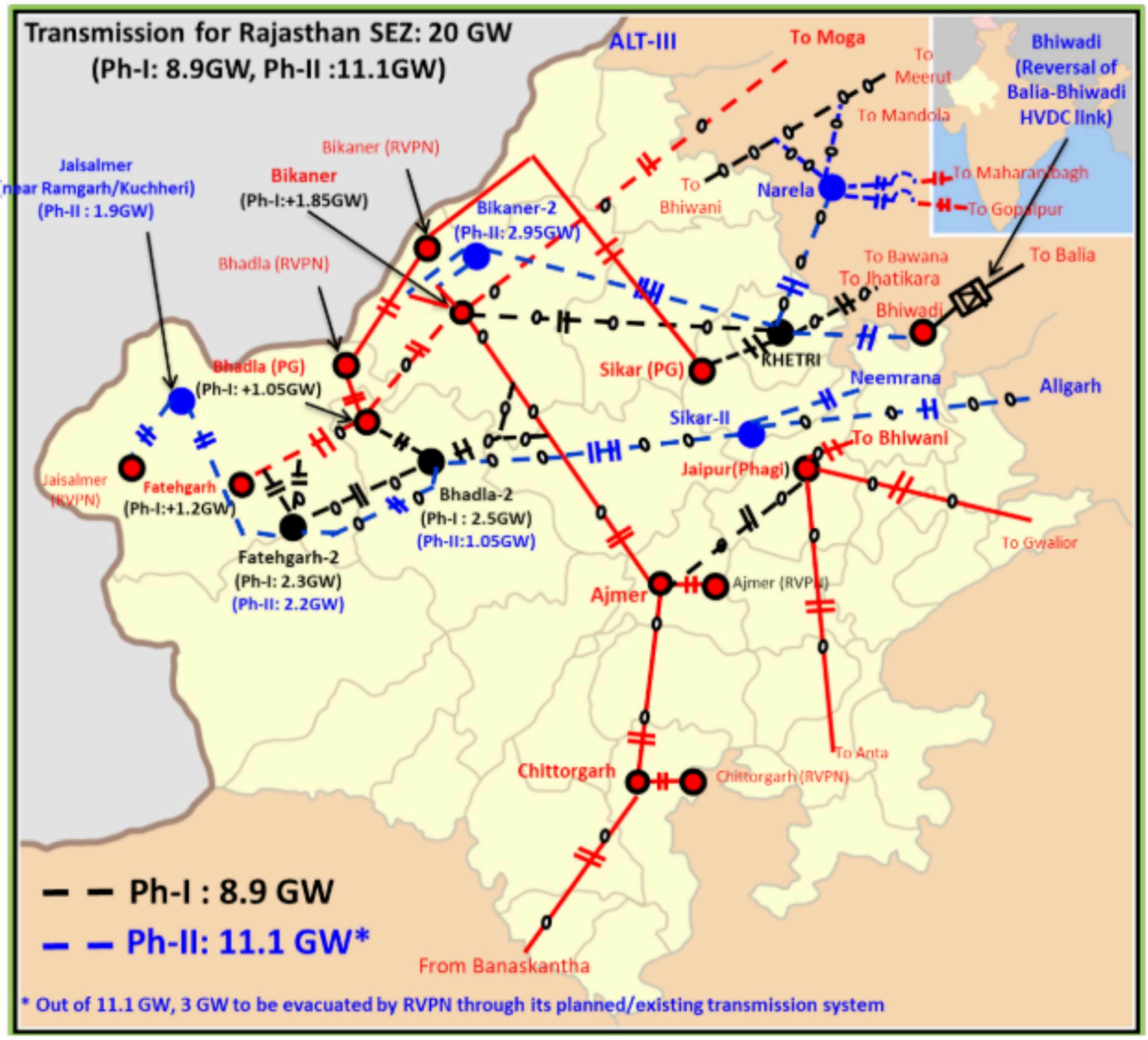
Decision required from Forum:

Members may please deliberate.

A.15 Expediting transmission system related to evacuation of RE power in Western Rajasthan (agenda by NRLDC)

A.15.1 Transmission system strengthening scheme for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under phase II –Part C was approved in 5th meeting of NRSCT held on 13.09.2019. Subsequently, SPV named POWERGRID Sikar Transmission Ltd., was acquired on 04.06.2021 and as per TSA implementation schedule was provided as Dec 2022 for commissioning of 765/400kV Sikar-II and associated transmission system.

A.15.2 There has been delay of two years with respect to commissioning of 765 kV Bhadla 2 - Sikar 2 D/C lines. Due to non-availability of 765 kV Bhadla 2 - Sikar 2 D/C lines the Rajasthan ISTS RE system is already deeply stressed and the lines from RE complex remain heavily loaded as already more than 5GW of solar generation is being evacuated for which complete associated transmission system is yet to be commissioned. There are issues related to high loadings in the RE complex and it would be difficult to provide major shutdowns of existing transmission lines such as outage of 765 KV lines from Bikaner as it would further stress the available transmission system.



A.15.3 In case of availability of 765 KV-Bhadla 2-Sikar-2 lines, the RE complex would be connected to load centers. Interconnection with load will also help to stabilise the grid and the impact of frequent transient fault impact could be minimized.

A.15.4 Recently, the proposed shutdown of 765kV Bikaner-Moga D/C and 765kV Bikaner-Khetri D/C are regularly being discussed at OCC levels, wherein it has been discussed that if this shutdown is allowed at present, there shall be RE curtailment of the order of 1500 MW to 3500 MW under different scenarios. In view of above, shutdown of 765kV Bikaner-Moga D/C and 765kV Bikaner-Khetri D/C were not approved in the present scenario considering the quantum of RE curtailment.

A.15.5 In the remaining portion of the current financial year (2024-25), approx. 3300 MW additional RE is proposed to be integrated progressively in the Rajasthan RE complex. However, with the existing transmission network, it is not possible to evacuate further RE generation, till additional transmission system including 765 KV-Bhadla 2-Sikar-2 lines are charged. The present grid is already under lot of stress in Western Rajasthan and all efforts are being made from NRLDC side to maximize the evacuation of RE power. Therefore, actions are required from POWERGRID side on war footing basis.

A.15.6 The matter was also discussed in 75th NRPC meeting held on 28.08.2024. In the meeting, POWERGRID was requested to expedite commissioning of 765 KV-Bhadla 2-Sikar-2 lines and 765kV Sikar2- Aligarh and 400kV Sikar-2-Neemrana lines transmission lines along with 765/400kV Sikar2 substation.

A.15.7 POWERGRID representative informed that land was provided to POWERGRID in Dec 2023 for Sikar-II and accordingly the project was slightly delayed. Following timelines were provided for anticipated transmission elements during the meeting:

- 765kV Bhadla2-Sikar-2 D/C is expected by Nov-Dec 2024.
- 400kV Sikar-2-Neemrana D/C lines is expected by Sep 2024 end.
- 765kV Sikar-2-Aligarh D/C lines is expected by Oct 2024 end.
- 765/400kV Sikar-2 substation is expected by Dec 2024, therefore all elements will be effectively charged by Dec 2024.

A.15.8 As on date, 400kV Sikar-2-Neemrana D/C and 765kV Sikar-2-Aligarh D/C lines have been commissioned however, complete portion of 765kV Bhadla2-Sikar-2 D/C is yet to be energized.

A.15.9 POWERGRID is requested to expedite commissioning of 765 KV-Bhadla 2-Sikar-2 lines which has been delayed by more than two years and provide latest status. Further, it is suggested that other transmission system which is being implemented as part of RE evacuation is commissioned in expeditious manner so that maximum RE generation is integrated to the grid.

Decision required from Forum:

Members may please deliberate.

A.16 Workforce adequacy guidelines for load despatch centers and Guidelines for deputation of workforce from SLDCs to GRID-INDIA (agenda by NRLDC)

A.16.1 MoP vide communication dated 30.10.2024 (**Annexure-XX**) had circulated Workforce Adequacy Guidelines for Load Dispatch Centers and Guidelines for deputation of Workspace from SLDCs to Grid - India for fixed terms.

- Workforce Adequacy Guidelines for Load Dispatch Centers will serve as a Bench Mark for enhancing the Load Despatch Centres to ensure that LDCs are equipped with sufficient skilled manpower resources.

- Guidelines for Load Dispatch Centers and Guidelines for deputation of Workspace from SLDCs to Grid focus on fostering collaboration and knowledge sharing among various SLDCs

A.16.2 The Guideline proposes the following allocation

LDCs - Workforce Staffing Norms						
SN	**Function**	**NLDC**	**RLDC**	**Large SLDC**	**Medium SLDC**	**Emerging SLDC**
System Operation						
1	System Operation - Operational Planning	18	18	18	16	9
2	Real Time Grid Operation (For SO only)	31	31	31	26	18
3	Post-Despatch	10	10	10	10	4
Sub -Total (SO)		**59**	**59**	**59**	**52**	**31**
Market Operation						
4	Open Access Administration	5	4	4	1	1
5	Market Coordination	4	4	4	3	1
6	Inter-face Energy Metering, Accounting and Settlement	10	8	8	4	1

7	Regulatory Affairs, Market Operation Planning and Coordination	7	5	5	1	1
Subtotal - MO		**26**	**21**	**21**	**9**	**4**
Logistics						
8	Logistics _Operation technology	15	14	14	8	3
9	IT Logistics	9	9	9	6	3
10	Communication Logistics	4	4	4	2	2
Subtotal - Logistics		**28**	**27**	**27**	**16**	**8**
REMC						
11	REMC Logistics	3	3	3	2	1
Cyber Security						
12	**Cyber Security**	**17**	**8**	**14**	**13**	**10**
Support Functions						
13	Contract Services	3	3	3	2	2
14	Finance and Accounts	9	9	9	5	3
15	HR & Admin	8	8	8	4	3
Subtotal -Support Functions		**20**	**20**	**20**	**11**	**8**
Grand-Total		**153**	**138**	**144**	**103**	**62**

A.16.3 In Northern region, following is classification of SLDCs:

a. Large SLDC: Rajasthan, UP, Punjab, Haryana
b. Medium SLDC: Delhi, HP, Uttarakhand, J&K and Ladakh
c. Emerging SLDC: Chandigarh

A.16.4 IEGC 2023 has mandated all utilities including LDCs to perform new tasks. It has come out of discussion that with the present manpower in LDCs, it is challenge to perform all the tasks mentioned in the IEGC 2023 within the timelines provided. This point also emerged during discussion between various RLDCs/NLDC and CERC in the matter related to CERC order 9/SM/2024 dated 07.10.2024.

A.16.5 Based on the guidelines issued by MoP, NRLDC has suggested that LDCs ensure sufficient manpower in their control centers so that all tasks are completed in time bound manner.

Decision required from Forum:

Members may please deliberate

A.17 J&K Telemetry Issues (agenda by NRLDC)

A.17.1 Reliability and accuracy of SCADA data and its associated communication system is essential for monitoring and coordinating operations of a large electricity grid. It helps in visualization and management of the critical grid element failure/grid incident in real time and minimizes the possibility of any untoward incidences/disturbances.

A.17.2 Real-Time data availability from Jammu and Kashmir is very poor. There is zero visibility of data in J&K stations at J&K and NRLDC. With poor monitoring of data, it is very difficult to monitor grid in efficient manner.

A.17.3 The matter has been discussed in various TCC and TeST Meetings but there is no improvement of the same. Brief details are as follows:

- Under SCADA upgrade project M/s Siemens at all 400KV / 220 KV and 132 KV substations/generating Stations of J&K PDD installed 66 RTUs.
- RTUs were not integrated with Control centre due to non-availability of communication network.
- RTUs were tested locally and commissioned without data availability at Control Centre.
- Due to Non availability of data, JK PDD is not able to monitor its drawal from grid and its generation. It is dependent of Central sector data for monitoring of drawal.
- Matter was also discussed in Special Meeting with J&K on 28.07.2020 where in Representative of J&K informed that they have given consultancy work to POWERGRID for installation of OPGW in J&K. However, due to funding issue OPGW work has been stalled by POWERGRID. According to J&K almost 95% of the work is complete and once funding issue is resolved Non-availability of telemetry issue will be resolved.
- Further, it was informed that payment issues were resolved and many communication links were commissioned and pending link would be commissioned by December 2022.

- Matter was also discussed in 47th TCC-49th NRPC Meeting, J&K confirmed that they will resolve the issues mutually with POWERGRID so that data starts reporting to SLDC/ NRLDC.
- During 19th TeST Meeting dated 07.03.2022, J & K representative informed that by 31st December 2022 all 70 RTUs will be integrated with SLDC.
- During 20th TeST Meeting held on 09.09.2022 it was discussed that J&K informed that although some of the links have been commissioned but data reporting is yet to start due to disconnection of CT/PT cables at site / other integration issues of the RTU. Further it was informed that they are in process of rectification of RTU issues and joint visit is planned with M/s Siemens.
- During 64th NRPC Meeting held on 24th March 2023 it was informed that joint visit could not be conducted and after discussions it was decided that a joint meeting shall be conducted comprising members from Siemens, POWERGRID, J&K and NRLDC to resolve the RTU integration issues.
- During 68th NRPC Meeting held on 18th Aug 2023 Representative from J&K informed that there is no improvement in regard to telemetry and they are taking up with POWERGRID and Siemens.
- Issue was also discussed in 23rd TeST Meeting on 21st Sep 2023 and Special Meeting with J&K on 12th Oct 2023 where in J&K confirmed they will start the process of RTU integration with the support of Vendor. However, till date there is no improvement in data reporting from J&K Sub-stations.
- Issue was also discussed in 24th TeST Meeting on 09th Feb 2024.
- Further Issues was discussed in 50th TCC- 74th NRPC held on 28th/29th June 2024 where J&K representative informed that they are in discussion with OEM i.e. M/s Siemens for integration of RTUs. Further, they are arranging fund of approx. 34crore, so that communication links can be commissioned.
- As per information received from J & K there is no improvement in regard to RTU Integration/ Communication links commissioning.

Decision required from Forum:

J&K may update the status.

A.18 Non-availability of Real-Time data from PTCUL (agenda by NRLDC)

A.18.1 As per details submitted by PTCUL out of 58 Sub-Station/Generating Stations data from only 26 Sub-stations are integrated at SLDC.

A.18.2 The same issue was also informed to PTCUL vide letter (Ref: - NRLDC/SLII/2019-20) dated: - 05.03.2020 38.3. Issue was discussed in Special Meeting with PTCUL held in July 2020 and December 2020. Subsequently issue was also discussed in 17th, 18th & 19th Test Meeting and 45th TCC-48th NRPC and 47th TCC-49th NRPC, 64th NRPC.

A.18.3 During 47th TCC -49th NRPC dated 27.12.2021, representative from PTCUL informed that they are in the process of tendering of RTU and OPGW Installation work and informed that they would expedite the installation works, and is expected to be completed in 6 months.

A.18.4 During 52nd NRPC Meeting dated 31.12.2022 NRPC Meeting PTCUL informed that PTCUL representative informed that they are on the verge of finalizing the OPGW project and order will be placed in one-month duration. Tender has been floated for RTU.

A.18.5 During 22nd TeST Meeting representative from PTCUL informed that last tender was cancelled due to higher rates then estimate; there was approximate 39% more than estimate. Further, it was informed that they have prepared fresh DPR for RTU & OPGW installation and they would submit the proposal within next 7-10 days. After approval, PTCUL will initiate tendering process and try to expedite the work.

A.18.6 It may be noted that SCADA upgradation project is also in progress, PTCUL is requested to please match the timelines with SCADA project, so that RTU can be integrated along with new SCADA commissioned.

A.18.7 During 26th TeST Meeting, representative from PTCUL informed that the project is stuck due to non-availability of funding from PSDF. After detailed discussion forum suggested PTCUL to explore alternate arrangements for project funding such as its own funds or state PSDF and complete RTU /OPGW procurement.

Decision required from Forum:

PTCUL may update the status.

A.19 Non-payment issues related to DSM Pool Account (agenda by NRLDC)

A.19.1 Hon'ble CERC has approved "Detailed Procedure for recovery of charges in case of deficit in the Deviation and Ancillary Service Pool Account" (effective from 15.10.2024) for recovering the deficit in the pool for the period prior to 16.09.24 (Legacy dues).

A.19.2 In line with the approved procedure, NLDC had published statement namely "Net Deviation & Ancillary Services Pool Account Deficit Recovery Statement for period prior 16.09.2024 (Legacy Dues)" dated 11.11.2024, specifying the All-India deficit of Deviation and Ancillary Services Pool Accounts and per instalment amount to be paid by the drawee DICs. Details of deficit recovery of NR constitutes are given below:

Sr. No.	DIC	Total Pending Due	Instalment
1	UP	2,68,53,67,413	13,42,68,371
2	Haryana	1,67,16,28,418	8,35,81,421
3	Rajasthan	1,47,34,79,616	7,36,73,981
4	Punjab	1,46,82,60,314	7,34,13,016
5	Delhi	1,29,40,23,118	6,47,01,156
6	J&K	54,99,80,111	2,74,99,006
7	Uttarakhand	39,14,40,897	1,95,72,045
8	Himachal Pradesh	27,14,44,395	1,35,72,220
9	Chandigarh	8,51,95,453	42,59,773
10	Railway	4,55,69,616	22,78,481
11	POWERGRID HVDC	22,15,628	1,10,781
12	NFL	5,32,116	26,606
Total		9,93,91,37,095	49,69,56,857

i. Non-payment of pool deficit recovery:

Latest status of amount received as on 10.12.2024 is shown below:

Sr. No.	DIC	Total Pending Due	Instalment	Instalment-1 Due Date: 21/11/2024	Instalment-2 Due Date: 28/11/2024	Instalment-3 Due Date: 05/12/2024	Instalment-4 Due Date: 12/12/2024

1	UP	2,68,53,67,413	13,42,68,371	-	-	-	-
2	Haryana	1,67,16,28,418	8,35,81,421	8,35,81,421	8,35,81,421	8,35,81,421	-
3	Rajasthan	1,47,34,79,616	7,36,73,981	7,36,73,981	7,36,73,981	7,36,73,981	-
4	Punjab	1,46,82,60,314	7,34,13,016	7,34,13,016	7,34,13,016	7,34,13,016	-
5	Delhi	1,29,40,23,118	6,47,01,156	6,47,01,156	6,47,01,156	6,47,01,156	-
6	J&K	54,99,80,111	2,74,99,006	-	-	-	-
7	Uttrakhand	39,14,40,897	1,95,72,045	1,95,72,045	1,95,72,045	1,95,72,045	-
8	Himachal Pradesh	27,14,44,395	1,35,72,220	1,35,72,220	1,35,72,220	1,35,72,220	-
9	Chandigarh	8,51,95,453	42,59,773	-	-	-	-
10	Railway	4,55,69,616	22,78,481	22,78,481	-	-	-
11	POWERGRID HVDC	22,15,628	1,10,781	1,10,781	1,10,781	1,10,781	1,10,781
12	NFL	5,32,116	26,606	26,606	26,606	26,606	-
Total		**9,93,91,37,095**	**49,69,56,857**	**33,09,29,707**	**32,86,51,226**	**32,86,51,226**	**1,10,781**

Uttar Pradesh, Jammu & Kashmir, and Chandigarh have not paid the instalment of pool deficit recovery.

ii. Non-payment of Deviation Charges:

Jammu & Kashmir has not paid the deviation charges since February 2024. Total outstanding as on date is ₹ 114.47 Cr.

Decision required from Forum:

Concerned entities are requested to provide update.

A.20 Submission of Bank Account Details by Chandigarh (agenda by NRLDC)

A.20.1 Despite repeated request, Chandigarh are yet to be submit the bank account details for enabling electronic mode of payments from the pool accounts.

A.20.2 NRLDC could not release a payment of Rs 1.82 crore towards deviation charges/reactive energy charges to Chandigarh due to the lack of required bank account information. UT Chandigarh is again requested to complete the Formalities related to submission of the required Bank details to NRLDC for Timely Disbursement of Deviation and Reactive Energy Charges from the NRLDC Deviation and Ancillary Service Pool Account.

Decision required from Forum:

Chandigarh U/T may provide update.

A.21 Not opening of LC against Default in Deviation charges (agenda by NRLDC)

A.21.1 Following entities have not opened LC against default in payment of deviation charges in FY 2023-24

Sl. No.	Name of NR Pool members	No of defaults in Deviation Payment during FY 2023-24	LC Amount in Rs.
1	ABC RENEWABLE	11	20,29,307
2	Adept Renewable Technologies	7	28,63,177
3	AMP Energy Green Six	10	26,18,812
4	HIMACHAL PRADESH	1	3,89,22,672
5	HPPCL	4	5,97,366
6	JAMMU AND KASHMIR	43	8,03,50,659
7	NFL	3	1,22,167
8	NHPC	1	36,94,975
9	NPC	2	40,98,418
10	NTPC SOLAR	2	32,40,692
11	RAJASTHAN	2	5,37,18,885
12	Transition Energy	4	13,12,674

Decision required from Forum:

Concerned entities are requested to provide update.

A.22 Procurement of cold spare transformers and reactor for Northern Region (agenda by POWERGRID)

A.22.1 Agenda for procurement of cold spare transformers and reactor for Northern Region has been discussed in OCC 226th OCC meeting wherein following was agreed by Forum: -

Capacity wise details of transformers and reactors with spare requirement in Northern Region

Sl No	State/ UT	MVA Rating and Phase	Voltage	Total installed unit	Spare Required as per CERC report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
1	DELHI	3Ø-500 MVA	400/220	10	1	1	0		Tughlakabad	
2	HARYANA	3Ø-500 MVA	400/220	17	1	2	0		Manesar GIS & Panchkula (Given to PSTCL)	
3	PUNJAB	3Ø-500 MVA	400/220	12	1	1	0		Moga	
4	RAJASTHAN	3Ø-500 MVA	400/220	32	2	1	0		Jaipur South	
5	UTTAR PRADESH	3Ø-500 MVA	400/220	15	1	1	0		Lucknow	
6	UTTARAKHAND	3Ø-500 MVA	400/220	1	1	0	1	26.81		Required at Roorkee
Total for Northern Region:				87	7	6	1	26.81		

Sl No	State/ UT	MVA Rating and Phase	Voltage	Total installed unit	Spare Required as per CERC report	RPC Approved Spares	Qty Proposed for procureme	Approx. Cost (Rs. In Cror	Availability of RPC Spare	Remarks

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							nt	e)		
1	DELHI	3Ø-315 MVA	400/220	3	1	0	1	20.24		Maharanibagh/ Bawana
2	HARYANA	3Ø-315 MVA	400/220	22	2	1	0		Ballabgarh (GSI)	
3	HIMACHAL PRADESH	3Ø-315 MVA	400/220	3	1	0	1	20.24		Required at Nallagarh
4	JAMMU & KASHMIR	3Ø-315 MVA	400/220	3	1	0	1	20.24		Required at Sambha
5	PUNJAB	3Ø-315 MVA	400/220	10	1	2	0		1 under procurement in POWERGRID & Ludhiana - Given to DTL	
6	RAJASTHAN	3Ø-315 MVA	400/220	18	1	1	0		Bhiwadi - Given to RVPNL	
7	UTTAR PRADESH	3Ø-315 MVA	400/220	21	2	2	0		2 under procurement in PO	

									WERGRID	
8	UTTARAKHAND	3Ø-315 MVA	400/220	4	1	0	1	20.24		Required at Dehradun
Total for Northern Region:				84	10	6	4	80.96		

Apart from the above, 03 nos. 400/220/33kV ICTs given to DTL on loan basis.

Sl No	State/UT	MVA Rating and Phase	Voltage	Total installed unit	Spare Required as per CERC report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
1	UTTAR PRADESH	3Ø-200 MVA	220/132	2	1	1	0		Raibareilly	
Total for Northern Region:				2	1	1	0	0		

Sl No	State/UT	MVA Rating and Phase	Voltage	Total installed unit	Spare Required as per CERC report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
	CHANDIGARH	3Ø-160 MVA	220/66	2	1	0	1	11.7		Required at Chandigarh
Total for Northern Region:				2	1	0	1	11.7		

Sl. No.	State	Voltage Rating	Capacity in MVAR	Total installed Unit	Spare required as per CERC Committee report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
1	Delhi	420 kV	125	3	1	0	1	13.00		
2	Haryana	420 kV	125	11	1	0	1	13.00		
3	HP	420 kV	125	1	1	0	1	13.00		
4	J&K	420 kV	125	2	1	0	1	13.00		
5	Punjab	420 kV	125	7	1	0	1	13.00		
6	Rajasthan	420 kV	125	12	1	0	1	13.00		
7	UP	420 kV	125	21	2	0	1	13.00		
8	Uttrakhand	420 kV	125	2	1	0	1	13.00		
Total for Northern Region:				59	9	0	8	104		

Sl. No.	State	Voltage Rating	Capacity in MVAR	Total installed Unit	Spare required as per CERC Committee report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
1	Haryana	420 kV	80	7	1	0	1	11.25		
2	HP	420 kV	80	4	1	0	1	11.25		
3	J&K	420 kV	80	2	1	0	1	11.25		
4	Punja	420	80	2	1	0	1	11.2		

	b	kV						5		
5	Rajasthan	420 kV	80	7	1	0	1	11.25		
6	UP	420 kV	80	16	1	0	1	11.25		
7	Uttrakhand	420 kV	80	1	1	0	1	11.25		
Total for Northern Region:				39	7	0	7	78.75		

Sl. No.	State	Voltage Rating	Capacity in MVAR	Total installed Unit	Spare required as per CERC Committee report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
1	Haryana	420 kV	50	12	1	0	1	9.26		
2	HP	420 kV	50	4	1	0	0	0		
3	HP	420 kV	63	2	1	0	1	9.56		
4	J&K	420 kV	50	5	1	0	0	0		
5	J&K	420 kV	63	3	1	0	1	9.56		
6	Punjab	420 kV	50	8	1	0	0	0		
7	Punjab	420 kV	63	4	1	0	1	9.56		
8	Rajasthan	420 kV	50	22	2	0	0	0.00		
9	Rajasthan	420 kV	63	2	1	0	1	9.56		
10	UP	420 kV	50	36	2	0	0			
11	UP	420 kV	63	11	1	0	1	9.56		

12	Uttrakhand	420 kV	50	0	0	0	1	9.56		
Total for Northern Region:				109	13	0	7	66.62		

Sl. No.	State	Voltage Rating	Capacity in MVAR	Total installed Unit	Spare required as per CERC Committee report	RPC Approved Spares	Qty Proposed for procurement	Approx. Cost (Rs. In Crore)	Availability of RPC Spare	Remarks
1	Haryana	220 kV	25	2	1	0	1	5.00		
2	J&K	220 kV	25	1	1	0	1	5.00		
3	LADAKH	220 kV	25	2	1	0	1	5.00		
4	Punjab	220 kV	25	3	1	0	1	5.00		
5	UP	220 kV	25	1	1	0	1	5.00		
6	Uttrakhand	220 kV	25	2	1	0	1	5.00		
Total for Northern Region:				11	6	0	6	30		

Special type of transformer

1	GIS Maharani Bagh	3Ø-500 MVA	400/220	2	1	0	1	30		HV bushings: Oil to GIS IV Bushings: Oil to Oil
2	GIS Baghpat	3Ø-500 MVA	400/220	2	1	0	1	30		

Special type of Reactors

1	GIS Manesar	420 kV	125	2	1	0	1	14.00		HV bushings: Oil to GIS
2	GIS Baghpat	420 kV	125	1	1	0	1	14.00		

A.22.2 Considering the shortages of Cold spare Transformers and lead time for procurement, procurement of Cold spare Transformers & Reactors on regional basis at cost estimate of Rs 486.84 Cr has been concurred in 226th OCC. POWERGRID has put the same for approval of NRPC Forum.

Decision required from Forum:

Members may please deliberate and accord approval accordingly.

A.23 Report of Committee on Futuristic analysis for requirement of Synchronous Condensers based on System Strength and Inertia considerations for Northern Region (agenda by NRPC Secretariat)

A.23.1 In the 71st NRPC meeting held on 29th January 2024, it was deliberated that RE power is being integrated in fast pace country-wide and to ensure grid stability and provide inertial support in RE complex, requirement of dynamic compensation like Synchronous Condensers needs to be identified separately based on the detailed reactive power planning studies and the Short Circuit Ratios (SCRs) at different locations.

A.23.2 As per the decision taken in 71st NRPC meeting, a committee of members from CEA, NRPC, NRLDC, CTU and STU was to be constituted under chairmanship of Member Secretary, NRPC to do futuristic analysis for requirement of Synchronous Condensers based on the inertia considerations for Northern Region.

A.23.3 Accordingly, a committee was formed under Chairmanship of Member Secretary, NRPC along with members from CEA, NRPC, NRLDC, NLDC, NTPC, BHEL, CTU and STUs to do futuristic analysis for the requirement of Synchronous Condensers based on the inertia considerations for Northern Region.

A.23.4 Subsequently, the Committee conducted 05 nos. of meetings wherein deliberations on the requirements of Synchronous Condenser including other available technologies were done. During the committee meetings, presentations by different OEMs viz BHEL, Hitachi and Andritz Hydro were also made, highlighting various technological options available and its suitability under different system requirements. Committee have finalized its report and the same is attached at **Annexure-XXI.**

A.23.5 Committee has concluded that in view of huge RE capacity addition in the Northern Region, particularly in Rajasthan State, and the challenges thereafter like Oscillations in RE complexes, Reactive Power, Inertia & Short Circuit ratio (SCR) requirements must be addressed accordingly. The Committee is in, therefore, consensus of installation of SynCons in RE complexes because of its inherent advantages of providing inertia, reactive power & short circuit strength to the Grid.

A.23.6 Following are the recommendations of the committee:

i. In view of huge RE capacity addition in the Northern Region, particularly in Rajasthan State, the Committee agreed with consensus for installation of SynCons in existing substation in RE complexes because of the following advantages of SynCons:

   a) Enhancement in System Strength/ Short Circuit Ratio (SCR)

   b) Fast Reactive Power Support during Faults/Transients

   c) Increased Inertia and Frequency Response

   d) Damping of Low Frequency Oscillations

   e) Steady-state Reactive Power Support

ii. As per the study results, the committee recommends installation of first SynCon of 2 X +300/-200 MVAR at 400kV level either at Fatehgarh-II (Priority-1) or Fatehgarh-I (Priority-2) Substation with the completion timeline of 2026-2027 as the land for installation of SynCons is available at Fatehgarh-II Substation of POWERGRID.

iii. Committee also recommends installation of additional SynCons in timelines of 2027-28, 2028-29 & 2029-30 as per table 11.1 of the report based on the evolving scenarios & studies for above timeline.

iv. Committee recommends to consider SynCon as 'transmission asset' similar to STATCOM & SVC for its compensation mechanism with cost recovery through monthly transmission charges (Regional component). Further, it is recommended that the active power consumed by SynCon be treated as transmission losses within the ISTS and not be charged under deviations.

Availability computation of SynCon shall be on similar lines as specified for STATCOM in relevant regulations notified by respective commissions from time to time. The weightage factor shall be considered on pro-rata basis i.e. ratio of maximum available capacity to rated capacity of SynCon.

v. The CEA/MoP may consider the installation of above SynCons in TBCB or RTM mode similar to other transmission projects.

vi. The Committee also recommends that technical standards and other regulatory framework for adoption of SynCons may be notified on priority by concerned authorities.

vii. Committee also recommends to explore the idle/underutilized existing gas-based power plants in the country for utilization in synchronous condenser mode via suitable arrangements of clutch in gas power plants located in RE rich areas. Further, after year 2030, existing retired coal based TPS may also be explored for utilization as SynCons

A.23.7 The report shall be submitted to CEA.

Decision required from Forum:

Forum may take note of the above Committee Report and approve the same for further submission to CEA.

A.24 Uniform Protection Protocol (agenda by NRPC Secretariat)

A.24.1 In pursuance to the discussion of the 14th NPC meeting (held on 03.02.2024), a uniform protection protocol was finalized after the Protection subgroup meetings held on 21.05.2024 and 02.07.2024.

A.24.2 The finalized protection protocol is attached as **Annexure-XXII**. NPC division, CEA has prepared the Uniform Protection Protocol in accordance with Clauses 12(2) & 13 of the Indian Electricity Grid Code, 2023 (IEGC 2023) notified by the Central Electricity Regulatory Commission.

A.24.3 The Uniform Protection Protocol was approved in 15th NPC Meeting held at Nagpur on 14.11.2024 and it shall be applicable to all Regional's entities, State/Central/Private Generating Companies/ Generating Stations, SLDCs, RLDCs, CTU, STUs, Transmission Licensees connected at 220 kV (132 kV for NER) & above and RPCs.

A.24.1 In view of above, it is requested that all stakeholders may note and ensure the compliance of the same, as also agreed in the 54th Protection Sub-Committee meeting (held on 25.11.2024).

Decision required from Forum:

Submitted for kind information to Members of NRPC Forum.

A.25 Procurement of Five (5) Minute Interface Energy Meters (IEMs) with Automatic Meter Reading (AMR) System for PAN India (agenda by NRPC Secretariat)

A.25.1 **Background**:

A Joint Committee (JC) comprising members from all Regional Power Committees (RPCs), Central Electricity Authority (CEA), Central Transmission Utility (CTU), Power Grid Corporation of India Ltd. (PGCIL), and Grid-India (formerly POSOCO) finalized the Technical Specifications (TS) for 5/15 Minute Interface Energy Meters (IEMs) equipped with Automatic Meter Reading (AMR) and Meter Data Processing (MDP) for the interstate transmission system on a PAN India basis. These finalized specifications were circulated by the NPC Division, CEA, on 6th July 2022.

A.25.2 **Technical Specifications Highlights**:

a. All IEMs procured under this scheme shall support a 5-minute time block configuration.

b. These meters will record and transmit 5-minute block data to the regional AMR system, which will compute and convert this data to the 15-minute time block format, in line with regulatory requirements.

c. A provision for 1-minute instantaneous MW power flow data from the IEMs to the SLDCs (State Load Dispatch Centers) for viewing purposes is also included.

A.25.3 **Implementation Approval**:

The scheme for implementing 5-minute IEMs along with the AMR system on PAN India was approved for NR portion in the 74th NRPC meeting held on 29th June 2024.

A.25.4 **Transition Roadmap**:

In the 15th NPC meeting, following was decided i.r.o. the subject matter:

a. Procurement of new meters for fresh installations or replacement purposes should align with the approved Technical Specifications (TS). Since the scheme for 'Procurement of Five (5) Minute Interface Energy Meters along with AMR System for PAN India' has already been approved, and all non-compliant IEMs with the new TS are to be replaced, it would be prudent to procure new IEMs outside the scope of and prior to the larger implementation scheme, ensuring alignment with the approved TS to prevent any wastage during the upcoming procurement or installation process.

b. The NPC Secretariat will issue a formal communication to all stakeholders regarding this decision.

Decision required from Forum:

Submitted for information to the members of NRPC Forum.

A.26 Standard Operating Procedure (SOP) for Voice over Internet Protocol (VoIP) Connectivity for Utilities from RLDC Exchanges (agenda by NRPC Secretariat)

A.26.1 **Background**:

A draft SOP addressing the requirements of Transmission System Providers (TSPs) for VoIP connectivity with RLDC systems was prepared by CTU and approved in the

23rd TeST Sub-Committee meeting of NRPC on 21st September 2023. It was referred to the NPC for national-level finalization to address requirements in other regions.

In compliance with the 14th NPC meeting held on 3rd February 2024, a sub-committee was constituted under the chairmanship of Member Secretary, NRPC, with representatives from RPCs, PCD and NPC Divisions (CEA), RLDCs/Grid-India, CTU, PGCIL, and private TSPs. The sub-committee held three meetings (16th May, 26th June, and 8th August 2024) to deliberate on the SOP.

A.26.2 **SOP Objectives**:

The finalized SOP provides a comprehensive framework for:

a. Application and approval processes for VoIP connectivity for Control/Coordination Centers.

b. Documentation, compliance requirements, and infrastructure installation guidelines.

A.26.3 **Approval**:

The SOP was approved by NPC in its 15th meeting held on 14th November 2024 and has been referred to all stakeholders for adoption.

Decision required from Forum:

For information to the members of NRPC Forum.

A.27 Unified Accounting Software (UAS) for RPCs (agenda by NRPC Secretariat)

Background:

A.27.1 A meeting to discuss the implementation of the Unified Accounting Software for RPCs under the chairmanship of Member (GO&D), CEA was held on 20.11.2023 at Sewa Bhawan, New Delhi wherein following decisions were taken:

- ERPC shall be the Nodal RPC for implementation of Unified Accounting Software for RPCs.
- A Joint Committee shall be formed with representatives (Director/Superintending Engineer/ Deputy Director Level) from all RPCs, GM Division, CEA and NPC Secretariat.
- DPR, NIT and other documents may be prepared through a consultant.

A.27.2 In the 14th NPC meeting held on 3rd February 2024, the following decisions were made:

- Finalization of the standard output formats for commercial accounts.
- A proposal for the implementation of the Unified Accounting Software for RPCs may be prepared and thereafter, the DPR may be submitted to nodal agency i.e. NLDC for PSDF funding.
- National Energy Account be considered in scope of Unified Accounting Software.

A.27.3 In a review meeting of RPC secretariats taken by the Chairperson, CEA, on 7th August 2024, the following updates were provided:

- NRPC was assigned as the nodal RPC for UAS implementation.
- Preparation of the Detailed Project Report (DPR), Notice Inviting Tenders (NIT), and related documents to be done in-house by the committee.

A.27.4 Subsequently, the NPC Secretariat reconstituted the Committee for UAS implementation under chairmanship of Member Secretary, NRPC with officers from all RPC Secretariats, GM Division, CEA and NPC Secretariat with updated Terms of Reference (ToR) . One of the ToR of the committee is to recommend on possible sources of funding- PSDF or RPC funds.

Current Status:

A.27.5 The committee has recommended that while the Capital Expenditure of project may be funded through PSDF, the O&M Expenditure may be funded through RPC funds.

A.27.6 The DPR is in its final stage of preparation and will be submitted to the PSDF Secretariat, NLDC in due course for funding approval under the PSDF. Total estimated cost of project is ₹ 25,92,84,793/- (Capital Expenditure is ₹ 21,05,14,950 and O&M Cost for 4 years is ₹ 4,87,69,843/-).

A.27.7 Brief scope of works is as follows:

- Design & Development of application in a centralized architecture with main Data Centre at NRPC and Disaster Recovery Centre at SRPC.

- Develop modules for all existing energy accounting functions across RPCs
- Develop modules for envisaged energy accounting functions of NPC
- Develop APIs for seamless integration with external systems (WBES, AMR, etc.)
- Create a customer ticketing portal for regional entities to raise ticket and track accounting discrepancies
- Migrate data from existing RPC systems (7 years of historical data)
- Provide administrator and operator level training
- On-site warranty support for 1 year from Go-Live
- 4 years of Comprehensive Annual Maintenance Contract (C-AMC)
- Optional 2+3 years of Annual Maintenance Contract (C-AMC) extension
- Deploy resident engineers and provide 24x7 online support

Decision required from Forum:

Forum may deliberate on above proposal and accord approval for submission of DPR by MS, NRPC to PSDF Secretariat for grant.

A.28 Capacity Building/ Study Tour Programme for Northern Regional Constituents through PSDF Fund (Agenda by NRPC Secretariat)

A.28.1 In 45th NRPC meeting held on 08.06.2019, NRPC Secretariat proposed a capacity building programme for studying the power exchange of Nordic countries, role of TSO (Transmission System Operator), Renewable Energy in power trading, EV integration with grid etc. to be carried out for Northern Region Constituents.

A.28.2 In 44th TCC & 47th NRPC Meetings (held on 10th and 11th December, 2019), POWERGRID presented the detailed report and commercial implication of the program. However, due to COVID pandemic, the program could not be completed.

A.28.3 In 48th TCC & 70th NRPC Meeting (held on 17-18 Nov 2023), the proposal was discussed again and it was decided to review the study program to include topics related to RE integration.

A.28.4 In 71st NRPC meeting held on 29.01.2024, DPR was approved for PSDF grant. However, due to revision of cost by POWERGRID, revised DPR was approved in 49th TCC/ 72nd NRPC meeting (held on 29-30 March, 2024).

A.28.5 DPR was submitted to PSDF Secretariat vide letter dated 13.05.2024. However, PSDF Secretariat vide mail dated 20.05.2024 informed that during the 22nd Monitoring Committee meeting, a decision has been taken to withhold the sanction of New Projects. Accordingly, the program could not be completed.

A.28.6 Now, PSDF Secretariat vide letter dated 04.12.2024 has informed that in the 23rd Monitoring Committee meeting, it was decided to accept new projects including deemed returned and requested to submit fresh proposal along with latest cost estimates.

A.28.7 Accordingly, this project has been once again taken up as CAG has also mentioned during audit of NRPC for completion of capacity building program.

A.28.8 A meeting was held on 05.12.2024 with ASCI team and POWERGRID to explore capacity building program on latest technology and latest cost estimates.

A.28.9 Accordingly, a capacity building/ study tour has been prepared by POWERGRID in consultation with Administrative Staff College of India (ASCI) attached as **Annexure-XXIII.**

A.28.10 Programme Design:

The 7-day international study tour will provide a detailed understanding of:

(i) Energy Transition Frameworks: Policies and strategies for renewable energy integration and decarbonization.

(ii) Energy Markets: The functioning of the electricity market in Europe, including the roles of TSOs and DSOs.

(iii) Hydrogen Economy: The development of green hydrogen and its integration into national energy systems.

(iv) Renewable Energy Penetration: The European experience of achieving high penetration of wind, solar, and hydropower into the grid.

(v) The tour will include site visits, workshops, and discussions with energy policymakers, experts, utilities, and industry leaders in each country to deepen participants' understanding of these issues.

A.28.11 Details of Activities for Study Tour:

(i) The programme will be implemented in four batches of 15 officers each over the period of 04 months (Apr-July 2025).

(ii) A batch of 15 participants will participate for each 7-day program from member utilities of NRPC including Central Transmission Utility (CTU), State Transmission Utilities (STUs), Distribution Companies (DISCOMs), State Load Despatch Centres (SLDCs), Generators (including ISGS), ISTS Transmission Licensees in Northern Region, Grid Controller of India Limited and Northern Regional Power Committee (NRPC) Secretariat, Central Electricity Authority (CEA), and Ministry of Power, GoI.

A.28.12 Programme Fee:

(i) Rs 6,24,000 plus GST per participant for international component of 7 days, for a minimum of 15 participants in a batch, and

(ii) Rs 1,50,000 plus GST per batch for Indian component at Manesar of 2 days, for a minimum of 15 participants per batch.

(iii) Total Cost shall be tentatively INR. 4,48,87,200/- (including GST@18% for 60 officials).

A.28.13 As per rules of PSDF grant, only government beneficiary has been considered for this study tour. Accordingly, the tentative break-up of batches is as below:

Serial No.	State/Organization	1st Batch	2nd Batch	3rd Batch	4th Batch	Remarks*
1	**MoP/CEA**	1	1	1	1	
1	**Delhi**	1	1	0	1	Among TRANSCO/STU, GENCOs, SLDC
2	**Haryana**	1	1	1	1	Among TRANSCO/STU, GENCOs, DISCOMs, SLDC
3	**Rajasthan**	1	1	1	1	Among TRANSCO/STU, GENCOs, DISCOMs, SLDC
4	**Uttar Pradesh**	1	1	1	1	Among TRANSCO/STU, GENCOs, DISCOMs, SLDC
5	**Uttarakhand**	1	1	1	1	Among TRANSCO/STU, GENCOs, DISCOMs, SLDC
6	**Punjab**	1	1	1	1	Among

						TRANSCO/STU, GENCOs, DISCOMs, SLDC
7	**Himachal Pradesh**	1	1	1	1	Among TRANSCO/STU, GENCOs, DISCOMs, SLDC
8	**UT of J&K**	1	0	0	0	
9	**UT of Ladakh**	1	0	0	0	
10	**UT of Chandigarh**	1	0	0	0	
11	**NRPC Secretariat**	1	2	2	2	
13	**NRLDC**	1			1	
14	**NLDC**	1			1	
15	**PGCIL**	1			1	
16	**CTUIL**		1			
17	**NTPC**		1		1	
18	**BBMB**		1			
19	**THDC**		1			
20	**SJVN**		1			
21	**NHPC**			1	1	
22	**NPCIL**			1		
23	**APCPL**			1		
24	**MEJA Urja Nigam Ltd.**			1		
25	**NVVN**			1		
26	**NTPC Green Energy Ltd**			1		
Total		**15**	**15**	**15**	**15**	

A.28.14 Such capacity building program has already been conducted in ERPC, and SRPC.

Decision required from Forum:

(i) Approval of above study tour under PSDF grant.

(ii) To authorize MS, NRPC for submission of DPR for PSDF grant.

(iii) To authorize MS, NRPC to finalize the course contents in consultation with ASCI/POWERGRID.

(iv) To authorize MS, NRPC for signatory for opening and operating of bank account to handle the above fund

(v) To authorize MS, NRPC to finalize and enter into an agreement with ASCI/POWERGRID for above study tour.

A.29 Centralized Database for Protection Settings in Northern Region to be implemented under PSDF (agenda by NRPC Secretariat)

A.29.1 In 48th TCC & 70th NRPC Meeting (held on 17-18 Nov 2023), NRPC Committee has approved for development of a portal through PSDF for Centralized database containing details of relay settings for grid elements connected to 220 kV and above. The scope was already approved in the above meeting.

A.29.2 Further, a meeting was held on 08.01.2024 with POWERGRID to deliberate on tendering, wherein POWERGRID desired number of sub-stations and elements for which relay details shall be modelled in Centralized Database for preparation of estimate of work for implementation of the portal.

A.29.3 In view of above, it was requested vide letter dtd. 23.01.2024 to NRLDC/NLDC and SLDCs of Northern region to furnish the details of all elements connected at 220 kV and above, in respective control area latest by 30.01.2024. A reminder mail dtd. 06.02.2024 was also sent for the same.

A.29.4 Based on the received data, compiled status was presented in the 50th PSC meeting held on 29.04.2024. Subsequently, Utilities were requested to send pending data for no. of relays and substations within a week. It was also decided to consider tentative/ average data if details are not submitted by utilities within a week.

A.29.5 Compilation of numbers for sub-station, relay and licensee for calculation tool has been done. After considering assumption, the numbers are as below:

S.N.	Number of substations (220 kV and above in Northern Region)	Number of relays	Number of licenses of protection calculation tool
1	965	39380	87 (Already approved in 49th PSC meeting)

Details are attached as **Annexure-XXIV.**

A.29.6 It is to highlight that above-mentioned no. of relays and no. of substations are going to be freezed after the discussion of upcoming 55th Protection Sub-Committee meeting (scheduled on 20.12.2024). Accordingly, finalized nos. may be approved by

NRPC Forum.

A.29.7 It is also to mention that PSDF Secretariat vide letter dated 04.12.2024 has intimated that now PSDF fund has been opened which was blocked for some time.

A.29.8 The scope of database portal was approved in 48th TCC & 70th NRPC Meeting (held on 17-18 Nov 2023) as attached as **Annexure- XXV**. The point no. D of approved scope is going to be discussed in the upcoming 55th Protection Sub-Committee meeting as procedure for approval of protection setting has been recently approved in 75th NRPC meeting as attached as **Annexure-XXVI**. Accordingly, point no. D shall be put up for final approval of NRPC Forum.

A.29.9 POWERGRID has been asked to submit draft DPR and cost estimate for PSDF approval vide letter dated 12.12.2024 (enclosed at **Annexure-XXVII)** to streamline the project in parallel.

A.29.10 Subsequently, based on the discussion in the 52nd TCC/77th NRPC meeting, final no. of relays and substations shall be communicated to POWERGRID at the time of award of project to modify the cost estimate accordingly.

Decision required from Forum:

i. *Approval of number of sub-station and relays for the project.*

ii. *Approval of scope of the project.*

A.30 The demolition and reconstruction of residential and non-residential buildings within the Ballabgarh substation premises are proposed under the Rihand Transmission System through Additional Capitalization in the 2024-29 Tariff Block (agenda by POWERGRID)

A.30.1 POWERGRID has submitted that the residential and non-residential buildings at Ballabgarh substation were constructed under the Rihand Transmission System between (1988 -1998) and are currently in service. These assets shall complete approximately 30 years of useful service life during the 2024-29 Tariff Block.

A.30.2 Subsequently, the demolition and reconstruction of residential and non-residential buildings within the substation premises at Ballabhgarh, Bassi, Mandola and Hisar

Substation were proposed during the 216th OCC meeting held on February 14, 2024, through Additional Capitalization in the 2019-24 Tariff Block.

A.30.3 During the meeting, MS, NRPC, recommended that

QUOTE

"*He suggested that structural assessment of these projects may be carried out by an appropriate agency, such as NCCBM. Subsequently, the proposal may be taken up for approval in the NRPC meeting*."

UNQUOTE

A.30.4 Minutes of the 216th OCC meeting are attached as **Annexure-XXVIII.**

A.30.5 Subsequently, NCCBM completed the structural assessment at the Ballabgarh substation, while testing is still in progress at the Hisar, Bassi, and Mandola substations.

A.30.6 NCCBM conducted an assessment at the Ballabhgarh substation, including the residential quarters, transit camp, and recreation center. The primary inspection took place on April 18, 2024, followed by a detailed structural assessment on July 25-26, 2024. The final assessment report was submitted to POWERGRID on December 11, 2024.

A.30.7 NCCBM's recommendation for Ballabhgarh Substation is provided based on the findings of the detailed assessment report.

QUOTE

"Considering the buildings are load bearing structures, these quarters buildings are not safe for living in its present condition. Also, it seems that if the repair of these buildings will be done, it won't increase the service life of the structures."

UNQUOTE

A.30.8 Detail assessment report of Ballabgarh SS is attached as **Annexure-XXIX.**

A.30.9 In light of the above, POWERGRID has proposed to demolish the old and deteriorated residential quarters and non-residential buildings (Transit Camp and Recreational Centre) at the Ballabgarh station and rebuild them under the Rihand Transmission System through Additional Capitalization in the 2024-29 Tariff Block with an tentative cost of ₹28.7 crore including of GST. Detail cost estimate will be submitted after approval.

Tentative cost estimate for demolition and reconstruction of residential and non-residential buildings at Ballabgarh SS		
Residential building		
	No of quarter	Estimated cost in crore (Inclusive of GST)
colony quarters	21	21.4
Non- Residential building		
Transit camp	1	5.7
Recreation centre	1	1.6
Total		28.7 Crore

A.30.10 Accordingly, POWERGRID has submitted the proposal for demolishing and reconstructing building at Ballabgarh substation with a tentative cost estimate of **₹28.7 crore** under **ADD-CAP** (2024-29) for approval of NRPC Forum.

Decision required from Forum:

Forum may deliberate and give consent to POWERGRID for demolishing and reconstructing building at Ballabgarh substation with a tentative cost estimate of ₹28.7 crore under ADD-CAP (2024-29).

A.31 Diversion of spare 500MVA 400/220kV transformer from Lucknow SS (PG) to Prayagraj (PG) (agenda by POWERGRID)

A.31.1 Maha Kumbh Mela is going to be organized at Prayagraj from 14th January 2025 to 26th February 2025. It is a prestigious event of national importance. UP and Central government both are monitoring the event at utmost level. It is very necessary to maintain the uninterrupted supply of electricity supply to Prayagraj and KUMBH Region during the event. Increase in demand is expected in and around Pryagraj (Allahabad) due to very huge gathering of pilgrims during Kumbh Mela.

A.31.2 Maximum Loading of the 03 Nos. 315MVA ICTs at Prayagraj violates the N-1 contingency with peak maximum loading of around 280 MW per ICT. Thus, 500 MVA ICT-4 along with its associated bays was approved for Prayagraj Substation to cater to the increased loading requirement during N-1 contingency. 500 MVA ICT-4 is under procurement and the Civil works of the said ICT Bays have commenced at Prayagraj with completion schedule of April’25.

A.31.3 500MVA TOSHIBA make spare ICT is available at Lucknow 400 kV Substation (PG) as Northern RPC spare.

A.31.4 In view of above, POWERGRID has proposed that the ICT available at Lucknow may be diverted to Prayagraj to meet contingent requirement, if any. The New ICT being procured for Prayagraj shall be diverted to 400/220 kV Lucknow Substation. Forum may deliberate to bear the loading /unloading & transportation expenses.

Decision required from Forum:

Forum may discuss and accord approval for diversion of 500MVA TOSHIBA make spare ICT of Lucknow to Prayagraj. Accordingly, Members may also deliberate to bear the loading /unloading & transportation expenses.

A.32 Training on electrical protection of power system for NRPC constituents (agenda by NRPC Secretariat)

A.32.1 IEGC 2023 has added new chapter for protection code. Accordingly, various new provisions have been added such as protection audit, protection performance indices, approval of protection settings by RPCs.

A.32.2 It has been observed that there is lack of experts related to protection domain in various utilities. The same was also highlighted in recent PSC/ NRPC meetings.

A.32.3 NRPC Secretariat has already conducted training programs in past for capacity building of officers. Accordingly, it is proposed to conduct one training program for officers of protection domain of NRPC constituents.

A.32.4 The cost shall be paid from available fund in NRPC Fund. There shall be no additional financial burden on members.

Decision required from Forum:

Forum may discuss the proposal.

A.33 Formation of Information Security Division (ISD) in SLDCs with adequate manpower (agenda by NRLDC)

A.33.1 As per CEA (Cyber Security in Power Sector) Guidelines, 2021, establishment of Information Security Division (ISD), headed by CISO needs to be done and the ISD must be functional on 24x7x365 basis. It has to be manned by sufficient numbers of Engineers having valid certificate of successful completion of course on cyber security of Power Sector from the Training Institutes designated by CEA.

A.33.2 Considering the critical nature of cyber security requirements in Load Despatch Centres, the following steps are requested –

- Formation of Information Security Division (ISD) at respective SLDCs.
- Adequate training and certification of personnel handling IT & Cyber Security works in SLDCs (incl. those deployed in ISD).
- Establishment of Security Operation Centre (SOC) to act as an automation tool for ISD personnel.

A.33.3 A letter from NRLDC with ref. NRLDC/NR-CSCF/Aug’24/ dated 20-Aug-2024 had already been issued to states regarding this. It was deliberated during 3rd GO-NR-CSCF meeting held on 13-Dec-2024 also and serious concerns were raised about delay in formation of ISD at state-level.

A.33.4 Being a critical matter of cyber security having a severity to impact 24x7 operation of electricity grid, urgent action on these points may be required.

Decision required from Forum:

Forum may discuss for taking necessary action.

Agenda for NRPC meeting

B.1 Outstanding Contribution for FY 2024-25 (agenda by NRPC Secretariat)

B.1.1 Demand Letter for contribution towards NRPC fund for the year 2024-25 was sent on 10.04.2024 to all the constituent members. It was also mentioned that beyond 30th June, 1% simple interest shall be levied. Accordingly, NRPC Secretariat has received contributions from organizations.

B.1.2 It is mentioned that payment has been received from 43 constituent members.

a. UT of Ladakh has not paid the contribution amount of Rs 12,00,000 for FY 2024-25. It is mentioned that Reminder letter for payment was sent on 8th July, 2024 (enclosed as **Annexure-B.I**). DO Letter from MS, NRPC was also sent on 12.08.2024 (enclosed as **Annexure-B.II**). However, payment has not been received till date.

b. It is mentioned that Talwandi Sabo Power Ltd. and UT of Chandigarh paid the contribution amount, but have not paid the interest amount. Interest amount of Rs 24,000 and Rs 12,000 is pending from TSPL and UT of Chandigarh respectively.

B.1.3 Details of total outstanding contribution is mentioned below:

S. No.	Name of Constituent	Period (FY)	Contribution amount (Rs)	Penalty (Rs)	Total Outstanding amount (Rs)
1	UT of Ladakh	2024-25	12,00,000	72,000	12,72,000
2	Talwandi Sabo Power Ltd.	2024-25	0	24,000	24,000
3	UT of Chandigarh	2024-25	0	12,000	12,000
	Total				Rs 13,08,000

B.1.4 It is requested to kindly pay the contribution amount and the interest amount at the earliest to avoid further levying of penalty charges.

Decision required from Forum:

Members may please deliberate and suggest necessary action.

B.2 RE generators having more than 1000 MW installed capacity as permanent members of NRPC (agenda by NRPC Secretariat)

B.2.1 It is mentioned that in that as per the decisions taken in the 75th NRPC meeting, RE generators having more than 100MW were made permanent member of NRPC and demand letter dated 30.09.2024 seeking contribution of Rs 12,00,000/- Rs was sent to these organizations. The contribution amount was to be paid within 2 months of issuance of demand letter.

B.2.2 Accordingly, details of present status of contribution from these generators is:

S. No.	Name of Constituent	Period (FY)	Contribution amount (Rs)	Status	Total Outstanding amount (Rs)
1	Adani Green Energy Limited	2024-25	12,00,000	**Paid**	-
2	ReNew Power Private Limited	2024-25	12,00,000	**Not Paid**	12,00,000
3	Azure Power India Pvt. Limited	2024-25	12,00,000	**Paid**	-
4	Avaada Energy Private Limited	2024-25	12,00,000	**Paid**	-
5	NTPC Green Energy Limited	2024-25	12,00,000	**Paid**	-
	Total				**Rs 12,00,000**

B.2.3 Therefore, payment of Rs 12,00,000 is pending from Renew Power Private Limited for FY 2024-25. It is requested to kindly pay the contribution amount at the earliest.

Decision required from Forum:

Members may please deliberate and suggest necessary action.

B.3 Replacement of Old Sewer Line System with New One, Revamping of Underground Water Tank, and Other Miscellaneous Civil Works in NRPC Staff Quarters and Office Block (Agenda by NRPC Secretariat)

B.3.1 The existing infrastructure in the NRPC staff quarters and office block has been in use for several decades. This includes the sewer line system, underground (UG) water tank, and other civil components that have aged significantly, leading to frequent maintenance issues and operational inefficiencies.

B.3.2 The current sewer line system is prone to blockages, leaks, and overflows, leading to health and hygiene concerns. Also, the underground water tank has shown signs of wear, such as seepage and contamination risks, necessitating immediate repair and revamping. Various ancillary structures and facilities require renovation to ensure safety, functionality, and aesthetic appeal.

B.3.3 Therefore, following works are proposed for Office Premises and Guest House (R&M Work) as below-

i. **Replacement of Waste Pipes:** The waste pipes in the office premises and guest house have deteriorated over time, leading to leakage and blockages. Replacement with durable pipes is essential for smooth waste disposal and maintaining hygiene.

ii. **Replacement of Commode in Ladies Toilet (2nd Floor**): The commode in the ladies' toilet on the 2nd floor has aged and requires replacement to ensure proper functionality and user comfort.

iii. **Replacement of Maintenance Shafts to Stop Seepage**: Existing maintenance shafts are contributing to seepage issues. Replacing these shafts will prevent further structural damage and improve water management.

B.3.4 Further, following works are proposed for NRPC Staff Colony (R&M Work) as below-

i. **Minor Civil Works:** Repair of main MS doors, including change of locks for better security & Installation of new mosquito nets to enhance comfort and health.

ii. **Providing Skirting on Outside Walls and Staircase Areas**: Adding skirting on the outer walls and staircase areas will help prevent water seepage and enhance the aesthetic appeal.

iii. **Replacement of Waste Pipes and Sewage Drain Pipes**: Existing pipes need replacement due to frequent clogging and leakage issues. New pipes will improve sanitation and reduce maintenance costs.

iv. **Construction of an Additional Toilet**: Provision of one additional toilet as per the demand and feasibility to meet the requirements of residents and staff.

v. **Revamping/Modification of Underground Main Water Tank:** The underground main water tank requires modification to ensure leak-proof storage, better water quality, and reduced maintenance needs.

B.3.5 Proposed works are to be executed by CPWD. As per the preliminary cost estimate for the project, as submitted by CPWD to NRPC is Rs. 97,45,100 /-including material, labor, and contingency expenses **(Details at Annexure-B.III).**

B.3.6 Major expenditure for above works is likely to be incurred in next FY i.e., 2025-26 considering the time taken by CPWD for invitation of tenders and award of works.

B.3.7 Approval of NRPC members is requested to proceed with the process for awarding the contract to CPWD to execute the proposed works.

Decision required from Forum:

Forum may discuss and accord approval for the above-mentioned works accordingly.

B.4 Audit Report (Consolidated Receipt and Payment Account for 2023-24) based on audit conducted by external Agency hired through GeM Portal) (agenda by NRPC Secretariat)

B.4.1 In 67th meeting of NRPC held on 30.06.2023, Conduct of Business Rules, 2023 of NRPC was finalised by NRPC Forum. As per rule 31 of Conduct of Business Rules, 2023 of NRPC, the “NRPC – Fund” account for each financial year shall be audited as per SOP issued by CEA.

B.4.2 Accordingly, Bid for Review of Financial Statements, Financial Reporting Framework, Audit report was floated on GeM Portal. Bid (GEM/2024/B/5352283) was awarded through Gem Contract GEMC-511687756212223 to L1 Bidder M/s GGPS AND ASSOCIATES at a cost of Rs 22,000/- (inclusive of taxes).

B.4.3 M/s GGPS AND ASSOCIATES conducted audit of NRPC fund account for 2023-24 in November 2024 and submitted Audit report. The detailed Audit Report is attached at **Annexure-B.IV.** Salient points as observed by the auditor are as under:

a) The consolidated receipt and payment account of NRPC for the year ended 31st March 2024 is prepared in all material respects in accordance with the applicable financial reporting framework and reflects a true and fair view of the receipts and payments of the organization during the year.

b) Cash system of accounting is followed by the management.

c) There were no cash transactions or expenditures recorded as having been used by the management in the course of operations for the period under review.

d)The accounting transactions are not maintained using standard accounting software. Auditor believes that implementing accounting software would strengthen the organization internal controls and facilitate more reliable financial reporting in the future.

Decision required from Forum:

Forum may take note of audit report of NRPC Fund for FY 2023-24.

B.5 Small Hydro Power Projects-The Need for a Level Playing Field (agenda by Bonafide Himachalies Hydro Power Developers Association)

B.5.1 BHHPDA has desired to highlight the certain issues pertaining to transmission cost and sale of power related to Small Hydro Power Projects.

B.5.2 Presentation (enclosed as **Annexure-B.V**) has been submitted by BHHPDA highlighting several critical issues faced by Small Hydro Projects (SHP) that require immediate attention and policy interventions.

Decision required from Forum:

Members may discuss.

B.6 Hosting of next physical TCC & NRPC meeting (agenda by NRPC Secretariat) (agenda by NRPC Secretariat)

B.6.1 It is proposed that next physical TCC & NRPC meeting may be hosted by POWERGRID. NRPC Secretariate to finalize date & venue of the meeting in consultation with Powergrid.

Decision required from Forum:

Forum may deliberate on hosting of next physical meeting.

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NRPC Members for FY 2024-25

S. No.	NRPC Member	Category	Nominated/ Notified/Delegated Member	E-mail
1	Member (GO&D), CEA	Member (Grid Operation & Distribution), Central Electricity Authority (CEA)	Member (GO&D), CEA	member.god@cea.nic.in
2	Member (PS), CEA	Nodal Agency appointed by the Government of India for coordinating cross-border power transactions	Member (PS), CEA	memberpscea@nic.in
3	CTUIL	Central Transmission Utility	Chief Operating Officer	pcgarg@powergrid.in
4	PGCIL	Central Government owned Transmission Company	Director (Operations)	tyagir@powergrid.in
5	NLDC	National Load Despatch Centre	Director (System Operation)	rk.porwal@grid-india.in
6	NRLDC	Northern Regional Load Despatch Centre	Executive Director	nroy@grid-india.in
7	NTPC	Central Generating Company	Director (Finance)	jaikumar@ntpc.co.in
8	BBMB		Chairman	cman@bbmb.nic.in
9	THDC		CGM (EM-Design)	rrsemwal@thdc.co.in
10	SJVN		CMD	sectt.cmd@sjvn.nic.in
11	NHPC		Director (Technical)	rajkumar0610.rkc@gmail.com
12	NPCIL		Director (Finance)	df@npcil.co.in
13	Delhi SLDC	State Load Despatch Centre	General Manager	gmsldc@delhisldc.org
14	Haryana SLDC		Chief Engineer (SO&C)	cesocomml@hvpn.org.in
15	Rajasthan SLDC		Chief Engineer (LD)	ce.ld@rvpn.co.in
16	Uttar Pradesh SLDC		Director	directorsldc@upsldc.org
17	Uttarakhand SLDC		Chief Engineer	anupam_singh@ptcul.org
18	Punjab SLDC		Chief Engineer	ce-sldc@punjabsldc.org
19	Himachal Pradesh SLDC		Managing Director	mdhpsldc@gmail.com
20	DTL	State Transmission Utility	CMD	cmd@dtl.gov.in
21	HVPNL		Managing Director	md@hvpn.org.in
22	RRVPNL		CMD	cmd.rvpn@rvpn.co.in
23	UPPTCL		Managing Director	md@upptcl.org
24	PTCUL		Managing Director	md@ptcul.org
25	PSTCL		CMD	cmd@pstcl.org
26	HPPTCL		Managing Director	md.tcl@hpmail.in
27	IPGCL	State Generating Company	Managing Director	md.ipgpp@nic.in
28	HPGCL		Managing Director	md@hpgcl.org.in
29	RRVUNL		CMD	cmd@rrvun.com
30	UPRVUNL		Director (Technical)	director.technical@uprvunl.org
31	UJVNL		Managing Director	mdujvnl@ujvnl.com
32	HPPCL		Managing Director	md@hppcl.in
33	PSPCL	State Generating Company & State owned Distribution Company	CMD	cmd-pspcl@pspcl.in
34	UHBVN	State owned Distribution Company (alphabetical rotaional basis/nominated by state govt.)	Managing Director	md@uhbvn.org.in
35	Jodhpur Vidyut Vitran Nigam Ltd.		Managing Director	md.jdvvnl@rajasthan.gov.in
36	Paschimanchal Vidyut Vitaran Nigam Ltd.		Managing Director	md@pvvnl.org
37	UPCL		Managing Director	md@upcl.org
38	HPSEB		Managing Director	md@hpseb.in
39	Prayagraj Power Generation Co. Ltd.	IPP having more than 1000 MW installed capacity	Head (Commercial & Regulatory)	sanjay.bhargava@tatapower.com
40	Aravali Power Company Pvt. Ltd		CEO	brahmajig@ntpc.co.in
41	Apraava Energy Private Limited		CEO	niraj.gupta@apraava.com
42	Talwandi Sabo Power Ltd.		COO	Vibhav.Agarwal@vedanta.co.in
43	Nabha Power Limited		CEO	sk.narang@larsentoubro.com
44	MEIL Anpara Energy Ltd		COO & WTD, Executive Director	anandkumar.singh@meilanparapower.com arun.tholia@meilanparapower.com
45	Rosa Power Supply Company Ltd		Station Director	Hirday.tomar@relianceada.com
46	Lalitpur Power Generation Company Ltd		Managing Director	vksbankoti@bajajenergy.com
47	MEJA Urja Nigam Ltd.		CEO	hopmeja@ntpc.co.in
48	Adani Power Rajasthan Limited		COO, Thermal, O&M	jayadeb.nanda@adani.com
49	JSW Energy Ltd. (KWHEP)		Head Regulatory & Power Sales	jyotiprakash.panda@jsw.in
50	TATA POWER RENEWABLE	IPP having less than 1000 MW installed capacity (alphabetical rotaional basis)	Zonal Head	dhmahabale@tatapower.com
51	UT of J&K	From each of the Union Territories in the region, a representative nominated by the administration of the Union Territory concerned out of the entities engaged in generation/ transmission/ distribution of electricity in the Union Territory.	Chief Engineer, JKSPDCL/JKPDD	cejkpcl2@gmail.com/sojpdd@gmail.com
52	UT of Ladakh		Chief Engineer, LPDD	cepdladakh@gmail.com
53	UT of Chandigarh		Executive Engineer, EWEDC	elop2-chd@nic.in
54	NPCL	Private Distribution Company in region (alphabetical rotaional basis)	Head-Commercial	ssrivastava@noidapower.com
55	Fatehgarh Bhadla Transmission Limited	Private transmission licensee (nominated by cetral govt.)	AVP-O&M	nitesh.ranjan@adani.com
56	NTPC Vidyut Vyapar Nigam Ltd.	Electricity Trader (nominated by central govt.)	CEO	ceonvvn@ntpc.co.in
57	ReNew Power Private Limited	RE Generating Company having more than 1000 MW installed capacity	CEO	sumant@renew.com
58	NTPC Green Energy Limited		CEO	rajivgupta@ntpc.co.in
59	Azure Power India Pvt. Limited		CEO	sunil.gupta@azurepower.com
60	Avaada Energy Private Limited		CEO	kishor.nair@avaada.com
61	Adani Green Energy Limited		COO	chaitanya.sahoo@adani.com

List of addressee (via mail)				
TCC Members for FY 2024-25				
S. No.	**TCC Member**	**Category**	**Nominated/ Notified/Delegated Member**	**E-mail**
1	Director (Operation), HPSEBL	Chairperson, TCC		manojupretisolan@gmail.com
2	Member (GO&D), CEA	Member (Grid Operation & Distribution), Central Electricity Authority (CEA)	Chief engineer(GM Division)	cegm-cea@gov.in
3	Member (PS), CEA	Nodal Agency appointed by the Government of India for coordinating cross-border power transactions	Chief Engineer, PSPA-I Division	i.sharan@nic.in
4	CTUIL	Central Transmission Utility	Dy Chief Operating Officer	ashok@powergrid.in
5	PGCIL	Central Government owned Transmission Company	ED, NR-I	aloksharma99@powergrid.in
6	NLDC	National Load Despatch Centre	Head of NLDC	susha@grid-india.in
7	NRLDC	Northern Regional Load Despatch Centre	Executive Director	nroy@grid-india.in
8	NTPC	Central Generating Company	Regional ED, NR	rednr@ntpc.co.in
9	BBMB		Member (Power)	mp@bbmb.nic.in
10	THDC		GM (EMD)	neerajverma@thdc.co.in
11	SJVN		Director (Projects)	de.sectt@sjvn.nic.in
12	NHPC		ED (O&M)	hod-om-co@nhpc.nic.in
13	NPCIL		Outstanding Scientist & ED (commercial)	nrchoudhary@npcil.co.in
14	Delhi SLDC	State Load Despatch Centre		nomination awaited
15	Haryana SLDC		Chief Engineer/SO & Comml.	cesocomml@hvpn.org.in
16	Rajasthan SLDC			nomination awaited
17	Uttar Pradesh SLDC		Chief Engineer (PSO)/Chief Engineer (C&S)	cepso@upsldc.org
18	Uttarakhand SLDC			nomination awaited
19	Punjab SLDC		Chief Engineer	ce-sldc@pstcl.org
20	Himachal Pradesh SLDC			nomination awaited
21	DTL	State Transmission Utility	Director (Operation)	dir.opr@dtl.gov.in
22	HVPNL		Director (Projects)	directorprojects@hvpn.org.in
23	RRVPNL		Chief Engineer (PP&D)	ce.ppm@rvpn.co.in
24	UPPTCL		Director (Planning & Commercial)	director_comm@upptcl.org
25	PTCUL		Chief Engineer	ce_oandmk@ptcul.org
26	PSTCL		Director / Technical	dir-tech@pstcl.org
27	HPPTCL		GM (C&D)	gmcd.tcl@hpmail.in
28	IPGCL	State Generating Company	Director(Tech.)	corporate.ppcl@gmail.com
29	HPGCL		Director/Technical	dirtech@hpgcl.org.in
30	RRVUNL		Dy. Chief Engineer	dyce.elect.katpp@rrvun.com
31	UPRVUNL		Director (Technical)	director.technical@uprvunl.org
32	UJVNL		General Manager	kkjaiswal99@gmail.com
33	HPPCL		Director (Electrical) General Manager(Electrical)	dir_elect@hppcl.in gm_elect@hppcl.in
34	PSPCL	State Generating Company & State owned Distribution Company		nomination awaited
35	UHBVN	State owned Distribution Company (alphabetical rotaional basis/nominated by state govt.)		nomination awaited
36	Jodhpur Vidyut Vitran Nigam Ltd.			nomination awaited
37	Paschimanchal Vidyut Vitaran Nigam Ltd.			nomination awaited
38	UPCL		Director (P)	dpupcl29@gmail.com
39	HPSEB			nomination awaited
40	Prayagraj Power Generation Co. Ltd.	IPP having more than 1000 MW installed capacity	Head – Commercial & Regulatory	Sanjay.bhargava@tatapower.com
41	Aravali Power Company Pvt. Ltd		CEO	brahmajig@ntpc.co.in
42	Apraava Energy Private Limited			nomination awaited
43	Talwandi Sabo Power Ltd.		Dy. Head O&M	ravinder.thakur@vedanta.co.in
44	Nabha Power Limited			nomination awaited
45	MEIL Anpara Energy Ltd		COO & WTD, Executive Director	anandkumar.singh@meilanparapower.com arun.tholia@meilanparapower.com
46	Rosa Power Supply Company Ltd		VP-Technical Services	Niranjan.Jena@relianceada.com
47	Lalitpur Power Generation Company Ltd		GM Electrical	aupadhyay.ltp@lpgcl.com
48	MEJA Urja Nigam Ltd.		GM (O&M)	piyushkumar@ntpc.co.in
49	Adani Power Rajasthan Limited		AVP	Manoj.taunk@adani.com
50	JSW Energy Ltd. (KWHEP)		Head of Plant	kaushik.maulik@jsw.in
51	TATA POWER RENEWABLE	IPP having less than 1000 MW installed capacity (alphabetical rotaional basis)		nomination awaited
52	UT of J&K	From each of the Union Territories in the region, a representative nominated by the administration of the Union Territory concerned out of the entities engaged in generation/ transmission/ distribution of electricity in the Union Territory.		nomination awaited
53	UT of Ladakh			nomination awaited
54	UT of Chandigarh			nomination awaited
55	NPCL	Private Distribution Company in region (alphabetical rotaional basis)		nomination awaited
56	Fatehgarh Transmission Limited	Private transmission licensee (nominated by cetral govt.)		nomination awaited
57	NTPC Vidyut Vyapar Nigam Ltd.	Electricity Trader (nominated by central govt.)		nomination awaited
58	ReNew Power Private Limited	RE Generating Company having more than 1000 MW installed capacity		nomination awaited
59	NTPC Green Energy Limited			nomination awaited
60	Azure Power India Pvt. Limited			nomination awaited
61	Avaada Energy Private Limited			nomination awaited
62	Adani Green Energy Limited			nomination awaited

Special Invitees:

1. Smt. Nandita Gorlosa, Chairman, NERPC & Hon'ble Power Minister, Govt. of Assam, Block D, Ground Floor, Janata Bhawan, Dispur, Assam, 781006 [Email: nanditagorlosa77@gmail.com], Telephone no: (0361) – 2237032(O)
2. Shri Gaurav Gupta, Chairperson, SRPC & Managing Director, Karnataka Power Corporation Limited & ACS Energy Department GoK, 240, 2nd floor Vikasa Soudha, Bengaluru, Karnataka 560001. [Email: prs.energy@gmail.com ; acs@karnataka.gov.in] Tel -08022252373
3. Shri Vishal Kumar Dev, IAS, Chairman, ERPC, Principal Secretary to Govt., Department of Energy, Govt. of Odisha, Bhubaneswar. [Email- chairman@gridco.co.in] Tel -06742540098
4. Shri P. Dayanand Chairman CSPTCL & Chairman, WRPC, Office of Chairman, Vidyut Seva Bhavan, Danganiya, Raipur 492 013 (C.G.) [Email: chairmancspc@gmail.com] Tel. 0771 2574000
5. Smt. Rishika Saran, Member Secretary, NPC, Sewa Bhawan, R. K. Puram, New Delhi-66 [Email-cenpc-cea@gov.in]
6. Shri Deepak Kumar, Member Secretary, WRPC, Plot No- F-3, MIDC Area, Marol, Opp. SEEPZ, Central Road, Andheri (East), Mumbai-40093. [email: ms-wrpc@nic.in] Tel - 02228221636
7. Shri Asit Singh, Member Secretary, SRPC, No.29, Race Course Cross Road, Bengaluru-560009. [Email: mssrpc-ka@nic.in] Tel -08022287205/9449047107
8. Shri N.S. Mondal, Member Secretary, ERPC,14,Golf Club Road, ERPC Building, Tollygunje,Kolkata-700033. [Email: mserpc-power@nic.in]- Tel 03324239651/9958389967
9. Shri K B Jagtap, Member Secretary, NERPC, NERPC Complex, Dong Parmaw, Lapalang, Shillong-793006. [Email: ms-nerpc@gov.in] Tel -03642534077/ 8652776033
10. Shri Brieflee Lyngkhoi, Chief Engineer, GM Division, CEA, Sewa Bhawan, R. K. Puram, New Delhi-66 [Email: cegm-cea@gov.in]

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Status of action taken on decision 51st TCC & 76th NRPC meeting

S.N.	Agenda	Decision of 52nd TCC & 76th NRPC	Status of action taken
A.4	Installation of CO_2 injection (seeding) system in HVDC Mundra and Mahendragarh Terminal system (agenda by ATIL)	Forum deferred the agenda to discuss in the upcoming OCC meeting.	Agenda was discussed in the 225th OCC meeting held on 12.11.2024 wherein OCC Forum constituted a committee under the chairmanship of SE(O), NRPC with representatives from NLDC, NRLDC, POWERGRID, ATIL and concerned utility from Haryana. The committee to submit recommendations within three months on the need of the CO_2 injection system.
A.5	Implementation of Automatic Demand Management Scheme (ADMS) by DISCOMs in NCT of Delhi as mandated by IEGC Regulations (agenda by DTL)	Forum instructed DTL to proceed further to implement the ADMS scheme.	DTL may update.
A.6	Restoration of damaged tower No.4 (C-Type) of double circuit line connecting Noida Sector-	Forum decided that Committee formed for the assessment & usability of the Interstate	A letter dated 28.11.2024 has been sent to Chairperson, CEA by NRPC

	62 and Sahibabad to DTL 220kV Gazipur S/Stn. [Delhi-UP Corridor] (agenda by DTL)	lines i.e. 220 kV S/C MIA (Alwar) -BTPS (Badarpur) Line and 132 kV S/C Hisar-Sadulpur (Rajgarh) under the chairmanship of GM, CTUIL will also look into this issue along with additional members from DTL and UPPTCL.	Secretariat, requesting that a policy/guideline for retirement of very old lines (50-60 years old) and utilize the existing corridors the may be devised by CEA/CTU for optimal utilization of existing transmission resources in the country.
A.9	Communication System Outage Planning Portal (agenda by POWERGRID)	Forum deferred the agenda to the upcoming TeST meeting likely to be held in the November 2024.	The agenda was discussed in the 26th TeST meeting held on 19.11.2024. It was also apprised that as per 15th NPC meeting discussion, Communication System Outage Planning Portal shall also be developed under the scope of the National UNMS. POWERGRID will give presentation on the same to NRLDC and NRPC.
A.10	Procurement of cold spare transformers and reactor for Northern	Forum deferred the agenda to first discuss in the upcoming OCC	Agenda was discussed in the 225th OCC meeting held on

	Region (Agenda by POWERGRID)	meeting along with existing availability of Transformers and Reactors, Cold spare requirements of Transformers and Reactors with cost estimate and estimated burden going to be incurred on each state. After the approval of OCC Forum, POWERGRID may bring the agenda in subsequent NRPC meeting accordingly.	12.11.2024 wherein OCC Forum asked POWERGRID to submit a consolidated, capacity-wise list of the total number of transformers required as spares on a regional basis. The list should include the current shortfall in ICTs, the number of ICTs allocated States/UT's of NR as regional spares, and the expected timeline for their return. Agenda was also discussed in the 226th OCC meeting held on 16.12.2024. Forum recommended the proposal for approval by NRPC Forum.

A.18.5 ED (O&M), NHPC raised concern that timeline mentioned in the SOP is of long duration and there is no provision for late installation of meter by POWERGRID.

A.18.6 POWERGRID representative requested CTUIL to develop a web portal for managing metering installation request where manual intervention can be avoided and timelines can be optimized further.

A.18.7 MS, NRPC appreciated the above suggestion of POWERGRID.

A.18.8 POWERGRID highlighted about the long pending dues regarding payment of installed meters. Forum suggested POWERGRID to bring the matter in upcoming NRPC meeting.

<u>NRPC Deliberation</u>

A.18.9 COO, CTUIL conveyed all utilities to provide assistance to the POWERGRID for meter installation and highlighted that POWERGRID will also charge the amount appropriately. Citing the significant financial implication of incorrect meter data in various energy accounts, he apprised that meter installation and replacement concerns will be amply addressed through this procedure and utilities will be able to ensure furnishing the correct meter data.

A.18.10 Member (GO&D), CEA advised the utilities that they should try to resolve such issues of payment of meter replacement mutually.

A.18.11 MS, WRPC asked CTUIL to put up this agenda in the WRPC meeting also. Member (GO&D), CEA added that CTUIL may put up the same agenda in other regions also and/or NPC.

A.18.12 Forum agreed with the decision taken in the TCC meeting and directed to proceed ahead with the implementation of SOP in the Northern region.

Decision of Forum

Forum decided that Utilities may again submit comment, if any, within one week to CTU and CTU may incorporate the same and finalise SOP without any need of further approval from NRPC forum.

A.19 Supply & Installation of AMR Compatible ISTS Interface Energy Meters along with AMR (Automatic Meter Reading) System under the scheme “5 min Interface Energy Meter along with AMR system”-For all five regions as PAN India level (agenda by CTUIL)

<u>TCC Deliberation</u>

A.19.1 EE (C), NRPC apprised that a Joint Committee (JC) comprising the members from each RPC, CEA, CTU/PGCIL & POSOCO has prepared Technical Specifications (TS) of the "5/15 Minute Interface Energy Meters (IEMs) with Automatic Meter Reading (AMR) and Meter Data Processing (MDP)" for interstate transmission system at PAN India basis. NPC Division, CEA vide letter dated 6th July 2022 had circulated the final copy of the TS. This Technical specification includes:

- All the procured IEMs shall be configured as 5 min time block. These meters shall record and send 5 min block data to regional AMR system for necessary computation to convert 5 min Time Block data to 15 min Time block data (in line with regulations).
- Provision of 1 min instantaneous MW power flow data from IEMs to SLDC, for viewing purpose

A.19.2 In view of the above for making the system future ready for 5 min Time Block, while also complying the present regulations for 15 min time block for Scheduling, Accounting, Metering & Settlement; JC TS is being adopted for the above-mentioned project proposal as following:

S. No.	**Items**	**Details**
1.	Name of Scheme	Supply and installation of AMR compatible 5 min Interface Energy Meter along with AMR Systems- For all five regions NER, ER, NR, WR & SR.as PAN India.
2.	Scope of the scheme	1. Supply of AMR compatible 5 min Interface Energy Meters for all ISTS metering points of All five regions, 2. Installation of new AMR compatible IEMs by replacing existing meters in case of existing points and for newly added metering points. (Replacement work & New Installation work) 3. Supply and installation of AMR systems in dual LAN configuration at central location along with DCU, Ethernet Switch and other accessories at substation end and AMR software along with servers, consoles, historian software, database, printer, firewall, furniture, etc. at RLDC end to receive 5 min load profile data in auto mode. 4. Provision of streaming online instantaneous MW data at a user configurable rate (minimum 1 min) via AMR system for viewing purpose. 5. AMC includes Operations & Maintenance work (including data processing & report generation from

S. No.	Items	Details
		AMR) for complete AMR system for 7 years. 6. On line Data storage of Raw Data & processed data for three years. The complete scope of IEM & AMR scheme shall be broadly in line with the Technical Specification (Section 1 & 2 of Part 1) circulated by NPC Division, CEA vide letter dtd. 6th July 2022. *Note: MDP system which is also part of the above TS mentioned shall be implemented by respective RLDC and would match the timeline schedule with IEM & AMR project.*
3.	Conceptual Architecture of AMR connectivity of ISTS Meters	**Annexure-XXV**
4.	Objective / Justification	For Indian Power system, commercial settlements of energy generation and consumption are being computed through Availability Based Tariff (ABT) and Deviation Settlement Mechanism (DSM) which are in vogue for energy accounting. Availability Based Tariff was implemented in India in 2002/2003 considering the settlement period as 15-min. Government of India (GoI) has set a Renewable Energy (RE) target of 500 GW by 2030. In the last few years approximately since a decade, the need for implementing 5-minute meters along with AMR system for regional energy accounting and settlement at the Inter State level has been discussed and deliberated in various apex level forums & Committees. A PAN India pilot project on 5-minute metering was implemented as per the directive from Hon'ble CERC in 2018. A report on the pilot project covering implementation aspects, challenges and suggested way forward has been submitted by POSOCO for perusal of the Hon'ble Commission This issue was discussed in OCC/TCC/RPC meetings at regional level and it was discussed to replace the existing SEMs (15-min Block) with AMR compatible Interface

S. No.	Items	Details
		Energy Meters (5-min Block) and implementation of Automated Meter Reading (AMR) and Meter Data Processing (MDP) system for efficient and faster accounting. Moreover, there is a need expressed by States to get streaming online instantaneous MW data at a user configurable rate (minimum 1 min) at SLDCs via AMR system for viewing purpose to manage their drawl. A Joint Committee (JC) comprising the members from each RPC, CEA, CTU/PGCIL & POSOCO has been prepared Technical Specifications (TS) of the "5/15 Minute Interface Energy Meters (IEMs) with Automatic Meter Reading (AMR) and Meter Data Processing (MDP)" for interstate transmission system at PAN India basis. NPC Division, CEA vide letter dated 6th July 2022 had circulated the final copy of the TS. This Technical specification includes: • All the procured IEMs shall be configured as 5 min time block. These meters shall record and send 5 min block data to regional AMR system for necessary computation to convert 5 min Time Block data to 15 min Time block data (in line with regulations). • Provision of 1 min instantaneous MW power flow data from IEMs to SLDC, for viewing purpose only. CTUIL sent a letter dtd. 27.06.2023 to CERC (attached as **Annexure-XXVI**) stating that nodal agency for AMR system implementation may be identified. CTUIL also informed NPC division, CEA vide letter dtd. 24.07.2023 (attached as **Annexure-XXVII**) that JC TS calls for 5 min Time block recording by ISTS IEMs whereas as per CEA metering regulation it is 15 min time block. In this regard, Grid-India NLDC specified to NPC, CEA that 5-minute time block could be considered for procurement of new ISTS IEM, AMR & MDP (attached as **Annexure-XXVIII**). Subsequently NPC CEA, coordinated a joint meeting (mail attached as **Annexure-XXIX**) amongst the stakeholders comprising of CERC, Grid India (NLDC, RLDCs) & CTUIL, chaired by CEA Regulatory division dated 18th August'23 to check the feasibility for amendment of the CEA metering regulation in line with the ongoing developments and requirements of 5 min time block recording in IEMs.

S. No.	Items	Details
		In view of the above-mentioned system requirement of 5 min Time Block, while also complying the present regulations for 15 min time block for Scheduling, Accounting, Metering & Settlement; JC TS is being adopted for the above-mentioned project proposal.
5.	Deliberations in RPCs	The scheme was discussed in all the RPCs and the status is as below: Scheme is approved in SRPC if 50% fund is available from PSDF(July'23). Scheme is in principle approved in NERPC (June'23) and WRPC (Feb'2023) as well. Funding status to be updated to the forums. For NRPC- In 72nd NRPC meeting, CTU was advised to refer the case to NPC subgroup of communication to review the technical specifications in consultation with states. For ERPC- A special meeting was proposed in 47th TCC-Nov'22 meeting to deliberate the project in detail in line with the life of the existing AMR system, which is going to be ended on 31st March 2026. Project Cost was informed to all RPCs during Year 2022/23.
6.	Estimated DPR Cost	Rs. 444.87 Cr. excluding AMC & Rs 152.62 Cr. for 7 years AMC *Costing to be updated considering latest no. of meters and locations at the time of tendering.
7.	Implementation timeframe	Approx. 24 months from gazette Notification.
8.	Implementation Mode	To be deliberated

A.19.3 Grant from PSDF for the FY 24-25 is not available as per MoP order. Accordingly, the **funding** was also to be **deliberated**. Earlier 90% of the project cost was allocated for grant.

A.19.4 Implementation **mode** for the project was also to be **deliberated** by the forum before approval.

A.19.5 In the 72nd NRPC meeting, CTU was advised to take-up the matter to NPC subgroup of communication to review the technical specifications in view of the requirements of some states for integrating 1 minute MW data with SLDC. (Attached as **Annexure-XXX**).

a. CTU took up the above issue with NPC Secretariat.

b. In the process, inputs from Grid-India were received. (Attached as **Annexure-XXXI)**. Grid-India highlighted that the interface energy meter data is primarily required for deviation accounting at the inter-state level in line with the prevailing CERC regulations. Any State specific requirement may be considered based on the feasibility study and without compromising the relevant standards and regulatory provisions.

c. CTU endorsed the above views of Grid-India regarding meter data and its flow as per CEA Metering Regulations & CERC Grid code and other relevant regulations and Technical Specification of IEM finalized by JC.

Subsequently, the issue was also deliberated in a meeting with NRPC secretariat, NPC, CTU, NLDC and NRLDC wherein:

a. Extract from the approved JC Technical Specification (TS) for ISTS Metering System were presented as follows:

"Utilities take decisions for their drawal management, based upon real-time MW SCADA data which generally leads to increased DSM penalty, which is computed subsequently from weekly Interface Energy Meters (IEM) energy data

In view of the new DSM regulation and its amendments, which are more stringent, there is a need expressed by States to get streaming online instantaneous MW data at a user configurable rate (minimum 1 min) at SLDCs via AMR system. This instantaneous MW data is only for the purpose of taking actions/decisions in real time for grid monitoring & discipline."

b. Thus, it was agreed that the inclusion of above provision in TS reflected/confirmed that views of various stakeholders were deliberated by JC while finalizing TS.

c. It was also agreed that the present JC TS would facilitate compliance to the provisions of the CEA metering regulation which mandates that the data shall be communicated to RLDCs using secured and dedicated communication system. The same is quoted below.

"(b) The metered data shall be communicated to the respective Load Despatch Centre by using a secured and dedicated communication system".

d. NRLDC informed that AMR based metering system has become an immediate need of the sector and hence should be implemented at the earliest.

e. CTU informed that the AMR metering agenda is being taken up in all the RPCs so that the scheme is taken up in implementation at the earliest after approval of NCT. Further, 1-minute MW IEM data is already envisaged to be provided to SLDCs to take real-time operational decisions to minimize DSM penalty.

f. In view of the fact that TS for the scheme was finalized by the Joint Committee after taking views from all the stakeholders and the scheme needs to be approved & implemented without any further delay, the review of TS was not recommended at this stage. It was also agreed that any new state specific requirements, the one put up before the forum in 72nd NRPC meeting, will lead to further delay without serving any valuable purpose defined in CEA metering regulations.

A.19.6 The scheme has been approved in SRPC, WRPC and NER OCC (Attached as **Annexure-XXXII).** After approval from rest of the RPCs, the scheme shall be further taken up to NCT for final approval for implementation. The proposed scheme may be approved by NRPC for implementation on pan-India basis.

A.19.7 In view of above, CTUIL proposed that the AMR scheme may be approved.

A.19.8 MS, NRPC conveyed CTUIL may proceed ahead to get the approval of same from other remaining RPCs.

<u>NRPC Deliberation</u>

A.19.9 Member (GO&D), CEA highlighted current metering regulations provides to install IEMS capable of recording active energy data in a 15-minute time-block. Since, the proposed IEMs are capable of recording active energy reading in a 5 minutes time-block and data will be further converted to 15-minutes time-block, CEA metering regulations does not need any amendment to implement this scheme.

A.19.10 Further, it was gathered that since funds are not available in PSDF, mode of funding and implementation mode may be discussed in the NCT meeting.

A.19.11 Forum was in consonance with the deliberation held in the TCC meeting.

Decision of Forum

A.19.12 *Forum approved the scheme of Supply & Installation of AMR Compatible 5 min ISTS Interface Energy Meters along with AMR (Automatic Meter Reading) System with mode of funding and implementation mode to be deliberated in the NCT meeting.*

MINUTES OF MEETING
FOR
50th MEETING OF COMMERCIAL SUB-COMMITTEE OF NRPC

ITEM-1 Confirmation of Minutes of 49th Meeting of Commercial Sub Committee of NRPC

1.1 EE(C) apprised that the minutes of 49th Commercial Sub-committee meeting were issued vide letter dated 05.06.2024 and no comments on minutes have been received till date.

1.2 Members confirmed the minutes of 49th meeting of Commercial Sub-committee of NRPC.

ITEM-2 Automatic meter reading (AMR) system (Agenda by POWERGRID)

2.1 EE(C) NRPC apprised that the AMC for the AMR system, responsible for centrally collecting SEM data at NRLDC, expired in June 2023 under the original contract. To ensure the smooth continuation of AMR services, the contract is being extended periodically.

2.2 POWERGRID stated that CTUIL is in the process of procuring and implementing 5-minute block SEMs along with the AMR service. However, the completion of this project is expected to take 2-3 years. Currently, the contract has been extended until June, 2025. POWERGRID stated that it needs clarification for further course of action when the contract expires.

2.3 EE(C), NRPC clarified that as long as the system requires it, the AMC contract should be renewed, as it is essential for energy accounting.

Decision of Sub-committee:

2.4 It was decided that until the new AMR system is fully implemented, the existing AMC contract should be extended.

ITEM-3 Separate bills may be raised for the HVDC Auxiliary Consumption Billing by M/s NTPC (Agenda by POWERGRID)

3.1 POWERGRID informed that in April 2024, NRPC issued energy accounts under a single category named "PG-HVDC-NR." Since POWERGRID manages six HVDC stations, they were unable to verify the scheduled energy for each HVDC substation individually, as the energy breakdown by substation was not provided.

3.2 POWERGRID suggested that if the station-wise schedules were included in the REA (Regional Energy Account) reports, they could verify the schedule used for REA billing against the schedules provided by POWERGRID.

3.3 EE(C), NRPC stated that separate schedules for each POWERGRID station can still be viewed on WBES. POWERGRID (commercial) official was apprised of the process of verification of station-wise energy from WBES. Also, other relevant features in WBES for verification will be explored if issue persists. He further enquired whether any discrepancies had been observed so far in the REA accounts concerning HVDC station schedules. POWERGRID informed that no issues have been observed till date.

Kalkitech
intelligent energy systems

Upgradation of Automated Meter Data Reading System

In

Northern Region

POWER GRID CORPORATION OF INDIA LTD.

Prepared by:

Kalki Communication Technologies Ltd.,
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Table of Contents

I.Background

KALKI Tech has deployed SYNC5000 Meter-data Reading (AMR) Application for Northern Region currently utilized for collection of meter data from Special Energy Meters at Northern Region Load Dispatch Centre (NRLDC) and its substations.[1]

Kalkitech supplied SYNC2000 Data Collecting Unit (DCU) is installed at each downstream location and acts as interface between central data collection system at NRLDC and SEMs installed at that location.

These locations are owned by POWERGRID or Inter State Generating Stations (ISGS).

II.Requirement for Upgrade:

1) Many automation systems which are deployed beyond 5 years are now found to be more vulnerable to cybersecurity threat as both Applications and the edge devices then used are not designed to protect from the cyber threats.

2) With the increasing number of substations under the Northern region and the number of IEMS meters to be read are increasing every year.

3) Also, Application needs to be upgraded to meet the new regulatory requirements of 5 min block data as and when the IEMS is changed from 15 min block to 5 min block data.

4) Also the Application needs support of the advanced security suite defined in the DLMS as and when the IS adapt the same for IEMS Meters.

5) Technology upgradation

III.Overview:

This document would cover the features which can be expected of the upgraded system including security upgrades, new user experience and scalability. Migration efforts are also described in this document with the stated objective to meet functional and capacity expansion requirements from the upgrade in a phased manner.

[1] PGCIL NRLDC AMR Tender N1/C&M/11-12/O&M/AMR/19 documents

The actual upgrade is taken at two levels. At the existing infrastructure level at the head end, the system would be upgraded to a platform which executes all the present-day function of the existing system which also incorporates additional native modules hosted on the platform.

The other systemic upgrade would happen at the DCU level. After the upgrade is through the Device would be transformed as a grid edge device ready for connection establishment after due process is followed for certificate download from the authorized CA server of the new remote upgraded server.

Kalkitech upgrading procedures would involve the setting up of a data platform called the Kalki.io data platform. The Kalki.io data platform is an IoT data platform meant to perform large scale data acquisitions with high performance. The design of the system is aimed at being a scalable data hub for managing and maintaining incoming / outgoing traffic with secure connection and user management. By virtue of being a cloud-based system every datapoint which hits the system is accessed as a JSON tag retrievable by standard Web Based APIs.

The data platform also hosts various modules as a native application which includes the DLMS based AMR application which conforms to the updated regulatory framework, Audit trail, Dashboard play store, Notifications, HA-Proxy , Docker based design for scalability and redundancy

The upgraded platform will also allow collaboration and information sharing with internal and external stakeholders such as generation, transmission, distribution, OA customers, and regulatory agencies in an effective and transparent fashion.

Key Features of the system upgraded to Kalki.io Platform

I.AMR Module conforming to Latest Regulatory guidelines.

To accommodate latest regulatory guidelines of moving to 5 minute scheduling and settlement system considering the multiple advantages, the AMR Application is upgraded to support this requirement

In keeping with the SAMAST guidelines, all entities connected at the transmission level of the intra state system are identified as pool members. Each Interface boundary metering for every pool member is configured by a template-based mechanism. The templates can be cloned to create additional boundary meter interfaces without the need for manual entry. Once a boundary meter is created, data polling for this meter can be automatically scheduled. The system also detects any gaps in load profile/midnight profile database and is programmed to identify missing entries. The missing entries are indexed, and these indexes are polled to refill gaps and maintain integrity of the system data.

The AMR module maintains detailed statistics of the number of polls created and transmitted to the last mile network, the number of polls which were responded to successfully and the number of polls which are left acknowledged. In addition, time sync uses a delta method which accounts for time latency within the network.

II. Application High Availability and Scalability using Dockers

Redundancy is achieved by Dockers to back up applications to new instances during unplanned termination. The platform is built on cloud virtualization supported with docker-container technologies. Docker container image is a standalone, executable package of software that includes everything needed to run an application: code, runtime, system tools, system libraries and settings. This standard unit of software packages up code and all its dependencies, so the application runs quickly and reliably from one computing environment to another.

Docker Virtualization technologies deployed by the platform Spawn, Terminate and Re-spawn Application instances automatically. An application process or instance killed because of hardware or fatal software failures is immediately remedied by a new instance on the next available redundant application hardware.

Applications both Native and third party are containerized for redundancy and optimum spread of resources. The lack of hardware resource of any kind will prompt the Docker to run their container in another sector of the first available server resource.

By switching containerized applications between servers based on optimal resource usage the platform would always ensure full-service availability of the Head end system applications.

Only a drastic and sudden reduction of server resources would force the Kalki.io platform to be out of Service.

III.AMR Web Portal User Interfaces and User Dashboard store

The virtualized platform hosts its own web server and APIs as a containerized application.

All user log in sessions via web browser are tracked using token bearer authorization for AES256 encryption and user passwords are stored with bcrypt hash iteration.

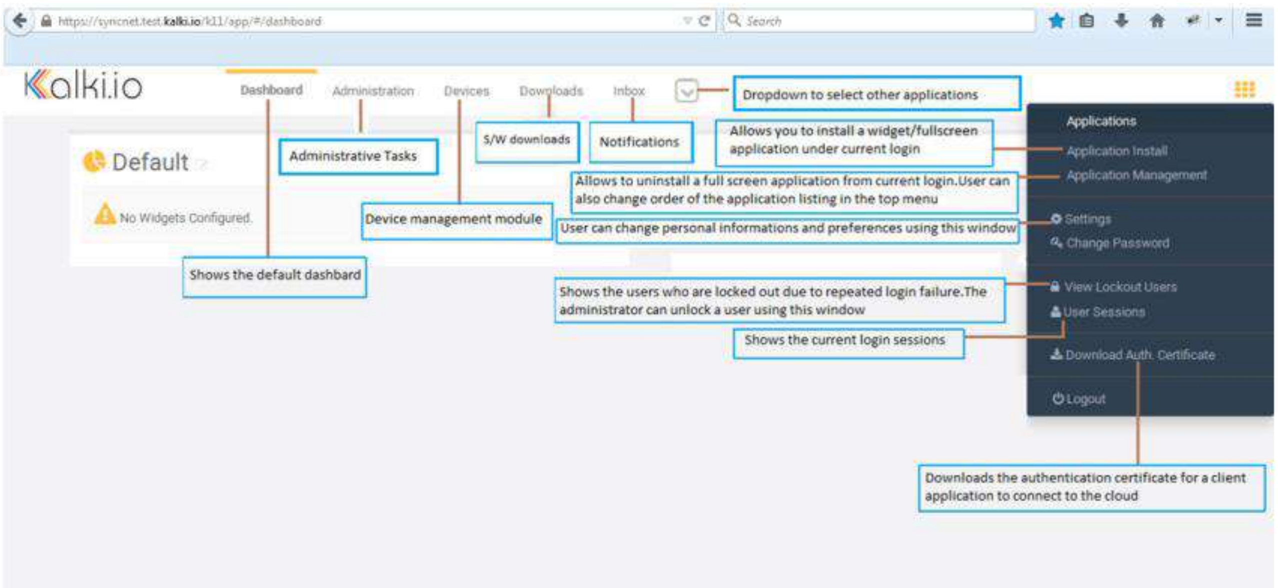

Figure III-1

The Kalki.io platform transforms all input data inside the system into a JSON data sources so that they can be used as arguments for HTML /JS scripts and displayed by a Web client.

Web pages developed in the Kalki.io IDE actively uses real time or processed JSON data for publishing onto local web client interfaces. The users are created by an advanced user management system in which roles and their privileges are defined. And only those users in possession of adequate credentials are allowed access to the web pages launched by the server.

Reports server, Dashboard server, third party Applications deployed from the application play store are all accredited users for Kalki.io IDE or JSON data sources contained within the platform.

The Web Server is the main Graphical user interface which provides access to all historical data and reports available in the system, for viewing and downloading by external clients/users in addition to dashboards from dashboard store or developed applications deployed from the application play store. Thus Data, Displays, Input forms and Reports requested by External users/clients are serviced by Web servers.

All External clients/users connect to the web servers only where access is allowed or restricted as per RBAC User Management. Therefore, the Web server is expected to service and heavy lift simultaneous connection request by clients or downstream grid edge devices which will peak or drop as per field requirements. Suitable load balancing is achieved by use of HA Proxy provided among the web servers where each serves proportionate number of clients. However, in case of failure of one of the servers, all the clients automatically switch to the other available web server(s).

Secure Web Service Access to external applications

Supplied system support Web Services that allows external user and application to interact with web service APIs to publish and subscribe any data. The platform is as a result able provide to interface with external stakeholders like Generating plants, RE Users, Transmission entities or Open access customers to enter data into or extract data from the system. Every data parameter in Kalki.io is automatically modelled as a JSON tag accessed on standard web services like REST API and following the same cyber security protocols mandated by the system for Web clients including checks by the user management system and token bearer authentication on the header URL for HTTPS based web service.[2]

Information access to external peer applications is controlled by Platform User Management and Cybersecurity[3]

Dashboards and Dashboard-Store:

The Kalki platform also features the dashboard containerized application as the preeminent application for user graphical experience. This application is tightly integrated to the web server and serves as the menu to launch other applications. The dashboard can access all data from its JSON tag. The platform also hosts a dashboard store with a library of widgets each with its own functionality A range of data from any JSON source can be grouped into an argument for the Widgets on the dashboard store.

Widgets are available for Trends and Graphical Apps including standard X-Y Scatter plots and statistical Histograms.

In addition, the Dashboard also has AMR focused Dashboard widgets which can be deployed on the home page displaying real time information so that users have situation awareness of the platform downstream Network.Table 1.

This dashboard is henceforth referred as the AMR Home dashboard.[4]

Table 1

Widget	Description
Data Availability	Graphically (Line graph) represents the availability of load profile data for a group of meters for a given duration
Poll Summary (Meter Group)	Shows a bar graph with the number of successful and failed polls for a meter group
Monitored Meter Events	Shows a pie chart with number of events generated by a meter group based on the category. User needs to map the events to be monitored
Device Communication Status	Shows the communication status of the devices configured under a device group in a pie chart. User can drill down to see the list of devices which are in on/off state. User can drill down further to see the mesh network diagram

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[2] Data exchange models and interfaces complying to REST APIs web service confirming with JSON data format for the Kalki.io platform would be provided to End user and external stakeholder. This information can be used for interoperability with other control central applications or stakeholder application.

[3] External web applications must be authenticated using OAuth 2.0 and token bearer mechanism.

AMR users of the platform is also provided a dashboard called the meter face plate[5]. This is a meter centric dashboard which is packaged with columns of widget representing details pertaining to the meter data centric to the meter chosen. The Meter Faceplate provided a field to select the Meter in question from all the meters monitored in the Network. The Meter face plate dashboard will automatically publish the feeder Maximum demand, Active Energy Import/Export, Total Monthly consumption and graph out the Load Survey profiles. The Meter faceplate can also be modified to contain a Demand Poll execution sequence, inform outages, and provide a total count of all events provided by the meter.**Figure III-2**

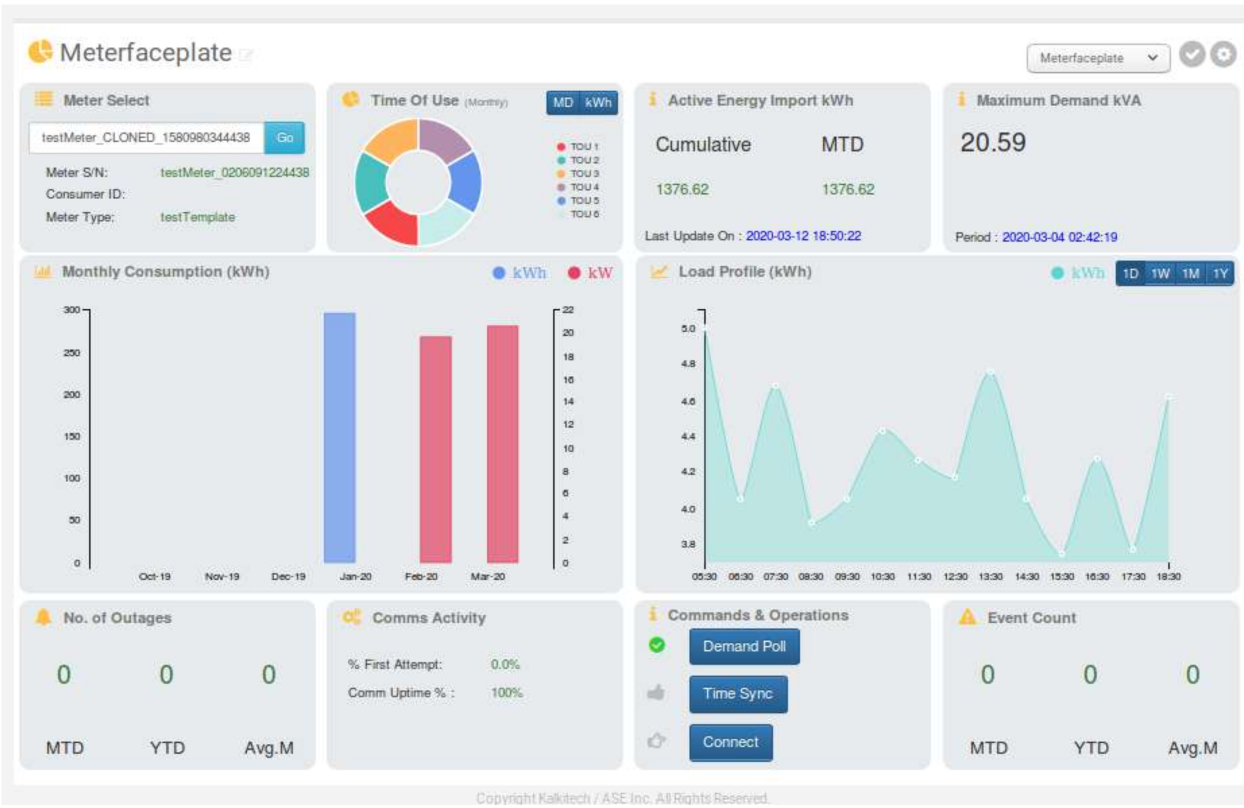

Figure III-2

IV.Connection management using Scalable HA Proxy and Secure Web Socket

The platform manages all connections including simultaneous buildup of incoming/outgoing connections coinciding at the same point of time by HA-Proxy for connection establishment, disconnection, and reconnection of active channels.

The platform is mainly tasked with two types of heavy lifting connections where simultaneous connections must be created and managed. One is the connections for the Web Interface HTTPS and

[5] The AMR Meter Faceplate Dashboard captures individual Meter information. The AMR Dashboard Home Page on the captures information at a global scale.

the other are the incoming connections from last mile DCUs.

Both the connections for the HTTPS interface and DCU incoming connections terminate on the platform HA Proxy.

HA Proxy allows high availability, load balancing, and proxying for TCP and HTTP-based applications by redistribution of incoming connections and high throughput by spreading the requests to multiple servers .

The connection that are established by the platform are by secure web socket only. The SSL certificates issued by a competent Certificate Authority (CA) are cached in the platform and inside the outgoing (web server) or incoming entities (DCU). Only those connections which have matching certificates between them, and platform are authorized for further data transactions.

The connections through the Data WAN would be secured using TLS1.2 web socket connections for all inbound connections from field. DCUs are ill legitimized and disconnected by the platform the moment its detects the SSL certificate is not downloaded from the qualified CA server or suffers mismatch during handshake.[6]

For every successful connection to Meter and meter poll the poll counter in the dashboard for the respective meter is incremented by 1 in the meter faceplate dashboard and the total success polls in the AMR Home dashboard is also likewise incremented for display field and histogram widget.

V.Device Management and Notifications

The device management application for connected devices is an active application for device oversight. Device oversight is achieved by tracking Device statistics of every device in the platform ecosystem real time.

This would include diagnostic review of all DCU statistics collected by the platform from each DCU. Any outlier is analysed and put out to a watchdog list for notification

The device management instance of the platform also features a device configuration system. Every configuration is tagged with revision numbers, description and time stamped. Each of these configurations can be visited for roll out to SYNC devices. The configuration roll out to a device would store the configuration in the designated device memory buffer. Only a specific command by an authorized user will apply the configuration.

Configurations and firmware which are rolled out from the central facility are archived for reference or future roll out. The Kalki.io platform together with the DCUs also ensures that configuration done locally at site during commissioning/maintenance are synchronized automatically with the central configuration repository for archives

New updates for security patches on firmware upgrades are executed on batch mode using a global update for all authorized gird edge devices in the Kalki.io platform ecosystem. Centralized configuration management software provides firmware update feature to update firmware of

[6] *Without valid certificates no connection from a device can be made to the Kalki.io Platform*

downstream DCUs in batch mode without the user needing to initiate firmware update one by one. Firmware update is done in a highly secure manner, the Centralized configuration management module authenticates and signs to be rolled out firmware. [7]

The device management software also provisions capacity to update meter firmware from the base location where kalki.io is hosted. Metre manufacturers having a firmware update job wherein all metres or subset of meters has to be embedded with an update patch, then these updates can be effected on a global roll out via the DCU to all metres.[8]

VI.Audit trail

The system provides audit trail of user and system activities either failed or successful. A trail of all activities against username, role and timestamp are registered in column and row wise format with a system generated unique ID.

The trail would be comprehensive enough to include security violations, attempted intrusions and unwanted access. Trail logs would include version control, Configurations rolled out and any Alarms deemed critical enough by the system to warrant an inclusion in the Audit trail.

The Kalki.io System supports detailed audit trail to keep track of various system activities.

- Every connection (user/applications) to the data acquisition platform is logged in an audit log with the user/object that authenticated, the date and time and the action executed.
- The audit log is filterable based on different actions such as
    - Log in successful
    - Log in failed
    - Log out
    - Scheduled job added such as Meter reading or RTU configuration changes
    - Schedule changed
    - Write command to the field devices
- The user interface has a section showing remote service history (ie contact points between the DCU device and the data acquisition software platform for service actions (firmware, config, changes etc)).
- It logs the connectivity type, records of changes that were executed, with username and timestamp

VII.User Management and Role Based Access Control

In the Kalki.io platform user management scheme, every stakeholder is a potential user. In this scenario a regulator, consumer or vendor are all legitimate candidates of being users. Each user

[7] DCUs are designed to accept only signed firmware and configuration
[8] This provision is for SYNC2000 M3 DCU connected to the Kalki.io platform.

would be interested in a specific dataset and privileges would be built around these data sets.

The system includes mechanisms for defining and controlling user access to the platform environment and applications. A least-privilege concept such that users are only allowed to use or access functions for which they have been given authorization are available.

To conform to Access Control and a least privilege concept, a RBAC (Role based access control) is implemented as the Main User Management feature to enforce user access rights in the form of roles with fine-grained permissions. Access rights include user-access to installed components and individual actions within components. Apart from UI users, same shall be applicable to other actors in the system like device connections and containerized applications hosted on the platform.

Web pages developed in the Kalki.io IDE actively uses real time or processed data for publishing local web client interfaces. Their users are created by an advanced user management system in which roles and their privileges are defined. And only those users in possession of adequate credentials are allowed access to the web pages launched by the server. [9]

The role-based access control (RBAC) is the mainstay for the Kalki.io User Management System and pervades throughout all modules of the application where restrictive access is required. Every user is presented with security credentials and shortlisted under a organization defined role to enforce rights and privileges for data access across the system.

VIII. Upgrade of the Kalkitech SYNC DCU

The Kalki.io data platform is also a IoT Platform and can connect to a ecosystem of IoT devices. The existing system is host with Kalkitech SYNC DCU with MODEM is deployed at the individual stations. These boxes are independent and self-contained embedded hardware running protocol-based applications which are used for protocol conversion/Data Concentration by interfacing with Meter IEDs.

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[9] *User Interface Login Security for Web Clients is also a function of User Management, and the platform offers the following security:*

- *Login session is tracked using Bearer authorization token-based mechanism*
- *Bearer authorization token is an AES256 encrypted blob with HMAC-SHA256 (Hmac-ed after encryption to mitigate padding oracle attack)*
- *UI based on AngularJS and REST APIs*
- *Encryption key changes every 30 minutes (configurable)*
- *Login tokens are only valid until the user logs out of the system*
- *User passwords are stored as a bcrypt hash with 12 iterations*
- *Temporary user lockout after 3 failed attempts (configurable), for 15 minutes (default))*
- *Forced password reset with configurable duration*
- *Disable user and forced logout support*
- *Forced multi-factor authentication support*

The upgrade plan will have deployed devices transformed into Grid Edge device to the Kalki.io Head end platform for authorized secure connection (after verification of device certificates downloaded from a competent CA server) . The DCU with MODEM after upgrade will be equipped for:

A. *Signed Firmware and Configuration*

The DCU after the upgrade will not accept firmware and configurations which are not signed from an authorized source. The platform or a configuration software authorized[10] by the platform can digitally sign created configuration or updated firmware.

The upgraded DCU will read the digital signature applied to a configuration file or firmware file to confirm that the file has been created by an authorized entity and has not been altered or corrupted.

B. Secure Web socket connections[11]

Every DCU in the network is embeddable with SSL certificates which matches with a copy in the platform certificate repository. The SSL certificate contains the platform URL and Key. The DCU will attempt to establish secure web socket connection to this URL only through available last mile networks.

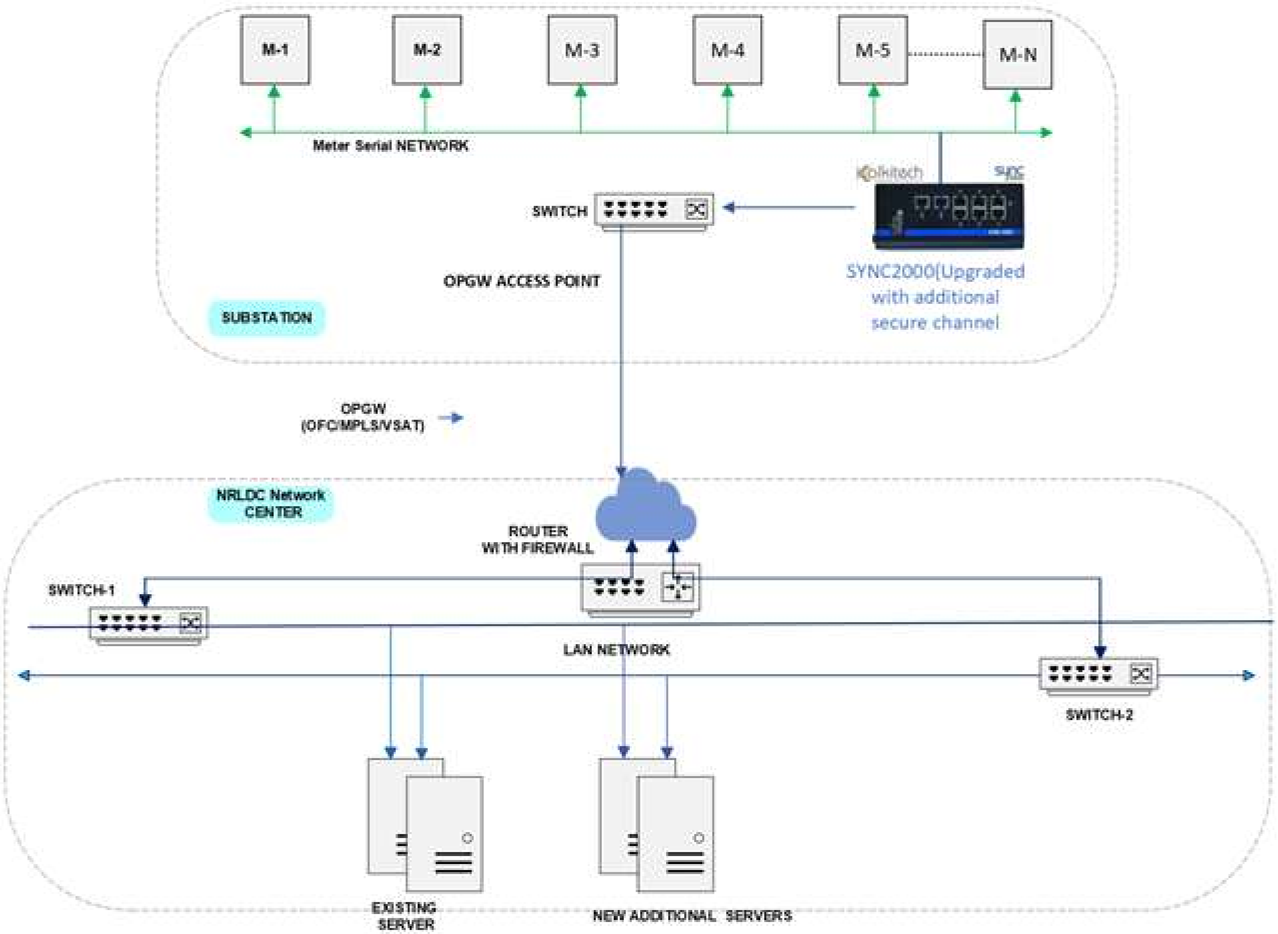
IX.Solution Architecture of the Upgraded system

The downstream DCU after the upgrade is configured with one additional channel suited to the station last mile network access to Remote control room. The new channel is a secure web socket connection to a Kalki.io platform URL as provided in configuration. The existing unsecure DCU channel to the legacy head end system is left undisturbed and data transfer is carried as usual through existing 3G/GPRS Radio or OPGW.

.

[10] Unauthorized copies of the configuration software are prevented from accessing any features of the DCU

[11] Supports TLS 1.2 transport layer security



Two additional servers procured under the upgrade scheme is commissioned to host the Kalki.io platform with a single instance of a database (DB) server and Application/web server. The platform database is generated using dumps from legacy DB and a phase wise roll out of the AMR module would commence. During the phase wise deployment, the DCUs will establish secure connections to Kalki.io platform instance hosted on these two servers using the recently configured second channel.

The Migration policy is aimed at having the upgrade with minimum downtime to existing system. To achieve this objective, there would be a transition period before the new upgraded Kalki.io platform comes into operation full swing.

In this transition period, the DCU will co-exist with both instances of the Head end by simultaneous connection via unsecure connection to legacy instance and another secure connection to Kalki.io Instance.

After total roll out and customer sign off the legacy servers would be upgraded to contain two redundant additional instances of the platform bringing to a total two database instance and two application/server instances for the Kalki.io Platform as envisaged in the total upgraded scheme.

The DCU would also be simultaneously reconfigured to cull the unsecure legacy channel for the secure channel to Kalki.io platform to completely takeover.

X.Bill of Quantity

S.No	Item	Quantity
1	Servers with 2.4 Ghz Xeon Intel 2* 8 Core Processor, 64 GB RAM[12]	2
2	Windows DNS Server	1 License
3	Upgraded Secure Firmware for existing SYNC2000 DCU and reconfiguration services	Lot
4	Kalki.io AMR Platform licensed for 5000 Meters with 500 DCUs connections and services.	Single license

[12] To augment the server infrastructure already in place. The upgrade aims to reuse all Network and Hardware infrastructure currently being used by the legacy system.

PRICE SCHEDULE_PGCIL NR1AMR SYSTEM UPGRADE _SF_34170

Sl No	Particulars	Unit	Qty	Unit Ex-Work (FOR-D) (in INR)	Total Ex-works (FOR-D) price	Applicable GST in % per unit	Applicable GST per Unit (INR)	Unit Ex-Works Price with GST	Total price with GST (INR)
			A	B	C=A x B	D	E=D x B	F=B+E	G=A x F
1	Kalki.io AMR Platform licensed for 5000 Meters with 500 DCUs connections and services.	Nos	1	1,50,00,000	1,50,00,000	18%	27,00,000	1,77,00,000	1,77,00,000
2	Upgraded Secure Firmware for existing SYNC2000 DCU and reconfiguration services	Nos	400	6,000	24,00,000	18%	1,080	7,080	28,32,000
3	Installtion and Comissioining Services of the New Application at Control Centre Server	LS	1	30,00,000	30,00,000	18%	5,40,000	35,40,000	35,40,000
	Grand Total Price in INR				**2,04,00,000**				**2,40,72,000**

Thanking You
With Sincere Regards
Kalki Communication Technologies Pvt Ltd

JP MISHRA
MOB:8826549696

Annexure-VI

पावर ग्रिड कारपोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
POWER GRID CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)
पावरग्रिड

केन्द्रीय कार्यालय : "सौदामिनी" प्लॉट सं. 2, सैक्टर-29, गुडगाँव-122 001, हरियाणा
फोन : 0124-2571700-719, फैक्स : 0124-2571760, 2571761 तार 'नेटग्रिड'
Corporate Office : "Saudamini" Plot No. 2, Sector-29, Gurgaon-122 001. Haryana
Tel. : 0124-2571700-719, Fax : 0124-2571760, 0124-2571761 Gram : 'NATGRID'

सदर्भ संख्या / Ref. No.

CIN: L40101DL1989GOI038121

C/CP/ NRSS-XXXVIII

March 30, 2017

MEMORANDUM

विषय: "उत्तरी क्षेत्र पारेषण प्रणाली सुदृनीकरण योजना (एन आर एस एस) - XXXVIII से संबन्धित आईसीटी और बेज़ का प्रावधान" का निवेश अनुमोदन

Sub: Investment approval for "ICTs & Bays associated with Northern Region System Strengthening Scheme (NRSS – XXXVIII)"

The Board of Directors of POWERGRID, in exercise of powers delegated to it by the Department of Public Enterprises (DPE), Ministry of Heavy Industries and Public Enterprises, Government of India through its Office Memorandum No. 26(3)/2005-GM-GL-92 dated 1st May, 2008 and Office Memorandum No. DPE/11(2)/97-Fin. dated 22nd July, 1997 (modified subsequently through Office Memorandum No. 18(24)/2003-GM-GL.64 dated 5th August, 2005), have accorded investment approval for **"ICTs & Bays associated with Northern Region System Strengthening Scheme (NRSS – XXXVIII)"** in its 339th meeting held on March 29, 2017, as per the details given below:

1. **परियोजना का कार्य क्षेत्र/ Scope of Project**

   Broad scope of the project is given at **Annex-I**.

2. **परियोजना की लागत एवं वित्तपोषण/ Project Cost & Funding**

   Estimated cost of the project is ₹ **337.75 crore** (including an IDC of ₹ 21.46 crore) based on October, 2016 price level. The abstract cost estimate is attached at **Annex-II**.

   Project is proposed to be implemented through domestic borrowings/ bonds/ External Commercial Borrowings (ECBs) and POWERGRID's internal resources with a debt : equity ratio of 70:30.

3. **कार्यान्वयन कार्यक्रम/ Commissioning Schedule**

   The project is scheduled to be commissioned within 27 months from the date of investment approval.

   This is issued in pursuance of 339th meeting of Board of Directors of POWERGRID held on March 29, 2017.

सतीश 30/3/17

(सतीश कुमार जे.)

उप महाप्रबंधक (केन्द्रीय आयोजना)

वितरण/ Distribution:

1. Commissioner, Power Development Deptt., Govt. of Jammu & Kashmir, Mini Secretariat, Jammu
2. Managing Director, Himachal Pradesh Power Transmission Corporation Ltd., Barowalias House, Khalini, Shimla - 171 002
3. CMD, Punjab State Transmission Corporation Ltd., PSEB Head Office, The Mall, Patiala - 147 001
4. CMD, Haryana Vidyut Prasaran Nigam Ltd., Shakti Bhawan, Sector-6, Panchkula (Haryana)- 134 109
5. CMD, Rajasthan Rajya Vidyut Prasaran Nigam Ltd., Vidyut Bhawan, Janpath, Jaipur-302 005.
6. CMD, UPPCL, Shakti Bhawan, 14, Ashok Marg, Lucknow- 226 001
7. Managing Director, PTCUL, Vidyut Bhawan, Majra, Dehradun – 248 002
8. Managing Director, Delhi Transco Limited (DTL), Shakti Sadan, Kotla Road, New Delhi- 110 002
9. Chief Engineer, Electricity Deptt., Chandigarh Administration, Mini Secretariat (U.T.), Sector-9, Chandigarh

प्रति - विनम्र सूचनार्थ/ Copy for kind information, please:

1. PS to Secretary (Power), MoP, Shram Shakti Bhawan, New Delhi- 110 001
2. Chairperson, CEA, Sewa Bhawan, R.K. Puram, New Delhi - 110 066
3. Secretary, CERC, 3rd & 4th Floor, Chanderlok building, 36, Janpath, New Delhi
4. CEO (POSOCO), B-9 (1st Floor), Qutab Institutional Area, Katwaria Sarai, New Delhi -110016
5. CEO, NITI Aayog, Yojana Bhawan, New Delhi
6. Advisor, PAMD, NITI Aayog, Yojana Bhawan, New Delhi
7. Member Secretary, NRPC, 18/A, Shaheed Jeet Singh Sansanwal Marg, Katwaria Sarai, New Delhi- 110 016
8. Member (Power Systems), CEA, Sewa Bhawan, R.K.Puram, New Delhi- 110 066
9. Secretary, CEA, Sewa Bhawan, R.K.Puram, New Delhi- 110 066 – **03 copies**
10. Deputy Director General (PI), Ministry of Statistics & Programme Implementation, Sardar Patel Bhawan, New Delhi
11. Joint Secretary & Financial Advisor, MoP, Shram Shakti Bhawan, New Delhi
12. Joint Secretary (Transmission), MoP, Shram Shakti Bhawan, New Delhi
13. Joint Secretary (Plan Finance Div.-II), Ministry of Finance, North Block, New Delhi
14. Director (Transmission), MoP, Shram Shakti Bhawan, New Delhi
15. Director, Ministry of Finance (Plan Finance Div.), North Block, New Delhi
16. Deputy Secretary, Cabinet Secretariat, Rashtrapati Bhawan, New Delhi
17. Under Secretary, Finance & Budget Section, MoP, Shram Shakti Bhawan, New Delhi

(सतीश कुमार जे.)
उप महाप्रबंधक (केन्द्रीय आयोजना)

<u>Important Note</u>:

The Board has desired that the following critical activities may be monitored:

(i) Award of package(s) in March, 2017.
(ii) Timely supply of major equipment.
(iii) Risk Management Matrix indicating various milestones to be monitored for the subject project is attached at **Annex-III**.

<u>वितरण</u>:

सीओओ : सीटीयु - प्लानिंग एवं स्मार्ट ग्रिड/ टेलीकॉम

का. निदेशक: वाणिज्यि एवं आरसी/ सीएमजी/ ईआरपी एवं आईटी/ एचवीडीसी/ अभियांत्रिकी - एसएस, टीएल एवं सिविल / वित्त – Sh. S. Vaithilingam / वित्त – Sh. Ranjan Kr. Srivastava/ संविदा सेवाएं/ ईएसएमडी, सीएसआर & एलए/ एनटीएएमसी/ उत्तरी क्षेत्र-I/ उत्तरी क्षेत्र-III/ परिसंपत्ति प्रबंधन/ मानव संसाधन/ क्यूए एंड आई, सीसीसी/ एलडी एंड सी

महाप्रबंधक I/C (MM)

महाप्रबंधक : मानव संसाधन एवं विधि/ लागत अभि.

अपर महाप्रबंधक (विधि)

कंपनी सचिव

<u>विनम्र सूचनार्थ</u>:

निदेशक (वित्त)/ निदेशक (परिचालन)/ निदेशक (परियोजना)/ निदेशक (कार्मिक)/ मुख्य सतर्कता अधिकारी

सतीश, 30/3/17

(सतीश कुमार जे.)
उप महाप्रबंधक (केन्द्रीय आयोजना)

Annex-I

"ICTs & Bays associated with Northern Region System Strengthening Scheme (NRSS – XXXVIII)"

Broad scope of work is as follows:

Substation

i) Creation of 400kV level at Aligarh(PG) 765kV GIS switching Station – Extn

a. Provision of 2x1500MVA 765/400kV ICTs along with associated bays

b. Provision of 2 Nos. of 400kV line bays for termination of Aligarh Prithla 400kV D/c line under TBCB

ii) Extension of 400kV Neemrana(PG) substation

a) Provision of 2 Nos. of 400kV line bays for termination of Neemrana-Dhanonda 400kV D/c line under TBCB

***

ANNEX- II

ABSTRACT COST ESTIMATE

ICTS & BAYS ASSOCIATED WITH NORTHERN REGION SYSTEM STRENGTHENING SCHEME (NRSS)-XXXVIII

(For Base Cost)

(Rupees in Crores)

Oct-2016

SL. No	Description	Amount (Rs. in Crs.)
A	Preliminary Survey & Soil Investigation	0.00
B	Land Acquisition for Substation and R & R Compensation	0.00
C	Cost of Compensation for Transmission Lines	
	i) Compensation towards Crop, Tree, PTCC, Land & Others	0.00
	ii) Compensation towards Forest	0.00
		0.00
D	Civil Works	
	i) Infrastructure for substations	0.40
	ii) Non Residential Buildings	0.00
	iii) Colony for Trans. Lines & Substations	0.00
		0.00
E	Equipment Cost	
	a) Transmission Lines	0.00
	b) Sub-Stations	251.81
	C) LD&C/Telecom	0.00
	D)HVDC	0.00
F	**Sub Total (A to E)**	**252.21**
G	Special Tools & Plants	0.00
H	Incidental Expediture During construction (IEDC) 10.75% of [F-C(ii)]	27.11
I	Contingencies @ 3% of [F-C(ii)]	7.57
J	Centages & Contingencies @ 0% on Compensatory Afforestation (considering Rs. 0 per Ha)	0.00
K	Customs Duty @ 23.884% (including handling charges)	29.40
L	Overheads payable to SEBs	0.00
	SubTotal (A to L)	**316.29**
M	IDC	21.46
	GrandTotal	**337.75**
	Foreign Exchange Component	123.09

ANNEX- III

RISK MANAGEMENT MATRIX FOR ICTs & BAYS ASSOCIATED WITH NORTHERN REGION STRENGTHENING SCHEME (NRSS) - XXXVIII

Sl. No.	Risk Parameters	MS-1	MS-2	MS-3	MS-4	Completion	Responsibility Centre*	Remarks
A	Award of Major Work Pkgs.							
1	Sub-station Package	Award within 1-2 months of IA					CC, CS	
B	Sub-station Packages							
1	Site Mobilisation	Within 5-6 months from LOA				Before schedule completion of project	Site Project Head	

Note: * Overall In-charge for Responsibility Centre is Head of the respective Region/ Department.

CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

Petition No. 649/TT/2020

Coram:

Shri Jishnu Barua, Chairperson
Shri Arun Goyal, Member
Shri Ramesh Babu V., Member

Date of Order: 02.08.2024

In the matter of:

Approval under Regulation 86 of the Central Electricity Regulatory Commission (Conduct of Business) Regulations, 1999 for determination of transmission tariff for 2019-24 tariff period under the Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019 for **Asset I** - 1X1500 MVA 765/400 kV ICT-II alongwith associated bays and 2 Nos. 400 kV Line Bays for termination of 400 kV D/C Prithala-Aligarh TBCB Line at Aligarh 765 kV Switching Sub-station and **Asset II** - 1X1500 MVA 765/400 kV ICT-I at Aligarh 765 kV Switching Sub-station under "ICTs and Bays Associated with Northern Region System Strengthening Scheme (NRSS-XXXVIII)".

And in the matter of:

Power Grid Corporation of India Limited,
"Saudamini", Plot No. 2,
Sector 29, Gurgaon-122001 (Haryana) **.... Petitioner**

Vs.

1. Rajasthan Rajya Vidyut Prasaran Nigam Limited,
Vidyut Bhawan, Vidyut Marg,
Jaipur-302005 (Rajasthan).

2. Ajmer Vidyut Vitran Nigam Limited,
132 kV, GSS RVPNL Sub-Station Building,
Caligiri Road, Malviya Nagar,
Jaipur-302017 (Rajasthan).

3. Jaipur Vidyut Vitran Nigam Limited,
132 kV, GSS RVPNL Sub-Station Building,
Caligiri Road, Malviya Nagar,
Jaipur-302017 (Rajasthan).

4. Jodhpur Vidyut Vitran Nigam Limited,
132 kV, GSS RVPNL Sub-Station Building,

Caligiri Road, Malviya Nagar,
Jaipur-302017 (Rajasthan).

5. Himachal Pradesh State Electricity Board,
Vidyut Bhawan, Kumar House Complex Building II,
Shimla-171004 (Himachal Pradesh).

6. Punjab State Electricity Board,
Thermal Shed Tia,
Near 22 Phatak,
Patiala-147001 (Punjab).

7. Haryana Power Purchase Centre,
Shakti Bhawan, Sector-6,
Panchkula-134109 (Haryana).

8. Power Development Department,
Government of Jammu & Kashmir,
Mini Secretariat, Jammu.

9. Uttar Pradesh Power Corporation Limited,
(Formerly Uttar Pradesh State Electricity Board),
Shakti Bhawan, 14, Ashok Marg,
Lucknow-226001 (Uttar Pradesh).

10. Delhi Transco Limited,
Shakti Sadan, Kotla Road,
New Delhi-110002.

11. BSES Yamuna Power Limited,
B-Block,Shakti Kiran, Building (Near Karkadooma Court),
Karkadooma 2nd Floor,
New Delhi-110092.

12. BSES Rajdhani Power Limited,
BSES Bhawan, Nehru Place,
New Delhi-110019.

13. Tata Power Delhi Distribution Limited,
NDPL house, Hudson Lines Kingsway Camp,
Delhi-110009.

14. Chandigarh Administration,
Sector-9, Chandigarh.

15. Uttarakhand Power Corporation Limited,
Urja Bhawan,
Kanwali Road, Dehradun (Uttarakhand).

16. North Central Railway,
Allahabad (Uttar Pradesh).

17. New Delhi Municipal Council,
Palika Kendra, Sansad Marg,
New Delhi-110002.

18. Gurgaon-Palwal Transmission Limited,
F-1, The Mira Corporate Suites,
1 & 2, Ishwar Nagar, Mathura Road,
New Delhi-110 065.

19. Haryana Vidyut Prasaran Nigam Limited,
Shakti Bhawan, C-4, Sector-6,
Panchkula-134109 (Haryana). **… Respondent(s)**

For Petitioner : Shri Mohd. Mohsin, PGCIL

For Respondents : Shri Deep Rao Palepu, Advocate, GPTL

ORDER

The Petitioner, Power Grid Corporation of India Limited, has filed the instant Petition for determination of the transmission tariff for the period from COD to 31.3.2024 under the Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019 (hereinafter referred to as the “2019 Tariff Regulations”) in respect of the following assets (hereinafter referred to as the “transmission assets”) under “ICTs and Bays Associated with Northern Region System Strengthening Scheme (NRSS-XXXVIII)” in Northern Region (hereinafter referred to as the “transmission project”):

Asset I - 1X1500 MVA 765/400 kV ICT-II along with associated bays and 2 Nos. 400 kV line bays for termination of 400 kV D/C Aligarh-Prithala TBCB line at Aligarh 765 kV Switching Sub-station, and

Asset II - 1X1500 MVA 765/400 kV ICT-I at Aligarh 765 kV Switching Sub-station.

2. The Petitioner has made the following prayers in the instant Petition:

"1) Admit the capital cost as claimed in the Petition and approve the Additional Capitalisation incurred / projected to be incurred.

2) Approve DOCO of asset-I and Asset-II as 01.11.2019 and 12.12.2019 respectively under provision 5 (2) of CERC (Terms and conditions of Tariff) Regulation, 2019.

3) Approve the Transmission Tariff for the tariff block 2019-24 block for the asset covered under this petition, as per para –8 above.

4) Condone the delay and allow IDC/IEDC as claimed in the petition as delay is on account of force majeure as per CERC Regulations'2019 22(2)(a) "uncontrollable factors"

5) Allow the petitioner to recover the shortfall or refund the excess Annual Fixed Charges, on account of Return on Equity due to change in applicable Minimum Alternate/Corporate Income Tax rate as per the Income Tax Act, 1961 (as amended from time to time) of the respective financial year directly without making any application before the Commission as provided in Tariff Regulation 2019 as per para 8 above for respective block.

6) Approve the reimbursement of expenditure by the beneficiaries towards petition filing fee, and expenditure on publishing of notices in newspapers in terms of Regulation 70 (1) Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019, and other expenditure (if any) in relation to the filing of petition.

7) Allow the petitioner to bill and recover Licensee fee and RLDC fees and charges, separately from the respondents in terms of Regulation 70 (3) and (4) Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019.

8) Allow the petitioner to bill and adjust impact on Interest on Loan due to change in Interest rate on account of floating rate of interest applicable during 2019-24 period, if any, from the beneficiaries.

9) Allow the petitioner to file a separate petition before Hon'ble Commission for claiming the overall security expenses and consequential IOWC on that security expenses as mentioned at para 8.8 above.

10) Allow the petitioner to claim the capital spares at the end of tariff block as per actual.

11) Allow the Petitioner to bill and recover GST on Transmission Charges separately from the respondents, if GST on transmission is levied at any rate in future. Further, any taxes including GST and duties including cess etc. imposed by any statutory/Govt./municipal authorities shall be allowed to be recovered from the beneficiaries.

12) Allow interim tariff in accordance with Regulation 10 (3) of Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019 for purpose of inclusion in the PoC charges.

and pass such other relief as Hon'ble Commission deems fit and appropriate under the circumstances of the case and in the interest of justice."

Background of the case

3. The brief facts of the case are as follows:

(a) The Investment Approval (IA) of the transmission project was accorded by the Board of Directors of the Petitioner's Company in its 339th meeting held on 29.3.2017 and circulated vide Memorandum No. C/CP/NRSS-XXXVIII dated 30.3.2017, at an estimated cost of ₹33775 lakh including IDC of ₹2146 lakh at October 2016 price level. As per the IA, the project is scheduled to be commissioned within 27 months from the date of the IA, i.e., by 28.6.2019.

(b) The scope of the transmission project was discussed and agreed upon in the 35th Standing Committee Meeting (SCM) on Power System Planning of the Northern Region held on 3.11.2014, the 34th meeting of the Empowered Committee on Transmission held on 13.4.2015, and the 33rd and 36th NRPC meetings on Transmission for the Northern Region, held on 11.11.2014 and 24.12.2015, respectively.

(c) The scope of work covered under the transmission project is as follows:

i) Creation of 400 kV level at Aligarh (PG) 765 kV GIS switching Station – Extension -

a) Provision of 2x1500 MVA 765/400 kV ICTs along with associated bays

b) Provision of 2 Nos. of 400 kV line bays for termination of Aligarh - Prithala 400 kV D/C line under TBCB

ii) 400 kV Neemrana (PG) Sub-station Extension -

a) Provision of 2 Nos.400 kV line bays for termination of Neemrana-Dhanonda 400 kV D/C line under TBCB

(d) The Petitioner has claimed the date of commercial operation (COD) of the transmission assets under Regulation 5(2) of the 2019 Tariff Regulations due to the delay in the commissioning of the 220 kV network at Prithala Sub-station under the scope of HVPNL. The details of the transmission assets covered in the instant Petition are as follows:

Sr. No	Name of Asset	COD (claimed under Regulation 5(2) of the 2019 Tariff Regulations)
1	**Asset I -** 1X1500 MVA 765/400 kV ICT-II along with associated bays and 2 Nos. 400 kV line bays for termination of 400 kV D/C Aligarh-Prithala TBCB line at Aligarh 765 kV Switching Sub-station.	1.11.2019
2	**Asset II -** 1X1500 MVA 765/400 kV ICT-I at Aligarh 765 kV Switching Sub-station	12.12.2019

(e) The details of the remaining transmission asset not covered in the instant Petition are as follows:

Sr. No	Name of Asset	COD	Remarks
1	2 Nos. 400 kV line bays at Neemrana Sub-station for termination of 400 kV D/C Neemrana-Dhanonda transmission line	26.2.2019	Petition No. 118/TT/2020 is filed under the 2019 Tariff Regulations

(f) The details of scheduled date of commercial operation (SCOD), COD and time over-run of the transmission assets are as follows:

Assets	SCOD	COD (claimed under Regulation 5(2) of 2019 Tariff Regulations)	Time over-run
Asset -I	28.6.2019	1.11.2019	4 Months 2 Days
Asset -II	28.6.2019	12.12.2019	5 Months 13 Days

4. The Respondents are distribution licensees, Power Departments, and transmission licensees, who are procuring transmission services from the Petitioner, mainly beneficiaries of the Northern Region.

5. The Petitioner has served a copy of the Petition on the Respondents, and notice regarding the filing of this Petition has also been published in the newspapers in accordance with Section 64 of the Electricity Act, 2003 (‘the Act’). No comments or

suggestions have been received from the general public or Respondents in response to the aforesaid notices published in the newspapers by the Petitioner. Uttar Pradesh Power Corporation Limited (UPPCL), i.e., Respondent No. 9, has filed its reply vide affidavit dated 30.10.2021 and has raised the issues of delay in the proposed COD, the need for prudence check with respect to completion cost and Additional Capital Expenditure (ACE), and security expenses. Gurgaon Palwal Transmission Limited (GPTL), Respondent No. 18, has filed its reply vide affidavit dated 27.11.2021 and has prayed to impose the liability for delay in COD on HVPNL and not on GPTL.

6. During the course of the hearing the matter on 6.2.2024, learned counsel for GPTL submitted that GPTL had filed Petition No. 90/MP/2020 claiming that its associated transmission line was affected by *force majeure* events, which has a bearing on the instant matter. He further submitted that as per the Record of Proceedings (RoP) dated 1.8.2022 in Petition No. 649/TT/2020, the order in the present Petition has to be issued after the issuance of the order in Petition No. 90/MP/2020. The Commission, vide order dated 19.5.2024, has disposed of Petition No. 90/MP/2020.

7. The order in the matter was reserved on 6.2.2024. However, the order could not be passed before Shri P. K. Singh, a former Member, demitted the office. Therefore, the matter was heard again on 29.5.2024 and the order was reserved.

8. This order is issued considering the submissions made by the Petitioner in the Petition accompanied by an affidavit dated 3.7.2020 and its subsequent affidavits dated 15.9.2021, and 24.8.2022. UPPCL's and GPTL's have filed their replies vide affidavits dated 30.10.2021 and 27.11.2021, respectively, and the Petitioner's rejoinders thereto.

9. Having heard the Petitioner's representative, learned counsel for GPTL, and having perused the material on record, we proceed to dispose of the Petition.

DETERMINATION OF ANNUAL FIXED CHARGES FROM COD TO 31.3.2024 FOR THE 2019- 24 TARIFF PERIOD

10. The Annual Fixed Charges (AFC) claimed by the Petitioner in respect of the transmission assets for the 2019-24 tariff period are as follows:

(₹ in lakh)

Asset-I					
Particulars	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Depreciation	222.01	657.34	743.73	786.94	786.94
Interest on Loan	218.40	610.67	641.99	625.30	563.71
Return on Equity	228.02	675.14	763.89	808.26	808.26
Interest on working capital	25.25	67.21	71.65	74.13	74.48
O&M Expenses	348.81	868.90	899.50	931.72	964.08
Total	**1042.49**	**2879.26**	**3120.76**	**3226.35**	**3197.47**

(₹ in lakh)

Asset-II					
Particulars	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Depreciation	140.50	506.92	567.84	598.32	598.32
Interest on Loan	133.74	458.81	477.30	463.01	418.17
Return on Equity	145.64	525.45	588.60	620.18	620.18
Interest on working capital	16.78	58.23	61.65	63.70	64.25
O&M Expenses	240.22	819.49	848.45	878.98	909.59
Total	**676.88**	**2368.90**	**2543.84**	**2624.19**	**2610.51**

11. The details of the Interest on Working Capital (IWC) claimed by the Petitioner in respect of the transmission assets are as follows:

(₹ in lakh)

Asset-I					
Particulars	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
O&M Expenses	69.99	72.41	74.96	77.64	80.34
Maintenance Spares	125.99	130.34	134.93	139.76	144.61
Receivables	308.64	354.98	384.75	397.77	393.13
Total	**504.62**	**557.73**	**594.64**	**615.17**	**618.08**
Rate of Interest (in %)	12.05	12.05	12.05	12.05	12.05
Interest on Working Capital	**25.25**	**67.21**	**71.65**	**74.13**	**74.48**

(₹ in lakh)

Asset-II					
Particulars	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
O&M Expenses	66.01	68.29	70.70	73.25	75.80
Maintenance Spares	118.81	122.92	127.27	131.85	136.44

Receivables	274.41	292.06	313.62	323.53	320.96
Total	**459.23**	**483.27**	**511.59**	**528.63**	**533.20**
Rate of Interest (in %)	12.05%	12.05%	12.05%	12.05%	12.05%
Interest on Working Capital	**16.78**	**58.23**	**61.65**	**63.70**	**64.25**

Date of Commercial Operation ("COD")

12. The Petitioner has claimed the COD of Asset-I as 1.11.2019 and Asset-II as 12.12.2019 in terms of Regulation 5(2) of the 2019 Tariff Regulations as the associated 220 kV downstream transmission system under the scope of HVPNL was not ready.

13. Regulation 5 of the 2019 Tariff Regulations provides as follows:

*"**5. Date of Commercial Operation:** (1) The date of commercial operation of a generating station or unit thereof or a transmission system or element thereof and associated communication system shall be determined in accordance with the provisions of the Grid Code.*

(2) In case the transmission system or element thereof executed by a transmission licensee is ready for commercial operation but the interconnected generating station or the transmission system of other transmission licensee as per the agreed project implementation schedule is not ready for commercial operation, the transmission licensee may file petition before the Commission for approval of the date of commercial operation of such transmission system or element thereof:

Provided that the transmission licensee seeking the approval of the date of commercial operation under this clause shall give prior notice of at least one month, to the generating company or the other transmission licensee and the long term customers of its transmission system, as the case may be, regarding the date of commercial operation:

Provided further that the transmission licensee seeking the approval of the date of commercial operation of the transmission system under this clause shall be required to submit the following documents along with the petition:

(a) Energisation certificate issued by the Regional Electrical Inspector under Central Electricity Authority;
(b) Trial operation certificate issued by the concerned RLDC for charging element with or without electrical load;
(c) Implementation Agreement, if any, executed by the parties;
(d) Minutes of the coordination meetings or related correspondences regarding the monitoring of the progress of the generating station and transmission systems;
(e) Notice issued by the transmission licensee as per the first proviso under this clause and the response;
(f) Certificate of the CEO or MD of the company regarding the completion of the transmission system including associated communication system in all respects."

."

14. The Commission vide RoP for the hearing dated 1.8.2022 directed the Petitioner

to submit a note regarding the purpose of the 2X1500 MVA ICTs at Aligarh Sub-station and power flow details of the 2X1500 MVA ICTs.

15. In response, the Petitioner, vide affidavit dated 24.8.2022, has submitted that as per the agenda of the 35th SCM held on 3.11.2014, HVPNL requested for the creation of new three 400 kV Sub-station, one at Kadarpur, the other one at Sohna Road in Gurgaon area and one 400 kV Sub-station at Prithala in Palwal area as a part of Inter-State Transmission System (ISTS). The first two Sub-stations have been proposed to cater to the load demand of Sectors 58 to 67 and Sectors 68 to 80 of Gurgaon, respectively. The creation of the Prithala Sub-station would meet the power demand of the area to be developed under the Prithala Development Plan. Besides, it will also act as a main feeding source for Palwal, Rangla Rajpur, and Meerpur Kurli. A meeting was held in the CEA on 3.9.2014 to discuss the same in which, it was decided that the joint studies would be carried out by HVPNL and CTUIL in the Petitioner's office. HVPNL furnished the district-wise load projections of Haryana for the 13th Plan (2021-22). Considering the load growth in and around Gurgaon, it was proposed that a bigger ring connecting the existing 400 kV Sub-station of Dhonda-Faruk Nagar (to be created by LILO of Dhonda-Daulatabad D/C line)-Daulatabad-Gurgaon (PG)-Sona-Manasher-Neemrana-Dhonanda may be created around Gurgaon area with 400 kV Quad conductor.

16. In the 35th SCM, the following was agreed:

- To meet the growing load demand in Gurgaon and Palwal and its adjoining areas and to serve the consumers with reliable power, the establishment of three nos. 2X500 MVA, 400/220 kV Sub-stations at Sohna Road, Kadarpur, and Prithala along with associated 400 kV connectivity, i.e. Aligarh-Prithala-

Kadarpur-Sohna Road 400 kV D/C corridor, LILO of Gurgaon-Manesar 400 kV D/C line at Sohna Road and Neemrana-Dhanonda 400 kV D/C line was agreed to be implemented under ISTS (TBCB) based on the request from HVPNL.

- 400/200 kV Sohna Road Sub-station was proposed to cater to the load demand of Sectors 58 to 67 of Gurgaon, whereas 400/220 kV Kadarpur Sub-station was proposed to cater to Sectors 68 to 80 loads of Gurgaon. The 400/220 kV Prithala Sub-station would feed Palwal, Rangla Rajpur, Meerpur Kurli, and adjoining areas. Further, looking at the load growth in Prithala and around Gurgaon areas, a bigger ring around Gurgaon connecting 400 kV Sub-station of Dhanonda-Farukh Nagar-Sohna Road-Manesar-Neemrana-Dhanonda was also proposed.

- Prithala Sub-station was proposed to be connected to ISTS grid at 400 kV to Aligarh (PG) 765 kV switching station and for this purpose 400 kV level was agreed to be created at Aligarh (PG) 765 kV switching station through 2x1500 MVA, 765/400 kV ICTs. 2 nos. 400 kV line bays at Aligarh (PG) for termination of Aligarh-Prithala 400 kV D/C line and 2 nos. 400 kV line bays at Neemrana (PG) for termination of Neemrana-Dhanonda 400 kV D/C line were also agreed to be implemented.

The lines under the scheme were planned with a quad conductor configuration (subsequently changed to HTLS), having a capacity of about 2000 MW for each circuit. Considering the N-1 contingency and requirement of capacity, 2 nos. 765/400 kV 1500 MVA ICT were planned at Aligarh Sub-station.

17. We have gone through the submissions of the Petitioner. The Relevant extracts of the 35th SCM of NR wherein 2X1500 MVA ICTs at Aligarh Sub-station were approved are as follows:

> *"9. Creation of new 400kV substations in Gurgaon area and Palwal area as a part of ISTS- Agenda by HVPN.*
> --
> --
> --
> *CE HVPNL as well as SE UPPCL stated that the feed to Prithala from Aligarh would be a better solution as number of lines from Agra S/S are coming to Gurgoan area and the 765 kV Aligarh switching st. may be changed as 765/400 S/S by adding 2x1500 MVA ICT. They further stated that to take care of the increasing problem of short circuit level, all 400 kV S/S should be designed to handle 50 KA fault current. After detailed deliberation the following proposals were agreed by the Standing Committee with the following scope of works:*
> *i) Creation of 400 kV level at Aligarh S/S by adding 2x1500 MVA 765/400 kV ICT*
> *ii) --*
> ***The Standing Committee agreed and concurred with the proposal."***

18. The Relevant extracts of the minutes of the 33rd meeting of the Northern Regional Power Committee and 29th meeting of TCC wherein 2X1500 MVA ICTs at Aligarh Sub-station were approved are as follows:

> *"**D.6.2.3 Creation of new 400/220 kV substations in Gurgaon area and Palwal area as a part of ISTS***
>
> *Representative of CTU, POWERGRID informed that to cater the load demand of sector 58 to sector 67 and sector 68 to sector 80 of Gurgoan and the area to be developed under Prithala Development Plan, following ISTS Transmission system had been agreed in the 35th SCM:*
>
> *i) Aligarh (POWERGRID) – Prithala, 400 kV D/C Quad line*
>
> *ii) 400 kV D/C Quad line from Prithala – Kadarpur (400 kV) S/S*
>
> *iii) 400 kV D/C Quad line from Kadarpur – Sona Road (400 kV) S/S*
> *iv) LILO of Gurgoan – Manesar D/C line at Sona Road S/S*
>
> *v) Neemrana – Dhonanda (HVPNL) 400 kV D/C Quad line*
>
> *vi) Creation of 400/220 kV, 2*500MVA substations at Kadarpur in Gurgaon area*
>
> *vii) Creation of 400/220 kV, 2*500 MVA substations at Sona Road in Gurgaon area*
>
> *viii) Creation of 400/220 kV, 2*500 MVA substations at Prithala in Palwal area*
>
> *ix) **Provision of 2 nos. of 765/400 kV 1500 MVA at Aligarh (POWERGRID).***

*x) To cater to the future load growth of the area, space provision of 2*500MVA transformation capacity augmentation at each of these substations may be kept.*

Members of NRPC while agreeing to the proposal stated that the 220 kV connectivity must be ensured by HVPNL in the matching time frame."

19. As per the above minutes, we are of the view that 2 nos. 1500 MVA transformers at Aligarh were planned to cater to HVPNL's drawl requirement. The COD of the transmission assets is being claimed under Regulation 5(2) of the 2019 Tariff Regulations, as both the assets were charged on a "no load" basis. as, there was no power flow in the transmission line due to the non-commissioning of the downstream system under the scope of HVPNL.

20. Regulation 5(2) of the 2019 Tariff Regulations provides that in case the transmission system or element thereof executed by a transmission licensee is ready for commercial operation but the inter-connected generating station or the transmission system of other transmission licencee as per the agreed project implementation schedule is not ready for commercial operation, the transmission licencee may file a Petition before the Commission for approval of the date of the commercial operation of such transmission system or element thereof.

21. In the instant case, the Petitioner sought approval of the COD of Asset-I and Asset-II as 1.11.2019 and 12.12.2019, respectively as its associated downstream asset under the scope of HVPNL was not ready because of which the Petitioner was not able to declare the COD of Assets-I and II.

22. HVPNL was not initially impleaded as a Respondent in the present Petition, but it was impleaded as a Respondent to the present Petition on the direction of the Commission vide RoP dated 26.10.2021.

23. The Commission vide RoP dated 26.10.2021 directed the Respondents, including HVPNL, UPPCL, and GPTL, to file their respective replies in the matter. However, no response was received from HVPNL on the Petitioner's plea for approval of COD of Assets-I and II under Regulation 5(2) of the 2019 Tariff Regulations and the status of the associated downstream assets under its scope. Since HVPNL did not file any reply, we deal with the Petitioner's plea for approval of COD of Assets-I and II on the basis of the information available on record.

Asset-I:

24. The Petitioner has sought a declaration of COD of Asset-I as of 1.11.2019 under Regulation 5(2) of the 2019 Tariff Regulations. In support of COD of Asset-I, the Petitioner has placed on record the Energisation Certificates dated 4.10.2019 under Regulation 43 of the Central Electricity Authority (CEA) (Measures relating to Safety and Electric Supply) Regulations, 2010, 'No-load' RLDC Charging Certificate dated 2.1.2020, certifying that successful trial operation was completed on 31.10.2019 and CMD Certificate as required under the Grid Code. The relevant portion of the 'no-load' certificate in the case of Asset-I is as follows:

Certificate of Completion of Trial Run Operation of 400kV bays no 401-403 and 405-406 at Aligarh (PG)

संदर्भ

i) CPCC, POWERGRID, NRTS-3, New Delhi Communication dated **09.10.2019 & 15.10.2019** regarding the submission of pre charging documents for 765kV, 3x500 MVA ICT-2 and Prithala(GPTL) line-1,2 bays and associated main & tie bays of Aligarh(PG) ICT-1.

ii) Real time code issued by NRLDC on request CPCC, POWERGRID, NRTS-3, New Delhi **26.10.2019, 29.10.2019 & 30.10.2019(NRLDC Code: NR1910-3946, 3826 & 3827).**

iii) CPCC, POWERGRID, NRTS-3, New Delhi, Communication dated **13.12.2019** regarding the submission of post charging documents.

Based on above references, it is hereby certified that the following Transmission elements have been successfully completed the trial operation:

Name of Transmission Asset:	**1. 400kV Main bay no 401 of 765kV, 3x500 MVA ICT-1 at Aligarh (PG).** **2. 400kV Tie bay no 402 at Aligarh (PG).** **3. 400kV Main bay no 403 of Prithala line-1 at Aligarh (PG).** **4. 400kV Tie bay no 405 at Aligarh (PG).** **5. 400kV Main bay no 406 of Prithala line-2 at Aligarh (PG).** **(Above elements were charged at no load)**
Owner of Transmission Asset:	**1. POWERGRID**
Date and Time of Energization for Commencement of trial run operation:	**1. 30.10.2019/10:54 hrs.** **2. 30.10.2019/10:55 hrs.** **3. 30.10.2019/10:56 hrs.** **4. 29.10.2019/18:57 hrs.** **5. 29.10.2019/19:06 hrs.**
Date and Time of completion of trial run operation:	**1. 31.10.2019/10:54 hrs.** **2. 31.10.2019/10:55 hrs.** **3. 31.10.2019/10:56 hrs.** **4. 30.10.2019/18:57 hrs.** **5. 30.10.2019/19:06 hrs.**

यह प्रमाणपत्र ट्रांसमिशन तत्व के परीक्षण संचालन के सफल समापन को प्रमाणित करने के लिए केंद्रीय विद्युत नियामक आयोग (टैरिफ की नियम और शर्तें) विनियमन, 2019 के विनियमन 5.2(b) के अनुसार जारी किया जा रहा है। किसी अन्य उद्देश्य के लिए इस प्रमाणपत्र का उपयोग प्रतिबंधित है।

एस एस बड़पंडा 2/1/2020
एस. एस. बड़पंडा
कार्यकारी निदेशक (उ. क्षे. भा. प्रे. केंद्र),

Certificate of Completion of Trial Run Operation of 765kV,3x500 MVA ICT-2 along with associated bays of both sides, 765kV bays no 813-817 bay at Aligarh (PG)

संदर्भ

i) CPCC, POWERGRID, NRTS-3, New Delhi Communication dated 09.10.2019 & 15.10.2019 regarding the submission of pre charging documents for 765kV, 3x500 MVA ICT-2 and Prithala(GPTL) line-1,2 bays and associated main & tie bays of Aligarh(PG) ICT-1.

ii) Real time code issued by NRLDC on request CPCC, POWERGRID, NRTS-3, New Delhi 26.10.2019, 29.10.2019 & 30.10.2019(NRLDC Code: NR1910-3460, 3820, 3970,3973,3984,3979 & 3977).

iii) CPCC, POWERGRID, NRTS-3, New Delhi, Communication dated 30.10.2019, 04.11.2019 & 08.11.2019 regarding the submission of post charging documents.

Based on above references, it is hereby certified that the following Transmission elements have been successfully completed the trial operation:

Name of Transmission Asset:	1. 765kV, 3x500 MVA ICT-2 along with associated bays 818(765kV side main) & 404(400kV side main) at Aligarh (PG). 2. 765kV Tie bay no 817 at Aligarh (PG). 3. 765kV Future main bay no 816 at Aligarh (PG). 4. 765kV Main bay no 815 of 765kV, 3x500 MVA ICT-1 at Aligarh (PG). 5. 765kV Tie bay no 814 at Aligarh (PG). 6. 765kV Future main bay no 813 at Aligarh (PG). (Above Element were charged at no load)
Owner of Transmission Asset:	1. POWERGRID
Date and Time of Energization for Commencement of trial run operation:	1. 30.10.2019/16:00 hrs. 2. 30.10.2019/16:17 hrs. 3. 30.10.2019/16:43 hrs. 4. 30.10.2019/17:38 hrs. 5. 30.10.2019/17:22 hrs. 6. 30.10.2019/17:00 hrs.
Date and Time of completion of trial run operation:	1. 31.10.2019/16:00 hrs. 2. 31.10.2019/16:17 hrs. 3. 31.10.2019/16:43 hrs. 4. 31.10.2019/17:38 hrs. 5. 31.10.2019/17:22 hrs. 6. 31.10.2019/17:00 hrs.

यह प्रमाणपत्र ट्रांसमिशन तत्व के परीक्षण संचालन के सफल समापन को प्रमाणित करने के लिए केंद्रीय विद्युत नियामक आयोग (टैरिफ की नियम और शर्तें) विनियमन, 2019 के विनियमन 5.2(6) के अनुसार जारी किया जा रहा है। किसी अन्य उद्देश्य के लिए इस प्रमाणपत्र का उपयोग प्रतिबंधित है।

एस एस बड़पंडा 7/1/2020
एस. एस. बड़पंडा
कार्यकारी निदेशक (उ. क्षे. भा. प्रे. केंद्र),

25. It is observed that the Petitioner has claimed tariff for 2 nos. 400 kV line bays for termination of the Aligarh-Prithala 400 kV D/C line. However, the Petitioner has submitted the CEA Energization Certificate for line-1 bay only and has not submitted the CEA Energisation Certificate for line-2 bay. It is also observed that the Petitioner has submitted a ‘no-load’ RLDC Certificate for line-2 bay only and not for line-1 bay. Accordingly, the Petitioner is directed to submit the required CEA Energisation Certificate and RLDC Charging Certificate for the remaining line bays at the time of

truing-up.

Asset-II:

26. The Petitioner has claimed the COD of Asset-II as 12.12.2019. In support of the actual COD of Asset-II, the Petitioner has placed on record the Energisation Certificate dated 5.12.2019 under Regulation 43 of the CEA (Measures relating to Safety and Electric Supply) Regulations, 2010, 'no-load' RLDC Charging Certificate dated 2.1.2020 certifying the completion of trial operation on 11.12.2019 and the CMD Certificate as required under the Grid Code. The extract of the no-load certificate for Asset-II is as follows:

प्रमाणपत्र सं०:पोसोको/एनआरएलडीसी/एसओ-I /260/ 100-102 दिनांक: 02.01.2020

Certificate of Completion of Trial Run Operation of 765kV, 3x500 MVA ICT-1 at Aligarh (PG)

संदर्भ

i) CPCC, POWERGRID, NRTS-3, New Delhi Communication dated 22.11.2019 & 06.12.2019 regarding the submission of pre charging documents for 765kV, 3x500 MVA ICT-1 at Aligarh(PG).
ii) Real time code issued by NRLDC on request CPCC, POWERGRID, NRTS-3, New Delhi 09.12.2019 & 10.12.2019(NRLDC Code: NR1912-1716, 1997 & NLDC Code-542).
iii) CPCC, POWERGRID, NRTS-3, New Delhi, Communication dated 13.12.2019 regarding the submission of post charging documents.

Based on above references, it is hereby certified that the following Transmission elements have been successfully completed the trial operation:

Name of Transmission Asset:	1. 765kV, 3x500 MVA ICT-1 at Aligarh (PG). (Above ICT was charged at no load)
Owner of Transmission Asset:	1. POWERGRID
Date and Time of Energization for Commencement of trial run operation:	1. 10.12.2019/19:30 hrs.
Date and Time of completion of trial run operation:	1. 11.12.2019/19:30 hrs.

यह प्रमाणपत्र ट्रांसमिशन तत्व के परीक्षण संचालन के सफल समापन को प्रमाणित करने के लिए केंद्रीय विद्युत नियामक आयोग टैरिफ की नियम और शर्तें) विनियमन, 2019 के विनियमन 5.2(b) के अनुसार जारी किया जा रहा है। किसी अन्य उद्देश्य के लिए इस प्रमाणपत्र का उपयोग प्रतिबंधित है।

एस एस बड़पंडा 3/1/2020
एस. एस. बड़पंडा
कार्यकारी निदेशक (उ. क्षे. भा. प्रे. केंद्र),

27. Regulation 3 (20) of the 2019 Tariff Regulations defines the word 'element' and the same is reproduced as follows:

> *"(20) 'Element' means an asset which has been distinctively defined under the scope of the transmission project in the Investment Approval such as transmission lines including line bays and line reactors, substations, bays, compensation device, Interconnecting Transformers;"*

28. As per the above definition of the word 'element' given under Regulation 3 of the 2019 Tariff Regulations, an element can be treated as a separate asset only if it is distinctively defined in the IA.

29. As per the IA dated 29.3.2017, the scope of the work is mentioned as follows:

i) **Creation of 400 kV level at Aligarh (PG) 765 kV GIS switching Station – Extension -**

a) Provision of 2x1500 MVA 765/400 kV ICTs along with associated bays

30. In the instant case, the Petitioner has split the 2X1500 MVA ICTs and associated bays at Aligarh Sub-station and claimed the COD of one part of the 1500 MVA ICT and the associated bay as 1.11.2019 and second part of 1500 MVA ICT and the associated bay as 12.12.2019 under Regulation 5(2) of the 2019 Tariff Regulations as the associated 220 kV downstream transmission system under the scope of HVPNL is not ready.

31. We are of the view that the Petitioner can claim the COD of the transmission asset under Regulation 5(2) of the 2019 Tariff Regulations if it has completed its scope of work as per the IA. Since, in the instant case, 2x1500 MVA 765/400 kV ICTs along with associated bays were completed only on 12.12.2019, we are not inclined to approve the COD of Asset-I as 1.11.2019.

32. Accordingly, the COD of Asset-I and Asset-II is approved as 12.12.2019, wherein

the complete scope of the work, i.e., 2x1500 MVA 765/400 kV ICTs along with associated bays, was completed. It is noted that as on 12.12.2019, the downstream transmission system under the scope of HVPNL was not ready. Accordingly, HVPNL is liable to pay the transmission charges and the same has been dealt with in this order in the subsequent paragraph under the head of 'Sharing of Transmission Charges'.

Capital Cost

33. Regulation 19 of the 2019 Tariff Regulations provides as follows:

*"**19 Capital Cost:** (1) The Capital cost of the generating station or the transmission system, as the case may be, as determined by the Commission after prudence check in accordance with these regulations shall form the basis for determination of tariff for existing and new projects.*

(2) The Capital Cost of a new project shall include the following:

(a) The expenditure incurred or projected to be incurred up to the date of commercial operation of the project;

(b) Interest during construction and financing charges, on the loans (i) being equal to 70% of the funds deployed, in the event of the actual equity in excess of 30% of the funds deployed, by treating the excess equity as normative loan, or (ii) being equal to the actual amount of loan in the event of the actual equity less than 30% of the funds deployed;

(c) Any gain or loss on account of foreign exchange risk variation pertaining to the loan amount availed during the construction period;

(d) Interest during construction and incidental expenditure during construction as computed in accordance with these regulations;

(e) Capitalised Initial Spares subject to the ceiling rates in accordance with these regulations;

(f) Expenditure on account of additional capitalization and de-capitalisation determined in accordance with these regulations;

(g) Adjustment of revenue due to sale of infirm power in excess of fuel cost prior to the date of commercial operation as specified under Regulation 7 of these regulations;

(h) Adjustment of revenue earned by the transmission licensee by using the Asset-before the date of commercial operation;

(i) Capital expenditure on account of ash disposal and utilization including handling and transportation facility;

(j) Capital expenditure incurred towards railway infrastructure and its augmentation for transportation of coal upto the receiving end of the generating station but does not include the transportation cost and any other appurtenant cost paid to the railway.

(k) Capital expenditure on account of biomass handling equipment and facilities, for co-firing;

(l) Capital expenditure on account of emission control system necessary to meet the revised emission standards and sewage treatment plant;

(m) Expenditure on account of fulfilment of any conditions for obtaining environment clearance for the project;

(n) Expenditure on account of change in law and force majeure events; and

(o) Capital cost incurred or projected to be incurred by a thermal generating station, on account of implementation of the norms under Perform, Achieve and Trade (PAT) scheme of Government of India shall be considered by the Commission subject to sharing of benefits accrued under the PAT scheme with the beneficiaries.

(3) The Capital cost of an existing project shall include the following:

(a) Capital cost admitted by the Commission prior to 1.4.2019 duly trued up by excluding liability, if any, as on 1.4.2019;

(b) Additional capitalization and de-capitalization for the respective year of tariff as determined in accordance with these regulations;

(c) Capital expenditure on account of ash disposal and utilization including handling and transportation facility;

(d) Capital expenditure on account of ash disposal and utilization including handling and transportation facility;

(e) Capital expenditure incurred towards railway infrastructure and its augmentation for transportation of coal up to the receiving end of generating station but does not include the transportation cost and any other appurtenant cost paid to the railway; and

(f) Capital cost incurred or projected to be incurred by a thermal generating station, on account of implementation of the norms under Perform, Achieve and Trade (PAT) scheme of Government of India shall be considered by the Commission subject to sharing of benefits accrued under the PAT scheme with the beneficiaries."

(4) The capital cost in case of existing or new hydro generating station shall also include:

(a) cost of approved rehabilitation and resettlement (R&R) plan of the project in conformity with National R&R Policy and R&R package as approved; and

(b) cost of the developer's 10% contribution towards Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) and Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) project in the affected area.

(5) The following shall be excluded from the capital cost of the existing and new projects:

(a) The Asset-forming part of the project, but not in use, as declared in the tariff petition;

(b) De-capitalised Asset-after the date of commercial operation on account of replacement or removal on account of obsolescence or shifting from one project to another project:

Provided that in case replacement of transmission Asset-is recommended by Regional Power Committee, such Asset-shall be decapitalised only after its redeployment;

Provided further that unless shifting of an Asset-from one project to another is of permanent nature, there shall be no de-capitalization of the concerned asset.

(c) In case of hydro generating stations, any expenditure incurred or committed to be incurred by a project developer for getting the project site allotted by the State Government by following a transparent process;

(d) Proportionate cost of land of the existing project which is being used for generating power from generating station based on renewable energy; and

(e) Any grant received from the Central or State Government or any statutory body or authority for the execution of the project which does not carry any liability of repayment."

34. The Petitioner vide Auditor's Certificate dated 20.5.2020 has claimed the following capital cost incurred as on COD and Additional Capital Expenditure (ACE) projected to be incurred in respect of the transmission assets:

(₹ in lakh)

Assets	**FR Apportioned approved Cost**	**Capital Cost on COD**	**Projected ACE**			**Total Capital Cost as on 31.3 2024**
			2019-20	**2020-21**	**2021-22**	
Asset-I	18674.82	8294.31	2900.25	1575.07	1575.07	14344.70
Asset-II	14066.62	8280.10	484.87	1120.82	1120.82	11006.61

Cost Overrun

35. The estimated completion cost of the transmission assets based on the Auditor's Certificate works out to ₹14344.70 lakhs for Asset-I and ₹11006.61 lakhs for Asset-II, including IEDC and IDC, which is within the FR apportioned approved cost of ₹18674.82 lakh for Asset-I and ₹14066.62 lakhs for Asset-II. Therefore, there is no cost overrun.

Time Overrun

36. The IA for the transmission assets in the instant Petition was accorded on 29.3.2017, and as per the IA, the transmission assets were scheduled to be put into commercial operation within 27 months from the date of IA, i.e., by 28.6.2019. The details of the time over-run with respect to the transmission assets are as follows:

Assets	**SCOD**	**Claimed COD**	**Time over-run**
Asset -I	28.6.2019	1.11.2019	4 Months 2 Days
Asset -II	28.6.2019	12.12.2019	5 Months 13 Days

37. The Petitioner, vide affidavit dated 15.9.2021, has submitted that GPTL declared the deemed COD of the 400 kV D/C Aligarh-Prithala transmission line w.e.f. 6.8.2019

and proposed the commissioning of Assets-I and II at the Petitioner's end w.e.f. 1.11.2019 and 12.12.2019, respectively. However, power flow from the Assets-I and II started w.e.f. 18:41 hrs on 18.3.2020 when the load was added at Prithala Sub-station. The Petitioner has submitted that Assets I and II were ready for regular service after successful charging and commissioning from 30.10.2019 and 11.12.2019, respectively, but were prevented from providing regular service due to the delay in the commissioning of the 220 kV network at Prithala Sub-station which were to be constructed by HVPNL. This delay was not attributable to the Petitioner, and the same was beyond its control. Hence, the Petitioner has prayed to consider the COD of Asset-I and Asset-II under the provisions of Regulation 5(2) of the 2019 Tariff Regulations.

38. The Petitioner has submitted that the shutdown of 765 kV Bus-I and Bus-II is a pre-requisite for the completion of erection, testing, and commissioning for the creation of the 400-kV level Sub-station at Aligarh. Shut-downs for both buses were initially required for the 765-kV bus bar extension and, subsequently, for carrying out the different tests on the GIS. The delay in the commissioning of Asset-I at Aligarh 765 kV Switching Sub-station under NRSS-XXXVIII was mainly due to a delay in getting shut-down of 765 kV Bus-I and Bus-II for carrying out existing bus bar extension along with different tests.

39. The Petitioner vide e-mail dated 3.7.2019 communicated to NRPC that the shut-down of 765 kV Bus-I and Bus-II was applied for 17.7.2019 - 18.7.2019 and for 22.7.2019 - 23.7.2019, respectively, in the 161st OCC (Operational Coordination Sub-committee) meeting. However, due to an increase in demand load in July-August 2019, NRPC advised to avoid shut-down for the requested period, vide e-mail dated 19.7.2019. The Petitioner again applied for the shut-down of 765 kV Bus-I and Bus-II

vide e-mail dated 29.7.2019 and 3.8.2019 from 21.8.2019 to 23.8.2019 (for Bus-I) and from 24.8.2019 to 26.8.2019 (for Bus-II) for coupling of existing bus to extension part and for various dates ranging from 29.8.2019 to 9.9.2019 for carrying out the different tests (HV test, Impulse test, and inter-connection, etc.) in the 162nd OCC meeting. However, due to the higher demands in NR and the affected Hydro Generation System, NRPC advised to avoid the shut-down of Aligarh Bus vide e-mail dated 27.8.2019. Accordingly, only the shutdown of Bus-I was allowed from 3.9.2019 to 6.9.2019, and the same was availed. Again, the Petitioner applied for the shut-down of the 765 kV Bus-I and Bus-II vide e-mail dated 20.9.2019 for coupling of the existing bus to extension part from 25.9.2019 to 27.9.2019 and shut-down of the 765 kV Bus-I and Bus-II on various dates ranging from 29.9.2019 to 12.10.2019 for carrying out different tests was applied in the 163rd OCC meeting. However, the shutdown of Bus-II was postponed till 1.10.2019 due to the late revival of the Agra-Jhatikara Line and 800 kV HVDC Champa-Kurukshetra Bipole Line. Accordingly, the shutdown of Bus-II was availed from 1.10.2019 to 3.10.2019 for coupling the existing Bus-II to the extension part and from 4.10.2019 to 6.10.2019 for carrying out the HV test. Further, due to the delay in the approval of the shutdown of Bus-II for coupling of the existing bus to the extension part and overlapping of the shut-down period (from 29.9.2019- 3.10.2019) of Bus -I and Bus-II for carrying out Impulse and HV test, the further shutdown got deferred and postponed to new dates in October 2019, and finally shutdowns were availed by 25.10.2019.

40. UPPCL vide affidavit dated 31.10.2021 has submitted that the SCOD of Asset-I and Asset-II was 28.6.2019, and all the reasons submitted by the Petitioner are beyond SCOD. For the shutdown, the first e-mail was sent on 29.7.2019 (for Bus-I) and

3.8.2019 (For Bus-II). The proposed dates for shut-down were 21.8.2019 - 23.08.2019 (for Bus-I) and 24.8.2019 - 26.8.2019 (for Bus-II), respectively, for coupling of the existing bus to the extension part. The UPPCL has submitted that the nature of work under the scope, shut-down of 765 kV Bus-I, and Bus-II is a pre-requisite for completion of erection, testing, and commissioning for the creation of the 400 kV level Sub-station at Aligharh. UPPCL has further submitted that the request for shutdown was rejected vide Minutes of the 161st OCC meeting, and the above Minutes have been signed by the authorized person of the Petitioner and not by the Competent Authority on behalf of the OCC. Therefore, the Petitioner may be directed to submit the Minutes of Meeting of the 161st OCC meeting duly signed by the authorised signatory.

41. In response, the Petitioner has submitted that it was unable to commission both the transmission assets in time due to a delay in the approval of the bus bar shut-down by NRPC at 765 kV Aligarh switching station. The Petitioner has further submitted that the detailed justifications, along with the supporting documents, have been provided in the Petition. The Petitioner has submitted the chronology of the events of delay in getting the shutdown and charging of assets associated with the transmission project and the same are as follows:

S. No.	Particulars	Remarks	Date
1	Shut-down requested for of 765 kV Bus-I and Bus-II of Aligarh GIS already existing/Operating Sub-station	Shut-down requested for connecting Old GIS Bus to new GIS Bus. Copy of mail enclosed.	3.7.2019
2	Shut-down rejected in 161st OCC meeting held on 15.7.2029	Outage report enclosed and at sl. no. 26 & 27. Shut-down applied for the said period rejected	15.7.2019

3	Shut-down was not approved by NRPC	NRPC opined that continuous outage of Aligarh Bus may be avoided during the high demand season of NR. Copy of mail enclosed.	19.7.2019
4	Once again shut-down requested for of 765 kV Bus-I and Bus-II of Aligarh GIS already existing/Operating Sub-station	The Petitioner indicated its urgency and importance in the mail sent to NRPC.	29.7.2019
5	Deemed COD declared for Prithala Sub-station **(**In the scope of GPTL)		8.8.2019
6	Shut-down rejected in 162nd OCC meeting held on 13.8.2019	Outage report enclosed and at S. No. 26 & 27 Shut-down applied for the said period rejected	13.8.2019
7	NRPC intimated to the Petitioner via mail to postpone /to defer shut-down based on 162nd OCC Outage report	---	16.8.2019
8	Once again shut-down requested for of 765 kV Bus at Aligarh GIS already existing/Operating Sub-station	The Petitioner reiterated its urgency and importance in mail sent to NRPC.	19.8.2019
9	The Petitioner requested NRPC to share the status of shut-down	---	22.8.2019
10	NRPC sent mail to the Petitioner mentioning to avoid shut-down of Aligarh Sub-station	NR demand is on the higher side and hydro generation in NR is getting affected due to the high silt issue. So, the shut-down of Aligarh bus may be avoided.	27.8.2019
11	Shut down of 765 kV Bus Bar-II at Aligarh GIS has been approved in OCC 163 to facilitate the execution work of extension of 765 kV GIS at Aligarh	---	16.9.2019 Report issued on 24.9.2019
12	The Petitioner requested NRLDC to arrange shut-down as per 163rd OCC approval	---	20.9.2019
13	NRLDC did not allowed to avail the shut-down	NRLDC, in its mai,l stated that the request may be considered after the revival of the 765 kV Agra-Jhatikara line & proposed SD of the HVDC Champa-Kurukshetra pole	20.9.2019

14	The Petitioner requested NRLDC/NLDC to arrange shut-down	---	26.9.2019 27.9.2019
15	Shut-down for Bus-I and Bus-II at Aligarh GIS Sub-station got approved	Shut-down for Bus-I and Bus-II at Aligarh GIS Sub-station got approved for the following period: 1. 765 kV Bus-II - Continuous Basis-(From 09:00 hrs on 29.9.2019 to 18:00 hrs on 1.10.2019) - for inter-connection of existing system to new system. 2. 765 kV Bus-II-Daily Basis -(From 09:00 hrs on 2.10.2019 to 18:00 hrs on 4.10.2019 for Carrying out HV & Impulse test of extension part	27.9.2019
16	The Petitioner requested NRLDC/NLDC to arrange opening code of Bus-II at Aligarh GIS from 0900 hrs of 29.9.2019	---	29.9.2019
17	NLDC/NRLDC did not allow shut-down	NLDC reiterated that shut-down of 765 kV Aligarh Bus-II will be facilitated after revival of HVDC Champa-Kurukshetra Bi-pole	
18	The Petitioner requested NRLDC/NLDC to accord shut-down of Bus-II at Aligarh GIS from 0900 hrs of 1.10.2019	---	30.9.2019
19	The Petitioner requested NRLDC/NLDC to issue Bus-II outage code	---	1.10.2019
20	The Petitioner requested NRLDC/NLDC to accord shut-down of Bus-I at Aligarh GIS	---	9.10.2019 10.10.2019
21	Shut-down Accorded by NRLDC/NLDC for Bus-I and Bus-II at GIS Aligarh Sub-station 1.10.2019 to 15.10.2019	Said shut-down are approved in 163 OCC but not considered by NRLDC/NLDC on approved dates due to the extension of Agra-Jhatikala S/D	15.10.2019

		and Champa-Kurshetra line	
22	Finally, shut-downs were availed by 25.10.2019 for final connection of extension part to the existing Aligarh Sub-station	---	---
23	No load charging done for **Asset-I** 1X1500 MVA 765/400 kV ICT-II alongwith associated bays and 2numbers 400 kV Line Bays for termination of 400 kV D/C Aligarh-Prithala TBCB Line at Aligarh 765 kV Switching Sub-station **(In the scope of the Petitioner)**		30.10.2019
24	No load charging done for **Asset II -** 1X1500 MVA 765/400 kV ICT-I at Aligarh 765kV Switching Sub-station **(In the scope of the Petitioner)**		11.12.2019
25	COD proposed for Asset-I and Asset-II		1.11.2019 and 12.12.2019

42. Further, the Petitioner has submitted that the shut-down was requested for 2 to 10 days to carry out all the work. However, the final shut-down was availed on 25.10.2019, and the first shutdown was requested from 17.7.2019 vide e-mail dated 3.7.2019. Thus, there is a delay in availing the shutdown to carry out the activities which is beyond the control of the Petitioner. The Petitioner has further submitted that the OCC outage details are the authentic documents downloaded from the NRPC`s website.

43. GTPL has submitted that it has no objection to the grant of the proposed COD of 1.11.2019 for Asset-I as claimed by the Petitioner to the extent that no liability in any form is imposed on GPTL for any mismatch period since it was not responsible for any delay whatsoever. GPTL is developing an inter-State transmission project to meet the growing load demand in Gurgaon and Palwal areas and to serve the customers with reliable power, which requires the development and construction of various transmission lines and elements, including the creation of 400/220 kV 2x500 MVA GIS

Sub-station at Prithala in Palwal area along with 1 no. 125 MVAR Bus Reactor (Prithala Sub-station). GPTL has submitted that the Transmission Service Agreement (TSA) dated 4.3.2016 was executed by GPTL with its Long-Term Transmission Customers (LTTCs), according to which the SCOD for the Prithala Sub-station was 13.5.2019. However, the execution of the Prithala Sub-station suffered from certain delays attributable to HVPNL. GPTL has submitted that the approval for the energisation of Prithala Sub-station from the CEA was received on 31.7.2019, and, thereafter, Prithala Sub-station was declared as deemed commissioned w.e.f. 8.8.2019. The Petitioner has admitted that the Asset-I was ready for regular service after successful charging and commissioning from 30.10.2019. However, it was prevented from providing regular service due to a delay in the commissioning of the 220-kV network at the Prithala Sub-station, which was to be constructed by HVPNL. GPTL has further prayed that liability for the delay ought to be imposed on HVPNL alone as the delay in operationalization of the Petitioner's assets is not attributable to GPTL.

44. In response, the Petitioner has reiterated its submission made in the rejoinder to the reply of UPPCL. In addition, the Petitioner has submitted that the delay in shut-down approval was mainly to meet the load requirements of the local areas and due to security and smooth running of the National Grid. Since the delay in availing/approval of the shut-down to carry out the activities was beyond the control of the Petitioner, the time over-run may be condoned for the transmission assets as per Regulation 22(2) of the 2019 Tariff Regulations.

45. The Petitioner, vide affidavit dated 24.8.2022, has submitted that after completion of the 400 kV system, power flow was started at Aligarh Sub-station on 18.3.2020 (238 MW on each ICT) at 18:41 hrs. At that time, a 220-kV downstream system was not

available at any of the three Sub-stations. The 220kV system was under execution in a progressive manner. Further, power flow on ICT-I and ICT-II was 286.10 MW each at 10:20 hrs of 8.8.2022 at 765/400 kV GIS Aligarh, and maximum power flow through each ICT was 647.42 MW on 18.8.2021.

46. The Petitioner, vide affidavit dated 28.6.2024, has reiterated its submission with respect to the delay in putting Asset-I into commercial operation. In addition, the Petitioner has submitted that the shutdown was not being granted by NRPC/NRLDC despite the Petitioner's request due to the reason that there was peak/ high demand of power/ grid requirement and the interest of consumers have been sub-served as they were benefitted with power and requirement of grid was met. The rationale for not passing on the transmission charges to the beneficiaries/ consumers before the actual COD is that the consumers can only be billed once the power flow has started. Therefore, in the peculiar circumstances of the present case and keeping in view the principles enshrined in Section 61(d) of the Act, while the consumer interests have been safeguarded, the Petitioner should also not be burdened to bear mismatch charges.

47. We have considered the submissions of the Petitioner, UPPCL, and GTPL. As per the I.A. dated 29.3.2017, the SCOD of the transmission assets is 28.6.2019, against which Asset-I and Asset-II were proposed to be put into deemed commercial operation on 1.11.2019 and 12.12.2019, respectively. Thus, there is a time overrun of 126 days and 167 days in the commissioning of Asset-I and Asset-II, respectively. The Petitioner has attributed the time overrun in the case of Asset-I and Asset-II towards the delay in getting approvals for the shut-down of 765 kV Bus-I and Bus-II. As mentioned above, the COD of Asset-I and Asset-II have been approved as 12.12.2019, thus there is a time over-run of 167 days in putting both the transmission assets into commercial

operation.

48. As per the Gantt chart submitted by the Petitioner, the Petitioner had to start testing on 16.5.2019 and finish the same by 28.6.2019. As per the original plan of work, the Petitioner had to complete testing and commissioning work within 44 days. The Petitioner was not ready for testing and putting the transmission assets into commercial operation prior to SCOD of the transmission asset, i.e., by 28.6.2019. The Petitioner, vide e-mail dated 3.7.2019, for the first time, applied for shutdown for the connection of the old GIS Bus to the new GIS extension of 765 kV Bus-I and Bus-II for the period from 17.7.2019 to 18.7.2019 and from 22.7.2019 to 23.7.2019, respectively. However, the 161st OCC meeting rejected the shutdown approval for the above-mentioned dates. The Petitioner, vide e-mail dated 29.7.2019 and 3.8.2019, had again applied for shutdown from 21.8.2019 to 23.8.2019 for Bus-I and from 24.8.2019 to 26.8.2019 for Bus-II. However, the 162nd OCC allowed the shutdown of Bus-I from 3.9.2019 to 6.9.2019. The Petitioner, vide e-mail dated 20.9.2019, had further applied for a shutdown of 765 kV Bus-II and finally availed the shutdown by 25.10.2019. The time period from 17.7.2019 to 25.10.2019 (100 days) was impacted on account of the shutdown approval. We are of the view that had the Petitioner applied for shutdown prior to the SCOD of the transmission assets, the transmission assets could have been put into commercial operation within the scheduled time. However, the Petitioner itself applied for the shutdown much later and finally completed the shutdown process by 25.10.2019. It is observed that 44 days were required for the testing and commissioning activities after completion of the erection work as per the original planning. Thus, considering that the system had been erected and shutdown was approved by the OCC as per the request made by the Petitioner, in that event, a minimum time of 44 days

was expected to be taken for the testing and commissioning. Accordingly, the time period of days is condoned, and the time period beyond days is not condoned.

49. The Petitioner had to commission both the ICTs together. However, the Petitioner has claimed the different CODs for both the transmission assets/ ICTs. In the case of Asset-II, the Petitioner has claimed the COD as 12.12.2019. However, the Petitioner has failed to submit the reasons for the additional time taken from 1.11.2019 to 12.12.2019 for the commissioning of Asset-II. Therefore, the time period from 1.11.2019 to 12.12.2019 is not condoned in the case of Asset-II. Nevertheless, a period of 44 days in all is condoned in the case of Asset II as well.

50. Out of the total time overrun of 167 days, the time overrun of 56 days is condoned on account of the shut-down approval, and the time period of 111 days is not condoned.

51. The details of time over-run condoned/ not condoned are as follows:

Assets	SCOD as per IA	COD	Time over-run claimed w.r.t SCOD	Time over-run condoned	Time over-run not condoned
Asset-I	28.6.2019	12.12.2019	167 days	days	111 days
Asset-II	28.6.2019	12.12.2019	167 days	days	111 days

<u>Interest During Construction (IDC) and Incidental Expenditure During Construction (IEDC)</u>

52. The Petitioner has claimed IDC in respect of the transmission assets and has submitted the Auditor’s Certificate dated 20.5.2020 in support of the same. The Petitioner has furnished the computation of IDC along with year-wise details of the IDC discharged.

53. The loan amount as on the COD has been mentioned in Form-6 and Form-9C. The loan details submitted in Form-9C for the 2019-24 tariff period and IDC

computation statement have been considered for the purpose of IDC calculation on a cash basis and on an accrued basis. The un-discharged IDC as on COD has been considered as ACE during the year in which it has been discharged. IDC on a cash basis up to COD has been worked out based on the loan details given in the statement showing the discharge of IDC and Form-9C for the transmission assets. The Petitioner is directed to submit the information on actual interest rates at the time of truing-up.

54. Accordingly, based on the information furnished by the Petitioner, IDC considered in respect of the transmission assets is as follows:

(₹ in lakh)

Assets	IDC as per Auditor's Certificate	IDC Admissible	IDC disallowed due to time over-run not condoned	IDC discharged as on COD	IDC Un-discharged as on COD	IDC Discharge During	
						2019-20	2020-21
	A	B	C=A-B	D	E=B-D	F	G
Asset-I	263.79	180.51	83.28	172.67	7.84	0.00	7.84
Asset-II	144.60	49.84	94.76	33.13	16.71	0.00	16.71

55. The Petitioner has claimed IEDC and has submitted Form-12A and Auditor's Certificate in support of its claim.

56. We have considered the submissions of the Petitioner and have examined Form-12A along with the Auditor's Certificate submitted by the Petitioner in support of its claim. The IEDC allowed for the transmission assets is as follows:

(₹ in lakh)

Assets	IEDC claimed	Less: IEDC disallowed due to time over-run not condoned	IEDC allowed
Asset-I	297.01	33.37	263.64
Asset-II	300.89	33.80	267.09

Initial Spares

57. Regulation 23(d) of the 2019 Tariff Regulations provides that Initial Spares shall be capitalised as a percentage of plant and machinery cost up to the cut-off date, subject to the following ceiling norms:

> *"(d) Transmission System*
> *i. Transmission line: 1.00%*
> *ii. Transmission sub-station*
> *- Green Field: 4.00%*
> *- Brown Field: 6.00%*
>
> *iii. Series Compensation devices and HVDC Station: 4.00%*
> *iv. Gas Insulated Sub-station (GIS)*
> *- Green Field: 5.00%*
> *- Brown Field: 7.00%*
> *v. Communication System: 3.50%*
> *vi. Static Synchronous Compensator: 6.00%"*

58. The Petitioner has claimed the following Initial Spares for the transmission assets:

(₹ in lakh)

Assets	Particulars	Plant & Machinery cost up to the cut-off date (₹ in lakh) (excluding IDC and IEDC)	Initial Spares claimed (₹ in lakh)	Ceiling limit (in %)
Asset-I	Sub-Station	13572.99	796.31	7
	PLCC	210.90	4.45	3.5
Asset-II	Sub-Station	10486.00	633.70	7
	PLCC	75.12	2.23	3.5

59. We have considered the submissions of the Petitioner. The Petitioner has claimed Initial Spares on PLCC under the communication system separately. This issue has been dealt with in the Commission's order dated 26.5.2022 in Petition No. 203/TT/2021. The relevant portions of the order dated 26.5.2022 are as follows:

> *"61. We have considered the submissions of the Petitioner and MPPMCL. Though PLCC is a communication system, it has been considered as part of the sub-station in the 2014 Tariff Regulations and the 2019 Tariff Regulations and the norms for sub-station have been specified accordingly. Form-5 under Part-III of the 2019 Tariff Regulations requires a transmission licensee to provide "Elementwise Break-up of Project/ Asset/ Element Cost for Transmission System or Communication System". The details which are required*

to be furnished with regard to (a) transmission line are: preliminary works, transmission lines material, taxes and duties; (b) for Sub-stations: preliminary works & land, civil works, substation equipment, spares, taxes and duties; and for (c) communication system: preliminary works, communication system equipment, taxes and duties. PLCC is a part of sub-station equipment at Sl. No. 6.5 of Form-5 under the head "Sub- station equipment" and there is no mention of PLCC under communication system.

62. Therefore, as discussed above, we are not inclined to grant Initial Spares separately towards PLCC under communication system since Initial Spares claimed towards PLCC are included in sub-station."

60. Based on the information available on record, the Initial Spares in respect of the transmission assets are allowed as per the respective percentage of the plant and machinery cost (including the cost of PLCC) for each asset as on the cut-off date. Initial Spares allowed in respect of the transmission assets are as follows:

Assets	Particulars	Plant & Machinery cost up to the cut-off date (₹ in lakh) (excluding IDC and IEDC)	Allowable Initial Spares (₹ in lakh)	Ceiling limit (in%)	Initial Spares allowed (₹ in lakh)
Asset-I	Sub-station	13783.89	977.22	7	800.76
Asset-II	Sub-station	10561.12	747.06	7	635.93

Capital Cost allowed as on COD

61. Accordingly, the capital cost allowed in respect of the transmission assets as on COD is as follows:

(₹ in lakh)

Assets	Capital Cost claimed in Auditor's Certificate as on COD (A)	Less: IDC disallowed due to time over-run not condoned	Less: Un-discharged IDC as on COD (B)	Less: IEDC disallowed due to time over-run not condoned	Capital Cost as on COD (C) = (A-B)
Asset-I	8294.31	83.28	7.84	33.37	8169.82
Asset-II	8280.10	94.76	16.71	33.80	8134.83

62. Further, the Petitioner is directed to submit the revised Auditor's Certificates at the time of truing up in case of Asset-I as per the approved COD.

Additional Capital Expenditure (“ACE”)

63. Regulations 24 and 25 of the 2019 Tariff Regulations provide as follows:

*“**24. Additional Capitalization within the original scope and up to the cut-off date:***

(1) The Additional Capital Expenditure in respect of a new project or an existing project incurred or projected to be incurred, on the following counts within the original scope of work, after the date of commercial operation and up to the cut-off date may be admitted by the Commission, subject to prudence check:

(a) Undischarged liabilities recognized to be payable at a future date;

(b) Works deferred for execution;

(c) Procurement of initial capital spares within the original scope of work, in accordance with the provisions of Regulation 23 of these regulations;

(d) Liabilities to meet award of arbitration or for compliance of the directions or order of any statutory authority or order or decree of any court of law;

(e) Change in law or compliance of any existing law; and

(f) Force Majeure events:

Provided that in case of any replacement of the assets, the additional capitalization shall be worked out after adjusting the gross fixed assets and cumulative depreciation of the assets replaced on account of de-capitalization.

(2) The generating company or the transmission licensee, as the case may be shall submit the details of works asset wise/work wise included in the original scope of work along with estimates of expenditure, liabilities recognized to be payable at a future date and the works deferred for execution.”

***“25. Additional Capitalisation within the original scope and after the cut-off date**:*

(1) The ACE incurred or projected to be incurred in respect of an existing project or a new project on the following counts within the original scope of work and after the cut-off date may be admitted by the Commission, subject to prudence check:

a) Liabilities to meet award of arbitration or for compliance of the directions or order of any statutory authority, or order or decree of any court of law;
b) Change in law or compliance of any existing law;
c) Deferred works relating to ash pond or ash handling system in the original scope of work;
d) Liability for works executed prior to the cut-off date;
e) Force Majeure events;
f) Liability for works admitted by the Commission after the cut-off date to the extent of discharge of such liabilities by actual payments; and g) Raising of ash dyke as a part of ash disposal system.

(2) In case of replacement of assets deployed under the original scope of the existing project after cut-off date, the additional capitalization may be admitted by the Commission, after making necessary adjustments in the gross fixed assets and the cumulative depreciation, subject to prudence check on the following grounds:

(a) The useful life of the assets is not commensurate with the useful life of the project and such assets have been fully depreciated in accordance with the provisions of these regulations.

(b) The replacement of the asset or equipment is necessary on account of change in law or Force Majeure conditions;

(c) The replacement of such asset or equipment is necessary on account of

(d) The replacement of such asset or equipment has otherwise been allowed by the Commission."

64. The Petitioner has claimed actual/ projected ACE in respect of the transmission assets for the 2019-24 tariff period on account of the balance and retention payments under Regulations 24(1)(a) and 24(1)(b) for the works executed within the cut-off date. The details are as follows:

(₹ in lakh)

Assets	**Actual/ Projected ACE**		
	2019-20	**2020-21**	**2021-22**
Asset-I	2900.25	1575.07	1575.07
Asset-II	484.87	1120.82	1120.82

65. UPPCL has submitted that the ACE indicated in Form-1A is as per the books of accounts of the Petitioner Company. However, when compared with the Auditor's Certificate for capital cost, there is no mention of liability position, or the certificate of the capital cost on a cash basis. UPPCL has further submitted that the Auditor's Certificate should either mention that the capital cost is on a cash basis or position of liability as on COD should be specifically mentioned to portray the right picture. UPPCL has also submitted that the estimated expenditures (on a cash basis) for the Financial Years (FYs) 2020-21 and 2021-22 in respect of Asset-I, as per Auditor's Certificate, are ₹1575.07 lakh and ₹1575.07 lakh, respectively. However, in Form-1A and Form-7

(Statement of ACE after COD), ₹1391.27 lakh has been shown as the discharge of liabilities with ₹183.80 lakhs on account of ACE in 2021-22, totalling ₹1575.07 lakhs. This is in contradiction with the Auditor's Certificate, which does not talk about the position of liabilities at all. As per Form-4A (Statement of Capital Cost), ₹1391.27 lakh has been shown as un-discharged IDC, which was discharged in 2021-22, whereas in Form-6 (Financial Package up to COD), ₹1575.07 lakh has been shown as ACE. Similar ambiguity exists in respect of Asset- II as well. The Commission may direct the Petitioner to clarify the position. UPPCL has also submitted that the position of liabilities, being important for the determination of cash cost as also tariff, need to be certified by the Auditor together with the subsequent discharges thereof for prudence check.

66. In response, the Petitioner has submitted that the Auditor's Certificate is prepared on a cash basis except for the IDC, which is on an accrued basis. The Petitioner has further submitted that the ACE consists of liability payment and addition to the gross block, which is bifurcated in Form-1A, Form-7, and Form-4A. However, the Auditor's Certificate indicates the total payment made, i.e., on a cash basis.

67. The Petitioner, vide affidavit dated 28.6.2024, has submitted that the Commission's order dated 19.5.2024 in Petition No. 90/MP/2020 is a decree, and in view of the fact that no prejudice can be caused to the interests of the consumers, Regulation 25(1)(d) of the 2019 Tariff Regulations will be applicable and any consequences which follow by virtue of operation of law, has to be given effect to, which is the capitalization of the transmission charges in the capital cost of the project.

68. We have considered the submissions of the Petitioner and UPPCL. ACE claimed

on account of the balance and retention payments are allowed under Regulations 24(1)(a) and 24(1)(b) of the 2019 Tariff Regulations. The actual/ projected ACE allowed is subject to truing up in respect of the transmission asset, and the same is as follows:

(₹ in lakh)

Particulars	Asset-I		
	2019-20	**2020-21**	**2021-22**
Proposed ACE allowed under Regulations 24(1)(a) and 24(1)(b) of the 2019 Tariff Regulations	2900.25	1575.07	1575.07
Add: IDC discharge	0.00	7.84	0.00
Total	**2900.25**	**1582.91**	**1575.07**

(₹ in lakh)

Particulars	Asset-II		
	2019-20	**2020-21**	**2021-22**
Proposed ACE allowed under Regulations 24(1)(a) and 24(1)(b) of the 2019 Tariff Regulations	484.87	1120.82	1120.82
Add: IDC discharge	0.00	16.71	0.00
Total	**484.87**	**1137.53**	**1120.82**

Capital Cost as on 31.3.2024

69. Accordingly, the capital cost allowed in respect of the transmission assets as on 31.3.2024 is as follows:

(₹ in lakh)

Assets	Capital Cost claimed as on COD	Actual / Projected ACE			Total Capital Cost as on 31.3 2024
		2019-20	**2020-21**	**2021-22**	
Asset-I	8169.82	2900.25	1582.91	1575.07	14228.05
Asset-II	8134.83	484.87	1137.53	1120.82	10878.04

Debt-Equity Ratio

70. Regulations 18 of the 2019 Tariff Regulations provides as follows:

*"**18. Debt-Equity Ratio:** (1) For new projects, the debt-equity ratio of 70:30 as on date of commercial operation shall be considered. If the equity actually deployed is more than 30% of the capital cost, equity in excess of 30% shall be treated as normative loan:*

Provided that:

i. where equity actually deployed is less than 30% of the capital cost, actual equity shall be considered for determination of tariff:

ii. the equity invested in foreign currency shall be designated in Indian rupees on the date of each investment:

iii. any grant obtained for the execution of the project shall not be considered as a part of capital structure for the purpose of debt: equity ratio.

Explanation.-*The premium, if any, raised by the generating company or the transmission licensee, as the case may be, while issuing share capital and investment of internal resources created out of its free reserve, for the funding of the project, shall be reckoned as paid up capital for the purpose of computing return on equity, only if such premium amount and internal resources are actually utilised for meeting the capital expenditure of the generating station or the transmission system.*

(2) The generating company or the transmission licensee, as the case may be, shall submit the resolution of the Board of the company or approval of the competent authority in other cases regarding infusion of funds from internal resources in support of the utilization made or proposed to be made to meet the capital expenditure of the generating station or the transmission system including communication system, as the case may be.

(3) In case of the generating station and the transmission system including communication system declared under commercial operation prior to 1.4.2019, debt: equity ratio allowed by the Commission for determination of tariff for the period ending 31.3.2019 shall be considered:

Provided that in case of a generating station or a transmission system including communication system which has completed its useful life as on or after 1.4.2019, if the equity actually deployed as on 1.4.2019 is more than 30% of the capital cost, equity in excess of 30%shall not be taken into account for tariff computation;

Provided further that in case of projects owned by Damodar Valley Corporation, the debt: equity ratio shall be governed as per sub-clause (ii) of clause (2) of Regulation 72 of these regulations.

(4) In case of the generating station and the transmission system including communication system declared under commercial operation prior to 1.4.2019, but where debt: equity ratio has not been determined by the Commission for determination of tariff for the period ending 31.3.2019, the Commission shall approve the debt: equity ratio in accordance with clause (1) of this Regulation.

(5) Any expenditure incurred or projected to be incurred on or after 1.4.2019 as may be admitted by the Commission as additional capital expenditure for determination of tariff, and renovation and modernisation expenditure for life extension shall be serviced in the manner specified in clause (1) of this Regulation.

(6) Any expenditure incurred for the emission control system during the tariff period as may be admitted by the Commission as additional capital expenditure for determination of supplementary tariff, shall be serviced in the manner specified in clause (1) of this Regulation."

71. The details of the debt-equity ratio considered for the purpose of computation of tariff for the 2019-24 period in respect of the transmission assets are as follows:

(₹ in lakh)

Funding Asset-I	Capital Cost as on COD (₹ in lakh)	(in %)	Total Capital Cost as on 31.3.2024 (₹ in lakh)	(in %)
Debt	5718.87	70.00	9959.64	70.00
Equity	2450.95	30.00	4268.42	30.00
Total	**8169.82**	**100.00**	**14228.05**	**100.00**

(₹ in lakh)

Funding Asset-II	Capital Cost as on COD (₹ in lakh)	(in %)	Total Capital Cost as on 31.3.2024 (₹ in lakh)	(in %)
Debt	5694.38	70.00	7614.63	70.00
Equity	2440.45	30.00	3263.41	30.00
Total	**8134.83**	**100.00**	**10878.04**	**100.00**

Depreciation

72. Regulation 33 of the 2019 Tariff Regulations provides as follows:

*"**33. Depreciation**: (1) Depreciation shall be computed from the date of commercial operation of a generating station or unit thereof or a transmission system or element thereof including communication system. In case of the tariff of all the units of a generating station or all elements of a transmission system including communication system for which a single tariff needs to be determined, the depreciation shall be computed from the effective date of commercial operation of the generating station or the transmission system taking into consideration the depreciation of individual units:*

Provided that effective date of commercial operation shall be worked out by considering the actual date of commercial operation and installed capacity of all the units of the generating station or capital cost of all elements of the transmission system, for which single tariff needs to be determined.

(2) The value base for the purpose of depreciation shall be the capital cost of the Asset-admitted by the Commission. In case of multiple units of a generating station or multiple elements of a transmission system, weighted average life for the generating station of the transmission system shall be applied. Depreciation shall be chargeable from the first year of commercial operation. In case of commercial operation of the Asset-for part of the year, depreciation shall be charged on pro rata basis."

(3) The salvage value of the asset shall be considered as 10% and depreciation shall be allowed up to maximum of 90% of the capital cost of the asset:

Provided that the salvage value for IT equipment and software shall be considered as NIL and 100% value of the assets shall be considered depreciable;

Provided further that in case of hydro generating stations, the salvage value shall be as provided in the agreement, if any, signed by the developers with the State Government for development of the generating station

Provided also that the capital cost of the assets of the hydro generating station for the purpose of computation of depreciated value shall correspond to the percentage of sale of electricity under long-term power purchase agreement at regulated tariff:

Provided also that any depreciation disallowed on account of lower availability of the generating station or unit or transmission system as the case may be, shall not be allowed to be recovered at a later stage during the useful life or the extended life.

(4) Land other than the land held under lease and the land for reservoir in case of hydro generating station shall not be a depreciable asset and its cost shall be excluded from the capital cost while computing depreciable value of the asset.
(5) Depreciation shall be calculated annually based on Straight Line Method and at rates specified in Appendix-I to these regulations for the Asset-of the generating station and transmission system:

Provided that the remaining depreciable value as on 31st March of the year closing after a period of 12 years from the effective date of commercial operation of the station shall be spread over the balance useful life of the asset

(6) In case of the existing projects, the balance depreciable value as on 1.4.2019 shall be worked out by deducting the cumulative depreciation as admitted by the Commission upto 31.3.2019 from the gross depreciable value of the assets.

(7) The generating company or the transmission licensee, as the case may be, shall submit the details of proposed capital expenditure five years before the completion of useful life of the project along with justification and proposed life extension. The Commission based on prudence check of such submissions shall approve the depreciation on capital expenditure.

(8) In case of de-capitalization of assets in respect of generating station or unit thereof or transmission system or element thereof, the cumulative depreciation shall be adjusted by taking into account the depreciation recovered in tariff by the de-capitalized asset during its useful services.

(9) Where the emission control system is implemented within the original scope of the generating station and the date of commercial operation of the generating station or unit thereof and the date of operation of the emission control system are the same, depreciation of the generating station or unit thereof including the emission control system shall be computed in accordance with Clauses (1) to (8) of this Regulation.

(10) Depreciation of the emission control system of an existing or a new generating station or unit thereof where the date of operation of the emission control system is subsequent to the date of commercial operation of the generating station or unit thereof, shall be computed annually from the date of operation of such emission control system based on straight line method, with salvage value of 10%, over a period of

a) twenty-five years, in case the generating station or unit thereof is in operation for fifteen years or less as on the date of operation of the emission control system; or

b) balance useful life of the generating station or unit thereof plus fifteen years, in case the generating station or unit thereof is in operation for more than fifteen years as on the date of operation of the emission control system; or

c) ten years or a period mutually agreed by the generating company and the beneficiaries, whichever is higher, in case the generating station or unit thereof has completed its useful life."

73. We have considered the submissions of the Petitioner. The IT equipment has been considered as part of the gross block and depreciated using the Weighted Average Rate of Depreciation (WAROD). WAROD at Annexure has been worked out after considering the depreciation rates of IT and non-IT assets as prescribed in the 2019 Tariff Regulations. The salvage value of IT equipment has been considered as 'Nil', i.e., the IT asset has been considered 100% depreciable. Depreciation allowed in respect of the transmission assets for the 2019-24 tariff period is as follows:

(₹ in lakh)

Asset-I						
	Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
A	Opening Gross Block	8169.82	11070.07	12652.98	14228.05	14228.05
B	Addition during the year 2019-24 due to projected ACE	2900.25	1582.91	1575.07	0.00	0.00
C	Closing Gross Block (A+B)	11070.07	12652.98	14228.05	14228.05	14228.05
D	Average Gross Block (A+C)/2	9619.94	11861.53	13440.52	14228.05	14228.05
E	Average Gross Block (90% depreciable assets)	9432.03	11629.83	13177.97	13950.12	13950.12
F	Average Gross Block (100% depreciable assets)	187.91	231.70	262.55	277.93	277.93
G	Depreciable value (excluding IT equipment and software) (E*90%)	8488.83	10466.84	11860.17	12555.11	12555.11
H	Depreciable value of IT equipment and software (F*100%)	187.91	231.70	262.55	277.93	277.93
I	Total Depreciable Value (G+H)	8676.74	10698.54	12122.72	12833.04	12833.04
J	Weighted average rate of Depreciation (WAROD) (in %)	5.49%	5.49%	5.49%	5.49%	5.49%
K	Lapsed useful life at the beginning of the year (Year)	0.00	0.00	1.00	2.00	3.00
L	Balance useful life at the beginning of the year (Year)	24.00	24.00	23.00	22.00	21.00
M	**Depreciation during the year (D*J)**	**160.05**	**650.72**	**737.34**	**780.54**	**780.54**
N	Cumulative Depreciation at the end of the year	160.05	810.77	1548.11	2328.65	3109.19
O	Remaining Aggregate Depreciable Value at the end of the year	8516.69	9887.77	10574.61	10504.39	9723.85

(₹ in lakh)

Asset-II						
	Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
A	Opening Gross Block	8134.83	8619.70	9757.22	10878.04	10878.04
B	Addition during the year 2019-24 due to projected ACE	484.87	1137.53	1120.82	0.00	0.00
C	Closing Gross Block (A+B)	8619.70	9757.22	10878.04	10878.04	10878.04
D	Average Gross Block (A+C)/2	8377.26	9188.46	10317.63	10878.04	10878.04
E	Average Gross Block (90% depreciable assets)	8249.31	9048.12	10160.05	10711.90	10711.90
F	Average Gross Block (100% depreciable assets)	127.95	140.34	157.59	166.15	166.15
G	Depreciable value (excluding IT equipment and software) (E*90%)	7424.38	8143.31	9144.04	9640.71	9640.71
H	Depreciable value of IT equipment and software (F*100%)	127.95	140.34	157.59	166.15	166.15
I	Total Depreciable Value (G+H)	7552.33	8283.65	9301.63	9806.85	9806.85
J	Weighted average rate of Depreciation (WAROD) (in %)	5.44	5.44	5.44	5.44	5.44
K	Lapsed useful life at the beginning of the year (Year)	0.00	0.00	1.00	2.00	3.00
L	Balance useful life at the beginning of the year (Year)	25.00	25.00	24.00	23.00	22.00
M	**Depreciation during the year (D*J)**	**138.11**	**499.48**	**560.86**	**591.32**	**591.32**
N	Cumulative Depreciation at the end of the year	138.11	637.59	1198.44	1789.77	2381.09
O	Remaining Aggregate Depreciable Value at the end of the year	7414.22	7646.06	8103.18	8017.09	7425.76

Interest on Loan ("IoL")

74. Regulation 32 of the 2019 Tariff Regulations provides as follows:

*"**32. Interest on loan capital:** (1) The loans arrived at in the manner indicated in Regulation 18 of these regulations shall be considered as gross normative loan for calculation of interest on loan.*

(2) The normative loan outstanding as on 1.4.2019 shall be worked out by deducting the cumulative repayment as admitted by the Commission up to 31.3.2019 from the gross normative loan.

(3) The repayment for each of the year of the tariff period 2019-24 shall be deemed to be equal to the depreciation allowed for the corresponding year/period. In case of de-capitalization of asset, the repayment shall be adjusted by taking into account cumulative repayment on a pro rata basis and the adjustment should not exceed cumulative depreciation recovered upto the date of de-capitalisation of such asset.

(4) Notwithstanding any moratorium period availed by the generating company or the transmission licensee, as the case may be, the repayment of loan shall be considered

from the first year of commercial operation of the project and shall be equal to the depreciation allowed for the year or part of the year.

(5) The rate of interest shall be the weighted average rate of interest calculated on the basis of the actual loan portfolio after providing appropriate accounting adjustment for interest capitalized:

Provided that if there is no actual loan for a particular year but normative loan is still outstanding, the last available weighted average rate of interest shall be considered;

Provided further that if the generating station or the transmission system, as the case may be, does not have actual loan, then the weighted average rate of interest of the generating company or the transmission licensee as a whole shall be considered.

(5a) The rate of interest on loan for installation of emission control system shall be the weighted average rate of interest of actual loan portfolio of the emission control system or in the absence of actual loan portfolio, the weighted average rate of interest of the generating company as a whole shall be considered.

(6) The interest on loan shall be calculated on the normative average loan of the year by applying the weighted average rate of interest.

(7) The changes to the terms and conditions of the loans shall be reflected from the date of such re-financing".

75. The weighted average rate of interest of IoL has been considered on the basis of the rates prevailing as on COD for the respective loans. The Petitioner has prayed that the change in interest rate due to the floating rate of interest applicable, if any, during the 2019-24 tariff period will be adjusted. Accordingly, the floating rate of interest, if any, shall be considered at the time of truing-up.

76. IoL has been worked out in accordance with Regulation 32 of the 2019 Tariff Regulations. IoL allowed in respect of the transmission assets is as follows:

(₹ in lakh)

Asset-I						
	Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
A	Gross Normative Loan	5718.87	7749.05	8857.09	9959.64	9959.64
B	Cumulative Repayments up to Previous Year	0.00	160.05	810.77	1548.11	2328.65
C	Net Loan-Opening (A-B)	5718.87	7588.99	8046.32	8411.53	7630.99
D	Addition due to ACE	2030.18	1108.04	1102.55	0.00	0.00

Asset-I						
	Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
E	Repayment during the year	160.05	650.72	737.34	780.54	780.54
F	Net Loan-Closing (C+D-E)	7588.99	8046.32	8411.53	7630.99	6850.45
G	Average Loan (C+F)/2	6653.93	7817.66	8228.92	8021.26	7240.72
H	Weighted Average Rate of Interest on Loan (in %)	7.84	7.79	7.79	7.79	7.79
I	**Interest on Loan (G*H)**	**158.16**	**609.17**	**641.22**	**625.03**	**563.94**

(₹ in lakh)

Asset-II						
	Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
A	Gross Normative Loan	5694.38	6033.79	6830.06	7614.63	7614.63
B	Cumulative Repayments up to Previous Year	0.00	138.11	637.59	1198.44	1789.77
C	Net Loan-Opening (A-B)	5694.38	5895.68	6192.47	6416.18	5824.86
D	Addition due to ACE	339.41	796.27	784.57	0.00	0.00
E	Repayment during the year	138.11	499.48	560.86	591.32	591.32
F	Net Loan-Closing (C+D-E)	5895.68	6192.47	6416.18	5824.86	5233.54
G	Average Loan (C+F)/2	5795.03	6044.07	6304.33	6120.52	5529.20
H	Weighted Average Rate of Interest on Loan (in %)	7.48	7.48	7.48	7.48	7.48
I	**Interest on Loan (G*H)**	**131.46**	**452.10**	**471.56**	**457.80**	**413.48**

Return on Equity ("RoE")

77. Regulations 30 and 31 of the 2019 Tariff Regulations provide as follows:

*"**30. Return on Equity:** (1) Return on equity shall be computed in rupee terms, on the equity base determined in accordance with Regulation 18 of these regulations.*

(2) Return on equity shall be computed at the base rate of 15.50% for thermal generating station, transmission system including communication system and run-of-river hydro generating station, and at the base rate of 16.50% for the storage type hydro generating stations including pumped storage hydro generating stations and run-of-river generating station with pondage:

Provided that return on equity in respect of Additional Capitalization after cut-off date beyond the original scope excluding Additional Capitalization due to Change in Law, shall be computed at the weighted average rate of interest on actual loan portfolio of the generating station or the transmission system or in the absence of actual loan portfolio of the generating station or the transmission system, the weighted average rate of interest of the generating company or the transmission licensee, as the case may be, as a whole shall be considered, subject to ceiling of 14%.

Provided further that:

i. *In case of a new project, the rate of return on equity shall be reduced by 1.00% for such period as may be decided by the Commission, if the generating station or transmission system is found to be declared under commercial operation without commissioning of any of the Restricted Governor Mode Operation (RGMO) or Free Governor Mode Operation (FGMO), data telemetry, communication system up to load dispatch centre or protection system based on the report submitted by the respective RLDC;*

ii. *in case of existing generating station, as and when any of the requirements under (i) above of this Regulation are found lacking based on the report submitted by the concerned RLDC, rate of return on equity shall be reduced by 1.00% for the period for which the deficiency continues;*

iii. *in case of a thermal generating station, with effect from 1.4.2020:*
   a) *rate of return on equity shall be reduced by 0.25% in case of failure to achieve the ramp rate of 1% per minute;*
   b) *an additional rate of return on equity of 0.25% shall be allowed for every incremental ramp rate of 1% per minute achieved over and above the ramp rate of 1% per minute, subject to ceiling of additional rate of return on equity of 1.00%:*

   Provided that the detailed guidelines in this regard shall be issued by National Load Dispatch Centre by 30.6.2019.

(3) The return on equity in respect of additional capitalization on account of emission control system shall be computed at the base rate of one year marginal cost of lending rate (MCLR) of the State Bank of India as on 1st April of the year in which the date of operation (ODe) occurs plus 350 basis point, subject to ceiling of 14%;"

31. Tax on Return on Equity:*(1) The base rate of return on equity as allowed by the Commission under Regulation 30 of these regulations shall be grossed up with the effective tax rate of the respective financial year. For this purpose, the effective tax rate shall be considered on the basis of actual tax paid in respect of the financial year in line with the provisions of the relevant Finance Acts by the concerned generating company or the transmission licensee, as the case may be. The actual tax paid on income from other businesses including deferred tax liability (i.e. income from business other than business of generation or transmission, as the case may be) shall be excluded for the calculation of effective tax rate.*

(2) Rate of return on equity shall be rounded off to three decimal places and shall be computed as per the formula given below:

Rate of pre-tax return on equity = Base rate / (1-t)

Where "t" is the effective tax rate in accordance with clause (1) of this Regulation and shall be calculated at the beginning of every financial year based on the estimated profit and tax to be paid estimated in line with the provisions of the relevant Finance Act applicable for that financial year to the company on pro-rata basis by excluding the income of non-generation or non-transmission business, as the case may be, and the corresponding tax thereon. In case of generating company or transmission licensee paying Minimum Alternate Tax (MAT), "t" shall be considered as MAT rate including surcharge and cess.

Illustration-

(i) In case of a generating company or a transmission licensee paying Minimum Alternate Tax (MAT) @ 21.55% including surcharge and cess:

Rate of return on equity = 15.50/(1-0.2155) = 19.758%

(ii) In case of a generating company or a transmission licensee paying normal corporate tax including surcharge and cess:

(a) Estimated Gross Income from generation or transmission business for FY 2019-20 is Rs 1,000 crore;
(b) Estimated Advance Tax for the year on above is Rs 240 crore;
(c) Effective Tax Rate for the year 2019-20 = Rs 240 Crore/Rs 1000 Crore = 24%;
(d) Rate of return on equity = 15.50/ (1-0.24) = 20.395%.

(3) The generating company or the transmission licensee, as the case may be, shall true up the grossed up rate of return on equity at the end of every financial year based on actual tax paid together with any additional tax demand including interest thereon, duly adjusted for any refund of tax including interest received from the income tax authorities pertaining to the tariff period 2019-24 on actual gross income of any financial year. However, penalty, if any, arising on account of delay in deposit or short deposit of tax amount shall not be claimed by the generating company or the transmission licensee, as the case may be. Any under-recovery or over-recovery of grossed up rate on return on equity after truing up, shall be recovered or refunded to beneficiaries or the long term customers, as the case may be, on year to year basis."

78. The Petitioner has submitted that the MAT rate is applicable to it. MAT rate applicable in the year 2019-20 has been considered for the purpose of RoE, which shall be trued-up in accordance with Regulation 31(3) of the 2019 Tariff Regulations. Accordingly, RoE allowed in respect of the transmission assets is as follows:

(₹ in lakh)

	Asset-I					
	Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
A	Opening Equity	2450.95	3321.02	3795.89	4268.42	4268.42
B	Addition due to ACE	870.08	474.87	472.52	0.00	0.00
C	Closing Equity (A+B)	3321.02	3795.89	4268.42	4268.42	4268.42
D	Average Equity (A+C)/2	2885.98	3558.46	4032.16	4268.42	4268.42
E	Return on Equity (Base Rate) (in %)	15.500	15.500	15.500	15.500	15.500
F	Tax Rate applicable (in %)	17.472	17.472	17.472	17.472	17.472
G	Rate of Return on Equity (Pre-tax)	18.782	18.782	18.782	18.782	18.782
H	**Return on Equity (Pre-tax) (D*G)**	**164.39**	**668.35**	**757.32**	**801.69**	**801.69**

(₹ in lakh)

Asset-II						
	Particulars	2019-20 (Pro-rata for 111 days)	2020-21	2021-22	2022-23	2023-24
A	Opening Equity	2440.45	2585.91	2927.17	3263.41	3263.41
B	Addition due to ACE	145.46	341.26	336.25	0.00	0.00
C	Closing Equity (A+B)	2585.91	2927.17	3263.41	3263.41	3263.41
D	Average Equity (A+C)/2	2513.18	2756.54	3095.29	3263.41	3263.41
E	Return on Equity (Base Rate) (in %)	15.500	15.500	15.500	15.500	15.500
F	Tax Rate applicable (in %)	17.472	17.472	17.472	17.472	17.472
G	Rate of Return on Equity (Pre-tax)	18.782	18.782	18.782	18.782	18.782
H	**Return on Equity (Pre-tax) (D*G)**	**143.16**	**517.73**	**581.36**	**612.93**	**612.93**

Operation & Maintenance Expenses ("O&M Expenses")

79. The O&M Expenses claimed by the Petitioner in respect of the transmission assets are as follows:

(₹ in lakh)

Particulars	2019-20	2020-21	2021-22	2022-23	2023-24
Asset-1					
Sub-station	346.99	864.51	895.11	927.33	959.69
Communication system	1.82	4.39	4.39	4.39	4.39
Total O&M Expenses	**348.81**	**868.90**	**899.50**	**931.72**	**964.08**
Asset-II					
Sub-station	239.75	817.92	846.88	877.41	908.02
Communication system	0.47	1.57	1.57	1.57	1.57
Total O&M Expenses	240.22	819.49	848.45	878.98	909.59

80. Regulations 35(3)(a) and 35(4) of the 2019 Tariff Regulations provides as follows:

*"**35 (3) Transmission system**: (a) The following normative operation and maintenance expenses shall be admissible for the combined transmission system:*

Particulars	***2019-20***	***2020-21***	***2021-22***	***2022-23***	***2023-24***
Norms for sub-station Bays (₹ Lakh per bay)					
765 kV	*45.01*	*46.60*	*48.23*	*49.93*	*51.68*
400 kV	*32.15*	*33.28*	*34.45*	*35.66*	*36.91*
220 kV	*22.51*	*23.30*	*24.12*	*24.96*	*25.84*
132 kV and below	*16.08*	*16.64*	*17.23*	*17.83*	*18.46*

Particulars	*2019-20*	*2020-21*	*2021-22*	*2022-23*	*2023-24*
Norms for Transformers (₹ Lakh per MVA)					
765 kV	*0.491*	*0.508*	*0.526*	*0.545*	*0.564*
400 kV	*0.358*	*0.371*	*0.384*	*0.398*	*0.411*
220 kV	*0.245*	*0.254*	*0.263*	*0.272*	*0.282*
132 kV and below	*0.245*	*0.254*	*0.263*	*0.272*	*0.282*
Norms for AC and HVDC lines (₹ Lakh per km)					
Single Circuit (Bundled Conductor with six or more sub-conductors)	*0.881*	*0.912*	*0.944*	*0.977*	*1.011*
Single Circuit (Bundled conductor with four sub-conductors)	*0.755*	*0.781*	*0.809*	*0.837*	*0.867*
Single Circuit (Twin & Triple Conductor)	*0.503*	*0.521*	*0.539*	*0.558*	*0.578*
Single Circuit (Single Conductor)	*0.252*	*0.260*	*0.270*	*0.279*	*0.289*
Double Circuit (Bundled conductor with four or more sub-conductors)	*1.322*	*1.368*	*1.416*	*1.466*	*1.517*
Double Circuit (Twin & Triple Conductor)	*0.881*	*0.912*	*0.944*	*0.977*	*1.011*
Double Circuit (Single Conductor)	*0.377*	*0.391*	*0.404*	*0.419*	*0.433*
Multi Circuit (Bundled Conductor with four or more sub-conductor)	*2.319*	*2.401*	*2.485*	*2.572*	*2.662*
Multi Circuit (Twin & Triple Conductor)	*1.544*	*1.598*	*1.654*	*1.713*	*1.773*
Norms for HVDC stations					
HVDC Back-to-Back stations (Rs Lakh per 500 MW) (Except Gazuwaka BTB)	*834*	*864*	*894*	*925*	*958*
Gazuwaka HVDC Back-to-Back station (₹ Lakh per 500 MW)	*1,666*	*1,725*	*1,785*	*1,848*	*1,913*
500 kV Rihand-Dadri HVDC bipole scheme (Rs Lakh) (1500 MW)	*2,252*	*2,331*	*2,413*	*2,498*	*2,586*
±500 kV Talcher- Kolar HVDC bipole scheme (Rs Lakh) (2000 MW)	*2,468*	*2,555*	*2,645*	*2,738*	*2,834*
±500 kV Bhiwadi-Balia HVDC bipole scheme (Rs Lakh) (2500 MW)	*1,696*	*1,756*	*1,817*	*1,881*	*1,947*
±800 kV, Bishwanath-Agra HVDC bipole scheme (Rs Lakh) (3000 MW)	*2,563*	*2,653*	*2,746*	*2,842*	*2,942*

Provided that the O&M expenses for the GIS bays shall be allowed as worked out by multiplying 0.70 of the O&M expenses of the normative O&M expenses for bays;

Provided further that:

i. *the operation and maintenance expenses for new HVDC bi-pole schemes commissioned after 1.4.2019 for a particular year shall be allowed pro-rata on the basis of normative rate of operation and maintenance expenses of similar HVDC bi-pole scheme for the corresponding year of the tariff period;*

ii. *the O&M expenses norms for HVDC bi-pole line shall be considered as Double Circuit quad AC line;*

iii. *the O&M expenses of ±500 kV Mundra-Mohindergarh HVDC bipole scheme (2000 MW) shall be allowed as worked out by multiplying 0.80 of the normative O&M expenses for ±500 kV Talchar-Kolar HVDC bi-pole scheme (2000 MW);*

iv. *the O&M expenses of ±800 kV Champa-Kurukshetra HVDC bi-pole scheme (3000 MW) shall be on the basis of the normative O&M expenses for ±800 kV, Bishwanath-Agra HVDC bi-pole scheme;*

v. *the O&M expenses of ±800 kV, Alipurduar-Agra HVDC bi-pole scheme (3000 MW)shall be allowed as worked out by multiplying 0.80 of the normative O&M expenses for ±800 kV, Bishwanath-Agra HVDC bi-pole scheme; and*

vi. *the O&M expenses of Static Synchronous Compensator and Static Var Compensator shall be worked at 1.5% of original project cost as on commercial operation which shall be escalated at the rate of 3.51% to work out the O&M expenses during the tariff period. The O&M expenses of Static Synchronous Compensator and Static Var Compensator, if required, may be reviewed after three years.*

(b) The total allowable operation and maintenance expenses for the transmission system shall be calculated by multiplying the number of sub-station bays, transformer capacity of the transformer (in MVA) and km of line length with the applicable norms for the operation and maintenance expenses per bay, per MVA and per km respectively.

(c) The Security Expenses and Capital Spares for transmission system shall be allowed separately after prudence check:

Provided that the transmission licensee shall submit the assessment of the security requirement and estimated security expenses, the details of year-wise actual capital spares consumed at the time of truing up with appropriate justification.

***(4) Communication system**: The operation and maintenance expenses for the communication system shall be worked out at 2.0% of the original project cost related to such communication system. The transmission licensee shall submit the actual operation and maintenance expenses for truing up."*

81. We have considered the Petitioner's submissions. The Petitioner has claimed O&M Expenses separately for PLCC under Regulation 35(4) of the 2019 Tariff Regulations for Stage-I combined asset @ 2% of its cost. The Petitioner has made a similar claim in other Petitions as well. Though PLCC is a communication system, it has been considered as part of the sub-station in the 2014 Tariff Regulations as well

as in the 2019 Tariff Regulations and the norms for sub-station have been specified accordingly. Accordingly, the Commission, vide order dated 24.1.2021 in Petition No. 126/TT/2020, has already concluded that no separate O&M Expenses can be allowed for PLCC under Regulation 35(4) of the 2019 Tariff Regulations, even though PLCC is a communication system. Therefore, the Petitioner's claim for separate O&M Expenses for PLCC @2% is not allowed.

82. The O&M Expenses allowed in respect of the transmission assets are as follows:

(₹ in lakh)

Asset-I					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Sub-station Bays (Numbers)					
765 kV: Aligarh ICT Bay I (GIS*)	1	1	1	1	1
400 kV: Aligarh ICT Bay (GIS*)	1	1	1	1	1
400 kV: Aligarh Line Bays (GIS*)	2	2	2	2	2
Norms (₹ lakh/bay)					
765 kV	31.507	32.620	33.761	34.951	36.176
400 kV	22.505	23.296	24.115	24.962	25.837
Total Sub-station	**99.02**	**102.51**	**106.11**	**109.84**	**113.69**
Transformer (MVA)					
765 kV: Aligarh 1500 MVA ICT	1500	1500	1500	1500	1500
Norms					
765 kV	0.491	0.508	0.526	0.545	0.564
Total Transformer	**736.50**	**762.00**	**789.00**	**817.50**	**846.00**
Total O&M Expenses	**253.40**	**864.51**	**895.11**	**927.34**	**959.69**

(₹ in lakh)

Asset-II					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Sub-station Bays (Numbers)					
765 kV: Aligarh ICT Bay I (GIS*)	1	1	1	1	1
400 kV: Aligarh ICT Bay (GIS*)	1	1	1	1	1
Norms (₹ lakh/bay)					
765 kV	31.507	32.620	33.761	34.951	36.176
400 kV	22.505	23.296	24.115	24.962	25.837
Total Sub-station	**54.01**	**55.92**	**57.88**	**59.91**	**62.01**
Transformer (MVA)					
765kV: Aligarh 1500 MVA ICT	1500	1500	1500	1500	1500
Norms					

Asset-II					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
765 kV	0.491	0.508	0.526	0.545	0.564
Total Transformer	**736.50**	**762.00**	**789.00**	**817.50**	**846.00**
Total O&M Expenses	**239.75**	**817.92**	**846.88**	**877.41**	**908.01**

**O&M Expenses for the GIS bays shall be allowed as worked out by multiplying 0.70 of the O&M Expenses of the normative O&M Expenses for bays*

Interest on Working Capital ("IWC")

83. Regulations 34(1)(c), 34(3), 34(4), and 3(7) of the 2019 Tariff Regulations provides as follows:

*"**34. Interest on Working Capital**: (1) The working capital shall cover:*

…..

(c) For Hydro Generating Station (including Pumped Storage Hydro Generating Station) and Transmission System:

(i) Receivables equivalent to 45 days of annual fixed cost;

(ii) Maintenance spares @ 15% of operation and maintenance expenses including security expenses; and

(iii) Operation and maintenance expenses, including security expenses for one month."

"(3) Rate of interest on working capital shall be on normative basis and shall be considered as the bank rate as on 1.4.2019 or as on 1st April of the year during the tariff period 2019-24 in which the generating station or a unit thereof or the transmission system including communication system or element thereof, as the case may be, is declared under commercial operation, whichever is later:

Provided that in case of truing-up, the rate of interest on working capital shall be considered at bank rate as on 1st April of each of the financial year during the tariff period 2019-24.

(4) Interest on working capital shall be payable on normative basis notwithstanding that the generating company or the transmission licensee has not taken loan for working capital from any outside agency."

***"3. Definition** - In these regulations, unless the context otherwise requires:-*

*(7) '**Bank Rate**' means the one year marginal cost of lending rate (MCLR) of the State Bank of India issued from time to time plus 350 basis points;"*

84. The Petitioner has submitted that it has computed the IWC for the 2019-24 period

considering the SBI base rate plus 350 basis points as on 1.4.2019. The Petitioner has considered the rate of IWC as 12.05%. The IWC is worked out in accordance with Regulation 34 of the 2019 Tariff Regulations. The rate of IWC considered is 12.05% (SBI 1 year MCLR applicable as on 1.4.2019 of 8.55% plus 350 basis points) for the year 2019-20, 11.25% (SBI 1 year MCLR applicable as on 1.4.2020 of 7.75% plus 350 basis points) for the year 2020-21, 10.50% (SBI 1 year MCLR applicable as on 1.4.2021 of 7.00% plus 350 basis points) for the years 2021-22 and 2022- 23 and 12.00% (SBI 1 year MCLR applicable as on 1.4.2023 of 8.50% plus 350 basis points) for the year 2023-24. The components of the working capital and interest allowed thereon with respect to the transmission assets are as follows:

(₹ in lakh)

Asset-I					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Working Capital for O&M Expenses (O&M Expenses for one month)	69.63	72.04	74.59	77.28	79.97
Working Capital for Maintenance Spares (15% of O&M Expenses)	125.33	129.68	134.27	139.10	143.95
Working Capital for Receivables (Equivalent to 45 days of annual fixed cost /annual transmission charges)	305.80	351.99	381.32	394.36	390.94
Total Working Capital	**500.75**	**553.71**	**590.18**	**610.74**	**614.87**
Rate of Interest for working capital (in %)	12.05	11.25	10.50	10.50	12.00
Interest of working capital	**18.30**	**62.29**	**61.97**	**64.13**	**73.78**

(₹ in lakh)

Asset-II					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Working Capital for O&M Expenses (O&M Expenses for one month)	65.88	68.16	70.57	73.12	75.67
Working Capital for Maintenance Spares (15% of O&M Expenses)	118.58	122.69	127.03	131.61	136.20
Working Capital for Receivables (Equivalent to 45 days of annual fixed cost /annual transmission charges)	271.26	288.64	309.94	319.88	318.37
Total Working Capital	**455.72**	**479.48**	**507.54**	**524.61**	**530.24**

Rate of Interest for working capital (in %)	12.05	11.25	10.50	10.50	12.00
Interest of working capital	**16.65**	**53.94**	**53.29**	**55.08**	**63.63**

Annual Fixed Charges for the 2019-24 Tariff Period

85. The transmission charges allowed in respect of the transmission assets for the 2019-24 tariff period are as follows:

(₹ in lakh)

Asset-I					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Depreciation	160.05	650.72	737.34	780.54	780.54
Interest on Loan	158.16	609.17	641.22	625.03	563.94
Return on Equity	164.39	668.35	757.32	801.69	801.69
O&M Expenses	253.40	864.51	895.11	927.34	959.69
Interest on Working Capital	18.30	62.29	61.97	64.13	73.78
Total	**754.30**	**2855.04**	**3092.96**	**3198.73**	**3179.64**

(₹ in lakh)

Asset-II					
Particulars	**2019-20 (Pro-rata for 111 days)**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Depreciation	138.11	499.48	560.86	591.32	591.32
Interest on Loan	131.46	452.10	471.56	457.80	413.48
Return on Equity	143.16	517.73	581.36	612.93	612.93
O&M Expenses	239.75	817.92	846.88	877.41	908.01
Interest on Working Capital	16.65	53.94	53.29	55.08	63.63
Total	**669.13**	**2341.17**	**2513.95**	**2594.54**	**2589.37**

Filing Fee and Publication Expenses

86. The Petitioner has sought reimbursement of the fee paid by it for filing the Petition and publication expenses. The Petitioner shall be entitled to reimbursement of the filing fees and publication expenses in connection with the present Petition directly from the beneficiaries on a pro-rata basis in accordance with Regulation 70(1) of the 2019 Tariff Regulations.

Licence Fee and RLDC Fees and Charges

87. The Petitioner shall be entitled to reimbursement of licence fee in accordance with Regulation 70(4) of the 2019 Tariff Regulations for the 2019-24 tariff period. The Petitioner shall also be entitled to recovery of RLDC fees and charges in accordance with Regulations 70(3) of the 2019 Tariff Regulations for the 2019-24 tariff period.

Goods and Services Tax

88. The Petitioner has submitted that if GST is levied at any rate and at any point of time in the future on charges of transmission of electricity, the same shall be borne and additionally paid by the Respondent(s) to the Petitioner and the same shall be charged and billed separately by the Petitioner. Further, additional taxes, if any, are to be paid by the Petitioner on account of the demand from the Government/ Statutory Authorities; the same may be allowed to be recovered from the beneficiaries.

89. We have considered the Petitioner’s submissions. Since GST is not levied on transmission service at present, we are of the view that Petitioner’s prayer is pre-mature.

Security Expenses

90. The Petitioner has submitted that security expenses in respect of the transmission assets has not been claimed in the instant Petition, and it would file a separate Petition for claiming the overall security expenses and consequential IWC.

91. UPPCL has submitted that the Commission may not allow any ad-hoc expenditure on account of the security expenses by escalating the actual of 2018-19 by 3.5% p.a., which will be against Regulation 35(3)(c) of 2019 Tariff Regulations and

outside the ambit of the instant Petition as well.

92. In response, the Petitioner has reiterated its submissions as made in the Petition.

93. We have considered the above submissions of the Petitioner and UPPCL. The Petitioner has claimed the consolidated security expenses for all the transmission assets owned by it on a projected basis for the 2019-24 tariff period on the basis of actual security expenses incurred in the year 2018-19 in Petition No. 260/MP/2020. The said Petition has already been disposed of by the Commission, vide order dated 3.8.2021. Therefore, the Petitioner's prayer in the instant Petition for allowing it to file a separate Petition for claiming the overall security expenses and consequential IWC has become infructuous.

Capital Spares

94. The Petitioner has prayed to be allowed its claim of capital spares at the end of the tariff period as per actual.

95. We have considered the Petitioner's submissions. The Petitioner's claim, if any, shall be dealt with in accordance with the provisions of the 2019 Tariff Regulations at the time of truing up of the 2019-24 tariff period.

Sharing of Transmission Charges

96. The Petitioner vide affidavit dated 28.6.2024 has submitted that the Commission, in its order dated 19.5.2024 in Petition No. 90/MP/2019, has held that the applicable transmission charges from the deemed COD (i.e., 8.8.2019) of the AP Line and the Prithala Sub-station of GPTL to 29.10.2019 shall be payable by HVPNL and the

Petitioner in the ratio of 50:50. The Petitioner also submitted that in Petition No. 90/MP/2019 there ought to have been no liability imposed upon it as despite availability of its assets after successful charging on 30.10.2019, GPTL's assets, namely, AP Line and Prithala Sub-station were prevented from providing regular service due to delay in the commissioning of the downstream 220 kV lines at Prithala Sub-station under the scope of HVPNL and/or due to a delay in the commissioning of the GPTL's assets connected to AP line.

97. We have considered the submissions of the Petitioner. The COD of Asset-I and Asset-II has been approved as 12.12.2019 under Regulation 5(2) of the 2019 Tariff Regulations as the associated 220 kV downstream transmission system under the scope of HVPNL was not ready. Regulation 6(2) of the 2019 Tariff Regulations, which contains detailed provisions with regard to liability for mismatch of the COD between the generating station and transmission system or between two transmission licensees of a connected transmission system, is applicable in the case of the transmission asset. The Regulation 6(2) of the 2019 Tariff Regulations provides as follows:

> "***6. Treatment of mismatch in date of commercial operation:***
> *……..*
>
> *(2) In case of mismatch of the date of commercial operation of the transmission system and the transmission system of other transmission licensee, the liability for the transmission charges shall be determined as under:*
>
> > *(a) Where an interconnected transmission system of other transmission licensee has not achieved the commercial operation as on the date of commercial operation of the transmission system (which is not before the SCOD of the interconnected transmission system) and the Commission has approved the date of commercial operation of such transmission system in terms of clause (2) of Regulation 5 of these regulations, the other transmission licensee shall be liable to pay the transmission charges of the transmission system in accordance with clause (5) of Regulation 14 of these regulations to the transmission licensee till the interconnected transmission system achieves commercial operation:*
> >
> > *(b) Where the transmission system has not achieved the commercial operation as on the date of commercial operation of the interconnected transmission system of other transmission licensee (which is not before the SCOD of the transmission, the*

transmission licensee shall be liable to pay the transmission charges of such interconnected transmission system to the other transmission licensee or as may be determined by the Commission, in accordance with clause (5) of Regulation 14 of these regulations, till the transmission system achieves the commercial operation."

98. As stated above, the COD of the transmission asset has been approved as 12.12.2019 under Regulation 5(2) of the 2019 Tariff Regulations. As per Regulation 6(2)(b) of the 2019 Tariff Regulations, if an inter-connected transmission system of another transmission licensee is not ready on the COD of the transmission asset and if the COD of the transmission asset has been approved under Regulation 5(2) of the 2019 Tariff Regulations, the defaulting transmission licensee is required to bear the transmission charges of the transmission asset of the other transmission licensee till the COD of the inter-connected transmission system under its scope. In the instant case, the TBCB line under the scope of GPTL became ready on 8.8.2019 (as approved vide order dated 19.5.2024 in Petition No. 90/MP/2020), and the instant transmission assets could not be put to regular service on account of the non-readiness of 220 kV network at Prithala Sub-station which were under the scope of HVPNL. The power flow was started at Aligarh Sub-station on 18.3.2020 (238 MW on each ICT) at 18:41 hrs. Therefore, the transmission charges in the case of Asset-I and Asset-II from 12.12.2019 up to 17.3.2020 shall be borne by HVPNL, and from 18.3.2020, the transmission charges shall be included in the PoC Pool.

99. The With effect from 1.7.2011, the sharing of transmission charges for inter-State transmission systems was governed by the provisions of the 2010 Sharing Regulations. With effect from 1.11.2020, the 2010 Sharing Regulations has been repealed, and the sharing of transmission charges is governed by the provisions of the 2020 Sharing Regulations. Accordingly, the liabilities of DICs for arrears of the transmission charges determined through this order shall be computed DIC-wise in accordance with the

provisions of respective Tariff Regulations and shall be recovered from the concerned DICs through Bill 2 under Regulation 15(2)(b) of the 2020 Sharing Regulations. Billing, collection, and disbursement of transmission charges for subsequent periods shall be recovered in terms of provisions of the 2020 Sharing Regulations as provided in Regulation 57 of the 2019 Tariff Regulations.

100. To summarise,

(a) AFC allowed in respect of the transmission assets for the 2019-24 tariff period in the instant order are as follows:

(₹ in lakh)

Assets	2019-20	2020-21	2021-22	2022-23	2023-24
Asset-I	754.30	2855.04	3092.96	3198.73	3179.64
Asset-II	669.13	2341.17	2513.95	2594.54	2589.37

101. Annexure given hereinafter shall form a part of the order.

102. This order disposes of Petition No. 649/TT/2020 in terms of the above discussions and findings.

Sd/-	sd/-	sd/-
(Jishnu Barua) **Chairperson**	**(Arun Goyal)** **Member**	**(Ramesh Babu V.)** **Member**

Annexure

Asset-I

Particulars	Admitted Capital Cost as on COD (₹ in lakh)	Projected ACE 2019-24 (₹ in lakh)	Admitted Capital Cost as on 31.3.2024 (₹ in lakh)	Rate of Depreciation (in %)	Annual Depreciation as per Regulations 2019-20 (₹ in lakh)	2020-21 (₹ in lakh)	2021-22 (₹ in lakh)	2022-23 (₹ in lakh)	2023-24 (₹ in lakh)
Sub-station	7885.23	5,847.19	13732.42	5.28	490.24	604.47	684.94	725.07	725.07
PLCC	125.01	92.70	217.71	6.33	9.32	11.49	13.02	13.78	13.78
IT Equipment and software	159.59	118.34	277.93	15.00	28.19	34.75	39.38	41.69	41.69
Total	**8169.82**	**6,058.23**	**14228.05**		**527.74**	**650.72**	**737.34**	**780.54**	**780.54**
			Average Gross Block (₹ in lakh)		9619.94	11861.53	13440.52	14228.05	14228.05
			Weighted Average Rate of Depreciation (in %)		5.49	5.49	5.49	5.49	5.49

Asset-II

Particulars	Admitted Capital Cost as on COD (₹ in lakh)	Projected ACE	Admitted Capital Cost as on 31.3.2024 (₹ in lakh)	Rate of Depreciation (in %)	Annual Depreciation as per Regulations				
		2019-24 (₹ in lakh)			2019-20 (₹ in lakh)	2020-21 (₹ in lakh)	2021-22 (₹ in lakh)	2022-23 (₹ in lakh)	2023-24 (₹ in lakh)
Sub-station	7952.72	2,681.80	10634.52	5.28	432.42	474.29	532.58	561.50	561.50
PLCC	57.87	19.51	77.38	6.33	3.77	4.14	4.65	4.90	4.90
IT Equipment and software	124.24	41.91	166.15	15.00	19.19	21.05	23.64	24.92	24.92
Total	**8134.83**	**2,743.22**	**10878.04**		**455.38**	**499.48**	**560.86**	**591.32**	**591.32**
			Average Gross Block (₹ in lakh)		8377.26	9188.46	10317.63	10878.04	10878.04
			Weighted Average Rate of Depreciation (in %)		5.44	5.44	5.44	5.44	5.44

15.2 CTU further stated that as given in RE detailed Procedure "For the connectivity 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", therefore it is proposed that the above 5 nos. of 400 kV bays (Bhadla II- 3 nos., Fatehgarh-II- 1 no.& Fathegarh-III-1 no.) may be taken up for implementation under ISTS with time frame indicated above.

15.3 RVPN enquired about the status of earlier proposed 220 kV bays and transformation capacity at the above mentioned locations. CTU replied that all the 220 kV bays have been allotted and transformation capacity has been utilized. The Stage-II connectivity applications for these have already been received. Annexure-VIII

15.4 RVPN stated that earlier developers were seeking for 220 kV, then why 400kV connectivity has been proposed. CTU replied that as per SECI manufacturing tenders, RE generators have allocated bulk capacities of around 500 MW which may further enhance their capacity to 1000 MW. Therefore generators have requested for connectivity at 400 kV level under ISTS. This connectivity at 400 kV level is in addition to the bays allotted at 220 kV level.

15.5 RVPN stated that as discussed in the TCC meetings, space provision has been kept in Sikar-II for 8 nos. 220kV line bays and 4 nos. 400/220kV transformers. RVPN further opined that there is no space requirement as the commercial implications would be imposed on RVPN. CTU stated that there is no harm in keeping space provision as the same would be beneficial for Rajasthan for future expansion. RVPN stated that there would be no requirement in future as per STU, therefore space provision should not be kept. CTU agreed with RVPN and stated that the provision of 8 nos. 220kV line bays and 4 nos. 400/220kV transformers at Sikar-II would be deleted from the scope.

15.6 Members agreed with the proposal of 5 nos. of 400 kV bays (Bhadla II- 3 nos., Fatehgarh-II-1 no. & Fathegarh-III-1 no.) for implementation under ISTS with time frame indicated above.

16.0 2 nos. of 765kV GIS line bays Modules at Aligarh S/s

16.1 CEA stated that the transmission system strengthening scheme for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase-II was agreed in the 5th meeting of Northern Region Standing Committee on Transmission (NRSCT) held on 13.09.2019. The scheme also included Sikar-II – Aligarh 765kV D/c line along with 765kV line bays & line reactors at each end. However, it is to inform that 2 nos. of 765kV GIS line bay modules are already available at Aligarh S/s. Accordingly, it is proposed that above GIS line bay modules available at Aligarh S/s may be utilized for termination of Sikar-II – Aligarh 765kV D/c line and the provision for 2 nos. of bays at Aligarh S/s would be deleted from the scope.

16.2 Members noted the same.

17.0 Phasing of Transmission system strengthening scheme for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase II

17.1 CEA stated that the transmission system strengthening scheme for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase-II was agreed in the 5th meeting of Northern Region Standing Committee on Transmission (NRSCT) held on 13.09.2019 with completion schedule as Dec'21. Subsequently, Time frame of above mentioned scheme was discussed in a meeting held among CEA, MNRE, CTU & SECI on 22.05.2020 wherein it was decided to revise the completion schedule of the subject scheme as Mar'22/June'22, however, based on schedule of Stage-II Connectivity at

Forum directed that a separate meeting among constituents may be held next week to review the SPS scheme for Anpara Complex.

A.14. N-1 contingency violation in 400/220/33KV 315MVA ICT-I at BBMB Dehar (Agenda by Powergrid NR-2)

A.14.1. In the meeting, Powergrid NR-2 intimated forum that 315 MVA ICT at 400/220KV BBMB Dehar S/s is overloaded. On 315MVA ICT, load remains in the range of 300-315MW.

A.14.2. Punjab SLDC highlighted that they have also experienced problems due to the overloading of BBMB Dehar S/s.

A.14.3. Powergrid mentioned that ICT at BBMB Dehar is an ISTS element.

A.14.4. MS, NRPC asked Powergrid, PSTCL, HPPTCL and BBMB to internally discuss and thereafter submit a proposal for SPS as temporary relief for Transformer overloading. Further, for installation of new transformer at BBMB Dehar S/s, proposal may be submitted by Powergrid to CTU for study.

Decision of OCC Forum:

Forum asked Powergrid, PSTCL, HPPTCL and BBMB to internally have a discussion/study on the SPS as temporary relief for Transformer overloading at BBMB Dehar and submit accordingly. Further, for installation of new *transformer at BBMB Dehar S/s, proposal may be submitted by Powergrid to CTU for study.*

A.15. Failure of 400/220/33KV, 315 MVA ICT-1 at Kaithal on dated 11.05.2024 (Agenda by Powergrid NR-2)

A.15.1. Powergrid NR-2 intimated forum that 315 MVA ICT-1 at Kaithal failed while feeding persistent fault in 220KV Lines of HVPNL at 00:51 Hrs of 11.05.2024. Just before the failure, Fault current in 220KV Kaithal (PG)- Kaithal1 Line and 220KV Kaithal(PG)-Neemwala-2 and fed by above transformer was 20KA and 24KA respectively.

A.15.2. Powergrid NR-2 mentioned that in past also, the ICTs at Kaithal(PG) have faced circuit faults due to frequent faults in 220KV Lines Network of SEB with fault current in the range of 15-25KA and after each fault, Line is cleared by the owner with the comments that nothing is found abnormal even when fault current is in the range of 20 to 24KA.

A.15.3. In last one year, above ICT had faced more than 12 dead faults with fault current. Moreover, keeping A/R in auto mode results in 02 jerks to transformer for each fault.

A.15.4. Powergrid stated that AMP of ICT was carried out as per schedule and all test results including DGA results were normal before failure.

A.15.5. In the meeting, POWERGRID mentioned that Failed ICT is being replaced by them at its own cost.

A.15.6. In the meeting, HVPN mentioned that vide letter dated 14.06.2024 (copy enclosed as **Annexure-A.III)** on the cited matter they have submitted their observations for trippings 220kV lines emanating from POWERGRID Kaithal since May 2023.

A.15.7. MS, NRPC mentioned that with regard to the request of Powergrid for consideration of Outage of ICT at Kaithal due to above as deemed available, the said case would be examined by NRPC Sectt. as per CERC Tariff Regulation, 2024.

A.15.8. Further, MS NRPC mentioned that Root cause analysis for such faults would be deliberated in the upcoming Protection sub-committee meeting of NRPC scheduled in the second week of July 2024.

Decision of OCC Forum:

Forum stated that root cause analysis of fault at ICT Kaithal would be deliberated in the next Protection sub-committee meeting of NRPC, while request of POWERGRID for consideration of outage of ICT Kaithal would be examined by NRPC Sectt. as per CERC Tariff Regulation, 2024.

A.16. Tapping Tertiary of 765/400/33 kV ICT -2 for Reliable Auxiliary Power Supply to ±500kV HVDC Ballia Sub-Station (Agenda by POWERGRID, NR3)

A.16.1 NRPC representative apprised forum that the said matter was also deliberated in the 213th and 215th OCC meeting of NRPC wherein Powergrid NR-3 had highlighted the issue of reliable auxiliary supplies to ±500kV HVDC Ballia Sub-Station.

A.16.2 Presently, two auxiliary supplies have been provisioned at Ballia for HVDC and HVAC system. One is from tertiary of 200 MVA,400/132 KV ICT and another is UPPTCL feeder at 33 KV Levels.

A.16.3 In the meeting, Powergrid NR-3 mentioned that 400/132/33 KV, 200 MVA ICT is feeding 02 nos 132 KV Transmission Lines of UPPTCL connected to UPPTCL Sub-Station. In past, large no. of frequent faults have been detected in UPPTCL lines.

A.16.4 Further, Powergrid NR-3 has intimated that 33kV auxiliary supply from dedicated UPPTCL feeder is also not reliable and sometimes it fails 3-4 times in a month and outage duration in number of cases is more than 12 Hrs.

A.16.5 Considering the above, in 215th OCC meeting of NRPC, OCC Forum decided to form a committee under the chairmanship of Sr. GM(SO), NRLDC with members from POWERGRID, CTUIL and UPPTCL to examine the requirement of additional Auxiliary Power Supply to ±500kV HVDC Ballia Substation.

A.16.6 The recommendations of the committee are attached as AnnexureA.VI of agenda, wherein they have concurred with Powergrid proposal of *Additional source of Auxiliary Power connectivity from tertiary of 765/400/33 KV ICT-2 for reliable auxiliary supply to HVDC Ballai Sub-Station.*

circuit, loading pattern on other circuit may be studied. Resistive reach and load encroachment criteria may be reviewed for parallel circuit. Main and tie breaker priority pass may be reviewed.

A.13.18 EE (P), NRPC asked the protection simulation studies for this scenario. POWERGRID replied that analysis will be done by its study team for various fault scenarios.

A.13.19 It was gathered that this is going to be unique case for auto reclosure on phase-to-phase fault. Deliberation in detail is required. POWERGRID may perform simulation study or may approach/engage any expert/consultant for same.

Decision taken by Forum:

A.13.20 *Forum requested POWERGRID to perform protection simulation studies and then put up the matter again in upcoming meetings. POWERGRID may perform simulation study itself or may approach/engage any expert/consultant for same.*

A.14. Sudden failure of 400/220/33KV, 315 MVA ICT-1 at Kaithal during external faults in 220KV Lines (Agenda by POWERGRID, NR-2)

A.14.1 POWERGRID, NR-2 representative apprised that on 11.05.2024, there was fault in downstream network at Kaithal (PG). The sequence of events is as under:

1. 00:51:06.816 220kV Kaithal (PG)-HVPNL Neemwala-2 tripped on B_N Line fault, with fault current 23.6KA. Due to successful A/R at Kaithal (PG) end at 00:51:08.258 Hrs, above fault was repeated and again fed by ICT with fault current 23.5kA.
2. 00:51:10.808 220kV Kaithal (PG)-HVPNL Kaithal-1 tripped on B-N Line fault, with fault current 20kA. Due to successful A/R at Kaithal (PG) end at 00:51:11.858 Hrs, above fault was repeated and again fed by ICT with fault current 23.5kA.
3. 00:51:11.878 Hrs: ICT-1 had failed on failure of HV B-Phase winding while feeding above fault.

A.14.2 Further, he briefed the event through presentation attached as **Annexure- XVII.**

A.14.3 He mentioned that summary of faults fed by ICT in last 02 Years as below-

Total faults fed in last 24 months	23Nos	
Line faults with fault distance less than 2KM	10 Nos	Fault current in 20-24KA
Line faults with fault distance between 2-6kM	07 Nos	
Line faults with fault distance 7—20km	06 Nos	Fault current in 4-8KA

Note: Out of 23 No Line faults in 220KV Lines, 19 No Line faults were in B Phase and ICT also failed due to failure of B Phase winding.

A.14.4 Most of time fault is in the B phase of lines restricted to limited locations (in 6kM) and B winding of the transformer was also failed.

A.14.5 POWERGRID representative informed that again there was fault in 220KV Kaithal Neemawali 1&2 Lines on 01.06.2024, with fault current 25KA. As fault was very near to Substation, patrolling of the HVPNL line was carried out and following were the findings:

- Insufficient Jumper clearance was noticed in B-Phase in angle tower at LOC NO 4 of Kaithal (PG)-Neemwala-1&2 Lines. Similar clearance issues were found in other angle towers of the Line and suggested for Installation of additional horizontal polymer insulator to maintain sufficient clearance.

- Punctured porcelain insulators were found at No of locations in 220KV Kaithal Kaithal 1 &2 and 220KV Kaithal Cheekha 1 &2 Lines. HVPNL was suggested to replace all porcelain insulators with polymer insulators.

A.14.6 POWERGRID representative also added that many lines of HVPNL have the cracked and punctured porcelain insulator which again points out the problems associated with its transmission systems.

A.14.7 HVPNL representative conveyed that due to storm, there was earth wire found broken that led to tripping of line. He conveyed that fault is found generally in B phase due to being bottom most conductor. He mentioned that pilot string issues have already been resolved, however, if any other issue comes, same shall be resolved. He ensured that there will be no fault in future due to above defects. He also submitted that a number of Transformer had also failed in their distribution network, but failure is considered due to problem in transformer and not due to line faults.

A.14.8 POWERGRID representative submitted that distribution transformers cannot be compared with large ICTs. Further, POWERGRID representative informed that AMP & DGA of failed transformer was carried out as per schedule and all test results were normal.

A.14.9 Regarding the concern of failure of only this particular ICT, RVUNL representative opined that due to different percentage impedance of ICTs, the low impedance has most chances to feed the fault.

A.14.10 HVPNL representative highlighted that most of the faults are of zone -1 that got cleared within 50 to 100msec. However, Power transformers are designed to feed short circuit current for 1 sec.

A.14.11 POWERGRID representative mentioned that in this case fault have been fed by ICT many times rather than one or two times. POWERGRID representative further intimated that ICT has been replaced at its own cost.

A.14.12 POWERGRID representative submitted that in view of above facts, it may be concluded that ICT had failed due to frequent B-N line faults as mentioned above. As such, POWERGRID requested to condone above outage and may be attributed to others/HVPNL.

A.14.13 MS, NRPC directed HVPNL to increase the patrolling frequency of lines and may replace the insulators as per requirement. He conveyed that the availability for the above outage of ICT would be examined by NRPC Secretariat as per CERC Tariff Regulation, 2024 considering above discussion.

A.14.14 Subsequently, POWERGRID representative sought direction of Forum to implement adaptive auto reclosure scheme to avoid multiple faults feeding operations that causes undesirable stress on their assets. Forum addressed POWERGRID to bring the agenda for the same with supporting historical data.

Decision taken by Forum:

Forum guided HVPNL to increase patrolling frequency of its lines and insulators may be replaced as per requirement to avoid multiple trippings.

A.15. Status of remedial actions recommended during 50th PSC meeting (agenda by NRLDC)

A.15.1 NRLDC representative apprised that as per discussion in 50th PSC meeting, necessary remedial actions were recommended based on the analysis and discussion of the grid events. Constituents were requested to share the details of actions taken and present status via mail to NRLDC and NRPC. However, details not received on mail. During the meeting constituents were requested to apprise the status of the same. Constituents informed following during the meeting:

a) **Grid disturbance in 220kV Kunihar, Baddi complex during Feb'24**

50th PSC recommendations: PSC forum deliberated that in view of multiple incidents of grid events in this complex, a committee may be constituted for third party protection audit of Kunihar, Baddi complex. HP may also proceed with the process of third-party protection audit and shall share the report of the audit. HP was also requested to plan for suitable SPS scheme in this complex to avoid complete outage of the complex during contingency.

HPSEBL representative informed that protection audit of 220kV Kunihar has been awarded and it would be completed within next 15-20 days. In next phase, by 15th September, protection audit of substations in downstream and upstream of 220kV Kunihar S/s would be completed.

HPPTCL representative informed that, downstream network of 220kV Kala Amb(HP) is almost ready and within next 25 days it would be connected to the grid. It would provide 80-90 MVA loading relief to the 220kV Kunihar S/s.

NRLDC representative requested HPSEBL to coordinate with STU and try to resolve the already identified issues at the earliest so that undesired multiple elements tripping may be avoided.

PSC Forum requested HP to complete the protection audit as per mentioned timelines and resolve the protection related issues. HP was also requested to

Annexure-XI

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

दिनांकः 29.11.2024

सेवा में,

1. ED, POWEGRID-NR2, Jammu
2. CGM, NRLDC, New Delhi – 110016
3. CE(TS), HVPNL, Panchkula, Haryana
4. CE (SO&C), SLDC, HVPNL, Panchkula, Haryana

Subject: Meeting to discuss regarding Transmission system Availability of 400/220/33KV, 315 MVA ICT-1 at Kaithal (PG) due to Sudden failure during external faults in 220kV Lines

A meeting was held on 20.11.2024 (03:00 PM) at NRPC, Katwaria Sarai, New Delhi – 110016 to discuss the Transmission system Availability of Sudden failure of 315 MVA ICT-1 at 400/220/33KV sub-station, Kaithal (PG) due to external faults in 220kV Lines of HVPNL. Minutes of the meeting are enclosed herewith.

Signed by Dharmendra Kumar Meena
Date: 29-11-2024 16:15:07

डी. के. मीना
निदेशक (संरक्षण)

Meeting to discuss regarding Transmission system Availability of 400/220/33KV, 315 MVA ICT-1 at Kaithal (PG) due to Sudden failure during external faults in 220kV Lines

MS, NRPC welcomed all the participants and briefed that this issue has been deliberated in OCC and PSC meetings. This separate meeting has been called to further deliberate in detail regarding sudden failure of 315 MVA ICT-1 at 400/220/33KV sub-station, Kaithal (PG). Further, he requested to brief the agenda.

1. AEE, NRPC stated that issue of sudden failure of 315 MVA ICT-1 at 400/220/33kV Kaithal (PG) due to external faults in 220kV lines of HVPN was briefly discussed in the 220th OCC meeting held in June, 2024 and further deliberated in 51st PSC meeting held in July, 2024. In the meetings, POWERGRID has submitted that in last 02 Years 23 nos. of line faults were observed in 220kV Lines of HVPNL, out of which 19 Nos. Line faults were in B Phase. POWERGRID claimed in the meeting that ICT had failed due to frequent B-N faults in 220 kV lines of HVPNL and requested to grant the availability for the outage period of the ICT as the same was failed due to external reasons.
2. POWERGRID highlighted that 17 out of 23 Line Faults were within 6kM from Kaithal (PG) and due to very low impedance, very high fault currents in the range of 21 kA to 25 kA have been observed. He stated that BDV results, Oil DGA results, tan delta results were found to be acceptable and inspection was also carried out with M/s CGPISL on 13.05.2024. He informed that OEM was also of view that failure may be due to external faults in 220kV Lines. A copy of presentation made by POWERGRID during meeting is enclosed as **Annexure – I.**
3. NRLDC enquired about the BDV results of ICT taken in May, 2024. He highlighted that CH_4 has been increased in September, 2021 and reduced in further tests. He enquired about the action taken to reduce CH_4 levels. It was also requested that MoM of meeting with OEM may also be shared. POWERGRID stated that information will be shared at the earliest.
4. HVPNL informed that frequent patrolling of the 220 kV lines is being done and trippings are discussed in their monthly meetings. He highlighted that most of the faults are of zone -1 that got cleared immediately and protection of the lines have been operated perfectly. He also informed that due to storm on

11.05.2024, earth wire was broken which led to trippings and highlighted that A/R attempts are normally taken as per protection philosophy only. He mentioned that there are 03 nos. of ICTs and fault current is fed by all, hence failure of any ICT may be possible.

5. POWERGRID stated that impedances of parallel ICTs are ideally same, but practically they are not. Further, impedance being seen by ICT also depends on connection and distance from Bus, CT, CVT etc. due to which major fault currents might have flown through ICT-1 only.
6. SE, NRPC highlighted that in the Standing Committee report of Experts on Failure of 220 kV & above voltage class equipment (April 2019 – December 2021, copy attached as **Annexure-II**) probable cause of Failure of 315 MVA, 400/220 kV ICT III at Allahabad Substation of PGCIL is mentioned as regular faults on 220 kV lines, due to which transformer insulation might have been weakened. It was also observed that in this case also prior to the failure, the transformer has endured approximately 14 Nos. through faults occurring on 220 kV lines in the past 18 months. The ICT was CGL make, commissioned in 2014 and failed in July, 2019.
7. He also highlighted that as per above Committee report (September 2015 – December 2016, **Annexure-III**) for the 315 MVA, 400/220/33 kV ICT- I at 400 kV Meramundali Grid substation of OPTCL, probable cause has been mentioned as flow of severe current in B phase and it appeared that the failure might have taken place due to failure of B-phase winding insulation or B phase HV bushing. The ICT was BHEL make, commissioned in 2005 and failed in November, 2016.
8. MS, NRPC stated that as per the above Standing Committee report of CEA, it may be inferred that in the past also frequent faults on a particular phase created stress on the insulation of winding, resulting into failure of the ICT. He further mentioned that due to high fault current, stress on insulation of transformer winding is created for brief moment till fault is cleared and generally causes no harm to the ICT. However, if the number of fault is more in a particular phase of ICT, frequent stress may damage the insulation and may lead to failure of ICT.
9. In the extant case, it is very difficult to pinpoint exact cause of failure but it appears that B phase ICT may have been damaged due to frequent faults in lines as similar failures already happened in the past also in different ICTs

across the country as concluded in the above Standing Committee Report of CEA. MS, NRPC asked for opinion of other members. All the participants also expressed that frequent fault on a particular phase may result in insulation damage and failure of ICT. He further enquired regarding provisions of regulations for grant of availability for such cases.

10. NRLDC informed that as per Appendix IV clause 6 sub clause (ii) of tariff regulations, outage caused by grid incident/disturbance are not attributable to the transmission licensee, e.g. faults in a substation or bays owned by another agency causing an outage of the transmission licensee’s elements, and tripping of lines, ICTs, HVDC, etc., due to grid disturbance. However, such elements need to be restored while normalizing the grid after instruction from RLDC within reasonable time, the element will be considered not available for the period of outage after issuance of RLDC’s direction for restoration. Hence, applicability of this clause for condoning this outage is not clear.

11. It was also informed that as per Appendix IV clause 6 sub clause (iii) outage period beyond one month and up to three months which can be excluded for the purpose of sub-clause (i) and (ii) of this clause shall be declared after the decision at RPC Forum. The total outage period as per the verified outage details of NRLDC is 764 hrs 35 mins (11.05.2024 00:51 to 11.06.2024 21:26) which is more than one month.

12. Representative of PowerGrid mentioned that in this case, restoration of element after RLDC instruction not applicable as ICT failed due to frequent external fault. However, Powergrid replaced the failed ICT within record time and made the system operation to original configuration. MS, NRPC stated that deemed availability for the above outage of ICT need to be examined further as per CERC Tariff Regulation, 2024. He requested POWERGRID to submit the details as discussed in the meeting.

Decision of the meeting:

a. All members agreed that frequent faults in 220 kV lines might be reason for failure of the 400/220/33KV, 315 MVA ICT-1 at Kaithal (PG) however exact reason can be concluded after detailed analysis by Standing Committee of CEA on Failure of 220 kV & above voltage class equipment.

b. *POWERGRID to submit BDV results of ICT taken in May, 2024, action taken to reduce CH_4 levels in September, 2021, MoM of meeting with OEM for further examination for deemed availability.*

c. *Since, total verified outage period is more than 30 days (and less than 3 months), deemed availability can be granted by NRPC Forum only. Accordingly, Powergrid, may submit the agenda to NRPC Secretariate for discussion in NRPC Forum.*

Meeting ended with vote of thanks to the Chair

List of Participants:

NRPC secretariat

1. Sh. V. K. Singh, Member Secretary, NRPC
2. Sh. D. K. Meena, SE(O), NRPC
3. Sh. Kaushik Panditrao, AEE, NRPC
4. Sh. Lokesh Agarwal, AEE, NRPC

POWERGRID NR-II

5. Sh. Shafat Ahmed, Sr. GM (AM I/C)
6. Sh. Jagat Ram, GM
7. Sh. Rakesh Kumar Gupta, CM

HVPNL

8. Sh. Amit Maan, Executive Engineer
9. Sh. Paramvir Singh, Executive Engineer
10. Sh. Akash Deep Sharma, Executive Engineer
11. Sh. Nikhil Garg, SDO/AEE
12. Sh. Sunil Kumar, SSE

NRLDC, Grid-India

13. Sh. Sunil Aharwal, GM
14. Sh. Mahavir Prasad Singh, Sr. DGM
15. Sh. Bikas Kumar Jha, DGM
16. Sh. Deepak Kumar, DM
17. Smt. Sugata Bhattacharya, DM
18. Sh. Mantoo Yadav, AM

Annexure - I

Failure of 400/220/33kV 315MVA ICT-1 on 11-05-2024 at Kaithal SS

1

History of transformer

400/220/33KV 315MVA , CGL Make

Date of Commissioning : 30.10.2005

Last AMP Done (Yearly AMP) : 15 March'2024

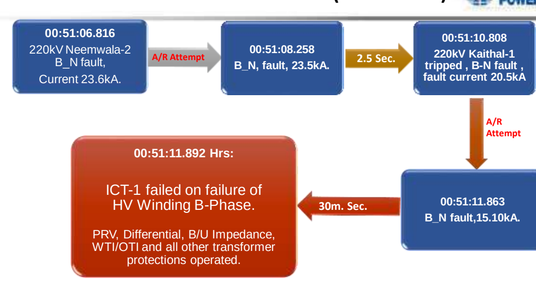
Date of Failure : 11.05.2024

2

Fault History

- 23 Line Faults in last 02 Years fed by Kaithal ICTs
- 19 out of 23 faults were B-N fault.
- 17 out of 23 Line Faults were with in 6KM
- Low Fault distance > low fault impedance > very high fault current(>21.0 A to 25.0KA).

EVENTS RESULTING IN ICT FAILURE(11.05.2024)



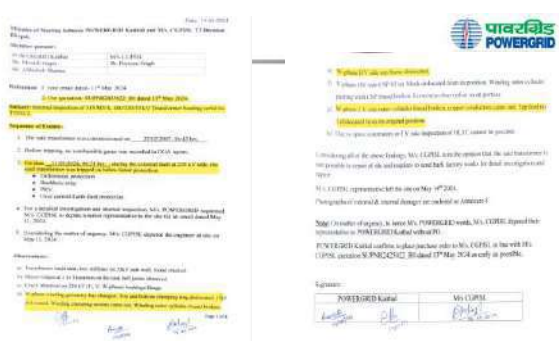
- Both Line faults were B-N Faults and ICT failure was also on B-N Fault

4

Inspection of ICT by OEM

Internal inspection by OEM and findings

- Transformer failed during external faults at 220KV Side
- W-Phase winding geometry changed.
- W-Phase Winding outer cylinder broken, CSP dislocated.
- W-Phase, HV side top frame dislocated.
- W- Phase LV side outer cylinder broken.



W-Phase winding geometry changed

Tripping of 400/220/33kV 315MVA ICT-1 on 11-05-2024

Previous communications with HVPNL

220KV Kaithal-1

Protection not operated at HVPNL end

Z-2 Fault with delayed fault clearance

Email — POKAITHAL powergrid

Req:- Non -operation of protetcion system / Circuit Breaker at HVPNL End for 220KV Kaithal- Kaithal Ckt-1

From : POKAITHAL <pgkaithal@powergrid.co.in> — Wed, May 27, 2020 01:17 PM

Subject : Req:- Non -operation of protetcion system/ Circuit Breaker at HVPNL End for 220KV Kaithal- Kaithal Ckt-1 — 1 attachment

To : xentstkl <xentstkl@hvpn.org.in>, sse220kvktl <sse220kvktl@hvpn.org.in>

Sir,

Please find attached DR wherein Fault current variation of 4.44 KA was observed in Y -N phase in 220KV Kaithal- Kaithal Ckt-1 and NO opening of Circuit Breaker is observed at HVPNL end inspite of occurance of such a Heavy Fault Current.

As Circuit Breaker Opened/ Operated at POWERGRID Kiathal end , after observance of Zone -2 timing tripping , please note that such type of incidence may create disturbance in Grid Stability , therefore, kindly analysis the non -operation of protetcion system as well as Circuit Breaker at your end please.

This is for your kind information & necessary action at your end with immediate effect please.

Regards
DGM - I/C
POWERGRID Kaithal

220KV Kaithal-1 PLCC Failure

Re: To check the functioning of auto reclosure and PLCC carrier protection at 400kv Substation PGCIL Khanpur, Kaithal so as to avoid the tripping of 220kV PGCIL (Kaithal)-Kaithal line occurred due to transient fault.

From : POKAITHAL <pgkaithal@powergrid.co.in> — Thu, Jan 07, 2021 07:02 PM

Subject : Re: To check the functioning of auto reclosure and PLCC carrier protection at 400kv Substation PGCIL Khanpur, Kaithal so as to avoid the tripping of 220kV PGCIL (Kaithal)-Kaithal line occurred due to transient fault.

To : Executive Engineer TS Kaithal <xentstkl@hvpn.org.in>

Cc : Superintending Engineer TS Karnal <setskrl@hvpn.org.in>, Substation Engineer <sse220kvktl@hvpn.org.in>

Dear Sir

PLCC Panel pertaining to M/s HVPNL, therefore, healthiness of same shall be ensured by M/s HVPNL itself, therefore, kindly confirm the same at your end please.

[illegible]

& kindly also provide recorded DR & Event logger details of M/s HVPNL-Kaithal SS end for further analysis at our end [illegible]

Matter may please be treated on URGENT basis please.

Regards
DGM, Kaithal

220KV Kaithal-1 PLCC mal-operation

Regarding receiving of DT (Direct Trip) of 220kV Kaithal PGCIL Ckt-1

From : PGKAITHAL <pgkaithal@powergrid.co.in> Wed, Feb 03, 2021 06:03 PM

Subject : Regarding receiving of DT (Direct Trip) of 220kV Kaithal PGCIL Ckt-1 1 attachment

To : Executive Engineer TS Kaithal <xentsktl@hvpn.org.in>, Substation Engineer <sse220kvcheeka@hvpn.org.in>

Cc : shriamitkumar DGM Kaithal <shriamitkumar@powergridindia.com>

Sir,

Please see attached DR , wherein 220kV Kaithal - Cheeka Ckt-1 tripped on **DT received from Cheeka S/s End** on dated 03.02.21 Time 17:23 Hrs . Copy of DR is also enclosed for your kind reference.

Since, **PLCC panel of M/s HVPNL has auto generated the DT Trip**, which was cause for tripping of CB (Circuit Breaker) at POWERGRID Kaithal SS end Only.

In context of above, your are requested to kindly depute the concerned executive to rectify the same at the earliest , besides that **Carrier Receiving Alarm is also continuously persisting on 200kV Kaithal - Cheeka- Ckt-2** at POWERGRID Kaithal end.

Matter be treated on TOPMOST priority for the healthiness of system please.

With Regards
Amit Kumar
DGM Kaithal SS

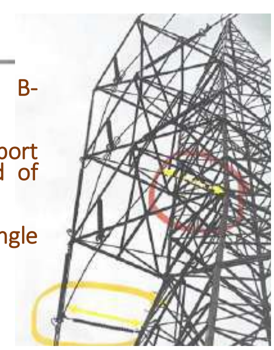
Correspondance with HVPNL REGARDING Line Faults

Problem still persisting

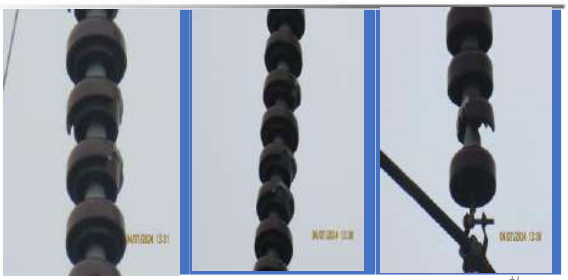
- Frequent Faults with fault current as high as 25KA
- Lines are properly maintained as per HVPNL
- We carried out patrolling of HVPNL Lines upto 6 KM from Kaithal Substation and following were the observations

15

- 220KV Neembali-1&2 Lines
- Less jumper clearance in B-Phase
- Only 01 Horizontal support insulator provided instead of 02
- Problem persisting in all Angle towers



220KV Kaithal 1 &2 Lines



27th TCC and 30TH NRPC MOM :

27th TCC & 30th NRPC Meetings (27th and 28th Feb, 2014) - Minutes

B.4.2.2 He stated that it was also observed that flashovers had taken place at many locations where conventional insulators had been replaced with anti-fog insulators. Based on discussions in the special meetings, the OCC in its meeting held on 17.02.2014 recommended following proposals for approval of TCC/NRPC :

(i) Utilities would take necessary steps such as replacement of conventional insulators with polymer insulators and cleaning of porcelain insulators in already known and newly identified areas to avoid tripping of lines in next winter.

(ii) If cleaning is to be carried out through outsourcing, the bidding process shall be so timed that orders are placed on or before end of September 2014.

(iii) In future all new transmission lines in plain areas would be built with polymer insulators only and also existing anti-fog insulators would be replaced with polymer insulators in phased manner

Actual cause of fault

Date of commissioning of Lines :

- 220KV Kaithal-1 : 30.10.2005
- 220KV Kaithal-2 : 28.11.2005
- 220KV Cheekha-1: 30.10.2005
- 220KV Cheekha-2 : 28.11.2005

- Issue of replacement of Porcelain insulators with polymer insulators has been discussed a nos of times in previous OCC, NRPC & TCC meetings.

Final submission

- ICT Has Completed 19 Years of useful life against life of 25 Years as per CERC regulations
- Financial implication for New ICT Commissioned = 21.50 Crore
- There is no additional financial implication on HVPNL due to above availability certification

Thank you

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220KV Fault summary in SEB Lines in last 02 Years

Sr. No.	Line name	Date	Time	Fault Type	Fault distance	Fault Current (kA)
1	220KV Neemawala 2	01.06.2024	16:46:50:223	B-G	900 Meter	21.1
2	220KV Neemawala 1	01.06.2024	16:46:50:222	B-G	700 Meter	21.5
3	220KV Neemawala 2	11.05.2024	00:51:06:827	B-G	900 Meter	23.2
4	220KV Kaithal-1	11.05.2024	00:51:10:818	B-G	600 Meter	20.2
5	220KV Kaithal-2	13.02.2024	04:43:22:023	B-G	15.6KM	4.7
6	220KV Kaithal-1	13.02.2024	04:43:21:524	B-G	18.5KM	4.6
7	201L Cheeka-1	13.10.2023	22:52:25:785	RG	2.1KM	16.7
8	220KV Neemawala 1	05.07.2023	14:40:15:547	Y-G	23.0KM	4.8

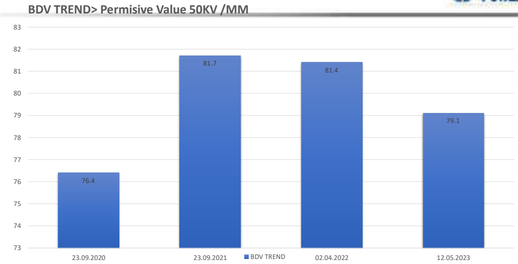
220KV Line Fault summary at Kaithal in last 02 Years

Sr. No.	Line name	Date	Time	Fault Type	Fault distance	Fault Current (kA)
9	220KV Neemawala 1	24.05.2023	03:51:54:438	B-G	1.9kM	22.9
10	220KV Neemawala 2	24.05.2023	03:51:43:118	B-G	6.4kM	23.5
11	220KV Cheeka-2	18.05.2023	00:54:10:377	YB-G	1.8kM	Iy=17.5 Ib=17.4
12	220KV Neemawala 2	18.05.2023	00:31:04:020	B-G	5.6kM	23.1
13	220KV Neemawala 1	18.05.2023	00:34:09:296	B-G	11.7kM	10.6
14	220KV Kaithal-2	13.05.2023	10:27:33:798	B-G	6.1kM	10.2
15	220KV Kaithal-2	20.12.2022	03:29:52:470	RG	10.3kM	8.3
16	220KV Cheeka-2	19.12.2022	05:13:17:427	BG	15.8kM	7.9

220KV Line Fault summary at Kaithal in last 02 Years

Sr. No.	Line name	Date	Time	Fault Type	Fault distance	Fault Current (kA)
17	220KV Cheeka-2	23.08.2022	00:20:04:725	RYG	100Meter	22.6
18	220KV Neemawala 2	17.06.2022	04:00:57:425	BG	5.6kM	24.2
19	220KV Neemawala 2	23.05.2022	19:52:04:878	BG	5.7kM	23.4
20	220KV Neemawala 1	23.05.2022	19:53:03:349	BG	2.0kM	23.4
21	220KV Neemawala 2	23.05.2022	03:25:47:548	BG	5.4kM	24.4
22	220KV Neemawala 2	14.04.2022	18:03:56:426	BG	5.2kM	25.0
23	220KV Neemawala 1	14.04.2022	18:03:57:900	BG	2.0kM	24.8

BDV TREND> Permisive Value 50KV /MM

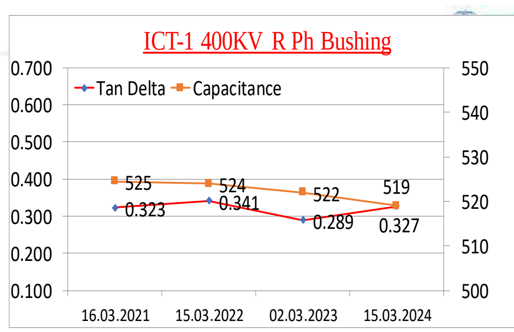


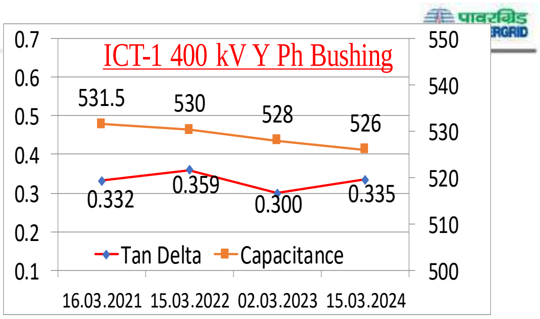
Transformer Oil DGA Results

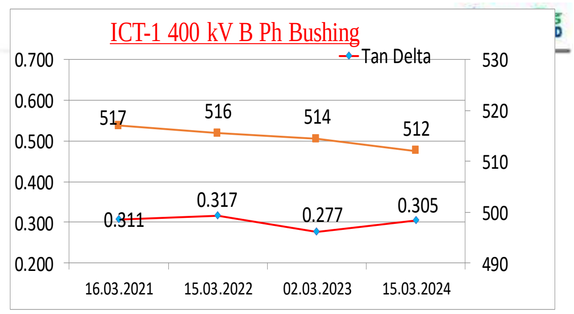
Sr. No.	Description	Sample date	H2	CH4	C2H4	C2H6	C2H2	Remarks
1	Kaithal- ICT-1	11-05-2024	1364	12	974	174	1928	After Fault
2	Kaithal- ICT-1	10-05-2024	4	18	15	6	0	Before Fault
3	Kaithal- ICT-1	30-03-2024	0	14	16	6	0	Before Fault
4	Kaithal- ICT-1	28-11-2023	0	25	18	6	0	2023
5	Kaithal- ICT-1	12-06-2023	0	18	15	6	0	2023
6	Kaithal- ICT-1	14-03-2023	5	15	18	6	0	2023
7	Kaithal- ICT-1	26-09-2022	9	18	25	9	0	2022
8	Kaithal- ICT-1	02-04-2022	0	16	14	6	0	2022
9	Kaithal- ICT-1	23-09-2021	6	974	18	6	0	2021
10	Kaithal- ICT-1	20-03-2021	4	15	12	4	0	2021

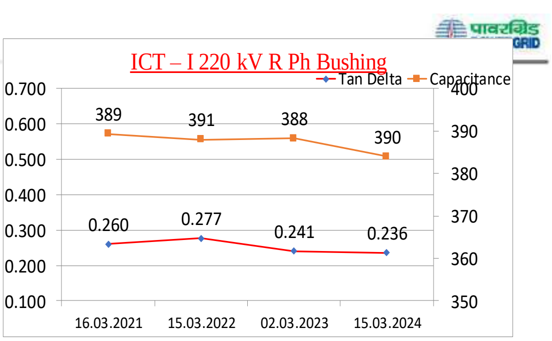
CC-CL IR MEASUREMENT

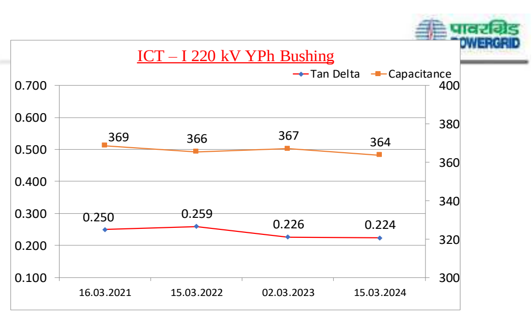
Measurement Position	DOM-15.03.2022	DOM-15.03.2024
CC-G	950 MΩ	960 MΩ
CL-G	1000 MΩ	1012 MΩ
CC-CL	980 MΩ	995 MΩ




ICT-1 400 kV Y Ph Bushing
0.7
0.6
0.5
0.4
0.3
0.2
0.1
550
540
530
520
510
500
531.5
530
528
526
0.332
0.359
0.300
0.335
Tan Delta
Capacitance
16.03.2021
15.03.2022
02.03.2023
15.03.2024


ICT-1 400 kV B Ph Bushing
Tan Delta
0.700
0.600
0.500
0.400
0.300
0.200
530
520
510
500
490
517
516
514
512
0.311
0.317
0.277
0.305
16.03.2021
15.03.2022
02.03.2023
15.03.2024


ICT – I 220 kV R Ph Bushing
Tan Delta
Capacitance
0.700
0.600
0.500
0.400
0.300
0.200
0.100
400
390
380
370
360
350
389
391
388
390
0.260
0.277
0.241
0.236
16.03.2021
15.03.2022
02.03.2023
15.03.2024


ICT – I 220 kV YPh Bushing
Tan Delta
Capacitance
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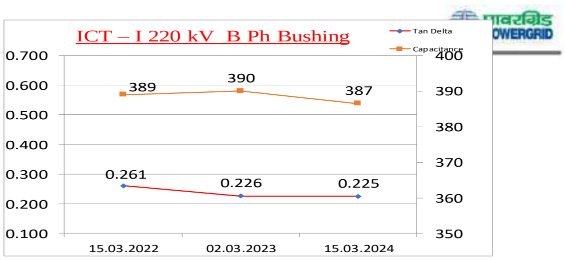
0.600
0.500
0.400
0.300
0.200
0.100
400
380
360
340
320
300
369
366
367
364
0.250
0.259
0.226
0.224
16.03.2021
15.03.2022
02.03.2023
15.03.2024


ICT – I 220 kV B Ph Bushing
Tan Delta
Capacitance
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0.600
0.500
0.400
0.300
0.200
0.100
400
390
380
370
360
350
389
390
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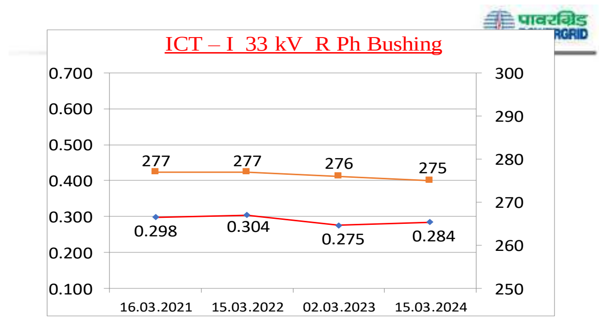
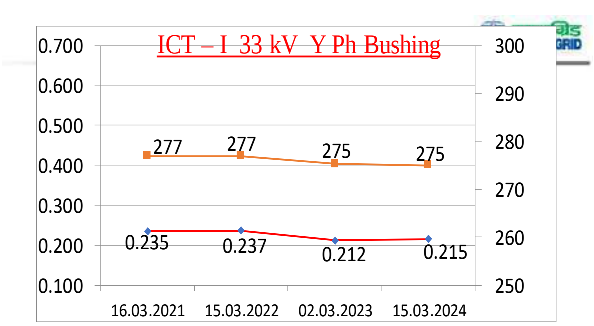
0.261
0.226
0.225
15.03.2022
02.03.2023
15.03.2024


ICT – I 33 kV R Ph Bushing
0.700
0.600
0.500
0.400
0.300
0.200
0.100
300
290
280
270
260
250
277
277
276
275
0.298
0.304
0.275
0.284
16.03.2021
15.03.2022
02.03.2023
15.03.2024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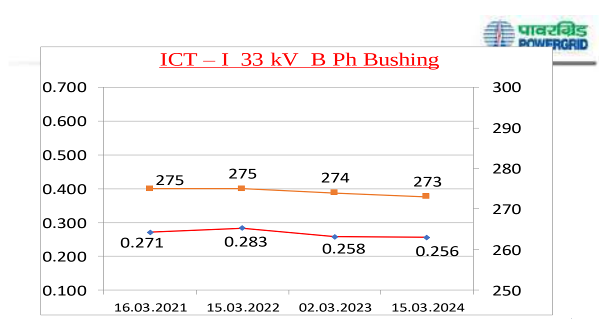
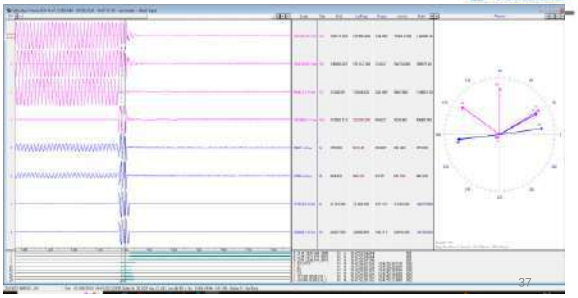
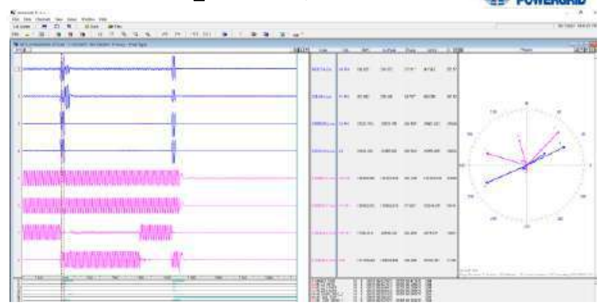
0.600
0.500
0.400
0.300
0.200
0.100
300
290
280
270
260
250
277
277
275
275
0.235
0.237
0.212
0.215
16.03.2021
15.03.2022
02.03.2023
15.03.2024


ICT – I 33 kV B Ph Bushing
0.700
0.600
0.500
0.400
0.300
0.200
0.100
300
290
280
270
260
250
275
275
274
273
0.271
0.283
0.258
0.256
16.03.2021
15.03.2022
02.03.2023
15.03.2024

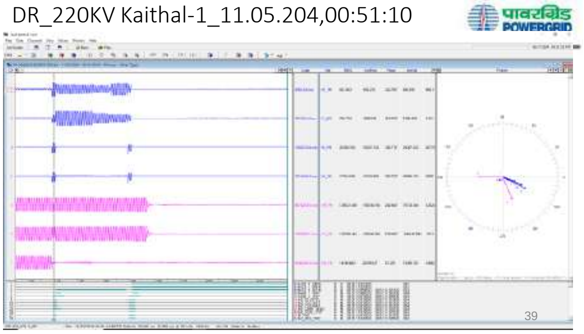
DR_Neemawali_1-01.06.2024, 16:47:52:222



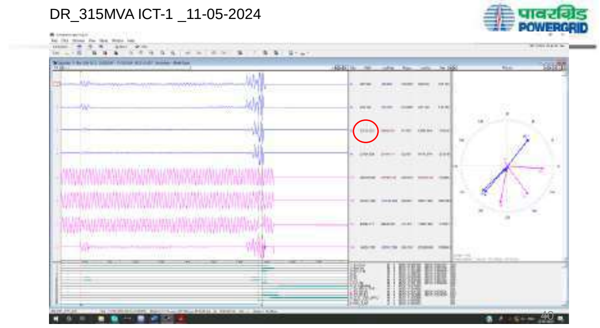
220KV Neemawali 2_11.05.2024, 00:51:06.816



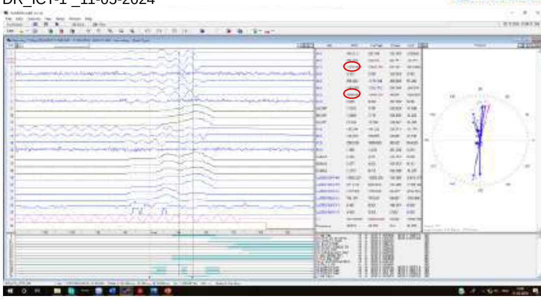
DR_220KV Kaithal-1_11.05.204,00:51:10



DR_315MVA ICT-1 _11-05-2024



DR_ICT-1 _11-05-2024



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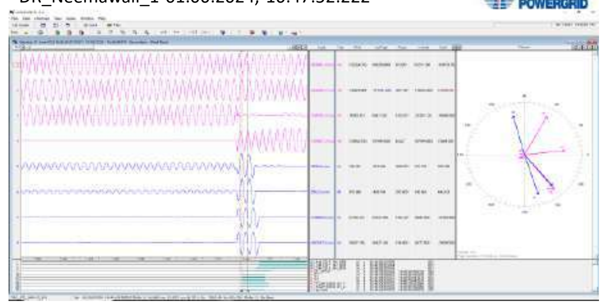
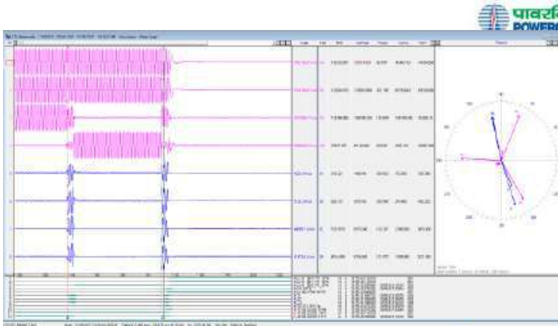
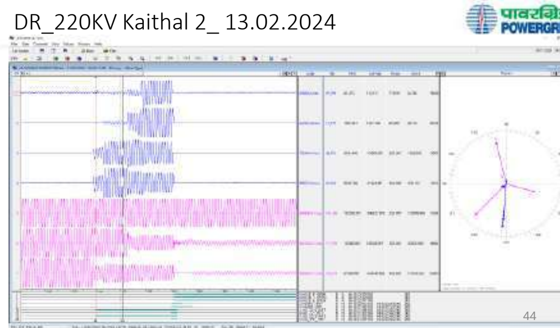


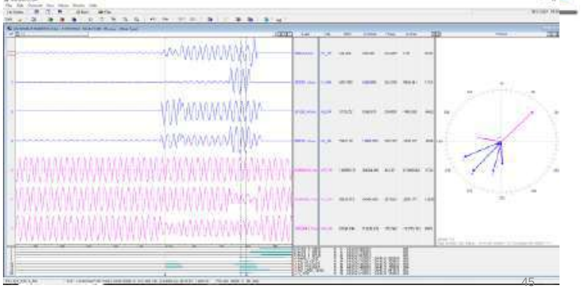


DR_220KV Kaithal 2_ 13.02.2024

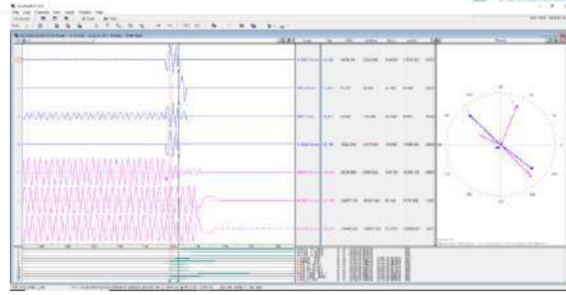


44

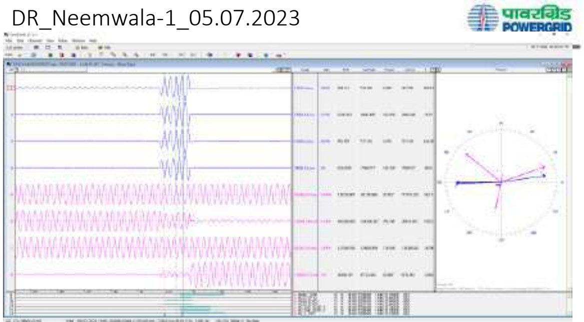
DR_Kaithal_13.02.2024



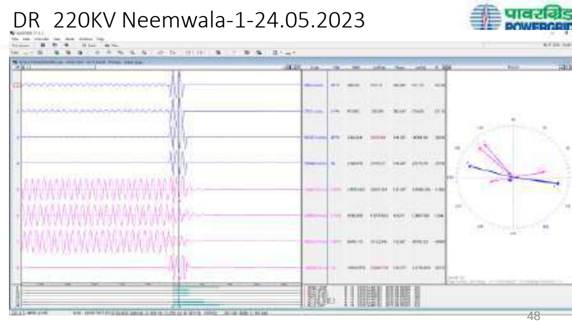
DR_Cheekha-1_13.10.2023

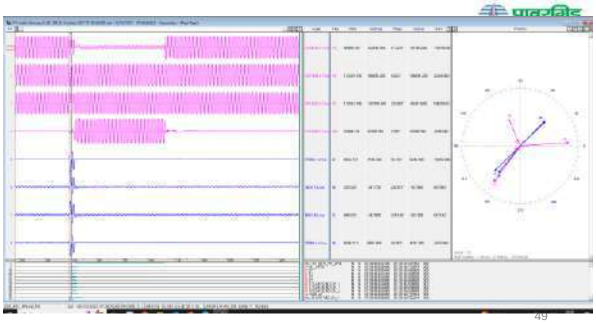


DR_Neemwala-1_05.07.2023

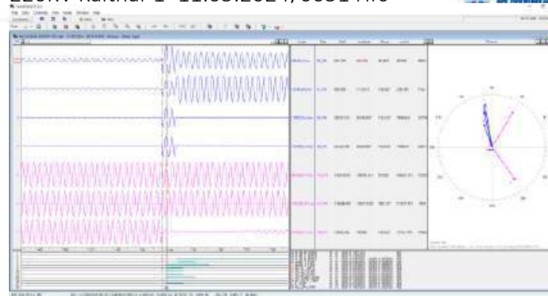


DR_220KV Neemwala-1-24.05.2023





220KV Kaithal-1 11.05.2024, 0051 Hrs



• Coil supporting plateform

Failure of 400/220/33kV 315MVA ICT-1 on 11-05-2024

- Details of other protection operated
  - 00:51:11.892 ICT-1 PRV trip
  - 00:51:11.893 ICT-1 Differential trip
  - 00:51:11.922 ICT-1 HV IN>2 trip (B/U Imp)
  - 00:51:11.986 ICT-1 WTI trip
  - 00:51:11.998 ICT-1 OTI trip

- Full load current of ICT
- 315MVA ICT HV Side Full load Current=454A
- 315MVA ICT, IV Side full load Current=827A
- 500MVA ICT, HV Full load current=721A
- 500MVA ICT, IV Full load current=1313A
- % Impedance=12.5%
- Maximum Fault current ICT can Feed:
- 315MVA ICT, 220 V Side= 5.7KA
- 500MVA ICT, 220 V Side= 10.5kA

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Associated tripping at Kaithal SS on 11.05.2024

8.	Name of the tripped elements & time of tripped elements	ICT-1 Tripped Time 00:51:11:861 Hrs. Dated 11.05.2024					
		220kv Neemwala Ckt-2 Time 00:51:06:827 Hrs Date 11.05.2024		220kv Kaithal Ckt-1 Time 00:51:10:823 Hrs Date 11.05.2024		315 MVA ICT-1 Time 00:51:11:861 Hrs Date 11.05.2024	
		Relay Flag	Annunciation Facia Flag	Relay Flag	Annunciation Facia Flag	Relay Flag	Annunciation Facia Flag
		AR optd Bph fault Ib=23.76kA Dist.=873.6m SOTF optd at 00:51:07:308 Ib=24kA	M1 and M2 OPTD 21 AR optd AR LO SOTF	AR optd Bph fault Ib=20kA Dist.=625m SOTF optd at 00:51:11:882 Ib=20kA	M1 and M2 OPTD 21 AR optd AR LO SOTF	Diff optd ,86A/B optd, Buch trip, OTI trip, PRV1/2 trip, OTI alarm, WTI alarm, OLTC surge trip, buchholz alarm	Diff optd ,86A/B optd, Buch trip, OTI trip, PRV trip, OTI alarm, WTI alarm, OLTC surge trip, buchholz alarm
	Reason	220kv Kaithal ckt-1 and 220kV Neemwala ckt-2 line auto reclose and tripped on reclaim time/SOTF due heavy storm conditions at Kaithal area				Due to multiple tripping at 220kv line and heavy through fault current feed by ICT-1 jerk/Mechanical vibration observed	

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Porcelain insulators in 220KV Kaithal and Cheekha

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ICT Value


Re: Petition link for Rihand Stage -II

Dear Sir,

ICT at Kaithal S/s

Asset	Asset Class	Quantity	Base Unit of Measure	Asset Description	Capitalized on	Gross Value	Dep	Net Value as on 30.09.24
[illegible]	101013	1	NO	AUTO TRANSFORMER NE	30-10-2008	[illegible]	[illegible]	[illegible]

With thanks and regards

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Annexure - II

220 केवी और उससे अधिक वोल्टेज वर्ग सबस्टेशन उपकरणों की विफलता पर विशेषज्ञों की स्थायी समिति की रिपोर्ट (अप्रैल 2019 - दिसंबर 2021)

REPORT OF STANDING COMMITTEE OF EXPERTS ON FAILURE OF 220 kV & ABOVE VOLTAGE CLASS SUBSTATION EQUIPMENT

(APRIL 2019 - DECEMBER 2021)

Government of India
Central Electricity Authority
Ministry of Power
New Delhi

(In fulfillment of CEA's obligation under Section 73(1) of the Electricity Act, 2003)

2. **Failure Report of 315 MVA, 400/220 kV ICT III at Allahabad Substation of PGCIL**

A.	Name of Substation	:	Allahabad
B.	Utility/Owner of substation	:	PGCIL
C.	Faulty Equipment	:	ICT
D.	Rating	:	315 MVA, 400/220 kV
E.	Make	:	CGL
F.	Sr. No.	:	T10319/1
G.	Year of manufacturing	:	2013
H.	Year of commissioning	:	2014
I.	Date and time of occurrence/discovery of fault	:	07.07.2019 at 0751 hrs
J.	Information received in CEA	:	04.09.2020
K.	Fault discovered during	:	Operation
L.	Present condition of equipment	:	Not repairable
M.	Details of previous maintenance	:	Carried out as per utility's norms and results were within permissible limits
N.	Details of previous failure	:	No previous failure
O.	Sequence of events/ Description of failure	:	On 07.07.2019 at 0751 hrs, the ICT tripped with the following indications and caught fire: 07:51:44:977: General trip 07:51:44:977: Differential trip operated 07:51:44:977: REF operated 07:51:45:028: PRD operated 07:51:45:036: Backup O/C operated 07:51:45:061: 400 kV and 220 kV CB tripped 07:51:45:071: Buchholz trip
P.	Details of Tests done after failure	:	No tests could be conducted as the transformer caught fire.
Q.	Observations	:	Internal flashover resulted in bursting of main tank near bolted joints. OLTC, stiffeners etc. were completely burnt. Winding insulation was also burnt entirely. Prior to the failure, the transformer has endured approximately 14 Nos. through faults occurring on 220 kV lines in the past 18 months.
R.	Probable cause of failure	:	Operation of differential relay and buchholz alarm indicates internal fault. Due to regular faults on 220 kV lines, the transformer insulation might have been

			weakened. As the transformer had caught fire it is not possible to assess the internal condition of the transformer.

Annexure - III

२२० के वी एवं उच्चतर विभव के सबस्टेशनों के क्षतिग्रस्त उपकरणों पर विशेषज्ञों की स्थायी समिति की रिपोर्ट

(सितम्बर २०१५-दिसंबर २०१६)

REPORT OF STANDING COMMITTEE OF EXPERTS ON FAILURE OF 220 kV & ABOVE VOLTAGE CLASS SUBSTATION EQUIPMENT
(SEPTEMBER 2015-DECEMBER 2016)

भारत सरकार

Government of India

केन्द्रीय विद्युत प्राधिकरण

Central Electricity Authority

विद्युत मंत्रालय

Ministry of Power

नई दिल्ली

New Delhi

(विद्युत अधिनियम २००३ की धारा ७३(एल) के तहत के.वि.प्रा. के दायित्व का निर्वहन करते हुए)

(In fulfillment of CEA's obligation under Section 73(1) of the Electricity Act, 2003)

			3) Transformer oil sample were sent for testing on 22.04.2015 and test results were normal. 4)Transformer bay maintenance was done on 28.02.16
N.	Details of previous failure	:	None
O.	Sequence of events/ Description of failure	:	On 02.06.16 at 0315 hrs, 400 kV bushing of R phase auto transformer of ICT2 bank flashed over and strong fire emanated. ICT2 tripped on following relays: differential relay, buchholz relay R-ph, PRD trip R-ph, OSR R-ph, winding temp trip and oil temp trip. Fault current on HV side is recorded as 15352 A and LV side 2198 A.
P.	Details of Tests done after failure	:	None, as transformer is completely burnt.
Q.	Probable cause of failure	:	Operation of buchholz, PRD, OSR, WTI & OTI trip indicates that high energy discharge might have took place inside transformer which caused pressure rise in the tank. Failure of bushing causing arcing inside transformer followed by oil leakage from bushing might have resulted in fire. Internal inspection of transformer is required to assess the condition of the winding & the core and to ascertain the exact cause of failure.

18. Failure of 315 MVA, 400/220/33 kV ICT- I at 400 kV Meramundali Grid substation of OPTCL.

A.	Name of Substation	:	400 kV Meramundali Grid Substation
B.	Utility/Owner of substation	:	Odisha Power Transmission Corporation Ltd.
C.	Faulty Equipment	:	Auto Transformer
D.	Rating	:	315 MVA, 400/220/33 kV
E.	Make	:	BHEL, Bhopal
F.	Sr. No.	:	6005742
G.	Year of manufacturing	:	2002
H.	Year of commissioning	:	2005 (May 31st)

I.	Date and time of occurrence/discovery of fault	:	12.11.2016@ 23:11 hrs
J.	Information received in CEA	:	13.12.2016
K.	Fault discovered during	:	Operation
L.	Present condition of equipment	:	Completely damaged
M.	Details of previous maintenance	:	Measurement of Insulation Resistance, Capacitance & Tan delta on bushings and windings on 0.3.03.15; oil testing including DGA on 19.05.16 and leakage current measurement of LA on 31.01.15 were carried out and results were found to be in order.
N.	Details of previous failure	:	Nil
O.	Sequence of events/ Description of failure	:	On 12.11.2016 at 23:11 hrs., a loud sound was heard accompanied by tripping of both sides CBs of the ICT. with following relay indications: 1. Differential relay 2. High set over current & earth fault relay at LV and HV sides 3. REF relay 4. PRV 5. Buchholz relay 6. WTI 7. OTI HV & LV bushings burst and all LAs on both HV & LV sides were damaged. B phase HV side caught fire, which further spread to entire ICT. Fault current of 31.251 kA in 400 kV side (B phase) and 5.35 kA in 220 kV side (B-phase) was recorded in disturbance recorder of differential relay. The fire was contained through water and foam tenders in six hours. At the time of failure, the load on the transformer was 100 MW.
P.	Details of Tests done after failure	:	There was extensive damage to the main tank, bushings, windings, core and other accessories; hence, no test could be done.

Q. Observations :

a) The ICT was found with huge damage in main tank, core, winding including all its accessories like conservator, pipe work, headers, A-frame, radiator and fans which were burnt due to excessive fire.
b) The main tank foundation was also found damaged with few cracks in the concrete and cooling bank foundation was completely damaged. The MS channel embedded with rails was found dislodged from foundation.
c) All windings were burnt exposing bare copper shrunk towards the bottom. The core was burnt, damaged & dislodged and was found lying on the bottom in the tank.
d) All 400 kV, 220 kV, 33kV & Neutral bushings were found completely damaged. All OLTC were damaged and burnt. One tank stiffener below the IV-B phase was dislodged from the main tank and had flown around 25 m away from ICT.
e) All LAs of 220 kV side and 400 kV side were damaged. However, counters of only 400 kV side LAs were found burnt. The counter reading of R-phase 220 kV side LA showed one increment from pre-fault reading.
f) The Pre-fault temperature of ICT were seen and found normal.
g) Differential relay was not synchronized with GPS clock.
h) Transformer was manufactured in 2002 and commissioned in 2005. During this period how transformer was stored or maintained is not known.

R. Probable cause of failure : From the operation of Differential, REF, O/C & E/F relays and flow of severe current in B phase it appears that the failure might have taken place due to failure of B-phase winding insulation or B phase HV bushing. Flow of severe current in windings might have led to rise in winding & oil temperature and operation of WTI & OTI Trip. High energy arcing due to fault might have led to sudden pressure rise in tank and tripping of Buchholz & PRV. Oil attained temperature beyond fire point and contacted fire after coming in contact with the oxygen through cracked tanks.

Annex - A(1)

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Summary record of the 16th Standing Committee Meeting on Transmission System Planning in Northern Region held in NREB on 24.03.04

List of the participants annexed.

Welcoming the participants of the meeting, Chief Engineer (SP&PA) thanked MS(NREB) for arranging the meeting at a short notice. He stated that the agenda for the meeting mostly covers the transmission system from the hydro projects of Northern Region. He stated that many hydro projects in Uttaranchal, Himachal Pradesh and J&K were being envisaged, for benefits in the 11th plan/ early 12th plan time frame. CEA was in the process of framing a master plan for evolving the transmission system from these generation projects so that phased development of transmission system for evacuation of power from generating projects can be taken up, so as to dovetail into ultimate transmission system planning for Northern Region. He asked Director (SP&PA) to proceed with the agenda items.

Item No. 1 - Evacuation system from Chamera III HEP

Director (SP&PA) stated that Chamera III (231 MW) would be located adjacent to existing stages of Chamera I and Chamera II in Ravi Basin. Besides Chamera III other contemporary hydro project like Kutehar (260 MW), Bharmour (45 MW), Kugti (45 MW), Budhil (70 MW) in the upstream of Chamera III were also envisaged in the Ravi Basin. Power from Chamera III was proposed to be evacuated at 220 kV.

He stated that three alternative system as indicated in the agenda were considered for evacuation of power from Chamera III. In alternative I pooling point near Chamera III and 400 kV therefrom to Jullundhar was proposed. The pooling point was also proposed to be connected to Chamera II at 400 kV. In alternate II 220 kV evacuation upto Hamirpur and there after evacuation through existing 220 kV Hamirpur – Jullundher lines was proposed. In alternate III 220 kV evacuation upto pooling point near Hamirpur and 400 kV lines thereafter to Jullundhar was proposed. Of these option Alternative-3 was considered to be better option due to the following reasons:-

(i) Difficulty in locating of adequate/.suitable land for construction of pooling point in hilly region.

(ii) Interconnection of Chamera III with the existing stages of Chamera would create deloading of the existing Kishenpur – Moga 765 kV line operated at 400 kV.

(iii) Considering the number of projects envisaged in Ravi basin a 400/220 kV pooling point was required to be established which would serve the purpose of evacuation of power from Ravi as well as Beas basin projects.

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(iv) Evacuation at 400 kV from pooling point in hills to the load center would create an over voltage/stability problem due to long line length and less load absorbtion capacity in the nearby area.

(v) With 220 kV evacuation option as per alternative II, the requirements for future projects of HP would call for additional network, leading to sub-optimal devlopment.

He stated that considering the above facts a 400/220 kV pooling point near Hamirpur had been envisaged, the location of which was to be finalised depending on the alignment of the line crossing of Chamera to Jullundhar viz-a-viz Parbati III to Amritsar line. He stated that with the commissioning of other upstream Ravi basin hydro projects, Kuther would be interconnected with Chamera III by SC line and 220 kV D/C line from Kutchar would be taken to Hamirpur pooling point. The Hamirpur – Jullandhar section charged at 220 kV with Chamera III would then be charged at 400 kV.

Addl. SE (Planning), HPSEB stated that other hydro projects like Hadsar (60 MW), Kugti (45 MW), Chamba (125 MW) and Baratunga (200 MW) were also envisaged in the same basin and these should also be consider to ascertain the adequacy of the transmission system. Director (SP&PA) stated that the projects upstream of Chamera III considered in the study were taken based on the information given by HPSEB earlier and if the projects being indicated by HPSEB were also envisaged then the 220kV line from Kutehar to Hamirpur could be constructed with Quad conductor.

Chief Engineer, RVPNL stated that the system envisaged from Chamera III indicates strengthening of the transmission portion upto Hamirpur / Jullandhar. However, further strengthening of the transmission system beyond Jullandhar had not been shown. Chief Engineer (SP&PA) stated that the studies were conducted for all India basis considering the requirement for evacuation of power from the generation projects as well as Regional and intra/inter regional transmission requirements. Wherever strengthening required was either covered as a part of works under strengthening of transmission system or evacuation system with other projects of Northern Grid. The existing transmission system beyond Jullandhar was adequate for evacuation of power from Chamera III as well as other projects envisaged in that valley. As such, no further strengthening of the transmission system beyond Jullandhar would be required.

Concluding the discussion Chief Engineer (SP&PA) stated that following system were recommended with Chamera III/ Kutchar HEP.

Transmission system associated with Chamera III

- Generation of Chamera III power at 220 kV level
- Creation of 400/220 kV pooling point near Hamirpur at suitable location.
- Chamera III – Hamirpur pooling point 220 kV D/C line with 2x0.5 conductor
- Additional 1 no. 220 kV bay at Chamera III for 220 kV S/C line from Kutchar
- Hamirpur – Jullandher 400 kV D/C line(operated at 220 kV)

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- POWERGRID to locate and purchase requisite land for Hamirpur S/S corresponding to requirement of 400 kV S/S

Transmission system from Kutehar

- Kutehar – Hamirpur 220 kV D/C with 2x0.5 conductor
- Kutehar – Chamera III 220 kV D/C with 2x0.5 conductor bunched into S/C
- Additional 2 nos. 220 kV bays at Kutehar for 220 kV lines from upstream projects
- LILO of Parbati Amritsar 400 kV D/C line at Hamirpur Pooling Point
- 400 kV operation of Hamirpur – Jullundhar D/C line

The members of the committee agreed for the proposal.

Item 2 - Power Evacuation system associated with Parbati-II (800 MW) and Koldam HEP(4x200 MW)

Director (SP&PA) stated that the evacuation system from Parbati II – Koldam HEP were agreed in the 14th Standing Committee Meeting wherein following evacuation system were envisaged.

Parbati II

- Parbati II to Koldam site 2xS/C with Quad Conductor

Koldam HEP

- Koldam – Nalagarh 400 kV D/C with Quad Conductor
- 400 kV Koldam – Ludhiana 400 kV D/C line with triple conductor
- 2 nos. of 400 kV bay for Koldam – Nalagarh/Parbati II lines.

System under northern region strengthening scheme
400 kV S/S at Ludhiana with 3x315 MVA ICT

He stated that the system envisaged in 14th Standing Committee Meeting considered commissioning of Koldam HEP ahead of Parbati II HEP. However subsequent indication was that, Parbati II was expected during 2007-08 time frame while Koldam was expected around 2008-09 time frame. Considering the uncertainty in the commissioning programme of the hydro projects, the following was suggested.

Transmission system common to Parbati II and Koldam which is to be programmed for commissioning matching with whichever comes first:

- Koldam – Nalagarh 400 kV D/C line with Quad conductor
  (in this, the provision for 400kV bays is to be kept for Nalagarh end only. The bays at other end get covered under Koldam or Parbati-II HEP)

Transmission System for Koldam HEP

- 2 nos. 400kV bays for Koldam-Nalagarh/Parbati-II lines.
- Koldam – Ludhiana 400 kV D/C line with Triple 'Snowbird' conductor

Transmission System for Parbati-II HEP

- Parbati II – Koldam 400kV 2xS/C lines with Quad conductor.
  (in this, the provision for 400kV bays is to be kept for Parbati-II end only. The bays at Kaldam/Nalagarh ends get covered under Koldam/ Common works)

The members of the standing committee agreed with the proposal.

DGM, POWERGRID stated that their study indicates that Koldam - Ludhiana line might not required to be constructed with triple conductor as twin conductor would be adequate and it would incur saving in the cost of transmission line. Director (SP&PA) stated that as suggested by DGM, POWERGRID the Koldam – Ludhiana could be constructed with twin conductor instead of triple conductor as envisaged earlier.

Item 3 - Evacuation system from Parbati III HEP (520 MW)

Director (SP&PA) stated that for evacuation of power from Parbati III HEP, a 400 kV S/C line between Parabti III and Parabti pooling point was considered and one of the line from Parbati to Koldam D/C line was to be LILOed at Parbati pooling point. Further from Parbati Pooling point 400 kV D/C line to Amritsar was envisaged. In view of serious R-O-W constraint experienced in the Parbati valley, it had been proposed to LILO both the circuits from Parbati III to Koldam at Parbati pooling point and dispensing with the additional circuit from Parbati III - Parbati pooling point. He further stated that for further evacuation of power 400 kV D/C line from Parbati Pooling point - Amritsar was proposed.

After deliberation, Chief Engineer (SP&PA) stated that following system were recommended with Parabti III HEP:-

(i) Stepping up the generation of Parbati III at 400 kV
(ii) Creation of 400kV pooling point at Parbati (**Panarsa**)
(iii) LILO of both line from Parbati to Koldam at Parabti Pooling point(**Panarsa**)
(iv) Parbati Pooling point - Amritsar 400 kV D/C line

The members of the Standing Committee agreed the above proposal

Item 4 - Evacuation system from Allain Dhuangan (192 MW) and Malana II (100 MW)

CE (SP&PA) stated that evacuation system with Allain Dhuangan /Malana II HEP was agreed in the 14th SCM of NR. However, due to some apprehension indicated by the promoters of the Allain Dhuangan /Malan II HEP regarding the availability of evacuation system matching with the commissioning of their projects a review meeting held on 23.02.04 in CEA with promoters of the company along with POWERGRID, NHPC as well as NTPC, discussed on the issue. In the meeting a view emerged that since Parbati II system would be available during the time frame of commissioning of Allain Dhuangan / Malana II projects so the power from these projects would be injected at Parbati pooling point and from there power would be evacuated to Northern Regional grid. The 220 kV transmission system from Allain Dhuangan/ Malana II and

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also 400/220 kV augmentation at Parbati pooling viz. including 400/220 kV ICTs, ICT bays on 400 kV side and total 220 kV switchyard would be at the cost of Allain Dhuangan/ Malana II project authorities and pooled wheeling charges for Northern Regional grid would be applicable for use of transmission system beyond Parbati Pooling point.

Item 5 - Power evacuation system from Koteshwar HEP

Director (SP&PA) stated that as a part of Tehri St I and Koteshwar HEP evacuation system, a 765/400 kV pooling point was to be created near Tehri and power from Koteshwar as well as Tehri Was to be pooled at Tehri pooling point. From Tehri pooling point power was to be stepped up at 765 kV and evacuated through Tehri – Meerut 765 kV 2xS/C line to the NR grid. However the creation of 765 / 400 kV pooling point in Uttaranchal hill had come under question as adequate land for creation of conventional 765/400 kV switchyard. Teams including officers from POWERGRID, CEA and THDC visited different sites and located land where GIS S/S could be constructed.

Accordingly the following evacuation system from and following system now proposed with Koteshwar HEP was being proposed.

- (i) Creation of 400 kV GIS pooling point by LILO of Tehri – Meerut 765 kV 2xS/C line to be charged at 400 kV
- (ii) Koteshwar to Tehri pooling point 400 kV D/C line
- (iii) Creation of 400 kV S/S at Roorkee with 2x315 MVA ICT by LILO pf Rishikesh – Moradnagar line
- (iv) 400kV S/C line from Meerut towards Roorkee – Muzzaffarnagar section of Rishikesh – Moradnagar section of the line so as to have
    - Meerut – Roorkeet 400 kV S/C
    - Meerut – Muzzaffarnagar 400 kV S/C line (covered by Tehri St- I)
    - Muzaffarnagar – Moradnagar S/C line
- (v) Provision of 50% series compensation of Tehri – Meerut 2xS/C line initially charged at 400 kV.

Director (SP&PA) stated that above system would be adequate for evacuation of power from Tehri St I as well as Koteshwar HEP. However with the commissioning of Tehri St II and upstream projects like Pala Maneri and Lahori Nagpala HEP there would be a need to upgrade the 400kV Tehri /Koteshwar GIS pooling point and Meerut S/S to 765 kV and charge the Tehri /Koteshwar pooling point – Meerut 765 kV 2xS/C line at 765 kV. For establishment of 765/400 kV S/S at Tehri /Koteshwar pooling point space would need to be created at a different tier in the hill.

CE (SP&PA) stated that 400 kV Muzaffarnagar – Roorkee portion of the Rishikesh – Moradnagar line which belongs to UPPCL could create a maintenance problem for POWERGRID. As such he suggested that POWERGRID should take necessary measures for acquiring the line from UPPCL so that future maintenance problem of the line could

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Agenda for 16th Meeting of the Standing Committee on Transmission System Planning in Northern Region

Item – I Evacuation system from Chamera III HEP (231 MW).

The Chamera III project would be located in Ravi Basin with an installed capacity of 231 MW adjacent to other stages of Chamera. The project has been accorded Techno-economic clearance of CEA and is included under the 10th plan programme. The other HE P's envisaged in the Ravi Basin viz Kutehar (260 MW), Bharmour (45 MW), Kugti (45 MW) and Budhil (70 MW) which are likely to come in the same time frame/near future were also considered for framing the transmission system capable of evacuation of about 600 MW of power. For evolving the evacuation system for Chamera III HEP the following alternative have been considered: **Alternative –I**

- Generation of Chamera III power at 220 kV level
- Creation of 400/220 kV pooling point near Chamera
- Chamera III – Pooling Point 220 kV D/C line
- Pooling Point – Jullandhar 400 kV D/C line
- Pooling Point – Chamera II 400 kV S/C line

Alternative –II

- Generation of Chamera III power at 220 kV level
- Creation of 220 kV pooling point near Chamera
- Chamera III – Pooling Point 220 kV D/C line
- Chamera PP – Hamirpur 220 kV D/C line
- Further evacuation of power through 220 kV existing Hamirpur – Jullandhar D/C line.

Alternative –III

Transmission system associated with Chamera-III:

- Generation of Chamera III power at 220 kV level
- Creation of 400/220 kV pooling point at Hamirpur
- Chamera III – Hamirpur Pooling Point 220 kV D/C line with 0.4 conductor
- Additional 1 no 220kV bay at Chamera-III for 220kV S/C 2x0.5

conductor

line from Kutehar

Transmission system from Kutehar

- Kutehar-Hamirpur 220kV D/C
- Kutehar-Chamera-III 220kV D/C
- Additional 2 nos 220kV bays at Kutehar for 220kV lines from

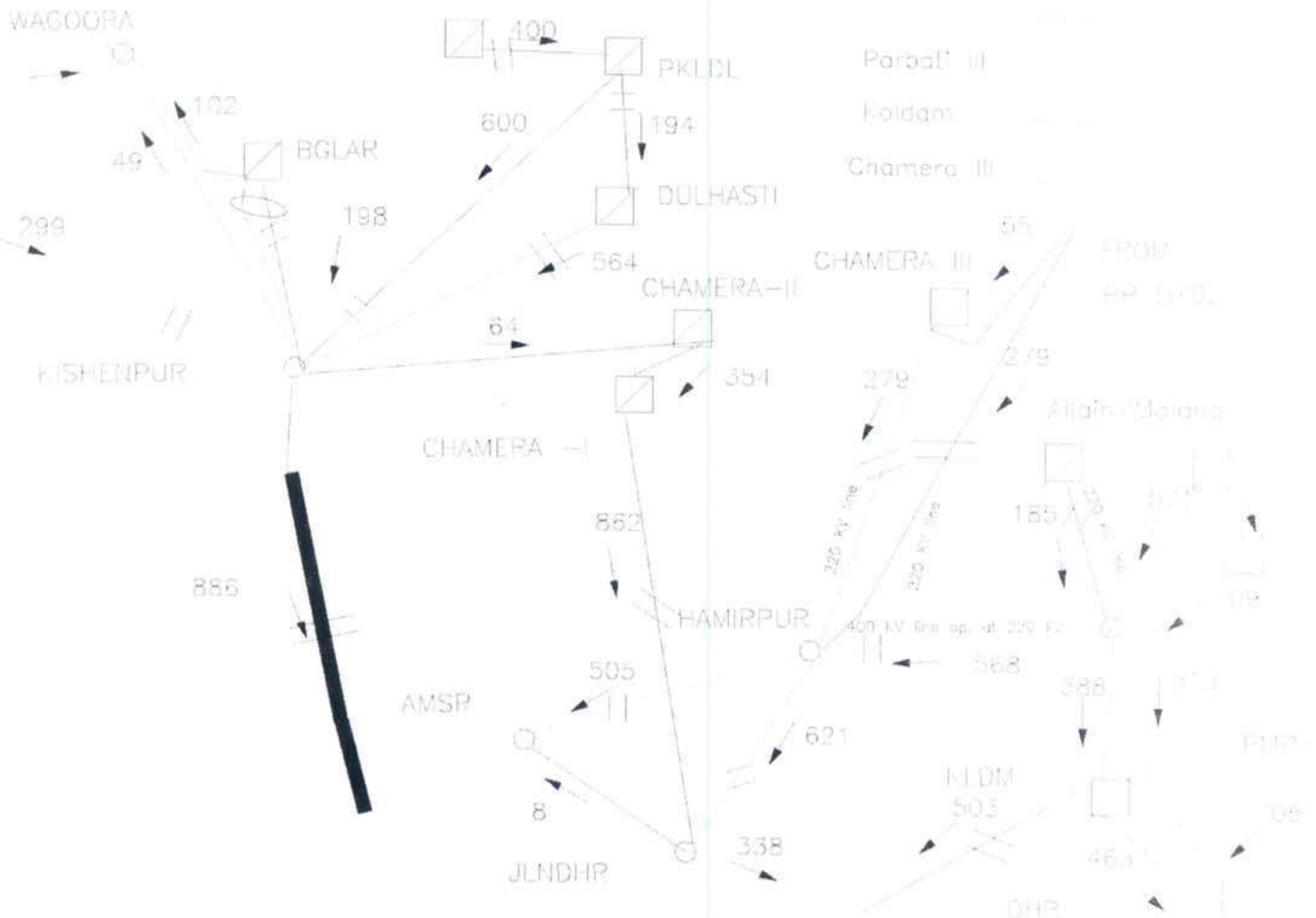
upstream projects Transmission system common for pooled evacuation and system strengthening:

- Hamirpur – Jullandher 400 kV D/C line
- Hamirpur – Amritsar 400kV D/C line

Alternative– I takes into account the evacuation of power from Chamera III as well as other future generation projects in the Ravi basin. As an when any new project is commissioned near Chamera basin the same could be fed to the pooling Point at 220 kV level and the further evacuation would take place through Chamera III system. However, with Chamer-II connected to pooling point, power flow may take place from Chamera II to Chamera pooling point, thereby consuming the spare capacity provided for other future projects in the basin and also deloading the already under utilized 765 kV Kishenpur – Moga lines.

Alternative–II is adequate for evacuation of power from Chamera –III, however, the 200 kV system beyond Hamirpur gets overloaded with the injection of power of Chamera III and would require further strengthening . Beside this, availability of land for creation of pooling point in the hilly Region could be difficult.

In alternative III, a 400/220 kV pooling point to be developed by POWERGRID at Hamirpur instead of in the hills as proposed in alternative I & II has been proposed. This alternative provides flexibility in project specific development of 220 kV and 400kV network towards 400/220 kV Hamirpur in phases. The other projects which are also expected in the upstream of Chamera can also be injected at Hamirpur for evacuation of power. Hamirpur pooling point also provides interconnectivity and evacuation system for projects in Ravi basin and Beas basin. Accordingly the same is recommended. **Case study for this alternative is as following:**



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CENTRAL ELECTRICITY AUTHORITY
SYSTEM PLANING AND PROJECT APRAISAL DIVISION

F. No.1/9/03-SP&PA/ **Dated: 13/05/04**

-As per List enclosed-

Subject: Minutes of 16th Standing Committee meeting on Power System Planning in Northern Region – Regarding Corrigendum

Sir,

With reference to the communication received from POWERGRID and subsequent fax massage dated 28/04/04 and 30/4 04 from NPCIL and NHPC respectively regarding some omission/ amendment required in the minutes of the 16th Standing Committee sent vide this office letter of even no. dt. 15.04.04, the corrigendum/addendum as enclosed, may be incorporated in the MoM of the 16th meeting of the standing committee.

Encl. As above

(S. K. Thakral)
Director (SP&PA)

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Annexure

Corrigendum to the minutes of the 16th Standing Committee Meeting

(1) Under **Item no. 1 – Evacuation system from Chamera III HEP**, in the transmission system finalized for Chamera III and Kutehar, it was decided to establish the pooling point at the location close to the alignment of Chamera-Jullundhar and Parbati-Amritsar lines. Accordingly, the transmission system for Chamera-III and Kutehar would be:

Transmission system associated with Chamera III

- Generation of Chamera III power at 220 kV level
- Creation of 400/220 kV pooling point at the location close to the alignment of Chamera-Jullundhar and Parbati-Amritsar lines. In the Chamera-III time frame, this would be only 220kV switching station which would be upgraded to 400kV in future.
- Chamera III – Pooling station 220 kV D/C line with 2x0.5 conductor
- Additional 1 no. 220 kV bay at Chamera III for 220 kV S/C line from Kutehar
- Pooling station – Jullandher 400 kV D/C line(operated at 220 kV)
- POWERGRID to locate and purchase requisite land for Pooling station corresponding to requirement of 400 kV S/S

Transmission system from Kutehar

- Kutehar – Pooling station 220 kV D/C with 2x0.5 conductor
- Kutehar – Chamera III 220 kV D/C with 2x0.5 conductor bunched into S/C
- Additional 2 nos. 220 kV bays at Kutehar for 220 kV lines from upstream projects
- LILO of Parbati Amritsar 400 kV D/C line at Pooling station
- 400 kV operation of Pooling station – Jullundhar D/C line

(2) Under **Item 2 – Power Evacuation system associated with Parbati-II (800 MW) and Koldam HEP (4x200MW)**, the decision regarding capacity of 400kV S/S at Ludhiana was taken in the 15th meeting of Standing Committee as 2x315 MVA instead of 3x315 MVA. Accordingly, the bullet point under the heading "System under Northern Region Strengthening Scheme" may be corrected to read as

- *400kV S/S at Ludhiana with 2x315 MVA ICT*

and the first line of the subsequent para be corrected to read as *"The above system was finalized in the 14th and 15th meeting of the Standing Committee considering ..."*.

(3) The suggestion of DGM, POWERGRID for change of conductor was in respect of Parbati pooling point – Amritsar 400kV D/C line and not in respect of Koldam-Ludhiana line. He had suggested to change the conductor of Parbati pooling point – Amritsar 400kV D/C line from AAAC to ACSR MOOSE and the same was agreed. The Koldam – Ludhiana 400kV D/C line remains with Triple ACSR conductor.

Accordingly, the last para under **Item 2 – Power Evacuation system associated with Parbati-II (800 MW) and Koldam HEP (4x200MW)**, reading *"DGM, POWERGRID stated that their study ...... conductor as envisaged earlier."* may be deleted and the following may be added under **Item 3 – Evacuation system from Parbati III HEP (520 MW)**:

"DGM, POWERGRID stated that their study indicates that Parbati pooling point – Amritsar line might not required to be constructed with AAAC conductor as ACSR MOOSE twin conductor would be adequate and it would incur saving in the cost of transmission line. The same was agreed."

(4) Under **Item 3 – Evacuation system from Parbati III HEP (520 MW)**, in the finalized system for Parbati-III, LILO of one circuit of Parbati-II – Koldam/Nalagarh line at Parbati-III has been inadvertently missed out. The same needs to be included in the list. Accordingly, the last para under this item would read as:

"After deliberation, Chief Engineer (SP&PA) stated that following system were recommended with Parabti III HEP:-

(i) Stepping up the generation of Parbati III at 400 kV
(ii) LILO of one circuit of Parbati-II – Koldam/Nalagarh line at Parbati-III
*(iii) Creation of 400kV pooling point at Parbati (**Panarsa**)*
*(iv) LILO of both line from Parbati to Koldam at Parabti Pooling point(**Panarsa**)*
(v) Parbati Pooling point - Amritsar 400 kV D/C line with twin ACSR MOOSE conductor

The members of the Standing Committee agreed the above proposal."

(5) While discussion the Evacuation system from Koteshwar HEP, it was decided to take-up the establishment of 400 kV Rookree S/S along with associated work expeditiously as a separate strengthening scheme. Accordingly, under **Item 5 – Power evacuation system from Koteshwar HEP**, the following may be appended:

"It was also decided to take-up the establishment of 400 kV Rookree S/S along with associated work expeditiously as a system strengthening scheme. Accordingly, POWERGRID would formulate a separate scheme for the works at Sl. Nos. (iii), (iv), and (vi) and taken-up this on priority."

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(6) Under **Item no. 10 – Evacuation system from Uri – II HEP (240 MW)**, the additional space at Uri II was to be checked for 400kV line bay and not 220kV line bay as inadvertently recorded in the minutes. Accordingly, the last line of first para under this item may be modified to read as:

"... at Uri II and if available one additional S/C line at 400 kV would be taken from Uri I to Wagoora".

(7) CE (ED-TAPS), NPCIL vide his letter of even no. Dated 28/4/04 have requested for following addendum in the item no. - 3 of

(8) Under **Item 3 of additional agenda – Transmission system from RAPP**

para 1 may be modified as under:

Director (SP&PA) stated that the evacuation system from RAPP unit 5,6,7 & 8 was agreed in the 14th Standing Committee Meeting of the NR, wherein a portion of the RRVPN system i.e. Kota – Kankroli 400kV 2xS/C was to be utilized for evacuation of power from RAPP stage 5,6,7&8. RRVPN had intimated POWERGRID their inability to construct the Kota – Kankroli lines as well as Kankroli – Bhinmal line matching with the RAPP timeframe. **The proposal for power evacuation system finalised during the 14th Standing Committee Meeting has already been put up by POWERGRID to CCEA for approval**. In view of this the proposal for RAPP was reviewed and following was suggested.

The concluding para may also be modified as under:
Concluding the discussion CE (SP&PA) stated that following system was recommended with RAPP C&D.

With RAPP unit 5&6

(i) RAPP – Kankroli 400kV D/C
(ii) RAPP – Kota 400kV S/C
(iii) Creation of 2x315 MVA and 3x315 MVA S/S at Kota and Kankroli respectively.

Supplementary regional scheme to match RAPP – 5&6 time frame:

(i) Kota – Merta 400 kV D/C line
(ii) Kankroli – Jodhpur 400kV S/C line

With RAPP unit 7&8

(i) RAPP – Jaipur 400kV D/C line of which one circuit to be LILOed at Kota
(ii) RAPP – Nagda (WR) 400 kV D/C (NR:WR::50:50)

RRVPNL would construct a 220 kV line to interlink with 400 kV S/S at Kota and Kankroli of POWERGRID with their 220 S/S at Kota and Kankroli respectively.

The Members of the Committee agreed with the proposal."

Annex. C

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1

Summary record of the 17th Standing Committee Meeting of transmission system planning of Northern Region held in NREB on 10th August 2004.

List of participants is enclosed at Annex.

Item 1- Confirmation of the minutes of the 16th SCM on power system planning in NR held on 24.3.04 at NREB, New Delhi.

Chief Engineer (SP&PA), CEA welcomed the participants of the 17th Standing Committee Meeting. He stated that the agenda for the meeting covers the hydro generation projects in Northern region which are likely to come during 11th plan time frame. Most of these projects were accorded TEC/ on the process of accordance of TEC by CEA.

He informed that the minutes of the 16th Standing Committee Meeting were circulated on 15.04.04 and the subsequent corrigendum to the minutes were also issued in 14.05.04. No objection from any utility regarding the minutes have been received so far except from Himachal Pradesh. He stated that in the corrigendum issued for the minutes of the meeting for 16th standing committee, it was stated that "Creation of 400/220 kV pooling point at a location close to the alignment of Chamera-Jullundhar and Parbati-Amritsar lines. In the Chamera-III time frame, this would be only 220kV switching station which would be upgraded to 400kV in future". However, HPSEB feel that the above information regarding the location of pooling point does not clearly define the location of the pooling point which may shift outside the boundary of HPSEB.

Director (Planning), HPSEB stated that in the 16th SCM it was decided that in Chamera III time frame there would be only 220 kV switching station, which would be upgraded to 400 kV in future by creation of 400/200 kV pooling point at a suitable location near Hamirpur and so stated in the original minutes. However, in the subsequent corrigendum issued in May 2004, the location of the substation had not been specified and it could be located anywhere even outside Himachal Pradesh.

Director (AI), CEA stated that spirit of the statement in the corrigendum issued was not to shift the location of the 400/220 kV pooling station outside Himachal Pradesh. However, for the specific assurance of Himachal Pradesh, it might be noted that in Chamera III time frame there would be only 220 kV switching station, which would be upgraded to 400 kV in future by creation of 400/200 kV pooling point (matching with Parbati III time frame) at a suitable location near Hamirpur.

The members of the Committee agreed for the same. CE (SP&PA) stated that since there was no objection from any of the member on any other issues of the minutes of the 16th Standing Committee Meeting so, the minutes of the 16th SCM along with the corrigendum issued with amendment regarding location of the pooling point near Hamirpur might be taken as confirmed.

Annex. D(1)
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Standing Committee on Power System Planning in Northern Region

Summary record of discussions in the 23rd meeting of the Standing Committee Meeting on Power System Planning of Northern Region held on 16th February 2008 at Dehradun

1. Confirmation of minutes of 22nd meeting

Minutes of 22nd meeting of the Standing Committee held on 12.3.2007 at Udaipur issued vide letter no. 1/9/2004-SP&PA/135-150 dated 13.04.07 and subsequent corrigendum issued vide letter no. 1/9/2007-SP&PA/540-555 dated 15.06.07 were confirmed.

2. Review of progress on Earlier Agreed Transmission schemes

Status of progress on earlier agreed schemes is enclosed at Annex-1.

RVPNL requested that works for the 220 kV bays at Bhiwadi and 400/220 kV transformer provision at Kota may be expedited.

3. Evacuation of power from Jhajjar TPS (1500 MW)

3.1 Jhajjar TPS (3x500 MW) would be located near Jhajjar, Haryana and would be developed by M/s Aravalli Power Corporation Limited and the beneficiaries of the power from Jhajjar are Delhi and Haryana in the ratio of 50:50.

Members noted the following evacuation systems for Jhajjar TPS.

To be constructed by generation developer for Delhi

- Jhajjar - Mundka 400 kV D/C line (the line would feed 400/220 kV transformers and further 220 kV system radially from Mundka not connecting to Delhi ring)

To be constructed by HVPNL for Haryana

(i) Jhajjar - Daulatabad 400 kV D/C line

(ii) Daulatabad 400 kV S/S

(iii) Daulatabad - Gurgaon (PGCIL sector-72) 400 kV D/C evolved as part ATS for Karcham Wangtoo and only Sonepat-Bahadurgarh section evolved as system strengthening, as this had become an urgent system strengthening, transmission charges for both lines viz. Abdullapur-Sonepat as well as Sonepat- Bahadurgarh would be payable as soon as commissioned not linked to commissioning schedule of Karcham Wangtoo HEP or any other generation project.

6.0 Region System Strengthening Scheme – New Proposal

6.1 It was also discussed and agreed that in view of increasing demand density the norm of providing 220 kV bays with 400/220 kV transformers would be revised as following:-

- **For 2x315 MVA - 6 nos. of line bays**
- **For 3rd 315 MVA transformer- 2 line bays**
- **For 500 MVA transformer - 4 nos. of line bays**

6.2 It was discussed and agreed that for meeting the increasing demands and increasing quantum of power supply required to be delivered from regional grid to state grids, there was need for providing new regional grid 400kV substations at Manesar in Haryana, Kotputli and Neemrana in Rajasthan, Hapur and Bagpat in U.P, Hamirpur in H.P, Dehradun in Uttrakhand (this would also facilitate power evacuation from Kotlibhel HEP) , New Wanpoh and one s/s for Jammu in J&K and S/S capacity augmentation at Patiala and Malerkotla in Punjab. Of these, s/s at Manesar and Bagpat would be GIS and s/s at Neemrana, Hapur, Hamirpur, Dehradun and other places could be GIS or open yard depending on availability of space.

6.3 HVPNL informed that they were constructing 400kV D/C line from Hissar TPS to Sirsa along with 400kV s/s at Sirsa for evacuation of power from their Hissar TPS and connectivity of this with Fatehabad 400/220kV s/s of PGCIL was required. For this 2 nos of 400kV bays at Fatahabad would be required so that LILO of one circuit of the Hissa-Sirsa 400kV D/C line at Fatehabad could be done. They also wanted to have 2 nos of 220kV bay at Fatehabad for feding to their 220kV Chomar s/s. HVPNL further stated that for this connectivity, application for Long Term Open Access was not required as Haryana had already planned adequate intra-state evacuation system for Hissar TPS. The proposal was discussed and agreed with provision that 2 nos of 400 kV bays at Fatehabad PGCIL would be provided by PGCIL at the cost of HVPNL. It was further agreed that the 2 nos of additional 220kV bays would also be provided and these would be part of regional pooled system in line with the revised norms for provision of 220kV bays as agreed.

6.4 HVPNL further stated that they had planned a new 400kV s/s at Nawada fr meeting growing demand of Faridabad. They proposed that LILO of the Samaypur-G.Noida circuit could be provided to create their new 400kV s/s at Faridabad (Nawada). This was agreed.

6.5 HVPNL further proposed to have another 400kV s/s in Gurgaon at Sector-20 getting feed through LILO of Samaypur-Bamnoli 400kV D/C line of DTL. It was decided to discuss it separately in a meeting between CEA,

6.6 HVPNL further stated that the 400 kV substation at Mohindergarh was being proposed as a regional substation. However, they had their own plan to take up Mohindergarh 400kV s/s under state sector and instead of at Mahindergarh, regional s/s at an alternate site in Bhiwani area could be considered. It was decided to examine this proposal and take up in the next meeting.

6.7 It was also discussed and agreed to provide a 400 kV D/C line from Bhiwadi to Moga via Rajasthan to provide a 400kV corridor directly connecting Rajasthan system to Punjab so as to avoid the fog affected areas where transmission lines trip during winter foggy conditions causing grid disturbances. Accordingly, the requirement of providing following new 400 kV substations along with 400kV feeding lines or LILOs to be developed as regional system strengthening for meeting increasing demands in the respective area was agreed as per following schemes:

<u>NRSS-XIII</u>

(1) Gurgaon (PG sec-72)-Manesar 400kV quad D/C

(2) Manesar 400kV GIS s/s 2 x 500 MVA 400/220kV

(3) Delinking Agra-Samaypur and Samaypur-Gurgaon (PG sec-72) 400kV lines from Samaypur and making a direct line from Agra to Gurgaon (PG sec-72) 400kV S/C circuit.

(4) LILO of 400kV Samaypur-G.Noida circuit to connect to the proposed new 400kV s/s of HVPNL at Faridabad (Nawada)

(5) 2 nos of 220kV bays at Fatehabad 400/220kV s/s.

NRSS-XIV

(1-) LILO of Nallagarh-Kaithal 400kV circuit (second ckt of Nalagarh-Hissar 400kV D/C line) at Patiala (first ckt is already LILOed)

(2) Addtitional 500MVA 400/220kV ICT at Patiala so as to increase transformation capacity from 2x315MVA to 2x315 + 1x500 MVA

(3) Addtitional 500MVA 400/220kV at Malerkolta so as to increase transformation capacity from 2x315MVA to 2x315 + 1x500 MVA

NRSS-XV

(1) Manesar-Neemrana 400kV D/C

(2) Bhiwadi-Neemrana 400kV D/C

(3) Neemrana 400kV 2x315 MVA 400/220kV

(4) LILO of Bhiwadi – Jaipur 400kV S/C circuit to create new 400kV s/s at Kotputli

(5) Kotputli 400kV 2x315 MVA 400/220kV

NRSS-XVI

(1) LILO of both circuits of Kishenpur-Wagoora 400kV D/C to create new 400kV s/s at New Wanpoh

(2) Kishenpur-New Wanpoh 400kV D/C

(3) New Wanpoh 400kV 2x315 MVA 400/220kV

NRSS-XVII

(1) Neemrana-Sikar 400kV D/C

NRSS-XVIII

(1) Dehradun - Bagpat 400kV quad D/C

(2) Dehradun 400kV 2x315 MVA 400/220kV

NRSS-XIX

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(1) LILO of both ckts of the Meerut-Kaithal 400 kV D/C line to create new 400kV s/s at Bagpat

(2) Bagpat 400kV GIS s/s with 2 x 500 MVA 400/220kV

(3) LILO of both ckts of Bareilly – Meerut 400 kV D/C line to create new 400kV s/s at Hapur

(4) Hapur 400kV 2x500 MVA 400/220kV

NRSS-XX

(1) LILO of one circuit of Parbati PS-Amritsar 400kV D/C to create new 400kV s/s at Hamirpur

(2) Hamirpur 400kV s/s with 2x315 MVA 400/220kV

All the above schemes were agreed.

6.3 It was further discussed and decided that requirement and connectivity arrangement for the following additional new 400kV s/s would be further studied and discussed in the next meeting:

- Jaipur (South)
- Faidabad (Mandkola)
- Muktsar or near by Moga so as to have alternate s/s near Moga.
- Kishenpur-Ramban 400kV D/C and Ramban 400/220kV s/s

7.0 **Second 400 kV line from Dulhasti HEP(3x130 MW)**

7.1 Members noted that for providing reliable evacuation system for Dulhasti HEP, CEA had recommended two numbers 400kV S/C lines between Delhasti HEP and Kishenpur. However, while considering the scheme for PIB, the PIB deferred the 2[nd] ckt. of 400 kV S/C Dulhasti – Kishenpur line on account of cost implication stipulating that situation may be reviewed depending upon the progress made by various generation projects in this area. Accordingly, Dulhasti HEP (3x130 MW) was operationalised with only one 400kV S/C line for power evacuation. NHPC, sighting evacuation bottleneck due to only one outlet circuit, had requested for review and revival of the proposal for the second line.

Annx – D(2)

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Government of India
Central Electricity Authority
SP&PA Division
R.K. Puram, New Delhi -110066

F.No. 1/9/SP&PA-12/ **Dated: 20/1/12**

-As per list enclosed-

Sub: The 30th meeting of the Standing Committee on Power System Planning of Northern Region

Sir,

It is intimated that the minutes of 30th meeting of the Standing Committee on Power System Planning of Northern Region held on **19th December 2011(Monday) at NRPC Conference Room, Katwaria Sarai, New Delhi** have been uploaded on the CEA website www.cea.nic.in (*path to access- wing specific document / power system related reports/ standing committee on power system planning/northern region*).

Your comments/suggestions are welcome.

Thanking You.

Yours faithfully,

(B.K.Sharma)
Director (SP&PA)

representative suggested for laying of 220 kV cables or pole type towers to overcome R-o-W constraint. PTCUL stated that laying of 220 kV cables was also not feasible.

After detailed discussions, it was decided that a committee consisting of CEA, POWERGRID, PTCUL, DTL and RVPNL be formed to undertake a site visit to explore all possible options for taking 220 kV outlets from 400 kV Roorkee substation. The issue will be revisited by the members thereafter.

5. Shifting of Line reactor from Merta S/s to Kota S/s

Director (SP&PA), CEA stated that Kota –Merta 400kV D/c line was planned with 50MVAR line reactor at Merta S/s and one circuit of the line had been LILOed at M/s Shree Cement's generation switchyard at Beawar for providing connectivity. With the above arrangement, the length of Shree Cement- Merta line had reduced to less than 80km and as such 50 MVAR line reactor was not required for this line. He informed that POWERGRID had proposed to shift this 50 MVAR line reactor to Kota S/s for its use as Bus Reactor.

RVPNL representative informed that this reactor might be used as a bus reactor at Merta S/s. POWERGRID representative stated that according to studies carried out with 50 MVAR bus reactor at Kota, the reactor would provide a voltage drop of approximately 5 kV at Kota & also help in reducing over voltages in the nearby area so the reactor might be used as a bus reactor at Kota. He also mentioned that 1 no. of 400 kV bus reactor bay would be required at Kota to implement above proposal.

Members agreed to the above proposal.

6. Connectivity of Hamirpur (Mattansidh) 220/132kV S/s of HPSEB with Hamipur 400/220kV S/s of POWERGRID

Director (SP&PA), CEA informed that HPSEB Ltd. had proposed to construct 220kV D/c line from Hamirpur(PG) substation to their existing 220 kV Hamirpur (Mattansidh) S/s and the existing 220kV D/c Jullandhar- Hamirpur(HPSEB) (ISTS) line be connected to Hamipur (PG) substation. HPPTCL representative informed that the distance from Hamirpur (HPSEB) to 400/220 kV Hamirpur(PG) substation is about 4 km.

POWERGRID representative stated that the above proposal was equivalent to LILO of Jullandhar – Hamirpur(HPSEB) 220 kV D/c (ISTS) line at 400/220 kV Hamirpur(PG) substation. POWERGRID also informed that 400/220 kV Hamirpur(PG) Substation & LILO of one circuit of Parbati Pooling station – Amritsar 400 kV D/c line at Hamirpur(PG) were already under construction as a part of NRSS-XX scheme and the 220 kV connectivity at this substation was urgently required for stable/reliable operation of the Parbati Pooling – Hamirpur – Amritsar 400 kV line as well as for effective utilization of Hamirpur 400/220 kV substation. He proposed to take up the works of LILO of 220kV Julandhar –Hamirpur D/c at Hamirpur (PG) S/s, as an ISTS scheme as the existing Jullandhar – Hamirpur 220 kV D/c line was an ISTS line.

Considering the urgency of work and the scope being very small, it was agreed that the above works might be carried out by POWERGRID as a part of some on-going scheme.

It was further informed that HPPTCL requested for four 220 kV line bays at Hamirpur 400/220 kV substation i.e. two for connecting their Kangoo S/s and two for connecting their proposed substation at Palampur. POWERGRID representative intimated that 6 nos. of line bays were already being provided at 400/220 kV Hamirpur(PG) substation. Out of these, 4 bays shall be utilized for LILO of 220 kV Jullandhar – Hamirpur D/c line and two bays could be provided for interconnection of proposed Kangoo S/s (HPSEB). The additional two nos. of 220 bays could be considered in future when required. POWERGRID requested HPPTCL to expedite the 220kV D/c interconnection from Hamirpur 400/220 kV substation.

Members agreed to the above proposal.

7. Installation of Bus Reactors and augmentation of transformation capacity at Dehar Generation Switchyard

Director (SP&PA), CEA stated that in order to control high voltages in the system (particularly during low hydro and light load conditions) at Dehar, a 125 MVAR bus reactor at Dehar generation switchyard was agreed during 15th meeting of Northern Regional Power Committee held on 23rd and 24th December, 2009.

POWERGID representative informed that during low hydro period, the 400/220kV, 250 MVA ICT at Dehar got overloaded. At several instances, this ICT was opened to avoid over loading, resulting in loss of interconnection between 400kV and 220kV levels at Dehar resulting in less reliable power supply to Punjab and this had also been highlighted in the Operation Feedback on Transmission Constraints submitted by NRLDC. It was also informed that the present ICT is more than 30 years old. The issue was discussed during the 29th Standing Committee Meeting held on 29/12/2010 and it was proposed to augment the existing transformation capacity by one additional 500 MVA transformer. In case of space constraint, it was proposed that existing 250 MVA transformer might be kept as spare and proposed 500MVA transformer be installed. BBMB had indicated space & transportation constraints for installation of 500 MVA ICT at Dehar. In 21st NRPC meeting, it was recommended that BBMB & POWERGRID would carry out joint inspection for availability of space at Dehar. Accordingly, Joint site visit of POWERGRID and BBMB was carried out and the main findings of the visit are listed below:

(a) **Installation of Bus Reactor at Dehar:** There is space constraint for installation of a bus reactor with conventional AIS bay equipments. Hence, GIS equipment needs to be considered for Bus Reactor. BBMB informed that transportation & installation of 125 MVAR reactor at Dehar is not feasible and option of 80 MVAR reactor may be explored. RVPNL stated that in view of the requirement of 125 MVAR reactor and transportation/space constraints, 2X63 MVAR Reactors might be considered.

After detailed discussions, it was agreed to provide 2 nos. of 63 MVAR bus reactors controlled through a single 400 kV bay.

Aunex. E

Annexure -II

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HIMACHAL PRADESH STATE ELECTRICITY BOARD LTD.
(A STATE GOVT. UNDERTAKING).

No: HPSEB/ESCHW-57/2011 :- 5106-07 Dated :- 21-10-11

To

The Executive Director (B-D),
PGCIL, Sector-29,
Gurgaon, Haryana.

Sub :- **To provide connectivity to 220/132KV Sub-Station Mattansidh (Hamirpur) with proposed 400/220KV PGCIL Sub-Station Chowki-Kankari (Hamirpur)**

Sir,

" Jai Hind",

In this context, it is submitted that 400/220KV Sub-Station of PGCIL is under execution at Village Chowki- Kankari Distt. Hamirpur (H.P). The location of this Sub-Station is about 4.00 Kms. from the existing 220/132KV Sub-Station HPSEB Ltd., Mattansidh (Hamirpur). At present this 220/132 KV Sub-Station of HPSEB Ltd. is being fed through 220KV D/C Jalandhar- Hamirpur Trans. line of PGCIL.

Since the proposed 400/220KV Sub-Station Hamirpur of PGCIL is very nearer to 220/132KV Sub-Station HPSEB Ltd., Mattansidh as such the 2 No. 220KV Incoming bays of 220 KV Sub-Station Mattansidh feeding through 220KV D/C Trans. Line from Jalandhar to Hamirpur can be used for interlinking 400/220KV Sub-Station of PGCIL Hamirpur with 220/132KV Sub-Station Mattansidh of HPSEB Ltd. by constructing 220KV D/C Trans. Line from 400/220KV Sub-Station of PGCIL to existing 220/132KV Sub – Station Mattansidh of HPSEB Ltd. and the existing 220KV D/C Jalandhar- Hamirpur line which is under the control of PGCIL may be connected to new 400/220KV Sub-Station of PGCIL at Hamirpur by PGCIL.

It is further, submitted that in addition to above, 4 Nos. 220KV bays shall also be provided for interfacing 220KV Sub-Station Kangoo and proposed 220KV Sub-Station Patti (Palampur) of HPSEB Ltd. with 400/220KV new Sub-Station Chowki-Kankari (Hamirpur) please.

Superintending Engineer,
Electrical System Circle,
HPSEB Ltd.,Hamirpur.

Copy to the Chief Engineer (ES), HPSEB Ltd., Hamirpur for information and necessary action please.

For examination & suitable action please at your end,

Sh. Mukesh Khanna
DGM(SEF)

इंजी
24/10/11

Superintending Engineer,
Electrical System Circle,
HPSEB Ltd.,Hamirpur.

Enclosure-I

Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh

S. No.	Items	Details
1.	Name of Scheme	**Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh**
2.	Scope of the scheme	• Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station* near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors **Future provisions at Robertsganj PS (excl. scope for present scheme): Space for** ➢ 765/400kV ICTs along with bays- 2 nos. ➢ 765 kV line bays along with switchable line reactors – 6 nos. ➢ 765kV Bus Reactor along with bay: 1 no. ➢ 400 kV line bays along with switchable line reactor –6 nos. ➢ 400kV line bays : 4 nos ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400kV Sectionalization bay: 2 sets ***along with provision of 80MVAr spare reactor (Single phase), 110MVAr (Single phase) & 500MVA spare transformer unit (Single phase)*** • 400kV line bays (4 nos.) for connectivity of PSP generation project (M/s Avaada & M/s Greenko) at Robertsganj PS • LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO) (LILO Length ckt1 ~ 65 km, LILO Length ckt2 ~ 75 km) • Establishment of 765 kV Prayagraj S/s* near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors **Future provisions at Prayagraj S/s (excl. scope for present scheme): Space for** ➢ 765/400kV ICTs along with bays- 4 nos. ➢ 765 kV line bays along with switchable line reactors – 4 nos. ➢ 765kV Bus Reactor along with bay: 1 nos. ➢ 400 kV line bays along with switchable line reactor –4 nos. ➢ 400kv line bays : 2 nos. ➢ 400 kV Bus Reactor along with bays: 2 no. ➢ 400kV Sectionalization bay: 1 set ***along with provision of 110MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase)***

S. No.	Items	Details
		• LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj (LILO length ~15km) • LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj (LILO length ~14km) • Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line (~185 km) Details of Transmission scheme is enclosed in ***Annexure-I.***
3.	**Depiction of the scheme on Transmission Grid Map**	Attached at **Exhibit-I**
4.	**Upstream/downstream system associated with the scheme**	765/400kV Varanasi, Fatehpur, Gaya & Sasaram are existing substation of POWERGRID. 765/400kV Varanasi(PG) S/s interconnected to Balia(PG), Kanpur(PG), Fatehpur (PG), Vindhyachal Pooling (PG) & Gaya (PG) (to be LiLoed at proposed Robertsganj PS) S/s at 765kV level and Allahabad(PG), Sarnath (UPPTCL), Jaunpur (UPPTCL), Sasaram (PG) & Sahupuri (UPPTCL) at 400kV level. 765/400kV Fatehpur(PG) S/s is interconnected to Agra(PG), Ghiror (under bidding), Varanasi (PG) (to be LiLoed at proposed Prayagraj S/s) & Sasaram (PG) (to be LiLoed at proposed Prayagraj S/s) at 765kV level and Allahabad(PG), Panki(UPPTCL), Mainpuri(PG), Singrauli (NTPC), Unchahar (NBPPL), at 400kV level. 765/400kV Gaya (PG) S/s is interconnected to Balia(PG) & Varanasi(PG) (to be LiLoed at proposed Robertsganj PS) S/s at 765kV level and Chandauti (PG), Koderma (PG), Maithon (PG), Chandwa (Jharkhand Pool) (NKTL) & North Karanpura (NTPC) (presently Under Construction), at 400kV level. 765/400kV Sasaram(PG) S/s is interconnected to Fatehpur (PG) (to be LiLoed at proposed Prayagraj S/s) at 765kV level and Varanasi (PG), Biharsharif (PG), Nabinagar-I (NTPC), Daltonganj (PG), at 400kV level.

S. No.	Items	Details
5.	**Objective / Justification**	1. The present scheme comprises Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh 2. In the 34th CMETS-NR meeting held on 20.09.2024 It was mentioned that connectivity applications of cumulative quantum of 5152 MW from two developers i.e. M/s Greenko (6 nos. of applications with cumulative quantum of 4032 MW) & M/s Avaada WB (1 application of 1120MW) near Robertganj area in Sonbhadra district, Uttar Pradesh was discussed in the earlier 31st CMETS-NR meeting held on 27.06.24. As per the schedule indicated in the applications, these PSP projects are expected to be commissioned progressively from Nov'26 upto Mar'28. 3. In the 31st CMETS-NR meeting, CMETS-NR, it was informed that to deliberate on planning of transmission System for evacuation of Power from Pumped Storage Plants, a meeting under Chairmanship of Chairperson, CEA was held on 28.05.2024. In the above meeting, it was decided that CTUIL while granting Connectivity to PSPs shall mention that PSPs shall not operate in generating mode during high RE generation period and if required, PSPs may inject power during high RE generation period based on margin available in the system. However, detailed analysis must be done based on the combination of sources at that node. 4. M/s Greenko vide letter dated 21.05.24 informed that in the initial phases of PSP development, it is envisaged as a Stand-alone storage project, the PSP project will draw power from renewable generation sources or conventional generation sources located at different location(s) in the grid for charging the pump storage plant and thereafter power will be injected into the grid for supplying power to the different beneficiaries connected to different location(s) in the grid. During PSP operation, typically during peak solar time (mainly between 11AM to 2 PM), the PSP project shall be able to draw power to the extent of 4032 MW (6X672MW) corresponding to pumping capacities of all six units. While, during generation hours which will be typically during non-solar or low solar hours, the maximum generation possible shall be to the extent of 3660 MW (6x610MW). For evolving the transmission scheme, the above mentioned maximum values of drawl and Generation may be considered. Same was also discussed in 31st CMETS-NR meeting. 5. CEA in the above CMETS-NR meeting confirmed that the Sonbhadra area may be considered as a potential zone for pumped storage projects. Accordingly, the transmission system for connectivity of M/s Greenko & M/s Avaada at Roberstganj PS shall be considered as common transmission system. 6. M/s Avaada & Greenko clarified in the meeting that they shall operate PSP units in synchronous condenser mode as per the reactive power requirement of the grid. Further, M/s Greenko and M/s Avaada shall also keep future provision of

S. No.	Items	Details
		Bus Reactor so that in case of future requirement the same can be installed by the applicant. 7. Accordingly, in the above CMETS-NR meeting, connectivity applications of M/s Avaada & Greenko were agreed for grant, and it was deliberated that the transmission scheme for Pump Storage plants in Sonbhadra district is presently under discussion. The scheme is currently tentative, which shall be finalized in subsequent CMETS-NR and other region (ER) CMETS meeting among CEA, CTUIL, Grid India & Stakeholders. The detailed transmission system shall be informed upon finalization and approval of the scheme. Further, NR-WR inter regional scheme to relieve loading of 765 kV Vindhyachal – Varanasi D/c line shall also be required for connectivity of Pumped Storage Projects in Sonbhadra district. M/s Greenko vide letter 10.09.24 requested that now they are moving forward with three applications (3x672MW) for their project out of earlier six nos. of applications (6x672MW), based on which 3 nos. applications of M/s Greenko were closed. As per the connectivity applications, M/s Greenko has provided generation schedule progressively from Nov'26 to Apr'27 and M/s Avaada has provided generation schedule of Dec'28 8. In view of the above, studies were carried out considering PSPs in drawl mode in Solar Max scenarios & injection mode in Peak load scenarios (evening peak). All India Study files for various scenarios (solar maximized, evening peak and night off peak) were circulated to NR stakeholders on 12.09.24. 9. In view of schedule of generation projects and for optimal utilization of transmission scheme, comprehensive tr. scheme is planned considering M/s Greenko and M/s Avaada PSP evacuation requirement (Maximum injection 3136MW, Maximum Drawl: 2730MW) including future requirement. Recently an additional PSP application of M/s Avaada for connectivity of 596 MW (Max Injection: 520 MW Max Drawl:596 MW) with generation schedule of Jun'29 was also granted at Robertsganj PS. However, in view of transmission being lumped elements, the planned scheme can cater upto 4 GW PSP connectivity quantum. 10. In the 34th CMETS-NR meeting, Grid-India stated to review the reactive compensation of 765kV Robertsganj PS – Prayagraj S/s D/c line. CTU stated that with proposed line reactors (240MVAr line reactor on both ends), Reactive compensation is bit on higher sider (~90%), therefore 330MVAr line at one of the end may be considered for above line based on studies. Accordingly, 330MVAr line reactor is considered at Robertsganj PS end for 765kV Robertsganj PS – Prayagraj S/s D/c line. 11. Grid-India enquired that line reactors may be reviewed w.r.t. line length of each sections formed after proposed LILO arrangements i.e. LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj & LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj. Grid-India stated that 765kV Fatehpur – Prayagraj section may get overcompensated with existing line reactor

S. No.	Items	Details
		configuration. CTU stated that after proposed LILO arrangement, reactive compensation is about 89% on 765kV Fatehpur – Prayagraj section (140 kms). Grid-India enquired about feasibility of removing 330MVAr existing line reactor at Fatehpur end or its replacement with 240MVAr line reactor. CTU stated that considering prevailing high voltage condition in NR (in some off peak scenarios), removal or replacement of 330MVAr line reactor at Fatehpur end may worsen the high voltage problem, however line length is tentative and will be reviewed in Gati Shakti portal. In the case of reduction of line length considerably, decision may be taken on removal/replacement of 330MVAr line reactor at Fatehpur end of 765kV Fatehpur – Prayagraj section (140 kms). CTU further stated that on all other line sections formed after LILO arrangement at Prayagraj S/s, reactive compensation is in order. 12. CEA stated that both the PSP projects are under advance stage, however DPR is yet to approve. On the query of CEA on additional generation considered at 400kV level, CTU informed that at present comprehensive scheme is planned for 4GW PSP potential and with connectivity quantum more than 4GW, adequacy of agreed transmission scheme shall be reviewed further. CEA and UPPTCL also agreed on the proposal. 13. Subsequently, Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh was also deliberated and agreed in 36th CMETS-ER meeting held on 29.10.2024 14. Considering above deliberations and receipt of connectivity application of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh, transmission system for evacuation of power from Pumped Storage Projects was agreed in 34th CMETS-NR & 36th CMETS-ER meeting
6.	**Estimated Cost**	**Rs. 4141 Cr.**
7.	**Need of phasing, if any**	Not Applicable
8.	**Implementation timeframe**	24 months from allocation of project (except for 2 nos. of 400kV line bays required for connectivity to M/s Avaada PSP with implementation timeframe of 31.12.28)
9.	**System Study for evolution of the proposal**	Studies discussed and agreed in following meeting • 34th CMETS-NR meeting held on 20.09.24 (Minutes of meeting attached in **Annexure-II**) • 36th CMETS-ER meeting held on 29.10.24 (Minutes of meeting attached in Annexure-III) Load flow results is attached at **Exhibit-II**

Exhibit-I

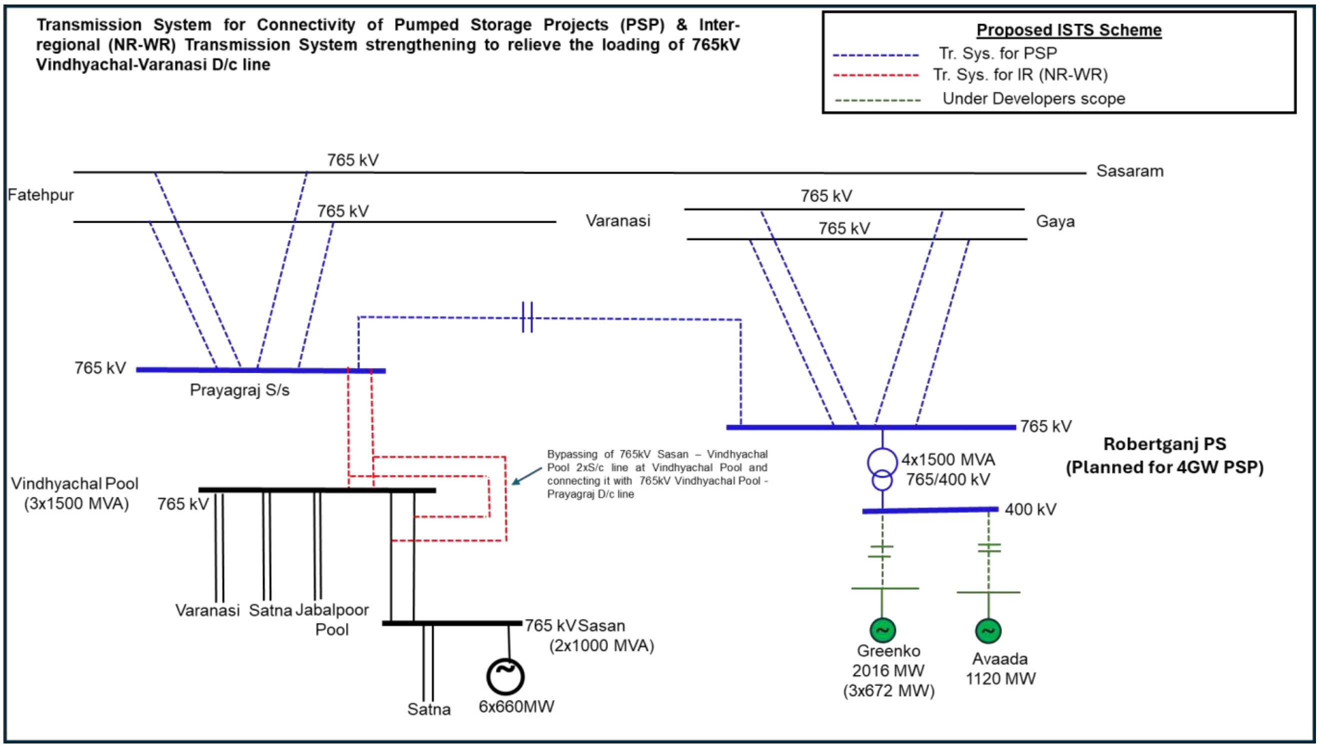
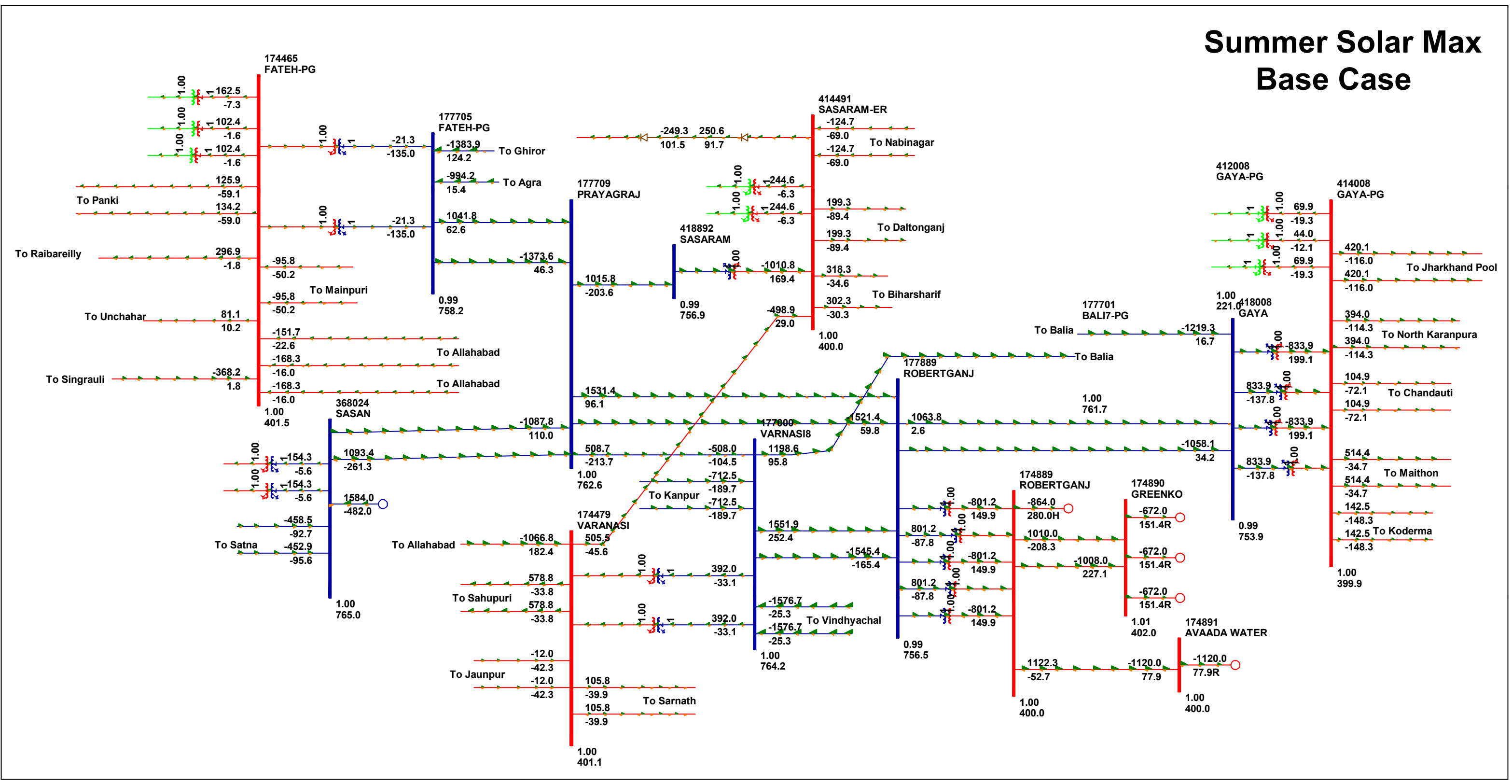
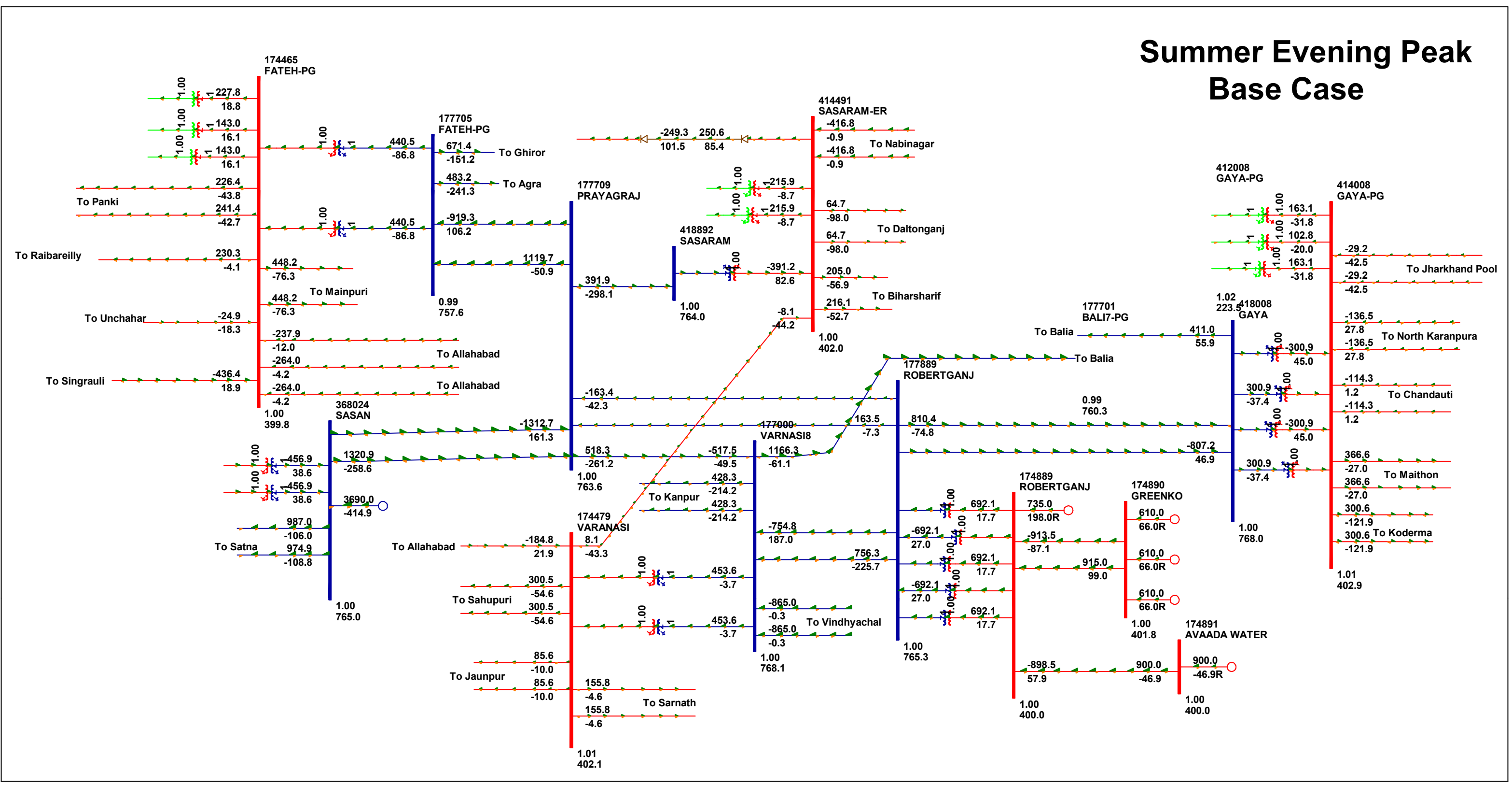


Fig : Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh

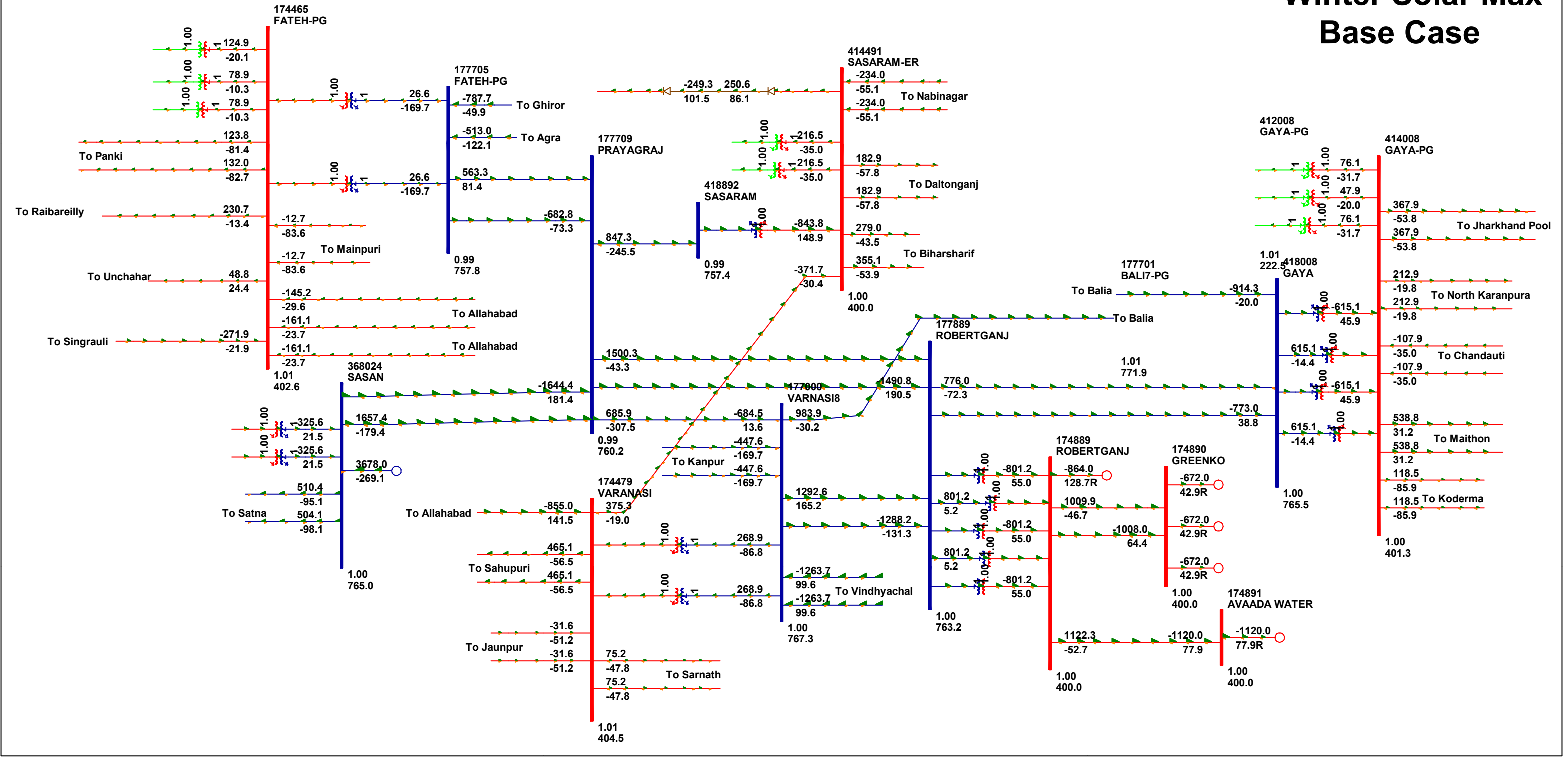
Exhibit-II


Summer Solar Max
Base Case
174465
FATEH-PG
177705
FATEH-PG
177709
PRAYAGRAJ
418892
SASARAM
414491
SASARAM-ER
412008
GAYA-PG
414008
GAYA-PG
177701
BALI7-PG
418008
GAYA
177889
ROBERTGANJ
174889
ROBERTGANJ
174890
GREENKO
174891
AVAADA WATER
177600
VARNASI8
174479
VARANASI
368024
SASAN
To Panki
To Raibareilly
To Unchahar
To Singrauli
To Mainpuri
To Allahabad
To Ghiror
To Agra
To Nabinagar
To Daltonganj
To Biharsharif
To Balia
To Jharkhand Pool
To North Karanpura
To Chandauti
To Maithon
To Koderma
To Kanpur
To Vindhyachal
To Satna
To Sahupuri
To Jaunpur
To Sarnath

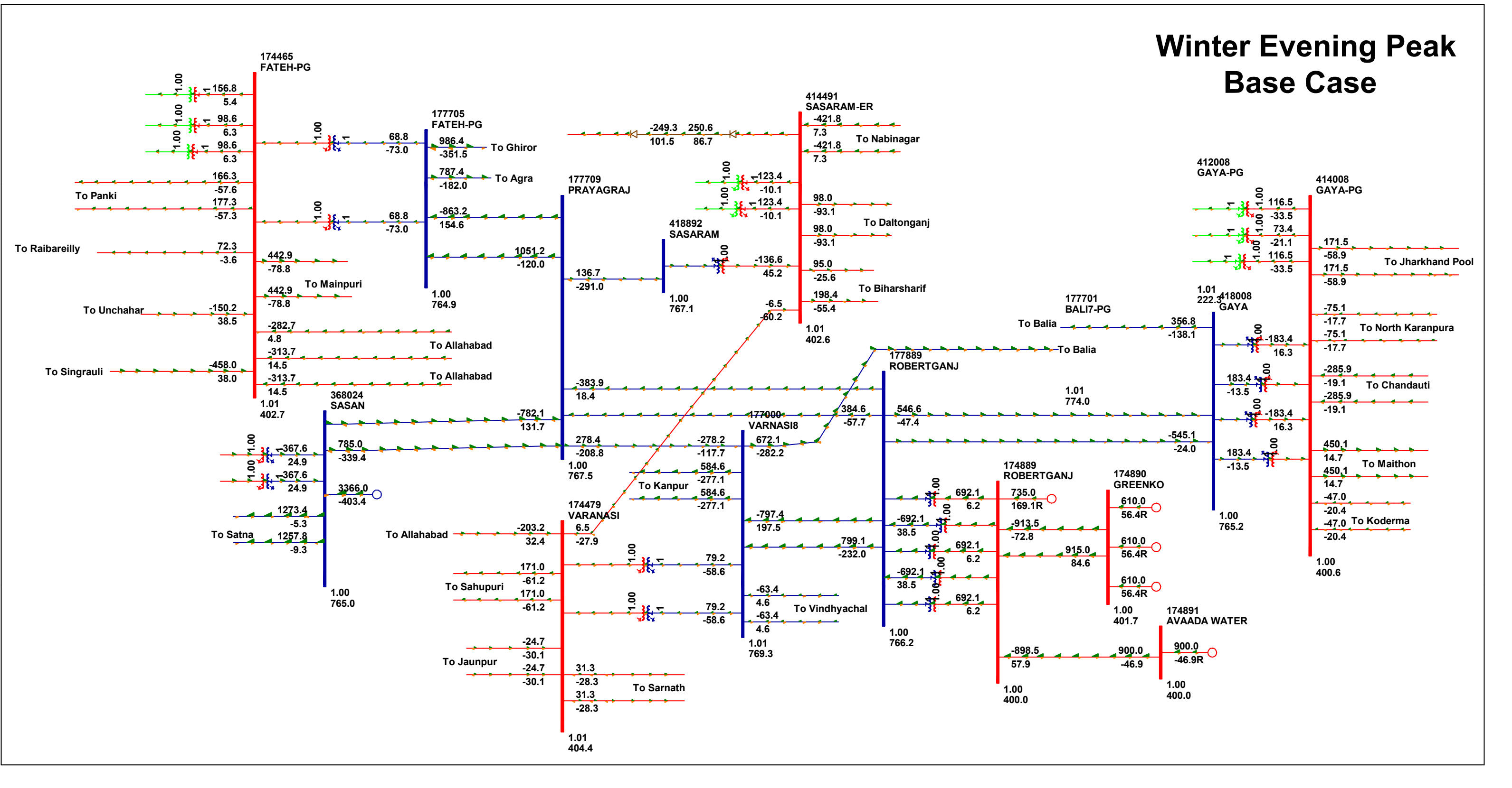
Summer Evening Peak Base Case

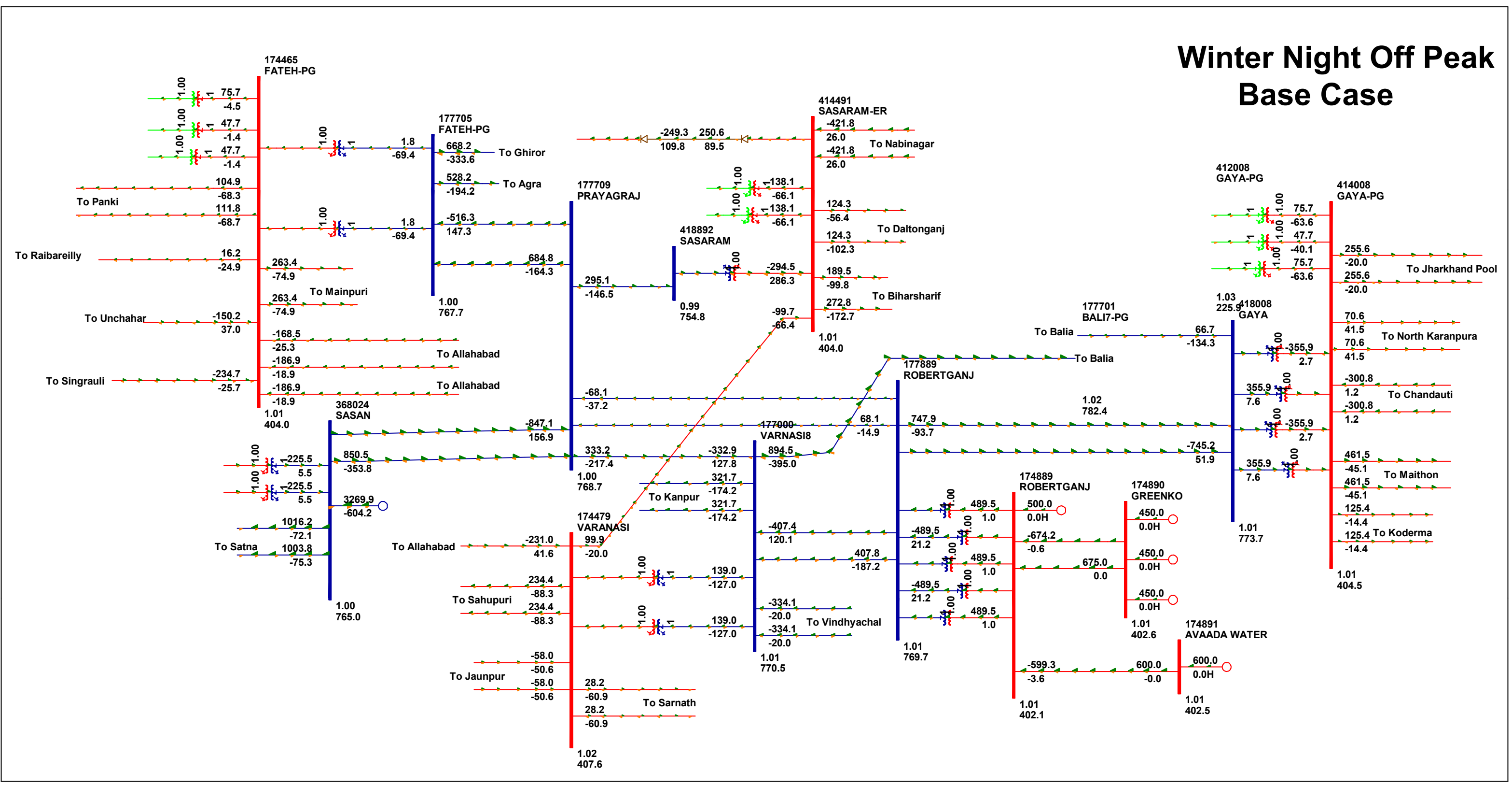


Winter Solar Max Base Case



Winter Evening Peak Base Case





Winter Night Off Peak
Base Case
174465
FATEH-PG
177705
FATEH-PG
To Ghiror
To Agra
To Panki
To Raibareilly
To Mainpuri
To Unchahar
To Allahabad
To Singrauli
177709
PRAYAGRAJ
368024
SASAN
To Satna
418892
SASARAM
414491
SASARAM-ER
To Nabinagar
To Daltonganj
To Biharsharif
177000
VARNASI8
177889
ROBERTGANJ
To Balia
177701
BALI7-PG
412008
GAYA-PG
414008
GAYA-PG
418008
GAYA
To Jharkhand Pool
To North Karanpura
To Chandauti
To Maithon
To Koderma
To Kanpur
174479
VARANASI
To Sahupuri
To Jaunpur
To Sarnath
To Vindhyachal
174889
ROBERTGANJ
174890
GREENKO
174891
AVAADA WATER

Annexure-I

Transmission System for connectivity of Pumped Storage Projects in Sonbhadra District in UP

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors **Future provisions:** ➢ 765/400kV ICTs along with bays- 2 nos. ➢ 765 kV line bays along with switchable line reactors – 6 nos. ➢ 765kV Bus Reactor along with bay: 1 no. ➢ 400 kV line bays along with switchable line reactor –6 nos. ➢ 400kV line bays : 4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400kV Sectionalization bay: 2 sets	Robertsganj PS - AIS • 765/400 kV 1500 MVA ICT- 4 nos. (13x500 MVA including one spare unit) • 765 kV ICT bays-4 no. • 400 kV ICT bays- 4 no. • 240 MVAr Bus Reactor-2 no. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for PSP interconnection)
2	LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)	a. Line Length ckt1 ~ 65 km (LILO length 65 km) b. Line Length ckt2 ~ 75 km (LILO length 75 km) • 765 kV line bays-4 nos. (at Robertsganj PS end) • 240 MVAr switchable line reactors at Robertsganj PS end – 2 nos. • Switching equipment for 240 MVAr switchable line reactors at Robertsganj PS end – 2 nos.
3	Establishment of 765 kV Prayagraj S/s near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors **Future provisions** **Space for** ➢ 765/400kV ICTs along with bays- 4 nos. ➢ 765 kV line bays along with switchable line reactors – 4 nos. ➢ 765kV Bus Reactor along with bay: 1 nos. ➢ 400 kV line bays along with switchable line reactor –4 nos. ➢ 400kv line bays : 2 nos. ➢ 400 kV Bus Reactor along with bays: 2 no. ➢ 400kV Sectionalization bay: 1 set	Prayagraj S/s -AIS • 330 MVAr Bus Reactor-2 nos. (7x110 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no.

4	LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj	Line Length ~15 km (LILO length 15km) • 765 kV line bays -2 nos.(at Prayagraj S/s end)
5	LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj	Line Length ~14 km (LILO length 14km) • 765 kV line bays-2 nos..(at Prayagraj S/s end)
6	Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line	Line Length – (~185 km) • 765 kV line bays at Robertsganj PS – 2 nos. • 765 kV line bays at Prayagraj S/s – 2 nos. • 765 kV, 330 MVAr switchable line reactors at Robertsganj PS – 2 nos. • Switching equipment for 765kV 330 MVAr switchable line reactors at Robertsganj PS – 2 nos. • 110 MVAr (765 kV) spare reactor single phase unit at Robertsganj PS end – 1 no.

सेंट्रल ट्रांसमिशन यूटिलिटी ऑफ इंडिया लिमिटेड
(पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड के स्वामित्व में)
(भारत सरकार का उद्यम)
CENTRAL TRANSMISSION UTILITY OF INDIA LTD.
(A wholly owned subsidiary of Power Grid Corporation of India Limited)
(A Government of India Enterprise)

Ref: CTU/N/00/CMETS_NR/34 **Date:** 08-10-2024

As per distribution list

Subject: 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region-Minutes of Meeting

Dear Sir/Ma'am,

Please find enclosed the minutes of the 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 20th September 2024 (Friday) through virtual mode.

The minutes are also available at CTU website (www.ctuil.in)

Thanking you,

Yours faithfully,

08/10/24

(Kashish Bhambhani)
General Manager (CTU)

"सौदामिनी", प्रथम तल, प्लॉट सं.2, सेक्टर-29, गुरुग्राम- 122001 (हरियाणा), दूरभाष: 0124-2822000, सीआईएन: U40100HR2020GOI091857
"Saudamini", 1st Floor, Plot No. 2, Sector-29, Gurugram-122001 (Haryana), Tel.: 0124-2822000, CIN: U40100HR2020GOI091857
Website: https://www.ctuil.in

Accordingly, the following ICT augmentation scheme is agreed at Bikaner-III PS in ISTS:

- Augmentation of 400/220 kV, 1x500 MVA (6th) ICT at Bikaner-III PS along with associated transformer bays

  Implementation Schedule: 18 months from allocation

B.5 Transmission System for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh:

It was stated that in the 31st CMETS-NR meeting held on 27.06.2, connectivity applications of cumulative quantum of 5152 MW from two developers i.e. M/s Greenko (6 nos. of applications with cumulative quantum of 4032 MW) & M/s Avaada WB (1 application of 1120MW) near Robertganj area in Sonbhadra district, Uttar Pradesh was discussed. As per the schedule indicated in the applications, these PSP projects are expected to be commissioned progressively from Nov'26 upto Mar'28. Details of applications are as under:

S.No	Applications	Connectivity (MW)	Start Date of Connectivity (As per Application)	Maximum Injection (MW)- As per application	Maximum Drawl (MW) – As per application
1	Greenko UP01 IREP Private Limited	672	16.11.2026	610	672
		672	01.02.2027	610	672
		672	16.04.2027	610	672
		672	16.04.2027	610	672
		672	01.07.2027	610	672
		672	16.12.2027	610	672
2	Avaada Waterbattery Private Limited	1120	31.03.2028	900	1120
	Total (MW)	**5152**		**4560**	**5152**

In the meeting, it was informed that to deliberate on planning of transmission System for evacuation of Power from Pumped Storage Plants, a meeting under Chairmanship of Chairperson, CEA was held on 28.05.2024. In the above meeting, it was decided that CTUIL while granting Connectivity to PSPs shall mention that PSPs shall not operate in generating mode during high RE generation period and if required, PSPs may inject power during high RE generation period based on margin available in the system. However, detail analysis must be done based on the combination of sources at that node.

M/s Greenko vide letter dated 21.05.24 informed that In the initial phases of PSP development, it is envisaged as a Stand-alone storage project, which means the PSP project will draw power from renewable generation sources or conventional generation sources located

at different location(s) in the grid for charging the pump storage plant and thereafter power will be injected into the grid for supplying power to the different beneficiaries connected to different location(s) in the grid. During PSP operation, typically during peak solar time (mainly between 11AM to 2 PM), the PSP project shall be able to draw power to the extent of 4032 MW (6X672MW) corresponding to pumping capacities of all six units. While, during generation hours which will be typically during non-solar or low solar hours, the maximum generation possible shall be to the extent of 3660 MW (6x610MW). For evolving the transmission scheme, the above-mentioned maximum values of drawl and Generation may be considered. Same was also discussed in 31st CMETS-NR meeting.

CEA in the above CMETS-NR meeting confirmed that the Sonbhadra area may be considered as a potential zone for pumped storage projects. Accordingly, the transmission system for connectivity of M/s Greenko & M/s Avaada at Roberstganj PS shall be considered as common transmission system.

CEA also informed that TOR has been issued to M/s Greenko Sonbhadra PSP (3660 MW) and presently under S&I. M/s Avaada in the meeting informed that the TOR of their project is approved and currently in pre DPR stage & they shall be submitting it to CEA for pre DPR chapter approvals.

M/s Avaada & Greenko clarified in the meeting that they shall operate PSP units in synchronous condenser mode as per the reactive power requirement of the grid. Further, M/s Greenko and M/s Avaada shall also keep future provision of Bus Reactor so that in case of future requirement the same can be installed by the applicant.

Accordingly, in the above CMETS-NR meeting, connectivity applications of M/s Avaada & Greenko were agreed for grant, and it was deliberated that the transmission scheme for Pump Storage plants in Sonbhadra district is presently under discussion. The scheme is currently tentative, which shall be finalized in subsequent CMETS-NR and other region (ER) CMETS meeting among CEA, CTUIL, Grid India & Stakeholders. The detailed transmission system shall be informed upon finalization and approval of the scheme.

Further, NR-WR inter regional scheme to relieve loading of 765 kV Vindhyachal – Varanasi D/c line shall also be required for connectivity of Pumped Storage Projects in Sonbhadra district.

In view of the above, studies were carried out considering PSPs in drawl mode in Solar Max scenarios & injection mode in Peak load scenarios (evening peak). All India Study files for various scenarios (solar maximized, evening peak and night off peak) were circulated to NR stakeholders on 12.09.24.

Subsequently, M/s Greenko had submitted requisite Connectivity BGs only for three application (3x672MW), out of 6 nos. M/s Avaada also submitted requisite Connectivity BGs for their 1120MW PSP project, therefore transmission scheme needs to be revised in view of reduction in connectivity quantum by M/s Greenko.

M/s Greenko vide letter 10.09.24 requested that as they are moving forward with three applications for their project, there may be a change in the transmission scheme from the originally planned scheme involving six Grid Connectivity applications. During CTU's review of this change in the transmission system, it may be necessary to consider including the bay implementation for terminating the dedicated transmission line at Robertsganj substation under the ISTS scope

In view of schedule of generation projects and for optimal utilization of transmission scheme, comprehensive tr. scheme is planned considering M/s Greenko and M/s Avaada PSP evacuation requirement (Maximum injection 3136MW, Maximum Drawl : 2730MW) including future requirement. However, in view of transmission being lumped elements, the planned scheme can cater upto 4 GW PSP connectivity quantum.

In the meeting, Grid-India stated to review the reactive compensation of 765kV Robertsganj PS – Prayagraj S/s D/c line. CTU stated that with proposed line reactors (240MVAr line reactor on both ends), Reactive compensation is bit on higher sider (~90%), therefore 330MVAr line at one of the end may be considered for above line based on studies. Accordingly, 330MVAr line reactor is considered at Robertsganj PS end for 765kV Robertsganj PS – Prayagraj S/s D/c line. On the query of direction of power flow from Varanasi to Robertsganj and Gaya to Robertsganj in Solar peak hours, CTU stated that during solar peak hours, PSP may operate in pumping mode and power will flow from Varanasi to Robertsganj PS and Robertsganj PS to Gaya S/s.

Grid-India enquired about line rating of 400kV Greenko- Robertsganj D/c line. CTU stated that considering three applications of 2016MW (3x672MW) of M/s Greenko, rating of dedicated line shall be considered commensurate to power transfer requirement under N-1 contingency of PSP plant.

Grid-India enquired that line reactors may be reviewed w.r.t. line length of each sections formed after proposed LILO arrangements i.e. LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj & LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj. Grid-India stated that 765kV Fatehpur – Prayagraj section may get overcompensated with existing line reactor configuration. CTU stated that after proposed LILO arrangement, reactive compensation is about 89% on 765kV Fatehpur – Prayagraj section (140 kms). Grid-India enquired about feasibility of removing 330MVAr existing line reactor at Fatehpur end or its replacement with 240MVAr line reactor. CTU stated that considering prevailing high voltage condition in NR (in some off peak scenarios), removal or replacement of 330MVAr line reactor at Fatehpur end may worsen the high voltage problem, however line length is tentative and will be reviewed in Gati Shakti portal. In the case of reduction of line length considerably, decision may be taken on removal/replacement of 330MVAr line reactor at Fatehpur end of 765kV Fatehpur – Prayagraj section (140 kms). CTU further stated that on all other line sections formed after LILO arrangement at Prayagraj S/s, reactive compensation is in order.

Grid-India enquired that whether PSP developers indicated their machine type i.e. fixed speed or variable speed type. M/s Greenko informed that they have fixed speed machines. M/s Avaada informed that they will revert on the same. M/s Greenko requested that during finalization of the scheme, 400kV bays at Robertsganj end for termination of 400kV Greenko-Robertsganj D/c line may be

considered in ISTS scope. CTU stated that as the scheme is still under approval and being revised in this meeting, same will be incorporated as part of comprehensive agreed transmission scheme and M/s Greenko shall have to fulfil Conn-BG2 requirement.

Grid-India also stated that 1200kV system may also be explored from above complex in future for evacuation of envisage PSP potential due to its proximal location form WR and ER region and firm power flow in most of the scenarios.

CTU further stated that based on agreed scheme in meeting, transmission system under applicant scope as well as common transmission system will be revised. It was also stated that M/s Avaada & Greenko shall operate PSP units in synchronous condenser mode (minimum one unit) as per the reactive power requirement of the grid.

CEA stated that both the projects are under advance stage, however DPR is yet to approve. On the query of CEA on additional generation considered at 400kV level, CTU informed that at present comprehensive scheme is planned for 4GW PSP potential and with connectivity quantum more than 4GW, adequacy of agreed transmission scheme shall be reviewed further. CEA and UPPTCL also agreed on the proposal

CTU enquired to UPPTCL about drawl requirement (220kV) from Robertsganj and Prayagraj S/s. UPPTCL stated that intra state transmission system (tentative) is already planned for evacuation of thermal power projects in the vicinity and in receipt of PSP application in future, new intra state schemes shall be planned. As part of above schemes, many new substations may be planned in intra state and can be utilized for drawl purpose of UP. Based on above, it was decided that provision of 220kV scope shall be deleted from future provisions at Robertsganj PS and Prayagraj PS, which was agreed by UPPTCL.

CTUIL in the meeting as well as their mail dated 20.09.24 requested POWERGRID to provide availability of OPGW on below lines so that provision of OPGW may be kept as part of present agreed scheme in case of non-availability of OPGW system

- 765 kV Fatehpur-Varanasi S/c line (proposed to be LILOed at Prayagraj S/s)
- 765 kV Fatehpur-Sasaram S/c line (proposed to be LILOed at Prayagraj S/s)
- 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS)

As per the inputs received from POWERGRID, OPGW is not available on the existing 765 kV Fatehpur-Varanasi S/c line & 765 kV Fatehpur-Sasaram S/c line which is proposed to be LILOed at Prayagraj S/s. Therefore, OPGW installation needs to be done to cater voice/data/tele-protection requirement for the proposed new Prayagraj S/s in matching time frame of comprehensive transmission scheme. Further as per above inputs, existing 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS), OPGW is available on the 2nd S/c of above line, therefore on other S/c line OPGW is not required as existing OPGW can be used for voice/data/tele-protection requirement for both the S/c lines as source and destination stations are same. No other comments were received.

Based on above deliberations, following ISTS transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District was agreed :

- Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station* near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors

  Future provisions at Robertsganj PS (excl. scope for present scheme): Space for

  - 765/400kV ICTs along with bays- 2 nos.
  - 765 kV line bays along with switchable line reactors – 6 nos.
  - 765kV Bus Reactor along with bay: 1 no.
  - 400 kV line bays along with switchable line reactor –6 nos.
  - 400kV line bays : 4 nos.
  - 400 kV Bus Reactor along with bays: 1 no.
  - 400kV Sectionalization bay: 2 sets

  ***along with provision of 80MVAr spare reactor (Single phase), 110MVAr (Single phase) & 500MVA spare transformer unit (Single phase)**

- 400kV line bays (4 nos.) for connectivity of PSP generation project (M/s Avaada & M/s Greenko) at Robertsganj PS
- LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS (~50 km) along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)
- Establishment of 765 kV Prayagraj S/s* near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors

  Future provisions at Prayagraj S/s (excl. scope for present scheme): Space for

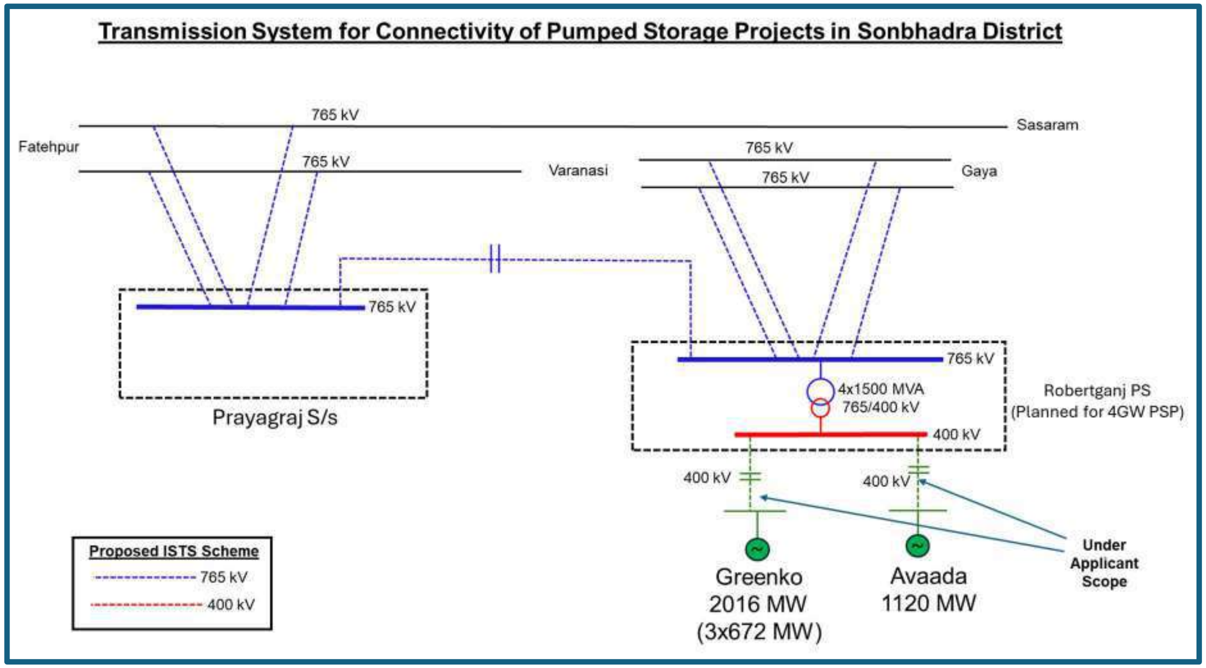
  - 765/400kV ICTs along with bays- 4 nos.
  - 765 kV line bays along with switchable line reactors – 4 nos.
  - 765kV Bus Reactor along with bay: 1 nos.
  - 400 kV line bays along with switchable line reactor –4 nos.
  - 400kv line bays : 2 nos.
  - 400 kV Bus Reactor along with bays: 2 no.
  - 400kV Sectionalization bay: 1 set

  ***along with provision of 110MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase)**

- LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj (~30 km)

- LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj (~30 km)
- Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line (~200 km)

From the studies, it was observed that considering drawl by PSPs in Peak RE hours (10AM to 2 PM), there is a requirement of additional inter-regional corridors towards WR which shall be discussed in subsequent section. However, it was gathered from Pump Storage project developers that they shall tie up with RE developers for drawing power in peak RE hours and shall be injecting power back in non RE peak hours(mainly during peak load period).



Further, Inter-regional (NR-WR) transmission System to relieve the loading of 765kV Vindhyachal-Varanasi D/c line was discussed and agreed in present meeting in subsequent section. This Inter regional transmission scheme is also required for evacuation of power from above Pumped Storage Projects in Sonbhadra District.

Annexure-III

सेंट्रल ट्रांसमिशन यूटिलिटी ऑफ इंडिया लिमिटेड
(पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड के स्वामित्व में)
(भारत सरकार का उद्यम)

CENTRAL TRANSMISSION UTILITY OF INDIA LTD.
(A wholly owned subsidiary of Power Grid Corporation of India Limited)
(A Government of India Enterprise)

संदर्भ/Ref: CTU/E/00/36th CMETS-ER

दिनांक/Date: 21-11-2024

वितरण सूची के अनुसार/ As per Distribution List

विषय/ Subject: पूर्वी क्षेत्र में पारेषण योजनाओं के विकास के लिए 36वी परामर्श बैठक के कार्यवृत्त (सीएमईटीएस-ईआर)/ Minutes of 36th Consultation Meeting for Evolving Transmission Schemes in Eastern Region (CMETS-ER)

महोदय/महोदया/ Sir/Ma'am,

पूर्वी क्षेत्र में पारेषण योजनाओं के विकास के लिए **36वी** परामर्श बैठक **29th अक्टूबर, 2024** को वीडियो कॉन्फ्रेंस के माध्यम से आयोजित की गई थी। इस संबंध में बैठक के कार्यवृत्त संलग्न है। यही CTUIL की वेबसाइट (*www.ctuil.in >> ISTS Planning & Coordination >> Consultation Meetings for ISTS >> Eastern Region*) पर भी उपलब्ध है।

The **36th** Consultation Meeting for Evolving Transmission Schemes in Eastern Region (CMETS-ER) was held on **29th October 2024** through video conferencing. In this regard, please find enclosed minutes of the meeting. The same is available on CTUIL website (*www.ctuil.in >> ISTS Planning & Coordination >> Consultation Meetings for ISTS >> Eastern Region*)

धन्यवाद/ Thanking you,

भवदीय / Yours faithfully,

राजेश कुमार
21.11.2024

(राजेश कुमार) / (Rajesh Kumar)
वरिष्ठ महाप्रबंधक (टी.पी-III & सी.पी)/ Sr. GM (TP-III & CP)

Encl.: as above

- CTU informed that applicant under Regulation 37.6 (1) of GNA Regulations, 2022 has applied for transition of 100MW Connectivity granted under Connectivity Regulations, 2009 to GNA under GNA Regulations.
- Presently, RTPS (1200MW) is connected to ISTS grid. Out of 1200MW, 446.75MW LTA granted to/from M/s RTPS was effective on firm basis, accordingly, deemed GNA of 446.75MW was provided under Regulation 18.1. Further, 144.71MW of MTOA was effective, accordingly, deemed GNA of 144.71MW was provided under Regulation 37.8(b) viz. [30MW North Central Railway till 30-11-2024; 30MW Indian Railway Gujarat (Western Railway) till 30-11-2024; 47.05MW Northern Railway till 01-12-2024; and 37.66MW North Western Railway till 07-12-2024]. Application of additional GNA of 116MW under Regulation 37.6(1) of GNA Regulations, 2022 was also agreed for grant in the 24th CMETS-ER held on 31-10-2023. Out of the balance quantum applicant vide application dated 04-10-2024 has requested for 100MW additional GNA under Regulation 37.6(1) of GNA Regulations, 2022.
- CTU further informed that the start date of said GNA has been indicated in the application as 01-11-2024, which is unrealistic. Further, considering that upon agreement for grant of GNA, Conn-BGs are to be furnished, Connectivity agreements are to be signed; accordingly, a reasonable start date of GNA may be provided by the applicant. CTU also mentioned that if applicant is able to furnish applicable Conn-BGs and complete other formalities well within the timelines, then applicant can request for early effectiveness of the GNA. Accordingly, the applicant requested to change the start date from 01-11-2024 to 01-12-2024.
- It was informed that as per system studies it is observed that the additional 100MW GNA can be granted through existing ISTS under normal and contingencies condition. **Stakeholders noted and agreed to the same.**
- CTU informed that as per Regulation 37.6 (1) (a) of the GNA Regulations *"(a) In case additional GNA as applied for under Regulation 17.2 can be granted on existing transmission system, the Nodal Agency shall grant such additional GNA on furnishing Conn-BG3 @ Rs.2 lakh/MW. Conn-BG3 shall be returned in five equal parts over the next five years starting from the year when such GNA becomes effective or in accordance with Regulation 16.2 of these regulations, whichever is later."*
- Accordingly, in terms of Regulation 37.6 (1) (a), the applicant is liable to furnish Conn-BG3 @ Rs.2 lakh/MW for grant of subject GNA. Upon receipt of Conn-BG3, intimation for grant of the subject GNA would be issued. **DVC noted and agreed.**
- In view of the above, it was agreed to grant the subject GNA of 100MW to DVC for its RTPS plant through existing ISTS.

B. ISTS expansion schemes in ER

5. Transmission system for Connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh

5.1. CTU informed that in the 31st CMETS-NR meeting held on 24-06-2024, Connectivity application of cumulative quantum of 5152MW (M/s Greenko: 4032MW and M/s Avaada: 1120MW) in Sonbhadra District, Uttar Pradesh were deliberated. Details are as under:

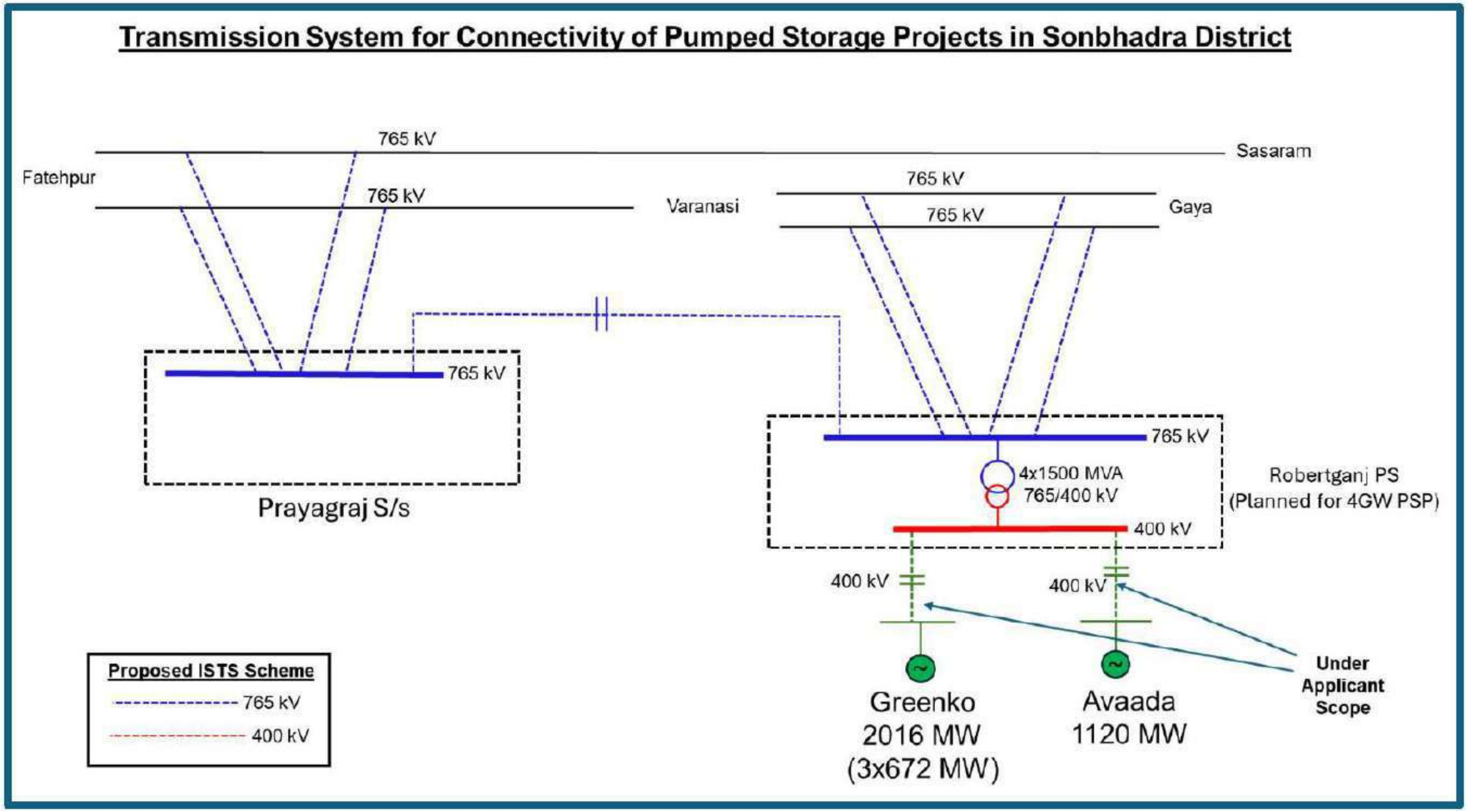
Sl. No.	Applications	Connectivity (MW)	Start Date of Connectivity (As per Application)	Maximum Injection (MW) - As per application	Maximum Drawl (MW) – As per application
1	Greenko UP01 IREP Private Limited	672	16-11-2026	610	672
		672	01-02-2027	610	672
		672	16-04-2027	610	672
		672	16-04-2027	610	672
		672	01-07-2027	610	672
		672	16-12-2027	610	672
2	Avaada Waterbattery Private Limited	1120	31-03-2028	900	1120
	Total (MW)	**5152**		**4560**	**5152**

5.2. For evacuation of power from Pumped Storage Plants, a meeting under Chairmanship of Chairperson, CEA was held on 28-05-2024. In the said meeting, it was decided that, CTUIL while granting Connectivity to PSPs shall mention that PSPs shall not operate in generating mode during high RE generation period and if required, PSPs may inject power during high RE generation period based on margin available in the system. However, detailed analysis must be done based on the combination of sources at that node.

5.3. M/s Greenko vide letter dated 21-05-2024 has mentioned that typically during Peak Solar hours, the Pump Storage Projects shall be drawing power upto the extant of 4032 MW (6x672 MW) & during non-solar hours Pump Storage Projects shall be generating upto the maximum extent of 3660 MW (6x610 MW). Accordingly, for evolving the transmission scheme, the above-mentioned maximum values of drawl and generation have been considered.

5.4. M/s Greenko had submitted requisite Connectivity BGs only for three applications (3x672MW), out of 6 nos. M/s Avaada also submitted requisite Connectivity BGs for their 1120MW PSP project, therefore transmission scheme was evolved in view of reduction in connectivity quantum by M/s Greenko. CTU informed that at present a comprehensive scheme is planned for 4GW PSP potential and with connectivity quantum more than 4GW, adequacy of agreed transmission scheme shall be reviewed further.

5.5. CEA in the 31st CMETS-NR meeting confirmed that the Sonbhadra area may be considered as a potential zone for Pumped Storage Projects. Accordingly, the transmission system for Connectivity of M/s Greenko & M/s Avaada at Roberstganj PS shall be considered as common transmission system.



5.6. In view of the above, in the 34th CMETS-NR held on 20-09-2024, Connectivity applications of M/s Avaada & M/s Greenko were agreed for grant with following transmission system:

(i) Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station* near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors

Future provisions at Robertsganj PS (excl. scope for present scheme): Space for

- 765/400kV ICTs along with bays- 2 nos.
- 765 kV line bays along with switchable line reactors – 6 nos.
- 765kV Bus Reactor along with bay: 1 no.
- 400 kV line bays along with switchable line reactor –6 nos.
- 400kV line bays : 4 nos.
- 400 kV Bus Reactor along with bays: 1 no.
- 400kV Sectionalization bay: 2 sets

*along with provision of 80MVAr spare reactor (Single phase), 110MVAr (Single phase) & 500MVA spare transformer unit (Single phase)

(ii) 400kV line bays (4 nos.) for connectivity of PSP generation project (M/s Avaada & M/s Greenko) at Robertsganj PS

(iii) LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS (~50 km) along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)

(iv) Establishment of 765 kV Prayagraj S/s* near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors

Future provisions at Prayagraj S/s (excl. scope for present scheme): Space for

- 765/400kV ICTs along with bays- 4 nos.
- 765 kV line bays along with switchable line reactors – 4 nos.
- 765kV Bus Reactor along with bay: 1 nos.
- 400 kV line bays along with switchable line reactor –4 nos.

- ➢ 400kv line bays: 2 nos.
- ➢ 400 kV Bus Reactor along with bays: 2 no.
- ➢ 400kV Sectionalization bay: 1 set

*along with provision of 110MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase)

(v) LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj (~30 km)

(vi) LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj (~30 km)

(vii) Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line (~200 km)

5.7. CTU presented the study results in the meeting and informed that the same are also available in the agenda of the 34th CMETS-NR along with other necessary details. If required, the same can be referred on CTUIL website @ https://ctuil.in/uploads/ists_consultation_meeting/agenda/172612555316Agenda%20for%2034th%20CMETS%20NR%20meeting%20to%20be%20held%20on%2019-09-2024.pdf

5.8. As per the inputs received from POWERGRID, OPGW is not available on the existing 765 kV Fatehpur-Varanasi S/c line & 765 kV Fatehpur-Sasaram S/c line which is proposed to be LILOed at Prayagraj S/s. Therefore, OPGW installation needs to be done to cater voice/data/tele-protection requirement for the proposed new Prayagraj S/s in matching time frame of comprehensive transmission scheme. Further as per above inputs, existing 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS), OPGW is available on the 2nd S/c of above line, therefore on other S/c line OPGW is not required as existing OPGW can be used for voice/data/tele-protection requirement for both the S/c lines as source and destination stations are same.

5.9. Grid-India stated that 765kV Fatehpur – Prayagraj section may get overcompensated with existing line reactor configuration. CTU stated that after proposed LILO arrangement, reactive compensation is about 89% on 765kV Fatehpur – Prayagraj section (140 kms). Grid-India enquired about feasibility of removing 330MVAr existing line reactor at Fatehpur end or its replacement with 240MVAr line reactor. CTU stated that considering prevailing high voltage condition in NR (in some off-peak scenarios), removal or replacement of 330MVAr line reactor at Fatehpur end may worsen the high voltage problem, however line length is tentative and will be reviewed in Gati Shakti portal. In the case of reduction of line length considerably, decision may be taken on removal/replacement of 330MVAr line reactor at Fatehpur end of 765kV Fatehpur – Prayagraj section (140 kms). CTU further stated that on all other line sections formed after LILO arrangement at Prayagraj S/s, reactive compensation is in order.

5.10. After detailed deliberations, the ISTS scheme/scope of works mentioned in paras 5.5 and 5.6 above were agreed.

6. Status of DTL of M/s JSW Energy (Utkal) Limited (JSWEUL)

6.1. CTU informed that connectivity of 700MW (2x350MW) has been granted to M/s JSW Energy (Utkal) Limited for its thermal generation project in Odisha on existing ISTS through DTL viz. JSW – Sundargarh (Jharsuguda) (ISTS) 400kV D/c (Twin Mosse) line.

6.2. Presently, evacuation of power from M/s JSW is taking place through interim arrangement viz. connection of one circuit of OPGC – Sundargarh 400 kV D/c ISTS line at suitable cross over point of IBEUL – Sundargarh (Jharsuguda) 400kV D/c line so as to form OPGC – IBEUL – Sundargarh 400 kV S/c line. In the meeting convened by CEA on 26-07-2024, it was agreed that "*IBEUL to complete the work of DTL by November 2024. CEA shall monitor the status of DTL fortnightly. M/s IBEUL to send fortnightly progress reports to CEA, ERPC, CTU, ERLDC, and OPTCL."*

6.3. M/s JSWEUL presented the updated status in the meeting. The balance quantity includes 1 no. foundation, 3 nos. tower erection, 4 nos. tower strengthening and 4 km stringing. Upon enquiry from OPTCL, M/s JSWEUL informed that the balance 1 no. foundation is in the MCL area where there are RoW issues. M/s JSWEUL mentioned that they are actively pursuing the matter with MCL and are confident that the DTL shall be completed and commissioned by Nov 2024.

6.4. The progress of DTL was noted and M/s JSWEUL was requested to put all efforts to complete the DTL as per agreed timeline of Nov 2024. **M/s JSWEUL noted and agreed.**

7. Status of downstream 220kV or 132kV network by STUs from the various commissioned and under-construction ISTS substations in ER

7.1. Numbers of ISTS sub-stations have been commissioned and some are under construction for which the downstream system is being implemented by the STUs. Based on the information provided by the states, updated information on planned/under-construction downstream system is given at **Annexure-II**.

7.2. STUs may update the status of the downstream system given at **Annexure-II** prior to the meeting for further deliberations in the meeting, if any.

Enclosure-II

Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line

S. No.	Items	Details
1.	Name of Scheme	**Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line**
2.	Scope of the scheme	• 765kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line(~220Km) • Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line (Bypassing length~1Km) Details of Transmission scheme is enclosed in ***Annexure-I.***
3.	Depiction of the scheme on Transmission Grid Map	Attached at **Exhibit-I**
4.	Upstream/downstream system associated with the scheme	765kV Prayagraj S/s along with LILO of 765kV Sasaram-Fatehpur line & 765kV Varanasi -Fatehpur line at 765 Prayagraj S/s & its interconnection with Robertsganj PS at 765kV level is planned as part of Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District. Uttar Pradesh. 765/400kV Sasan, is the existing switchyard of Sasan Power (SPL). 765/400kV Sasan S/s is presently interconnected with Satna(PG) & Vindhyachal Pool (PG) at 765kV level as well as with Vindhyachal PS at 400kV level. The 400kV interconnection is proposed to be changed to Vindhyachal-IV generating station as part of evacuation system for Singrauli-III (800MW) expansion project. 765/400kV Vindhyachal Pool is the existing substation of POWERGRID. 765/400kV Vindhyachal Pool is presently interconnected with Sasan, Satna, Jabalpur Pool & Varanasi substations at 765kV level and with Rihand & Vindhyachal-IV/V at 400kV level. As part of evacuation system for Singrauli-III (800MW) expansion project, Vindhyachal-IV is being redirected to Sasan switchyard at 400kV level & Singrauli-III/Vindhyachal-V are proposed to be interconnected at Vindhyachal PS at 400kV level.
5.	Objective / Justification	1. The present scheme comprises Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line. 2. In the 34th CMETS-NR meeting held on 20.09.2024, It was deliberated that as per discussion in 220th NR-OCC meeting held on 19.06.24, it is being observed that the flow on WR-NR corridor is very high and issues related to high loading of 765 kV Vindhyachal – Varanasi D/C during high NR Import

S. No.	Items	Details
		are being observed in real-time at the time of high demand in UP. 3. Further, due to this high loading of 765kV Vindhyachal-Varanasi D/c, violation of WR-NR ATC and NR simultaneous import is also being observed in real-time. WR-NR ATC violations in real-time would lead to situation wherein NR states would not be able to draw further power from Western region and as a result, may need to resort to over drawl or load shedding in case internal generation in NR is not available. 4. The issue was also highlighted by Grid-India in the meeting chaired by Addl. Secretary (MOP) on 29.05.24 & subsequent meeting in CEA regarding transmission constraints in Inter state and Intra state transmission system. It was deliberated that under N-1 contingency of one ckt of 765kV Vindhayachal-Varanasi D/c line may over load the other ckt. In the meeting CTU stated that line loadings will be reviewed along with transmission scheme to be planned with PSP generation. In view of that studies were carried out and comprehensive transmission scheme was evolved to resolve critical loading of 765kV Vindhyachal-Varanasi D/c line in N-1 Contingency condition as well as for evacuation of PSP projects in UP. 5. In the 34th CMETS-NR meeting, UPPTCL stated that 765/400kV Fatehpur S/s is being implemented as part of Bhadla-III – Fatehpur HVDC transmission system. UPPTCL requested to explore feasibility of interconnection of Fatehpur S/s with Sasan/Vindhyachal PS to relieve high loading. CTU stated that as deliberated earlier, loading of 765kV Vindhyachal-Varanasi D/c line is already high and with envisaged PSP generation, loadings will further increase in 2027-28 time frame. CTU further stated that 765/400kV Fatehpur S/s will only be available in 2029 timeframe and about 300kms from Sasan S/s. Considering above it is not feasible to utilize Fatehpur S/s for WR-NR inter regional link. CTU informed that in planning of future ISTS transmission schemes, utilization of 765/400kV Fatehpur S/s (being implemented as part of HVDC scheme) shall be explored with additional envisaged PSP potential (beyond 4GW). Grid-India and CEA agreed on the present proposal. It was also agreed that above strengthening scheme is required urgently to relieve the loading of 765kV Vindhyachal-Varanasi D/c line. 6. The NR-WR inter regional strengthening scheme was also agreed in the 32nd CMETS-WR meeting held on 24.09.24 7. Considering above deliberations, Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line was agreed in 34th CMETS-NR meeting held on 20.09.2024
6.	**Estimated Cost**	**Rs. 1876 Cr.**
7.	**Need of phasing, if any**	Not Applicable
8.	**Implementation timeframe**	24 months from allocation of project

S. No.	Items	Details
9.	**System Study for evolution of the proposal**	Studies discussed and agreed in following meeting • 34th CMETS-NR meeting held on 20.09.24 (Minutes of meeting attached in **Annexure-II**) • 32th CMETS-WR meeting held on 24.09.24 (Minutes of meeting attached in **Annexure-III**) Load flow results is attached at **Exhibit-II**

Exhibit-I

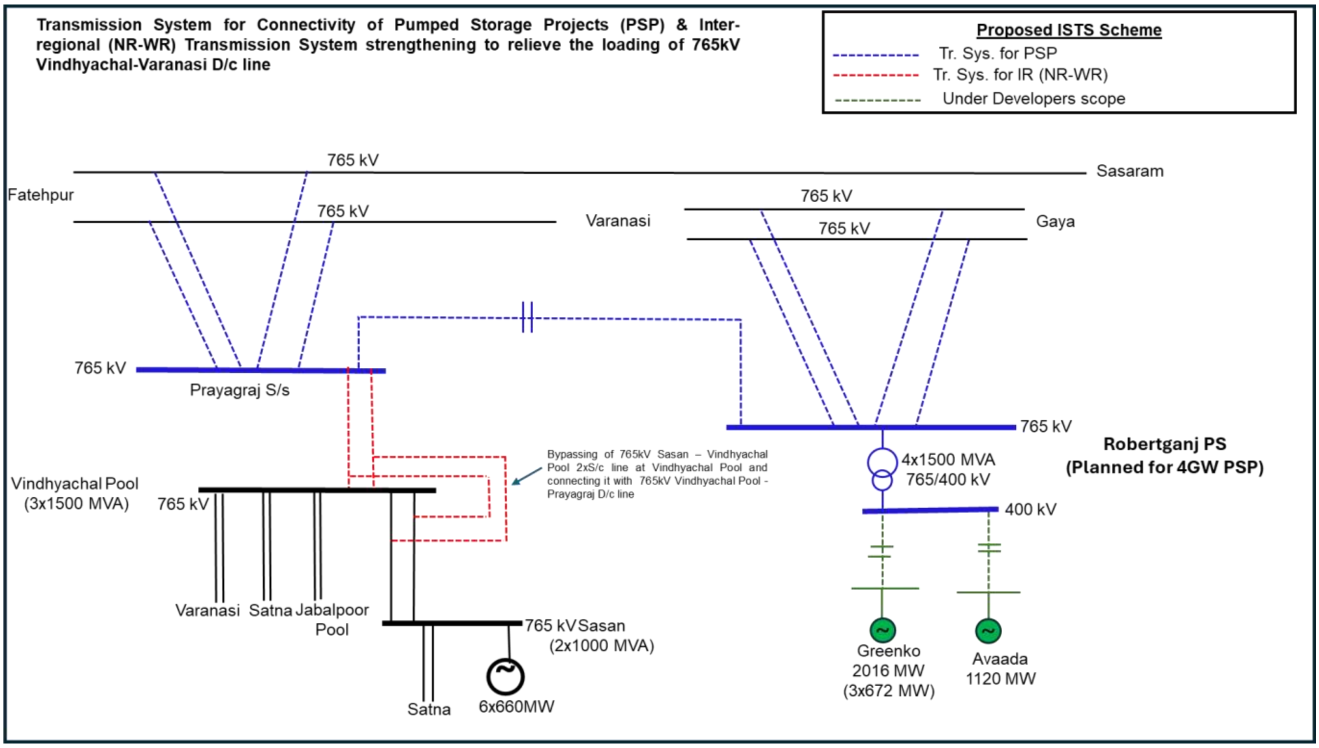
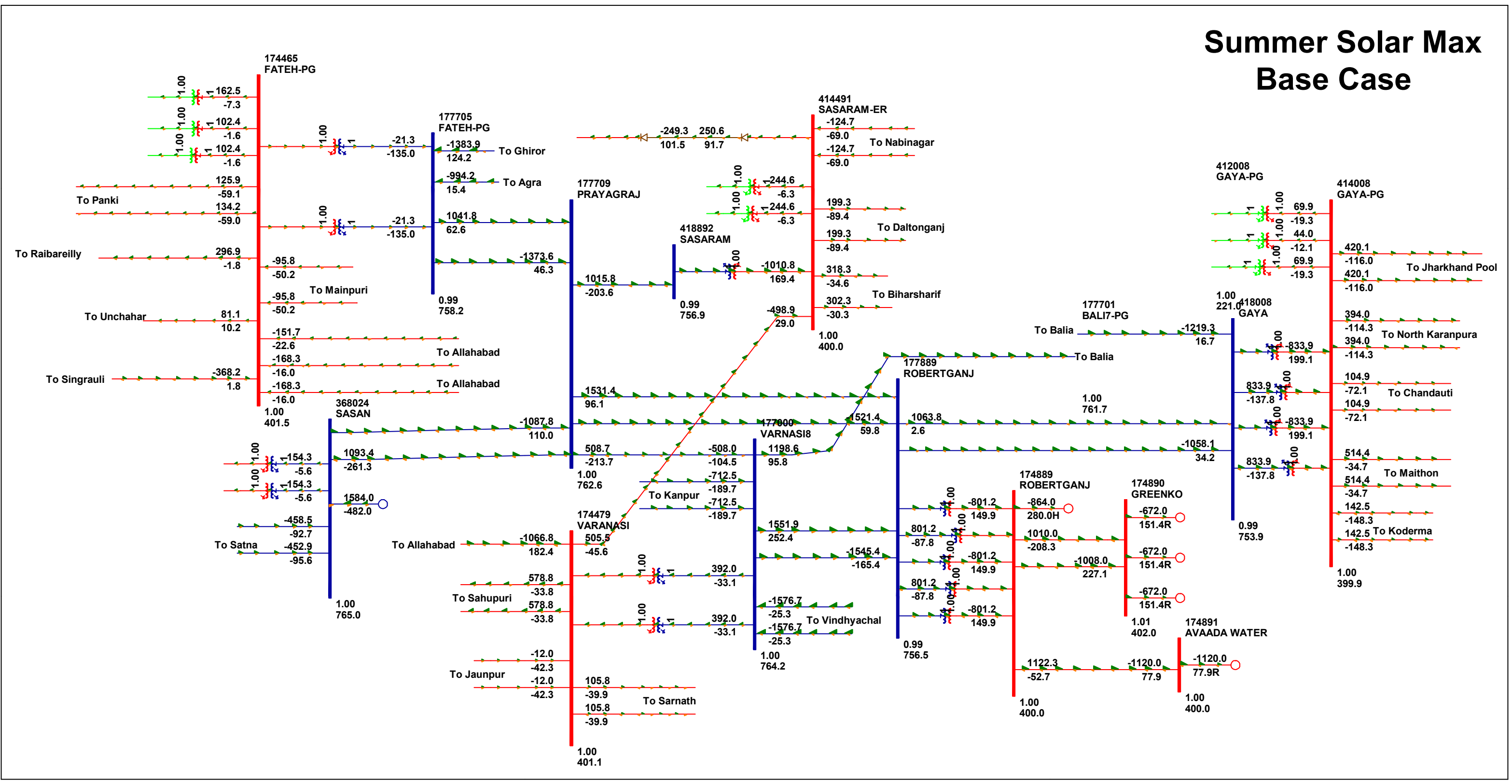
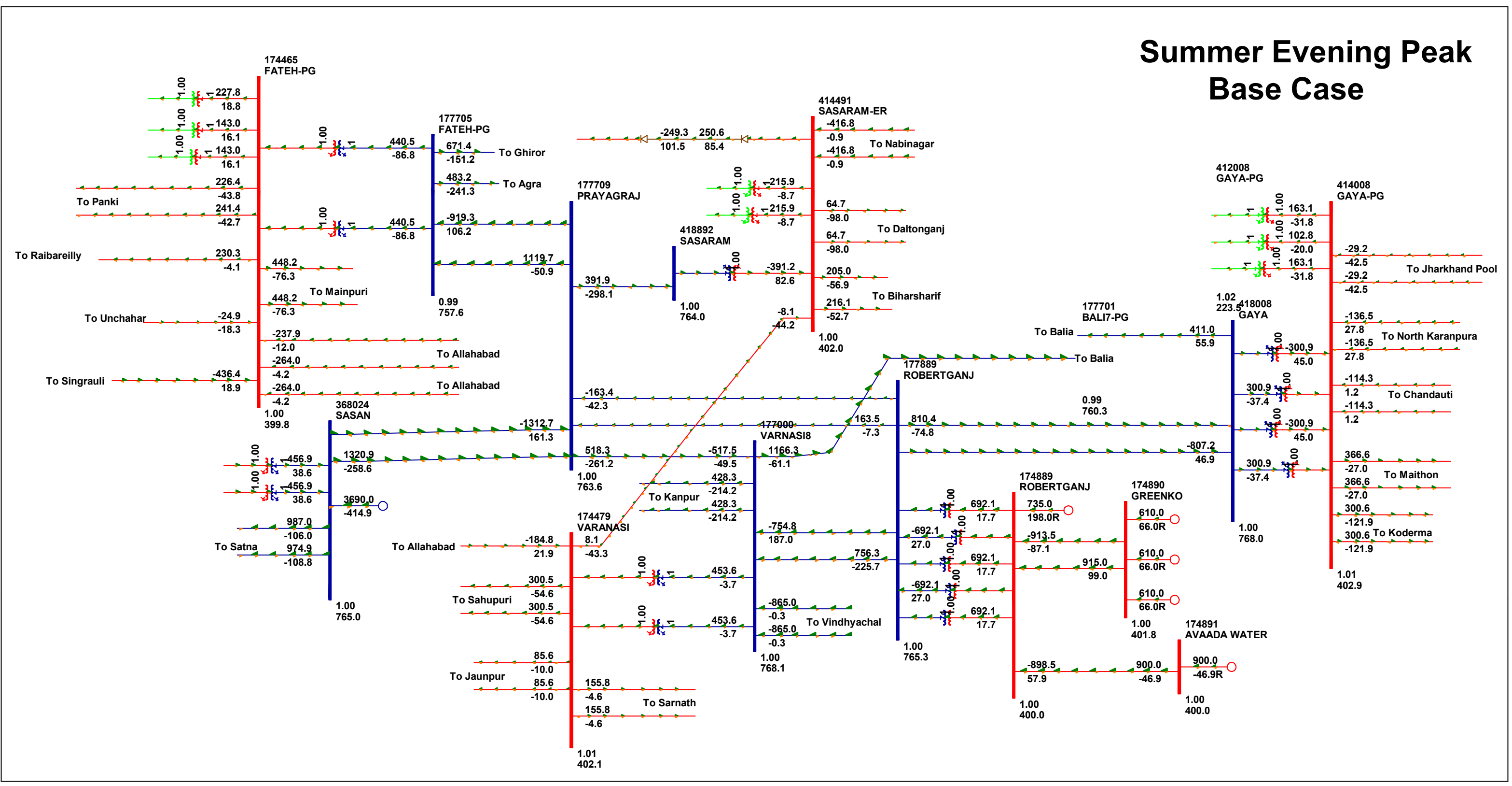


Fig : Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line

Exhibit-II



Summer Solar Max
Base Case
174465
FATEH-PG
177705
FATEH-PG
177709
PRAYAGRAJ
418892
SASARAM
414491
SASARAM-ER
412008
GAYA-PG
414008
GAYA-PG
418008
GAYA
177701
BALI7-PG
177889
ROBERTGANJ
174889
ROBERTGANJ
174890
GREENKO
174891
AVAADA WATER
368024
SASAN
177600
VARNASI8
174479
VARANASI
To Panki
To Raibareilly
To Unchahar
To Singrauli
To Mainpuri
To Allahabad
To Ghiror
To Agra
To Nabinagar
To Daltonganj
To Biharsharif
To Balia
To Jharkhand Pool
To North Karanpura
To Chandauti
To Maithon
To Koderma
To Satna
To Kanpur
To Sahupuri
To Jaunpur
To Sarnath
To Vindhyachal


Summer Evening Peak
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GREENKO
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AVAADA WATER
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To Unchahar
To Singrauli
To Mainpuri
To Allahabad
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To Ghiror
To Agra
To Nabinagar
To Daltonganj
To Biharsharif
To Balia
To Balia
To Jharkhand Pool
To North Karanpura
To Chandauti
To Maithon
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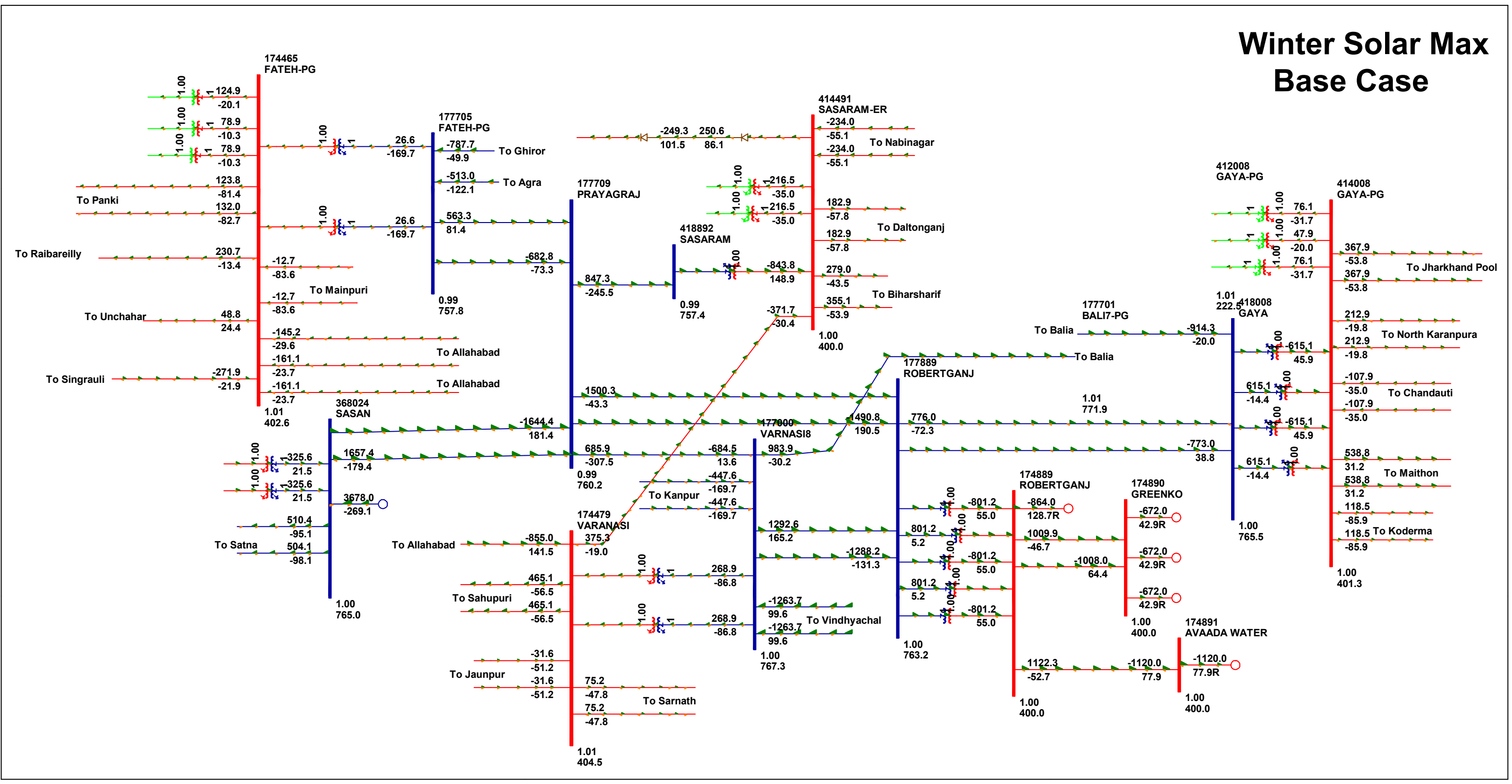
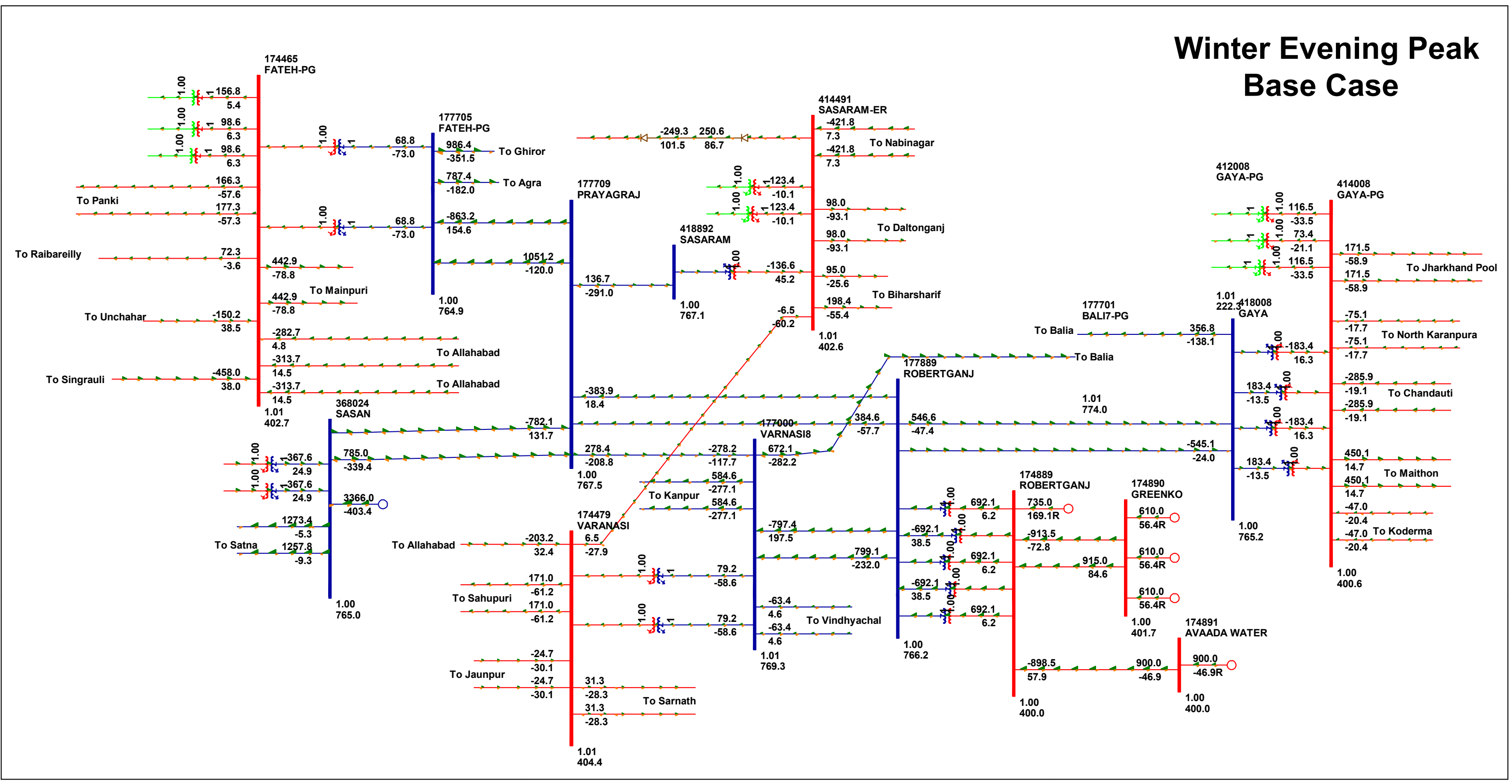
To Kanpur
To Sahupuri
To Jaunpur
To Sarnath
To Vindhyachal

Winter Solar Max Base Case

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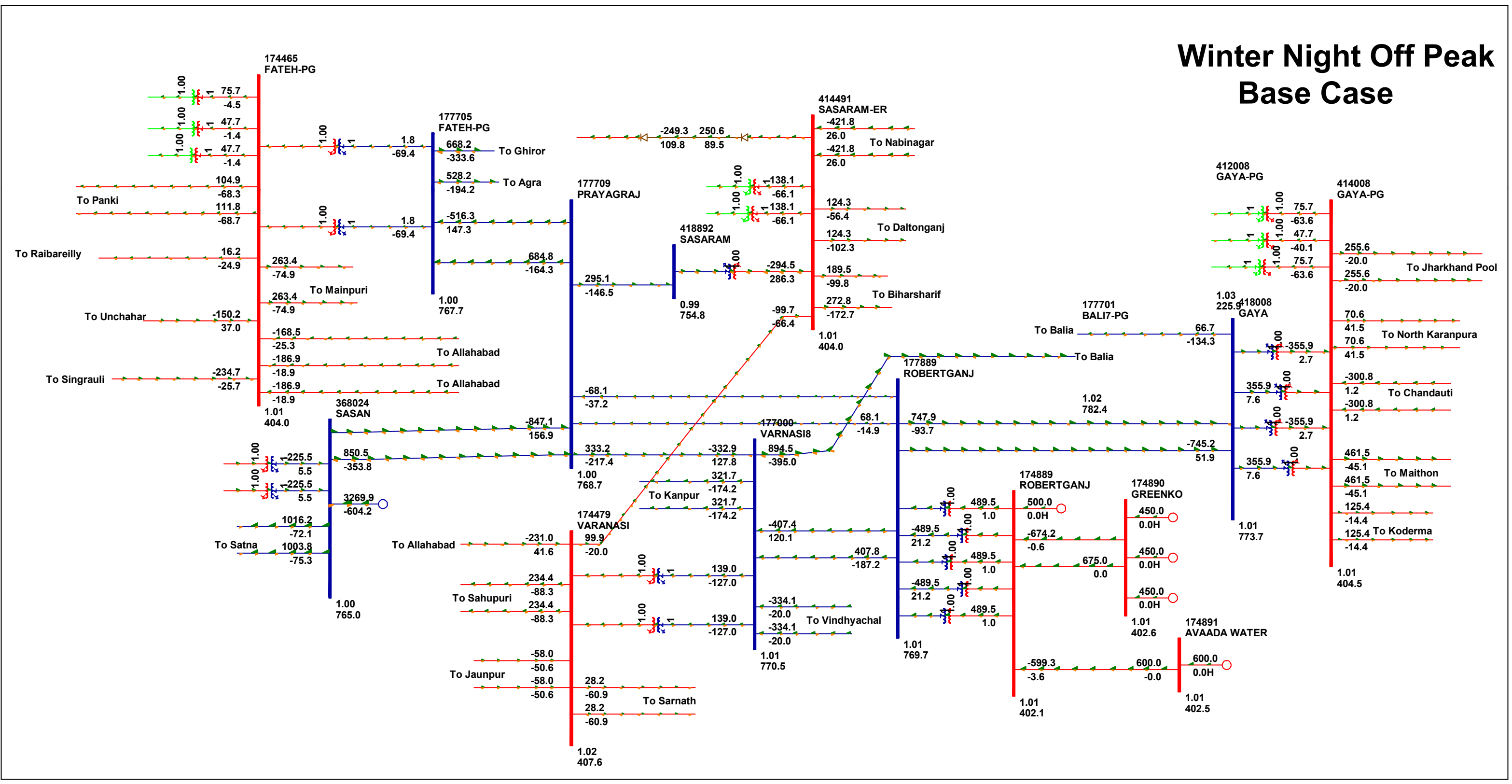
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To Satna
To Allahabad
To Kanpur
To Sahupuri
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To Sarnath
To Vindhyachal

Annexure-I

Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	765kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line	Line Length – (~220 km) • 765 kV line bays at Prayagraj S/s – 2 nos. • 765 kV, 330 MVAr switchable line reactors at Prayagraj end – 2 nos. • Switching equipment for 765kV 330 MVAr switchable line reactors at Prayagraj S/s – 2 nos.
2	Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line	Line Length - 1km (~0.5x2)

सेंट्रल ट्रांसमिशन यूटिलिटी ऑफ इंडिया लिमिटेड
(पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड के स्वामित्व में)
(भारत सरकार का उद्यम)
CENTRAL TRANSMISSION UTILITY OF INDIA LTD.
(A wholly owned subsidiary of Power Grid Corporation of India Limited)
(A Government of India Enterprise)

Ref: CTU/N/00/CMETS_NR/34 **Date:** 08-10-2024

As per distribution list

Subject: 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region-Minutes of Meeting

Dear Sir/Ma'am,

Please find enclosed the minutes of the 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 20th September 2024 (Friday) through virtual mode.

The minutes are also available at CTU website (www.ctuil.in)

Thanking you,

Yours faithfully,

08/10/24

(Kashish Bhambhani)
General Manager (CTU)

Accordingly, the following ICT augmentation scheme is agreed at Bikaner-III PS in ISTS:

- Augmentation of 400/220 kV, 1x500 MVA (6th) ICT at Bikaner-III PS along with associated transformer bays

  Implementation Schedule: 18 months from allocation

B.5 Transmission System for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh:

It was stated that in the 31st CMETS-NR meeting held on 27.06.2, connectivity applications of cumulative quantum of 5152 MW from two developers i.e. M/s Greenko (6 nos. of applications with cumulative quantum of 4032 MW) & M/s Avaada WB (1 application of 1120MW) near Robertganj area in Sonbhadra district, Uttar Pradesh was discussed. As per the schedule indicated in the applications, these PSP projects are expected to be commissioned progressively from Nov'26 upto Mar'28. Details of applications are as under:

S.No	Applications	Connectivity (MW)	Start Date of Connectivity (As per Application)	Maximum Injection (MW)- As per application	Maximum Drawl (MW) – As per application
1	Greenko UP01 IREP Private Limited	672	16.11.2026	610	672
		672	01.02.2027	610	672
		672	16.04.2027	610	672
		672	16.04.2027	610	672
		672	01.07.2027	610	672
		672	16.12.2027	610	672
2	Avaada Waterbattery Private Limited	1120	31.03.2028	900	1120
	Total (MW)	**5152**		**4560**	**5152**

In the meeting, it was informed that to deliberate on planning of transmission System for evacuation of Power from Pumped Storage Plants, a meeting under Chairmanship of Chairperson, CEA was held on 28.05.2024. In the above meeting, it was decided that CTUIL while granting Connectivity to PSPs shall mention that PSPs shall not operate in generating mode during high RE generation period and if required, PSPs may inject power during high RE generation period based on margin available in the system. However, detail analysis must be done based on the combination of sources at that node.

M/s Greenko vide letter dated 21.05.24 informed that In the initial phases of PSP development, it is envisaged as a Stand-alone storage project, which means the PSP project will draw power from renewable generation sources or conventional generation sources located

at different location(s) in the grid for charging the pump storage plant and thereafter power will be injected into the grid for supplying power to the different beneficiaries connected to different location(s) in the grid. During PSP operation, typically during peak solar time (mainly between 11AM to 2 PM), the PSP project shall be able to draw power to the extent of 4032 MW (6X672MW) corresponding to pumping capacities of all six units. While, during generation hours which will be typically during non-solar or low solar hours, the maximum generation possible shall be to the extent of 3660 MW (6x610MW). For evolving the transmission scheme, the above-mentioned maximum values of drawl and Generation may be considered. Same was also discussed in 31st CMETS-NR meeting.

CEA in the above CMETS-NR meeting confirmed that the Sonbhadra area may be considered as a potential zone for pumped storage projects. Accordingly, the transmission system for connectivity of M/s Greenko & M/s Avaada at Roberstganj PS shall be considered as common transmission system.

CEA also informed that TOR has been issued to M/s Greenko Sonbhadra PSP (3660 MW) and presently under S&I. M/s Avaada in the meeting informed that the TOR of their project is approved and currently in pre DPR stage & they shall be submitting it to CEA for pre DPR chapter approvals.

M/s Avaada & Greenko clarified in the meeting that they shall operate PSP units in synchronous condenser mode as per the reactive power requirement of the grid. Further, M/s Greenko and M/s Avaada shall also keep future provision of Bus Reactor so that in case of future requirement the same can be installed by the applicant.

Accordingly, in the above CMETS-NR meeting, connectivity applications of M/s Avaada & Greenko were agreed for grant, and it was deliberated that the transmission scheme for Pump Storage plants in Sonbhadra district is presently under discussion. The scheme is currently tentative, which shall be finalized in subsequent CMETS-NR and other region (ER) CMETS meeting among CEA, CTUIL, Grid India & Stakeholders. The detailed transmission system shall be informed upon finalization and approval of the scheme.

Further, NR-WR inter regional scheme to relieve loading of 765 kV Vindhyachal – Varanasi D/c line shall also be required for connectivity of Pumped Storage Projects in Sonbhadra district.

In view of the above, studies were carried out considering PSPs in drawl mode in Solar Max scenarios & injection mode in Peak load scenarios (evening peak). All India Study files for various scenarios (solar maximized, evening peak and night off peak) were circulated to NR stakeholders on 12.09.24.

Subsequently, M/s Greenko had submitted requisite Connectivity BGs only for three application (3x672MW), out of 6 nos. M/s Avaada also submitted requisite Connectivity BGs for their 1120MW PSP project, therefore transmission scheme needs to be revised in view of reduction in connectivity quantum by M/s Greenko.

M/s Greenko vide letter 10.09.24 requested that as they are moving forward with three applications for their project, there may be a change in the transmission scheme from the originally planned scheme involving six Grid Connectivity applications. During CTU's review of this change in the transmission system, it may be necessary to consider including the bay implementation for terminating the dedicated transmission line at Robertsganj substation under the ISTS scope

In view of schedule of generation projects and for optimal utilization of transmission scheme, comprehensive tr. scheme is planned considering M/s Greenko and M/s Avaada PSP evacuation requirement (Maximum injection 3136MW, Maximum Drawl : 2730MW) including future requirement. However, in view of transmission being lumped elements, the planned scheme can cater upto 4 GW PSP connectivity quantum.

In the meeting, Grid-India stated to review the reactive compensation of 765kV Robertsganj PS – Prayagraj S/s D/c line. CTU stated that with proposed line reactors (240MVAr line reactor on both ends), Reactive compensation is bit on higher sider (~90%), therefore 330MVAr line at one of the end may be considered for above line based on studies. Accordingly, 330MVAr line reactor is considered at Robertsganj PS end for 765kV Robertsganj PS – Prayagraj S/s D/c line. On the query of direction of power flow from Varanasi to Robertsganj and Gaya to Robertsganj in Solar peak hours, CTU stated that during solar peak hours, PSP may operate in pumping mode and power will flow from Varanasi to Robertsganj PS and Robertsganj PS to Gaya S/s.

Grid-India enquired about line rating of 400kV Greenko- Robertsganj D/c line. CTU stated that considering three applications of 2016MW (3x672MW) of M/s Greenko, rating of dedicated line shall be considered commensurate to power transfer requirement under N-1 contingency of PSP plant.

Grid-India enquired that line reactors may be reviewed w.r.t. line length of each sections formed after proposed LILO arrangements i.e. LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj & LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj. Grid-India stated that 765kV Fatehpur – Prayagraj section may get overcompensated with existing line reactor configuration. CTU stated that after proposed LILO arrangement, reactive compensation is about 89% on 765kV Fatehpur – Prayagraj section (140 kms). Grid-India enquired about feasibility of removing 330MVAr existing line reactor at Fatehpur end or its replacement with 240MVAr line reactor. CTU stated that considering prevailing high voltage condition in NR (in some off peak scenarios), removal or replacement of 330MVAr line reactor at Fatehpur end may worsen the high voltage problem, however line length is tentative and will be reviewed in Gati Shakti portal. In the case of reduction of line length considerably, decision may be taken on removal/replacement of 330MVAr line reactor at Fatehpur end of 765kV Fatehpur – Prayagraj section (140 kms). CTU further stated that on all other line sections formed after LILO arrangement at Prayagraj S/s, reactive compensation is in order.

Grid-India enquired that whether PSP developers indicated their machine type i.e. fixed speed or variable speed type. M/s Greenko informed that they have fixed speed machines. M/s Avaada informed that they will revert on the same. M/s Greenko requested that during finalization of the scheme, 400kV bays at Robertsganj end for termination of 400kV Greenko-Robertsganj D/c line may be

considered in ISTS scope. CTU stated that as the scheme is still under approval and being revised in this meeting, same will be incorporated as part of comprehensive agreed transmission scheme and M/s Greenko shall have to fulfil Conn-BG2 requirement.

Grid-India also stated that 1200kV system may also be explored from above complex in future for evacuation of envisage PSP potential due to its proximal location form WR and ER region and firm power flow in most of the scenarios.

CTU further stated that based on agreed scheme in meeting, transmission system under applicant scope as well as common transmission system will be revised. It was also stated that M/s Avaada & Greenko shall operate PSP units in synchronous condenser mode (minimum one unit) as per the reactive power requirement of the grid.

CEA stated that both the projects are under advance stage, however DPR is yet to approve. On the query of CEA on additional generation considered at 400kV level, CTU informed that at present comprehensive scheme is planned for 4GW PSP potential and with connectivity quantum more than 4GW, adequacy of agreed transmission scheme shall be reviewed further. CEA and UPPTCL also agreed on the proposal

CTU enquired to UPPTCL about drawl requirement (220kV) from Robertsganj and Prayagraj S/s. UPPTCL stated that intra state transmission system (tentative) is already planned for evacuation of thermal power projects in the vicinity and in receipt of PSP application in future, new intra state schemes shall be planned. As part of above schemes, many new substations may be planned in intra state and can be utilized for drawl purpose of UP. Based on above, it was decided that provision of 220kV scope shall be deleted from future provisions at Robertsganj PS and Prayagraj PS, which was agreed by UPPTCL.

CTUIL in the meeting as well as their mail dated 20.09.24 requested POWERGRID to provide availability of OPGW on below lines so that provision of OPGW may be kept as part of present agreed scheme in case of non-availability of OPGW system

- 765 kV Fatehpur-Varanasi S/c line (proposed to be LILOed at Prayagraj S/s)
- 765 kV Fatehpur-Sasaram S/c line (proposed to be LILOed at Prayagraj S/s)
- 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS)

As per the inputs received from POWERGRID, OPGW is not available on the existing 765 kV Fatehpur-Varanasi S/c line & 765 kV Fatehpur-Sasaram S/c line which is proposed to be LILOed at Prayagraj S/s. Therefore, OPGW installation needs to be done to cater voice/data/tele-protection requirement for the proposed new Prayagraj S/s in matching time frame of comprehensive transmission scheme. Further as per above inputs, existing 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS), OPGW is available on the 2nd S/c of above line, therefore on other S/c line OPGW is not required as existing OPGW can be used for voice/data/tele-protection requirement for both the S/c lines as source and destination stations are same. No other comments were received.

Based on above deliberations, following ISTS transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District was agreed :

- Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station* near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors

  Future provisions at Robertsganj PS (excl. scope for present scheme): Space for

  - 765/400kV ICTs along with bays- 2 nos.
  - 765 kV line bays along with switchable line reactors – 6 nos.
  - 765kV Bus Reactor along with bay: 1 no.
  - 400 kV line bays along with switchable line reactor –6 nos.
  - 400kV line bays : 4 nos.
  - 400 kV Bus Reactor along with bays: 1 no.
  - 400kV Sectionalization bay: 2 sets

  ***along with provision of 80MVAr spare reactor (Single phase), 110MVAr (Single phase) & 500MVA spare transformer unit (Single phase)**

- 400kV line bays (4 nos.) for connectivity of PSP generation project (M/s Avaada & M/s Greenko) at Robertsganj PS
- LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS (~50 km) along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)
- Establishment of 765 kV Prayagraj S/s* near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors

  Future provisions at Prayagraj S/s (excl. scope for present scheme): Space for

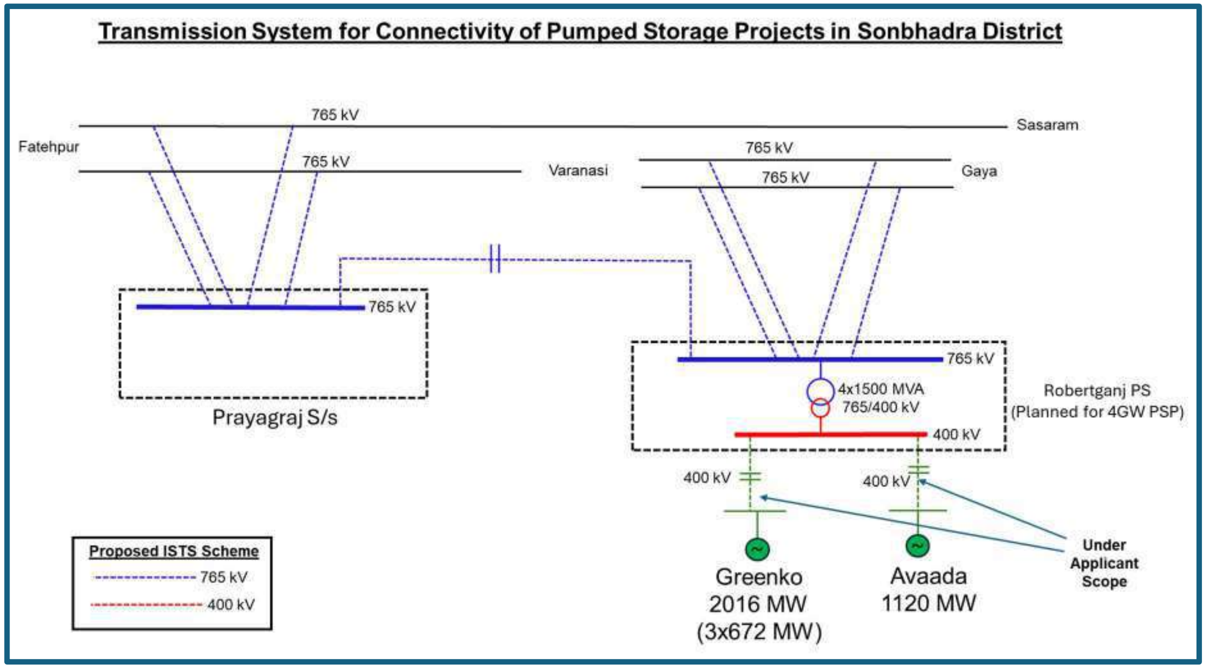
  - 765/400kV ICTs along with bays- 4 nos.
  - 765 kV line bays along with switchable line reactors – 4 nos.
  - 765kV Bus Reactor along with bay: 1 nos.
  - 400 kV line bays along with switchable line reactor –4 nos.
  - 400kv line bays : 2 nos.
  - 400 kV Bus Reactor along with bays: 2 no.
  - 400kV Sectionalization bay: 1 set

  ***along with provision of 110MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase)**

- LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj (~30 km)

- LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj (~30 km)
- Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line (~200 km)

From the studies, it was observed that considering drawl by PSPs in Peak RE hours (10AM to 2 PM), there is a requirement of additional inter-regional corridors towards WR which shall be discussed in subsequent section. However, it was gathered from Pump Storage project developers that they shall tie up with RE developers for drawing power in peak RE hours and shall be injecting power back in non RE peak hours(mainly during peak load period).



Further, Inter-regional (NR-WR) transmission System to relieve the loading of 765kV Vindhyachal-Varanasi D/c line was discussed and agreed in present meeting in subsequent section. This Inter regional transmission scheme is also required for evacuation of power from above Pumped Storage Projects in Sonbhadra District.

सेंट्रल ट्रांसमिशन यूटिलिटी ऑफ इंडिया लिमिटेड
(पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड के स्वामित्व में)
(भारत सरकार का उद्यम)

CENTRAL TRANSMISSION UTILITY OF INDIA LTD.
(A wholly owned subsidiary of Power Grid Corporation of India Limited)
(A Government of India Enterprise)

Ref: CTU/W/00/32nd CMETS-WR

Date: 11.10.2024

As per distribution list

Subject: Minutes of the 32nd Consultation Meeting for Evolving Transmission Schemes in Western Region held on 24.09.2024 -reg.

Sir,

Please find enclosed the minutes of 32nd Consultation Meeting for Evolving Transmission Schemes in Western Region held on 24.09.2024 through video conferencing.

The minutes are also available at our website (www.ctuil.in>>ISTS Planning and Coordination>>Consultation Meetings for ISTS).

Thanking you,

Yours faithfully,

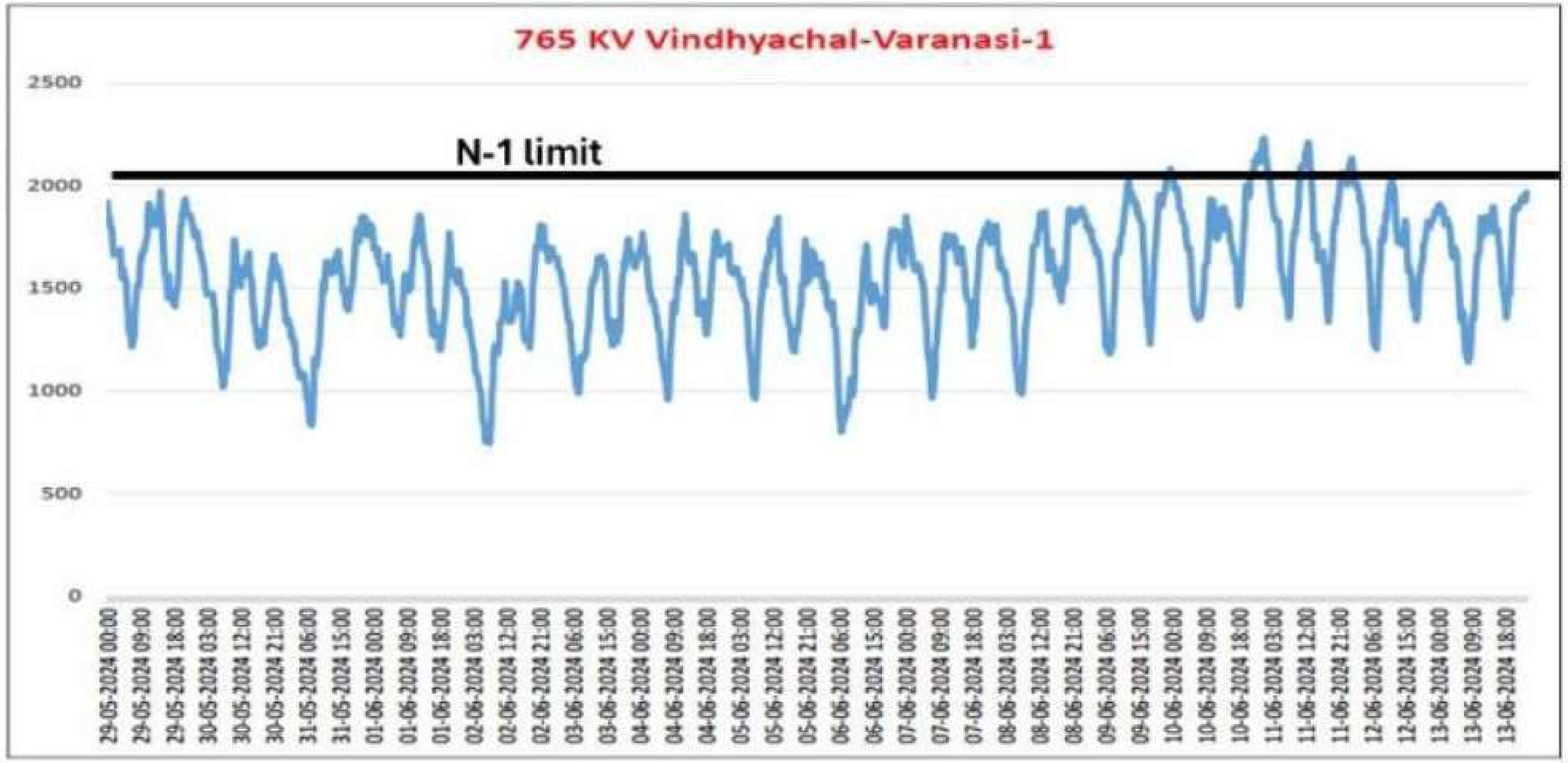
पार्थ सारथी दास

(Partha Sarathi Das)
Sr. General Manager

Encl.: As stated above

Inter-regional (NR-WR) Transmission System to relieve the loading of 765kV Vindhyachal-Varanasi D/c line

In 220th NR-OCC meeting held on 19.06.24, it was deliberated that at the time of high demand in UP, it is being observed that the flow on WR-NR corridor is very high and issues related to high loading of 765 kV Vindhyachal – Varanasi D/C during high NR Import are being observed in real-time:



High loading, beyond N-1 limits of 765kV Vindhyachal-Varanasi D/C lines

Further, due to this high loading of 765kV Vindhyachal-Varanasi D/c, violation of WR-NR ATC and NR simultaneous import is also being observed in real-time. WR-NR ATC violations in real-time would lead to situation wherein NR states would not be able to draw further power from Western region and as a result, may need to resort to over drawl or load shedding in case internal generation in NR is not available

The issue was also highlighted by Grid-India in the meeting chaired by Addl. Secretary (MOP) on 29.05.24 & subsequent meeting in CEA regarding transmission constraints in Inter state and Intra state transmission system. It was deliberated that N-1 contingency of one ckt of 765kV Vindhayachal-Varanasi D/c line will overload the other ckt. In the meeting CTU stated that line loadings will be reviewed along with transmission scheme to be planned with PSP generation. In view of that, studies were carried out (Result of system studies is enclosed in **Exhibit-1**) and scheme has been evolved to resolve critical loading of 765kV Vindhyachal-Varanasi D/c line as well as for evacuation of PSP projects in UP, following WR-NR Inter regional corridor is proposed:

- 765kV Vindhyachal Pool - Prayagraj D/c line (200-210km) along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line
- Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming **765kV Sasan - Prayagraj D/c line**

Note: Sasan vide e-mail dated 10.07.2024 has informed that they have reviewed the space available in Sasan switchyard and found that reactor for 765 KV Sasan- VPS Line-1 (PGCIL) can be accommodated however there is not enough space for accommodating the reactor for 765 KV Sasan-VPS Line-2 (CWRTL)

GRID-INDIA requested to check adequacy of reactive compensation on the line considering that charging is preferred from non-generator end (i.e. from Prayagraj end in this case).

It was informed that since there is not enough space for installation of 240MVAr LR at Sasan end, 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Sasan - Prayagraj D/c line has been proposed. This shall result in roughly 60% compensation on the line which should be adequate for line charging. Further, sufficient reactive compensation (2x330MVAr Bus reactors) is being planned at Prayagraj end also to keep precharging voltages low.

After deliberations, the above scheme was agreed with implementation time-frame of 24 months from award.

4. Request of GETCO for 2 nos. 220kV bays at Vapi-II S/s (VNLTL) for additional outlet from Vapi-II

GETCO vide letter dated 30.05.2024 has informed that GETCO had originally planned the following 220kV outlets from Vapi-II (GIS) S/s for which 4 nos. 220kV bays are already under implementation under ISTS as part of the S/s:

सेंट्रल ट्रांसमिशन यूटिलिटी ऑफ इंडिया लिमिटेड
(पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड के स्वामित्व में)
(भारत सरकार का उद्यम)
CENTRAL TRANSMISSION UTILITY OF INDIA LTD.
(A wholly owned subsidiary of Power Grid Corporation of India Limited)
(A Government of India Enterprise)

Ref: CTU/N/00/CMETS_NR/34 **Date:** 08-10-2024

As per distribution list

Subject: 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region-Minutes of Meeting

Dear Sir/Ma'am,

Please find enclosed the minutes of the 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 20th September 2024 (Friday) through virtual mode.

The minutes are also available at CTU website (www.ctuil.in)

Thanking you,

Yours faithfully,

काशिश 08/10/24

(Kashish Bhambhani)
General Manager (CTU)

Accordingly, the following ICT augmentation scheme is agreed at Bikaner-III PS in ISTS:

- Augmentation of 400/220 kV, 1x500 MVA (6th) ICT at Bikaner-III PS along with associated transformer bays

  Implementation Schedule: 18 months from allocation

B.5 Transmission System for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh:

It was stated that in the 31st CMETS-NR meeting held on 27.06.2, connectivity applications of cumulative quantum of 5152 MW from two developers i.e. M/s Greenko (6 nos. of applications with cumulative quantum of 4032 MW) & M/s Avaada WB (1 application of 1120MW) near Robertganj area in Sonbhadra district, Uttar Pradesh was discussed. As per the schedule indicated in the applications, these PSP projects are expected to be commissioned progressively from Nov'26 upto Mar'28. Details of applications are as under:

S.No	Applications	Connectivity (MW)	Start Date of Connectivity (As per Application)	Maximum Injection (MW)- As per application	Maximum Drawl (MW) – As per application
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		672	01.02.2027	610	672
		672	16.04.2027	610	672
		672	16.04.2027	610	672
		672	01.07.2027	610	672
		672	16.12.2027	610	672
2	Avaada Waterbattery Private Limited	1120	31.03.2028	900	1120
	Total (MW)	**5152**		**4560**	**5152**

In the meeting, it was informed that to deliberate on planning of transmission System for evacuation of Power from Pumped Storage Plants, a meeting under Chairmanship of Chairperson, CEA was held on 28.05.2024. In the above meeting, it was decided that CTUIL while granting Connectivity to PSPs shall mention that PSPs shall not operate in generating mode during high RE generation period and if required, PSPs may inject power during high RE generation period based on margin available in the system. However, detail analysis must be done based on the combination of sources at that node.

M/s Greenko vide letter dated 21.05.24 informed that In the initial phases of PSP development, it is envisaged as a Stand-alone storage project, which means the PSP project will draw power from renewable generation sources or conventional generation sources located

at different location(s) in the grid for charging the pump storage plant and thereafter power will be injected into the grid for supplying power to the different beneficiaries connected to different location(s) in the grid. During PSP operation, typically during peak solar time (mainly between 11AM to 2 PM), the PSP project shall be able to draw power to the extent of 4032 MW (6X672MW) corresponding to pumping capacities of all six units. While, during generation hours which will be typically during non-solar or low solar hours, the maximum generation possible shall be to the extent of 3660 MW (6x610MW). For evolving the transmission scheme, the above-mentioned maximum values of drawl and Generation may be considered. Same was also discussed in 31st CMETS-NR meeting.

CEA in the above CMETS-NR meeting confirmed that the Sonbhadra area may be considered as a potential zone for pumped storage projects. Accordingly, the transmission system for connectivity of M/s Greenko & M/s Avaada at Roberstganj PS shall be considered as common transmission system.

CEA also informed that TOR has been issued to M/s Greenko Sonbhadra PSP (3660 MW) and presently under S&I. M/s Avaada in the meeting informed that the TOR of their project is approved and currently in pre DPR stage & they shall be submitting it to CEA for pre DPR chapter approvals.

M/s Avaada & Greenko clarified in the meeting that they shall operate PSP units in synchronous condenser mode as per the reactive power requirement of the grid. Further, M/s Greenko and M/s Avaada shall also keep future provision of Bus Reactor so that in case of future requirement the same can be installed by the applicant.

Accordingly, in the above CMETS-NR meeting, connectivity applications of M/s Avaada & Greenko were agreed for grant, and it was deliberated that the transmission scheme for Pump Storage plants in Sonbhadra district is presently under discussion. The scheme is currently tentative, which shall be finalized in subsequent CMETS-NR and other region (ER) CMETS meeting among CEA, CTUIL, Grid India & Stakeholders. The detailed transmission system shall be informed upon finalization and approval of the scheme.

Further, NR-WR inter regional scheme to relieve loading of 765 kV Vindhyachal – Varanasi D/c line shall also be required for connectivity of Pumped Storage Projects in Sonbhadra district.

In view of the above, studies were carried out considering PSPs in drawl mode in Solar Max scenarios & injection mode in Peak load scenarios (evening peak). All India Study files for various scenarios (solar maximized, evening peak and night off peak) were circulated to NR stakeholders on 12.09.24.

Subsequently, M/s Greenko had submitted requisite Connectivity BGs only for three application (3x672MW), out of 6 nos. M/s Avaada also submitted requisite Connectivity BGs for their 1120MW PSP project, therefore transmission scheme needs to be revised in view of reduction in connectivity quantum by M/s Greenko.

M/s Greenko vide letter 10.09.24 requested that as they are moving forward with three applications for their project, there may be a change in the transmission scheme from the originally planned scheme involving six Grid Connectivity applications. During CTU's review of this change in the transmission system, it may be necessary to consider including the bay implementation for terminating the dedicated transmission line at Robertsganj substation under the ISTS scope

In view of schedule of generation projects and for optimal utilization of transmission scheme, comprehensive tr. scheme is planned considering M/s Greenko and M/s Avaada PSP evacuation requirement (Maximum injection 3136MW, Maximum Drawl : 2730MW) including future requirement. However, in view of transmission being lumped elements, the planned scheme can cater upto 4 GW PSP connectivity quantum.

In the meeting, Grid-India stated to review the reactive compensation of 765kV Robertsganj PS – Prayagraj S/s D/c line. CTU stated that with proposed line reactors (240MVAr line reactor on both ends), Reactive compensation is bit on higher sider (~90%), therefore 330MVAr line at one of the end may be considered for above line based on studies. Accordingly, 330MVAr line reactor is considered at Robertsganj PS end for 765kV Robertsganj PS – Prayagraj S/s D/c line. On the query of direction of power flow from Varanasi to Robertsganj and Gaya to Robertsganj in Solar peak hours, CTU stated that during solar peak hours, PSP may operate in pumping mode and power will flow from Varanasi to Robertsganj PS and Robertsganj PS to Gaya S/s.

Grid-India enquired about line rating of 400kV Greenko- Robertsganj D/c line. CTU stated that considering three applications of 2016MW (3x672MW) of M/s Greenko, rating of dedicated line shall be considered commensurate to power transfer requirement under N-1 contingency of PSP plant.

Grid-India enquired that line reactors may be reviewed w.r.t. line length of each sections formed after proposed LILO arrangements i.e. LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj & LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj. Grid-India stated that 765kV Fatehpur – Prayagraj section may get overcompensated with existing line reactor configuration. CTU stated that after proposed LILO arrangement, reactive compensation is about 89% on 765kV Fatehpur – Prayagraj section (140 kms). Grid-India enquired about feasibility of removing 330MVAr existing line reactor at Fatehpur end or its replacement with 240MVAr line reactor. CTU stated that considering prevailing high voltage condition in NR (in some off peak scenarios), removal or replacement of 330MVAr line reactor at Fatehpur end may worsen the high voltage problem, however line length is tentative and will be reviewed in Gati Shakti portal. In the case of reduction of line length considerably, decision may be taken on removal/replacement of 330MVAr line reactor at Fatehpur end of 765kV Fatehpur – Prayagraj section (140 kms). CTU further stated that on all other line sections formed after LILO arrangement at Prayagraj S/s, reactive compensation is in order.

Grid-India enquired that whether PSP developers indicated their machine type i.e. fixed speed or variable speed type. M/s Greenko informed that they have fixed speed machines. M/s Avaada informed that they will revert on the same. M/s Greenko requested that during finalization of the scheme, 400kV bays at Robertsganj end for termination of 400kV Greenko-Robertsganj D/c line may be

considered in ISTS scope. CTU stated that as the scheme is still under approval and being revised in this meeting, same will be incorporated as part of comprehensive agreed transmission scheme and M/s Greenko shall have to fulfil Conn-BG2 requirement.

Grid-India also stated that 1200kV system may also be explored from above complex in future for evacuation of envisage PSP potential due to its proximal location form WR and ER region and firm power flow in most of the scenarios.

CTU further stated that based on agreed scheme in meeting, transmission system under applicant scope as well as common transmission system will be revised. It was also stated that M/s Avaada & Greenko shall operate PSP units in synchronous condenser mode (minimum one unit) as per the reactive power requirement of the grid.

CEA stated that both the projects are under advance stage, however DPR is yet to approve. On the query of CEA on additional generation considered at 400kV level, CTU informed that at present comprehensive scheme is planned for 4GW PSP potential and with connectivity quantum more than 4GW, adequacy of agreed transmission scheme shall be reviewed further. CEA and UPPTCL also agreed on the proposal

CTU enquired to UPPTCL about drawl requirement (220kV) from Robertsganj and Prayagraj S/s. UPPTCL stated that intra state transmission system (tentative) is already planned for evacuation of thermal power projects in the vicinity and in receipt of PSP application in future, new intra state schemes shall be planned. As part of above schemes, many new substations may be planned in intra state and can be utilized for drawl purpose of UP. Based on above, it was decided that provision of 220kV scope shall be deleted from future provisions at Robertsganj PS and Prayagraj PS, which was agreed by UPPTCL.

CTUIL in the meeting as well as their mail dated 20.09.24 requested POWERGRID to provide availability of OPGW on below lines so that provision of OPGW may be kept as part of present agreed scheme in case of non-availability of OPGW system

- 765 kV Fatehpur-Varanasi S/c line (proposed to be LILOed at Prayagraj S/s)
- 765 kV Fatehpur-Sasaram S/c line (proposed to be LILOed at Prayagraj S/s)
- 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS)

As per the inputs received from POWERGRID, OPGW is not available on the existing 765 kV Fatehpur-Varanasi S/c line & 765 kV Fatehpur-Sasaram S/c line which is proposed to be LILOed at Prayagraj S/s. Therefore, OPGW installation needs to be done to cater voice/data/tele-protection requirement for the proposed new Prayagraj S/s in matching time frame of comprehensive transmission scheme. Further as per above inputs, existing 765 kV Varanasi- Gaya 2xS/c line (proposed to be LILOed at Robertsganj PS), OPGW is available on the 2nd S/c of above line, therefore on other S/c line OPGW is not required as existing OPGW can be used for voice/data/tele-protection requirement for both the S/c lines as source and destination stations are same. No other comments were received.

Based on above deliberations, following ISTS transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District was agreed :

- Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station* near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors

  Future provisions at Robertsganj PS (excl. scope for present scheme): Space for

  - 765/400kV ICTs along with bays- 2 nos.
  - 765 kV line bays along with switchable line reactors – 6 nos.
  - 765kV Bus Reactor along with bay: 1 no.
  - 400 kV line bays along with switchable line reactor –6 nos.
  - 400kV line bays : 4 nos.
  - 400 kV Bus Reactor along with bays: 1 no.
  - 400kV Sectionalization bay: 2 sets

  ***along with provision of 80MVAr spare reactor (Single phase), 110MVAr (Single phase) & 500MVA spare transformer unit (Single phase)**

- 400kV line bays (4 nos.) for connectivity of PSP generation project (M/s Avaada & M/s Greenko) at Robertsganj PS
- LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS (~50 km) along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)
- Establishment of 765 kV Prayagraj S/s* near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors

  Future provisions at Prayagraj S/s (excl. scope for present scheme): Space for

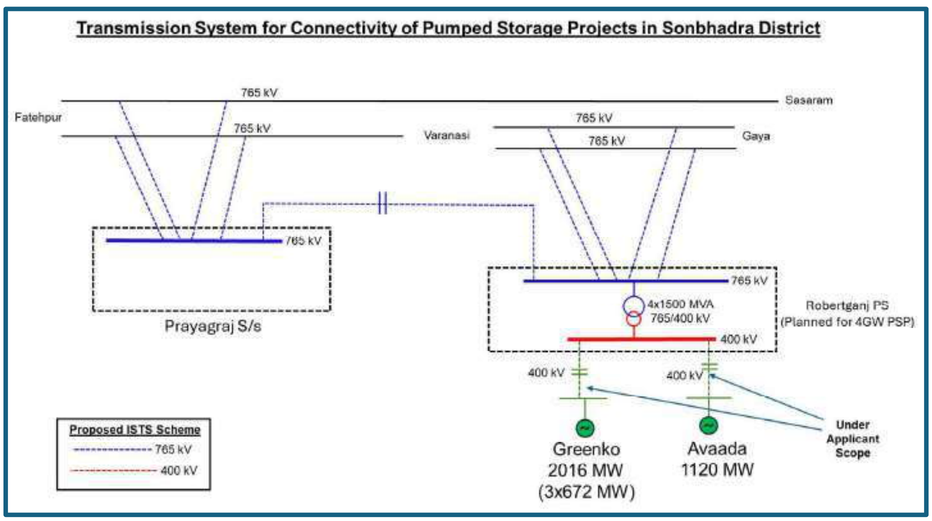
  - 765/400kV ICTs along with bays- 4 nos.
  - 765 kV line bays along with switchable line reactors – 4 nos.
  - 765kV Bus Reactor along with bay: 1 nos.
  - 400 kV line bays along with switchable line reactor –4 nos.
  - 400kv line bays : 2 nos.
  - 400 kV Bus Reactor along with bays: 2 no.
  - 400kV Sectionalization bay: 1 set

  ***along with provision of 110MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase)**

- LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj (~30 km)

- LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj (~30 km)
- Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line (~200 km)

From the studies, it was observed that considering drawl by PSPs in Peak RE hours (10AM to 2 PM), there is a requirement of additional inter-regional corridors towards WR which shall be discussed in subsequent section. However, it was gathered from Pump Storage project developers that they shall tie up with RE developers for drawing power in peak RE hours and shall be injecting power back in non RE peak hours(mainly during peak load period).



Further, Inter-regional (NR-WR) transmission System to relieve the loading of 765kV Vindhyachal-Varanasi D/c line was discussed and agreed in present meeting in subsequent section. This Inter regional transmission scheme is also required for evacuation of power from above Pumped Storage Projects in Sonbhadra District.

Transmission system for connectivity of M/s Greenko UP01 IREP Private Limited for its 6 nos. of connectivity applications ((App. No. 220000527-672 MW, 220000529-672 MW, 220000524-672 MW, 220000525-672 MW, 220000526-672 MW & 220000528-672 MW under GNA was agreed in 31st CMETS-NR meeting held on 27.06.24, which is as under:

Details of Transmission system for Connectivity under GNA:

A. Associated Transmission System (ATS): NIL

B. Transmission System under applicant scope

(i). Common Pooling station for Pumped Storage Projects of M/s Greenko UP01 IREP Private Limited (App. No. 220000527-672 MW, 220000529-672 MW, 220000524-672 MW, 220000525-672 MW, 220000526-672 MW & 220000528-672 MW) – Robertsganj Pooling Station 400 kV 2xD/c line(suitable to carry minimum 1400 MW per circuit at nominal voltage)*

**Minimum One unit to operate in Synchronous Condenser mode as per the requirement of the grid*

C. Transmission system for Connectivity under GNA (Tentative):

(i). Establishment of 5x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. Uttar Pradesh
(ii). LILO of both circuits of 765 kV Varanasi- Gaya 2xSc line at Robertsganj Pooling Station
(iii). Establishment of 765/400 kV 2x1500 MVA Prayagraj substation near Prayagraj(Uttar Pradesh)
(iv). Prayagraj – Sohawal 400 kV D/c line (Quad)
(v). LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj S/s
(vi). LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj S/s
(vii). Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 240 MVAr line reactor for each circuit at Robertsganj end.

D. Additional Inter regional (WR-NR)Transmission system for Connectivity under GNA (Tentative):

(i). 765kV Vindhyachal Pool - Prayagraj D/c line along with 240MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line
(ii). Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line

Start Date of Connectivity: 01.07.2027(interim). Final date shall be confirmed upon award of the system

Subsequently, as discussed above, M/s Greenko had submitted requisite Connectivity BGs only for three projects ((App No. 220000524-672 MW, 220000525-672 MW, 220000526-672 MW), out of 6 nos. of applications. In view of that revised transmission system for connectivity for three nos. of applications of M/s Greenko UP01 ((App No. 220000524-672 MW, 220000525-672 MW, 220000526-672 MW) is as under :

Details of Transmission system for Connectivity under GNA:

A. **Associated Transmission System (ATS): NIL**

B. **Transmission System under applicant scope**

(ii). Common Pooling station for Pumped Storage Projects of M/s Greenko UP01 IREP Private Limited (App. No. 220000524-672 MW, 220000525-672 MW, 220000526-672 MW) – Robertsganj Pooling Station 400 kV D/c line(suitable to carry minimum 2016 MW per circuit at nominal voltage)*

Minimum One unit to operate in Synchronous Condenser mode as per the requirement of the grid

C. **Transmission system for Connectivity under GNA (Tentative):**

(i). Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV Bus reactors
(ii). LILO of both circuits of 765 kV Varanasi- Gaya 2XS/c line at Robertsganj Pooling Station along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line
(iii). Establishment of 765kV Prayagraj substation near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors
(iv). LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj S/s
(v). LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj S/s
(vi). Robertsganj PS – Prayagraj 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj 765 kV D/c line

D. **Additional Inter regional (WR-NR) Transmission system for Connectivity under GNA (Tentative):**

(i). 765kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line
(ii). Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line

Start Date of Connectivity: 30.06.2027(interim). Final date shall be confirmed upon award of the system

Further, Transmission system for connectivity of M/s Avaada Waterbattery Private Limited under GNA, was also agreed in 31st CMETS-NR meeting held on 27.06.24, which is as under:

Details of Transmission system for Connectivity under GNA:

A. **Associated Transmission System (ATS): NIL**

B. **Transmission System under applicant scope** (i). M/s Avaada Waterbattery Private Limited Pumped Storage Project– Robertsganj Pooling Station 400 kV D/c line (Quad moose or equivalent conductor suitable to carry 1716 MW per circuit at nominal voltage)

C. <u>Transmission system for Connectivity under GNA: (Tentative)</u>

(i). Establishment of 5x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. Uttar Pradesh
(ii). LILO of both circuits of 765 kV Varanasi- Gaya 2xSc line at Robertsganj Pooling Station
(iii). Establishment of 765/400 kV 2x1500 MVA Prayagraj substation near Prayagraj(Uttar Pradesh)
(iv). Prayagraj – Sohawal 400 kV D/c line (Quad)
(v). LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj S/s
(vi). LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj S/s

D. <u>Additional Inter regional (WR-NR) Transmission system for Connectivity under GNA (Tentative):</u>

(i). 765kV Vindhyachal Pool - Prayagraj D/c line along with 240MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line
(ii). Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line

Start Date of Connectivity: 31.12.2028(interim). Final date shall be confirmed upon award of the system

In view of that revised transmission system for connectivity application of M/s Avaada Waterbattery ((App No. 220000553-1120 MW) is as under:

<u>Details of Revised Transmission system for Connectivity under GNA:</u>

A. <u>Associated Transmission System (ATS):</u> NIL

B. <u>Transmission System under applicant scope</u>

(i). M/s Avaada Waterbattery Private Limited Pumped Storage Project– Robertsganj Pooling Station 400 kV D/c line (Quad moose or equivalent conductor suitable to carry minimum 1716 MW per circuit at nominal voltage)

C. <u>Transmission system for Connectivity under GNA (Tentative):</u>

(i). Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV Bus reactors
(ii). LILO of both circuits of 765 kV Varanasi- Gaya 2xSc line at Robertsganj Pooling Station along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line
(iii). Establishment of 765kV Prayagraj substation near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors
(iv). LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj S/s
(v). LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj S/s

(vi). Robertsganj PS – Prayagraj 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj 765 kV D/c line

D. <u>Additional Inter regional (WR-NR) Transmission system for Connectivity under GNA (Tentative):</u>

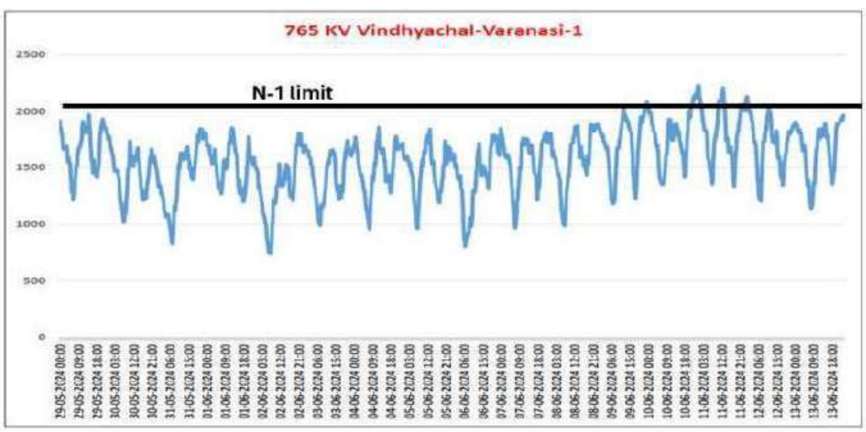
(i). 765kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line

(ii). Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line

Start Date of Connectivity: 31.12.2028(interim). Final date shall be confirmed upon award of the system

B.5 Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line

It was stated that in 220th NR-OCC meeting held on 19.06.24, it was deliberated that at the time of high demand in UP, it is being observed that the flow on WR-NR corridor is very high and issues related to high loading of 765 kV Vindhyachal – Varanasi D/C during high NR Import are being observed in real-time:



High loading, beyond N-1 limits of 765kV Vindhyachal-Varanasi D/C lines

Further, due to this high loading of 765kV Vindhyachal-Varanasi D/c, violation of WR-NR ATC and NR simultaneous import is also being observed in real-time. WR-NR ATC violations in real-time would lead to situation wherein NR states would not be able to draw further power from Western region and as a result, may need to resort to over drawl or load shedding in case internal generation in NR is not available

The issue was also highlighted by Grid-India in the meeting chaired by Addl. Secretary (MOP) on 29.05.24 & subsequent meeting in CEA regarding transmission constraints in Inter state and Intra state transmission system. It was deliberated that N-1 contingency of one ckt of 765kV Vindhayachal-Varanasi D/c line will over load the other ckt. In the meeting CTU stated that line loadings will be reviewed along with transmission scheme to be planned with PSP generation

In view of that studies were carried out and scheme was evolved to resolve critical loading of 765kV Vindhyachal-Varanasi D/c line in N-1 Contingency condition as well as for evacuation of PSP projects in UP.

In the meeting, UPPTCL stated that 765/400kV Fatehpur S/s is being implemented as part of Bhadla-III – Fatehpur HVDC transmission system. UPPTCL requested to explore feasibility of interconnection of Fatehpur S/s with Sasan/Vindhyachal PS to relieve high loading. CTU stated that as deliberated earlier, loading of 765kV Vindhyachal-Varanasi D/c line is already high and with envisaged PSP generation, loadings will further increase in 2027-28 time frame. CTU further stated that 765/400kV Fatehpur S/s will only be available in 2029 timeframe and about 300kms from Sasan S/s. Considering above it is not feasible to utilize Fatehpur S/s for WR-NR inter regional link. CTU informed that in planning of future ISTS transmission schemes, utilization of 765/400kV Fatehpur S/s (being implemented as part of HVDC scheme) shall be explored with additional envisaged PSP potential (beyond 4GW). Grid-India and CEA agreed on the proposal. It was also agreed that above strengthening scheme is required urgently to relive the loading of 765kV Vindhyachal-Varanasi D/c line. The NR-WR inter regional strengthening scheme was also discussed and agreed in 32nd CMETS-WR meeting held on 24.09.24

Based on above deliberations, following WR-NR Inter regional corridor is agreed in ISTS :

- 765kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line
- Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line

  Implementation Schedule: 24 months from allocation

B.6 Requirement of additional 1x500 MVA (5th), 400/220kV ICT at Maharani Bagh (PG) Substation

S. No.	Items	Details
1.	Name of Scheme	OPGW (48 Fiber) installation on existing 765kV Fatehpur-Varanasi S/c Line & 765kV Fatehpur-Sasaram S/c Lines which are proposed to be LILOed at new Prayagraj ISTS S/s
2.	Scope of the scheme	Supply and Installation of 48 Fiber OPGW on existing 765kV Fatehpur-Varanasi S/c Line **(223 Km.)** & 765kV Fatehpur-Sasaram S/c Line **(356 Km.)** which are proposed to be LILOed at new Prayagraj ISTS S/s including FOTE at Fatehpur & Repeater for Prayagraj-Sasaram Section of Fatehpur-Sasaram line **Total OPGW (48F) - 579 kms.** **Total FOTE – 2 Nos.**
3.	Objective / Justification	In the 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 20.09.2024 (MoM attached at **Annexure-XV**) transmission scheme “Transmission system for connectivity of Pumped Storage Projects in Sonbhadra District in Uttar Pradesh” was deliberated. In the scheme LILO of existing 765kV Fatehpur-Varanasi S/c Line & 765kV Fatehpur-Sasaram S/c Line are proposed at the new Prayagraj S/s (ISTS). OPGW availability on these lines were discussed in view of providing connectivity to new Prayagraj ISTS S/s. As per POWERGRID inputs, OPGW is not available on both lines. To meet data/ voice/ protection requirement between Fatehpur, Varanasi, Sasaram & Prayagraj Substations, OPGW needs to be installed over the 765kV Fatehpur-Varanasi S/c Line & 765kV Fatehpur-Sasaram S/c Line which are proposed to be LILOed on new Prayagraj ISTS S/s. Further as per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, “The primary path for tele-protection shall be on point-to-point Optical Ground Wire”

		Therefore, this OPGW also serves as primary tele-protection path for Prayagraj – Fatehpur, Prayagraj – Sasaram & Prayagraj – Varanasi Lines formed after LILO Further OPGW installation on 765kV Fatehpur-Varanasi S/c Line & 765kV Fatehpur-Sasaram S/c Lines were also deliberated in the 26th NRPC TeST meeting held on 19.11.24 (MoM awaited) where the requirement of FOTE at Fatehpur, Varanasi & Sasaram was also discussed. As per the inputs received from POWERGRID, FOTE shall be required at Fatehpur & Repeater at Prayagraj-Sasaram Section of Fatehpur-Sasaram line.
4.	Estimated Cost	**Rs. 33.24 crore (approx.)**
5.	Implementation timeframe	**24 months from the date of allocation**
6.	Implementation Agency	**POWERGRID**
7.	Implementation mode	**RTM mode**
8.	Deliberations in different meetings	34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 19.09.2024 (MoM attached at **Annexure-XV)** & 26th NRPC TeST held on 19.11.2024 (**MoM awaited**)

Annexure-XVII

सत्यमेव जयते

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
विद्युत संचार विकास प्रभाग
Power Communication Development Division
****

CEA-PS-17-24/1/2024-PCD Division/ **Date: 22-11-2024**

To,

(As per the attached list)

Subject: Facilitating Broadband expansion by allowing leasing of fiber on OPGW - regd.

This has reference to the DO letter dated 11th November 2024(No. 5-5/NBM-2024/PGCIL-OPGW) addressed to Secretary (MoP) from Department of Telecommunications, Ministry of Communications. Wherein MoP has been requested to consider laying at least 48F (48 Fibres) OPGW (Optical Ground Wire) in future transmission projects making provision for leasing of additional fibers for the use of telecom licensees i.e TSP (Telecom Service Provider)/ ISP (Internet Service Provider)/ IP (Internet Protocol)-1 etc.

During a review meeting of NER (North Eastern Region) Telecom projects, Hon'ble Minister for Communication had directed to facilitate broadband expansion by allowing leasing of fibers on OPGW of POWERGRID in place of leasing of bandwidth, so that rural areas and hinterlands can get good and reliable telecom connectivity.

In view of this, CTU (Central Transmission Utility), POWERGRID, STUs (State Transmission Utilities) and all the TSPs (Transmission Service Providers) are requested to incorporate the necessary provisions in the technical specifications of their future transmission schemes supporting the laying of at least 48F OPGW instead of 24F OPGW for the upcoming TBCB (Tariff based Competitive Bidding)/RTM (Regulated Tariff Mechanism) schemes. It is further advised that the schemes which are presently in bidding stage may also be modified accordingly by the BPCs (Bid Process Coordinators) wherever applicable.

This issues with the approval of Chairperson, CEA.

22/11/24
Chief Engineer (PCD)

(Addressed to the list below :)

S.No.	Designation	Address	E-mail
1.	COO, CTUIL	Plot No. 2, Sector – 29 Near IFFCO chowk Metro station, Gurugram – 122001	df@powergrid.in, do@powergrid.in, pcgarg@powergrid.in
2.	CMD, PGCIL	Powergrid, Saudamini, Plot No – 02, Sector – 29, Gurugram, Haryana 122001	cmd@powergridindia.com
3.	Chairman & Managing Director, PGCIL	Saudamini, Plot No. 2, Sector-29 Gurgaon-122001 (Haryana)	cmd@powergrid.in
4.	Chairman & Managing Director, APTRANSCO	Gunadala, Eluru Rd, Vijayawada, Andhra Pradesh 520004	cmd@aptransco.gov.in
5.	Chairman, APPGCL, Andhra Pradesh	Vidyut Soudha, Gunadala Eluru Road, Vijaywada Andhra Pradesh – 520 004	chairman@apgenco.gov.in
6.	Chairman & Managing Director, TCTL	Vidyut Soudha, Khairatabad, Hyderabad – 500082	cmd@tgtransco.com
7.	Chairman & Managing Director, TSPGCL	Vidyut Soudha, 'A' Block, Khairatabad, Hyderabad – 500 082 (Telangana)	cmd@tsgenco.co.in cmdtransco@telangana.gov.in
8.	Managing Director, TANTRANSCO	10th Floor/NPKRR Malikai, No. 144 Anna Salai, Chennai-600002	mdtantransco@tnebnet.org
9.	Chairman & Managing Director, KSEBL Kerala	Board Secretariat, Vidyuthi Bhavanam Pattom, Thiruvananthapuram – 695004	cmdkseb@kseb.in
10.	Managing Director, KPTCL	1st floor, Kaveri Bhawan, K. G. Road, Bangalore-560009	md@kpclgmail.com

11.	Director (Operations), MSETCL	C-19, E-Block Prakashganga, Bandra- Kurla Complex Bandra(E), Mumbai 400 051.	dirop@mahatransco.in, sealdc8100@mahatransco .in
12.	Managing Director, MSPGCL Maharashtra	Prakashgad, Plot No. G- 9, 4th Floor Bandra (E), Mumbai-400051	md@mahagenco.in
13.	Chief Engineer (Elect.), Goa Electricity	Department Vidyut Bhawan, Panji, Goa - 403001	cee-elec.goa@nic.in, elec.goa@nic.in
14.	Chairman, GUVNL Gujarat	Sardar Patel Vidyut Bhawan, Race Course, Vadodara- 390 007	md.guvnl@gebmail.com
15.	Chairman, Gujarat Urja Vikas Nigam Ltd.	Sardar Patel Vidyut Bhawan, Race Course, Vadodara- 390007	md.guvnl@gebmail.com
16.	Managing Director, GETCO	Sardar Patel Vidyut Bhawan, Race Course, Vadodara- 390 007	md.getco@gebmail.com
17.	Secretary, Dadra & Nagar Haveli Electricity Department	Dadar Nagar Secretariat, Silvassa- 396230	tapasyaraghav@gmail.co m
18.	Director (Operations) , RRVPNL	Vidyut Bhawan, Jyoti Nagar Jaipur, Rajasthan	dir.oper@rvpn.co.in cmd.rvpn@gmail.com
19.	Chairman, HVPNL	Shakti Bhawan, C4, Sector No. 6 Panchkula – 134109, Haryana	chairmanpu@gmail.com
20.	Managing Director, J&KPTCL	JKPTCK ,Power complex , bemina Srinagar (J&K) janipur jammu	mdjkptcl1@gmail.com
21.	Managing Director, HPPTCL	Himfed Building, BCS, New Shimla - 171009 (H.P.)	md@hppcl@gmail.com
22.	Managing Director, HPGCL Haryana	Room No.411,3rd Floor, Urja Bhawan,C-7, Sector-6, HPGCL Panchkula	md@hpgcl.org.in

23.	Managing Director, PTCL of Uttarakhand	Vidyut Bhawan, Saharnpur Road, Near I.S.B.T. Crossing, Dehradun,Uttarakhand – 248002	md.ptcul@rediffmail.com
24.	Managing Director, UJVNL (Uttarakhand)	Maharani Bagh, G M S Road, Dehradun	mdujvnl@ujvnl.com, md@ujvnl.com
25.	Chairman& Managing Director, BSPTCL	Vidyut Bhawan, Bailey Road Patna – 800021	mdcellbsptcl@gmail.com, cmd.bsphcl@gmail.com
26.	Managing Director, BSPGCL Bihar	5th Floor, Vidyut Bhawan, Bailey Road, Patna	md.bspgcl@gmail.com
27.	Chairman & Managing Director, PSTCL Punjab	The Mall, Mall Road, Patiala – 147001	cmd@pstcl.org
28.	Chairman & Managing Director, UPPTCL	7th Floor Shakti Bhawan, 14-Ashok Marg Lucknow Lucknow- 226001	cmd@upptcl.org, chairman@upptcl.org
29.	CMD, UPRVUNL	Shakti Bhawan,14-Ashok Marg, Lucknow226001	chairmanuppcl@gmail.co m md@uprvunl.org
30.	Managing Director, MPPTCL	Shakti Bhawan, Rampur, Jabalpur(MP) - 482 008	md@mptransco.nic.in, ce.pnd@mptransco.nic.in
31.	Managing Director, MPPGCL	Shakti Bhawan, Vidyutnagar, P.O. Jabalpur- 482 008	mppgcl@mp.nic.in
32.	Chairman, Jharkhand Urja Utpadan Nigam Ltd.	Engineering Building, HEC Dhurwa, Ranchi-834004	mdjuunl2018@gmail.com
33.	Managing Director, JUSNL Jharkhand	Engineering Buliding, HEC, Dhurwa, Ranchi – 834004	mdjusnl@gmail.com, md@jusnl.in
34.	Chairman & Managing Director, CSPHCL, Chhattisagarh	Vidyut Seva Bhawan,P.O. Sunder Nagar, Danganiya,	mdtransco@cspc.co.in, chairman@cspc.co.in

		Raipur- 492 013	
35.	Chairman & Managing Director, WBSETCL	Bidhan Nagar, Kolkata- 700 091.	md@wbsetcl.in
36.	Chairman & Managing Director, WBPDCL	Bidyut Unnayan Bhaban, plot 3/C, LABlock, Sector-III Salt Lake City, Kolkata - 700	wbpdcl@wbpdcl.co.in
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38.	Chairman, OPGCL Odisha	Zone-A,7th Floor, Fortune Towers, Chandrasekharpur, Bhubaneswar - 751023 Odisha	energy@nic.in
39.	Managing Director, CSPGCL	Vidyut Seva Bhawan P.O. Sunder Nagar, Danganiya, Raipur- 492 013 Chhattisgarh	mdgenco@cspc.co.in
40.	Chairman, Jharkhand Urja Utpadan Nigam Ltd.	Engineering Building, HEC Dhurwa, Ranchi- 834004	mdjuunl2018@gmail.com
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42.	Chairman, APGCL, Assam	Bijulee Bhawan, Paltan Bazar, Guwahati,Assam.	cgm.ppd@aegcl.co.in, anjanjc.aegcl@gmail.com, gm.mpr@aegcl.co.in, rakesh.kumar@apgcl.org
43.	Managing Director, AEGCL (Assam)	Bijulee Bhawan, Paltan Bazar, Guwahati- 781 001	managing.director@aegcl.co.in, md_aegcl@yahoo.co.in

44.	The Engineer-in-Chief, Power and Electricity Dept, Govt of Mizoram	Kawlphetha Building New Secretariat Complex, Khatla, Aizawl Mizoram 796001	eincpower@gmail.com
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46.	Chief Engineer, Nagaland Dept. of Power	Chief Engineer (D&R) Electricity House. A.G. Colony, Kohima – 797001	miaziekho77kehie@gmail.com
47.	Chairman & Managing Director, Meghalaya	Lumjingshai Short Round Road Shillong-793001	ewnong@yahoo.com, directormeptcl@gmail.com, cetranzemeptcl@gmail.com
48.	Chairman, TSECL Tripura	Bidyut Bhaban, Banamalipur, Agartala, Tripura - 799001	managing.director@tsecl.in
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50.	Commissioner-cum-Secretary(P), ANED (Andaman)	Secretariat , Andaman and Nicobar Islands, Port Blair- 744101	secyit.and@nic.in
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52.	Secretary, Puducherry Electricity	Department Secretariat, Puducherry- 605001	secycs.pon@nic.in, secytran@py.gov.in
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54.	Chairman & Managing Director, NTPC Ltd	NTPC Bhawan, Core 7, Scope Complex 7, Institutional Area Lodhi Road, New Delhi-110003	cmd@ntpc.co.in, amanna@ntpc.co.in, kamalverma@ntpc.co.in shipratyagi@ntpc.co.in
55.	Chairman & Managing Director, NHPC Ltd	Corporate Office, NHPC Office Complex, Sector 33 Faridabad- 121003, Haryana	cmd@nhpc.nic.in
56.	Chairman & Managing Director, NLC Ltd	Cuddalore District Block - 1, Neyveli Tamilnadu- 607 801	cmd@nlcindia.in
57.	Chairman & Managing Director, THDC Ltd	Pragatipuram, By Pass Road, Rishikesh 249 201	cmd@thdc.co.in
58.	Chairman & Managing Director, NPCIL	Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai-400094	npciltecrectt@npcil.co.in, cmdsecretariat@npcil.co.in
59.	Chairman & Managing Director, NEEPCO Ltd.	NEEPCO Ltd., Lower New Colony, Shillong-793003	cmdneepco@neepco.co.in
60.	Chairman, BBMB (Bhakhra)	Sector -19B, Madhya Marg, Chandigarh – 160019	cman@bbmb.nic.in
61.	Chairman & Managing Director, Damodar Valley Corp.	Head Quarter DVC Towers, VIP Road Kolkata-700054	chairman@dvc.gov.in
62.	Director General, EPTA	First Floor, 6 Basant Lok, Vasant Vihar, New Delhi - 110070	Dg.epta@epta.in, epta.dg@gmail.com
63.	Chairman & Managing Director, TATA Power	NDPL House, Hudson Lines, Kingsway Camp Delhi-110 009	vrshrikhande@tatapower.com, BD@tatapower.com, nitin.kumar@tatapower.com, neeraj.srivastava@tatapower.com, piyushkumar@tatapower.com

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65.	Managing Director, Adani Power Limited	Shantigram, Near Vaishnodevi Circle, S.G. Highway, Ahmedabad-382421 Gujarat	manish.karna@adani.com
66.	Manager, AESL	Adani Power Limited, 7th Floor, Sambhav Building, Judges Bunglow Road, Bodakdev, Ahmedabad, Gujarat-380015	Praveen.tamak@adani.com
67.	Managing Director, L&T IDPL	L&T Campus, TCTC Building, First Floor, Mount Poonamallee Road, Manapakkam, Chennai – 600089.	csr@lntecc.com
68.	Chairman & Managing Director, Reliance Power	Reliance Centre, Ground Floor 19, Walchand Hirachand Marg, Ballard Estate, Mumbai 400 001	
69.	Director, Darbhanga – Motihari Transmission Co. Ltd.	6th Floor, Plot No. 19 & 20, Film City, Sector 16 –A, Noida, Uttar Pradesh – 201301	Nimish.Sheth@SEKURA.IN, Neeraj.Verma@SEKURA.IN, Vijayanand.Semletty@Sekura.in
70.	Chairman & Managing Director, SJVN Ltd	SJVN Corporate Head Quarters, Shanan Shimla-06. SHIMLA – 171006 HP	sectt.cmd@sjvn.nic.in, nandlal.sharma@sjvn.nic.in
71.	Director, G R Infra Project Ltd	2nd Floor, Novus Tower, Plot No. 18, Sector 18, Gurugram, Haryana - 122015,	modassar.a@grinfra.com, ashwin@grinfra.com, transmission@grinfra.com, akul.s@grinfra.com

72.	Dy GM, G R Infra Project Ltd	Rajgarh Transmission Limited, C/O: G R INFRAPROJECTS LIMITED, 2nd Floor, Novus Tower, Plot No. 18, Sector 18, Gurugram State - Haryana Pin Code – 122015	rajgarhtransmission@grinfra.com
73.	CMD, Megha Engineering & Infrastructures Ltd	S-2 Technocrat Industrial Estate Balanagar Hyderabad - 500 037	jsrinivaskumar@meilgroup.in
74.	Chairman & Managing Director, PPCL	Himadri, Rajghat Power House Complex, New Delhi – 110002	md.ipgpp@nic.in
75.	Director & CEO, Indian Transmission Business Sterlite Power Transmission Ltd	DLF Cyber Park, Tower B, 9th Floor, Udyog Vihar Phase -III, Sector-20 Gurugram- 122008 Ph – 0124-4562000	balaji.sivan@sterlite.com, fahim.alam@sterlitepower.in, Sterlite.bd@sterlitepower.com, chandan.dutt@sterlite.com
76.	Dy. President Kalpataru Power Transmission Ltd	101, Kalpataru Synergy, Opp. Grand Hyatt, Vakola , Santacruz (E), Mumbai 400055. India.	milind.nene@kalptarupower.com, kaushal.thakkar@kalpatarupower.com, thakkarkaushal86@yahoo.com, ajay.tripathi@kalpatarupower.com
77.	Director, Torrent Power Ltd	Electricity House, Lal Darwaja, Ahmedabad – 380001	NAMANSHAH@torrentpower.com, kaushal.thakkar@kalpatarupower.com, kashyapdesai@torrentpower.com, MAYANKGUPTA@torrentpower.com, VATSALPATEL@torrentpower.com
78.	Associate Director, Commercial & Regulatory, Sekura	503A, Windsor, Off CST Road, Kalina Mumbai-400098	Vijayanand.Semletty@Sekura.in

79.	CMD, KEC International Limited	RPG House, 463, Dr. Annie Besant Road,Worli, Mumbai – 400030	kecindia@kecrpg.com
80.	CMD, Juniper Green Transmission Private Limited	F-9 First Floor, Manish Plaza-1, Plot No. 7, MLU, Sector 10, Dwarka South West Delhi 110075	rohit.gera@junipergreenenergy.com, rohit.gera91@gmail.com
81.	CMD, ReNew Transmission Ventures Private Limited	ReNew , Commercial Block-1, Zone 6, Golf Course Road DLF City Phase-V, Gurugram-122009	mohit.jain@renewpower.in, anuj.jain@renewpower.in, amit.kumar1@renewpower.in
82.	CMD, Apraava Energy Private Limited	7th Floor, FULCRUM, Sahar Road, Andheri (East) Mumbai 400 099	sumit.sinha@apraava.com, naveen.munjal@apraava.com, roshni.shah@apraava.com
83.	Head & VP, Regulatory & Contracts	Unit No. 101, First Floor, Windsor, Village KoleKalyan, off CST Road, Vidyanagari Marg, Kalina, Santacruz (East), Mumbai – 400 098	venkatraman.inumula@indigrid.com
84.	Senior Manager (Bidding & Business Development), IndiGrid Ltd	Unit No. 101, First Floor, Windsor, Village KoleKalyan, off CST Road, Vidyanagari Marg, Kalina, Santacruz (East), Mumbai – 400 098 Maharashtra	wasim.alam1@indigrid.com
85.	Managing Director, L&T IDPL	L&T campus TCTC building , First Floor, Mount Poonamalle Road, Manapakkam, Chennai-600089, Tamil Nadu	contactus@lntidpl.com csr@lntecc.com
86.	Chief Engineer, Electric M &RE Division	Electric M &RE Division, Choglamsar, Leh-Ladakh-194101	cepladakh@gmail.com

87.	Director (BD & Commercial), Apraava Energy	Apraava Energy Private Limited (FULCRUM 7th Floor, Next to Hyatt Regency, Sahar Road, Andheri (East), Mumbai – 400 099. India.	sumit.sinha@apraava.com
88.	Manager, Megha Engineering & Infrastructures Ltd	-	**shivaprasad@meilgroup.com**
89.	Manager ReNew Transmission Ventures Pvt Ltd	Renew.Hub, Commercial Block-1, Zone-6, Golf Course Road, DLF City Phase V, Gurugram, Haryana – 122009	mohit.jain@renew.com
90.	Asst. Vice President, Sterlite Power	DLF Cyber Park, 9th Floor, B Block, Udyog Vihar Phase III, Sector 20, Gurugram – 122008, Haryana, India	yash.tandon@sterlite.com
91.	Head Environment & Corporate Affairs, Resergent Power (TATA)	NRSS - XXXVI,Tata Power B-12 & 13 Shatabdi Bhawan, Sector-4, Noida State - Uttar Pradesh - 201301	rajnishmehrotra@tatapower.com

Annexure-XVIII

भारत सरकार
Government of India
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
पश्चिम क्षेत्रीय विद्युत समिति
Western Regional Power Committee
एफ -3, एमआयडीसी क्षेत्र, अंधेरी (पूर्व), मुंबई - 400 093
F-3, MIDC Area, Andheri (East), Mumbai - 400 093
दूरभाष Phone: 022- 28221636; 28200194/95/96;
Website : www.wrpc.gov.in
फैक्स Fax : 022 – 28370193
E-mail : as-wrpc@nic.in

आई एस ओ : 9001-2015
ISO : 9001-2015

सं. : पक्षेविस/ 50वीं/ पक्षेविस बैठक/ सहा.स. /2024/
No. : WRPC/50th/ WRPC Mtg./A.S./2024/ 9598-9709

दिनांक:
Dated: 24 SEP 2024

सेवा में/To,

(संलग्न सूची के अनुसार/
As per enclosed list)

विषय : पश्चिम क्षेत्रीय विद्युत समिति (पक्षेविसमिति) की 50वीं बैठक का कार्यवृत्त।

Sub : Minutes of 50th meeting of Western Regional Power Committee (WRPC).

महोदय/Sir,

इस पत्र के साथ दिनांक 24 अगस्त, 2024 को ऊटी (तमिलनाडू) में आयोजित पश्चिम क्षेत्रीय विद्युत समिति की 50वीं बैठक एवं इससे पहले दिनांक 23 अगस्त, 2024 को आयोजित तकनीकी समन्वय समिति की बैठक का कार्यवृत्त आपकी सूचना एवं आवश्यक कार्रवाई हेतु संलग्न है ।

Please find enclosed herewith the Minutes of the 50th meeting of Western Regional Power Committee held on 24th August 2024 at Ooty (Tamilnadu) preceded by Technical Coordination Committee meeting on 23rd August 2024 for your kind information and necessary action.

बैठक का कार्यवृत्त पक्षेविसमिति की वेबसाइट www.wrpc.nic.in पर भी उपलब्ध है ।
Minutes of the meeting is also available in the WRPC website: www.wrpc.nic.in.

यह सदस्य सचिव, पक्षेविसमिति के अनुमोदन से जारी किया जाता है ।
This issue with the approval of Member Secretary, WRPC, Mumbai.

धन्यवाद / Thanking you,

भवदीय / Yours faithfully,

संलग्न: उपरोक्तानुसार/As above

24/9/24
(दीपक शर्मा / Deepak Sharma)
कार्यपालक अभियंता / Executive Engineer

50th TCC Discussions:

SE (Operation), WRPC stated that the proposal for developing an online software module for COMWR (Communication Equipment Outage Coordination Meeting WR) was approved in the 49th WRPC meeting. However, in the subsequent SCADA meeting, CTUIL informed that the communication outage portal would be a part of UNMS package and hence, WRPC need not develop a separate portal for the same. CTUIL confirmed that the communication outage portal would be a part of UNMS package.

TCC recommended that WRPC secretariat should not go ahead with the proposed development of a communication portal as it would be a part of the UNMS package implemented by CTUIL.

50th WRPC Discussions:

MS WRPC briefed the agenda items and discussions held in TCC meeting. Member GO&D stated that the implementation of UNMS project might take some time and raised concerns about the communication planning till that period. MS WRPC clarified that the communication outage planning is still discussed in the regular OCC/Pre-OCC meetings for which data are collected through offline mode or emails and the same practice will be continued till the development of the online portal.

WRPC endorsed the recommendations of TCC.

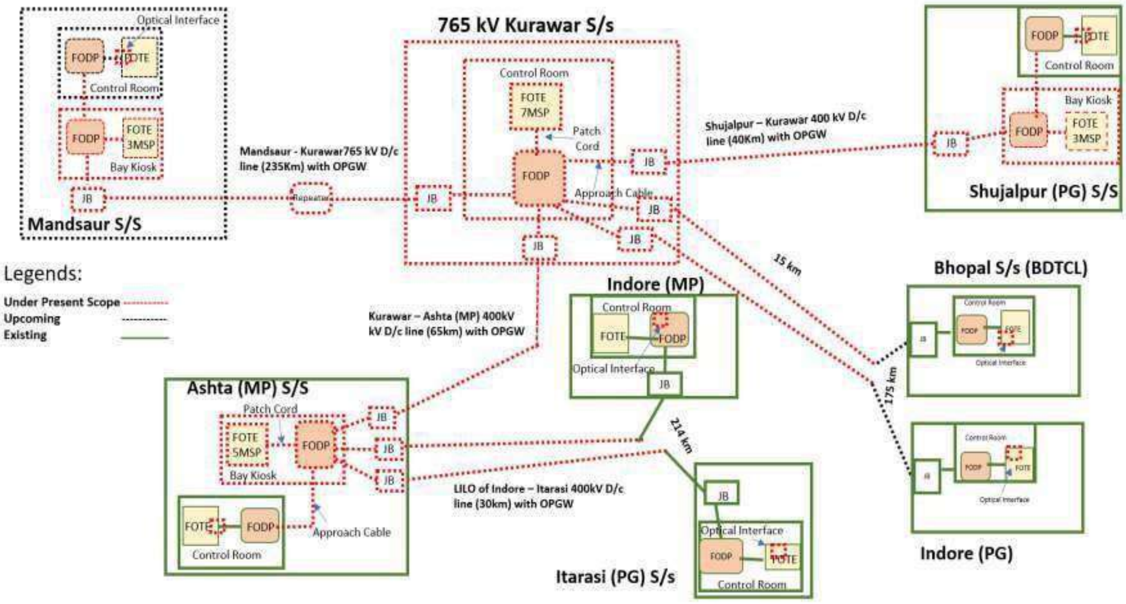
Item No. 6: Utilization of OPGW laid by M/s Indigrid on 765kV S/c Bhopal (BDTCL) – Indore (PG) line for line protection of proposed LILO at upcoming Kurawar S/S & ISTS Communication.

(CTUIL)

765kV S/c Bhopal (BDTCL) – Indore (PG) line (175km) was constructed under the TBCB project “System Strengthening For WR" by M/s Indigrid. OPGW on this line was not envisaged in the scope of RFP (**Annexure-6.1**). However, M/s Indigrid has laid OPGW in place of earth wire on this line at their own cost. They have also installed FOTE(STM-1) at Indore (PG) and Bhopal (BDTCL) ends. The FOTE is being used for line protection only and is not integrated with POWERGRID FOTE at Indore for ULDC data communication. All the data of Bhopal (BDTCL) S/s is reporting to WRLDC through POWERTEL Leased line only.

2. 765kV S/c Bhopal (BDTCL) – Indore (PG) line is approved to be LILOed at upcoming Kurawar S/s under transmission project “Transmission System for Evacuation of Power from Rajasthan REZ Ph-IV (Part-2: 5.5 GW) (Jaisalmer/Barmer Complex): Part H1”. The connectivity diagram is as follows:

Proposed Communication for Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2: 5.5 GW) (Jaisalmer/Barmer Complex): Part H1



3. Data of Kurawar S/s may be communicated through Shujalpur (PG) and Mandsaur S/s as both are connected to a wideband network. Earlier, OPGW on LILO part was not considered in the scope of RFP. CEA vide their letter dated 21.02.2024 stated that OPGW based tele protection may be mentioned in this scheme so that TSP can provide tele protection primarily based on OPGW and alternate path on PLCC as per clause 48, subclause 5 of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022. Accordingly, CTU has modified the RFP of the scheme and included OPGW on LILO section in RFP.

4. For providing the OPGW for protection of LILO lines as mentioned above, this agenda of providing OPGW based line protection of LILO of 765kV S/c Bhopal (BDTCL) – Indore (PG) line at Kurawar S/s, was discussed in the 5th WR ISTS Communication Planning Meeting (CPM) held on 28.03.2024 (**Annexure-6.2**). In the meeting:

a) M/s Indigrid informed that they have put up one PLCC and one DCPS/ FOTE based line protection for the 765kV S/c Bhopal (BDTCL) – Indore (PG) line. They further stated that only one pair fiber is being used/ maintained for line protection and status of healthiness/ losses of rest of the fibers are presently not available.

b) CTU requested M/s Indigrid to provide the connection agreement where it has been mentioned to provide one PLCC based and second OPGW based line protection as in the scope of RFP of this line, only PLCC based protection was mentioned with 100% backup.

c) CTU also requested M/s Indigrid to provide the OTDR test report of all the fibers to assess the healthiness of the OPGW.

5. M/s Indigrid provided the OTDR test report dated 21.10.2022 for the OPGW on 765kV S/c Bhopal Indore line (**Annexure-6.3**). It is found that 23 fibers are healthy and only 1 fiber is broken. Further, M/s Indigrid haven't provided the Connection Agreement till date even after multiple reminders from CTUIL.

6. In view of above, utilization of existing OPGW on 765kV Bhopal – Indore line of M/s Indigrid for line protection (in case of LILO) and ULDC communication along with upgradation of existing FOTE (if required) may be considered.

10th SCADA meeting discussion:

CTU /CEA (PDC) stated that although OPGW was not originally in the scope of RFP for BDTCL project, M/s Indigrid has installed OPGW using ISTS RoW and using OPGW-based line protection by STM-1 link for 765kV Bhopal (BDTCL)-Indore (PG) line along with another PLCC based line protection.

CTU further informed that as per the OTDR test report submitted by M/s Indigrid, the fibers of the said OPGW link are in healthy condition and lived a life of 10yrs only. Hence OPGW laid on the line shall now be made available through the LILO path (OPGW being provided by TSP) for line protection of the proposed LILO at upcoming Kurawar S/S for GRID operation purpose. Moreover, CTU also suggested that these fibers shall be used for ULDC data communication purposes for routing the data upto RLDC in place of the present operational leased line being used by M/s Indigrid for sending data upto WRLDC to achieve greater reliability and to reduce the Annual Recurring Charges of the lease line. They emphasised that this is an optimum and feasible solution for providing the GRID management applications for the ISTS network. They also suggested that M/s Indigrid may approach CERC for the recovery of additional tariff in this regard.

PCD, CEA informed that sharing of the OPGW link will ensure optimal utilizations of the assets and referred to a similar case of M/s. Indigrid which was deliberated in the NRPC meetings, wherein it was concluded that M/s. Indigrid is requested to share the OPGW network for the Grid operation.
M/s Indigrid, however, did not agree with the proposal citing their already executed commercial arrangements for the said line.

MS WRPC stated that M/s Indigrid has laid OPGW using ISTS RoW and therefore, they should share the fibers for protection and communication purposes as proposed by CTU.

50th TCC Discussions:

SE (Operation), WRPC briefed the agenda. MS WRPC asked M/s Indigrid to clarify whether their system is a part of ISTS. As M/s Indigrid confirmed that their system is a part of ISTS system, MS WRPC stated that in that case, BDTCL is responsible for the operation and maintenance of ISTS assets including the associated communication system.

M/s Indigid stated that the installed OPGW has already lived most of its useful life and therefore, an alternate scheme needs to be planned. MS WRPC informed that as per the OTDR test report submitted, the fibres are in healthy condition and therefore, utilizing them for communication purposes is the optimal solution available at present.

COO, CTU agreed with the view of MS WRPC and stated that M/s Indigrid is unnecessary making an issue and should share the fiber. The other TCC members also agreed with this viewpoint.

MS WRPC requested M/s Indigrid to share the fibers. He also advised them to approach CERC for recovery of additional tariff in this regard.

M/s Indigrid agreed to provide the OPGW fibres at BDTCL for the utilisation for ULDC purposes as per the modalities laid down in Hon'ble CERC order 94/MP/2021.

50th WRPC Discussions:

MS NRPC stated that the issue is complex and all regions are facing similar issues. He added that each RPC deals with such issues on a case-to-case basis at present and for streamlining things, a committee has been set up under Member (Power system), CEA to formulate guidelines for sharing of OPGW. Member (GO&D) stated that till the time the guidelines from CEA are issued, such cases may be brought to respective RPCs for deliberations and decisions.

WRPC recommended for usage of OPGW fibre at BDTCL for grid purposes as per the modalities laid down in Hon'ble CERC order 94/MP/2021.

Item No.7: PSDF Funding for "Establishment of SOC at SLDC Gujarat Establishment of Security Operation Centre (SOC) at SLDC, Vadodara, Gujarat".

(GETCO)

GETCO has submitted a proposal of "Establishment of SOC at SLDC Gujarat Establishment of Security Operation Centre (SOC) at SLDC, Vadodara, Gujarat" for PSDF funding. The DPR of the project is attached as **Annexure - 7.1**.

Annexure-XIX

S. No.	Items	Details
1.	Name of Scheme	Establishment of Samba- Jallandhar link for strengthening of ISTS communication system and ring protection to important ISTS nodes in NR
2.	Scope of the scheme	Supply & Installation of Optical Interfaces/ Amplifiers at the existing FOTE of Samba S/s (PG) & Jallandhar S/s (PG) with sharing of Indigrid OPGW.
3.	Objective / Justification	Redundant communication for Samba by utilization of OPGW on 400kV D/c Samba (PG) – Jalandhar (PG) line (owned by M/s Indigrid) was deliberated in the 22nd , 23rd & 26th TeST Meeting of NRPC held on 24.05.2023 & 21.09.2023, 19.11.2024 respectively. Utilization of this OPGW on 400kV D/c Samba (PG)-Jalandhar (PG) shall also provide ring protection to the following stations: **Samba (PG), Kishenpur (PG), Chamera-II (NHPC), Chamera-I (NHPC) & Jalandhar (PG)** As per Indigird OPGW on 400kV D/c Samba (PG) – Jalandhar (PG) line was not originally in their scope as per TSA, however installation has been carried out for commercial utilization at their own cost. As per 26th NRPC TeST Meeting (MoM awaited), it was finalised that in line with 50th WRPC meeting held on 24.08.2024 (Minutes attached at **Annexure-XVIII**) following were agreed: a. Indigrid shall provide six nos. of dark fibers for ISTS communication purpose and also maintain healthiness of the same, for commercial issues if any Indigrid may approach to CERC b. FOTE at both end at Samba & Jallandhar end to be installed under ISTS scheme same shall be prepared by CTUIL. As per inputs of POWERGRID vide email dtd. 12.12.2024 that Optical Interfaces/ Amplifiers at the

		existing FOTE of Samba S/s (PG) & Jallandhar S/s (PG) shall be required and there is no need of any additional FOTE.
4.	Estimated Cost	**Rs. 20 lakhs (approx.)**
5.	Implementation timeframe	**12 months from the date of allocation**
6.	Implementation Agency	**POWERGRID**
7.	Implementation mode	**RTM mode**
8.	Deliberations in different meetings	22nd & 23rd TeST Meeting of NRPC held on 24.05.2023 & 21.09.2023 respectively and 26th NRPC TeST held on 19.11.2024 (MoM awaited)

Annexure-XX

सं. 22-1306/4/2022-ओ एम [E-262577]
भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power

F-Wing, 2nd Floor, Nirman Bhawan
New Delhi, the 30th October, 2024

To,

1. Principal Secretary/Secretary (Energy) of State Governments/UTs.
2. CMD, Grid-India, New Delhi

Subject: Workforce Adequacy Guidelines for Load Despatch Centres and Guidelines for deputation of Workforce from SLDCs to Grid-India for fixed terms-reg.

Sir/Madam,

A copy each of the 'Workforce Adequacy Guidelines for Load Despatch Centres' and **'Guidelines for deputation of Workforce from SLDCs to Grid-India'** approved by the Hon'ble Minister of Power is forwarded herewith for information and compliance.

2. The Workforce Adequacy Guidelines for Load Despatch Centres will serve as a benchmark for enhancing the Load Despatch Centres by ensuring they are equipped with sufficient skilled human resources. The Guidelines for Deputation of Workforce from State Load Despatch Centres (SLDCs) to Grid-India focus on fostering collaboration and knowledge-sharing among various LDCs. These guidelines facilitate the exchange of personnel, thereby promoting functional cohesion and building a robust talent pool of Power System Operators.

3. By adhering to these guidelines, LDCs can enhance their operational capacity, ensure efficient management of the grid and ultimately contribute to the stability and reliability of the electricity supply across the nation. Compliance with these guidelines is essential for achieving the goal of a well-equipped and skilled workforce in the power sector.

Encl: As Above

Yours faithfully
30/10/24
(Parveen Dudeja)
Director (OM)
Email:parveen.dudeja@nic.in

Copy to : Chairperson, CEA

Copy for information to: PS to Hon. MoP /Sr. PPS to Secretary (Power)/ Sr. PPS to AS(SN)/ PPS to JS(OM)

Copy to: Incharge, NIC, Ministry of Power for uploading the guidelines on the website of Ministry of Power under 'New Notices' with heading "**Workforce Adequacy Guidelines for Load Despatch Centres and Guidelines for deputation of Workforce from SLDCs to Grid-India for fixed terms**".

Workforce Adequacy Guidelines for Load Despatch Centres

July 2024

Table of Contents

Introduction

The Electricity Act 2003 designates the Load Despatch Centres (LDCs) as apex bodies to ensure integrated, secure, reliable, economic, and efficient operation of power system under their jurisdiction. The LDCs would play an important role in facilitating the energy transition towards a sustainable and decarbonised electricity grid. Human Capital is the most important Asset in in any organizational setup. Human Resource adequacy has a direct effect on performance and efficiency of all functions and activities. Since LDCs carry out mission critical activities on a 24X7 basis, the availability of adequate human resources in the Load Despatch Centres play a very critical role for reliable and efficient power supply. These guidelines have been formulated to provide a benchmark for strengthening the State Load Despatch Centres by ensuring adequacy of skilled human resources.

The Committee on 'Manpower, Certification, and Incentives for System Operation and Ring-fencing Load Despatch Centres' 2008, estimated a total requirement of 60-70 persons in each Load Despatch Centre. However, it has been more than 14 years since the report was published and the landscape of Indian Power Sector has undergone major transformations since then.

The report on 'Capacity Building of Indian Load Despatchers'(CABIL) endorsed by the Forum of Regulators in 2018 elaborated the manifold expansion in the roles and responsibilities of the load despatch centres in India. The load despatch centres were placed in three groups viz Group-A (Large LDCs), Medium LDCs and Emerging LDCs. The total number of executives (including Supervisors, excluding staff for Sub-LDCs, Physical Security and REMC) in Group-A (Large LDCs) recommended in the report was in the range of 100 – 150 nos. The report further recommends additional 25 personnel for Renewable Energy Management Centres (REMCs).

Categorization of Load Despatch Centres

Considering the diversity of power system profile of different states in terms of their peak demand met, energy consumption and installed capacity of Renewable Energy Sources, all SLDCs have been categorised. Their Human Capital requirements are different as well. The thirty-five SLDCs have been grouped into three categories – Large SLDCs, Medium SLDCs, Emerging SLDCs. NLDC and RLDCs have been considered in the category of large LDCs for the purpose of estimating workforce requirement.

Table 1- Categorisation of SLDCs

S. No.	Large SLDCs	Medium SLDCs	Emerging SLDCs
1	Andhra Pradesh	Assam	Arunachal Pradesh
2	Gujarat	Bihar	Chandigarh
3	Haryana	Chhattisgarh	Dadra and Nagar Haveli /Daman & Diu
4	Karnataka	Damodar Valley Corporation	Goa
5	Maharashtra	Delhi	Manipur
6	Madhya Pradesh	Himachal Pradesh	Meghalaya
7	Punjab	Jammu & Kashmir and Ladakh	Mizoram
8	Rajasthan	Jharkhand	Nagaland
9	Tamil Nadu	Kerala	Puducherry
10	Telangana	Odisha	Sikkim
11	Uttar Pradesh	Uttarakhand	Tripura
12	West Bengal		Andaman & Nicobar*
13			Lakshadweep**

* As of now, LDC functions of A& N are being managed by the Energy Management Centre (EMC) at Port Blair. Considering the power system profiles such as Peak Demand Met, Energy Consumption and Installed Capacity of Renewable Energy Sources, A&N can be categorize under Emerging LDC.

** Managed by Electricity Department, Lakshadweep

The functions discharged by LDCs can be broadly classified into following categories - System Operation (SO), Market Operation (MO), Logistics, and

Support services. The System Operation function covers operational planning (including assessments, studies, crew management), real-time operation (including scheduling, forecasting, outage planning and reporting) and post despatch analysis (including reporting, MIS, feedback and analytics). The market operation function covers open access administration, day ahead market, real-time market, energy accounting and settlement activities, regulatory functions etc. Logistics covers decision support, Information technology. Cyber Security has emerged as an important function and requires dedicated specialized personnel. Support Services include human resource management, contract services, finance and account, establishment, administration are support services.

There are thirteen Renewable Energy Management Centre (REMC) in India which include the REMCs in Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Telangana, Tamil Nadu, Karnataka and Andhra Pradesh which are collocated with SLDCs. The REMCs are also envisaged for UT Ladakh and 3 more locations (under discussion stage). The REMC takes care of the forecasting, scheduling and real-time monitoring renewable energy resources. REMCs at all regions require dedicated, specialized employees.

Imperatives

In the past decade, due to rapid developments / interventions in the sector, through reforms, policy initiatives, changing corporate landscape and LDCs' own evolving roles in the Power Sector, several imperatives have emerged. Additional HR will be required to meet challenges related to exponential increase in electrical energy demand, growth in the economy and changes in technology, regulations, market design, administration and management of the power system. These imperatives will impact functions and require additional resources including Human Resources. Some of these are enumerated below:

1. Grid management has transitioned from supervisory role to sophisticated controls & faster Electricity Market administration such as Automatic Generation Control, System Integrity Protection Systems, Real Time

Market, Advance metering Architecture/Smart Grid. There is now an increased thrust on optimization – Economic Dispatch, Energy Optimization, Asset Optimization and Demand Optimization.

2. In addition to the round-the-clock System Operation, the Load Despatch Centres are expected to contribute in Market Operation, research & analysis, support / advocacy in regulatory affairs, Data dissemination (system data acquisition, Communication, IT systems) and other establishment services to carry out the various functions with suitably skilled workforce.

3. There have been dynamic changes in the electricity consumption patterns, in addition to this, System Operation is facing another major challenge of integration of Renewable resources, such as Solar & wind, in line with India's commitment to Climate change & NDC targets. This brings in new challenges in respect of its variability, intermittency and technological aspects associated with Power electronic devices. Further, constraints in terms of flexibility of conventional resources also contribute towards these challenges.

4. LDCs have undertaken several new work domains to improve reliability, security and economy, these include:- Load forecasting, RE forecasting, fuel security assessment, production cost optimization studies, generation outage planning, transmission outage planning, assessment of Transfer Capability, Reactive Power studies, Short circuit and transient stability studies, small signal stability studies, Electromagnetic transient studies, Mock black start drills, Activation of back up control centre, preparations for special events like festivals, natural calamities like cyclone, floods etc. and documentation of procedures (operating, restoration).

5. With advent of new players such as distributed generation, storage, electric vehicles, aggregators etc., there is a need for renewed thrust in areas such as Market Design, Open Access Administration, Day Ahead

Market, Real Time Market, Ancillary Services Market, Metering, Accounting, Settlement & Pool Accounts, Tax reconciliation & LDC fees and charges etc. With introduction of ancillary services, forecasting scheduling & deviation settlement regulations for RES, demand for market-based instruments (balancing & flexibility services viz. AGC, fast response tertiary regulation, ramping, load following etc.) is likely to arise on a significant scale. Hence, adequate personnel will be required to meet these challenges and carry out these evolving activities.

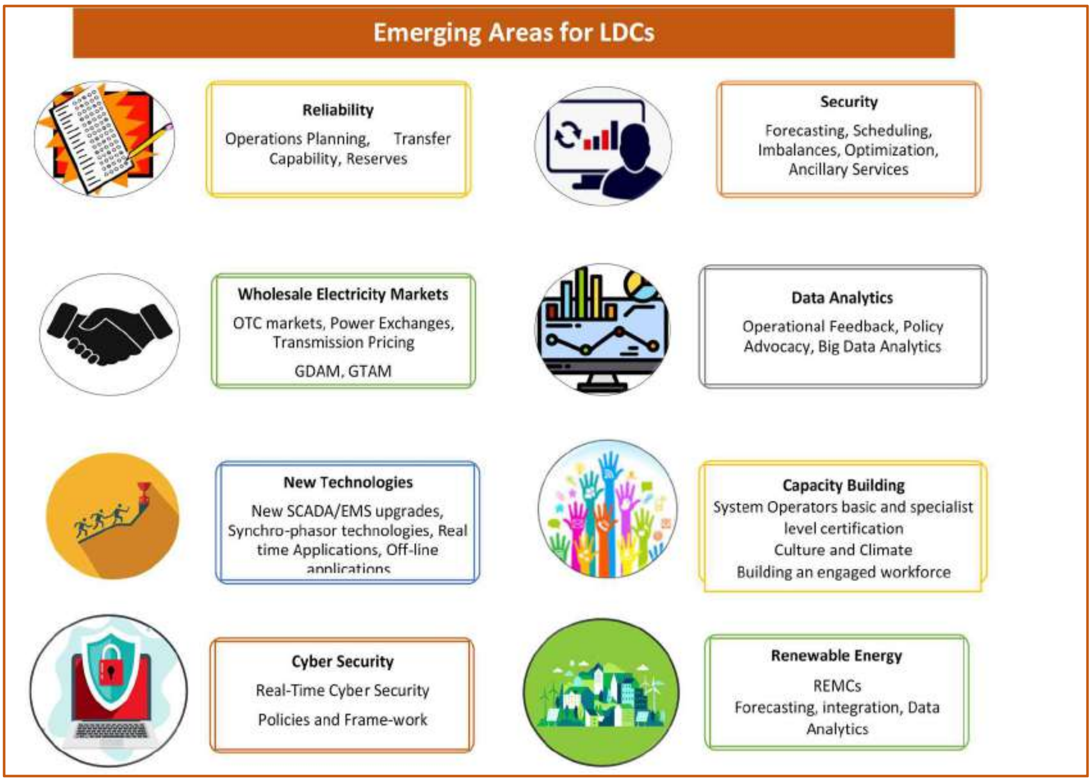
6. On technology front, focus areas essential for building and strengthening of technical infrastructure in LDCs are Engineering of new SCADA/EMS upgrades, Synchro-phasor technologies, Real time Applications, Off-line applications, Big Data Analytics tools, Website development, upgrading and maintaining Cyber security, etc.

7. Cyber Security is a new emerging area, where keeping updated, timely assessment of threats and facilitating collaboration on devising policies and strategies to strengthen Cyber Security efforts across Power Systems is important

8. Furthermore, for efficient running of the LDCs HR functions, Finance functions, Planning, Vigilance, etc. deployment of matching additional HR Resources would be a necessity.

9. There should be a sufficient number of power system operators to ensure that the grid can be operated safely and efficiently at all times, and that operators are not overworked. There is a need for some type of rotation of staff for scheduling, continuity of service and stress reduction of the power system operators, hence, a minimum tenure and reserve shift are important.

Figure 1- Emerging Areas for LDCs



Methodology adopted for working out HR Requirement

1. Based on existing functions and envisaged future functions, an organigram was prepared for LDCs.

2. Comprehensive list of existing and anticipated activities based on present area of operations and anticipated requirements was prepared.

3. Working out FTE (Full Time Equivalent) requirement for each activity- This was done based on daily time-required estimate for completion of each activity. FTEs have been estimated in particular function in increments of 0.25.

4. While estimating FTE Requirement, degree of automation and outsourcing which is present and/ or anticipated is also accounted for. Certain activities such as housekeeping, security etc. are envisaged to

be outsourced completely, with only supervisory function remaining with the LDCs.

5. In critical functions such as Real-Time System operation, it is essential to plan for contingencies and build reserves, a requirement underscored by COVID-19 Pandemic. Hence, in a major change of approach, a reserve shift has been considered, making it 5 shifts in total for Real –Time Grid Management.

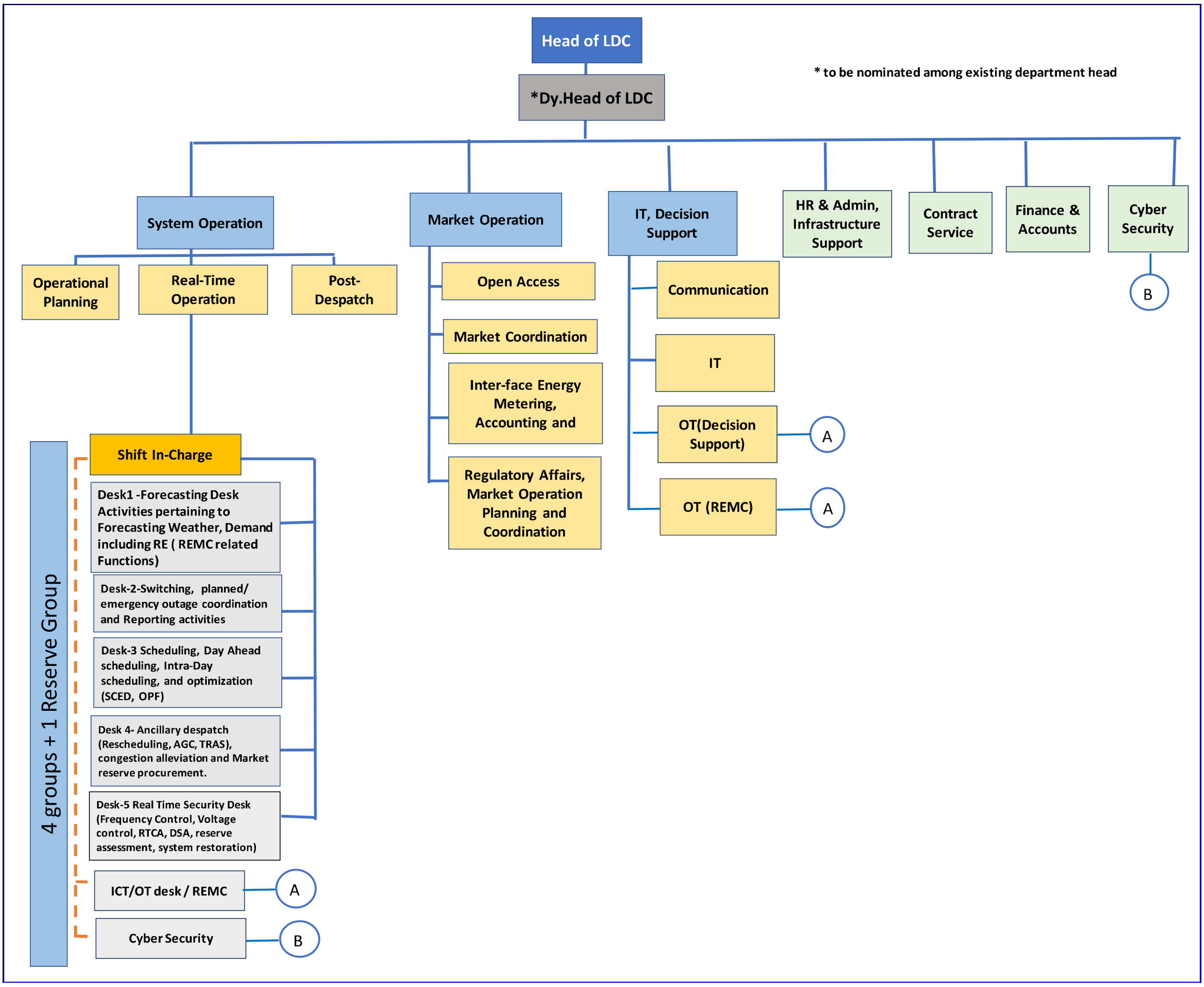
6. The number of activities performed in Large, Medium and emerging LDCs remain more or less the same, the volume and extent of the activities being carried out differs based on the size of the LDC, hence, the number of personnel differs at each LDC. There are certain statutory activities which will remain the same irrespective of the size of the LDCs and therefore, a minimum number of workforce allocation will be required at each LDC.

DEPARTMENT CATEGORISATION - NLDC, RLDCs & SLDCs

FTEs allocation has been done to these 7 Functions: i. System Operation,ii. Market Operation iii. Logistics iv. Cyber Security v. Contract Services vi. Finance and Accounts vii HR, Admin & Infrastructure Services. These numbers do not include workmen or staff requirement for non-core functions such as general upkeep of the premises, security, assistants etc. and do not include workmen, these requirements are different for every LDCs based on their local. Regional requirement and ongoing legacy.

Further, it is not envisaged that these numbers are achieved immediately, as culture and socialisation of employees is important it is important that there is a gradual scaling or workforce at every LDCs.

Figure 2- Typical Organogram for an LDC



1. System Operation

System Operation in each LDCs has been organized under three divisions- i. Operational Planning or Pre-Despatch; ii. Real-Time Operation- to be operated in Shifts, with respective Shift-In charges and with one offline In-charge, iii. Post-Despatch

a. Functions, roles and responsibilities of **Operational Planning** are as follows:-

i. Primary Frequency Response Testing
ii. Primary/secondary/tertiary reserve capacity assessment
iii. Validation of standards conformity test reports submitted by RE developers through in-house simulations
iv. Enforcement and Compliance of various standards and regulations under RE
v. Network model validation for simulation studies
vi. Fuel adequacy assessment
vii. Protection coordination, resilience coordination
viii. Enhanced coordination with stakeholders for system reliability for high impact low probability events (Lights off, cyclone, Solar Eclipse etc.
ix. Increasing number of Power System Elements- especially Renewables, EVs, Solar Roof-top
x. Studies such as Steady State Studies, Dynamic Studies, Optimisation Studies. Forecasting, Fuel Security Assessment and Generation & Network Outage Planning.
xi. Disaster Management Coordination
xii. Transnational Coordination, resilience coordination Mock black-start drills, contingency plans, Preparation for Special Events
xiii. Augmentation in Back-Up control centre operations- As a part of the initiatives to enhance resiliency of control centre operations, back-up control centres and disaster recovery systems are being implemented in some of the LDCs. Dedicated HR is required for satisfactory operation of these centres to enable them to cater for emergency situations.
xiv. Resource Crew Management, documentation

Some of the key additional functions also include Carrying out data intensive research consultation / collaboration with other grid operators, multilateral agencies, academia and other statutory bodies in India. Strengthening capabilities in system simulation, optimization, forecasting, model validation, data management, situational awareness, synchrophasor applications, dynamic security assessment and other decision support technologies, harmonization of operating procedure.

b. Functions, roles and responsibilities of **Real-Time Grid Operation** are as follows :

Real-Time operation is at the heart of any LDC. Therefore, adequate deployment of trained and certified personnel is required. Each control room must operate in five shift groups with 3-8 Nos. per shift. There would be total 5 shift groups. The fifth group is recommended to factor leave reserves and training needs of real-time operations personnel. This is in line with the international best practices. COVID-19 Pandemic has underscored the importance of Reserve Shifts. This fifth reserve group will ensure continuity of operation even in cases where entire groups have been quarantined Thus, the HR budget for real-time operations takes into account round-the clock operations, entitled leaves, public holidays, festivals, business travel, training, special assignments etc. making a total of 15 – 40 Nos. overall for control room shift operation.

These functions in each shift group have been segregated into desks, each desk will perform specific duties. Shifts will be headed by Shift In-charges, with an overall in-charge in offline (General Shift), to oversee and coordinate. The Desks are as follows:-

i. Desk 1- Forecasting Desk – Activities pertaining to Forecasting Weather, Demand including RE (REMC related Functions)

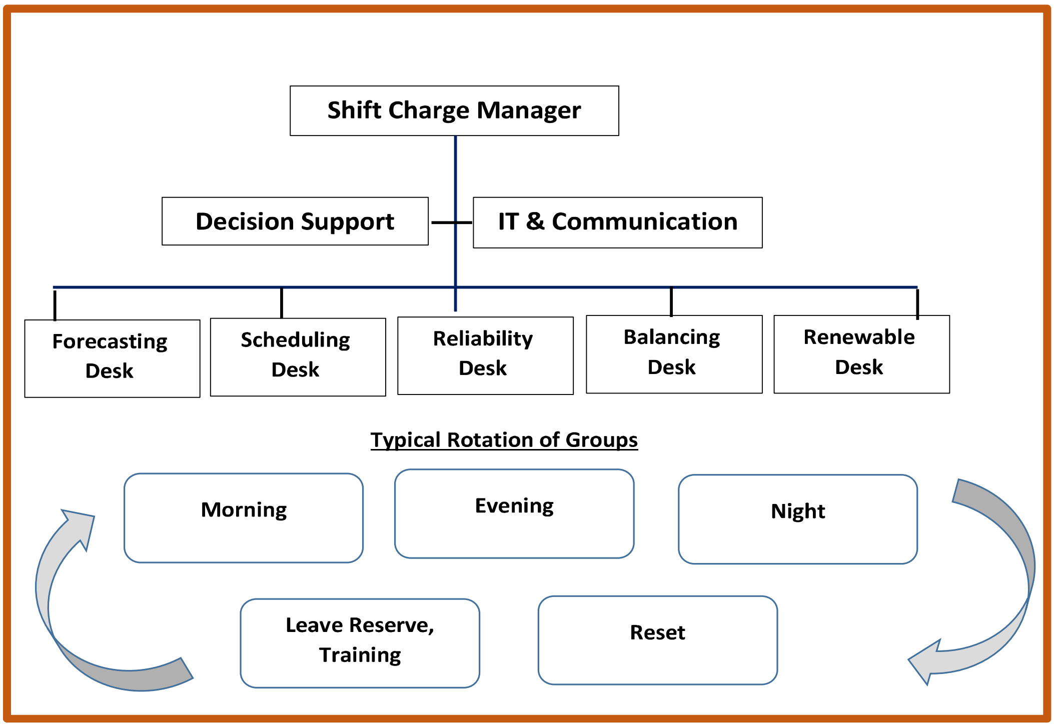
ii. Desk-2-Switching, planned/emergency outage coordination and Reporting activities

iii. Desk-3 Scheduling- Day Ahead scheduling, Intra-Day scheduling, and optimization (SCED, OPF)- for activities and functions pertaining to Security Constrained Economic Despatch and Optimal Power Flow.

iv. Desk 4- Ancillary despatch (Rescheduling, AGC, TRAS), congestion alleviation and market reserve procurement. This require dedicated persons in real-time for reserve assessment, reserve procurement from DAM/RTM and despatch and coordination with the ancillary service providers.

v. Desk-5 Real Time Security Desk (Frequency Control, Voltage control, RTCA, DSA, reserve assessment, system restoration).

Figure 3- Organogram of Real-time shift operation



c. Functions, roles and responsibilities of **Post Despatch** are as follows: -

i. System performance assessment.

ii. MIS and Reporting, Grid standards, code compliance monitoring and reporting.

iii. Low Frequency Oscillation Display and Analysis Evaluating Primary Response- Inertia and frequency response Ramp performance assessment AGC response assessment Network availability verification Grid incident/ disturbance analysis, reporting and documentation.

iv. Operation feedback compilation.

v. Simulation of events and learning, Data analytics and research.

2. Market Operation

Market Operation function is an evolving Dynamic Function, which is changing due to various regulatory initiatives and reforms. Market Operation has been organized under 4 divisions - Open Access, Market Coordination, Inter-face Energy Metering, Accounting and Settlement, Regulatory Affairs. Functions and activities related to Electricity markets are limited in medium and emerging LDCs, hence, comparatively the staffing requirements are lower in these LDCs. Functions, roles and responsibilities which have been added to Market Operation include: -

a. **Open Access Administration**:

i. Administration of Electricity Market through National Open Access Registry (NOAR) Short term open access - bilateral / e-bidding Open Access Short term open access - collective / DAM, RTM, billing, collection, disbursement, reconciliation

ii. Day Ahead Market, proposed GDAM, MBED, Market coupling

iii. Real Time Market

iv. Accounting and settlement of Secondary/Tertiary Reserve and Ancillary Services

v. Ancillary Services Market

vi. forecasting scheduling & deviation settlement regulations for RES

vii. Market based instruments (balancing & flexibility services viz. AGC, fast response tertiary regulation, ramping, load following etc.)

viii. DSM Amendment Regulations

b. Market Coordination:

i. Grid Access- User registration, fees and charge sharing

ii. Market Participants Coordination, allocations, Energy contracts, losses, regulation of power supply, Day Ahead Ancillary Requirement
iii. Finalisation of inter-change schedule

c. Inter-face Energy Metering, Accounting and Settlement:

i. Energy meter placement and integration, FTC clearance
ii. Meter data collection, AMR
iii. Energy meter data validation including with SCADA
iv. Energy meter data processing
v. Energy accounting (active & reactive) including trans-national accounting, Congestion Account
vi. Congestion, Ancillary (SRAS, TRAS...) account
vii. SCED account
viii. Transmission charge computation
ix. Pool account operation including reconciliation (Finance Executive)
x. Transnational exchanges Settlement and Reconciliation

d. Regulatory Affairs, Market Operation Planning and Coordination

i. Market analytics,
ii. Market design feedback
iii. Audit / Stakeholder coordination
iv. Physical Grid access administration-Connectivity, long/medium term access
v. Power purchase agreement, database
vi. Regulatory compliance verification coordination, first time charging coordination, Performance test, COD verification
vii. Filing petitions and replies
viii. Coordination with legal, regulatory institutions, law firms

3. Logistics

Logistics functions have been organised in 4 divisions which are:- i. Operation Technology; ii. Renewable Energy Management Centres; iii. Information Technology; iv. Communication.

Real-Time SCADA/ IT Support Desk - With automation of the scheduling process and introduction of ancillary despatch, AGC control system, dynamic security assessment, the real-time supervision of the communication and the information technology systems has become critical. This desk would oversee the decision support systems and the data and speech communication in real-time.

b. Functions, roles and responsibilities of **Operation Technology Logistics** are as follows**:**

i. Engineering of upgrades of SCADA/ EMS, R&M, Integration of PMU and RTU,
ii. Development & Maintenance-SCADA database, SCADA Display, ICCP,
iii. Synchro-Phasor Technologies- Database and display development & maintenance
iv. Real-Time Software Application - SCED, AGC, RRAS, State Estimation
v. Decision Support-State Estimation, EMS, Dynamic security assessment, Optimal Power Flow
vi. Dispatcher training simulator maintenance
vii. Local and remote back up control centre (incl REMC) maintenance
viii. Power Supply System - UPS/DG Set, Control Room Air Conditioning
ix. AMC coordination, certification, verification
x. Support for real-time ICT/OT desk / REMC Support

c. Functions, roles and responsibilities of **Information Technology - Logistics** are as follows:

Advanced digitization and automation requirements without compromising cyber security and hygiene. Effective redundancy and disaster recovery mechanism which is seamless and wide-spread. The thrust would be towards timely execution of the Technology roadmap that has been evolved through a wide consultation.

i. IT systems infrastructure, networking, hardware engineering design and maintenance
ii. -JanIT systems- Application software maintenance
iii. Information access control and security (Implementation of CISO,
iv. CERT-GO Advisories)
v. Information interface (Internal, external)
vi. Database administration and maintenance
vii. Application software design and development
viii. Data analytic system
ix. Disaster recovery system
x. Data lake, warehouse and mining

d. Functions, roles and responsibilities of **Communication Logistics** are as follows**:**

i. Voice communication (Internal and external, recording)
ii. Data communication - (PLCC, Leased line, Optic fibre, GPRS, VSAT, Satellite), Wi-Fi
iii. Remote Conferencing and Meeting Facilities- Audio-Visual
iv. Communication Network Availability Verification

4. Renewable Energy Management Centres(REMCs)

The REMCs in the southern, western, northern region and the national REMC in New Delhi began operations in February 2020 are being managed by GRID - INDIA. They require dedicated human resource for maintaining the IT systems, overseeing the operations, and other related IT, OT and forecasting aspects.

Functions, roles and responsibilities of **Renewable Energy Management Centre**s are as follows**:**

i. RES Integration
ii. REMC database/ Display development, maintenance, Support for Real-time REMC Desk
iii. Forecast Service Provider, Weather Service Provider coordination in REMC
iv. Availability and Performance Verification

5. Cyber Security

Cyber Security is a major focus area in view of changing Information Technology Landscape globally. A real-time 24X7 desk to coordinate activities and functions pertaining to Cyber Security in LDCs. RLDCs and NLDC are under the same corporate structure, a few cyber security functions have been centralised at GRID-INDIA, at the corporate level.

Functions, roles and responsibilities of **Cyber Security** are as follows**:**

i. Roles and responsibilities of CISO, Alternate CISO, and various requirement to coordinate with the statutory bodies and monitoring and ensuring cyber security initiatives and compliances within the LDC
ii. Coordination and enactment of cyber security controls and compliances.

i. SOC function - works related to 24 x 7 monitoring at Security operation Centre (if established at the organizational level) and analysis of the events thereof, . With future growth and possibility of establishment of NOC (Network Operation Centre), SOC at unit level etc. the requirement may also increase.

ii. CISO, CERT GO related coordination with stakeholders, CERT-In, NCIIPC

iii. ISMS compliance

iv. Real-time Cyber security monitoring

6. Support Functions– Contract Services, Finance and Human Resources

For efficient running of the LDCs the support functions like HR/ Admin, Finance, Planning, Vigilance, Contract service, Legal etc. play a very important role. The Work place policies keep up with necessary protective measures and implementation and provide solutions to issues between team members, avoiding risk for the company and its employees. The financial information are required to operate effectively and efficiently, keeping the overall guidelines and direction.

Functions, roles and responsibilities of **Support Functions** are as follows**:**

Finance & Accounts : Revenue Accounting & Reconciliation, Pool Accounts & STOA - Accounting & Reconciliation, Third party payment (CAPEX/REPAX/Opex, Admin exp.) - Accounting, Payments, MIS, Maintenance of BG, Establishment - (Salary & Employee Claims, Loans and Advances) - Payments to employees viz Salary, TA, Medical, Contingent claims, Lease payments, Tax calculation, Issuance of Form 16, Filing of quarterly and annual TDS returns, Payment to retired Employees claims, Financial Concurrence and Committee works, Banking , Payment to employees & Third party on daily basis, Bank Reconciliation, Liaoning with bank, Taxation - Deposit of monthly tax, Filing of Quarterly & Annual return, TDS reconciliation, Coordination with Income Tax Deptt. GST Returns & Compliance, internal, statutory and CAG audits etc.

HR/HRD & Admin : Performance Appraisal & Coordinating Promotion, HRD, HR Operation, Social Security and Compliances including IMS/ DPE/ MoP/ CERC etc., Recruitment, HR Operation, Social Security and Compliances including IMS/ DPE/ MoP/ CERC etc., House Keeping, Despatch, Reception & Visitor Management; Welfare, AMS, Sports, Other agencies; Ergonomics & ambience - Furniture, Lighting, Acoustics, horticulture, Public Address System etc.

Contract Service: Quotation collection, tender preparation, GeM portal, Bid processing, opening, Placing of LoA/PO, Contract closing.

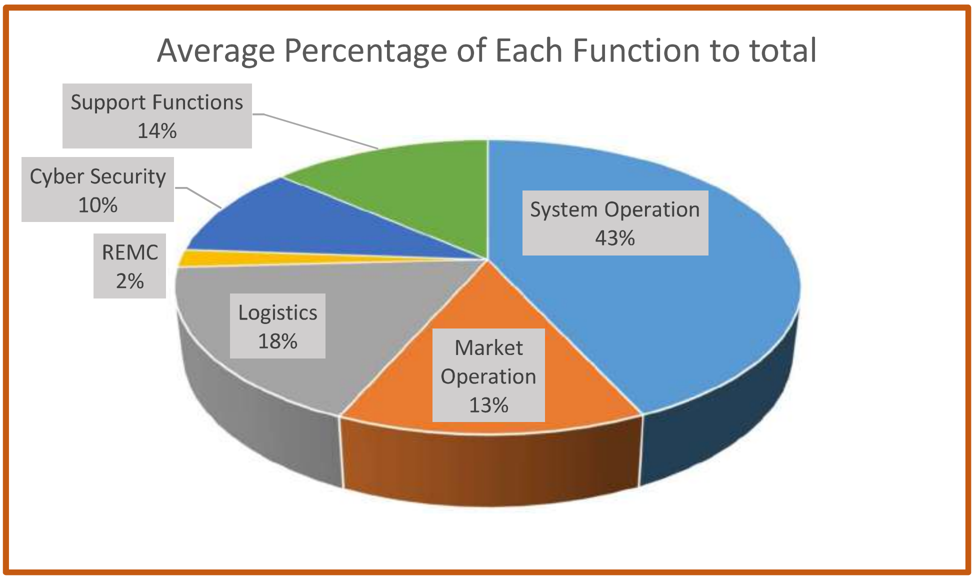
7. Summary of Function-wise Allocation of FTEs in LDCs are follows:-

Table 2- Function-wise Workforce allocation

LDCs - Workforce Staffing Norms						
SN	**Function**	**NLDC**	**RLDC**	**Large SLDC**	**Medium SLDC**	**Emerging SLDC**
System Operation						
1	System Operation - Operational Planning	18	18	18	16	9
2	Real Time Grid Operation (For SO only)	31	31	31	26	18
3	Post-Despatch	10	10	10	10	4
Sub -Total (SO)		**59**	**59**	**59**	**52**	**31**
Market Operation						
4	Open Access Administration	5	4	4	1	1
5	Market Coordination	4	4	4	3	1
6	Inter-face Energy Metering, Accounting and Settlement	10	8	8	4	1

7	Regulatory Affairs, Market Operation Planning and Coordination	7	5	5	1	1
Subtotal - MO		**26**	**21**	**21**	**9**	**4**
Logistics						
8	Logistics _Operation technology	15	14	14	8	3
9	IT Logistics	9	9	9	6	3
10	Communication Logistics	4	4	4	2	2
Subtotal - Logistics		**28**	**27**	**27**	**16**	**8**
REMC						
11	REMC Logistics	3	3	3	2	1
Cyber Security						
12	**Cyber Security**	**17**	**8**	**14**	**13**	**10**
Support Functions						
13	Contract Services	3	3	3	2	2
14	Finance and Accounts	9	9	9	5	3
15	HR & Admin	8	8	8	4	3
Subtotal -Support Functions		**20**	**20**	**20**	**11**	**8**
Grand-Total		**153**	**138**	**144**	**103**	**62**

Figure 4- Average percentage of each function



Level-Wise Requirement

In order to facilitate decision making and empower control rooms and functions to take decisions independently without any time lag and waiting for approval for all actions, it is imperative that appropriate senior level persons are deployed at every level.

Table 3- Level-wise Requirement at each LDC

Level	Percentage of total Workforce in LDCs
Top Management	1 %
Senior Management (experience of 20 years & above)	9 %
Middle Management (Experience of 15 -20 Years)	20 %
Working Executives (experience of below 15 Years)	70 %

a. Top Management:

Head of LDC- All LDCs are required to be headed by senior level executive, as they are required to interact with external stake-holder and give inputs. Hence, experienced and senior person is required who is able to communicate with all institutions such as SERCs, STUs & SLDCs and interact with head of institutions, at the level of Secretary of State Energy dept., CMD / Directors of other Power Utilities etc.

b. Senior Management:

i. They typically serve as Heads of functions (based on their seniority. Further, it is essential to keep succession planning in mind and these senior executives shall take the roles of Head of LDCs / future Directors of similar institutions.

ii. Represent LDCs at various forums and multi-lateral agencies. They are responsible for motivating their teams, leading and coordinating efforts, and have to undertake assignments.

c. Middle Management Level

Will head each shift group and divisions, within functions in LDCs including function like HR, Finance etc. It is essential that he/she is given responsibility to ensure that there is independent real-time decision making. They are empowered to take complex actions and decisions. Thus, there is decentralization of authority and responsibility.

d. Working Level

These are working and learning levels and these employees progress through the hierarchy to take more responsibilities.

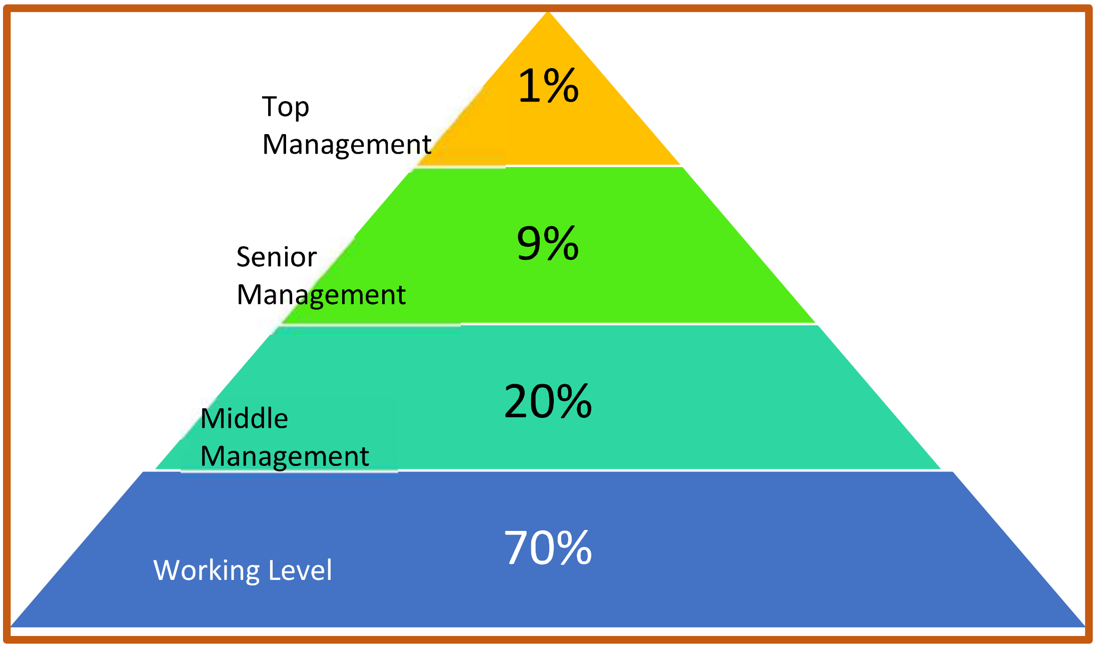


Figure 5- Level-wise distribution of Workforce

Creating Skilled and Motivated Workforce at LDCs

i. Training of System Operators

System operators need to be up-to-date with the evolving technology, policies, rules, standards, regulations, procedures and best practices. Therefore, capacity building through training and refresher programme has been implemented through National Power Training Institute (NPTI) for Load Despatchers. It is categorized into 3 levels - Basic Level, Specialist Level and Management Level. Basic Level System Operation programme is the foundation course required for all System Operators and can also be attended by those posted in other functional areas in LDCs. Basic Level Course on Cyber Security is required for those posted in IT & OT functions. The specialist courses on topics such as Reliability, Regulatory Framework in Power Sector, and Advanced course on Cyber Security are available for experienced specialist professionals employed in these respective fields in LDCs. The payment of Tuition fee for these courses is exempt for employees of SLDCs. Detailed list of Training Courses for LDC personnel is given at **Annexure-I.**

In addition to this, LDC personnel should also be encouraged to pursue online training and certification available at several national and international academic institutes and offered by Massive Online Open Courses (mooc) platforms such as LinkedIn Learning, Edx, Coursera etc. Learning has evolved from structured learning programs to individualised learning journeys where the content, pace, and assessment of the learning are tailored to the individual learner's needs and preferences. This approach allows learners to set their own learning goals. The learning journey must align to employees' career advancement as well as bridge the gaps between the present skills, knowledge and behaviours to what is required to meet future challenges and promote the mantra of 'Learning on the go'. Forum of Load Despatchers (FOLD) can also evolve its own e-learning platform, to cater to unique requirements of system operators.

ii. Certification of System Operators & Fixed Retainer-Ship Incentives

Presently, National Power Training Institute (NPTI) has been entrusted as Nodal Agency for Training & Certification of System Operators and various certification exams for Basic and Advance Level are being conducted by NPTI. List of training/certification programs is given at Annexure-I. As per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2022, Ref No. CEA-PS-16/1/2021-CEI Division, dated 8th June 2023, "***no personnel shall be engaged as Load Despatcher without certification***". For details guidelines regarding mandatory Training & Certification of Basic and Advance Level refer Central Electricity Authority's *"**Statutory Guidelines for Training and Certification of Load Despatchers & Recognition of Training Institutes' January 2024".***

The Load Despatchers who acquire the certificate of basic level and of advance level in their respective area of specialization shall be allowed a fixed retainer-ship amount during the validity of such certificate period in line with the Central Electricity Authority's "**Statutory Guidelines for Training and Certification of Load Despatchers & Recognition of Training Institutes' January 2024.**

iii. Short term exposure Programme for System Operators

Power system operators should have the necessary education and training to perform their duties, and should be regularly updated on new technologies and industry developments, there should be concerted efforts to increase collaboration and communication among System Operators from LDCs. A Short-Term Exposure Programme has been envisaged to provide opportunity the system operators to learn from each other and to propagate best-practices. Rotation of System Operators would also enhance cohesive working and coordination in operations. The programme will include 2-10 days' duration rotational assignments to other LDCs. The officials from one LDC will be rotated to other LDCs in System Operation, Market Operation and Logistics functions. Detailed modalities of the Short-Term Exposure Programme are given **as Annexure- II.**

iv. Tenure of Posting in SLDCs

Reliable and safe operation of power systems is critical to the country. Tacit knowledge gained through practical experience is essential for handling minute to minute challenges and for training new entrants. Therefore, a minimum posting for a period of three years is recommended for any official posted in SLDC. Any person posted in an LDC shall be provided training and must acquire relevant basic level certificate within six months of being posted in the LDC.

v. Creating a Progressive Culture

LDCs play a critical role in ensuring the reliability and efficiency of the electric power grid. Organizational culture, the values, beliefs, and practices that shape how an organization functions.

There have been immense transformations in the power sector resulting into an increase in the scope, volume and complexities of all the functions. LDC's external business environment has always been fast-evolving, requiring continuous knowledge upgradation and inherently challenging. The years ahead will bring additional challenges, both anticipated and uncertain. LDC's success in meeting them will depend largely on an engaged, highly skilled and motivated workforce.

In order to build competence and ensure that LDCs are able to deliver high levels of performance, due importance must be given to developing a progressive culture and creating an ecosystem that values employees and empowers them.

A strong organizational culture can help establish trust with stakeholders, by promoting transparency and consistency, LDCs can demonstrate its commitment to fair and impartial decision-making internally and externally.

When employees feel that they are valued and respected, they are more likely to be committed to the organization and motivated to perform at their best.

A positive organizational culture can improve communication and collaboration among employees, which can help ensure that the grid is operated in a safe and efficient manner. It can help in building teamwork and trust among employees, resulting in better coordination and better outcomes.

An LDC's culture plays an important role in encouraging innovation, improving communication, attracting and retaining talents and maintaining safety and compliance. A strong, positive culture can help the LDCs operate more effectively and efficiently, and ultimately better serve the nation.

LDCs must create and provide opportunities to their employees for continuous professional development, employees must be given exposure and networking opportunities to interact and network. LDCs must participate in national and international for a such as FOLD, NPSC etc. Mentorship must be provided to the new joinees in the organization in order to assimilate and socialize them to the culture. Reward and recognition mechanisms must be designed to recognize high performance individuals, motivate and reward them.

Behavioral Training on topics such as communication skills, leadership skills and skill based training on topics such as Data Analysis. It is important to develop strong values and ethics in the organization to develop high performance culture which empowers every employee.

Apart from Training and Certification, clearly defined procedures and protocols for handling different types of situations help create clearly defined goals for System Operators and enables them to do carry out their functions effectively. Established performance parameters for organisations, departments and individuals such as Key Performance

Indicators (KPIs), Annual Appraisal for System Operators help peomote accountability and excellence. These create a positive work environment, where everyone is aware of their goals, roles and responsibilities and is responsible for outcomes.

Tools and processes must be established to ensure that there is communication and collaboration among all System Operators, especially among different shift groups, off-line studies, post-despatch functions. Special measures such as peer-to-peer learning sessions mjust be organised to ensure this.

Conclusion

Given the strategic and unique nature of LDC's operations, it is important to ensure sufficient bench strength for diverse functional areas and adequate talent pool for leadership roles at senior and top management. Optimal deployment of human resources is imperative for employee satisfaction and motivation across functions, regions and levels. Deployment of additional HR coupled with their capacity building as detailed above, is vital to effectively carry out the statutory/corporate roles and responsibilities at present and in the future to the satisfaction of all its stakeholders.

List of Tables

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List of Abbreviations

1. LDCs- Load Despatch Centres
2. VUCA- Volatile Uncertain Complex and Ambiguous
3. REMC- Renewable Energy Management Centre
4. FTE- Full Time Equivalent
5. ESCerts- Energy Saving Certificates
6. RPO- Renewable Purchase Obligation
7. HPO- Hydro Purchase Obligation
8. REC- Renewable Energy Certificate
9. PAT- Perform Achieve Trade
10. CISF- Central Industrial Security Force
11. PSDF- Power System Development Fund
12. CERC- Central Electricity Regulatory Commission
13. CEA- Central Electricity Authority
14. MoP- Ministry of Power
15. CERT-GO- Computer Emergency Response Team Grid Operator
16. IMS- Integrated Management System
17. IT- Information Technology
18. OT- Operational Technology
19. NOAR- National Open Access Registry
20. SCED- Security Constrained Economic Despatch
21. AGC- Automatic Generation Control
22. EV- Electric Vehicles
23. DAM- Day Ahead Market
24. RTM- Real Time Market
25. STATCOM- Static Synchronous Compensator
26. SVC- Static Var Compensator
27. HVDC- High Voltage Direct Current
28. UFR- Under Frequency Relays
29. ROCOF- Rate of Change of Frequency
30. SPS- Special Protection Schemes
31. RPC- Regional Power Committee
32. FOLD- Forum of Load Despatchers
33. MIS- Management Information System
34. STOA- Short Term Open Access
35. SCADA- Supervisory Control and Data Acquisition
36. ICT- Information Communication Technology
37. PMU-Phasor Measurement Unit
38. RTU-Remote Terminal Unit
39. EMS- Energy Management System
40. UPS- Uninterruptible Power Supply
41. DG- Diesel Generator
42. CISO- Chief Information Security Officer
43. PLCC-Power Line carrier Communication
44. GPRS- General Packet Radio Service
45. VSAT-Very Small Aperture Terminal
46. ISMS- Information Security Management System

References

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2. Report on 'Capacity Building of Indian Load Despatchers'(CABIL)- http://www.forumofregulators.gov.in/data/reports/for%20report%20cabil.pdf

3. GRID - INDIA Vision 2030 document

4. Report on the Grid Disturbance on 30th July 2012 and 31st July 2012 https://cercind.gov.in/2012/orders/Final_Report_Grid_Disturbance.pdf

5. Ministry of Power order dated 18th March 2021, regarding establishing CERT-GO to be housed at GRID - INDIA

Annexure – I: Training and Certification Program for capacity building

1. System Operator Training Programmes

SN	Name of the Training Program	Level
1	Basic Level Programme on Power System Operation	Basic
2	Power Market	Specialist
3	Regulatory Framework in Power Sector	Specialist
4	Power System Logistics	Specialist
5	Power System Reliability	Specialist
6	RE source and Grid Integration	Specialist
7	Familiarization on Despatcher Training - Simulator	-
Cyber Security (Training cum Certification)		
8	Training and Certification Program on Cyber Security	Basic
9	Training and Certification Program on Cyber Security	Intermediate
10	Training and Certification Program on Cyber Security	Advance

2. System Operator Certification

SN	Name of the Certification	Level
1	Basic Level Power System Operation Certification	Basic
2	Advance Level Power System Reliability Certification	Specialist
3	Advance Level Regulatory Framework in Power Sector Certification	Specialist
4	Advance Level Market Operation	Specialist
5	Adance Level Power System Logistics Certification	Specialist

Annexure – II: Short Term Exposure Program

A Short-Term Exposure Programme to facilitate rotation of System Operators, to enhance cohesion and exposure among System Operators in LDCs is being implemented for all State Load Despatch Centres, Regional Load Despatch Centres and National Load Depatch Centre. The objective of this programme is to propagate best-practices, facilitate peer-to-peer learning from each other and propagate best-practices through hands on exposure of real time working of other LDCs This will be beneficial for new and emerging SLDCs, where resource adequacy concerns for multi-tasking executives have been expressed. The planned exposure programme comprises of rotation of LDC officials to other LDCs for a duration of Two to Ten Days.

1. Modalities
    a. Rotational assignments will be done on reciprocity basis. Generally, the ratio of requirement and number of persons to be rotated will endeavoured to be kept as 1:1, however, in certain cases especially for emerging LDCs this can be relaxed.
    b. All LDCs will analyse their own requirement, work out number of officers they wish to post to other LDCs for exposure, clearly specifying periods of assignments in both cases. Each LDC can prepare an **Annual Rotation Plan** for – (i) officials they wish to rotate to other LDCs and (ii) officials they can host in their LDC, keeping in mind their Human Resource Adequacy.
    c. The host organization may design specific programme including a few class-room sessions to facilitate the learning delivery in share with the visiting organization beforehand.
    d. In order to leverage familiarity and already established sense of comfort, initially the rotation will be within the same region.
    e. The Rotation will be in the areas of System Operation, Market Operation, Logistics and REMC Functions.

f. Any short-term assignment will be for a minimum period of 2 working days but not exceeding 10 working days in total.

2. Eligibility:-
    a. All LDC officials working in System Operation, Market Operation, Logistics and REMC functions will be eligible to be rotated to other LDCs.
    b. LDC officials should have minimum 1 year or regular service in an LDC before they can be considered for the exposure programme.

3. Execution
    a. LDCs can send their Annual Rotation Plan to the Forum of Load Despatchers (FOLD) Secretariat at the beginning of the Financial year.
    b. FOLD secretariat will compile requirements and assist in devising a Region-wise rotational plan on round-robin basis so that Human Resource adequacy is maintained at all Load Despatch Centres.
    c. This programme is focused on increasing capacity building of SLDCs, therefore, the focus must be on giving exposure to SLDC officials. However, to kickstart the programme, RLDCs and NLDC will start by posting their officers out to SLDCs and host officers from other LDCs in their region. FOLD Secretariat will coordinate the liasoning with LDCs, if require. Travel arrangement including accommodation & logistics will be done by respective LDCs.

4. TA/DA including accommodation expenses will be borne by the parent organization as per their rules. Host organization will not be obligated to provide any facility to the visiting officer.

Annexure to Short Term Exposure Programme:- Requirement Detail Format

Name of the LDC ____________________________

Total number of Job Roles identified for officers from other LDCs__________________________

Details of the roles identified for officers from other LDCs

Sl. No.	Department	Area of the task/ project	Proposed Assignment Details (To which the officer from LDCs will be deputed)	Proposed Period of the Assignment (Start Date & End Date)

GUIDELINES FOR DEPUTATION OF WORKFORCE FROM STATE LOAD DESPATCH CENTRES TO GRID-INDIA FOR FIXED TERMS

Table of Contents

A. Objective

1. Load Despatch Centres (LDCs) play a very important role in secure and reliable operation of the Grid. Grid Management has become challenging and complex. With such a vast size of the Grid, LDCs play an important role in facilitating the energy transition towards a sustainable and decarbonised electricity grid. Human Capital is the most important Asset in any organizational setup. Human Resource adequacy has a direct effect on performance and efficiency of all functions and activities. Since LDCs carry out mission critical activities on a 24X7 basis, the availability of trained human resources in the Load Despatch Centres is critical for reliable and efficient power supply. These guidelines have been formulated to strengthen the Load Despatch Centres by facilitating mobility of trained skilled human resources and thus, bolstering cooperation and cohesion.

2. To achieve these aims of improving cooperation across Load Despatch Centre (LDCs) and introducing cohesion in functions and propagating best-practices, a focused effort to enhance Human resource inter-change within LDCs is required. For this, Load Despatchers from SLDCs must be given adequate exposure and opportunities for career growth and learning. There should be regular exchange of Human Resources amongst the LDCs, especially SLDCs and Grid-India to facilitate better coordination, camaraderie and create a nation-wide Power System Operator talent pool.

3. In addition to the training and experience that load dispatchers receive during the recruitment process at the State Load Despatch Centre (SLDC), it is imperative to provide them with comprehensive exposure and prospects for career advancement and learning. Fostering a consistent exchange learning program between SLDCs and Grid-India thus becomes crucial. To support the developmental journey of SLDCs and enhance their learning experiences, Guidelines for Deputation of Workforce from SLDCs to GRID-INDIA for fixed terms have been drafted. Through this initiative, System Operators from SLDCs will get the chance to undergo training and hands-on work exposure at GRID-INDIA for a specified duration on fixed-terms deputation basis.

B. Methodology

1. A scheme has been formulated to provide an opportunity to eligible System Operators from State Load Despatch Centres (SLDCs) for exposure of working in Load Despatch Centres at Regional or National Level. The deputed officer will be given adequate training, work exposure etc. in Grid-India. The pay and perks of the officer during the period of deputation to GRID-INDIA will be as per applicable DPE guidelines.

2. Invitation for deputation from SLDCs will be sent annually by RLDCs and NLDC. Total workforce in Grid-India, which will be on deputation from SLDCs would be capped at 10% of the eligible technical executive strength in respective RLDCs/NLDC. Though, to start with this number may be kept as 1 % of the total eligible technical executive strength at a particular RLDC and may gradually be increased upto 10 % of the eligible technical executives of the RLDCs as the programme progresses. The officer on deputation from SLDCs will be given comprehensive exposure in the areas of System Operators, Market Operation and Logistics.

3. In order to ensure that there is uniformity across RLDCs and NLDC, the invitation to SLDCs for **deputation at RLDCs and NLDC will be for posts equivalent to the levels of E3 to E6 in Grid-India.**

4. The details Job description and responsibilities are given at Annexure.

5. The scheme is proposed to be rolled out by 2025, when mandatory certification of System Operators comes in to affect.

6. The System Operators from SLDCs will apply to Grid-India based on the annual vacancies released by RLDCs/NLDC. They will be shortlisted against the Job Description and thereafter selected through interview and other screening mechanisms, introduced as deemed fit.

7. **Duration of Deputation-** This exposure will be for a period of six months to three year on deputation basis.

8. **Mode of Deputation:** Through notification floated by RLDCs and NLDC, inviting applications for willingness from SLDCs executives. Since the approach is to fill the gap in terms of staffing numbers, skill sets and to enhance mobility for strengthening the LDCs, the vacancies may be operated Region-wise (WR, NR, ER, SR & NER).

9. **Mode of selection:** The selection will be done on merit basis (criteria for drawing the merit will be decided based on relevant factors) for the sanctioned vacancies for each region. The candidate meeting the criteria in the annexed job description will be further interviewed and assessed for suitability as required.

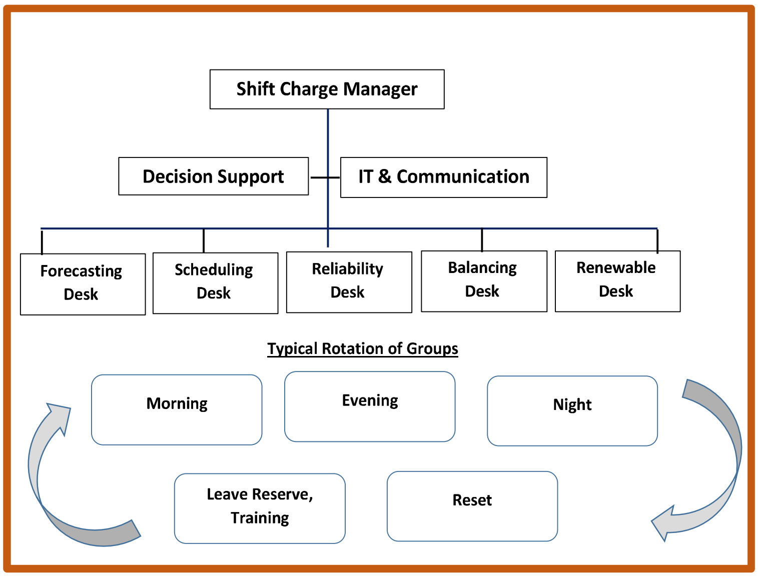
10. Consent of concerned SLDC will be obtained by the applicant at the time of forwarding of application.

C. Functional Domains Identified for Deputation

1. <u>System Operation</u>

The System Operation (SO) function covers operational planning (including assessments, studies, crew management), real-time operation (including scheduling, forecasting, outage planning and reporting) and post despatch analysis (including reporting, MIS, feedback, and analytics) and all operational functions pertaining to REMC etc.

Figure 1- Organogram of Real-time shift operation



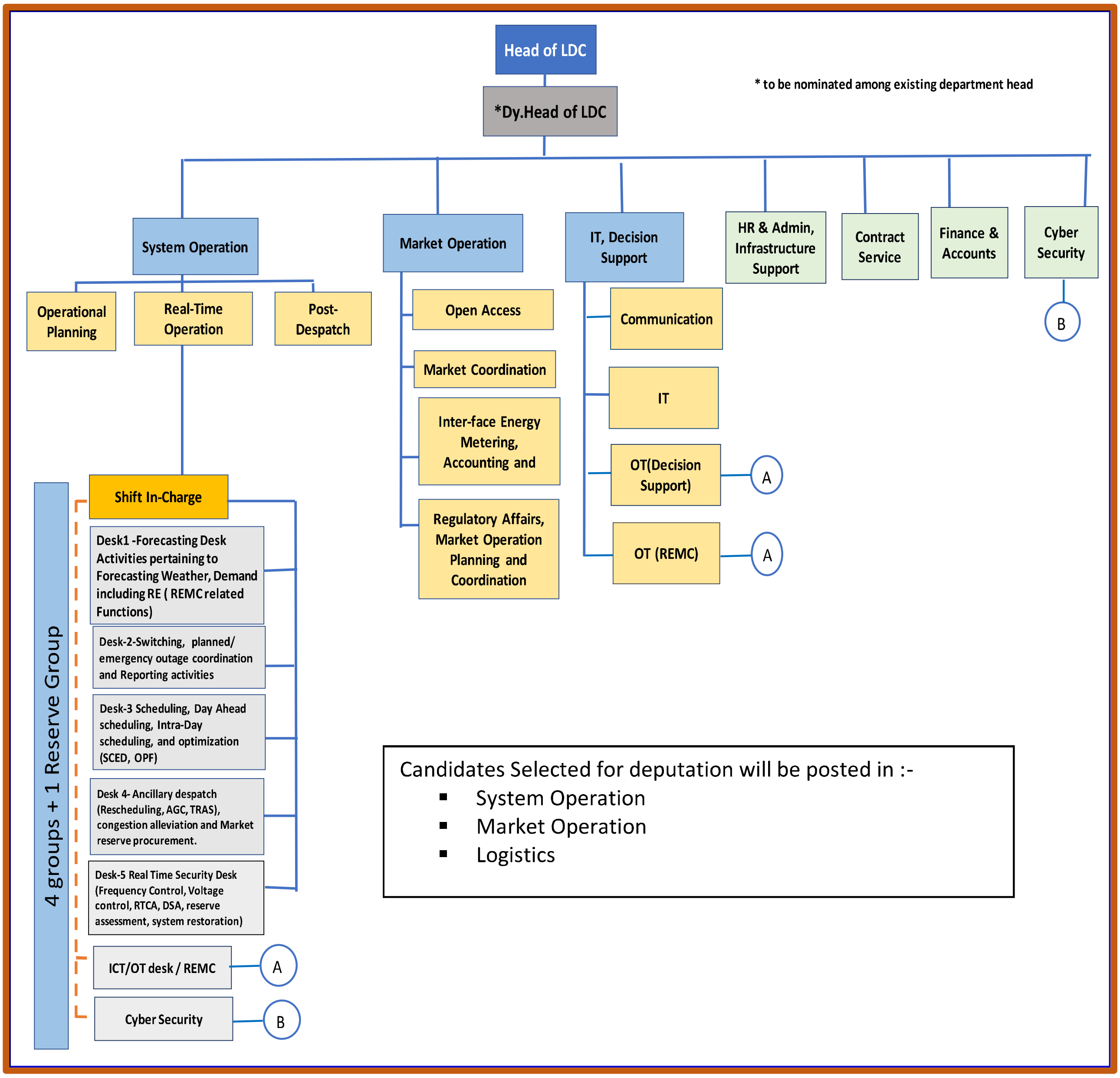
2. Market Operation

The Market Operation (MO) function covers open access administration, day ahead market, real-time market, energy accounting and settlement activities, regulatory functions etc. Market Operation function is an evolving Dynamic Function, which is changing due to various regulatory initiatives and reforms. Market Operation has been organized under 4 divisions - Open Access, Market Coordination, Inter-face Energy Metering, Accounting and Settlement, Regulatory Affairs.

3. Logistics

Logistics functions is essential to maintain situational awareness and support decision making in real-time. Technology plays an increasingly important role in Grid Management and will continue to increase in scope and importance. Logistics has e been organised in 4 divisions which are:- i. Operation Technology; ii. Renewable Energy Management Centres; iii. Information Technology; iv. Communication.

Figure 2- Organogram of Typical LDC


Head of LDC
*Dy.Head of LDC
* to be nominated among existing department head
System Operation
Market Operation
IT, Decision Support
HR & Admin, Infrastructure Support
Contract Service
Finance & Accounts
Cyber Security
B
Operational Planning
Real-Time Operation
Post-Despatch
Open Access
Market Coordination
Inter-face Energy Metering, Accounting and
Regulatory Affairs, Market Operation Planning and Coordination
Communication
IT
OT(Decision Support)
A
OT (REMC)
A
4 groups + 1 Reserve Group
Shift In-Charge
Desk1 -Forecasting Desk Activities pertaining to Forecasting Weather, Demand including RE (REMC related Functions)
Desk-2-Switching, planned/ emergency outage coordination and Reporting activities
Desk-3 Scheduling, Day Ahead scheduling, Intra-Day scheduling, and optimization (SCED, OPF)
Desk 4- Ancillary despatch (Rescheduling, AGC, TRAS), congestion alleviation and Market reserve procurement.
Desk-5 Real Time Security Desk (Frequency Control, Voltage control, RTCA, DSA, reserve assessment, system restoration)
ICT/OT desk / REMC
A
Cyber Security
B
Candidates Selected for deputation will be posted in :-
System Operation
Market Operation
Logistics

D. Annexure: Job Description and Responsibilities

1. Responsibilities

The System Operator plays a crucial role in the operation and management of a power system. The primary responsibility is to ensure the reliable and secure operation of the electrical grid. They continuously monitor the system's parameters, including voltage, frequency, and line flows, and take appropriate actions to balance electricity supply and demand. The selected System Operators will be posted in the following areas of the Load Despatch centres - SO, MO and Logistics. He/she is responsible for the efficient operation and management of a power system, and for achieving the corporate objectives.

2. Eligibility

- **Age & Experience:** Upper age limit (in years) and minimum no. of years of experience as on date of Notification

Level	*Upper Age Limit (in years)	Minimum no. of Years of Post Qualification Experience (excluding trainee period) as system Operators in SLDC (in years)
E3	32	3
E4	35	6
E5	38	9
E6	41	12

* Age relaxation as per govt.norms

- **Qualification:**

I. Graduate in Electrical /Computer Engineering/ IT/Electronics & Communication (Full time).

II. Valid certification as per Power System Operator Training and Certification framework conducted by NPTI (presently).

- **Experience:**

The applicant should have worked three to twelve years (depending on the position notified) as System Operator (excluding training period) in SLDCs in executive cadre as on the date of notification.

- **Pay Scale:** The pay of the officer on deputation will be as per DPE guidelines.

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E. Terms used:

LDCs	- Load Despatch Centres
RLDCs	- Regional Load Despatch Centres
SLDCs	- State Load Despatch Centres
ER	- Eastern Region
NER	- North-Eastern Region
NR	- Northern Region
SR	- Southern Region
WR	- Western Region
SO	- System Operation
MO	- Market Operation
REMC	- Renewable Energy Management Centres
RES	- Renewable Energy Source
OT	- Operation Technology

F. Table of Figures

Report of Committee

on

Futuristic analysis for requirement of Synchronous Condensers based on System Strength and Inertia considerations for Northern Region

NORTHERN REGIONAL POWER COMMITTEE

Ministry of Power

Government of India

December 2024

Acknowledgement

I would like to acknowledge and thank all Committee members from various organization viz., CEA, NRLDC, NLDC, NRPC, CTUIL, NTPC, BHEL, RVPNL, PSTCL and UPPCL for their active participation during the meetings and providing valuable inputs for this report. The technical support provided by NLDC/NRLDC and CTUIL is duly acknowledged. The report by NTPC 'Synchronous Condenser- A Novel Solution for Grid Stability for Integration of Renewables (Version 2.0)' was very helpful as reference document.

I also thank OEMs for Synchronous condensers, viz., BHEL, Hitachi, Siemens and Andritz Hydro for their active Participation and providing valuable technical inputs.

I would also like to acknowledge the efforts put by officers of NRPC, especially Shri Anzum Parwej (SE) and Shri Ravi Kant (EE) for convening the Committee meetings and preparing the Minutes and compiling the Report of the Committee.

(V. K. Singh)

Member Secretary, NRPC

List of Abbreviations

AC	Alternating Current
AVR	Automatic Voltage Regulator
BESS	Battery Energy Storage System
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
DC	Direct Current
EHV	Extra High Voltage
E-STATCOM	Enhanced Static Synchronous Compensator
FACTS	Flexible AC Transmission System
GCB	Generator Circuit Breaker
GENCO	Generation Company
GT	Gas Turbine
GW	Giga Watt
HVDC	High Voltage Direct Current
Hz	Hertz
IEGC	Indian Electricity Grid Code
kA	Kilo Ampere
kV	Kilo Volt
MVA	Mega Volt Ampere
MVAR	Mega Volt Ampere Reactive
MW	Mega Watt
NDC	Nationally Determined Contributions
NLDC	National Load Despatch Centre
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
PLF	Plant Load Factor
PSP	Pumped Storage Plants
PU	Per Unit
R&M	Renovation and Modernization
RE	Renewable Energy
RLDC	Regional Load Despatch Centre
ROCOF	Rate of Change of Frequency
RPM	Revolutions Per Minute
SCR	Short Circuit Ratio
SLDC	State Load Despatch Centre
SFC	Static Frequency Converter
STATCOMs	Static Synchronous Compensators
SVC	Static VAR Compensator
SYNCON	Synchronous Condenser
TRANSCO	Transmission Company
VFD	Variable Frequency Drive
VSC	Voltage Source Converter
UFLS	Under Frequency Load Shedding

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Executive Summary

The Government of India has set the target of establishing 500 GW of non – fossil generation capacity by 2030 and achieving net zero emissions by 2070. For achieving the COP26 commitments and Net Zero Emission (NZE) targets, there has been constant addition of renewable energy in the Indian grid over the past few years. The Renewable Energy generators are integrated into the power system with the use of inverter-based power electronic devices.

The renewable generators connected through these power electronic devices pose challenges to the power system as they cannot provide inertia, have the limitations of providing short circuit power, reactive power compensation and may also introduce harmonics in the power system. Therefore, the increase in renewable energy sources coupled with the withdrawal of conventional energy-based plants will pose considerable challenges for grid stability in future.

In the 71st NRPC meeting held on 29th January 2024, it was deliberated that RE power is being integrated at fast pace country-wide and to ensure grid stability and provide inertial support in RE complex, requirement of dynamic compensation like Synchronous Condensers needs to be identified at different locations based on the detailed studies.

Accordingly, a committee was formed under Chairmanship of Member Secretary, NRPC along with members from CEA, NLDC, NRLDC, NTPC, BHEL, CTU and STUs to do futuristic analysis for requirement of Synchronous Condensers based on the inertia considerations for Northern Region.

The Committee conducted numerous meetings wherein deliberations on the requirements of Synchronous Condenser including other available technologies were done. During the Committee meetings, presentation by different OEMs viz., BHEL, Hitachi & Andritz Hydro was also made highlighting the advantages of synchronous condenser in the Grid.

This brief highlight of the report is as below;

- In Chapter-1, 2 & 3, likely RE capacity in the country, need of Synchronous Condensers (SynCons) in the Grid for stability and reliability in high RE rich areas and the background for formation of the Committee has been elaborated.
- In Chapter-4, criteria for selection of site for Synchronous condensers based on inputs provided by NLDC has been discussed. As per advisory dated 20.01.2023 issued by CEA, no retirement or re-purposing of coal-based power stations shall be done before 2030. In view of the same, repurposing may not be possible before 2030. Committee agreed for installation of new machines (SynCons) up to year 2030 at suitable locations to be decided based on studies by CEA/CTU.
- In Chapter-5, study done by NRLDC on impact of Installing Synchronous Condenser in Present Scenario at Fatehgarh-II is presented which shows various benefits like 'Enhanced System Strength', 'Fast Reactive Power Support during Faults/Transients', 'Increased Inertia and Frequency Response', 'Damping of Low Frequency Oscillations' and Steady-state Reactive Power Support' are demonstrated.
- In chapter-6, various regulatory provisions pertaining to Synchronous Condensers has been described.

- In Chapter-7, other technological solutions like E-STATCOM, Hybrid SynCon & STATCOM with BESS are discussed.
- In Chapter-8, Global Scenario of SynCon is presented.
- Chapter-9 presents cost recovery mechanism for SynCon as prepared by NLDC. The committee deliberated and agreed that the Synchronous Condenser may be treated as a transmission element.
- Chapter-10 presents locations for installation of SynCons in Northern Region as provided by CTU in consultation with Grid India & CEA. Additional requirement of flywheel along with synchronous condenser to provide additional inertia in the Grid may be identified at time of finalization of proposal.
- Committee presents its recommendation in Chapter-11.

Committee has concluded that in view of huge RE capacity addition in the Northern Region, particularly in Rajasthan State, and the challenges thereafter like Oscillations in RE complexes, Reactive Power, Inertia & Short Circuit ratio (SCR) requirements must be addressed accordingly. The Committee is in, therefore, consensus of installation of SynCons in RE complexes because of its inherent advantages of providing inertia, reactive power & short circuit strength to the Grid.

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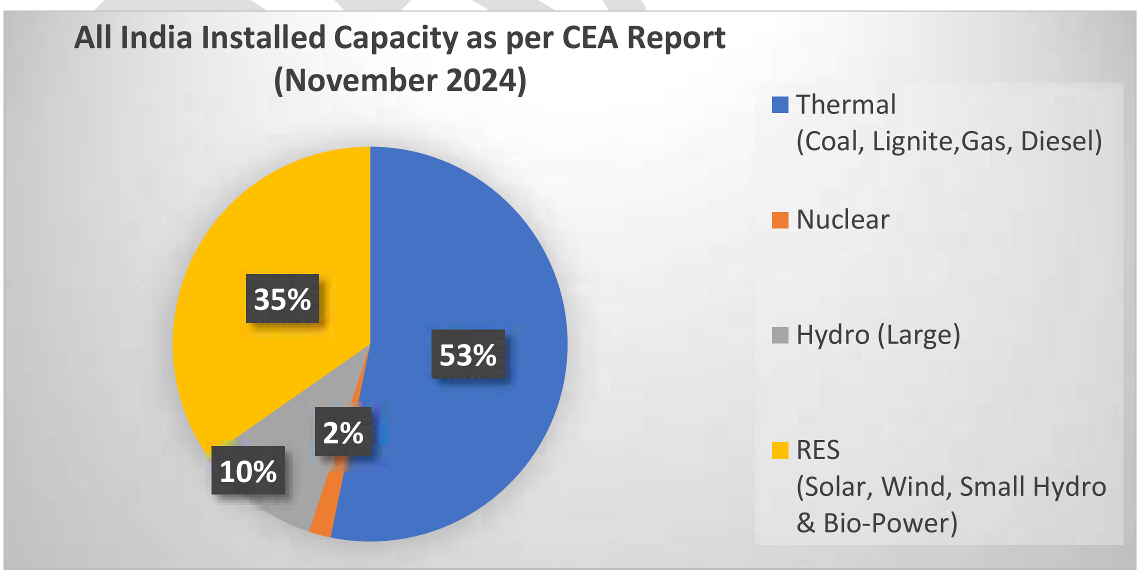
1. INTRODUCTION

At the COP26 climate summit in Glasgow in November 2021 the country has made commitment to achieve Net Zero Emissions by 2070. India has also made commitment for following short term targets:

- Increasing non-fossil fuel-based installed capacity to 500 GW by 2030,
- Meeting 50% of energy requirements from renewables BY 2030,
- Reducing cumulative carbon emissions by one billion tonnes by 2030, and
- Reducing emissions intensity of India's gross domestic product (GDP) by 45% by 2030, over 2005 levels.

India has set an ambitious target of 500 GW of non-fossil fuel-based Installed capacity by the year 2030. Going forward the RE share in All India Installed Capacity will increase significantly in comparison to that of conventional generators. Current RE Scenario in the country is as under:

CURRENT RE SHARE IN All INDIA INSTALLED CAPACITY

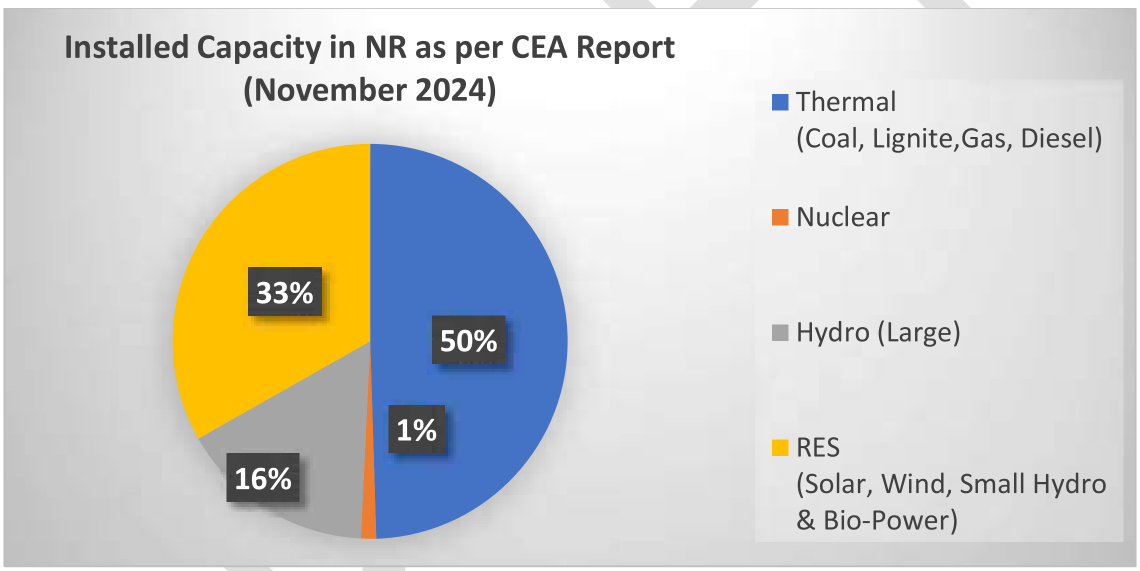


(Figure 1.1)

Table 1.1 All India Installed Capacity as per CEA Report (November 2024)

Technology	Capacity (GW)
Thermal (Coal Lignite, Gas & Diesel)	243.06
Nuclear	8.18
Hydro (Large)	46.97
RES (Solar, Wind)	158.55
Total	456.76

CURRENT RE SHARE IN NORTHERN REGION INSTALLED CAPACITY



(Figure 1.2)

Table 1.2 Northern Region Installed Capacity as per CEA Report (November 2024)

Technology	Capacity (GW)
Thermal (Coal Lignite, Gas & Diesel)	64.23

Nuclear	1.62
Hydro (Large)	20.83
RES (Solar, Wind)	43.07
Total	129.75

This transition is expected to significantly reduce the system inertia as the RE generators are connected to the grid using inverter-based power electronic devices and are unable to provide inertial response and have limitations of providing Short Circuit Power and Dynamic Reactive Power. Power System Inertia, Short Circuit Power and Dynamic Reactive Power, which are the key elements of grid stability have inherently been provided by the conventional generators.

The increase in renewable energy in the grid along with retirement of conventional energy-based plants may lead to a considerable decrease in inertia, short circuit strength, dynamic reactive power reserves, which are essential parameters for the overall stability and reliability of the power system.

The reason for the decrease in short circuit power due to increase in RE generation is that conventional generators produce significantly high level of short circuit power as compared to renewable generators which are limited by the rating of the inverters/converters. The kinetic energy of the conventional generators acts like a shock absorber to keep the grid frequency in control during sudden supply-demand changes over very short periods. In the absence of inertia from the system, there may be frequent generator tripping during the load fluctuations and this may even lead to cascading outages in system.

Further, as more and more renewable generation (low inertia) is replacing the conventional generation, the diminishing system strength and system inertia are posing new challenges to the grid stability and growing concern to the grid operators. Synchronous Condensers can be one of the solutions for improving system stability and reliability.

Indian grid experiences voltages higher than operating limits at more than half of the nodes for 10-20% of the time. To overcome this as a last resort, on an average, around sixty-five (65) lines at 400 kV level and above are opened on a daily basis to control high voltages and in a few instances, tripping incidents are reported on account of over-voltage and over-flux. These switching operations are rapidly increasing with additional transmission lines being commissioned for evacuation of renewable generation power which is not available throughout the day.

The voltage control ancillary services are a part of many power grids around the world. However, in the Indian Power system, for the last two decades, instead of direct ancillary service for voltage control, reactive power requirements are managed by mandatory support from grid connected generator.

Long distance transmission corridors may become unstable during system contingencies/faults due to lack of reactive power. Therefore, it is important to identify locations where reactive power reserves shall be required after renewable integration to ensure a stable and reliable system.

As a localized phenomenon, voltage changes in the system can be best addressed by providing reactive power support locally. Unlike real power, reactive power cannot be transferred across long distances in a bulk power system. Long distance and unchecked reactive power flows can give rise to substantial voltage variation across the system. Thus, it becomes necessary to maintain reactive power balances between sources of generation and points of demand on a 'zonal basis'.

With the accelerated expansion of grid over the past twenty years, commissioning of new EHV lines, HVDC etc. also helped in improving the grid voltage and 'low-voltage' issues. Instead, 'high-voltage' became the new problem.

The large-scale integration of renewable energy sources in Rajasthan RE complex primarily from wind and solar power has resulted in widespread use of power electronic devices in the power systems. This has resulted in the emergence of multi-frequency oscillation problems spanning multiple frequency segments, which seriously threaten system stability and even limit renewable energy power evacuation. Voltage oscillations in the renewable complex can originate from poorly tuned controllers, line switching, sudden variation in renewable generation, communication delays etc.

Synchronous condensers can be installed at strategic locations along a transmission network, near renewable generating stations, HVDC Stations etc.

2. Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region

Background of Committee formation

In the 71st NRPC meeting held on 29th January 2024, it was deliberated that RE power is being integrated in fast pace country-wide and to ensure grid stability and provide inertial support in RE complex, requirement of dynamic compensation like Synchronous Condensers needs to be identified separately based on the detailed reactive power planning studies and the Short Circuit Ratios (SCRs) at different locations. As per the decision taken in 71st NRPC meeting, a committee of members from CEA, NRPC, NRLDC, CTU and STU was to be constituted under chairmanship of Member Secretary, NRPC to do futuristic analysis for requirement of Synchronous Condensers based on the inertia considerations for Northern Region.

Document issued by CEA in December 2022 titled **"Transmission System for Integration of over 500 GW RE Capacity by 2030"** mentions that "For the planned transmission schemes in Northern Region, dynamic compensation requirement like STATCOMs, Synchronous Condensers etc. would be identified separately based on the detailed reactive power planning studies and the Short Circuit Ratios (SCRs) at different locations. Requirement of Synchronous condensers based on inertia considerations will also be assessed based on detailed studies."

In 71st NRPC meeting, NRLDC stated that as of now only STATCOMs are being planned in the transmission system and the planning of synchronous condenser is yet to be materialised. Therefore, such studies also need to be carried out at the planning level which could provide recommendations related to synchronous condensers or other suitable solutions to tackle such issues as being done by other countries in the world where RE power is being integrated at fast pace. CTUIL representative stated that synchronous condenser may support inertial requirement in the grid in general, but its location & efficacy may also be in other than Rajasthan region which can be explored after discussion with stakeholders.

Accordingly, a committee was formed under Chairmanship of Member Secretary, NRPC along with members from CEA, NRPC, NRLDC, NLDC, NTPC, BHEL, CTU and STUs to do futuristic analysis for the requirement of Synchronous Condensers based on the inertia considerations for Northern Region. The Constitution of Committee and subsequent amendment in constitution of committee is attached at **Annexure-I.**

The list of committee member is as under:

Table 2.1: List of Committee Members

S. No.	Name	Designation	Organization
1.	Sh. V. K. Singh	Member Secretary- In Chair	NRPC Sectt.
2.	Sh. Anzum Parwej	Superintending Engineer (System Study)	
3.	Sh. Ravi Kant	Executive Engineer (System Study)	
4.	Sh. Kanhaiya Singh Kushwaha	Asst. Director, PSPA-1	CEA
5.	Sh. V. Thiagarajan	Sr. GM	CTUIL
6.	Sh. Kashish Bhambhani	GM	CTUIL
7.	Sh. Sunil Kumar Aharwal	GM	NRLDC, Grid-India
8.	Sh. Bikas Kumar Jha	DGM	NRLDC, Grid-India
9.	Sh. Rahul Shukla	Chief Manager	NLDC, Grid-India

10.	Sh. Priyam Jain	Chief Manager	NLDC, Grid-India
11.	Sh. Nitin Kumar	Sr. XEN/Planning-1	PSTCL
12.	Ms. Ranjana	AE/Planning-1	PSTCL
13.	Sh. V. A. Kale	Superintending Engineer (P&P)	RRVPNL
14.	Dr. Om Prakash Mahela	Executive Engineer (PP&D)	RRVPNL
15.	Sh. Sanjeev Kumar Bhasker	Superintending Engineer	UPPTCL
16.	Sh. Suneet Mehta	DGM	NTPC
17.	Sh. Venkateswara Rao Bitra	DGM	NTPC
18.	Sh. Manoj Kumar	AGM	BHEL
19.	Ms. Asha Gupta	AGM	BHEL
20.	Sh. Vishal Naidu	DGM	BHEL
21.	Sh. Ranajit Dey	Sr. Manager	BHEL
22.	Sh. Dhanunjayudu Nasika	Manager	BHEL

Subsequently, the Committee conducted 05 nos. of meetings wherein deliberations on the requirements of Synchronous Condenser including other available technologies were done. During the committee meetings, presentations by different OEMs viz BHEL, Hitachi and Andritz Hydro were also made highlighting various technological options available and its suitability under different system requirements.

During the committee meeting, it was agreed that CEA, CTUIL and Grid-India shall workout the requirement of Synchronous Condenser up to year 2030 in Northern Region based on system studies. The Committee shall also recommend for the installation of first Synchronous Condenser at a suitable location of appropriate capacity (to be decided based on studies carried out by Grid India) in Northern Region. Minutes of various meetings of the committee are attached at **Annexure-II, III, IV, V & VI.**

3. SYNCHRONOUS CONDENSER

A synchronous condenser (SynCon) is a DC- excited synchronous machine whose shaft is not attached to any driving equipment/load (except flywheel, if any). Essentially, there are 2 technologies for the design of large synchronous electrical machines:

1. Cylindrical rotor (round rotor) synchronous machines
2. Salient pole synchronous machines

Both technologies have their own pros and cons. Both technologies are available from OEMs for SynCons.

Major use of SynCons can be as under:

- **System Inertia Support:** As large part of the future generation would be RE based, the inertial support in the grid would not be sufficiently available. Further depending on the operating policy adopted, like two shift operation etc, the inertial support would reduce during high RE generation periods. SynCons due to rotational energy of the generator and flywheel can provide instantaneous inertial response and play a crucial role in limiting sudden changes in frequency during system disturbances. The increase in RE penetration coupled with withdrawal of conventional energy sources from the grid can decrease the system inertia and increase Rate of Change of frequency (RoCoF). During large grid disturbances, a high Rate of Change of Frequency (RoCoF) can trigger the protection system to trip generating systems and lines out of service. SynCon can provide resistance to such sudden changes in frequency, maintaining system stability and reliability.
- **Reactive Power Support:** The excitation system of the SynCon is sensitive to the bus voltage and triggered into action with voltage deviation beyond

a certain threshold, allowing the SynCon to act as a source or sink. By increasing or decreasing the excitation (varying field current), the voltage output of the SynCon can be varied and thus reactive power can be either injected or absorbed from the grid. The SynCon voltage is varied so as to inject reactive power during the low voltage conditions such as fault in the grid.

- **Short circuit current management:** SynCons provide high level of short circuit current support during faults and improve transient stability by preventing voltage collapse. This becomes essential in areas having large concentration of renewable generation as these generation resources do not have significant short circuit contributions.

Typically, the synchronous condenser can vary from zero MVAR to full capacitive or inductive range almost immediately (0.5~3s) typically depending upon excitation and control systems, thereby maintaining the voltage profile of the grid during any transient disturbances. This fast response might help in preventing the IBRs to enter low/high voltage ride through mode in RE pockets. In addition to that, the rotor of synchronous machine has kinetic energy stored in it, and it can be released during grid events, thus providing inertia to the grid.

Synchronous Condenser have advantages like fault current support to improve power system electromagnetic strength, physical inertia to limit the initial RoCoF in the first swing, and reactive power support. Synchronous Condenser primarily does not have any inverter-based devices therefore there is no harmonic injection and it also helps to maintain the inherent sine wave to stabilize the voltage distortion following a transmission fault and facilitate grid following inverter fault ride through.

In the northern region, RE plants have reported tripping due to distorted waveform owing to phase jump issue and sensing of low frequency of inverters in the past. Synchronous Condensers would help in maintaining sine wave of voltage waveform and will reduce distortion. It is thus envisaged that tripping due to phase-jump and distorted waveform would reduce if Synchronous Condensers are available in the RE Complex.

One of the most suitable solutions for addressing the challenges of grid stability can be the installation of synchronous condensers in strategic locations. The synchronous condenser-based solutions can mitigate most of the challenges with renewable penetration.

System studies need to be carried out considering the planned renewable integration to identify possible locations for installation of mechanisms for providing reactive power. There are some challenges in SynCon deployment in India as under:

- Absence of demonstrable pilot study which can establish benefits of SynCons
- Lack of feasible cost recovery mechanism of SynCons
- No technical standards and well-defined condition assessment framework for adoption of SynCons
- Reluctance towards adoption of SynCons due to presence of other technologies such as STATCOM for reactive power.

Conversion of a retiring Thermal Power Plant into Synchronous Condenser

The conversion of a retiring plant at its existing location allows the use of existing equipment and infrastructure, thereby reducing the investments costs and providing an economical solution for critical ancillary services such as short circuit power, inertia and reactive power which can be provided as per the capability curve and design parameters of the retiring machine. Also, as per the advisory dated 20.01.2023 issued by CEA *(attached at **Annexure-VII**)*, no retirement or re-purposing of coal-based power stations shall be done before 2030. In view of the same, repurposing may not be possible before 2030. Thermal units having capacity less than 200 MW are expected to have challenges for repurposing due to their remaining life (as these generators are very old), limitation in providing required ancillary services (due to smaller rating), old design etc.

In view of the above constraints, Committee agreed that long-old retired generators may not serve the purpose of the system requirement and agreed for installation of new machines up to year 2030 at suitable locations to be decided based on studies by CEA/CTU.

Gas Power Plants as Synchronous Condensers

Gas power plants can be made to run either in 'Generation Mode' or in 'Synchronous Condenser Mode' with provision of a new clutch arrangement between the Generator and Turbine. When active power generation is required, the gas turbine is connected to the generator with the clutch closed. The gas turbine rotates the generator which creates active power which is delivered to the grid. When no active power is required, the gas turbine is connected to the generator with clutch closed, in order to start the unit. Once the generator is synchronized to the grid, the clutch is opened, and the gas turbine is stopped. The generator remains connected to the grid and is then operated as synchronous condenser. For provision of clutch various constraints like space requirement, foundation modification, necessary adjustment/relocation/ shifting of existing equipment, cost of modifications etc. need to be studied. Accordingly, feasibility study/check for each site needs to be carried out separately for provision of clutch in gas plants.

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4. Synchronous Condenser Location and Plant Selection Criteria for Indian Power System

Synchronous Condensers, being a high-speed rotating heavy mass, have emerged as the most optimized and strongest technical solution to deal with problems of low Inertia and short circuit power. Provision of Synchronous condensers is being made world-over to improve voltage stability as well as frequency stability in renewable power rich environments. The use of generators as synchronous condenser could benefit in improving grid stability as well as power quality. The synchronous condenser offers several advantages, which makes it a must for system planned with large scale renewable integration: -

1. Ability to meet system inertia, short circuit power and MVAR requirements arising due to addition of RE and retirement of conventional generator
2. To improve system stability for solar or wind plant fed system
3. Low voltage ride through capability during fault condition
4. Facilitates dynamic compensation
5. To meet reactive MVA of HVDC
6. Good overload capacity
7. Maintains power quality

It is important to develop a selection criterion, first for selecting the area where synchronous condensers are required to be installed. After area selection, the possibility of using an existing plant as Synchronous Condenser may be explored based on the techno-economic study and other standards. In case existing plants cannot be used, new synchronous condenser installation may be planned as per system requirement. The detailed strategy for planning a synchronous condenser in the system is given below:

Phase I: Criteria for Area Selection:

The area where the kinetic energy level has decreased below limits as mentioned in the dynamic study of long- or medium-term planning. If dynamic study couldn't be done due to unavailability of system dynamic data, then the thumb rule for area selection may be renewable power generation penetration crossing beyond 50%. In addition to renewable generation penetration, factors such as low short circuit level, low specific area inertia, connectivity and voltage variations should also be considered. Some additional parameters like proximity to load centers and HVDC systems are also used to identify the pockets in which the synchronous condenser installation is required.

Table 4.1- Criteria for Area Selection for Installation of Synchronous Condenser

S. No	Criteria Parameter	Recommendations	Rationale
1	Renewable penetration	>= 50%	Dynamic reactive support in area with low penetration of synchronous generation sources
2	Short circuit ratio	< 5	Weak system strength
3	Local kinetic energy	Below specified threshold, poorly damped oscillations	Kinetic Energy estimation at the level of control areas
4	Proximity to Renewable energy complexes	High priority over others. Graded approach based on distance is to be considered.	Proximity near RE complex provides system strength and improves performance of IBR
5	Proximity to HVDCs and load centres	Graded Approach based on proximity	Provides system strength and reduces HVDCs commutation failure
6	Voltage variations beyond ±0.05 pu	Graded Approach based on proximity	Reactive power impacts decreases away from injection point.

Phase II: Criteria for Plant Selection:

After the area selection, it is to be decided whether a new SynCon is to be deployed or an old thermal power plant due retire can be deployed. The ageing thermal plants in the selected pocket is needs to be analysed based on a techno-economic study. Ability of existing plant (if available) to meet the system requirements shall also be considered for the selection of existing plant for use as SynCon. Also, Residual Life Analysis (RLA) of major electrical equipment and system to be used after the conversion should be planned. The scope of RLA should include Turbo-Generator (TG), excitation system, generator transformer, generator relay panels, auxiliary systems and control equipment's etc., and electrical bay equipment.

Table 4.2 -Selection Criteria for SynCon

S.No.	Criteria Parameter	Recommendations
1	Greenfield installation/Conversion	Estimation of cost for installation of new plants with conversion of old plants. Old thermal plants need to be assessed for insulation level also.
2	Feasibility study	Review the generator's operating and maintenance history. Good visual inspection of all components.
3	Techno-economic studies	Cost benefit analysis. Estimation of costs and benefits incurred in a simple decommissioning of plants vis-à-vis repurposing them. Repurposing for Syncon operation vis-à-vis PV and BESS
4	Residual Life Analysis	Analysis to include Generator, excitation system and auxiliary systems etc.
5	Dynamic studies	Installation of Flywheel for higher inertia and system strength

Apart from criteria of plant selection and area selection, there is need to introduce some regulatory framework and market mechanisms to promote the wider deployment of Synchronous Condensers in India. It would include market mechanisms for cost recovery, changes in market mechanisms, usage as ancillary services etc.

SynCon land requirements and layout (as provided by Andritz Hydro) are attached at **Annexure-VIII**.

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5. STUDY ON IMPACT OF INSTALLING SYNCHRONOUS CONDENSER IN PRESENT SCENARIO AT FATEHGARH-II

The 1st meeting of the committee was held on 22.04.2024 wherein, after deliberations, it was agreed that Grid-India shall study impact of installing synchronous condenser in present scenario at Fatehgarh-II which has the least SCR in Western Rajasthan RE complex at ISTS level. Detailed study by Grid-India is attached at **Annexure-III** along with minutes of 2nd meeting of the committee.

Following are the observations of the study on analysing the impact of installing synchronous condenser in present scenario at Fatehgarh-II:

a) Enhanced System Strength / Short Circuit Ratio (SCR)

In the simulation study, 02 nos. of 354 MVA (+300/-200 MVAR) Synchronous Condensers have been considered at 220 kV Fatehgarh-II PG. The simulation study demonstrates that the deployment of Synchronous Condensers (SYNCON) improves the Short Circuit Ratio (SCR) of the RE pooling buses in Rajasthan. This can be attributed to the high fault current contribution capability of SYNCONs (around 4-5 pu) unlike the power electronic controller-based devices where contribution is limited to 1-1.1 pu. From the study results it can be seen that the short circuit level at 220kV level improves by about 2000 MVA and under fault condition at 765 kV level the improvement in voltage would be of the order of 0.1 pu is seen.

As the SynCons are considered at 220 kV Fatehgarh-II (A and B), increase in SCR/fault level is prominent at these buses. SCR of 220 kV Fatehgarh-II (A and B) is seen to increase from 4 and 11.4 to 4.8 and 14.4 respectively.

b) Fast Reactive Power Support during Faults/Transients

Synchronous condensers can play a critical role during faults and high voltage events in power systems due to their ability to provide substantial fault current, typically in the range of 4-5 per unit (p.u.). This high fault current capability is primarily due to the low sub-transient reactance, which allows the machine to respond rapidly to changes in system conditions.

Significant reactive power support has been observed in the simulation study from the proposed SynCons during faults as well as during post-fault high voltage conditions. The short circuit current response of the order of > 5 p.u. (normalized at 1 p.u. voltage) has also been observed depending on the severity of voltage dip/rise in the study case. The support received from SynCons has arrested the voltage dip/rise during transients and improved the system stability.

c) Increased Inertia and Frequency Response

Rate of change of frequency (RoCoF) experienced by the system for a given contingency varies across the system depending on the location of the contingency and availability of synchronous machines in the vicinity. This phenomenon is also being observed in Indian power system with increasing penetration of renewable generation.

In RE- rich pockets, inadequate inertial response could result in a very high rate of decline in frequency post generation loss and the frequency may dip to a level where automatic load shedding (last line of defence) UFR and df/dt gets triggered. The addition of the SYNCONs in RE rich pockets can improve the system's inertia and thereby the ability to resist fast changes in frequency.

The simulation results also show the improvement in nadir frequency and the RoCoF after deployment of SynCons in the Rajasthan RE complex.

d) Damping of Low Frequency Oscillations

The Rajasthan renewable complex has been experiencing Low Frequency Oscillations (LFOs) and the same has been a matter of concern for system reliability. It has been seen in the simulation study that deployment of synchronous condensers (with proper tuning of excitation system + AVR) can significantly help in damping of the oscillations.

e) Steady-state Reactive Power Support

The Excitation system and Automatic Voltage Regulator (AVR) of SynCon helps in maintaining the bus voltage at a desired level and contribute to local voltage control by providing dynamically varying reactive power support as per the machine limits. The simulation study results also demonstrate the improvement in voltage profile after deployment of SYNCONs.

From the above study results, it may be concluded that installation of Synchronous condenser in Northern Region has multiple benefits towards improvement of various grid parameters specially in RE pockets and it would help in stable operation of the grid.

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6. REGULATORY PROVISIONS

CERC IEGC REGULATIONS 2023

Following are the regulatory provisions given in CERC IEGC regulations 2023 regarding Synchronous Condenser or Synchronous Condenser Operation:

- **Clause 39.(7):** NLDC, RLDCs and SLDCs shall take appropriate measures to maintain the voltage within limits, inter-alia, using the following facilities, and the facility owner shall abide by the instructions of NLDC, RLDCs and SLDCs: (i) shunt reactors, (ii) shunt capacitors (excluding HVDC automatic control), (iii) TCSC, (iv) VSC based HVDC, (v) synchronous/non-synchronous generator voltage control including inverter based reactive power support, **(vi) synchronous condenser**, (vii)static VAR compensators (SVC), STATCOM and other FACTS devices, (viii) transformer tap change: generator transformer and inter-connecting transformer, (ix) HVDC power order or HVDC controller selection to optimise filter bank.
- **Clause 39. (10):** Hydro and gas generating units having this capability shall operate in synchronous condenser mode operation as per instructions of the RLDC or SLDC of the respective control area. Standalone synchronous condenser units shall operate as per the instructions of RLDC or SLDC, as per the respective control area. The compensation for such synchronous condenser mode operation shall be included in the procedure to be submitted by NLDC and approved by the Commission.
- **Clause 30. (9):** Inertia: The power system shall be operated at all times with a minimum inertia to be stipulated by NLDC so that the minimum

nadir frequency post reference contingency stays above the threshold set for under frequency load shedding (UFLS). To maintain the minimum inertia, the NLDC may, if required, bring quick start synchronous generation on bar and reschedule generation including curtailment of wind, solar and wind-solar hybrid generation, in coordination with the respective RLDCs and SLDCs. The compensation for such quick start synchronous generation shall be included in the procedure to be prepared by NLDC and approved by the Commission.

- **Clause 39. (11)**: Any commercial settlement for reactive power shall be governed as per the regulatory framework specified in Annexure–4 until the same is separately notified as part of the CERC Ancillary Services Regulations.

  where Annexure-4 specifies that:

  "…(c) All the Inverter Based Resources (IBRs) covering wind, solar and energy storage shall ensure that they have the necessary capability, as per CEA Connectivity Standards, all the time including non-operating hours and night hours for solar. The active power consumed by these devices for purpose of providing reactive power support, when operating under synchronous condenser/night-mode, shall not be charged under deviations and shall be treated as transmission losses in the ISTS."

Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020

Clause 6, 1 (b) Components and sharing of Regional Component (RC)

"Yearly Transmission Charges for static compensators (STATCOMs), static VAR compensators (SVCs), bus reactors, spare transformers, spare reactors **and any other transmission element(s)** located in the concerned region and identified by the Central Transmission Utility as being critical for providing stability, reliability and resilience in the grid.

Provided that where separate Yearly Transmission Charges are not available in respect of specific transmission elements, the Yearly Transmission Charges for such transmission elements shall be worked out and provided by the Central Transmission Utility, apportioning Yearly Transmission Charges approved by the Commission for the integrated project, based on indicative capital cost."

From above, it may be seen that regulatory provision has already been placed for installation of Synchronous Condenser and its tariff recovery.

CEA Manual on Transmission Planning Criteria, 2023

- **3.17 Inertia**

  3.17.2 With the high penetration of renewable energy sources like wind and solar power and gradual reduction/decommissioning of conventional generators, total system inertia of grid would decline. However, Battery Energy Storage Systems (BESS), **Synchronous Condenser** etc. can provide fast response to arrest the frequency decline and help restore the frequency.

- **5.4 Reactive Power compensation**

  5.4.1.2 Near to large RE complex(es) **synchronous condenser(s)** may be planned for dynamic voltage support, in addition to FACTS devices.

*****

7. OTHER TECHNOLOGICAL SOLUTIONS

Following are various other technological solutions apart from Synchronous Condensers provided by OEMs:

A) Enhanced STATCOM (E-STATCOM)

Enhanced STATCOM are STATCOMs integrated with super capacitors for energy storage which provides fast voltage/frequency support as well as synthetic inertia for shorter durations. It combines the advantages of two grid-stabilizing technologies into one solution, providing both active and reactive power.

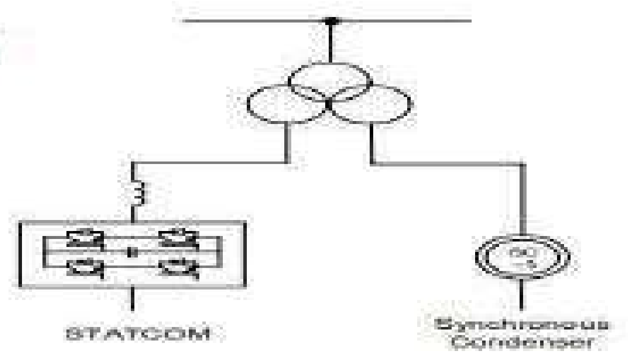
It has features like fast voltage/ frequency support, synthetic inertia, fault current contribution & system strength support. However, the fault current contribution and system strength support is limited to the rating of the device.

It has capabilities like up to over 400 MVAR in a single system – Grid-forming control and Scalable energy storage capacity in the hundreds of MWs.

(Fig 7.1)

B) Hybrid SynCon

The Hybrid SynCon consists of one parallel operating synchronous condenser along with one STATCOM. Hybrid Synchronous Condenser will combine the advantages of Synchronous Condenser and STATCOM technologies, having an optimized design due to performance and losses.



(Fig 7.2)

C) STATCOM with BESS

Battery energy storage system (BESS) in combination with STATCOMs have emerged as one of the possible solutions for active power control along with the compensation for reactive power. The integrated system compensates the reactive power and in addition stores energy in the storage system when generated power exceeds the demand and injects the stored power when the same is required in the system. However, the inertia response provided by STATCOM with BESS is not instantaneous as synchronous machines due to the use of complex measuring/comparing system (rate of change of frequency).

Studies are required to identify the most optimal technology or most optimal combination of technologies that cater to the network needs while costs remain economical.

Various technological options as discussed above may be considered by CEA/CTU while planning the new transmission system based on system studies, however, as mandated this committee has focused only on the requirements of Synchronous Condensers at existing substations/transmission networks in Northern Region.

*****

8. GLOBAL SCENARIO OF SYNCON DEPLOYMENT

Countries with high RE installed capacity and smaller power systems are leading the deployment as such power systems are vulnerable to stability threats on account of RE intermittency and faults. Countries like Denmark, Italy, UK, China, USA & Canada have deployed SynCons. India's share of RE will go beyond 50% of installed capacity by 2030, it is crucial to explore deployment of SynCon in power system for grid stability.

- Global installation of Synchronous Condensers

  - **Installation in Denmark:** More than 50% of generation in Denmark is from solar and wind generators. Based on the system studies carried out by local grid authorities, it was decided to install seven synchronous condensers at or near HVDC stations. Three of these synchronous condensers were commissioned in 2015.

  - **Installation for Qinghai-Henan UHVDC project (China):** Qinghai-Henan UHVDC is a 1587 800KV DC line to transmit RE power up to 8GW. Due to lack of dynamic reactive power in the system and to ensure system stability 27 nos. of 300 MVAR synchronous condensers have been commissioned for this project.

  - **Installation in Panhandle areas of Texas:** Texas Panhandle has a high wind potential and many high wind potential plant have been developed in the area. 2 nos. synchronous condensers were installed for improving the short circuit power. The synchronous condensers were commissioned in 2018.

- **Installations in South California, USA:** 7 nos. of large synchronous generators in the area for voltage regulation, inertia and short-circuit power.

- **Installation with Fly Wheel in Italy:** Italian transmission operator has tendered 16 nos. synchronous condensers with fly wheel for stabilizing the grid for short circuit power and inertia. 8 out of 16 nos. installation are proposed near HVDC stations.

- **Phoenix Hybrid STATCOM and Synchronous Condenser, UK**: The project consists of 70 MVA synchronous condenser and 70 MVA STATCOM at Scottish Power Transmission, Neilson substation. The system is designed to take advantages of both technologies.

- **Installation in South Australia:** For increasing the system strength, 4 nos. of synchronous condensers with flywheel have already been installed in the system.

It may be seen that Synchronous Condensers have already been/being installed across the countries all over the world having significant RE capacity. India is expected to achieve over 50% installed capacity from non-fossil fuel by year 2030, comprising mainly solar and wind capacity, it is right time to install new Synchronous Condenser in India also particularly in RE rich States, considering continuous addition of huge RE capacity in the Indian grid.

*****

9. COST RECOVERY MECHANISM

Presently, no cost recovery/tariff mechanism for synchronous condenser is specified in the regulations. Cost recovery/tariff mechanism is required for promoting installation of such devices. Uniform tariff mechanism for all such compensation devices may be adopted in this regard. (Presently STATCOMS are being installed as "Grid Element").

Synchronous condensers are rotating dynamic reactive power compensation devices that primarily exchange reactive power with the grid. The exchange of active power by these devices is minimal, limited to covering active power losses.

Accordingly, the following compensation mechanisms for a synchronous condenser facility can be considered:

a) **Classification as an active power generating unit:** Implementing a two-part tariff (Fixed and Variable charges). Variable charges could be based on the reactive power exchanged with the grid.

b) **Classification as a transmission asset:** Compensating through monthly transmission charges.

The reactive power exchange of a synchronous condenser is dependent on the grid voltage. If the voltage remains within permissible limits, there might be extended periods of no reactive exchange of the SynCon with the grid. Therefore, the first compensation mechanism which is based on reactive power exchange, may not be suitable at this stage and shall be explored in the future after gaining sufficient experience of the operation of these devices in the grid.

Given these considerations, synchronous condensers could be classified as transmission assets, with cost recovery through monthly transmission charges (regional component). The following clause from the CERC ISTS Transmission Charges regulation also supports this compensation mechanism:

Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020

Components and sharing of Regional Component (RC), Clause 6, 1 (b)

"Yearly Transmission Charges for static compensators (STATCOMs), static VAR compensators (SVCs), bus reactors, spare transformers, spare reactors ***and any other transmission element(s)*** *located in the concerned region and* ***identified by the Central Transmission Utility as being critical for providing stability, reliability and resilience in the grid.***

Provided that where separate Yearly Transmission Charges are not available in respect of specific transmission elements, the Yearly Transmission Charges for such transmission elements shall be worked out and provided by the Central Transmission Utility, apportioning Yearly Transmission Charges approved by the Commission for the integrated project, based on indicative capital cost."

Additionally, it is proposed that the active power consumed by a Synchronous Condenser be treated as transmission losses within the ISTS and not be charged under deviations. The following clause in the CERC Indian Electricity Grid Code, 2023 regulation supports this proposal:

Reactive Power Management

39 (11) Any commercial settlement for reactive power shall be governed as per the regulatory framework specified ***in Annexure–4*** *until the same is separately notified as part of the CERC Ancillary Services Regulations.*

where Annexure-4 specifies that:

Proposed Compensation Mechanism for Synchronous Condenser Facilities

"…(c) All the Inverter Based Resources (IBRs) covering wind, solar and energy storage shall ensure that they have the necessary capability, as per CEA Connectivity Standards, all the time including non-operating hours and night hours for solar. ***The active power consumed by these devices for purpose of providing reactive power support, when operating under synchronous condenser/night-mode, shall not be charged under deviations and shall be treated as transmission losses in the ISTS."***

Classifying synchronous condensers as transmission assets would also align their bidding and compensation methodology with other similar technologies, such as STATCOMs and SVCs, thereby ensuring uniformity across different technologies.

It is also suggested that the availability computation of SynCon shall be on similar lines as specified for STATCOM in relevant regulations notified by respective commissions from time to time. The weightage factor shall be considered on pro-rata basis i.e. ratio of maximum available capacity to rated capacity of SynCon.

In future, the compensation mechanism for dynamic reactive power compensation devices shall also factor in their performance in real-time.

*****

10. REQUIREMENT OF SYNCHRONOUS CONDENSER IN NORTHERN REGION

There are various challenges in re-purposing coal-based plants as synchronous condensers such as residual life, re-winding of generator, transportation to new location, warranty issues, hydrogen, land, water requirements etc. Also, new synchronous condensers have advantages of design as per system requirement, can be air cooled etc., thereby reducing the land water requirements. In view of the same, it is advisable to install new synchronous condensers.

As discussed during committee meetings, CTUIL and CEA have to carry out system study for requirement of synchronous condenser as already mentioned in 500 GW RE report. The studies would be carried out for every two-year time frame until the year 2030. The need for SynCons would be identified separately based on the detailed reactive power planning studies and the Short Circuit Ratios (SCRs) as well as inertia considerations at different locations. Further, the approach mentioned in Chapter 4 regarding criteria for area selection for installation of SynCons is also considered.

It is observed that in some of the existing sub-stations in Rajasthan viz. Bhadla PS, Bikaner PS & Bikaner-III PS are touching their designed short circuit level, therefore such stations may be excluded from the above consideration. Further, suitable location for the installation of SynCons in Rajasthan ISTS system, which includes a low SCR (<5) as well as no installation of dynamic compensation [to avoid interaction between STATCOM and SynCons], are being considered. Further adequate space should also be available in the identified substation for installations of SynCons.

Convergence issues are being faced for future timeframe dynamics files, for which discussion are being carried out with OEMs/Siemens (PSS/E) & IIT

Mumbai. Therefore, a methodology has been adopted to identify optimal location for installation of SynCons in the interim which includes low SCR (<5), proximity of HVDC station as well as no installation of dynamic compensation to avoid interaction between STATCOM and SynCons.

Location of SynCons as close to the generation [220kV] may appear to increase the SCR. However, at the same time at 400kV level its efficacy in supporting the grid will be more. Therefore, a prudent decision for SynCon placement at 220kV or 400kV needs to be taken on case-to-case basis.

Based on the connectivity grant, SCR, real time grid issues, following tentative locations have been identified for placement of SynCons. However, this shall be subject to availability of space at respective station:

Based on the system study, tentative locations (RE pooling stations) for installation of synchronous condensers in Northern Region is as under:

Table 11.1- Proposed locations for Synchronous Condenser in Rajasthan

S.No.	Pooling Station	Voltage level	Synchronous condenser units *	SCR (by 2029) w/o SynCon	Reason for requirement of SynCon
	Ph-I				
1	Fatehgarh-I	400kV	• 400kV – 2 nos.	10.1	• Sustained Oscillations on real time basis as observed by Grid-India and radialized connection • No Dynamic compensation device • **Space conformation is awaited from M/s ATL** • Proposed Timeframe: 2026-27
2	Fatehgarh-II	220KV (Sec-1 & 1A) or 400kV	• 220kv - 1 No. unit each (Section 1 & 1A) or • 400kV – 2 nos.	220kV – (5.7 & 7.2) 400kV - 5.4	• Sustained Oscillations on real time basis as observed by Grid-India • Recommended at 400kV level due to relative low SCR and more impact on Grid Faults (at Bhadla, Bikaner) • **STATCOM at 400kv level - extensive evaluation is required due to control**

S.No.	Pooling Station	Voltage level	Synchronous condenser units *	SCR (by 2029) w/o SynCon	Reason for requirement of SynCon
					interaction between STATCOM and SynCon. • **M/s POWERGRID vide mail 05.10.24 confirmed the space for 2x(80x95sqm) for installation of 2 nos. 300MVAr SynCon units (on 220kV or 400kv level)** • Proposed Timeframe: 2026-27 ***Based on recommendation of committee either Fatehgarh-II PS (Priority-1) or Fatehgarh-I PS (Priority-2) may be selected for installation of SynCon***
	Ph-II				
3	Fatehgarh-IV PS (Sec-2)	220kV or 400kV	• 220kV - 2 Nos.	3.5(220kV) 6(400kV)	• Recommended at 220kV level due to low SCR • No Dynamic compensation device • Proposed Timeframe: 2027-28
4	Ramgarh PS	400kV	• 400kV - 2 Nos.	7.5(220kV) 4.5 (400kV)	• Recommended at 400kV level due to Low SCR at 400kV level (2027-3.4 & 2029-4.5) • STATCOM at 400kV level - extensive evaluation is required due to control interaction between STATCOM and Syncon • Proposed Timeframe: 2027-28
5	Bhadla-III	220kV	•220kV - 2 Nos.	4.3(220kV) 4.7 (400kV)	• Recommended at 220kV level due to relative low SCR at 220kV level (2027-3.5 & 2029-4.3) • No Dynamic compensation device • Nearby HVDC at 400kV level (through 400kV Bhadla-III-Bhadla (HVDC) 2xD/c line) - extensive evaluation is required due to control interaction between HVDC and Syncon • Proposed Timeframe: 2027-28
	Ph-III				
6	Bikaner-II PS	220kV	•220kv - 1 No.	4.5(220kV) 7.3 (400kV)	• Recommended at 220kV level due to relative low SCR at 220kV level • Only 1 no. unit is suggested due to higher Short circuit MVA

S.No.	Pooling Station	Voltage level	Synchronous condenser units *	SCR (by 2029) w/o SynCon	Reason for requirement of SynCon
					• STATCOM at 400kv level - extensive evaluation is required due to control interaction between STATCOM and Syncon • Proposed Timeframe: 2029-30
7	Merta-II PS	220kV	•220kv - 1 No.	4.8 (220kV) 9.7 (400kV)	• Recommended at 220kV level due to relative low SCR at 220kV level • No Dynamic compensation device • Proposed Timeframe: 2029-30

1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) with Minimum H (natural) >3 s

Additional requirement of flywheel (with natural inertia of 1000-3000MWs) may be identified at time of finalization of proposal

In the analysis, it is observed that in some of the existing substations in Rajasthan viz Bhadla PS, Bikaner PS & Bikaner-III PS are touching their designed short circuit level, therefore such stations are excluded from the above consideration.

*****

11. RECOMMENDATIONS OF THE COMMITTEE

Following are the recommendations of the committee:

(i) In view of huge RE capacity addition in the Northern Region, particularly in Rajasthan State, the Committee is in consensus of installation of SynCons in RE complexes because of the following advantages of SynCons:

a) Enhancement in System Strength/ Short Circuit Ratio (SCR)
b) Fast Reactive Power Support during Faults/Transients
c) Increased Inertia and Frequency Response
d) Damping of Low Frequency Oscillations
e) Steady-state Reactive Power Support

(ii) As per the study results, the committee recommends installation of first SynCon of 2 X +300/-200 MVAR at 400kV level either at Fatehgarh-II (Priority-1) or Fatehgarh-I (Priority-2) Substation with the completion timeline of 2026-2027 as the land for installation of SynCons is available at Fatehgarh-II Substation of POWERGRID.

(iii) Committee also recommends installation of additional SynCons in timelines of 2027-28, 2028-29 & 2029-30 as per table 11.1 based on the evolving scenarios & studies for above timeline.

(iv) Committee recommends to consider SynCon as ‘transmission asset’ similar to STATCOM & SVC for its compensation mechanism with cost recovery through monthly transmission charges (Regional component). Further, it is recommended that the active power consumed by SynCon be treated as transmission losses within the ISTS and not be charged under deviations.

Availability computation of SynCon shall be on similar lines as specified for STATCOM in relevant regulations notified by respective commissions from time to time. The weightage factor shall be considered on pro-rata basis i.e. ratio of maximum available capacity to rated capacity of SynCon.

(v) The CEA/MoP may consider the installation of above SynCons in TBCB or RTM mode similar to other transmission projects.

(vi) The Committee also recommends that technical standards and other regulatory framework for adoption of SynCons may be notified on priority by concerned authorities.

(vii) Committee also recommends to explore the idle/underutilized existing gas-based power plants in the country for utilization in synchronous condenser mode via suitable arrangements of clutch in gas power plants located in RE rich areas. Further, after year 2030, existing retired coal based TPS may also be explored for utilization as SynCons.

*****

References:

1. Synchronous Condenser- A Novel Solution for Grid Stability for Integration of Renewables (Version 2.0) By NTPC
2. Reactive Power Management and Voltage Control Ancillary Services (VCAS) in India Reactive Power Management and Power System Operation Corporation Ltd. (A Government of India Enterprise) Power System Operation Corporation Ltd. March 2021 (Discussion paper)
3. Report on Events Involving Transmission Grid Connected Wind & Solar Power Plants by Grid India
4. Grid-India Report on Assessment of Inertia in Indian Power System (https://posoco.in/wp-content/uploads/2022/01/Assessment-of-Inertia-in-Indian-Power-System.pdf)
5. CEA Manual on Transmission Planning Criteria, 2023

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Annexure-I

भारत सरकार
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Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

सेवा में,

1. Chief Engineer, PSPA-1, CEA [Email: i.sharan@nic.in]
2. COO, CTUIL, [Email: pcgarg@powergrid.in]
3. Executive Director, NRLDC, Grid-India [Email: nroy@grid-india.in]
4. Chief Engineer, PSTCL, [Email: ce-tl@pstcl.org]
5. Chief Engineer, RVPNL, [Email: ce.ppm@rvpn.co.in]
6. Director (Planning & Commercial), UPPTCL, [Email: director_comm@upptcl.org]

विषय: Constitution of Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region -reg.

महोदय/ महोदया,

In the 71st NRPC meeting held on 29th January, 2024 (refer agenda A.7 of enclosed MoM dated 23rd February, 2024), it was deliberated that RE power is being integrated in fast pace country-wide and to ensure grid stability and provide inertial support in RE complex, requirement of dynamic compensation like Synchronous Condensers needs to be identified separately based on the detailed reactive power planning studies and the Short Circuit Ratios (SCRs) at different locations.

As per decision taken in 71st NRPC meeting, a committee of members from CEA, NRPC, NRLDC, CTU and STU is to be constituted under chairmanship of Member Secretary, NRPC to do futuristic analysis for requirement of Synchronous Condensers based on the inertia considerations for Northern Region.

In view of the above, a committee is constituted with following members from planning/system study group of different organizations:

Sr. No.	Name	Designation	Organization
1	Sh. V. K. Singh	Member Secretary- **In Chair**	NRPC Sectt.
2	Sh. Anzum Parwej	Superintending Engineer (System Study)	
3	Sh. Ravi Kant	Executive Engineer (System Study)	

4	Sh. Kanhaiya Singh Kushwaha	Asst. Director, PSPA-1	CEA
5	Sh. V. Thiagarajan	Sr. GM	CTUIL
6	Sh. Kashish Bhambhani	GM	
7	Sh. Sunil Kumar Ahirwal	GM	NRLDC
8	Sh. Bikash Kumar Jha	DGM	
9	Mr. Nitin Kumar	Sr. XEN/Planning-1	PSTCL
10	Ms. Ranjana	AE/Planning-1	
11	Sh. V. A. Kale	Superintending Engineer (P&P)	RRVPNL
12	Dr. Om Prakash Mahela	Executive Engineer (PP&D)	
13	Representative from UPPTCL (Nomination awaited)		

First meeting of the committee is scheduled on **19th April 2024 at 11:00 hrs through VC**. Meeting link will be shared in due course.

Kindly make it convenient to attend the meeting.

This issues with the approval of MS, NRPC.

Sd/-

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

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Northern Regional Power Committee
****

विषय: Meeting Notice of 2nd meeting of Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region -reg.

महोदय/ महोदया,

2nd meeting of Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region has been scheduled on **30-05-2024 at 03:00 PM through VC.** Meeting link will be shared in due course.

As per the decision in 1st meeting of the committee, CTU and BHEL are requested to arrange/ make Presentations on Synchronous Condensers and other advanced technologies.

Additional Nominations have been received from NTPC, BHEL and NLDC. In view of this, constitution of committee is as under:

S. no.	Name	Designation	Organization
1	Sh. V. K. Singh	Member Secretary- **In Chair**	NRPC Sectt.
2	Sh. Anzum Parvez	Superintending Engineer (System Study)	
3	Sh. Ravi Kant	Executive Engineer (System Study)	
4	Sh. Kanhaiya Singh Kushwaha	Asst. Director, PSPA-1	CEA
5	Sh. V. Thiagarajan	Sr. GM	CTUIL
6	Sh. Kashish Bhambhani	GM	
7	Sh. Sunil Kumar Ahirwal	GM	NRLDC
8	Sh. Bikash Kumar Jha	DGM	
9	Mr. Nitin Kumar	Sr. XEN/Planning-1	PSTCL

10	Ms. Ranjana	AE/Planning-1	
11	Sh. V. A. Kale	Superintending Engineer (P&P)	RRVPNL
12	Dr. Om Prakash Mahela	Executive Engineer (PP&D)	
13	Sh. Sanjeev Kumar Bhasker	Superintending Engineer	UPPTCL
14	Sh. Priyam Jain	Chief Manager	NLDC
15	Sh. Suneet Mehta	DGM	NTPC
16	Sh. Venkateswara Rao Bitra	DGM	
17	Sh. Manoj Kumar	AGM	BHEL
18	Ms. Asha Gupta	AGM	
19	Sh.Vishal Naidu	DGM	
20	Sh. Ranajit Dey	Sr. Manager	
21	Sh. Dhanunjayudu Nasika	Manager	

Kindly make it convenient to attend the meeting.

This issues with the approval of MS, NRPC.

Signed by Anzum Parwej
Date: 16-05-2024 17:41:18

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

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उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee
****

विषय: Meeting Notice of 3rd meeting of Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region -reg.

महोदय/ महोदया,

3rd meeting of Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region has been scheduled on **7th June 2024 at 11:00 AM through VC.** Meeting link will be shared in due course.

As per the decision in 2nd meeting of the committee, CTU is requested to arrange Presentations on Synchronous Condensers by M/s Siemens in the meeting.

Additional Nomination have been received from NLDC. In view of this, constitution of committee is as under:

S. no.	Name	Designation	Organization
1	Sh. V. K. Singh	Member Secretary- **In Chair**	NRPC Sectt.
2	Sh. Anzum Parwej	Superintending Engineer (System Study)	
3	Sh. Ravi Kant	Executive Engineer (System Study)	
4	Sh. Kanhaiya Singh Kushwaha	Asst. Director, PSPA-1	CEA
5	Sh. V. Thiagarajan	Sr. GM	CTUIL
6	Sh. Kashish Bhambhani	GM	
7	Sh. Sunil Kumar Ahirwal	GM	NRLDC
8	Sh. Bikash Kumar Jha	DGM	
9	Mr. Nitin Kumar	Sr. XEN/Planning-1	PSTCL

10	Ms. Ranjana	AE/Planning-1	
11	Sh. V. A. Kale	Superintending Engineer (P&P)	RRVPNL
12	Dr. Om Prakash Mahela	Executive Engineer (PP&D)	
13	Sh. Sanjeev Kumar Bhasker	Superintending Engineer	UPPTCL
14	Sh. Priyam Jain	Chief Manager	NLDC
15	Sh. Rahul Shukla	Chief Manager	
16	Sh. Suneet Mehta	DGM	NTPC
17	Sh. Venkateswara Rao Bitra	DGM	
18	Sh. Manoj Kumar	AGM	BHEL
19	Ms. Asha Gupta	AGM	
20	Sh.Vishal Naidu	DGM	
21	Sh. Ranajit Dey	Sr. Manager	
22	Sh. Dhanunjayudu Nasika	Manager	

Kindly make it convenient to attend the meeting.

Signed by Anzum Parwej
Date: 05-06-2024 17:24:20

This issues with the approval of MS, NRPC.

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

Annexure-II

भारत सरकार
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Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

विषय: Minutes of 1st Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 22.04.2024 through Video Conferencing.

महोदय/ महोदया,

1st Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region was held on 22.04.2024 through Video Conferencing. Minutes of the meeting is attached at **Annexure-I** for kind information and necessary action.

This issues with the approval of MS, NRPC.

Signed by Anzum Parwej
Date: 06-05-2024 12:28:01

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

Annexure-I

Minutes of 1st Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 22.04.2024 through Video Conferencing

At the outset, Member Secretary welcomed committee members and other participants in the meeting. He briefly described that in the 71st NRPC meeting held in January 2024, it was decided that there is need of dynamic compensation in the Northern Region because more RE Generation is being integrated in the Northern Grid. Accordingly, it was decided that a committee may be setup under Member Secretary and members comprising from NRLDC, CEA, CTU & STUs. Therefore, a committee was formed with members from NRPC, CEA, NRLDC, CTU, STUs and it was agreed that committee may opt any other experts. Subsequently, committee co-opted NTPC and BHEL from the first meeting itself and they also joined the first meeting. Officials from NLDC also joined the first meeting. The committee may deliberate on the requirement of synchronous condenser in the Northern Region and particularly system study will be required about the location, capacity of synchronous condenser, economics – whether old thermal plants due for retiring can be used as synchronous condenser, all these aspects are to be deliberated by this committee. A report should be prepared and submitted to MoP/CEA, so that road map towards installation of synchronous condenser can be started on ground.

2. Executive Engineer, NRPC gave a brief presentation on Synchronous condenser based on reports from NTPC and GRID INDIA.

Reports description are as under:

(i)NTPC report on the use of Generators as Synchronous Condensers for Grid stability aspects of short circuit power and inertia

(ii)Grid India: Discussion paper titled Voltage Control Ancillary Service to CERC in March 2021 and is available in public domain.

Brief points of the presentation are as under:

- The target for renewable generation is revised in COP26 to 500GW by 2030.
- The increase in renewable energy in grid along with retirement of conventional energy-based plants may lead to considerable decrease in inertia, short circuit strength, dynamic reactive power reserves which are essential parameters for overall stability and reliability of the power system.
- System studies need to be carried out considering the planned renewable integration to identify possible locations for installation of mechanisms for providing reactive power.
- The conversion of a retiring plant allows the use of existing equipment and infrastructure, thereby reducing the investments costs and providing an economical solution for critical ancillary services such as short circuit power, inertia and reactive power.
- Gas Power Plants can be converted to synchronous condensers by the provision of a clutch to connect the gas turbine and generator. When active power generation is required, the gas turbine is connected to the generator with the clutch closed.
- Further, as more and more renewable generation (low inertia) is replacing the conventional generators, the diminishing system inertia is posing new challenges to the grid stability and growing concern to the grid operators.
- As a localized phenomenon, voltage changes in the system can be best addressed by providing reactive power support locally. Unlike real power, reactive power cannot be transferred across long distances in a bulk power system. Long distance and unchecked reactive power flows can give rise to substantial voltage variation across the system. Thus, it

becomes necessary to maintain reactive power balances between sources of generation and points of demand on a 'zonal basis'.

- Converting an obsolete synchronous generator to a synchronous condenser is a viable, economical alternative to retiring the unit.
- Besides providing reactive power support, a synchronous condenser has other advantages like contributing to system short-circuit capacity, short term overload capability, system inertia etc.

3. NTPC informed that presently the above-mentioned report is for their internal circulation and study and the same can be shared to the committee members after updating data and subsequent internal approval from NTPC management.

Member Secretary, NRPC requested NTPC to share the report on Synchronous Condensers for the studies already carried out by them to all the committee members for reference.

4. Member Secretary, NRPC asked NRLDC to inform the committee about the issues faced on day-to-day basis by the System Operators which suggest requirement of synchronous condenser in RE pockets in Western Rajasthan.

NRLDC representative shared a brief presentation about the requirement of synchronous condensers and the present grid condition. The main points highlighted by NRLDC during their presentation are mentioned below:

a) The relevant extract of CEA report on the Transmission System for Integration of over 500 GW RE Capacity by 2030 was discussed. In the report it is mentioned that for the planned transmission schemes in Northern Region, dynamic compensation requirement like STATCOMs, Synchronous Condensers etc. would be identified separately based on the detailed reactive power planning studies and the Short Circuit Ratios (SCRs) at different locations. However, no synchronous condenser has been planned as of now.

b) The RE tripping event of 4870 MW and subsequent df/dt operation in various states leading to load shedding of nearly 630 MW in NR at 11.24 hrs on 06.04.2024 was also deliberated. It was mentioned that tripping on df/dt means that the rate of change of frequency was higher than stage-1 setting. This would have been due to large amount of generation loss and less localised inertia in Northern grid as df/dt tripping was reported only in Northern Region. Repeated events of RE generation loss in Northern Region leading to load shedding on high df/dt suggest issues related to local inertia in Northern Region.

c) The comparison between different technologies viz. Capacitors, SVC, STATCOM, Synchronous Condensers was elaborated, and various advantages of Synchronous Condensers was reflected upon including its overload capability, higher short circuit contribution due to no limitation of inverter current rating and inertial support which is not provided by SVCs & STATCOMs.

d) It was highlighted that in grid with low inertia issues such as severe power system transients, high rate of change of frequency (RoCoF) due to system disturbances, Extreme power system frequency (frequency nadir) swings during contingencies, deterioration of fault detection capabilities of associated protective devices are commonly observed apart from the inability to further integrate low-inertia renewable generation resources into the power system.

e) Advantages of synchronous condenser viz. Fault current support to improve power system electromagnetic strength, Physical inertia to limit the initial RoCoF in the first swing, Reactive power support was mentioned. It was also mentioned that synchronous condenser does not have any inverter-based devices therefore there is no harmonic injection and the synchronous condenser also helps to maintain inherent sine wave to stabilize the voltage distortion following a transmission fault and facilitate grid following inverter Fault Ride Through.

   It was also deliberated that RE plants have reported tripping due to distorted waveform owing to phase jump issue and sensing of low frequency of inverters in the past. Synchronous condenser would help in maintaining Sine wave of voltage waveform and will reduce distortion, it is thus envisaged that tripping due to phase-jump and distorted waveform would reduce if Synchronous condensers were available.

f) Several synchronous condensers have been installed across the world from Denmark, Germany and Italy to USA for improving the short circuit fault level or providing dynamic reactive power support. List of synchronous condensers installed worldwide as presented by NRLDC during the meeting is attached as **Annexure-II**.

g) Fault levels & SCR of ISTS RE Pooling stations in NR-Rajasthan was also presented. SCR less than 5 was highlighted at 400 KV and 220 KV side of Fatehgarh-2. NRLDC representative added that these SCR values are as per the present grid condition, and it may vary as per increased connectivity as per CTU planning for further transmission system and weaker nodes may be assessed again after commissioning of pending as well as upcoming lines which are under planning stage.

5. Member Secretary, NRPC asked CTU to provide the details for the future planning in RE pocket. CTU representative replied that SCR values which are observed to be low presently will increase with coming up of transmission lines in future and SCR value will meet CEA standards. Also, Synchronous condensers will definitely help in terms of inertia, SCR value and MVAR support but utilization of the same in world over is combination of both Synchronous condenser and STATCOM. Hence, synchronous condenser and STATCOM should be used in combination.

Member Secretary, NRPC opined that as per CEA report of 500 GW Renewable Generation (RE) corresponding transmission plan has been made and hence RE pooling station planning location, corresponding transmission lines and connectivity with load centres have already been planned. Member Secretary, NRPC enquired from CEA and CTU if any study has been carried out regarding installation of compensation devices corresponding to 500 GW Renewable Generation (RE).

CTU representative stated that pooling station wise STATCOM have been planned for controlling voltages which is quite effective for Voltage control however other features like higher short circuit current contribution and inertia are yet to be explored. He also stated that during solar peak hours, thermal generation on bar would be operating around 50% and margins would be available for inertia contribution.

Member Secretary, NRPC opined that a combination of devices would be required as per system requirement and hence system study should be carried out to know the node wise requirement as per the planned 500 GW Renewable Generation so that SCR improvement, Voltage profile improvement and inertia requirements would be met as available rotating mass would be less with more and more RE integration. Study may be carried out for different periods e.g. 2026, 2028, 2030 regarding the compensation requirements.

CTU representative stated the following:

a) Technology is evolving and Synchronous condenser is one of the options.
b) CTU shared a slide where an OEM Hitachi had come to CTU for showcasing their technologies where enhanced STATCOM(E-STATCOM) can be used, it has benefits of synchronous condenser as well as fast and slow voltage controls and controllability in enhanced way is available.
c) Using retired generating units as Synchronous condenser is a good option but if completely new synchronous condenser is to be installed then Hybrid-Synchronous condenser and E-STATCOM can also be explored.

CTU representative enquired whether GRID-INDIA has carried out any studies which show any improvement in grid situation in Western Rajasthan with synchronous condenser.

CTU representative also stated that they have requested Hitachi for dynamic data of Hybrid Synchronous condenser/ E-STATCOM and also requested BHEL to provide dynamic data of synchronous condenser being proposed by BHEL.

6. NRLDC representative stated that GRID-INDIA had done study which suggested improvement in transient stability with synchronous condenser. As a test case simulation was done with synchronous condenser connected at Bikaner-II and is included in report published by GRID-INDIA and is available @ *https://posoco.in/wp-content/uploads/2024/01/Report-on-Events-Involving-Transmission-Grid-Connected-Wind-Solar-Plants.pdf*

NRLDC representative also stated that Hybrid synchronous condenser and E-STATCOM are still to be implemented in sites worldwide therefore their efficacy is not clear as on date. Moreover, with such technologies, issues such as short circuit contribution may not be resolved whereas inertial issues may also persist. Already STATCOMs are being installed in Indian grid, therefore pilot with synchronous condenser would be the most suitable option.

7. CEA, PSPA-I representative stated that the criteria for selection of choosing location for installing synchronous condenser also needs to be discussed; result from simulation studies need to be considered for assessing requirement of synchronous condenser.

NRLDC representative stated that some of the common parameters which determine requirement of synchronous condenser include parameters such as short circuit ratio, df/dt in case of reference contingency.

8. NLDC representative stated that feedback regarding synchronous condenser is being regularly submitted in quarterly operational feedbacks to CTUIL/CEA. Moreover, selection criteria have also been prepared by NLDC and submitted in various forum. Selection criteria along with note as shared by NLDC is attached as **Annexure-III**.

9. MS, NRPC requested NTPC to share views on the matter. NTPC representative stated that as per recent directions from Govt., no thermal unit is to be retired till 2030, therefore option for utilising existing thermal unit as synchronous condenser may not be feasible. Moreover, shifting one generating unit which has already exhausted its life to a new location would also be costly as new civil constructions would be required and also the machine would have served its life.

Repurposing of existing coal power plants for use as synchronous condenser: NTPC informed that as per advisory dated 20.01.2023 issued by CEA, no retirement or re-purposing of coal-based power stations shall be done before 2030. In view of the same, repurposing may not be possible before 2030.

Advantages of New Synchronous Condenser over repurposing of existing coal-based plants: NTPC informed that there are various challenges for re-purposing coal-based plants as synchronous condensers such as residual life, re-winding of generator, transportation to new location, warranty issues, hydrogen, land, water requirements etc. Also, new synchronous condensers have advantages of design as per system requirement, can be air cooled etc., thereby reducing the land water requirements. In view of the same, it was discussed that it is advisable to install new synchronous condensers.

Possibility of using Gas Turbines for Synchronous condensers: NTPC informed that existing gas power plants can be made to run either in 'Generation Mode' or in 'Synchronous Condenser Mode' with provision of a new clutch arrangement between Generator and Turbine. In Rajasthan, NTPC has only one gas plants i.e., Anta.

Tariff Mechanism for Synchronous Condenser Installation: NTPC representative highlighted that presently, no cost recovery/tariff mechanism for synchronous condenser is available. It was also mentioned that the mechanism is required for promoting installation of such devices.

Also, it was discussed that uniform tariff mechanism for all such compensation devices is required (presently STATCOMS are being installed as "Grid Element").

Suggestions for way forward: Initially, a techno-commercial comparison of each type of compensation device (STATCOM, Synchronous Condenser, BESS etc.) or hybrid/combination of devices may be made for selecting the most suitable optimized solution based on ancillary service required.

A suggestive way forward was proposed in the meeting:

1. **Step-1:** Grid studies to be carried out for Short Circuit Ratio, inertia and dynamic reactive power with planned RE integration.
2. **Step-2:** Based on the system studies, installation of the equipment as per system requirement and selected solutions to be done.

It was also discussed that pilot installations (if not installed earlier) of different available solutions shall be required for understanding the ground performance of the compensation solutions.

10. Member Secretary, NRPC requested BHEL to share their views. BHEL representative stated that they are ready to design synchronous condenser up to 300 MVAr capacity. BHEL stated that they have the capability to design, manufacture and supply Synchronous condenser (SC) for a varied range (100 MVAr-300MVAr). As per the network requirement, synchronous condenser size may be selected with maximum size of 300 MVAr. For requirement of 600 MVAR Synchronous condenser, two 300 MVAR Synchronous condensers can be used. MS secretary asked how much time it could take for installation of 600 MVAR Synchronous Condenser. BHEL informed that generally installation may be completed in 1.5 to 2 years. However, in case of critical requirement, the work would be expedited. In order to demonstrate the advantages, efficacy/effectiveness of the SC in the Grid, BHEL proposed for a pilot project with Indigenous technology which will give a boost to Make in India drive. BHEL requested to provide an opportunity to make a presentation about BHEL's technical

capabilities and readiness in the upcoming meeting and to further deliberate on the modalities of pilot project.

NTPC and BHEL representatives suggested that a pilot project for new synchronous condenser needs to be implemented in the country to determine the utility of synchronous condenser in Indian grid.

11. Member Secretary, NRPC enquired RVPN regarding possibility of utilising Giral TPS and Dholpur TPS for synchronous condenser mode of operation.

RVPN representative agreed to confirm the same.

12. UPPTCL representative raised the queries in the meeting, especially in pointing out the strategic locations for synchronous condensers in coordination with UPSLDC as per the prevailing and forecasted grid parameters. Query regarding the utilization of UP Rajya Vidhyut Utpadan Nigam Limited owned generating units & other IPPs as synchronous condensers was also raised.

Member Secretary, NRPC suggested that STU must coordinate with their SLDCs and Generating unit to work out such possibilities at state level.

13. Committee will then submit its report in the next 3-4 months to CEA and Ministry of Power. Concrete action on ground would then take place towards installation of synchronous condensers.

Committee also deliberated that NLDC has already done work in the area for requirement of synchronous condenser in the grid and hence one member from NLDC may also be included in the committee.

14. Following was agreed after detailed deliberations:

1. CTUIL to arrange for presentation by OEM for other advanced technologies in next meeting.
2. BHEL to give presentation on synchronous condenser in next meeting.
3. CTUIL and CEA to carry out system study for requirement of synchronous condenser as already mentioned in 500 GW RE report. The studies would be done for every two-year time frame till year 2030.
4. Grid-India to study impact of installing synchronous condenser in present scenario at Fatehgarh-II which has the least SCR in Western Rajasthan RE complex.
5. Committee to deliberate on funding for synchronous condenser.
6. RVPN to explore possibility of utilising Giral TPS and Dholpur TPS for synchronous condenser mode of operation.
7. NTPC/BHEL to submit inputs from their side regarding synchronous condenser mode of operation before next subcommittee meeting.
8. NRPC to send official mail seeking nominations from NLDC, NTPC & BHEL

Member Secretary, NRPC thanked all participants and ended the meeting.

List of Participants

NRPC

1. Sh. V K Singh, Member Secretary ---- **In Chair**
2. Sh. Anzum Parwej, SE
3. Sh. Ravi Kant, EE

CEA

4. Sh. Kanhaiya Singh Kushwaha, Asst. Director

CTU

5. Sh. V. Thiagarajan, Sr. GM
6. Sh. Kashish Bhambhani, GM

NLDC

7. Sh. Vivek Pandey, Sr. GM
8. Sh. Priyam Jain, Chief Manager
9. Sh. Aman Gautam, Manager

NRLDC

10. Sh. Bikash Kumar Jha, DGM
11. Sh. Gaurav Singh, Chief Manager
12. Sh. Gaurav Malviya, Manager

PSTCL

13. Sh. Nitin Kumar, Sr. XEN/Planning-1
14. Ms. Ranjana, AE/Planning-1

RVPNL

15. Sh. V. A. Kale, Superintending Engineer (P&P)
16. Dr. Om Prakash Mahela, Executive Engineer (PP&D)

UPPTCL

17. Sh. Sanjeev Kumar Bahsker, SE

NTPC

18. Sh. Pankaj Kumar Gupta, GM
19. Sh. B S Jena, AGM
20. Sh. Suneet Mehta, DGM
21. SH. V R Bitra, DGM

BHEL

22. Sh. Manoj Kumar, AGM,
23. Sh. Vishal Naidu, DGM
24. Sh. Ranajit Dey, Sr. Manager

List of Synchronous Condenser Installations

Country	Location/Project Name	Inertia Constant MWs/MVA	Kinetic Energy MWs	Type of Machine cylindrical/salient pole (r.p.m.)	Rating		
					MVAr delivery	MVAr absorption	S.C. Support
Australia	Darlington Point	1.27	53	salient pole	42	-20	328
Australia	Darlington Point	1.27	53	salient pole	42	-20	328
Australia	Darlington Point	1.27	53	salient pole	42	-20	328
Australia	Darlington Point	1.27	53	salient pole	42	-20	328
Australia	Davenport	8.53	2x1100	cylindrical (3000)	2x129	2x-77	2x642
Australia	Finley	1.53	91.8	salient pole	60	-35	469
Australia	Finley	1.53	91.8	salient pole	60	-35	469
Australia	Haughton	1.57	102	salient pole	65	-27.3	492
Australia	Haughton	1.57	102	salient pole	65	-27.3	492
Australia	Kennedy Energy Park	2.1	10.5	salient pole	5	-5	48
Australia	Kennedy Energy Park	2.1	10.5	salient pole	5	-5	48
Australia	Kennedy Energy Park	2.1	10.5	salient pole	5	-5	48
Australia	Kiamal Solar Farm		340	cylindrical	190	-70	730
Australia	Robertstown		1100	cylindrical	125	-70	580
Australia	Silverton	1.33	53	salient pole	40	-20	325
Australia	Silverton	1.33	53	salient pole	40	-20	325
Australia	Tasmania	4.1	656	salient pole (273)	70	-72	
Australia	Tasmania	3.57	571	salient pole (273)	70	-61	
Australia	Tasmania	3.65	496	salient pole (167)	72	-74	
Australia	Tasmania	3.15	356	salient pole (200)	49	-44	
Australia	Tasmania	3.72	350	salient pole (167)	50	-42	
Australia	Tasmania	3.7	348	salient pole (167)	40	-46	
Australia	Tasmania	4.2	282	salient pole (600)	40	-20	
Australia	Tasmania	3.1	149	salient pole (500)	21	-17	
Canada	Cote Gold	1.0	7.5	salient pole	7.5	3.75	36
Canada	Cote Gold	1.0	7.5	salient pole	7.5	3.75	36
Canada	Cote Gold	1.0	7.5	salient pole	7.5	3.75	36
Canada	Hydro Quebec Cadillac	3x2.9	3x72.5	salient pole	3x25	3x-12.5	3x471
Canada	Hydro Quebec Copper Mountain	2x2.9	2x72.5	salient pole	2x25	2x-12.5	2x471
Canada	Rainbow Lake	1.43	71.5	salient pole	50	-30	467
Canada	Rainbow Lake	1.43	71.5	salient pole	50	30	467
Canada	Winnipeg, Dorsey Inverter station of BPI HVDC Bipole	1.41	226.4	salient pole	160	-80	0.653 (SCR)
Canada	Winnipeg, Dorsey Inverter station of BPI HVDC Bipole	1.99	318.09	salient pole	160	-80	0.653 (SCR)
Canada	Winnipeg, Dorsey Inverter station of BPII HVDC Bipole	2.2	660.0	salient pole	300	-165	0.653 (SCR)
Canada	Winnipeg, Riel Inverter station of BPIII HVDC Bipole	2.5	625.0	salient pole	4x250	4x-125	0.653 (SCR)
China	Guquan 2					-150	
China	Huaian 2					-150	
China	Jiuquan 2					-150	
China	Other locations 8					-150	
China	Taizhou 2					-150	
China	Ximeng 2					-150	
China	Xuming Substation (5 SynCons)					-150	
China	Zhalute 2				27x300	-150	
China	Ziangtan 2					-150	
Denmark	Bjaeverskov		450	cylindrical	270	-140	900
Denmark	Faero Island /Soderoy	2.3	18.4	salient pole	8	-7.5	127
Denmark	Fraugde		450	cylindrical	200	-120	1000
Denmark	Herslev		450	cylindrical	200	-120	1000
Estonia	Kiisa		1750	cylindrical	50	-50	900
Estonia	Püssi		1750	cylindrical	50	-50	900
Estonia	Viru		1750	cylindrical	50	-50	900
Georgia	Black Sea		80	cylindrical	60	-39	250
Germany	Ampirion GmbH				330		
Germany	Hoheneck		610	cylindrical	430	-260	1200
Germany	Oberottmarshausen		610	cylindrical	300	-200	1200
Germany	Tenne TSO				250		
Ireland	Moneypoint		4000	cylindrical	245	-111	830
Italy	Brindisi				2x250		
Italy	Brindisi Nord	7.08	1770	cylindrical	250	-125	Retrofit
Italy	Brindisi Nord	7.08	1770	cylindrical	250	-125	Retrofit

Country	Location/Project Name	Inertia Constant MWs/MVA	Kinetic Energy MWs	Type of Machine cylindrical/salient pole (r.p.m.)	Rating		
					MVAr delivery	MVAr absorption	S.C. Support
Italy	Fano		1780	cylindrical	250	-125	1100
Italy	Favara				170		
Italy	ICS Candia	7.08	1770	cylindrical	250	-125	1198
Italy	ICS Codrongianos	1.69	423	cylindrical	250	-125	1277
Italy	ICS Codrongianos	1.69	423	cylindrical	250	-125	1277
Italy	ICS Codrongianos	7.08	1770	cylindrical	250	-125	1198
Italy	ICS Foggia	7.08	1770	cylindrical	250	-125	1198
Italy	ICS Gagliano	7.08	1770	cylindrical	250	-125	1198
Italy	ICS Matera	7.08	1770	cylindrical	250	-125	1198
Italy	ICS Matera	7.08	1770	cylindrical	250	-125	1198
Italy	ICS Villanova	7.08	1770	cylindrical	250	-125	1198
Italy	Maida				2x250		
Italy	Partinico				170		
Italy	Rosara		1780	cylindrical	250	-125	1100
Italy	Selargius				2x250		
Korea	Jeju Island	1.93	2 x 97	salient pole / 1800	2 x 50	2 x -25	2 x 224
Netherlands	Rotterdam/Maasvlakte MPP2	10.5	500/625	cylindrical	280*	-280	
Norway	Feda		340	cylindrical	170	-90	740
Tasmania	Mussleroe	2x0.98	2x 13.7	salient pole	2x 14	2x-11	2x 127
UK	Grain		2 x 1700	cylindrical	2 x 115	-90	570
UK	Keith		450	salient pole	2*65	-57	
UK	Lister Drive	6.92	450	salient pole	65	-27	492
UK	Lister Drive	6.92	450	salient pole	65	-27	492
UK	Neilston	1.34	93.8	salient pole	70	-33	503
UK	Rassau		1100	cylindrical	60	-60	420
UK	Rassau		750	salient pole	60	-60	420
UK	Scottish Power				70		
UK	STATKRAFT				67		
USA	Alibates		470	cylindrical	160	-70	950
USA	Blackwater		470	cylindrical	158	-114	960
USA	California	1.46	3x118	salient pole / 1200	3X81	3X-35	3X324
USA	Connecticut	1.49	37	salient pole / 1800	25	-12.5	98
USA	Finlay solar park				60		
USA	Huckins Hill	2.2	121	salient pole	55	-32.2	539
USA	Maine - 1	1.95	117	salient pole / 1800	60	-27	350
USA	Maine - 2	1.95	117	salient pole / 1800	60	-27	350
USA	Midwest				560	-310	
USA	Miguel		2x470	cylindrical	450	- 225	970
USA	New Hampshire - 1	1.49	2x37	salient pole / 1800	2X25	2X-12.5	2X97
USA	New Hampshire - 2	1.49	2x37	salient pole / 1800	2X25	2X-12.5	2X97
USA	North Keene	2.2	121	salient pole	55	-32.2	539
USA	Panhandle Texas				2x175	2x-125	
USA	San Luis Rey		470	cylindrical	225	-120	970
USA	Shunoch	2.2	121	salient pole	55	-32.2	539
USA	Songs Mesa		470	cylindrical	225	-120	970
USA	Talega		470	cylindrical	225	-120	970
USA	Tule Canyon		470	cylindrical	160	-70	950
USA	Vermont	1.73	4x43	salient pole / 1800	4x25	4x-12.5	4x131
USA	Virginia - 1	1.39	2x139	salient pole / 1200	2X100	2X-50	2X342
USA	Virginia - 2	1.39	2x139	salient pole / 1200	2X100	2X-50	2X342
USA	Wyoming	1.84	120	salient pole / 1200	65	-40	310

Synchronous Condenser Location and Plant Selection Criteria for Indian Power System

Synchronous Condensers being a high-speed rotating heavy mass, have emerged as the most optimized and strongest technical solution to deal with problems of low Inertia. Provision of Synchronous condensers is being made world-over to improve voltage stability as well as frequency stability in renewable power rich environment. The use of generators as synchronous condenser could benefit in improving the grid stability as well as power quality. The synchronous condenser offers several advantages, which makes it a must for system planned with large scale renewable integration: -

1. Meet system MVAR requirements arising out of retiring generators
2. To improve system stability for solar or wind plant fed system
3. Low voltage ride through capability during fault condition
4. Facilitates dynamic compensation
5. To meet reactive MVA of HVDC
6. Good overload capacity
7. Maintains power quality

In Indian power system, the aging of thermal power plants offers a unique opportunity to the system operator for conversion of old thermal generation units into synchronous condensers. This solution can solve major issues of low system inertia, reactive power support and low short-circuit current. The retired and old thermal generation fleet are located across the entire country. It's important to develop a selection criteria, first for selecting the area where synchronous condensers are required to be installed. Then after the area, it's important to select a existing plant based on techno-economic study and other standards. The new plant can also be planned after area selection. The detailed strategy for planning a synchronous condenser in the system is given below:

1. Phase I : Criteria for Area Selection: The area where the kinetic energy level has decreased below limits as mentioned in the dynamic study of long or medium term planning. If dynamic study couldn't be done due to unavailability of system dynamic data , then thumb rule for area selection should be renewable power generation penetration crossing beyond 50 %. In addition to renewable generation penetration, factors such as low short circuit level, low specific area inertia and voltage variations should also be considered. Some additional parameters like proximity to load centers and HVDC systems are also used to identify the pockets in which the synchronous condenser installation is required.

S. No	Criteria Parameter	Recommendations	Rationale
1	Renewable penetration	>= 50%	Dynamic reactive support in area with low penetration of synchronous generation sources
2	Short circuit ratio	< 5	Weak system strength
3	Local kinetic energy	Below specified threshold, poorly damped oscillations	Kinetic Energy estimation at the level of control areas
4	Proximity to Renewable energy complexes	High priority over others. Graded approach based on distance is to be considered.	Proximity near RE complex provides system strength and improves performance of IBR
5	Proximity to HVDCs and load centres	Graded Approach based on proximity	Provides system strength and reduces HVDCs commutation failure
6	Voltage variations beyond ±0.05 pu	Graded Approach based on proximity	Reactive power impacts decreases away from injection point.

2. Phase II: Criteria for Plant Selection: After the area selection, the ageing thermal plants in the selected pocket is needs to be analysed based on the a techno-economic study. Also Residual Life Analysis (RLA) of major electrical equipment and system to be used after the conversion should be planned. The scope of RLA should include Turbo-Generator (TG), excitation system, generator transformer, generator relay panels, auxiliary systems and control equipment's etc., and electrical bay equipment. The RLA analysis needs to be done by third party based on the selection criteria by system operators.

S.No.	Criteria Parameter	Recommendations
1	Greenfield installation/Conversion	Estimation of cost for installation of new plants with conversion of old plants. Old thermal plants need to be assessed for insulation level also.
2	Feasibility study	Review the generator's operating and maintenance history. Good visual inspection of all components.
3	Techno-economic studies	Cost benefit analysis. Estimation of costs and benefits incurred in a simple decommissioning of plants vis-à-vis repurposing them. Repurposing for Syncon operation vis-à-vis PV and BESS
4	Residual Life Analysis	Analysis to include Generator, excitation system and auxiliary systems etc.
5	Dynamic studies	Installation of Flywheel for higher inertia and system strength

Apart from criteria of plant selection and area selection, there is need to introduce some regulatory framework and market mechanisms to promote the wider deployment of Synchronous Condensers in India. It would include market mechanisms for cost recovery , changes in market mechanisms, usage as ancillary services etc.

Annexure-III

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

विषय: Minutes of Meeting of 2nd Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 31.05.2024 through Video Conference

महोदय/ महोदया,

2nd Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region was held on 31.05.2024 through Video Conferencing. Minutes of the meeting is attached at **Annexure-I** for kind information and necessary action.

This issues with the approval of MS, NRPC.

Signed by Anzum Parwej
Date: 25-06-2024 10:13:22

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

Annexure-I

Minutes of Meeting of 2nd Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 31.05.2024 through Video Conferencing

At the outset, Member Secretary welcomed committee members and other participants in the meeting and directed EE, NRPC to proceed with agenda points.

2. EE, NRPC briefed on agenda points:
   (i) As per direction in first meeting, members from NTPC, NLDC & BHEL have been included in the committee.
   (ii) NTPC has shared its report on Synchronous condenser after taking appropriate approval and the same will be circulated among committee members.
   (iii) As per discussion in the previous meeting, BHEL is to make presentation on Synchronous condensers and CTU is to arrange presentation from other OEMs.
3. MS NRPC requested BHEL representatives to make a presentation on Synchronous Condensers. Salient points of the presentation are as under:
   a. As more Renewable Energy will integrate in the grid, grid may become a bit unstable due to intermittent nature of Renewable Energy. For making grid more stable, Synchronous Condensers (SynCon) will act as backbone of future stable grid.
   b. SynCon will provide:
      i. Reactive Power Compensation
      ii. Inherent System Inertia
      iii. Short Circuit power
   c. Reactive Power helps in maintaining the voltage level and in transportation of active power from generator to load.
   d. Inertia is required in the system to resist the changes in frequency. Synchronous generators add inertia to the power system through physical and electrical coupling of rotating masses. During sudden decrease in system frequency, the rotating masses will slow down, releasing kinetic energy stored in the form of active power injection to the grid, reducing frequency decay and damping further oscillations.
   e. Synchronous Condensers market requirement may be in range of 100-300 MVAr (Capacitive Power)
   f. BHEL is already making Synchronous generator which can be optimised to work as synchronous condensers with static excitation to cater fast response to system changes. Starting system shall be SFC + Turning gear. As per requirement, flywheel can be tailor made.
   g. Refurbishment of old phased out turbo-generators can also be done as synchronous condensers.
4. CTU informed that they have arranged presentations from M/s Hitachi and M/s Siemens. However, M/s Siemens may give presentation in next meeting. MS, NRPC requested M/s Hitachi to proceed with their presentation. Salient points of the presentation are as under:
   a. Since there is integration of RE in the grid, there are some concerns about System Inertia, System strength, Voltage control and frequency control will arise. These concerns need to be addressed to have secure and reliable grid.

b. For all the issues, a common solution may not be best. According to requirement of the grid, particular technology should be selected which best suits the need of the grid.
c. There are other technologies like STACOM with Grid forming control, Enhanced STATCOM & Hybrid Synchronous Condenser.
d. STATCOMs (GFM) are emulated to perform like a Synchronous condenser and will in comparison to traditional STATCOMs also contribute to system strength but it will be limited to 100 MVA if 100 MVAr STATCOM unlike Synchronous condenser which can support 3-4 times of its rating.
e. Enhanced STATCOM can support System Inertia, System strength, Voltage control and frequency control.
f. Based on requirement of grid whether high short circuit strength or high inertia or dynamic voltage control requirement, best technology should be selected.
g. As per CEA (Technical standard for connectivity to the grid) regulation, Short Circuit Ratio (SCR) at the interconnection point where the generating resource is proposed to be connected shall not be less than 5.
h. Many of major pooling stations are having lack of short circuit capability and several stations also have STATCOM systems. STATCOM with grid forming control will contribute to improvement of SCR.
i. Grid code of different countries like UK, Germany, US & Middle East have already started using Grid Forming control as a mandate. All requirements share common objective: instantaneously react to any change on the grid system and contributing to maintain its stability.
j. Hybrid Synchronous Condenser (H-SCS) consists of one parallel operating Synchronous condenser along with one STATCOM. It combines advantages of SynCon and STATCOM technologies, having an optimized design due to performance and losses.
k. Enhanced STATCOM integrated super capacitors for energy storage which provides Fast voltage/frequency support as well as synthetic inertia for shorter durations.

5. After the presentation of Hitachi, forum was open to questions. NTPC representative asked M/s Hitachi about the response time of the Enhanced STATCOM to which M/s Hitachi said that it is up to 40 ms w.r.t. voltage control however w.r.t. frequency deviation it will oppose the deviation as it is already in synchronism with grid and emulating the behaviour of synchronous machine. Super capacitors may support frequency response up to 30s.
6. NLDC representative asked Hitachi to explain that in Presentation SynCon is attributed to slow voltage and limited to inductive output. M/s Hitachi explained that if we take 100 MVAr Machine then it means that it can contribute 100 MVAr Capacitive but towards the inductive side it may around 50% of the rating although it may not be a thumb rule and may depend on various other factors.
7. BHEL representative asked M/s Hitachi about the footprint of 300 MAVr Enhanced STATCOM. M/s Hitachi replied that footprint of Enhanced STATCOM would that of conventional STATCOM of the same rating and additional space will be required for Super Capacitors that would depend on how much MW-s is required.
8. NTPC representative enquired about comparison of cost effectiveness of Enhance STATCOM and SynCon for providing short circuit power. M/s Hitachi replied that if there is required of only short circuit power to the grid then SynCon can contribute up to 4 times of its ratings whereas short circuit current contribution by Enhanced STATCOM will be 1 p.u. of its rating.

9. NLDC representative enquired that during fault we have to supply current for active power as well as reactive power support and therefore there will be compromise either on active power support or reactive power support. Experience in the RE pockets is that we experience large voltage dips after the fault and then loose lot of RE generation and therefore we need both active as well as reactive power support. M/s Hitachi replied that for this converter is to be designed accordingly by adding energy storage and add more converter cells for the additional stress.
10. BHEL representative asked about performance characteristic of E-STATCOM at sub-zero temperature and high altitude. M/s Hitachi replied two projects of E-STATCOM are awarded in Germany. Germany has cold winters and therefore requirement of low temperatures for E-STATCOM. For low temperatures, it can be installed but for high altitude there is currently no experience. For high altitude we need to review insulation coordination and do altitude correction. Also, with high altitude there may be transportation issues.
11. NTPC representative asked if any pilot for E-STATCOM have been done globally. M/s Hitachi replied that currently two projects of E-STATCOM are awarded in Germany. Simulation study of E -STATCOM response for inertia, short circuit strength for fault condition in network can be provided.
12. As per previous meeting decision, Grid-India did a study on impact of installing synchronous condenser in present scenario at Fatehgarh-II which has the least SCR in Western Rajasthan RE complex. The study was demonstrated by NLDC representative in the meeting and is attached at **Annexure-II.**

Member Secretary, NRPC thanked BHEL and Hitachi for their Presentations and all other participants in the meeting. CTU said that M/s Siemens will give presentation on synchronous condensers in the next meeting of the committee. The meeting ended with vote of thanks to the Chair.

List of Participants

NRPC

1. Sh. V K Singh, Member Secretary ---- **In Chair**
2. Sh. Anzum Parwej, SE
3. Sh. Ravi Kant, EE

CEA

4. Sh. Kanhaiya Singh Kushwaha, Asst. Director

CTU

5. Sh. V. Thiagarajan, Sr. GM
6. Sh. Kashish Bhambhani, GM

NLDC

7. Sh. Vivek Pandey, Sr. GM
8. Sh. Priyam Jain, Chief Manager
9. Sh. Aman Gautam, Manager

NRLDC

10. Sh. Bikash Kumar Jha, DGM
11. Sh. Gaurav Singh, Chief Manager
12. Sh. Gaurav Malviya, Manager

PSTCL

13. Sh. Nitin Kumar, Sr. XEN/Planning-1
14. Ms. Ranjana, AE/Planning-1

RVPNL

15. Sh. V. A. Kale, Superintending Engineer (P&P)
16. Dr. Om Prakash Mahela, Executive Engineer (PP&D)

UPPTCL

17. Sh. Sanjeev Kumar Bahsker, SE

NTPC

18. Sh. Pankaj Kumar Gupta, GM
19. Sh. B S Jena, AGM
20. Sh. Suneet Mehta, DGM
21. SH. V R Bitra, DGM

BHEL

22. Sh. Manoj Kumar, AGM,
23. Sh. Vishal Naidu, DGM
24. Sh. Ranajit Dey, Sr. Manager

Hitachi

25. Sh. Mikael Halonen
26. Sh. Giridharan P
27. Sh. Kishore S
28. Sh. Prabhat Ranjan

REPORT ON IMPACT OF INSTALLING SYNCHRONOUS CONDENSER IN PRESENT SCENARIO AT FATEHGARH-II

May 31, 2024

GRID CONTROLLER OF INDIA LTD.

Table of Contents

1. Background

In the 71st NRPC meeting held in Jan'24, the issues related to RE generation were deliberated. It was decided that there is urgent requirement of dynamic compensation in NR. Accordingly, a committee under the chairmanship of Member Secretary, NRPC was constituted with members from Grid-India, CTUIL, STUs, NTPC and BHEL.

The 1st meeting of the committee was held on 22.04.2024 wherein, after deliberations, following was agreed:

a) CTUIL shall arrange for presentations by OEM for other advanced technologies.
b) CTUIL and CEA shall carry out system study for requirement of synchronous condenser as already mentioned in 500GW RE report. The studies would be done for every two-year timeframe till year 2030.
c) Grid-India shall study impact of installing synchronous condenser in present scenario at Fatehgarh-II which has the least SCR in Western Rajasthan RE complex.
d) Committee to deliberate on funding for synchronous condenser.
e) RVPN to explore possibility of utilising Giral TPS and Dholpur TPS for synchronous condenser mode of operation.
f) NTPC/BHEL to submit inputs from their side regarding synchronous condenser mode of operation before next subcommittee meeting.

As per the decisions taken in the 1st meeting (refer point-c above), Grid-India has carried out the system studies to analyse the impact of installing synchronous condenser in the present scenario at Fatehgarh-II.

The study methodology and results are provided in subsequent sections.

2. Study Assumptions and Methodology

a) Updated all India load-flow and dynamics case has been considered for study purpose. Dynamic model of the all synchronous machines of >100 MVA (including exciter, PSS and turbine-governor model), ISTS connected RE, all the HVDCs and FACTS devices are considered in the dynamic study case. Dynamic models of intra-state RE are not available and hence, same have not been taken in the case.

b) **02 nos.** of **354 MVA (+300/-200 MVAR)** Synchronous Condensers have been considered at 220 kV Fatehgarh-II PG (one at each bus section) as shown in figure-1 below.

c) The dynamic parameters considered for Synchronous Condensers are provided at Table-1 and 2 below.

d) Following studies have been conducted to assess the impact of synchronous condensers:

- Impact on Short Circuit Ratio (SCR) of RE pooling stations in Rajasthan
- Impact on System Stability during faults

- Impact on System Inertia and Rate of Change of Frequency (ROCOF)
- Impact on Damping of Oscillations
- Impact on Steady-state voltage control through dynamic reactive power support

Figure 1: Network Diagram of Fatehgarh-II and connected stations

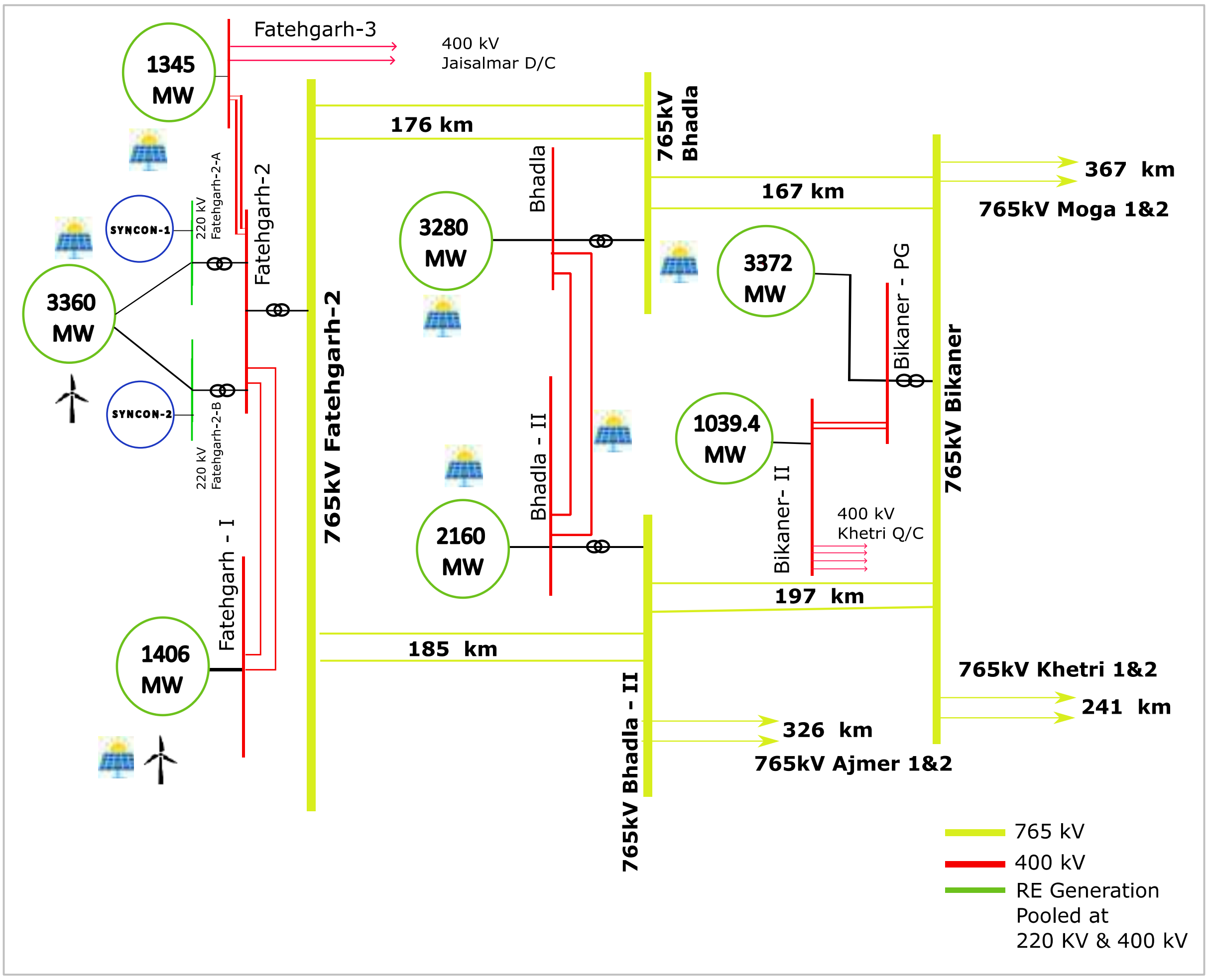
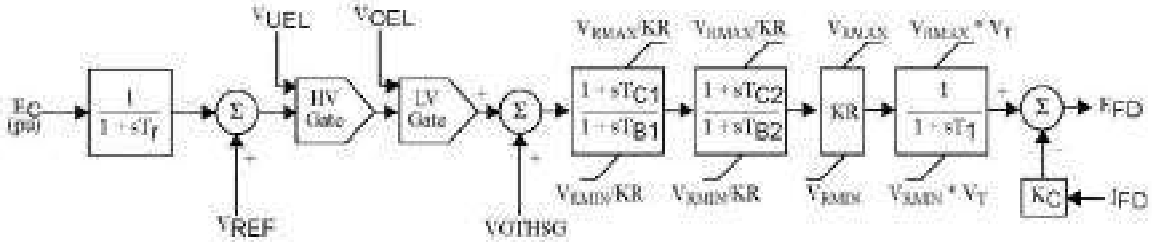


Table 1: Synchronous Condenser – Machine Parameters (GENROU)

S. No.	Parameter Description	Values
1.	T'do (> 0)	8.6000
2.	T''do (> 0)	0.0440
3.	T'qo (> 0)	0.9560
4.	T''qo (> 0)	0.7400
5.	H, Inertia	1.0000
6.	D, Speed Damping	0.0000
7.	Xd	1.8000
8.	Xq	1.7500
9.	X'd	0.2290
10.	X'q	0.3820
11.	X''d = X''q	0.1640
12.	Xl	0.1470
13.	S(1.0)	0.2480
14.	S(1.2)	0.7830

Table 2: Synchronous Condenser – Exciter+AVR Parameters

S. No.	Parameter Description	Values
1.	TR	0.0200
2.	TC1	1.0000
3.	TB1	10.0000
4.	TC2	0.1000
5.	TB2	0.1000
6.	KR (> 0)	500.0000
7.	VRMAX	11.7000
8.	VRMIN	-9.9450
9.	T1	0.0070
10.	KC	0.0000



The parameters have been taken from synchronous machine of similar size. Further, inertia has been reduced by 1/3rd. The parameters have also been verified against the parameters specified in CIGRE JWG A1/C4 TB 885: Guide on the Assessment, Specification and Design of Synchronous Condenser for Power System with Predominance of Low or Zero Inertia Generators [1] [2].

Key ratings of synchronous condenser										
		50Hz							50Hz	
Capacity	MVA	780	670	615	500	386	211	195	39	222
Frequency	Hz	50	50	50	50	50	50	50	50	60
Pole Number	-	2	2	2	2	2	2	2	18	36
Rotating Speed	min-1	3000	3000	3000	3000	3000	3000	3000	333	166.6
Cooling Type	-	H2/Water	H2	H2	H2	H2	Air	Air	Air	Air
Lagging reactive power @ Prated & Vt=1.0 p.u	MVA	580	505	473	400	310	170	195	21	115
Leading reactive power @ Prated & Vt=1.0 p.u.	MVA	340	400	258	165	170	82	80	25	200
Impedance Xd	%	181	184	200	220	181	200	173	119	90
Sub-transient Reactance Xd" (saturated) with tol.	%	21.3	26.2	15	18	16.4	12	15.3	27	24
Moment of Inertia (approx., SI Unit)	kg-m2	12300	8900	14300	9550	9200	6500	7300	131500	5250000
Kinetic Energy	MJ	607	440	705	471	454	318	361	80	799

3. Study Results

3.1 Impact on Short Circuit Ratio (SCR) of RE pooling stations in Rajasthan

The comparison of SCR at ISTS connected RE pooling stations in Rajasthan with and without synchronous condensers at 220 kV Fatehgarh-II (A) and 220 kV Fatehgarh-II (B) is provided below:

S. No.	Pooling Station	Installed Capacity (MW)	Fault MVA Base Case	SCR – Base Case	Fault MVA – With SynCon	SCR with SynCon
1.	220 kV Fatehgarh-II (Sec-A)	2490	9845	4.0	12003	**4.8**
2.	220 kV Fatehgarh-II (Sec-B)	855	9743	11.4	12280	**14.4**
3.	400 kV Fatehgarh-I	996	12426	12.5	13604	13.7
4.	220 kV Fatehgarh-III	1345	8514	6.3	8827	6.6
5.	220 kV Bhadla PG	3130	14000	4.5	14314	**4.6**
6.	220 kV Bhadla-II PG (Sec-A, B)	1314	10943	8.3	11131	8.5
7.	220 kV Bhadla-II PG (Sec-C)	420	7863	18.7	7964	19.0
8.	400 kV Bhadla-II	2284 550 (400kV) + 1734 (220kV)	21808	9.5	22624	9.9
9.	220 kV Bikaner PG	825	5720	6.9	5749	7.0
10.	400 kV Bikaner PG	3275 2450 (400 kV) + 825 (220 kV)	20104	6.1	20470	6.3
11.	220 kV Bikaner-II	990	5476	5.5	5498	5.6

3.2 Impact on System Stability during faults

The support received from synchronous condensers during faults in the Rajasthan RE complex and subsequent high voltage has been studied through following cases:

1. **RE plants in 'Q' priority mode**

    Fault Reactance: -2e+09

a) 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 100 ms – with and without SynCon
b) 3-ph fault at 765 kV Bhadla PG with fault clearing in 100 ms – with and without SynCon
c) 3-ph fault at 400 kV Fatehgarh-II PG with fault clearing in 100 ms – with and without SynCon
d) 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 200 ms – with and without SynCon

Fault Reactance: -2e+04

e) 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 100 ms – with and without SynCon
f) 3-ph fault at 400 kV Fatehgarh-II PG with fault clearing in 100 ms – with and without SynCon

2. **RE plants in 'P' priority mode**

    Fault Reactance: -2e+09

a) 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 100 ms – with and without SynCon
b) 3-ph fault at 400 kV Fatehgarh-II PG with fault clearing in 100 ms – with and without SynCon

The results are provided below.

3.2.1 RE plants in 'Q' priority mode

3.2.2.1 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 100 ms

Fault Reactance: -2e+09

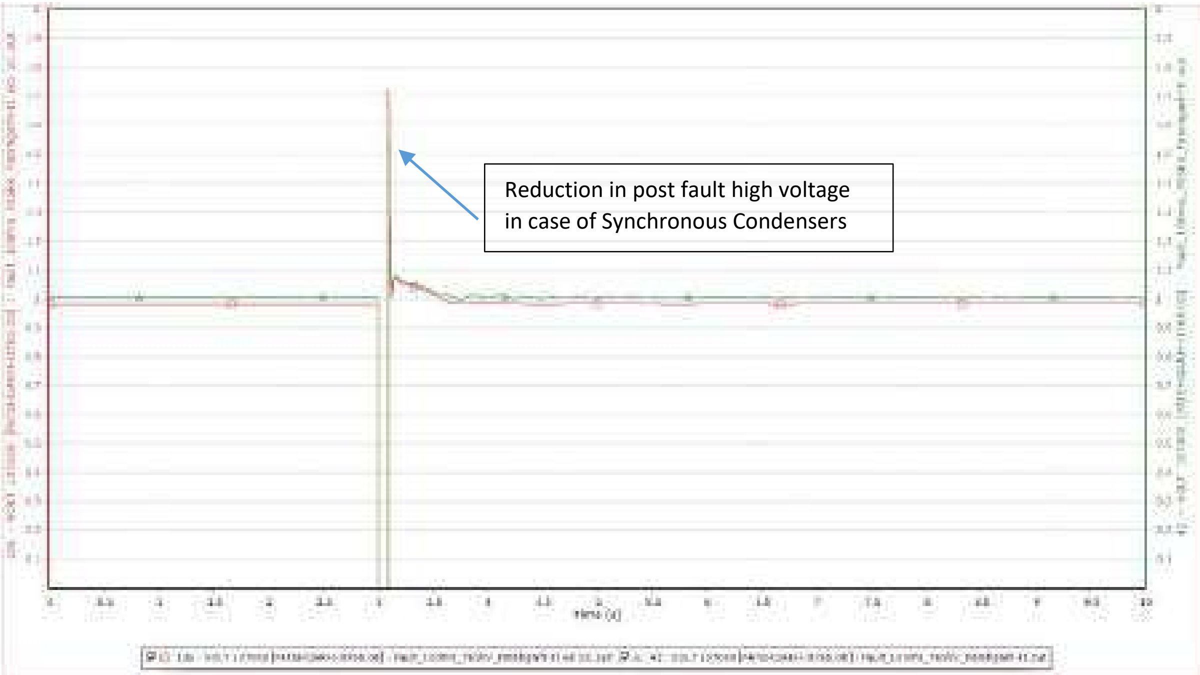


Figure 2: Voltage at 765 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec) without SynCon (Red) and with SynCon (Green)

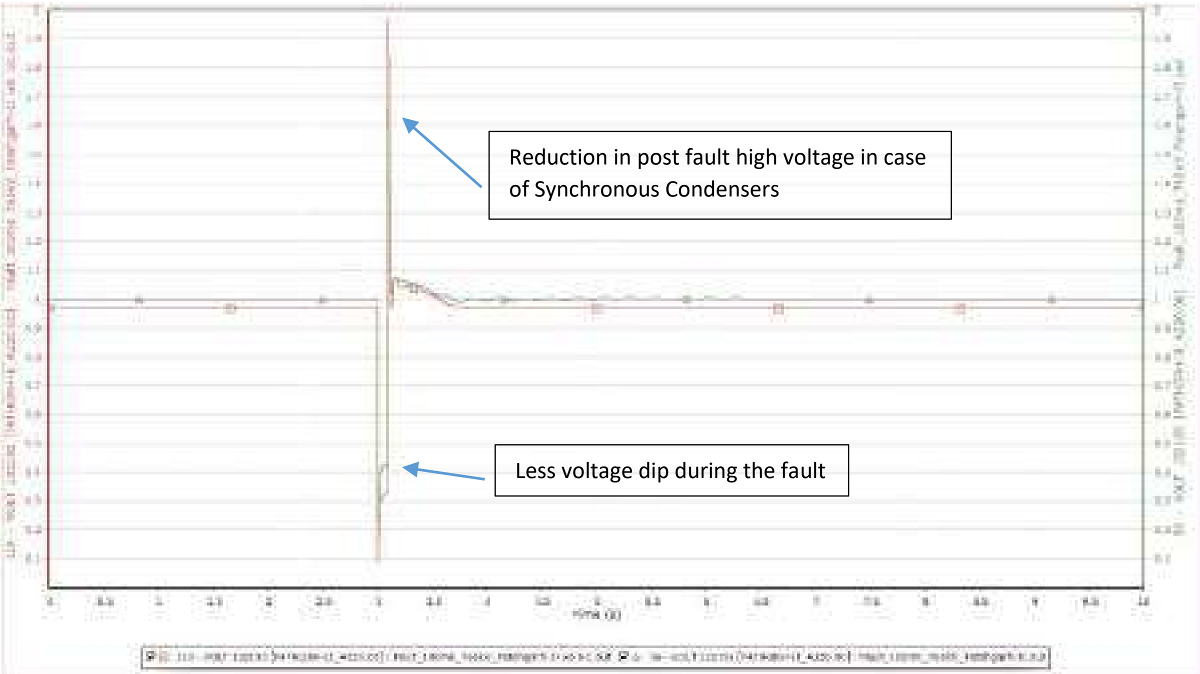


Figure 3: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

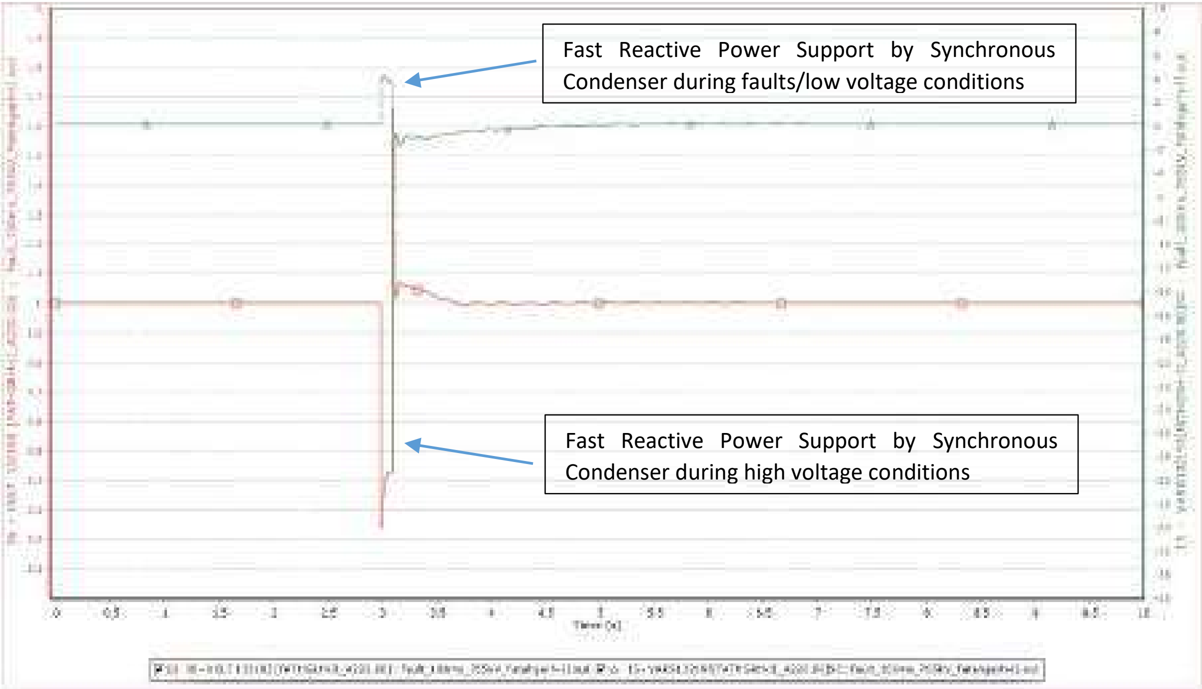


Figure 4: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

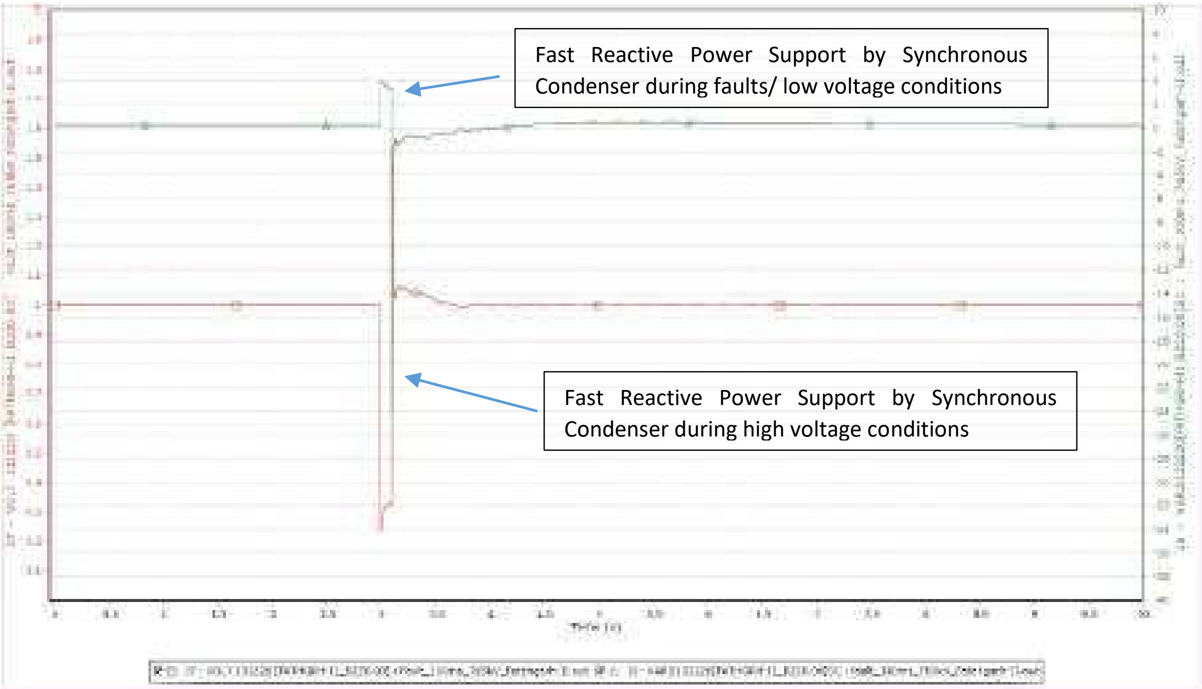


Figure 5: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

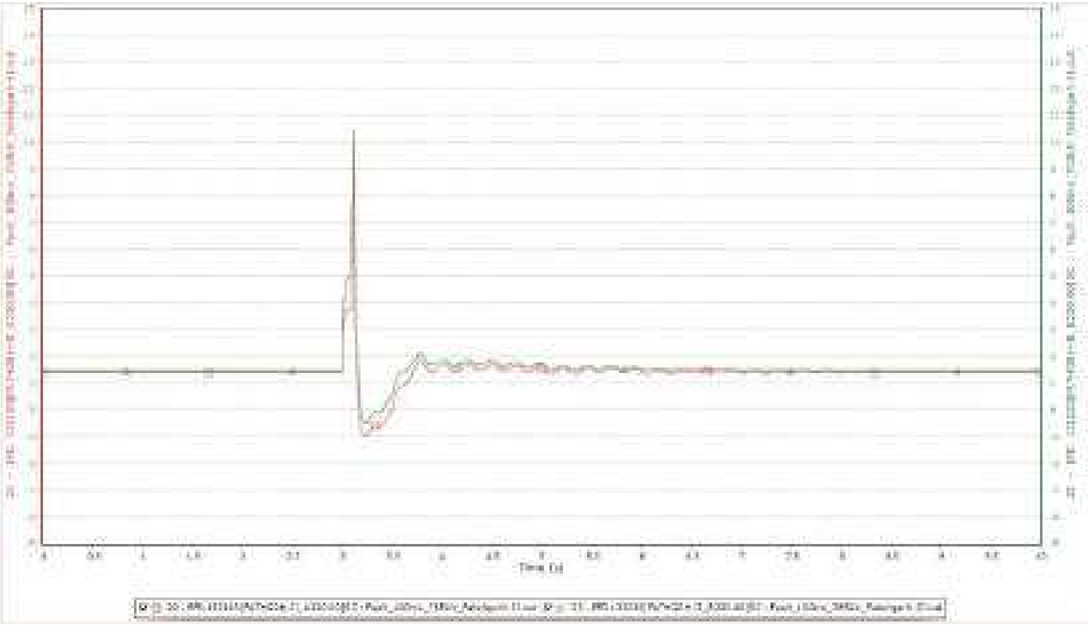


Figure 6: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) High voltage post fault clearance is observed in the system as the nearby RE plants are kept in “Q” priority mode. However, the high voltage is less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 765 kV Fatehgarh-II PG	T = 3.05 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.31 p.u.	0.41 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.21 p.u.	0.32 p.u.
4.	Voltage at 765 kV Fatehgarh-II PG	T = 3.10 sec	1.72 p.u.	1.55 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.96 p.u.	1.66 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.85 p.u.	1.54 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A - 2.69 p.u. B – 3.21 p.u.
8.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	x	A – (-) 4.97 p.u. B – (-) 4.40 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2.2 3-ph fault at 765 kV Bhadla PG with fault clearing in 100 ms

Fault Reactance: -2e+09

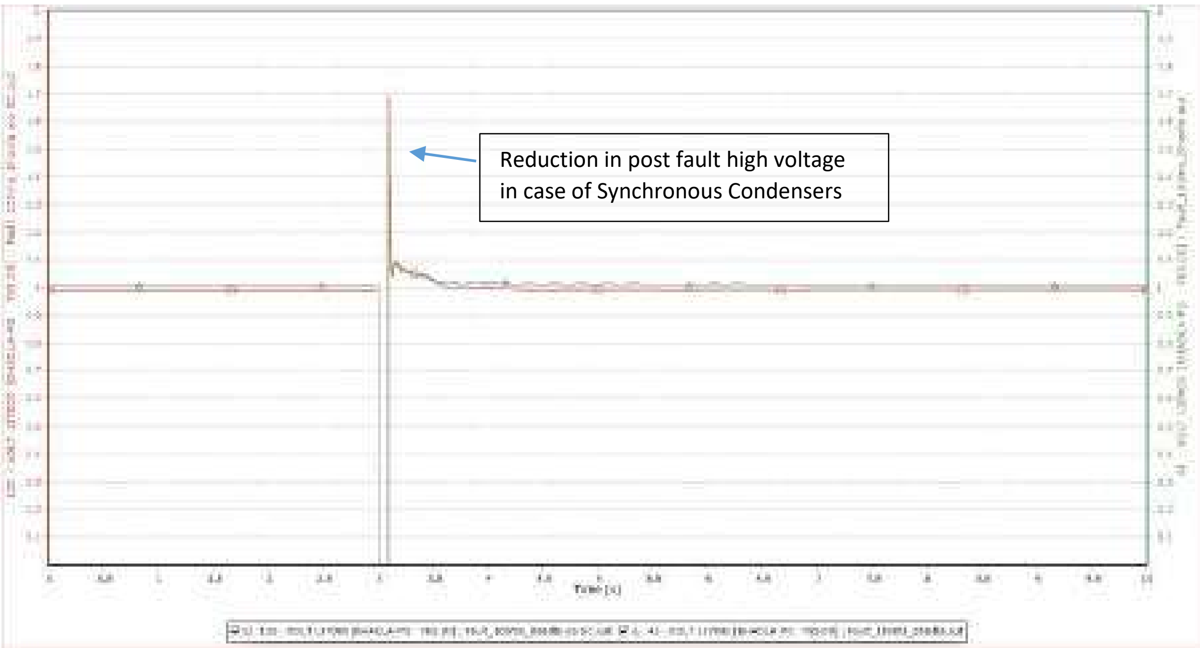


Figure 7: Voltage at 765 kV Bhadla PG bus (3-ph fault at t=3 sec)

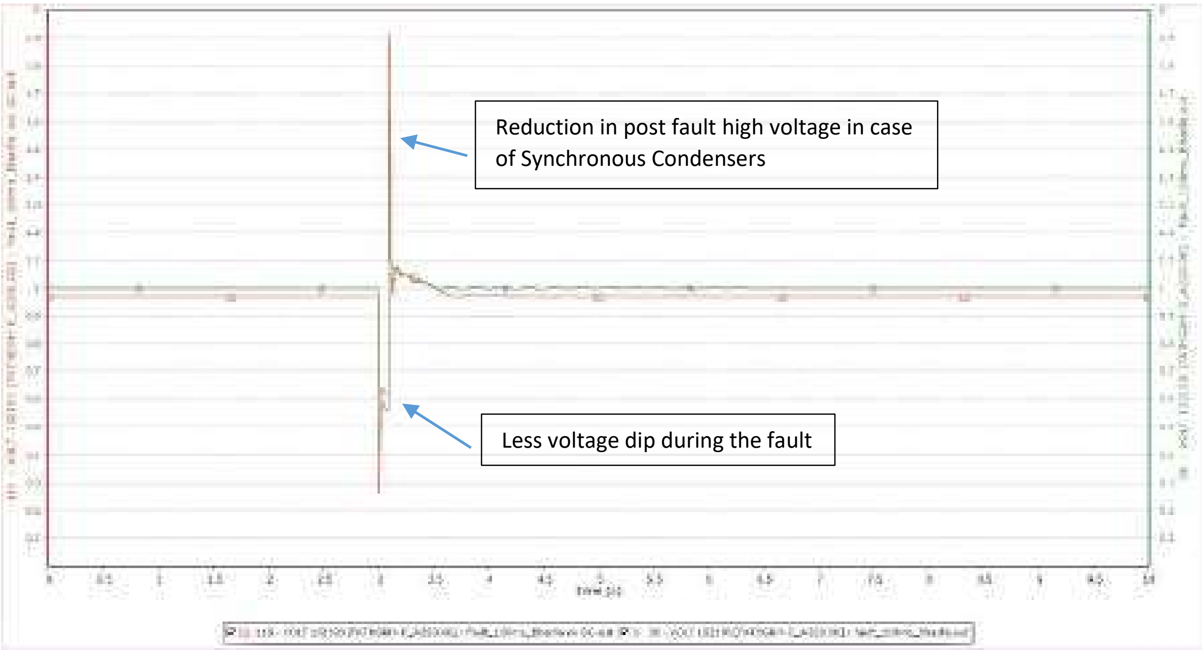


Figure 8: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

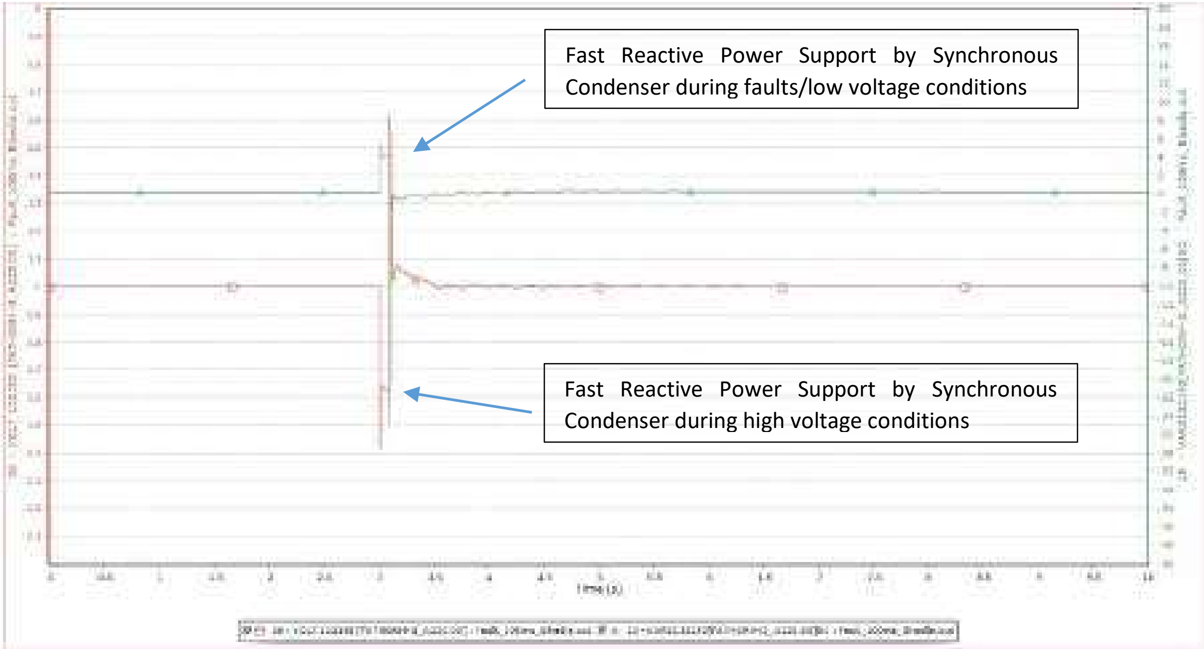


Figure 9: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

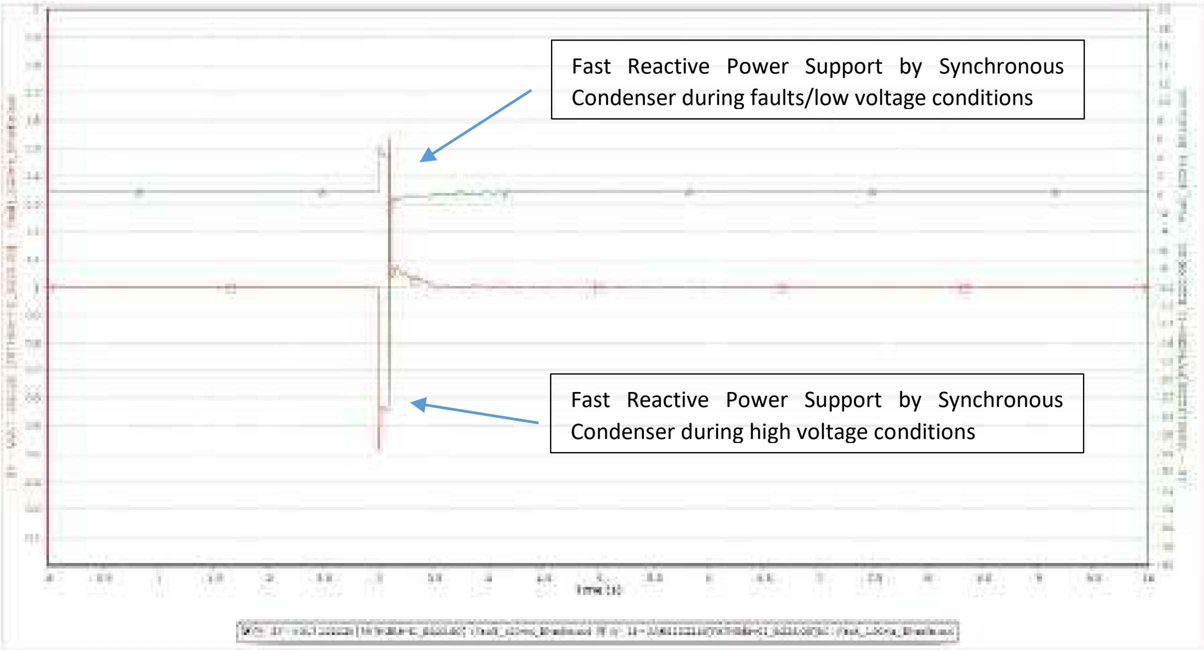


Figure 10: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-B

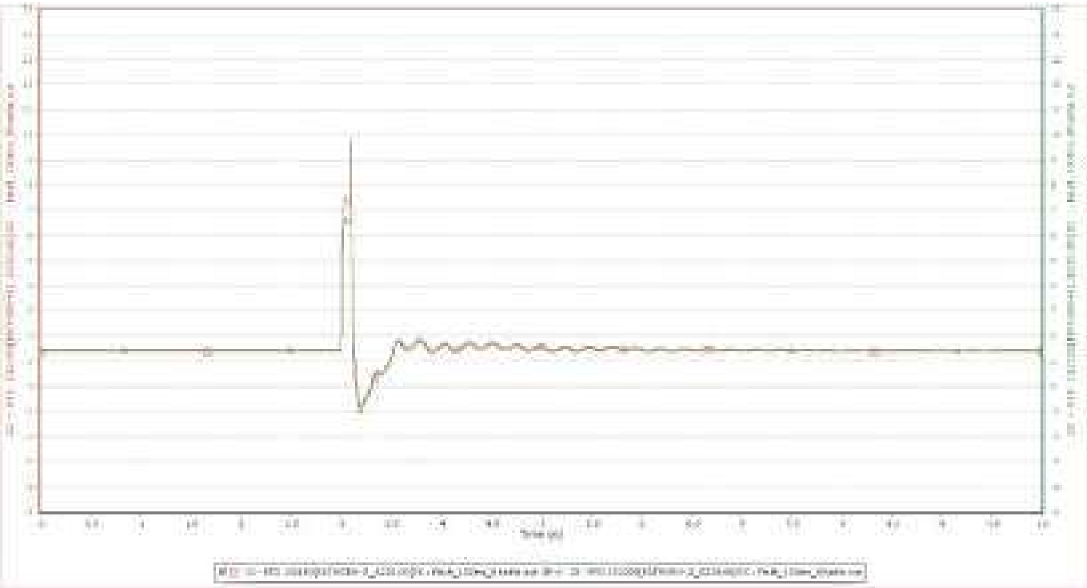


Figure 11: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) High voltage post fault clearance is observed in the system as the nearby RE plants are kept in "Q" priority mode. However, the high voltage is less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 765 kV Bhadla PG	T = 3.05 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.58 p.u.	0.63 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.49 p.u.	0.57 p.u.
4.	Voltage at 765 kV Bhadla PG	T = 3.10 sec	1.69 p.u.	1.56 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.92 p.u.	1.62 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.84 p.u.	1.53 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A – 1.83 p.u. B – 2.13 p.u.
8.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	x	A – (-) 4.33 p.u. B – (-) 3.88 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2.3 3-ph fault at 400 kV Fatehgarh-II PG with fault clearing in 100 ms

Fault Reactance: -2e+09

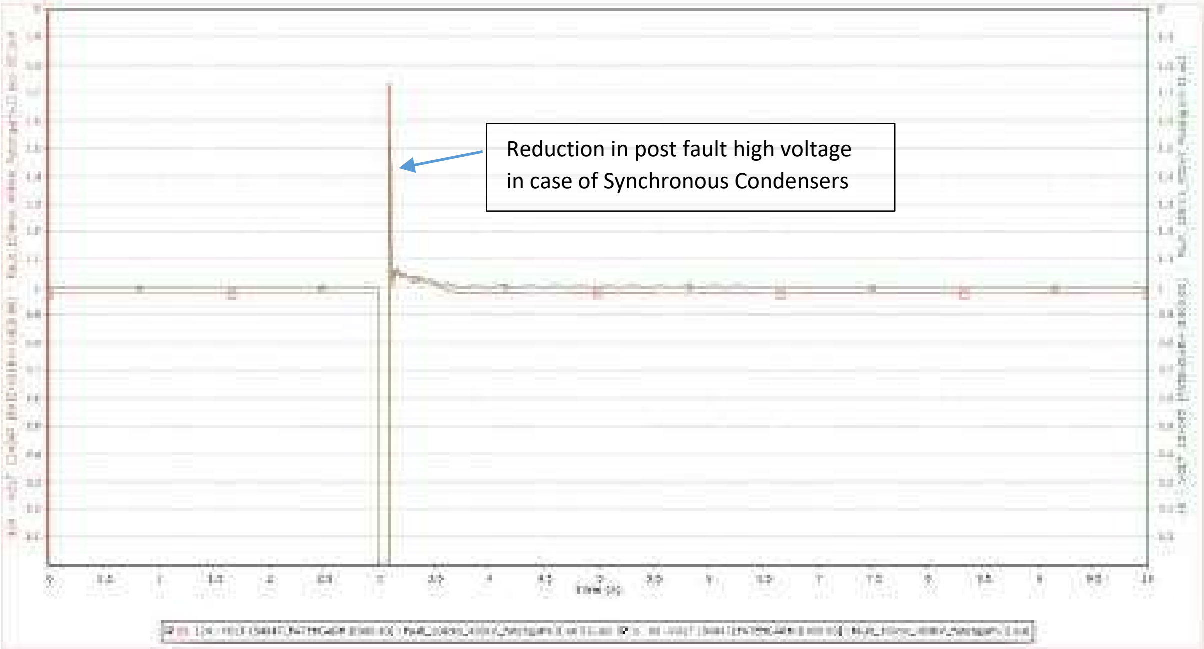


Figure 12: Voltage at 400 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec) without SynCon (Red) and with SynCon (Green)

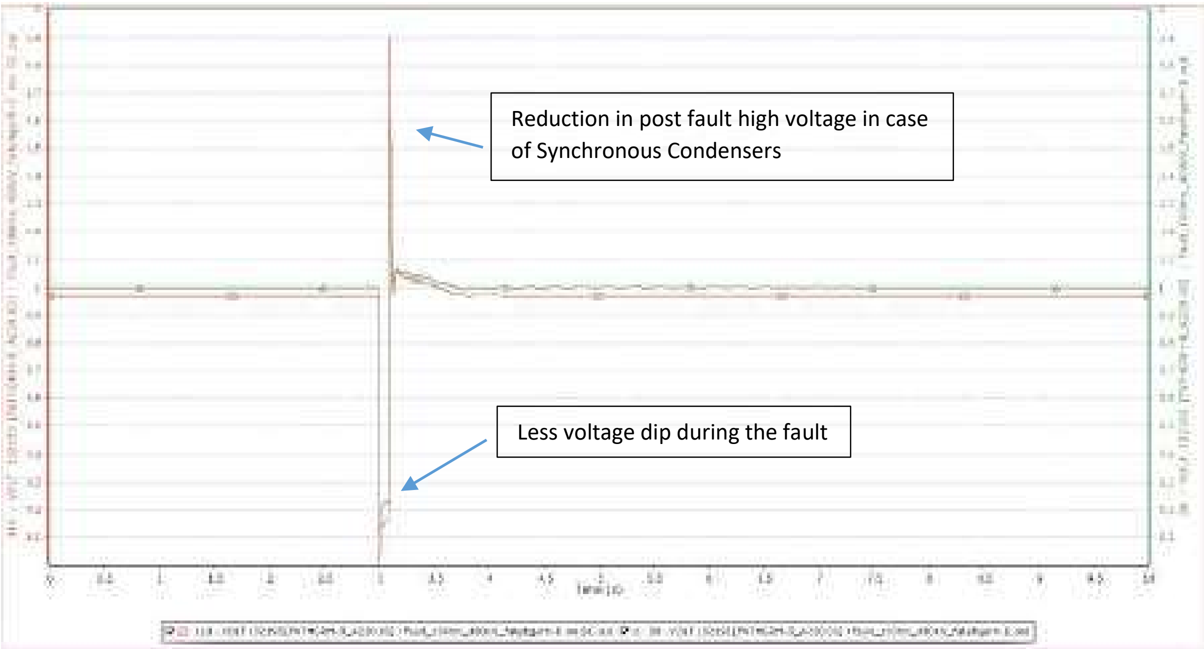


Figure 13: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

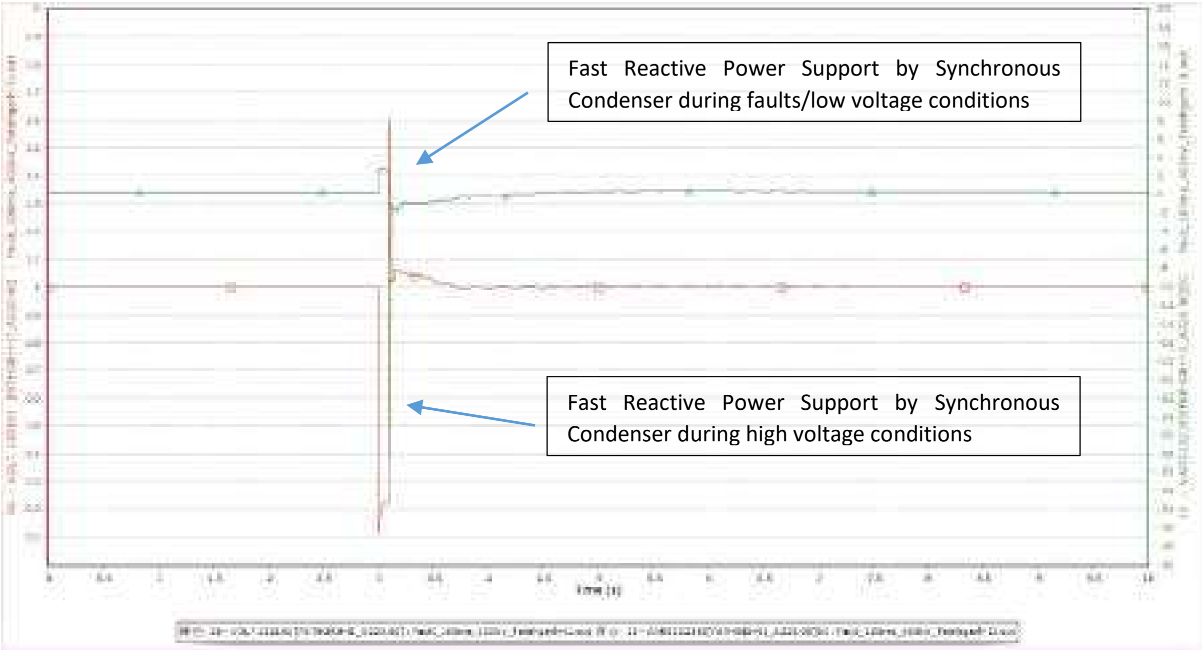


Figure 14: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

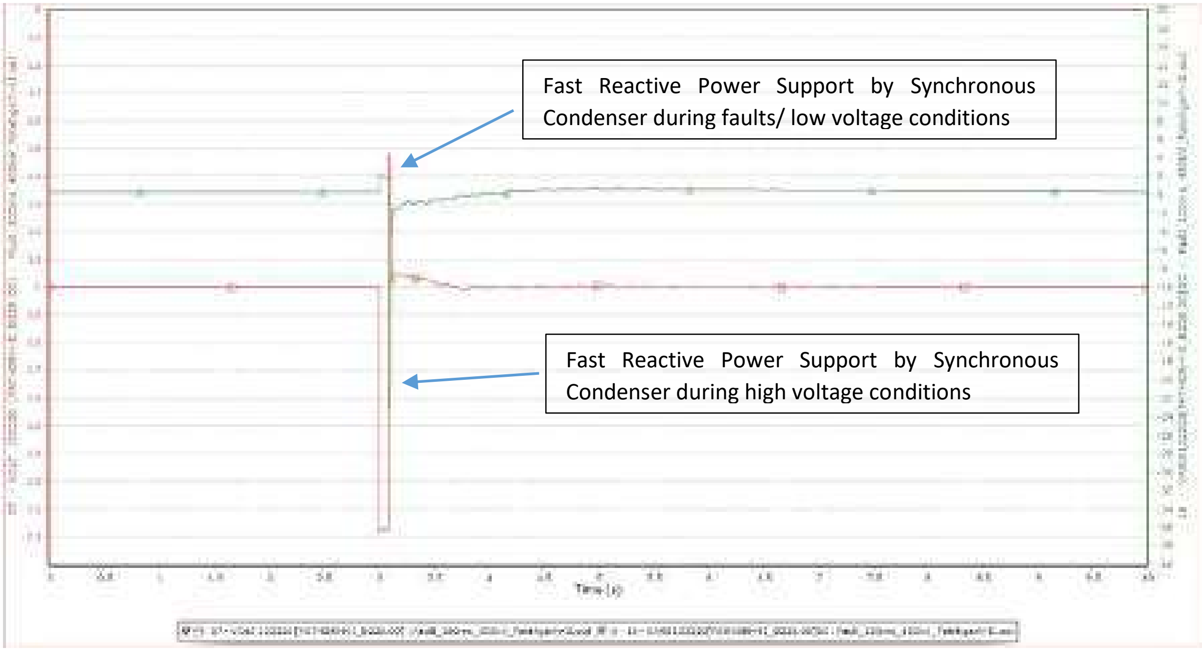


Figure 15: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

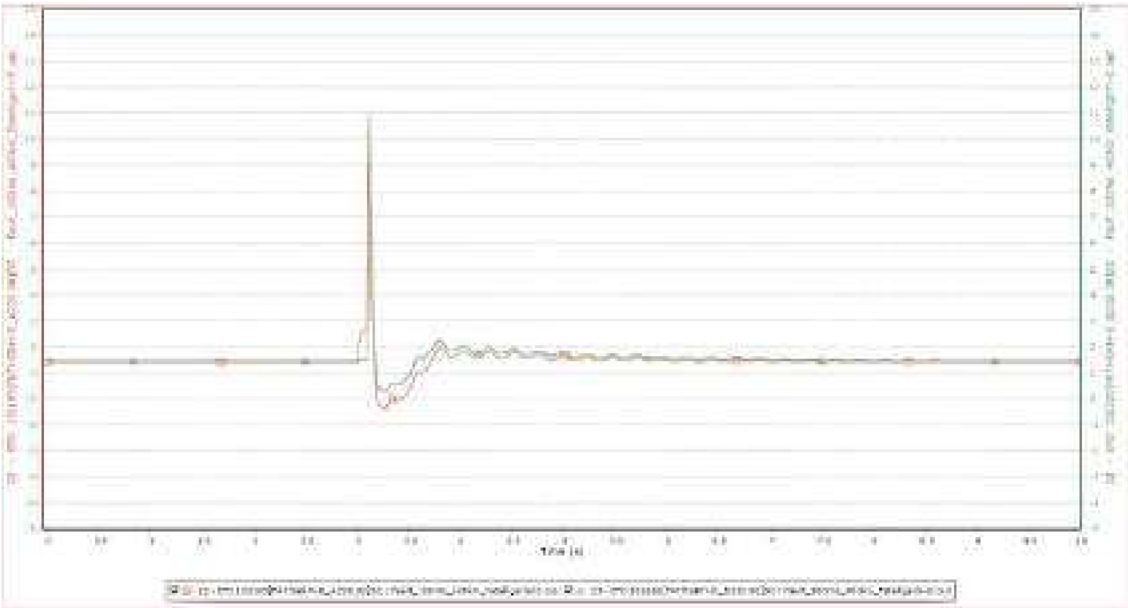


Figure 16: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) High voltage post fault clearance is observed in the system as the nearby RE plants are kept in "Q" priority mode. However, the high voltage is less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 400 kV Fatehgarh-II PG	T = 3.05 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.15 p.u.	0.22 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.04 p.u.	0.13 p.u.
4.	Voltage at 400 kV Fatehgarh-II PG	T = 3.10 sec	1.73 p.u.	1.52 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.90 p.u.	1.61 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.78 p.u.	1.48 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A – 3.49 p.u. B – 4.04 p.u.
8.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	x	A – (-) 5.01 p.u. B – (-) 4.43 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2.4 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 200 ms

Fault Reactance: -2e+09

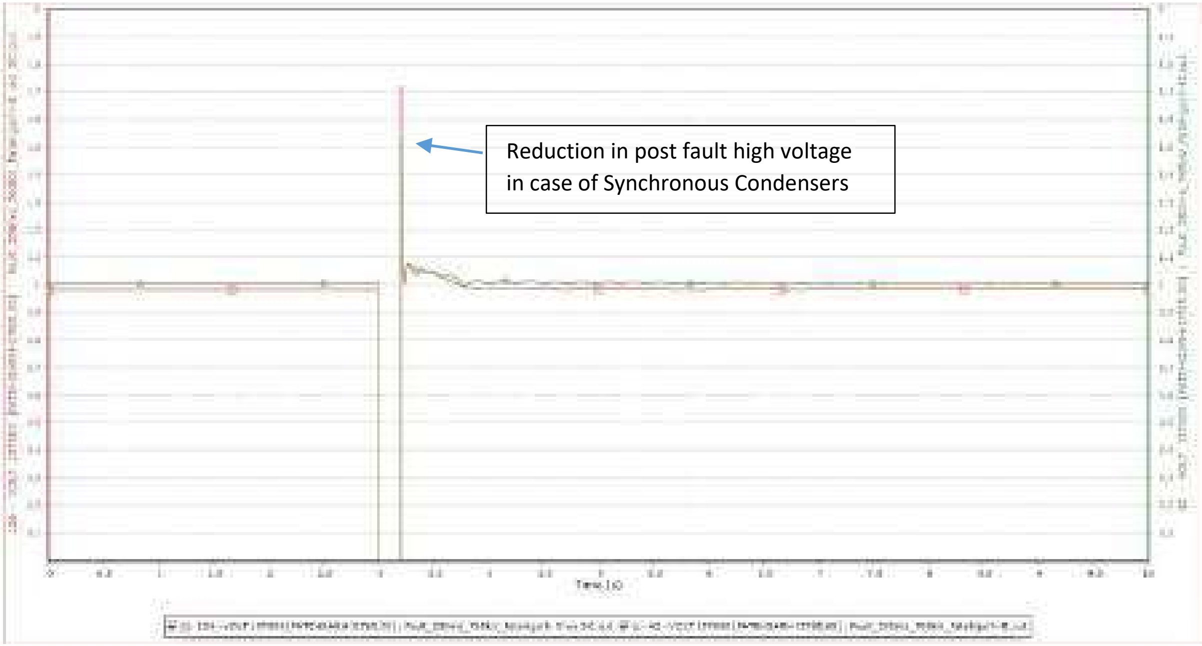


Figure 17: Voltage at 765 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec, 200 ms) without SynCon (Red) and with SynCon (Green)

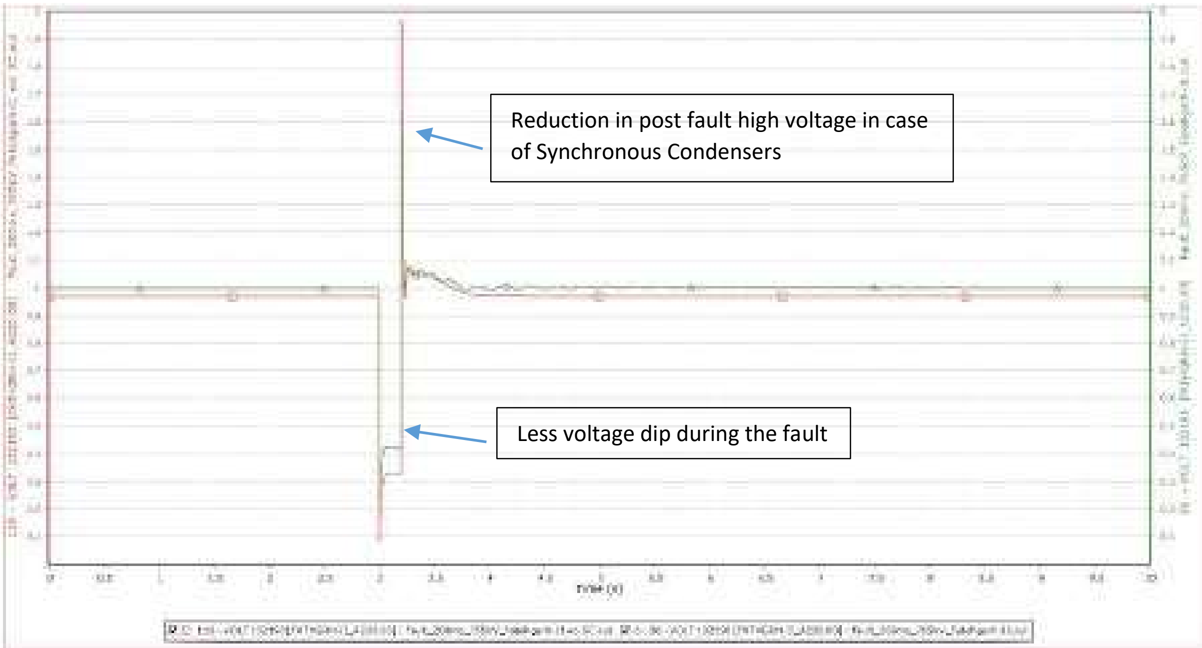


Figure 18: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

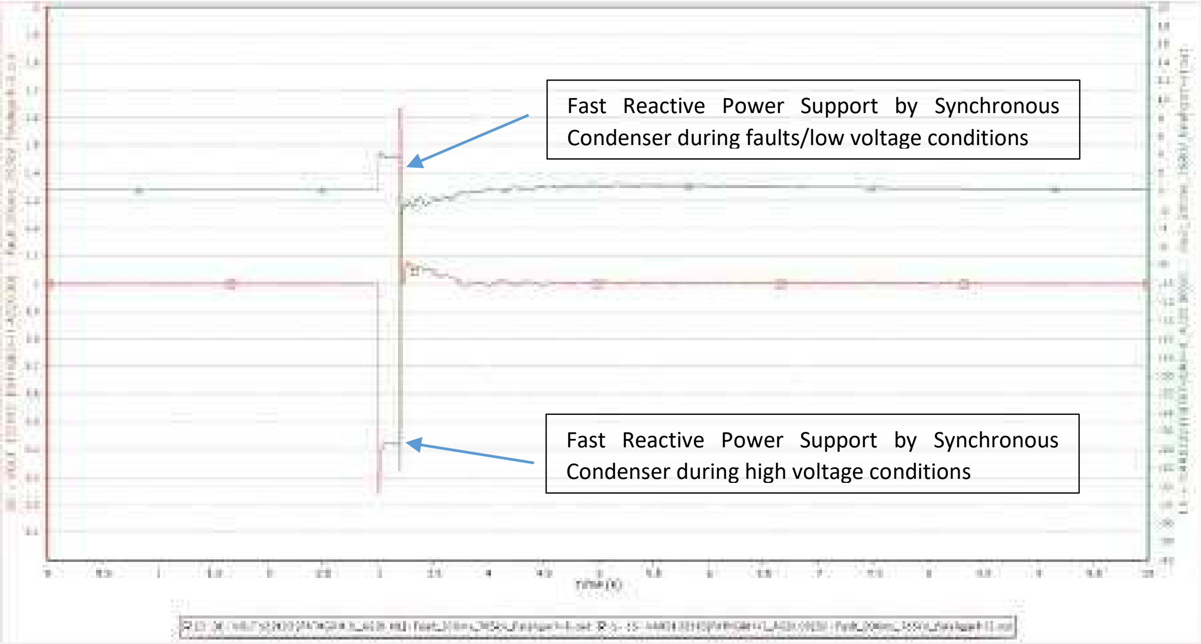


Figure 19: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

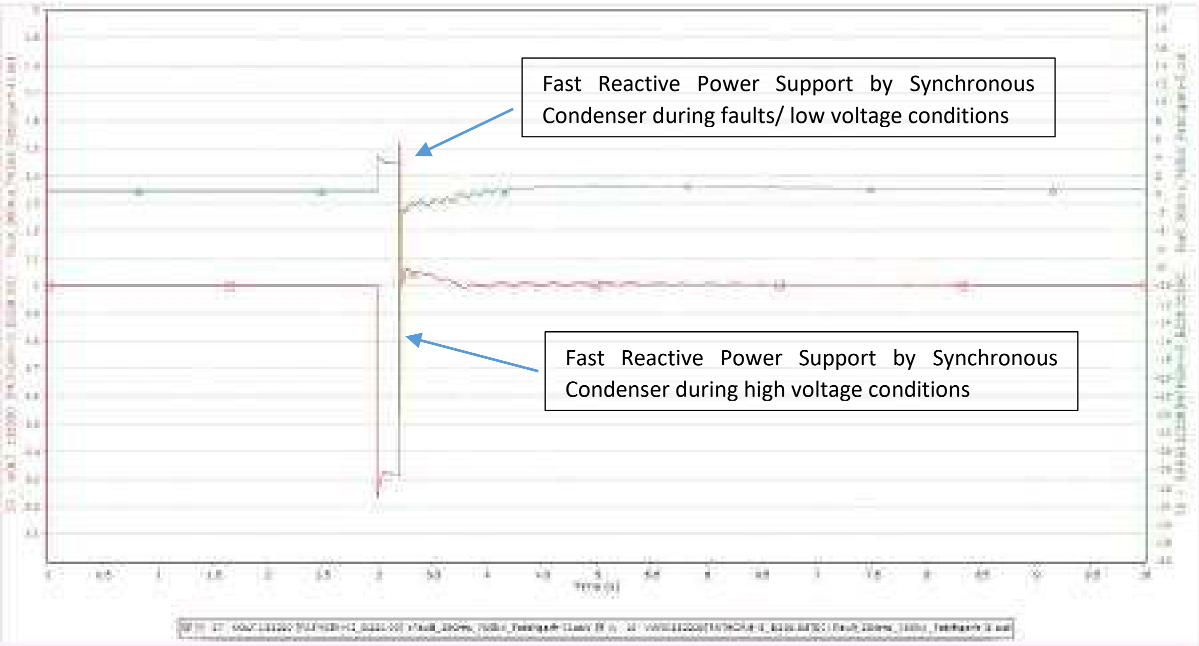


Figure 20: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

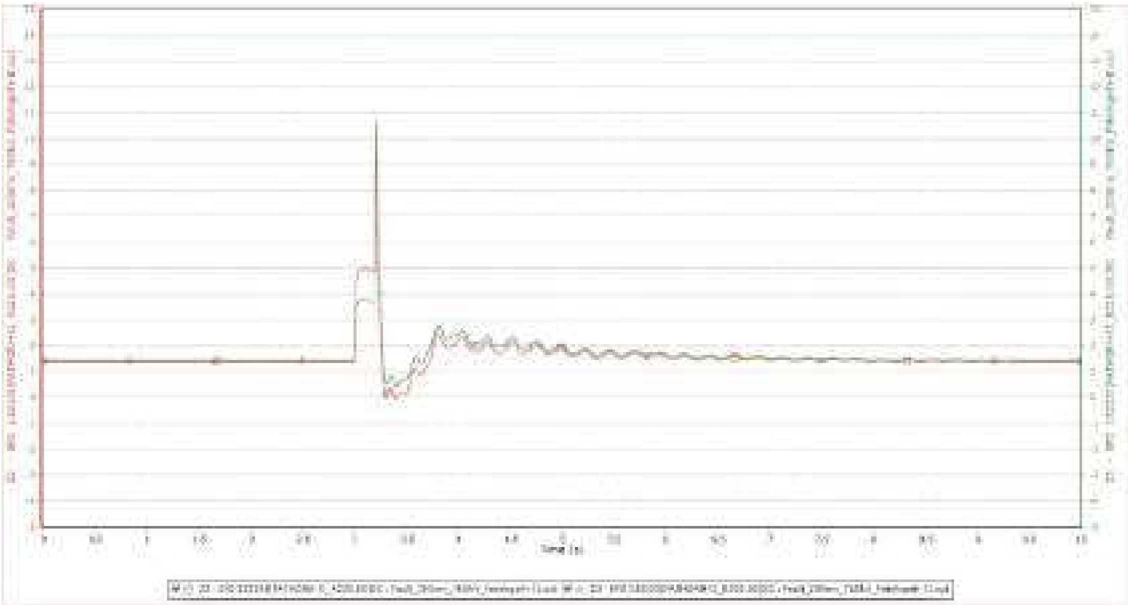


Figure 21: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) High voltage post fault clearance is observed in the system as the nearby RE plants are kept in "Q" priority mode. However, the high voltage is less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 765 kV Fatehgarh-II PG	T = 3.1 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.1 sec	0.33 p.u.	0.43 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.1 sec	0.21 p.u.	0.32 p.u.
4.	Voltage at 765 kV Fatehgarh-II PG	T = 3.2 sec	1.72 p.u.	1.53 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.2 sec	1.97 p.u.	1.64 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.2 sec	1.85 p.u.	1.51 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.1 sec	x	A – 2.10 p.u. B – 3.00 p.u.
8.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.2 sec	x	A – (-) 5.18 p.u. B – (-) 4.49 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2.5 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 100 ms

Fault Reactance: -2e+04

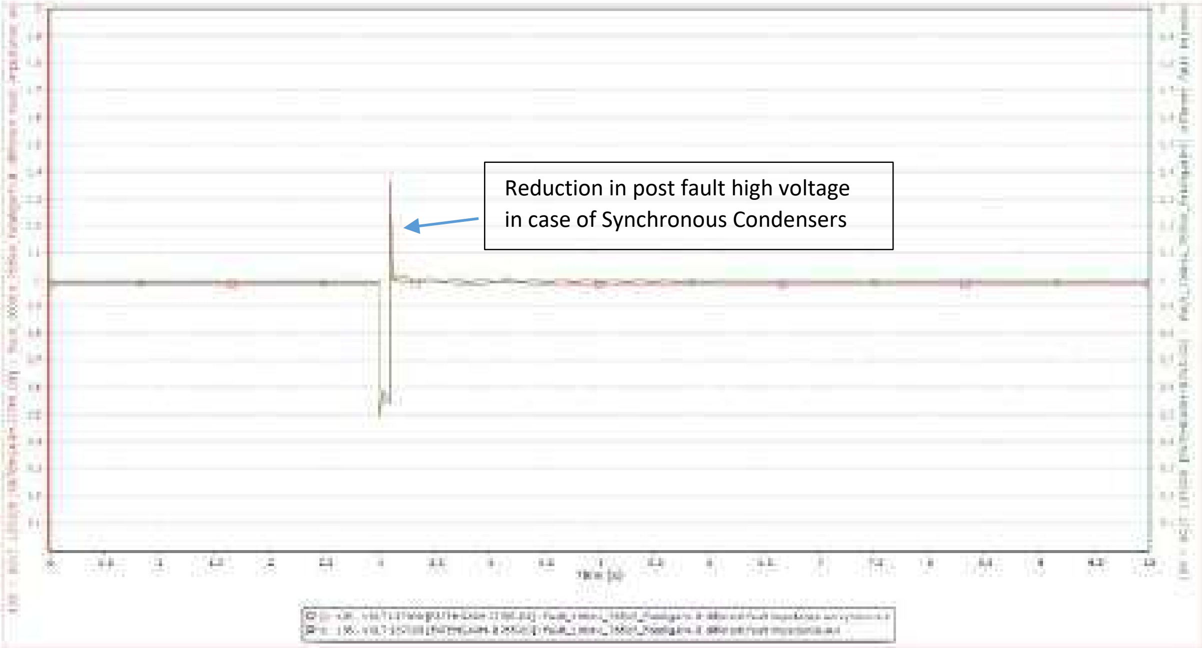


Figure 22: Voltage at 765 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec) without SynCon (Red) and with SynCon (Green)

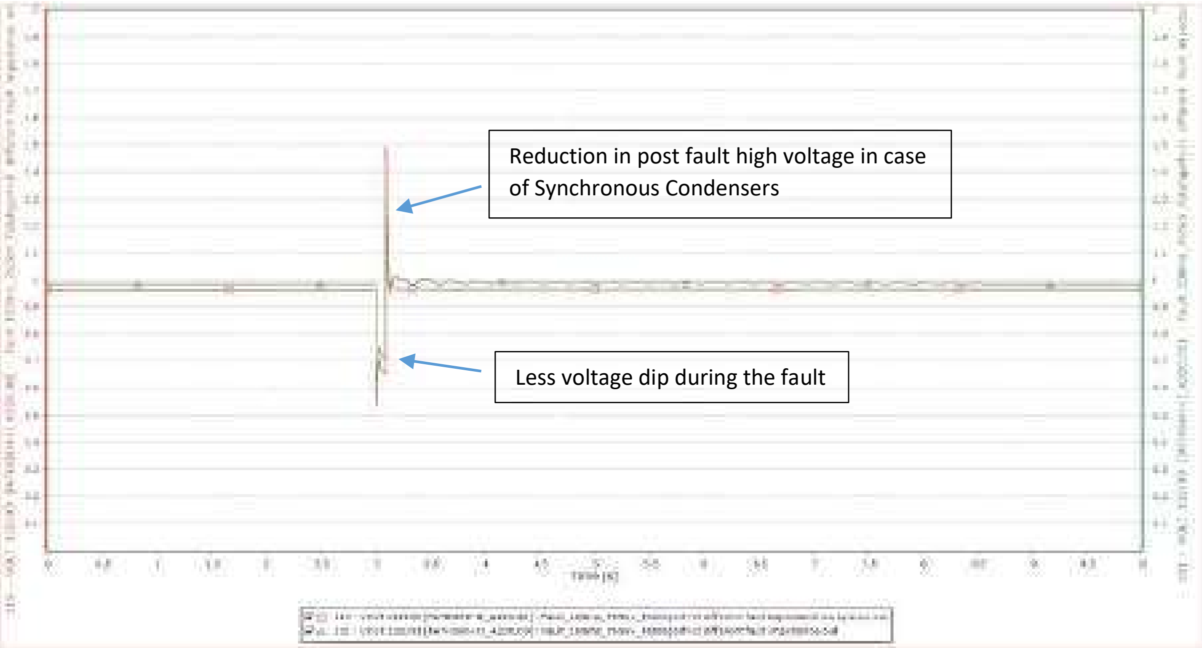


Figure 23: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

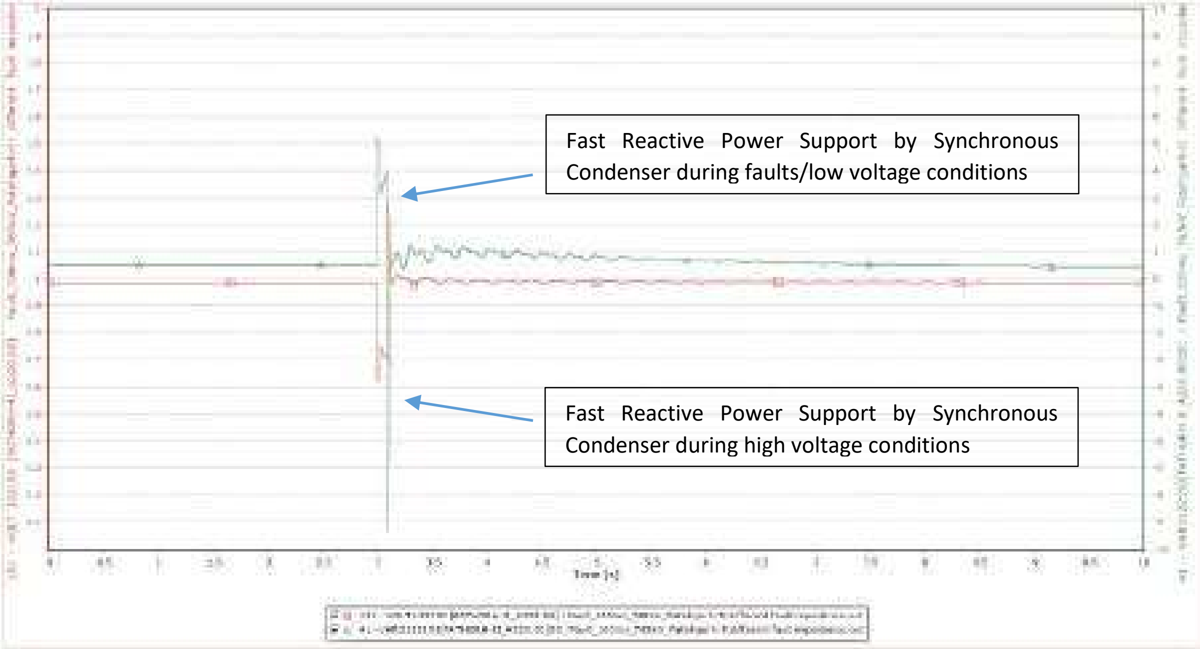


Figure 24: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

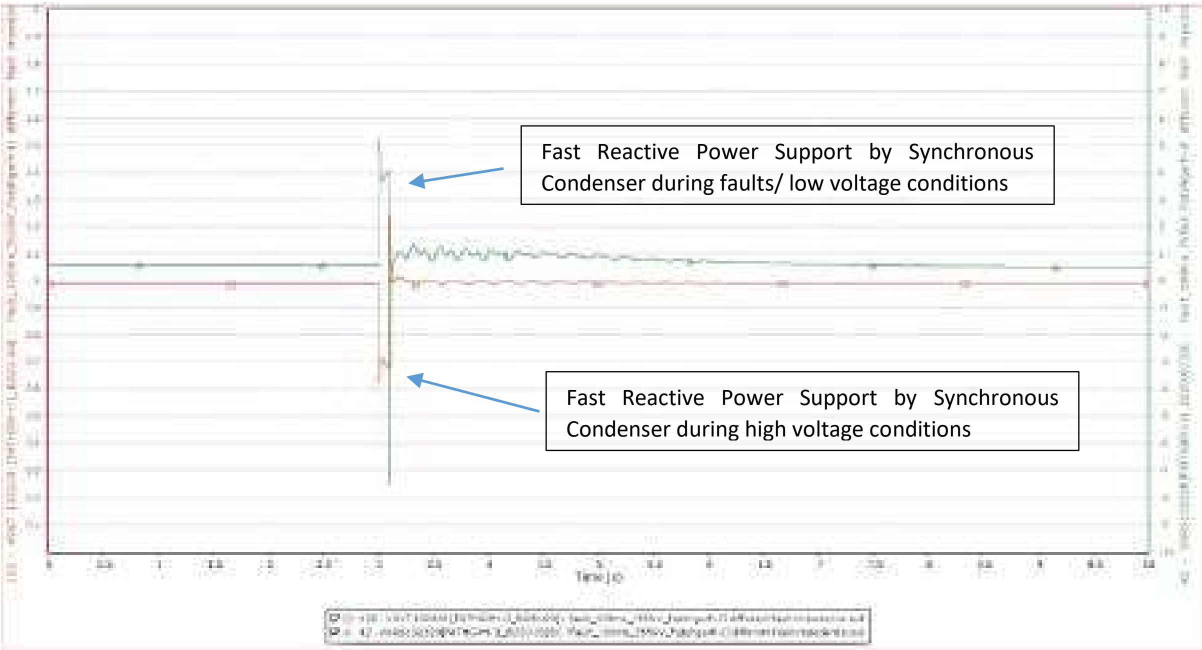


Figure 25: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

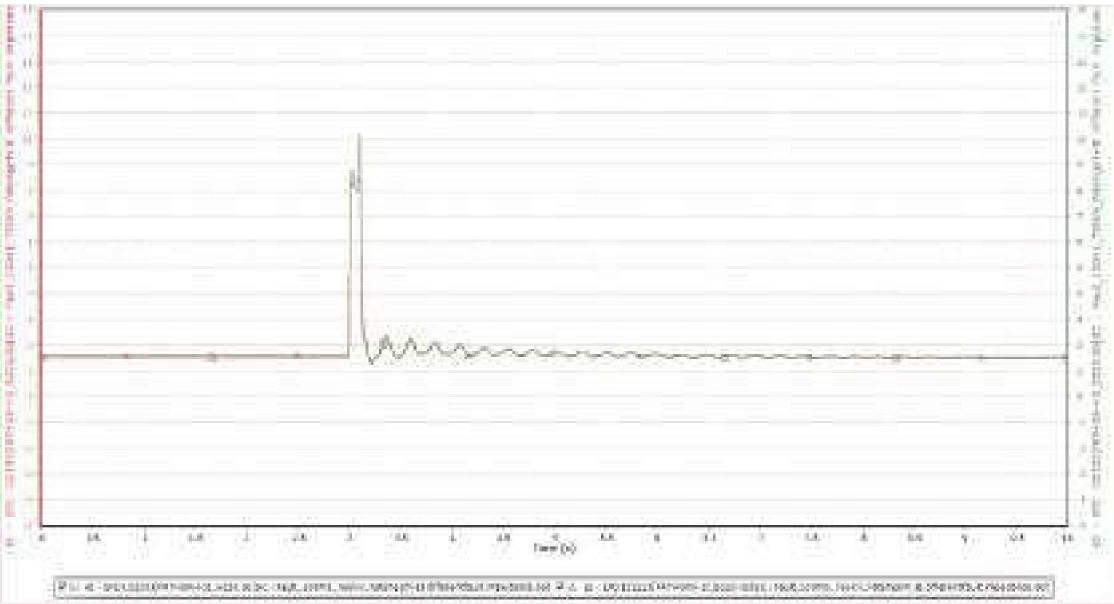


Figure 26: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) High voltage post fault clearance is observed in the system as the nearby RE plants are kept in "Q" priority mode. However, the high voltage is less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 765 kV Fatehgarh-II PG	T = 3.05 sec	0.55 p.u.	0.58 p.u.
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.69 p.u.	0.73 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.64 p.u.	0.70 p.u.
4.	Voltage at 765 kV Fatehgarh-II PG	T = 3.10 sec	1.36 p.u.	1.23 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.49 p.u.	1.29 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.48 p.u.	1.24 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A – 1.37 p.u. B – 1.52 p.u.
8.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	x	A – (-) 2.06 p.u. B – (-) 1.71 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2.6 3-ph fault at 400 kV Fatehgarh-II PG with fault clearing in 100 ms

Fault Reactance: -2e+04

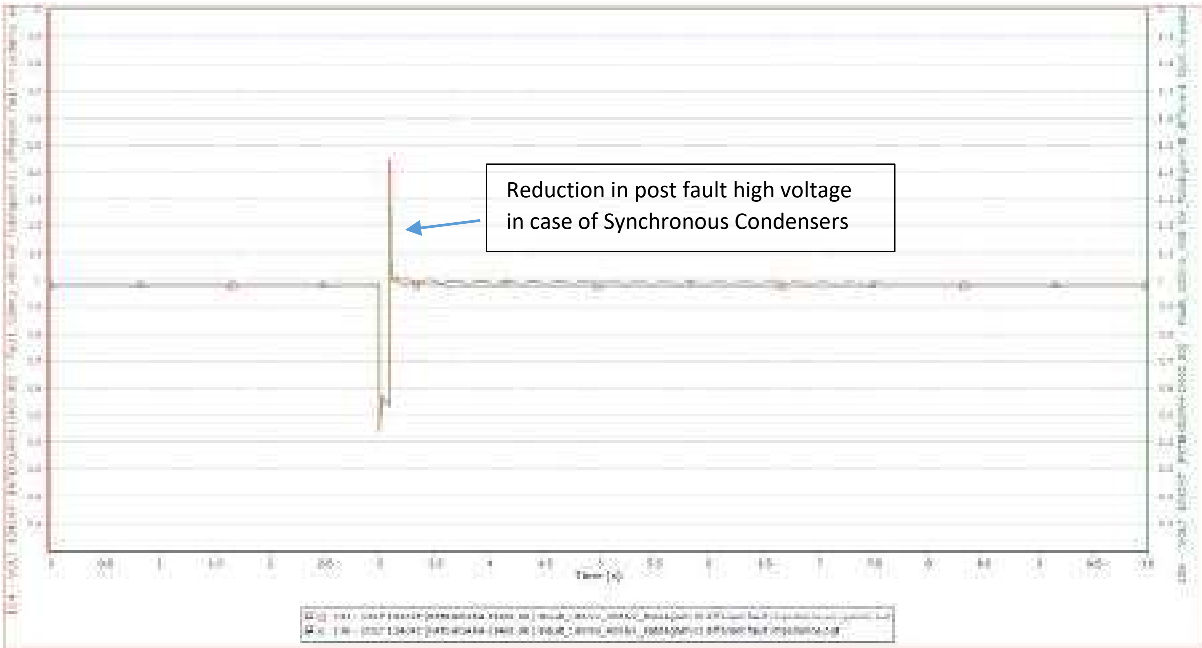


Figure 27: Voltage at 400 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec) without SynCon (Red) and with SynCon (Green)

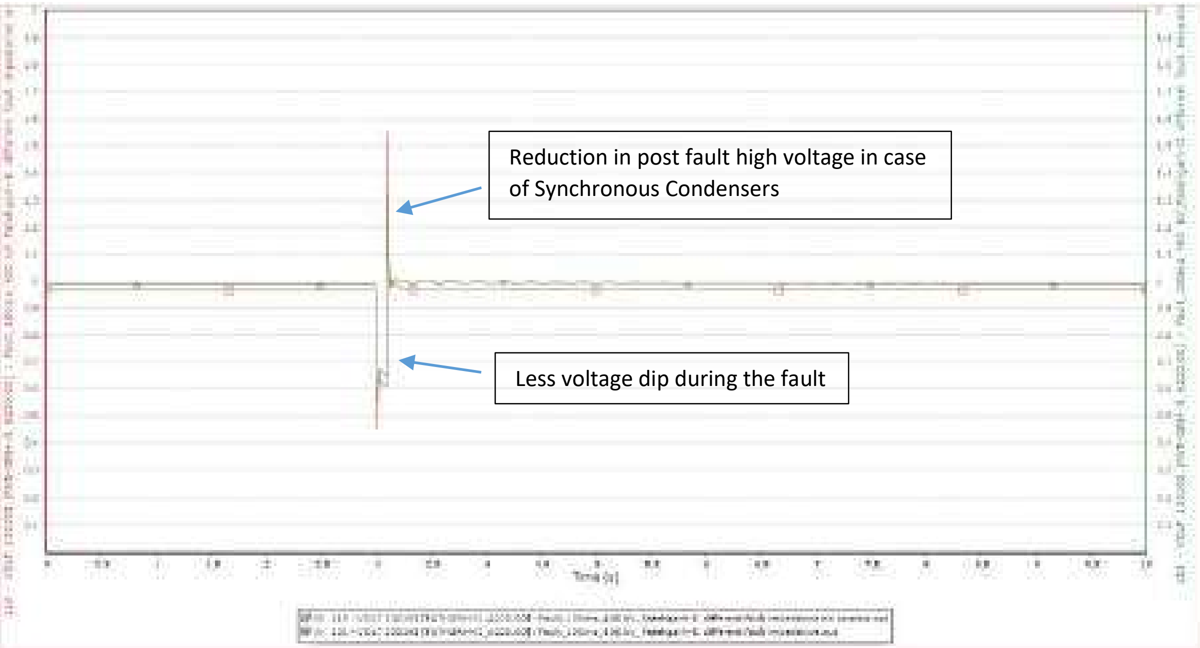


Figure 28: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

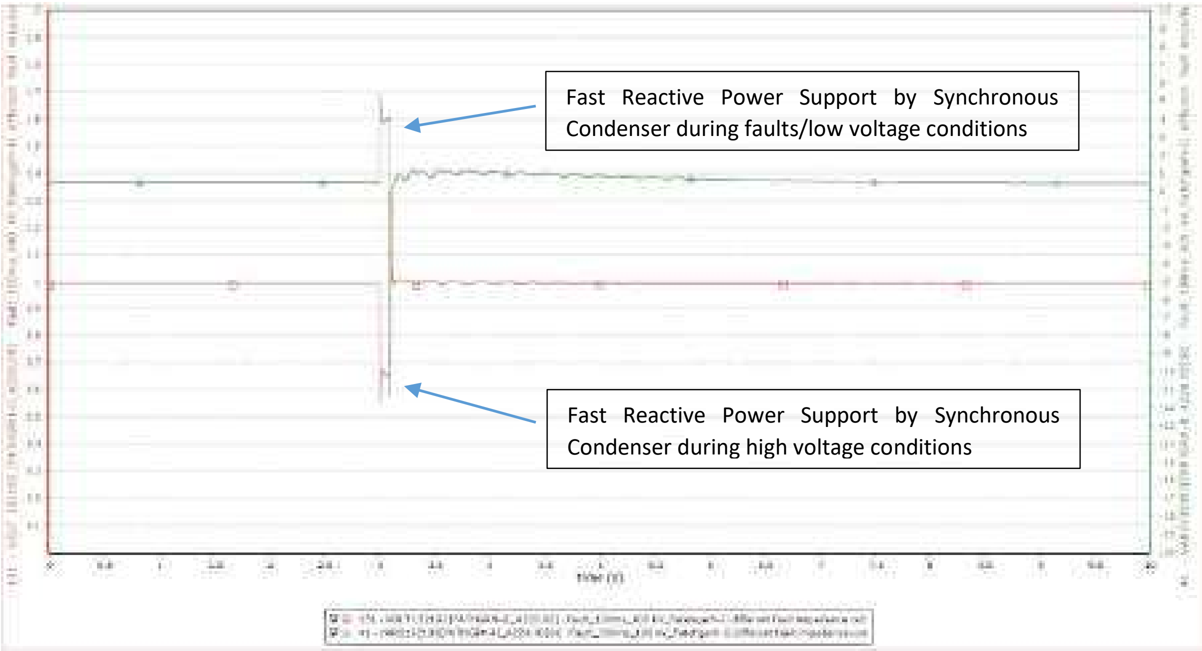


Figure 29: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

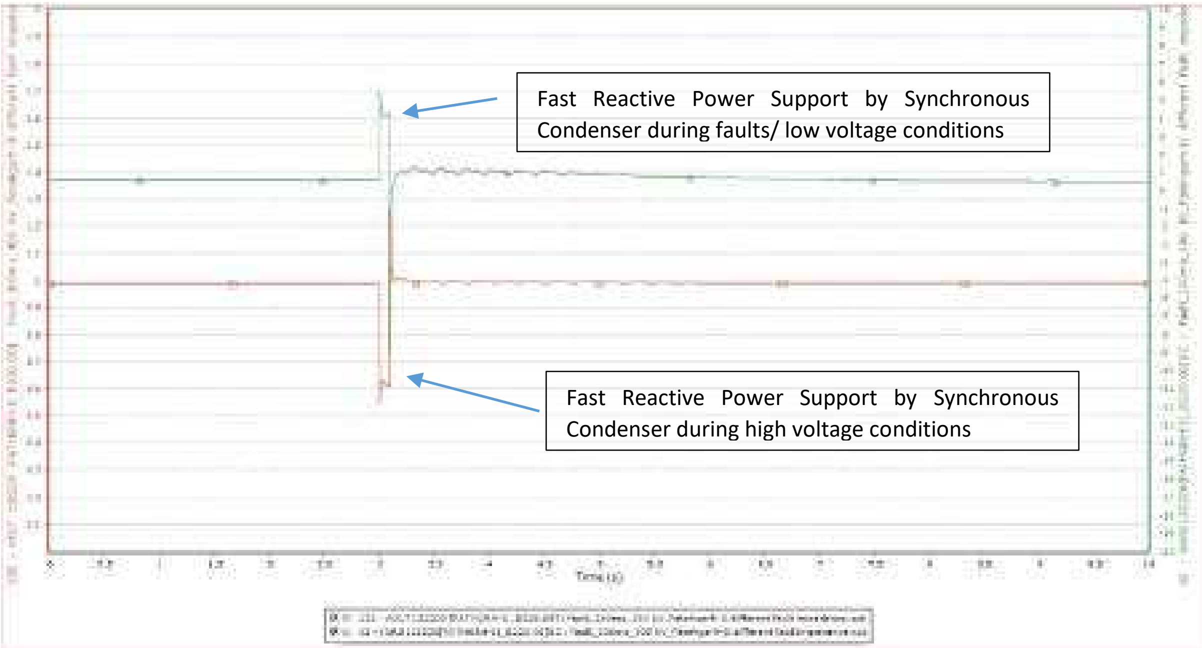


Figure 30: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

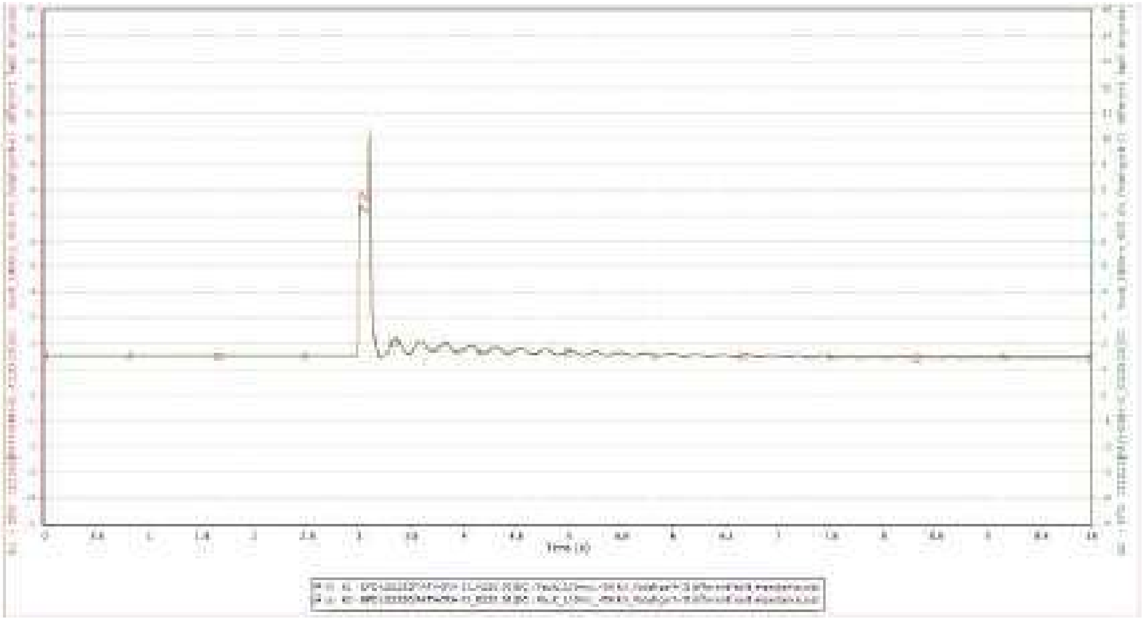


Figure 31: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) High voltage post fault clearance is observed in the system as the nearby RE plants are kept in "Q" priority mode. However, the high voltage is less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 400 kV Fatehgarh-II PG	T = 3.05 sec	0.56 p.u.	0.54 p.u.
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.66 p.u.	0.62 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.62 p.u.	0.57 p.u.
4.	Voltage at 400 kV Fatehgarh-II PG	T = 3.10 sec	1.44 p.u.	1.28 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.54 p.u.	1.33 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.47 p.u.	1.26 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A – 1.77 p.u. B – 2.08 p.u.
8.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	x	A – (-) 2.39 p.u. B – (-) 2.03 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2 RE plants in ‘P’ priority mode

3.2.2.1 3-ph fault at 400 kV Fatehgarh-II PG with fault clearing in 100 ms

Fault Reactance: -2e+09

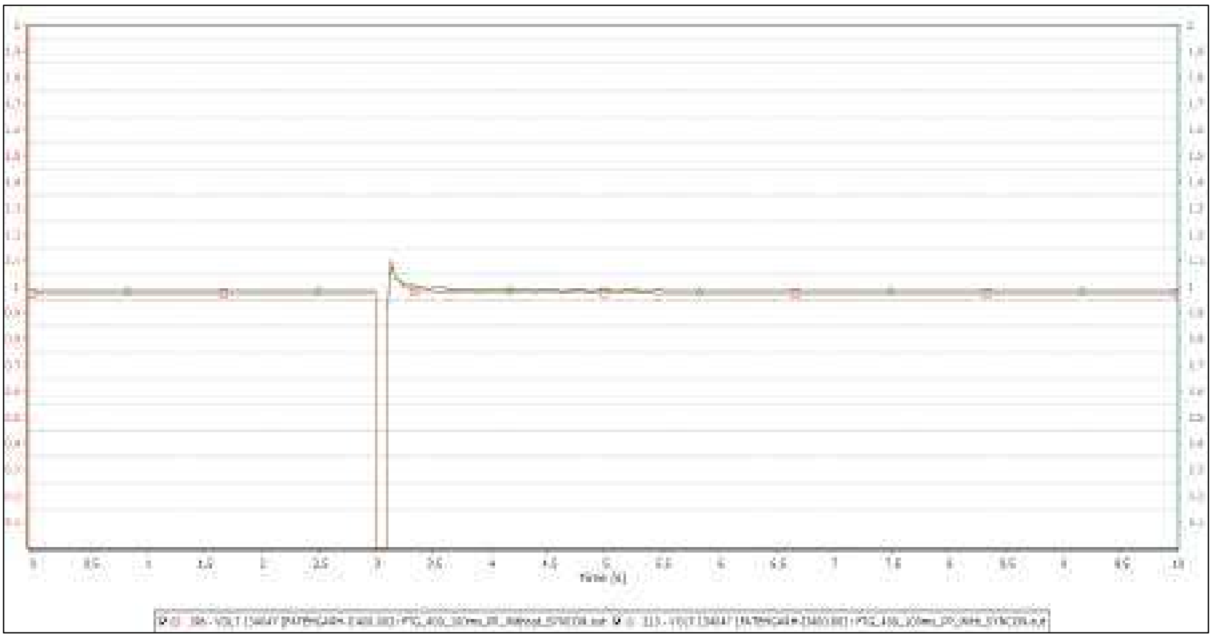


Figure 32: Voltage at 400 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec) without SynCon (Red) and with SynCon (Green)

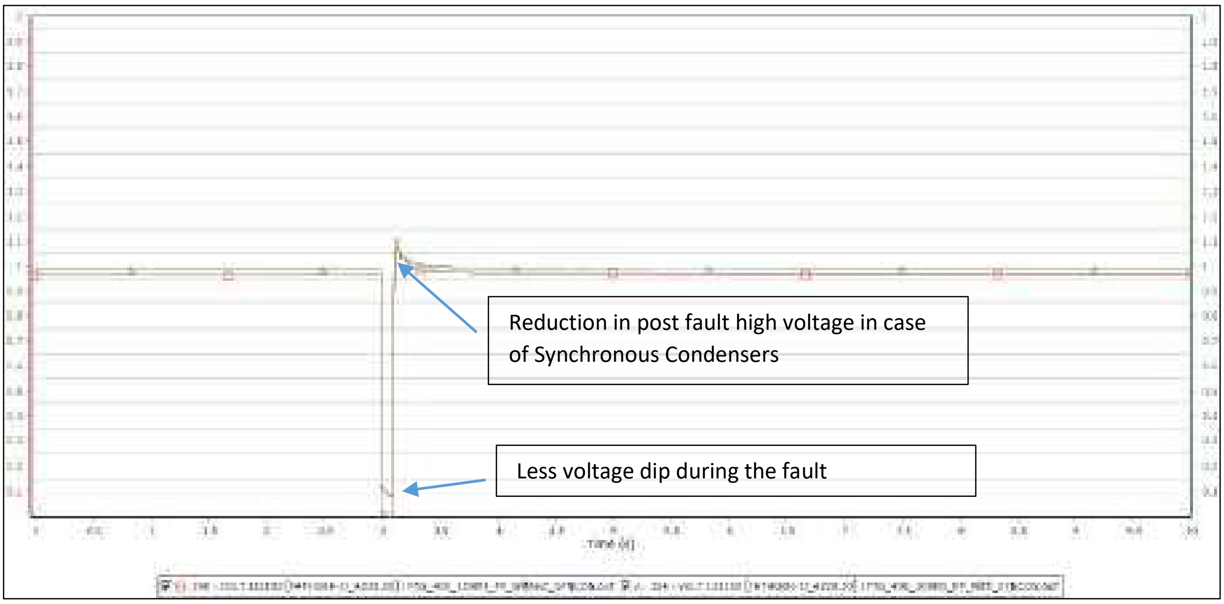


Figure 33: Voltage at 220 kV Fatehgarh-II (Bus-A) without SynCon (Red) and with SynCon (Green)

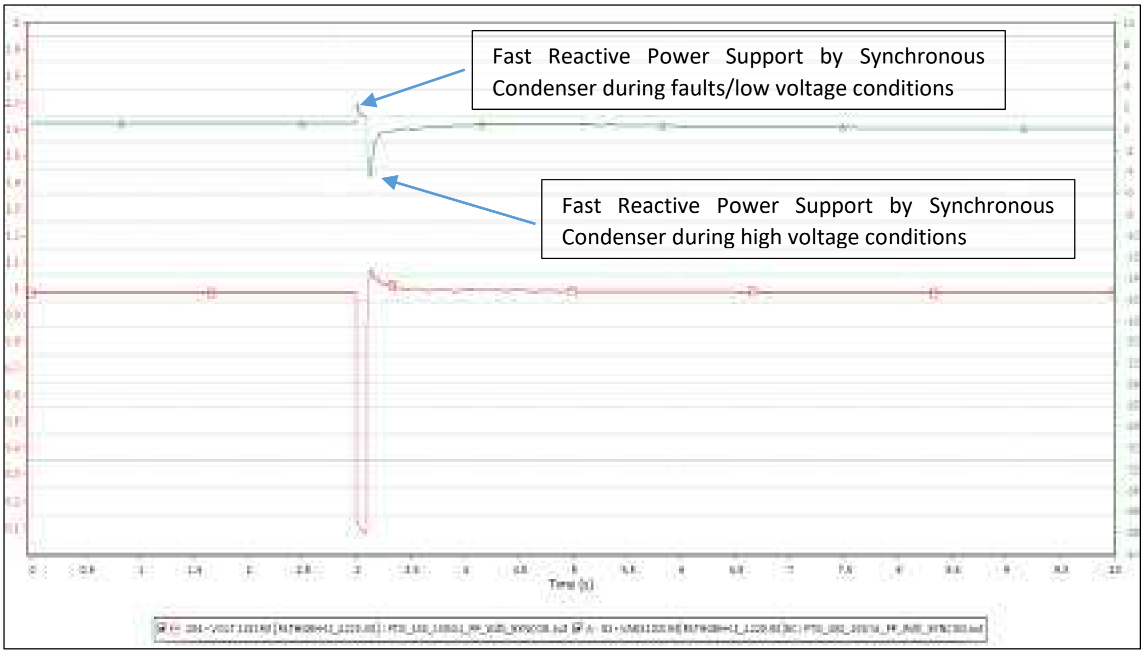


Figure 34: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

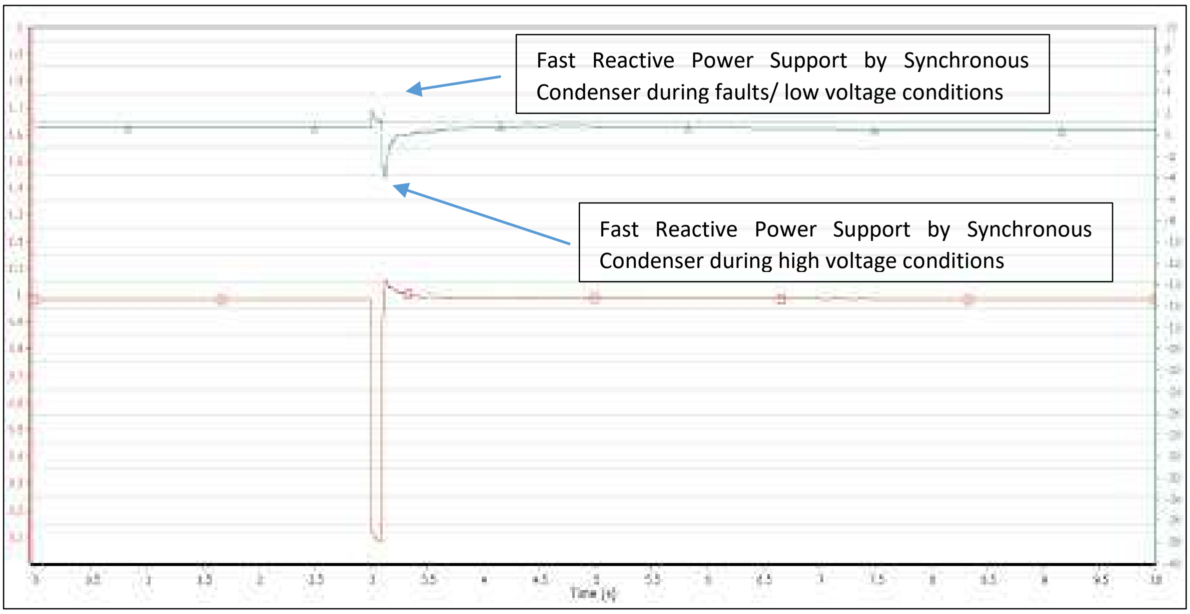


Figure 35: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

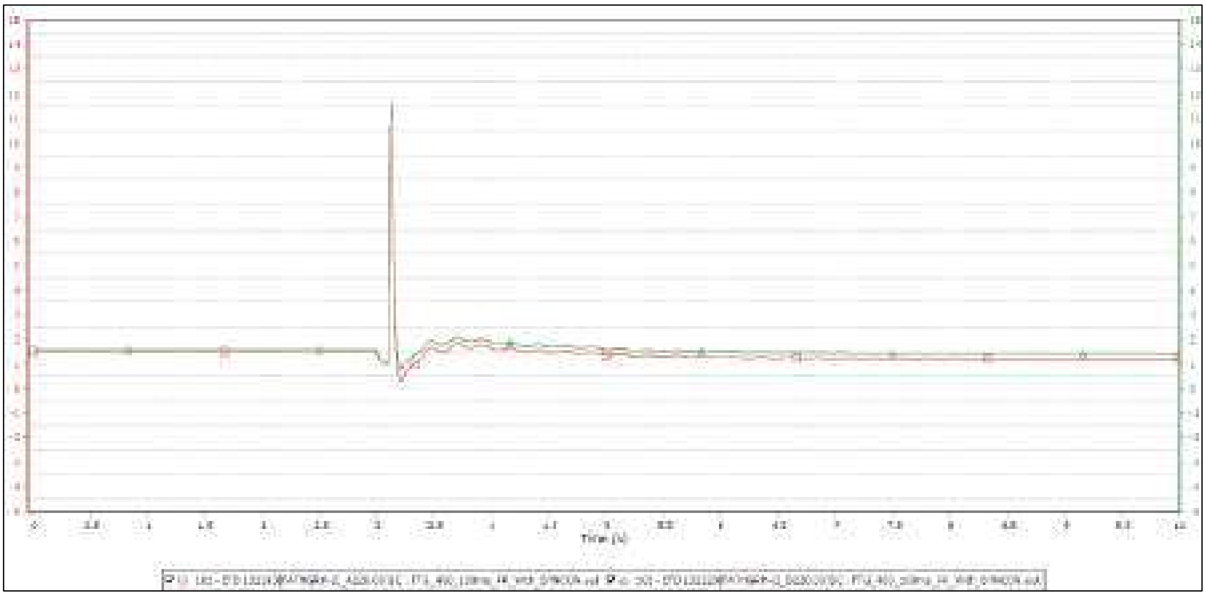


Figure 36: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) Post fault clearance, voltage rise is not observed in the system as the nearby RE plants are kept in "P" priority mode. However, this voltage is further reduced in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 400 kV Fatehgarh-II PG	T = 3.05 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0 p.u.	0.091 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0 p.u.	0.093 p.u.
4.	Voltage at 400 kV Fatehgarh-II PG	T = 3.10 sec	0.94 p.u.	0.92 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	0.90 p.u.	0.88 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	0.93 p.u.	0.89 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A – 4.32 p.u. B – 4.31 p.u.
8.	Reactive Power Support by SynCon-A and B	T = 3.10 sec	x	A – 0.90 p.u. B – 0.90 p.u.
9.	Response time of SynCons		x	Within one cycle

3.2.2.2 3-ph fault at 765 kV Fatehgarh-II PG with fault clearing in 100 ms

Fault Reactance: -2e+09

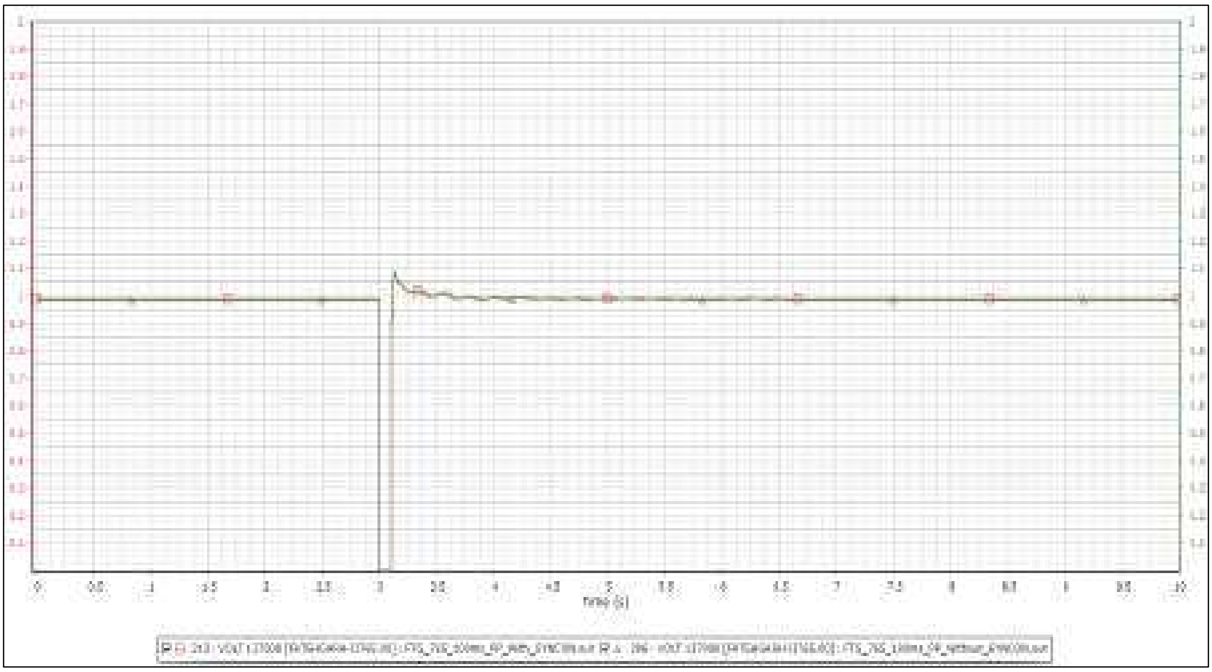


Figure 37: Voltage at 765 kV Fatehgarh-II PG bus (3-ph fault at t=3 sec) without SynCon (Red) and with SynCon (Green)

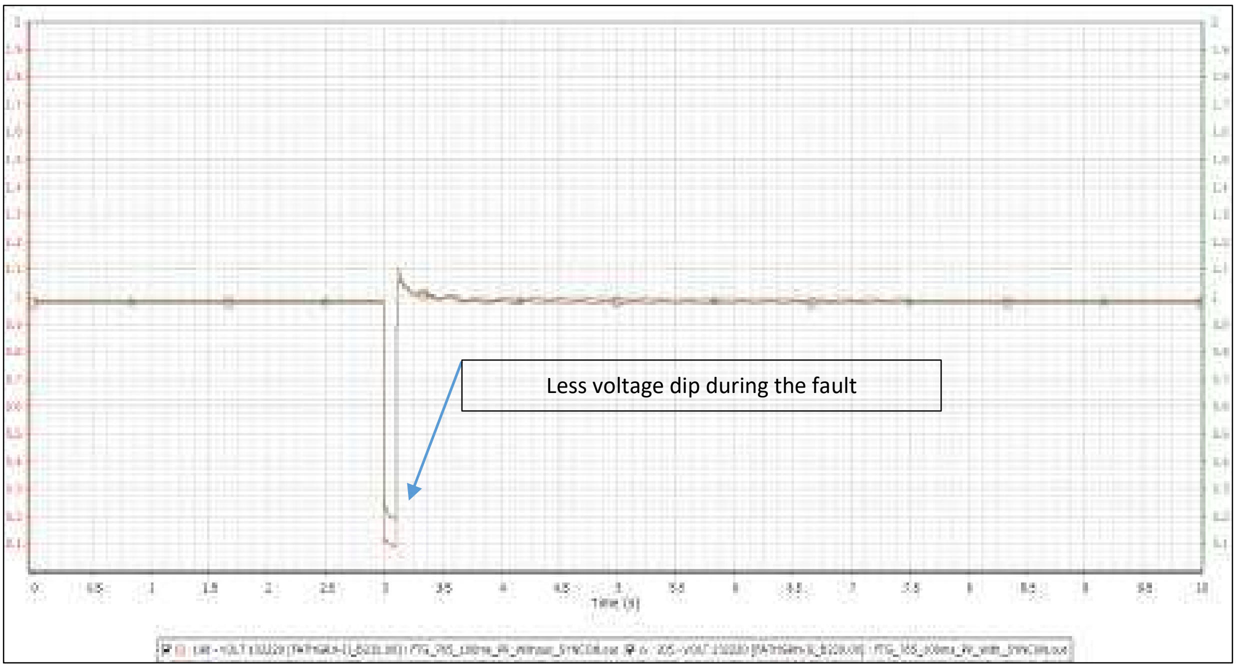


Figure 38: Voltage at 220 kV Fatehgarh-II (Bus-B) without SynCon (Red) and with SynCon (Green)

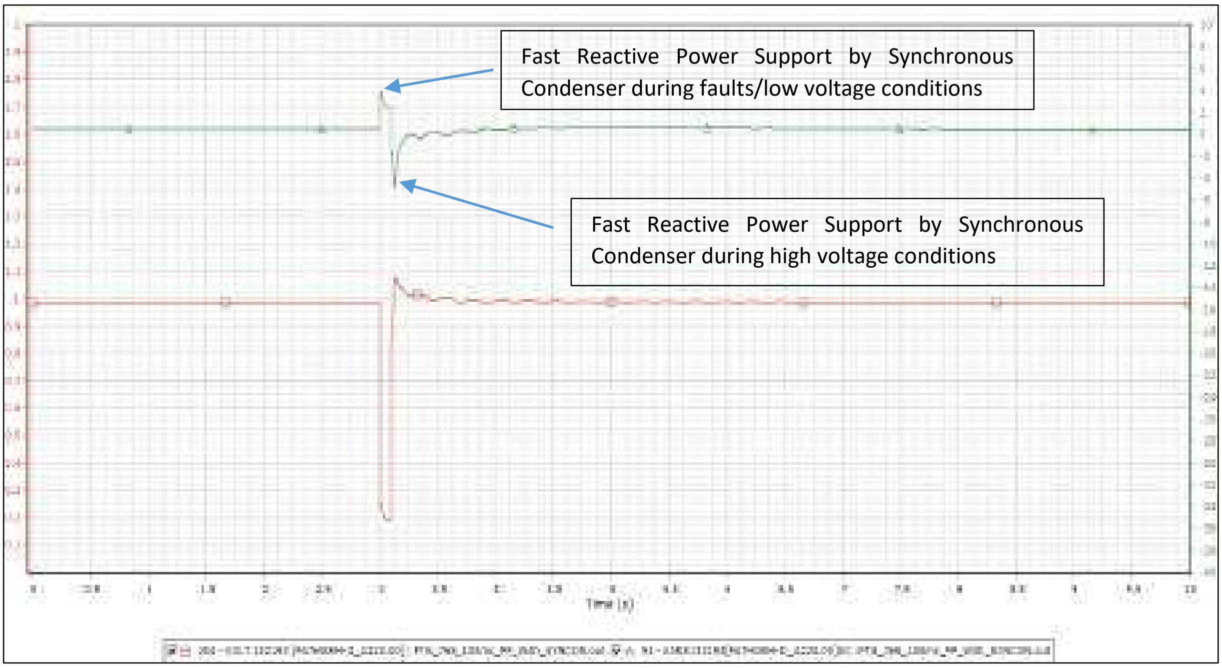


Figure 39: Voltage (Red) at 220 kV Fatehgarh-II (A) PG bus and Reactive Support (green, in p.u. – 100 MVA base) from SynCon-A

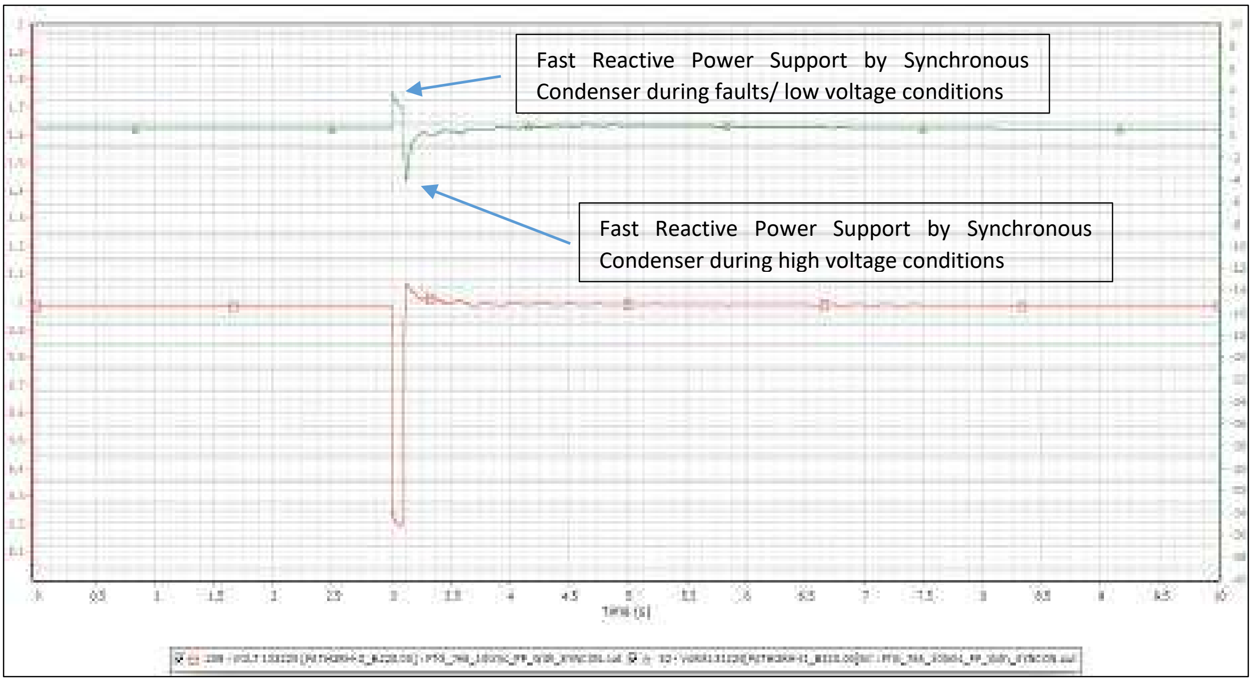


Figure 40: Voltage (Red) at 220 kV Fatehgarh-II (B) PG bus and Reactive Support (green. in p.u. – 100 MVA base) from SynCon-B

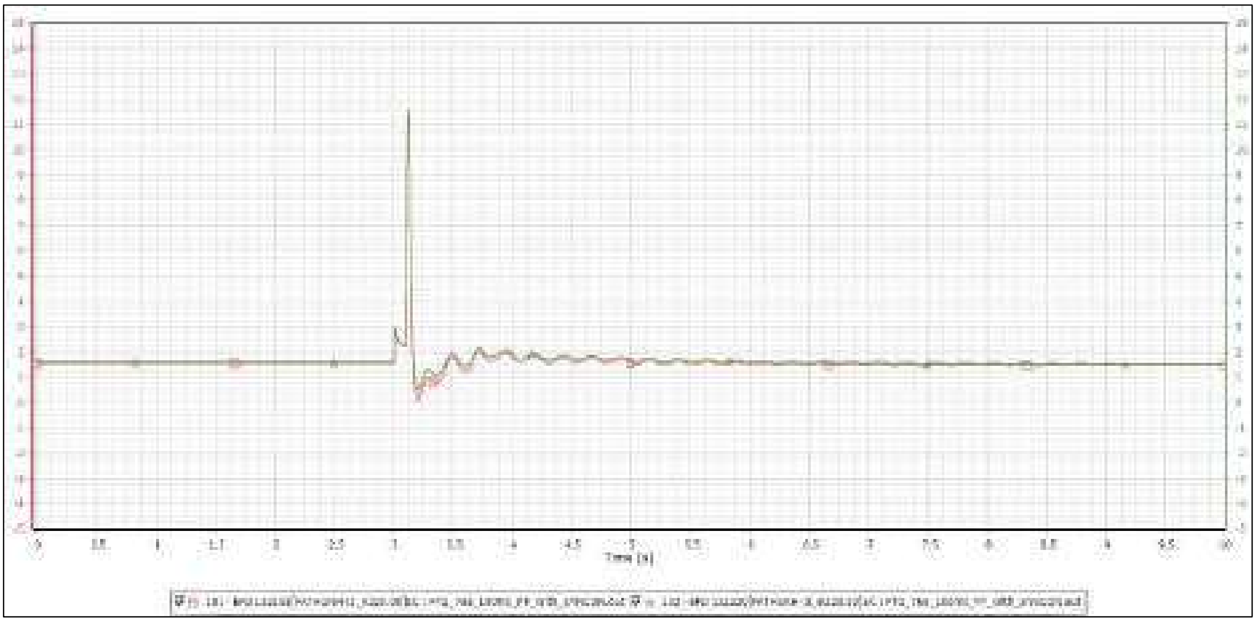


Figure 41: EFD (Field Voltage) of SynCon-A and SynCon-B

Observations:

a) During the fault, voltage dip seen is less in case of deployment of synchronous condensers. This is due to the fast reactive power support by the SynCons during the sub-transient period.

b) Post fault clearance, voltage rise is not observed in the system as the nearby RE plants are kept in "P" priority mode. However, this voltage is further reduced less in case of synchronous condensers due to the fast reactive absorption support.

Comparative table is provided below:

S. No.	Description	Time	Without SynCons at 220 kV Fatehgarh-II A and B	With SynCons at 220 kV Fatehgarh-II A and B
1.	Voltage at 765 kV Fatehgarh-II PG	T = 3.05 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.18 p.u.	0.20 p.u.
3.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.10 p.u.	0.21 p.u.
4.	Voltage at 765 kV Fatehgarh-II PG	T = 3.10 sec	0.88 p.u.	0.88 p.u.
5.	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	0.85 p.u.	0.84 p.u.
6.	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	0.86 p.u.	0.85 p.u.
7.	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	x	A – 3.81 p.u. B – 3.69 p.u.
8.	Reactive Power Support by SynCon-A and B	T = 3.10 sec	x	A – 0.49 pu B – 0.50 p.u.
9.	Response time of SynCons		x	Within one cycle

3.3 Impact on System Inertia and Rate of Change of Frequency (ROCOF)

3.3.1 Tripping of a Synchronous Generator (Suratgarh TPS)

The impact of synchronous condensers on system inertia[1] has been studied through tripping of unit of Suratgarh SCTPP (Pgen = 458 MW) with and without proposed synchronous condensers at Fatehgarh-II.

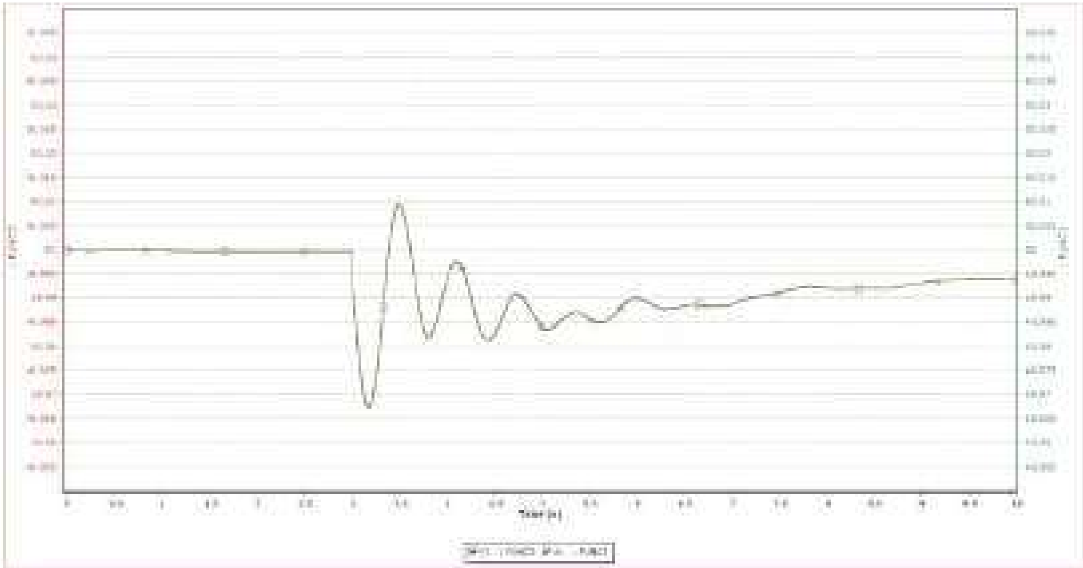


Figure 42: System Frequency (Red without SynCon and Green with SynCon) after tripping of Suratgarh SCTPP Unit at t =3 sec

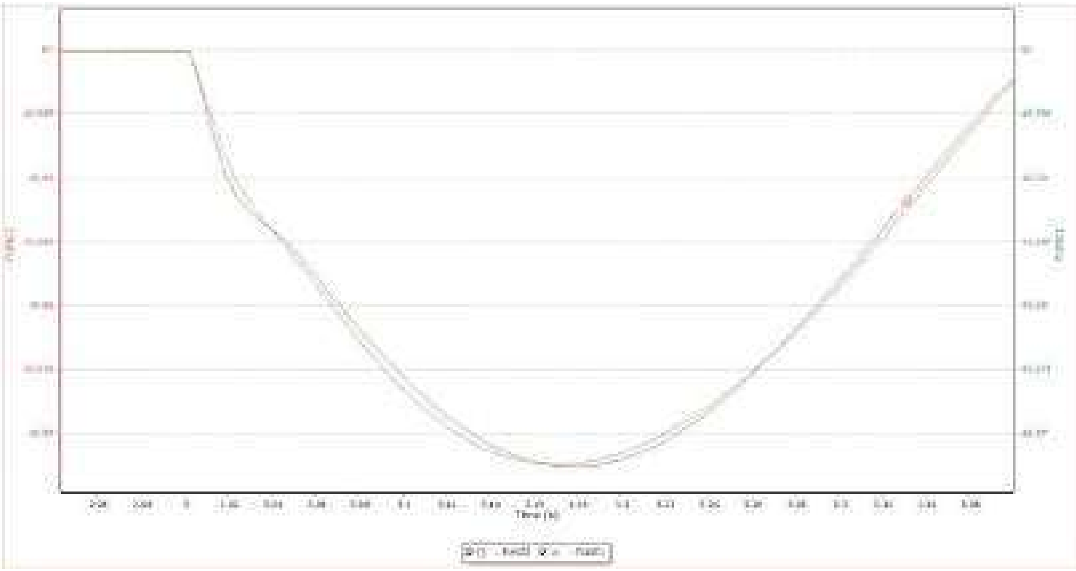


Figure 43: Zoomed version - System Frequency (Red without SynCon and Green with SynCon) after tripping of Suratgarh SCTPP Unit at t =3 sec

Improvement of 0.065 Hz/sec is seen in RoCoF for the same event after deployment of synchronous condensers.

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[1] *As some of the governor models are not available, study has been done only to analyze the relative improvement in rate of change of frequency*

3.3.2 Large RE Generation Event in Rajasthan RE Complex

a) Simulation study has also been conducted to simulate the loss of a large quantum of RE generation **(~1800 MW)** in Rajasthan RE complex and observe the frequency and RoCoF at different nodes.

b) The frequency response in case of the simulation studies is observed to be ideal with very high Power Number (~30,000 MW/Hz). The same differs from the practical observations where the Power Number varies between 10,000 – 15,000 MW/Hz.

c) The Rate of Change of Frequency (RoCoF) has been calculated in this case using first principle of derivative method. The same is observed to be higher for buses near to Rajasthan RE complex such as Alwar, Suratgarh, Chhabra etc. as compared to far away buses in other regions.

d) It may also be noted that the calculated RoCoF in this case may not be the same as observed by df/dt relays as there are multiple processing units, filters and robust logics for calculating the RoCoF at any point. The maximum RoCoF values plotted below are indication of the inertial strength of the concerned nodes.

e) The RoCoF calculated from actual PMU data using first principle also suggests similar observations.

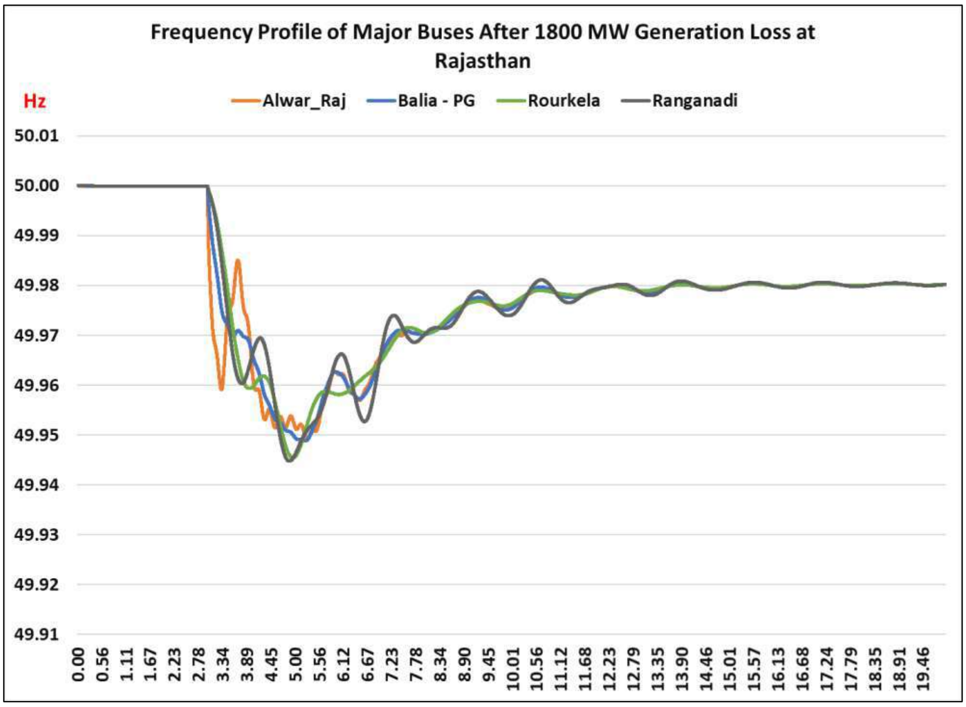


Figure 44: Simulated Frequency at Various Nodes after ~1800 MW Generation Loss in Rajasthan RE Complex with SYNCON – A & B at Fatehgarh - II

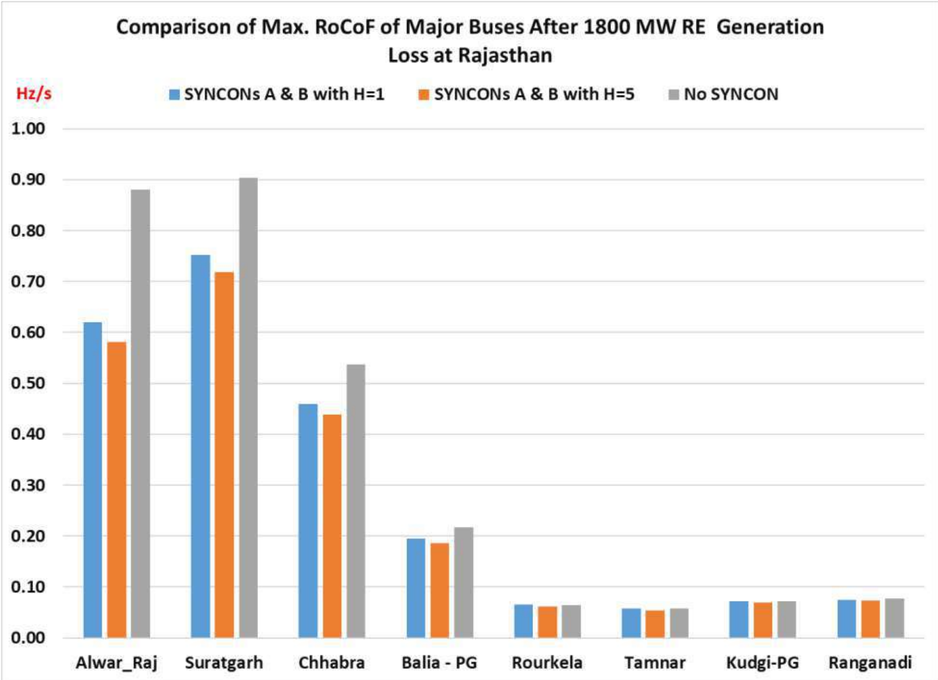


Figure 45: Maximum RoCoF Calculated at Various Nodes after ~1800 MW Generation Loss in Rajasthan RE Complex

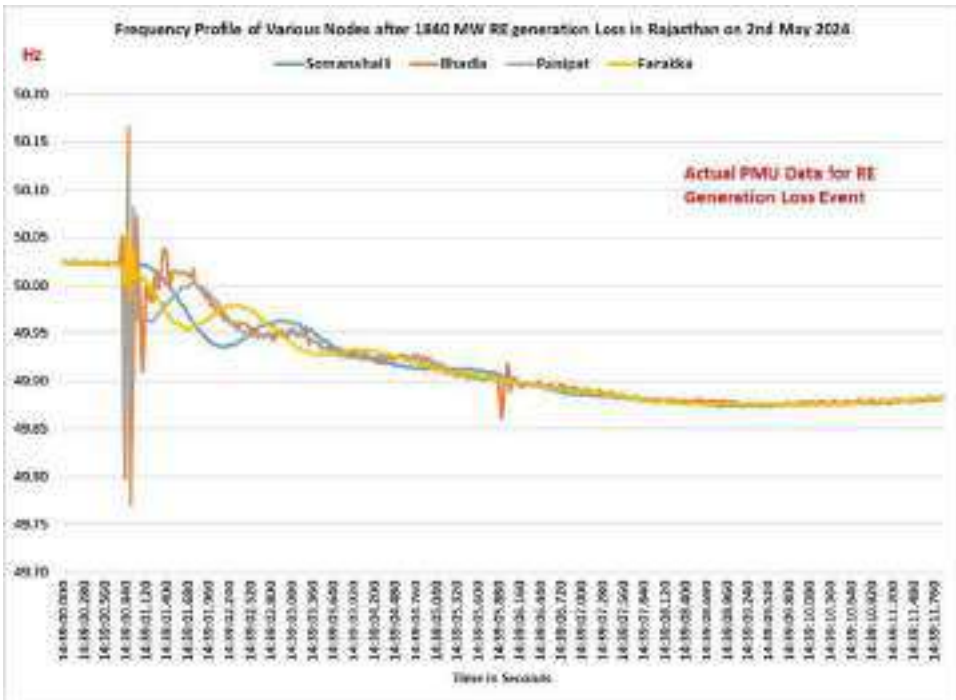


Figure 46: Measured Frequency (PMU) for ~1800 MW RE generation loss in Rajasthan (Zoomed Plot)

3.4 Impact on Damping of Oscillations

For this analysis, past oscillation data (source: PMU) has been played back to analyse the response of synchronous condensers during oscillations. As the response of RE plants and other elements is already captured in the PMU data, the analysis has been carried out on SMIB model.

3.4.1 Very low frequency oscillations (~0.04Hz)

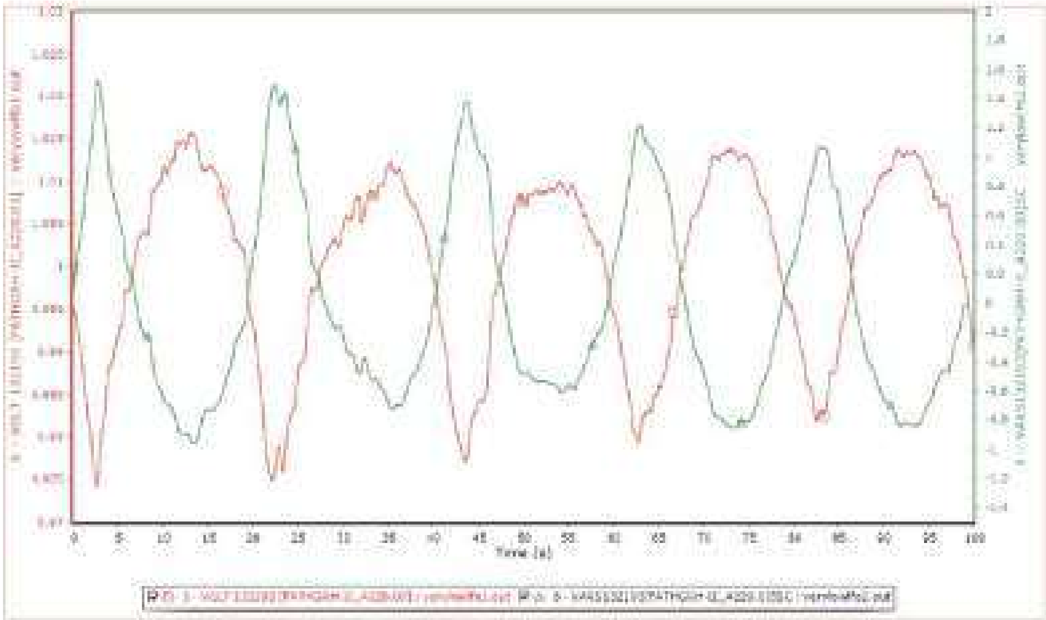


Figure 47: Bus Voltage (Red) and SynCon-A response (green, in p.u. – 100 MVA base)

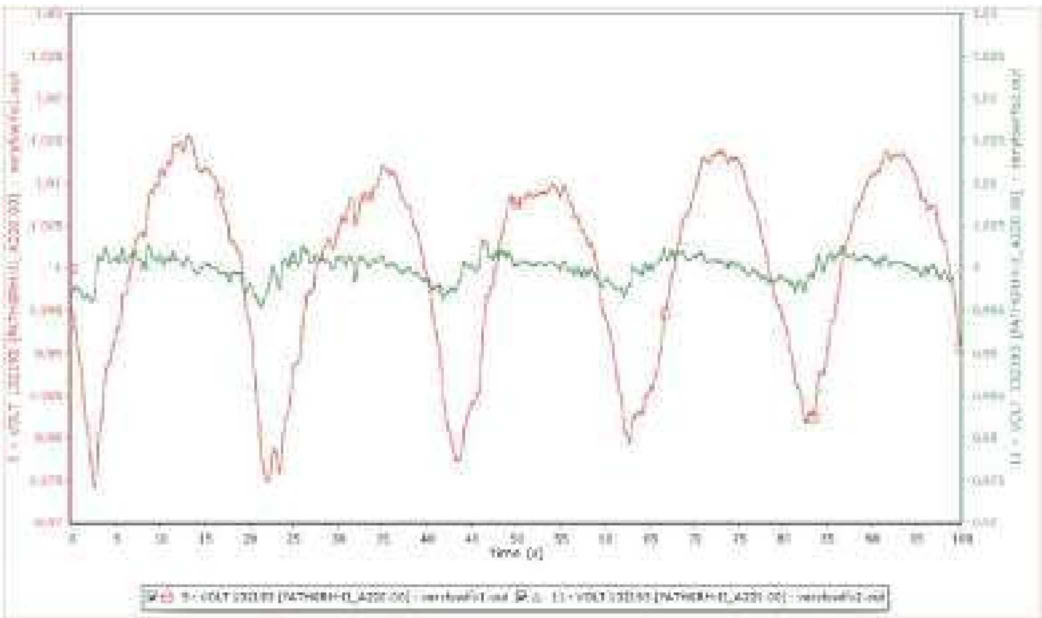


Figure 48: Bus Voltage without (red) and with (green) synchronous condensers

3.4.2 Low frequency oscillations (~2.8 Hz)

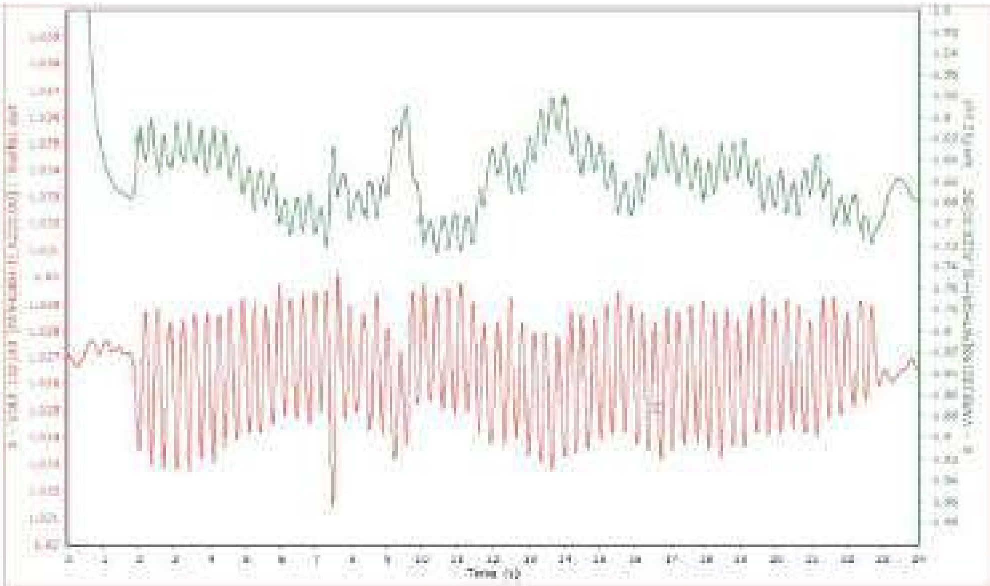


Figure 49: Bus Voltage (Red) and SynCon-A response SynCon-A response (green, in p.u. – 100 MVA base)

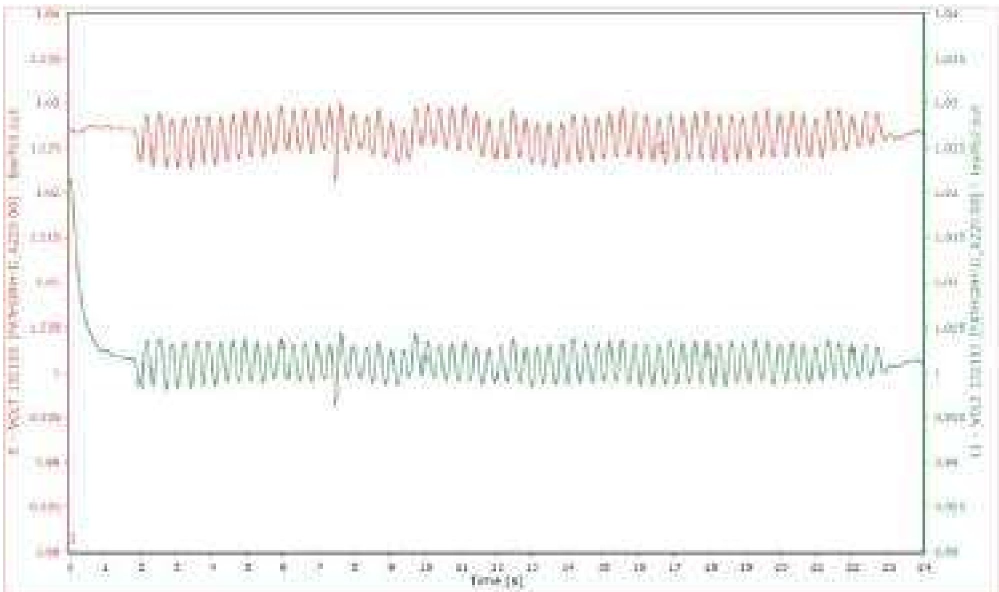


Figure 50: Bus Voltage without (red) and with (green) synchronous condensers

3.4.3 High Voltage Dips

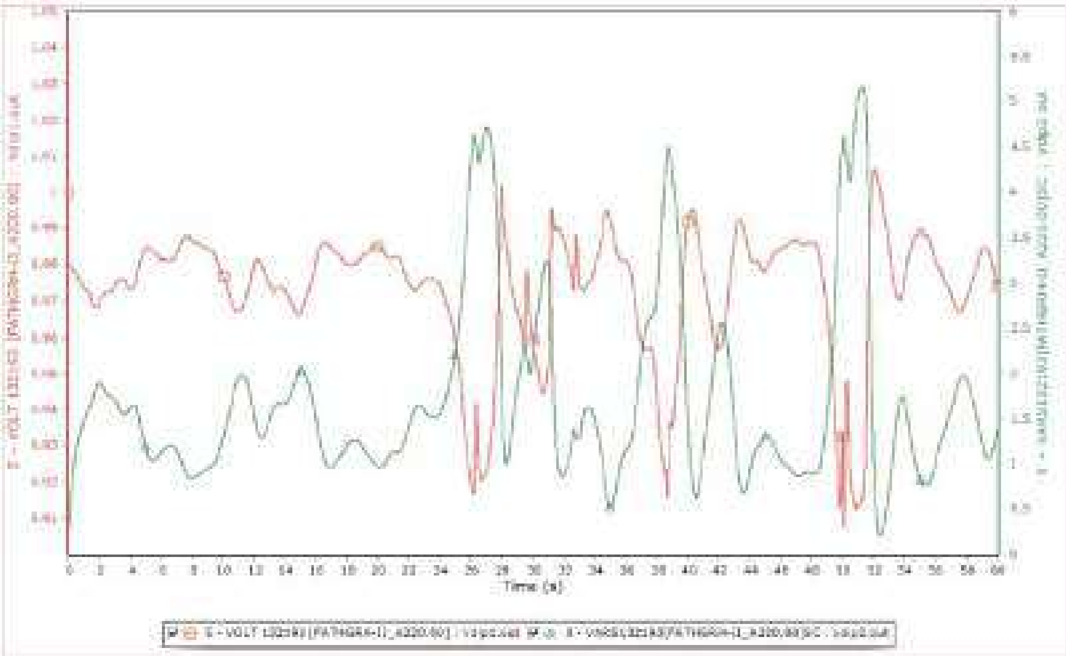


Figure 51: Bus Voltage (Red) and SynCon-A response (green, in p.u. – 100 MVA base)

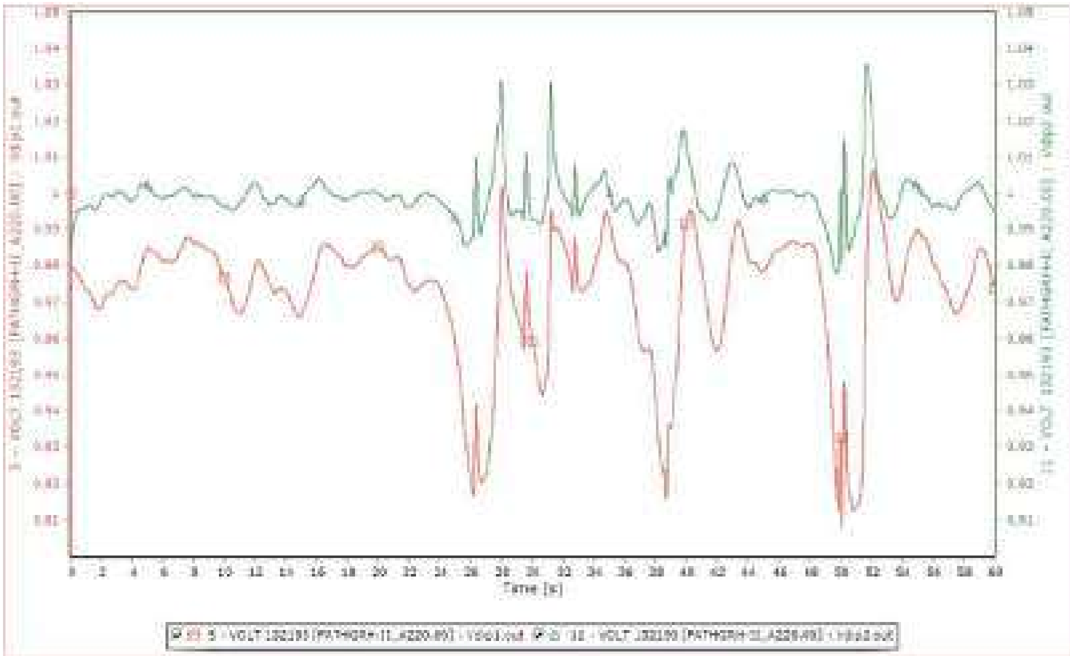


Figure 52: Bus Voltage without (red) and with (green) synchronous condensers

With fast AVR-Exciter gain, the synchronous condensers are observed to damp the oscillations in all 03 cases. However, in case of slow AVR response, the damping effect may not be significant and the SynCon response may also be opposite of the desired one.

3.5 Impact on Steady-state voltage control through dynamic reactive power support

Dynamic reactive power support from synchronous condensers has been analysed by applying step changes in voltages as shown below. The response time of SynCons has been observed to be ~1 sec.

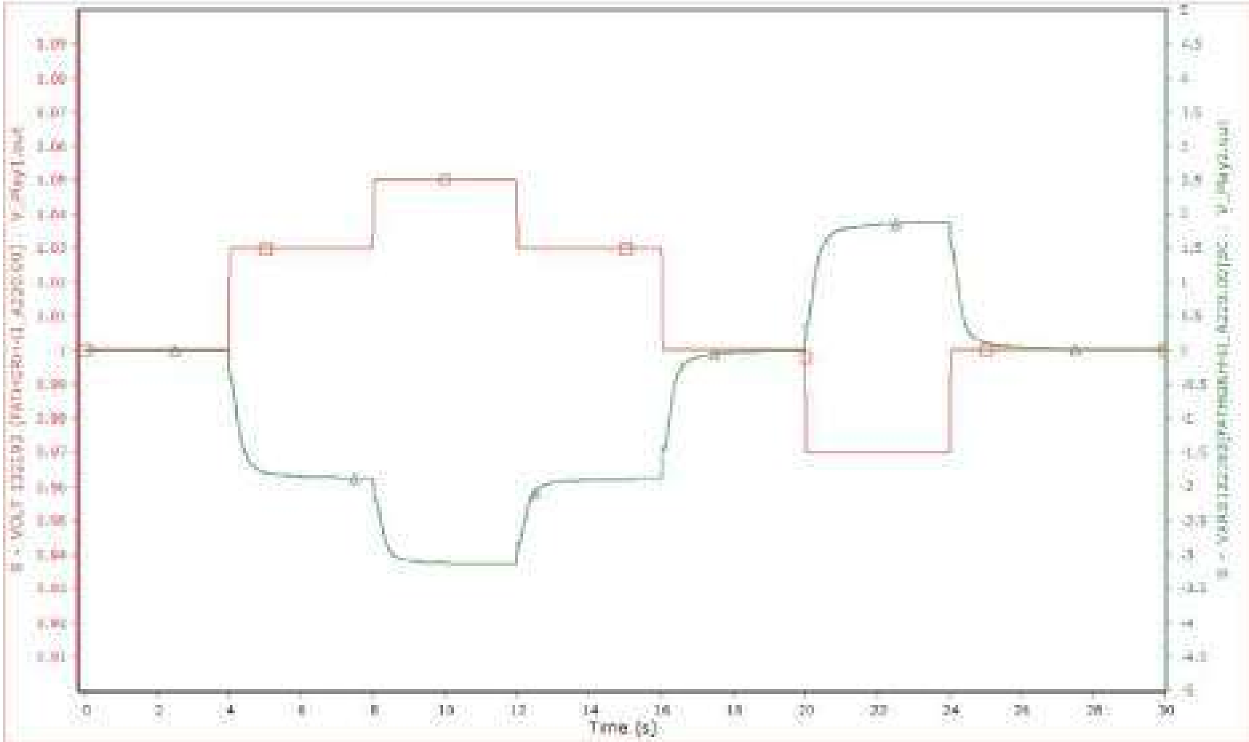


Figure 53: Bus Voltage (red) and Synchronous Condenser Response (green, in p.u. – 100 MVA base)

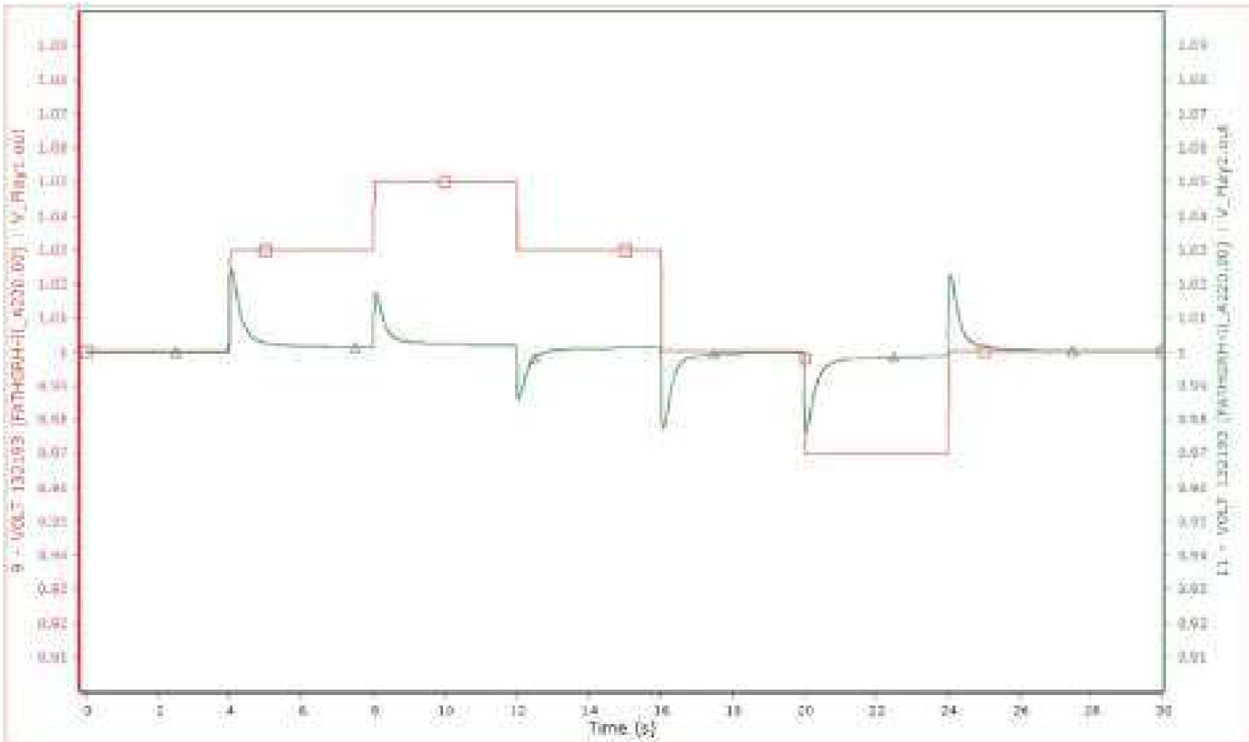


Figure 54: Bus Voltage without (red) and with (green) synchronous condensers

4. Important features of Synchronous Condensers

S. No.	Feature	Value
1.	Reactive Power Capability	+1.0 / -0.6 p.u. (inductive capability is ~60% of capacitive)
2.	Overload Capability	Yes
3.	Response Time - Sudden Voltage Changes	Immediately (within one cycle)
4.	Response Time to control actions	~1 sec (will depend on exciter-AVR gain)
5.	Contribution to System inertia	Yes (Increased impact with addition of flywheel)
6.	Contribution to short-circuit power	Yes, ~4-5 p.u.
7.	Reactive power support at very low/high voltage (LVRT/HVRT Capability)	Yes

5. Conclusion

Following are the observations of the study on analysing the impact of installing synchronous condenser in present scenario at Fatehgarh-II:

a) Enhanced System Strength / Short Circuit Ratio (SCR)

The simulation study demonstrates that the deployment of Synchronous Condensers (SYNCON) improves the Short Circuit Ratio (SCR) of the RE pooling buses in Rajasthan. This can be attributed to the high fault current contribution capability of SYNCONs (around 4-5 pu) unlike the power electronic controller based devices where contribution is limited to 1-1.1 pu.

As the SynCons are considered at 220 kV Fatehgarh-II (A and B), increase in SCR/fault level is prominent at these buses. SCR of 220 kV Fatehgarh-II (A and B) is seen to increase from 4 and 11.4 to 4.8 and 14.4 respectively. (refer section 3.1)

b) Fast Reactive Power Support during Faults/Transients

Synchronous condensers can play a critical role during faults and high voltage events in power systems due to their ability to provide substantial fault current, typically in the range of 4-5 per unit (p.u.). This high fault current capability is primarily due to the low sub-transient reactance, which allows the machine to respond rapidly to changes in system conditions.

Significant reactive power support has been observed in the simulation study from the proposed SynCons during faults as well as during post fault high voltage conditions. The short circuit current response of the order of > 5 p.u. (normalized at 1 p.u. voltage) has also been observed depending on the severity of voltage dip/rise in the study case (refer section 3.2). The support received from SynCons has arrested the voltage dip/rise during transients and improved the system stability.

c) Increased Inertia and Frequency Response

Rate of change of frequency (RoCoF) experienced by the system for a given contingency varies across the system depending on the location of the contingency and availability of synchronous machines in the vicinity. This phenomenon is also being observed in Indian power system with increasing penetration of renewable generation.

In RE rick pockets, inadequate inertial response could result in very high rate of decline in frequency post generation loss and the frequency may dip to a level where automatic load shedding (last line of defence) gets triggered. The addition of the SYNCONs in RE rich pockets can improve the system's inertia and thereby the ability to resist fast changes in frequency.

The simulation results also show the improvement in nadir frequency and the RoCoF after deployment of SynCons in the Rajasthan RE complex. (refer section 3.3)

d) Damping of Low Frequency Oscillations

The Rajasthan renewable complex has been experiencing Low Frequency Oscillations (LFOs) and the same has been a matter of concern for system reliability. It has been seen in the simulation study that deployment of synchronous condensers (with proper tuning of excitation system + AVR) can significantly help in damping of the oscillations. (refer section 3.4)

e) Steady-state Reactive Power Support

The Excitation system and Automatic Voltage Regulator (AVR) of SynCon helps in maintaining the bus voltage at a desired level and contribute to local voltage control by providing dynamically varying reactive power support as per the machine limits. The simulation study results also demonstrate the improvement in voltage profile (refer section 3.5) after deployment of SYNCONs.

References

1. CIGRE JWG A1/C4 TB 885: Guide on the Assessment, Specification and Design of Synchronous Condenser for Power System with Predominance of Low or Zero Inertia Generators

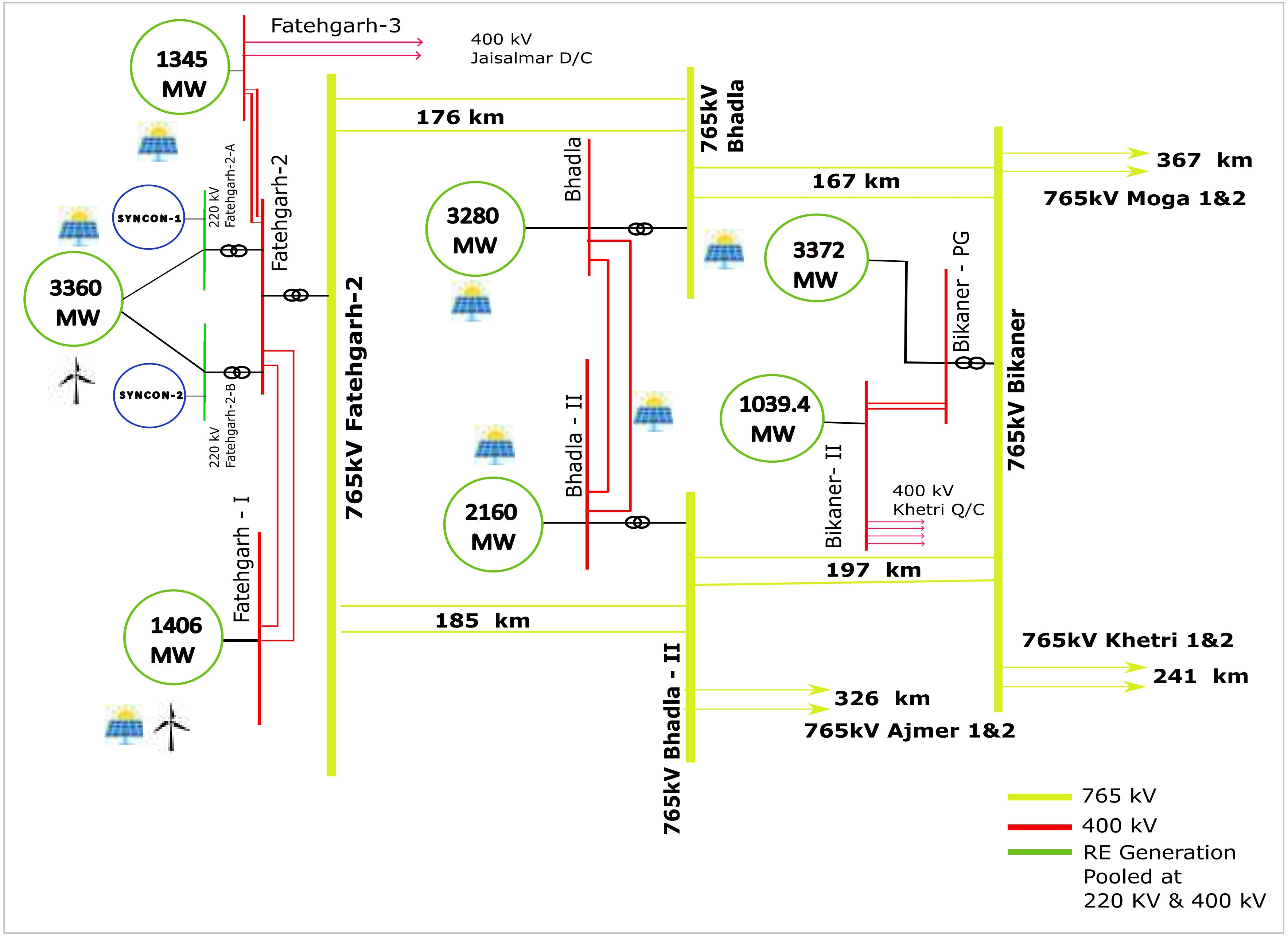
   https://www.e-cigre.org/publications/detail/885-guide-on-the-assessment-specification-and-design-of-synchronous-condenser-for-power-system-with-predominance-of-low-or-zero-inertia-generators.html

2. Dynamic Model Library – PSS/E (Siemens PTI)

3. S. Kynev, G. Pilz and H. Schmitt, "Comparison of modern STATCOM and synchronous condenser for power transmission systems," 2016 IEEE Electrical Power and Energy Conference (EPEC), Ottawa, ON, Canada, 2016 - https://ieeexplore.ieee.org/document/7771769

4. Y. Liu, S. Yang, S. Zhang and F. Z. Peng, "Comparison of synchronous condenser and STATCOM for inertial response support," 2014 IEEE Energy Conversion Congress and Exposition (ECCE), Pittsburgh, PA, USA, 2014, pp. 2684-2690

5. L. Bao, L. Fan and Z. Miao, "Comparison of Synchronous Condenser and STATCOM for Wind Farms in Weak Grids," 2020 52nd North American Power Symposium (NAPS), Tempe, AZ, USA, 2021, pp. 1-6, doi: 10.1109/NAPS50074.2021.9449775.



Fatehgarh-3
400 kV
Jaisalmar D/C
1345 MW
176 km
765kV Bhadla
367 km
167 km
765kV Moga 1&2
SYNCON-1
220 kV
Fatehgarh-2-A
Fatehgarh-2
3280 MW
Bhadla
3372 MW
Bikaner - PG
3360 MW
765kV Fatehgarh-2
765kV Bikaner
SYNCON-2
220 kV
Fatehgarh-2-B
1039.4 MW
Bhadla - II
Bikaner- II
400 kV
Khetri Q/C
2160 MW
Fatehgarh - I
197 km
185 km
1406 MW
765kV Khetri 1&2
241 km
326 km
765kV Ajmer 1&2
765kV Bhadla - II
765 kV
400 kV
RE Generation
Pooled at
220 KV & 400 kV

SCR Study Under Three Cases,

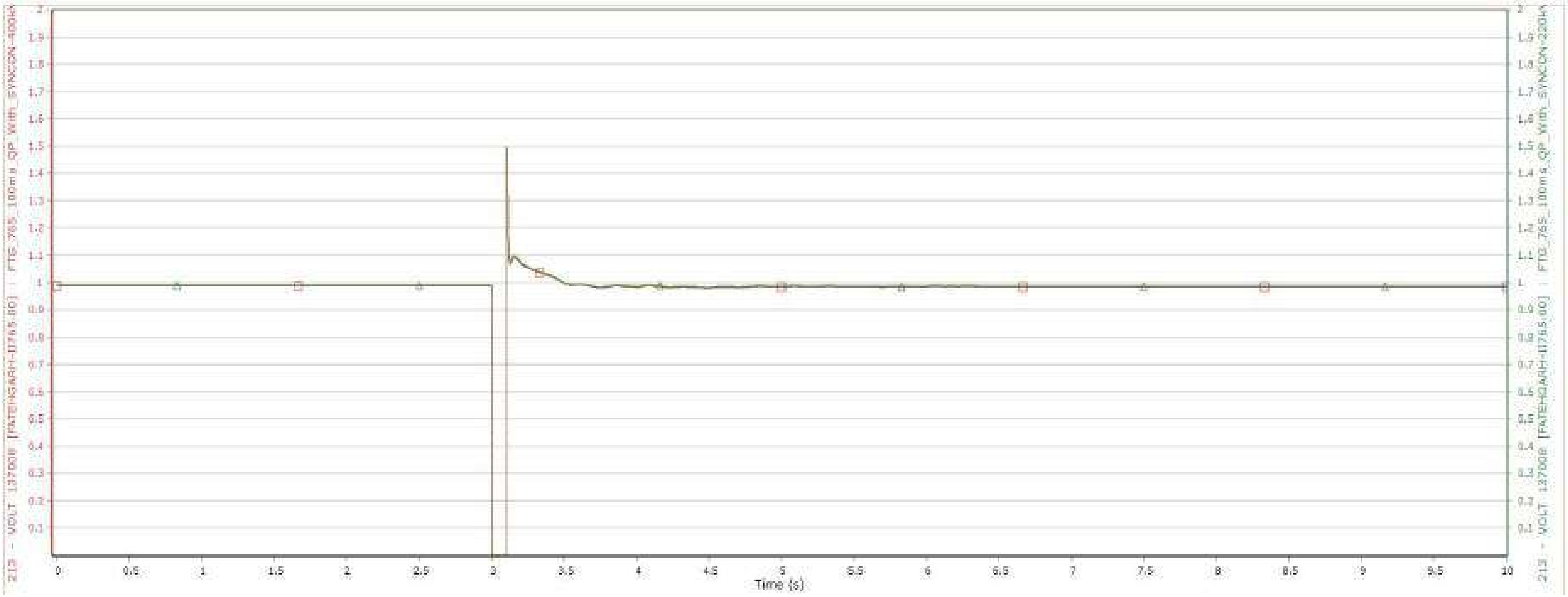
1. 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh - II Bus – 1 & 2
2. 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh - II Bus,
3. 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh - 1 Bus

S. No.	**Pooling Station**	**Installed Capacity**	**Base case**		**With 2x354 MVA SynCons at 220 kV Fatehgarh - II**		**With 2x354 MVA SynCons at 400 kV Fatehgarh - II**		**With 2x354 MVA SynCons at 400 kV Fatehgarh - I**	
		(MW)	Fault MVA	SCR	Fault MVA	SCR	Fault MVA	SCR	Fault MVA	SCR
1.	220 kV Fatehgarh-II (Sec-A)	2490	9950	4.00	12429	4.99	10687.00	4.29	10562	4.24
2.	220 kV Fatehgarh-II (Sec-B)	855	10198	11.93	12692	14.84	10916.00	12.77	10794	12.62
3.	400 kV Fatehgarh-I	996	13219	13.27	14300	14.36	14464.00	14.52	17524	17.59
4.	220 kV Fatehgarh-III	1345	8736	6.50	9002	6.69	9040.00	6.72	8990	6.68
5.	220 kV Bhadla PG	3130	14038	4.48	14341	4.58	14384.00	4.60	14328	4.58

Comparison of Dynamic Performance

1. Fault at 765 kV Fatehgarh – II Bus

Fault at 765 kV Fatehgarh – II Bus

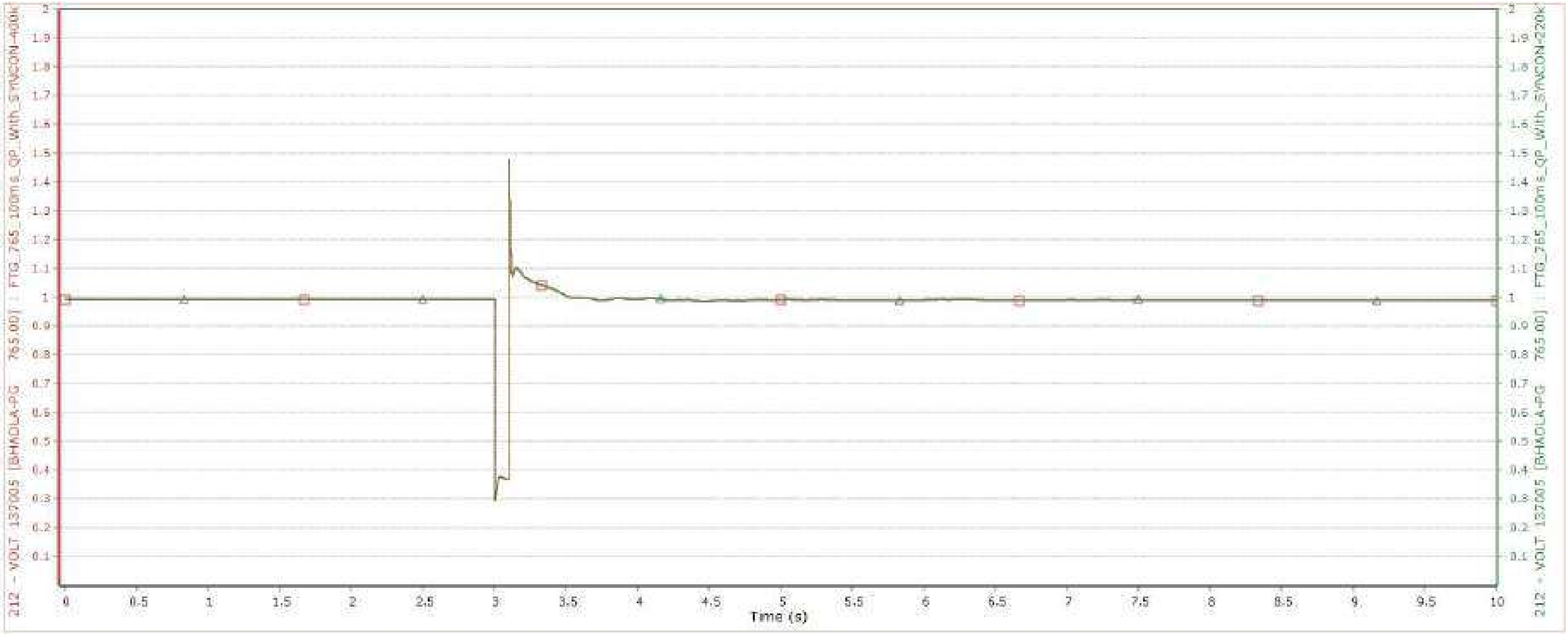


Bus Voltage (in p.u.) of 765 kV Fatehgarh - II – PG Bus

(Red – 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh - II Bus,

Green - 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh – II Bus – 1 & 2)

Fault at 765 kV Fatehgarh – II Bus

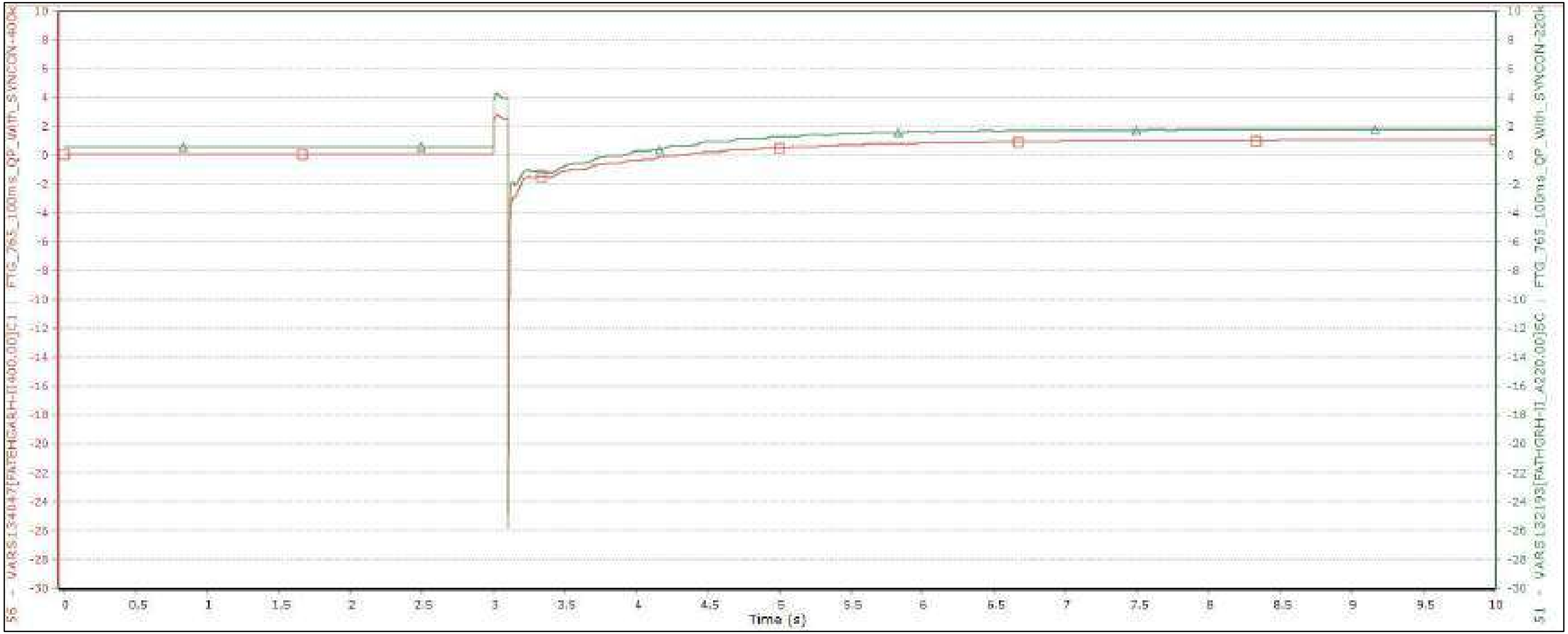


Bus Voltage (in p.u.) of 765 kV Bhadla – PG Bus

(Red – 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh – II Bus,

Green - 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh – II Bus – 1 & 2)

Fault at 765 kV Fatehgarh – II Bus



Reactive Support in p.u. – 100 MVA base from a SynCon
(Red – 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh - II Bus,
Green - 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh – II Bus – 1 & 2)

Fault at 765 kV Fatehgarh – II Bus

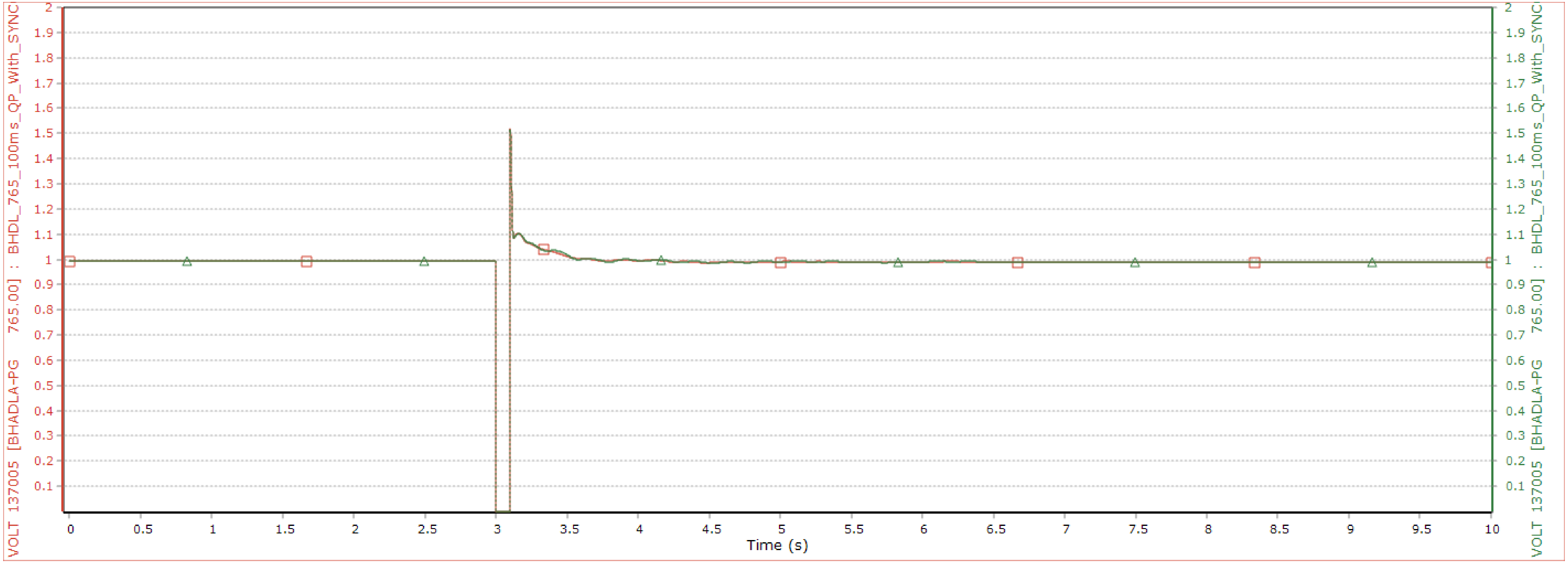
Comparison of SYNCON Performance

S. No.	Description	Time	With SynCons at 400 kV Fatehgarh-II Bus	With SynCons at 220 kV Fatehgarh-II A and B
1	Voltage at 765 kV Fatehgarh-II PG	T = 3.05 sec	0 p.u. (Bolted Fault)	0 p.u. (Bolted Fault)
2	Voltage at 400 kV Fatehgarh-II PG	T = 3.05 sec	0.214 p.u.	0.206 p.u.
3	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.363 p.u	0.41 p.u.
4	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.256 p.u	0.32 p.u.
5	Voltage at 765 kV Fatehgarh-II PG	T = 3.10 sec	1.492 p.u.	1.494 p.u.
6	Voltage at 400 kV Fatehgarh-II PG	T = 3.10 sec	1.521 p.u.	1.519 p.u.
7	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.69 p.u.	1.602 p.u.
8	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.56 p.u.	1.486 p.u.
9	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	A – 3.5 p.u. B – 3.5 p.u.	A - 2.78 p.u. B – 3.21 p.u.
10	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	A – (-) 4.616 p.u. B – (-) 4.616 p.u.	A – (-) 4.30 p.u. B – (-) 4.40 p.u.
11	Response time of SynCons	x	Within one cycle	Within one cycle

Comparison of Dynamic Performance

2. Fault at 765 kV Bhadla Bus

Fault at 765 kV Bhadla Bus

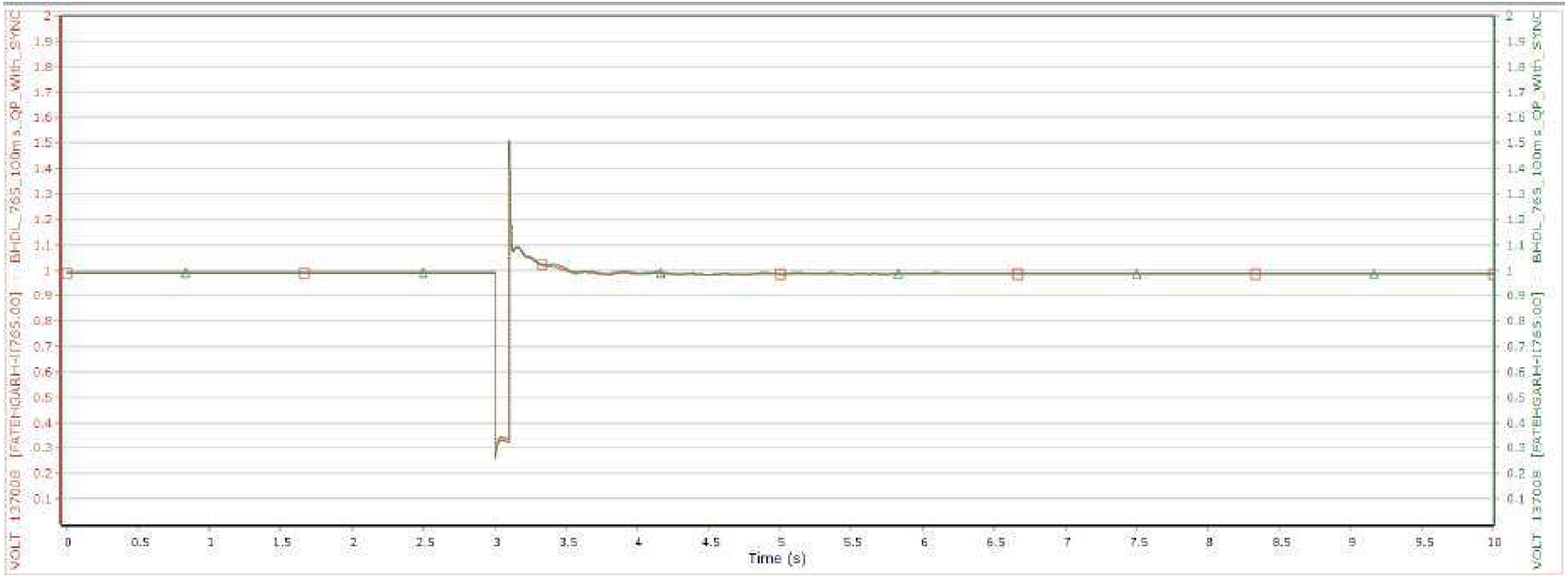


Bus Voltage (in p.u.) of 765 kV Bhadla – PG Bus

(Red – 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh – II Bus,

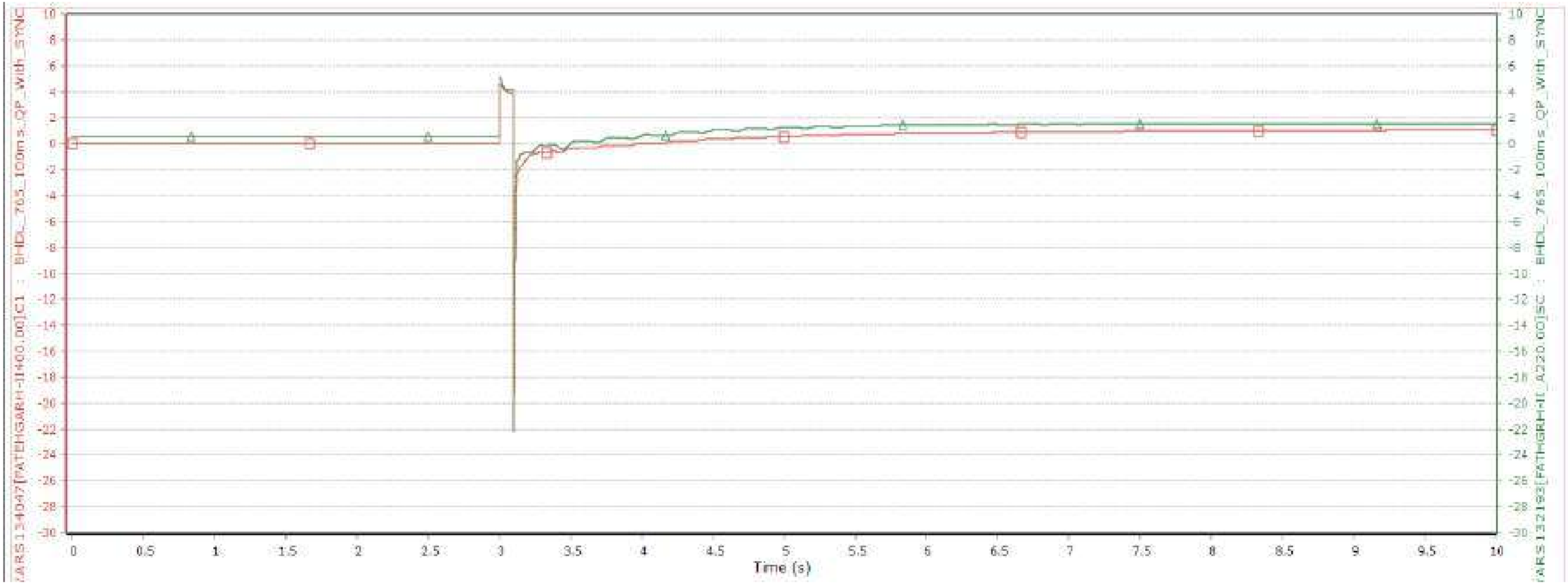
Green - 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh – II Bus – 1 & 2)

Fault at 765 kV Bhadla Bus



Bus Voltage (in p.u.) of 765 kV Fatehgarh – II - PG Bus
(Red – 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh – II Bus,
Green - 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh – II Bus – 1 & 2)

Fault at 765 kV Bhadla Bus



Reactive Support in p.u. – 100 MVA base from a SynCon
(Red – 2 x 354 MVA SYNCON Connected at 400 kV Fatehgarh – II Bus,
Green - 2 x 354 MVA SYNCON Connected at 220 kV Fatehgarh – II Bus – 1 & 2)

Fault at 765 kV Bhadla Bus

Comparison of SYNCON Performance

S. No.	Description	Time	With SynCons at 400 kV Fatehgarh-II Bus	With SynCons at 220 kV Fatehgarh-II A and B
1	Voltage at 765 kV Fatehgarh-II PG	T = 3.05 sec	0.344 p.u	0.332 p.u.
2	Voltage at 400 kV Fatehgarh-II PG	T = 3.05 sec	0.472 p.u.	0.453 p.u.
3	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.05 sec	0.572 p.u	0.584 p.u.
4	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.05 sec	0.502 p.u.	0.528 p.u.
5	Voltage at 765 kV Fatehgarh-II PG	T = 3.10 sec	1.512 p.u.	1.506 p.u.
6	Voltage at 400 kV Fatehgarh-II PG	T = 3.10 sec	1.525 p.u.	1.518 p.u.
7	Voltage at 220 kV Fatehgarh-II PG (Bus-A)	T = 3.10 sec	1.643 p.u.	1.546 p.u.
8	Voltage at 220 kV Fatehgarh-II PG (Bus-B)	T = 3.10 sec	1.556 p.u.	1.475 p.u.
9	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.05 sec	A – 2.424 p.u. B – 2.424p.u.	A - 2.01 p.u. B – 2.32 p.u.
10	Reactive Power/Current Support by SynCon-A and B (in p.u. at unity voltage)	T = 3.10 sec	A – (-) 4.109 p.u. B – (-) 4.109p.u.	A – (-) 4.02 p.u. B – (-) 3.54 p.u.
11	Response time of SynCons	x	Within one cycle	Within one cycle

Annexure-IV

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

विषय: Minutes of 3rd Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 07.06.2024 through Video Conference

महोदय/ महोदया,

3rd Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region was held on 07.06.2024 through Video Conferencing. Minutes of the meeting is attached at **Annexure-I** for kind information and necessary action.

This issues with the approval of MS, NRPC.

Signed by Anzum Parwej
Date: 01-07-2024 17:11:18

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

Annexure-I

Minutes of 3rd Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 07.06.2024 through Video Conferencing

At the outset, Member Secretary NRPC welcomed committee members and other participants in the meeting and directed EE, NRPC to proceed with agenda points. EE, NRPC briefed that as per the discussion in previous meeting of committee, CTU has arranged presentation on Synchronous Condensers from M/s Siemens. MS, NRPC requested M/s Siemens to proceed with their presentation. Salient points of the presentation are as under:

a. M/s Siemens use subset of their Generator portfolio for Synchronous Condensers. The ratings may vary as from 25 MVA to 560 MVA as per market need.
b. Bigger the machine, bigger is the capacity to serve short circuit power, Reactive power or inertia requirement for frequency control.
c. Modern trends are growth in renewable generation which is mostly non-synchronous connected via power electronic converters displacing existing conventional generation and HVDC connections are also growing in the power system.
d. Renewables and HVDC require a certain level of short circuit power. Low short circuit power may lead to voltage instability, cause of malfunction of protection system, deteriorated power quality- harmonics, flicker and voltage imbalance. SynCon strengthen the local grid by providing short circuit power.
e. Synchronous Condenser is an AC synchronous machine without a turbine which can generate or absorb reactive power; which can contribute to system inertia and also provide local short circuit power.
f. Under excited region is ~60% of the nominal rating in comparison to overexcited region in the reactive power capability curve of the SynCon due to limitation in reducing excitation current.
g. Synchronous condenser provides, balanced and clean AC voltage source and immediately opposes any voltage fluctuations. It can contribute short circuit power at HV bus 3-5 times of generator rated power.
h. Inertia in the system is provided by spinning mass of directly synchronized electrical machines. Systems with less inertia will be more unstable to a sudden power imbalance.
i. Synchronous condenser contributes to system inertia and immediately opposes any frequency fluctuations. Flywheel can be attached for higher inertia.

2. After the presentation of M/s Siemens, forum was open to questions. NLDC representative asked how much increase in inertia can be realised by use of flywheel. M/s Siemens replied that it depends on rotor dynamics how big flywheel can be coupled with generator.
3. NLDC representative also asked that capability on the inductive side is around 60% of the rated capacity, is there any way to increase the capability on the inductive side. M/s Siemens replied that it is a physical limitation of the machine as the excitation current cannot be decreased beyond a limit as there will be risk of machine losing synchronism.
4. NRLDC representative asked about cooling requirements of synchronous condensers as there are areas where water availability can be an issue or will the hydrogen cooling will be sufficient. M/s Siemens replied that Hydrogen cooling is not preferred but air cooling is preferred for synchronous condensers application. Cooling technology is totally enclosed water to air cooling and closed loop system. Ambient temperatures of 50 degrees Celsius

may not be a problem as higher the temperature, we do not need to trip the machine but it can be derated for the particular time.

5. NRLDC representative asked, in future there may be 6000 MW HVDC system in Rajasthan RE pocket, if that system goes out, then there will be huge voltage fluctuation, then how does SynCon will help in the situation. M/s Siemens replied that if this happens frequency may also be concern, whereas for voltage fluctuation, STATCOM may give faster response than SynCon.
6. NRLDC representative asked that most of the RE generators in Rajasthan are grid following and facing difficulties in riding through the fault and not able to meet compliance some of the time. With the increasing RE penetration, short circuit level will fall and also lot of harmonic injection will happen. As there is no conventional generator nearby and with synchronous condenser, it is possible that it will damp out some of the harmonics and will maintain sine wave and as a result of synchronous condenser support voltage waveform during the fault and after fault, it will be easier for inverter-based generator to ride through the fault. M/s Siemens replied that once the SynCon with high inertia is in the system, the impact of the fault on the grid will decrease although fault ride through is an inbuilt feature of the inverter-based generators. Severity for the FRT goes down with SynCon as during the fault SynCon may inject short circuit current and may help inverter to ride through the fault.
7. CEA representative said that E-STATCOM (STATCOM with energy storage) is also an emerging technology and what is cost comparison with SynCon. M/s Siemens replied that it may not be easy to compare both technologies and may depend on specifications based on actual requirements.
8. NTPC representative asked about compensation mechanism / tariff model for global SynCon installations. M/s Siemens replied that generally Siemens is not involved in tariff models and that is a question for developers however in UK market tariff bidding is based on additional MW-s (inertia).

MS NRPC thanked M/s Siemens and CTU for the Presentations and all other participants in the meeting. MS NRPC informed the committee that a conference on Synchronous Condenser is being organised by M/s Andritz Hydro on 11.06.2024 in NRPC conference room and committee members are invited to join the same. MS NRPC said that with the help of inputs from committee members & OEMs, a draft report will be prepared & circulated among committee members and next meeting may be held in physical mode in July 2024 for further deliberations. The meeting ended with vote of thanks to the Chair.

List of Participants

NRPC
1. Sh. V K Singh, Member Secretary ---- **In Chair**
2. Sh. Anzum Parwej, SE
3. Sh. Ravi Kant, EE

CEA

4. Sh. Kanhaiya Singh Kushwaha, Asst. Director

CTU

5. Sh. V. Thiagarajan, Sr. GM
6. Sh. Kashish Bhambhani, GM

NLDC

7. Sh. Vivek Pandey, Sr. GM
8. Sh. Priyam Jain, Chief Manager
9. Sh. Aman Gautam, Manager

NRLDC

10. Sh. Bikash Kumar Jha, DGM
11. Sh. Gaurav Singh, Chief Manager
12. Sh. Gaurav Malviya, Manager

PSTCL

13. Sh. Nitin Kumar, Sr. XEN/Planning-1
14. Ms. Ranjana, AE/Planning-1

RVPNL

15. Sh. V. A. Kale, SE (P&P)
16. Dr. Om Prakash Mahela, EE (PP&D)

UPPTCL

17. Sh. Sanjeev Kumar Bahsker, SE

NTPC

18. Sh. Pankaj Kumar Gupta, GM
19. Sh. B S Jena, AGM
20. Sh. Suneet Mehta, DGM
21. SH. V R Bitra, DGM

BHEL

22. Sh. Manoj Kumar, AGM,
23. Ms. Asha Gupta, AGM
24. Sh. Vishal Naidu, DGM
25. Sh. Ranajit Dey, Sr. Manager
26. Sh. Dhanunjayudu Nasika

Siemens

27. Sh. Amor Elkamel
28. Sh. Deepak Varma
29. Sh. Nileshwar
30. Sh. Ankit Pandey

Annexure-V

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

विषय: Minutes of 4th Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 30.08.2024 through Video Conference

महोदय/ महोदया,

4th Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region was held on 30.08.2024 through Video Conferencing. Minutes of the meeting is attached at **Annexure-I** for kind information and necessary action.

This issues with the approval of MS, NRPC.

Signed by Anzum Parwej
Date: 17-09-2024 16:28:17

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

Annexure-I

Minutes of 4th Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 30.08.2024 through Video Conference

At the outset, Member Secretary NRPC welcomed committee members and other participants in the meeting and directed EE, NRPC to proceed with agenda points.

2. EE, NRPC briefed that previously three meeting of the committee has been conducted. First meeting of the committee was held on 22.04.2024. In the first meeting, NRLDC and BHEL gave the presentation on SynCon. CTUIL and CEA were requested to carry out system study for requirement of synchronous condenser. Grid India was also requested to study the impact of installing synchronous condenser in present scenario at Fatehgarh-II which has the least SCR in Western Rajasthan RE complex. RRVPNL was requested to explore possibility of utilising Giral TPS and Dholpur TPS for synchronous condenser mode of operation. Second meeting of the committee was held on 31.05.2024. In the second meeting, M/s Hitachi gave the presentation on other technological solutions such as Enhanced- STATCOM & Hybrid SynCon. Grid India presented its study on impact of installing synchronous condenser in present scenario at Fatehgarh-II which has the least SCR in Western Rajasthan RE complex. Third meeting of the committee was held on 07.06.2024. In the third meeting, M/s Siemens gave the presentation on SynCon. In the third meeting of the committee, it was decided to make a draft report and circulate among committee members for their inputs & suggestions. Committee members were asked to provide general as well as specific inputs for the report however certain inputs have been received from NRLDC, NTPC & CTU only. OEM were also asked to provide estimated cost for installation as well as installation time of SynCon and other technological solutions.
3. EE NRPC briefed that CTUIL based on their study provided a list of proposed locations for Synchronous Condenser in Rajasthan and asked CTUIL representative to brief the committee members on the same. CTUIL representative said that suitable location for installation of SynCons in Rajasthan ISTS system which includes low SCR (<5) as well as with no installation of dynamic compensation [to avoid interaction in between STATCOM and SynCons] are considered. Criteria for area selection for installation of SynCon as given by NLDC was also considered. Adequate space should also be available in the identified substation for installations of SynCons. Based on the connectivity grant, SCR, real time grid issues, following tentative locations have been identified for placement of SynCons subject to availability of space at respective station:

S.No.	Pooling Station	Voltage level	Proposed Synchronous condenser rating*	SCR(by 2027) without SynCon	Reason for requirement of SynCon
1	Fatehgarh-I (wind and solar)	400kV	660MVA 2x[+]300/ (-)150MVAr H (natural) =4 s	9.9	Sustained Oscillations on real time basis as observed by Grid-India and radialized connection
2	Fatehgarh-IV PS (Sec-2)	220kV	660MVA 2x[+]300/	4.6(220kV)	Relatively Low SCR

			(-)150MVAr H (natural) = 4 s	6(400kV)	
3	Ramgarh PS	400kV	660MVA 2x[+]300/ (-)150MVAr H (natural) = 4 s	4.9(220kV) 3.4 (400kV)	Low SCR (with STATCOM), however requires extensive evaluation due to control interaction between STATCOM and Syncon
4	Bhadla-III	400kV	660MVA 2x[+]300/ (-)150MVAr H (natural) = 4 s	3.5(220kV) 3.2 (400kV)	Low SCR

Additional requirement of flywheel (with natural inertia of 1000-3000MWs) shall be identified at time of finalization of proposal.

Location of SynCons as close to the generation [220kV] may appear to increase the SCR. However, at the same time at 400kV level its efficacy in supporting the grid will be more. Therefore, a prudent decision for SynCon placement at 220kV or 400kV needs to be taken on case-to-case basis.

4. MS NRPC said that in the first meeting all members agree that there is a need of installation of SynCon in the country and it was thought that initially SynCon may be setup in at a particular location in Rajasthan based on study of CTUIL and CEA. Thereafter, as per requirement of SynCon in the timeline of years 2026, 2028 and 2030 shall be included in the report. If requirement of SynCon is decided by end of 2024, even then the whole process of tendering, awarding, installation and commissioning may take 2 to 3 years. However, CTUIL have given tentative requirement of SynCon by 2027. Therefore, if Committee members agree, Committee shall include requirement of SynCon from 2027, 2028, 2029 & 2030 corresponding to 500 GW non-fossil fuel-based energy capacity. Other technologies like E-STATCOM and Hybrid SynCon are also evolving but as per the mandate of this committee, we will only recommend SynCon of appropriate capacity at existing locations based on study by CTUIL and CEA based on system requirements, since for future/projects under planning stage, required reactive support with appropriate technology is already being considered at the approval/award stage itself.
5. CTUIL representative said that mainly criteria for selection of location for SynCon are substations in which more issues are being faced in real-time and low SCR in future substations. First location Fatehgarh-I is an existing substation and is radially connected to Fatehgarh-II at 400 kV level. Lot of oscillation are observed at Fatehgarh-I and Fatehgarh-II by Grid India. NRLDC did study on Fatehgarh-II but Fatehgarh-II is already having a STATCOM of 600 MVAR and SCR is also improving slowly at Fatehgarh-II. After upcoming connectivity, SCR at Fatehgarh-II may go beyond 5. SynCon at Fatehgarh-I will also help at Fatehgarh-II and it is therefore Fatehgarh-I is chosen over Fatehgarh-II. SynCon at Fatehgarh-I will also help at Fatehgarh-II. CTUIL also requested to do study on Fatehgarh-I to check the response of SynCon to different transients on real-time basis. Other 3 locations Fatehgarh-IV PS (sec-2), Bhadla-III PS and Ramgarh PS are under implementation which will come progressively in

year 2026 timeframe. CTUIL rep. said that full generation is considered based on the connectivity granted by CTUIL. While Fatehgarh-IV (sec-2) may have low SCR at 220 kV level, Ramgarh PS & Bhadla-III PS may have low SCR at both 220kV & 400kV level. Also, Ramgarh PS & Bhadla-III are connected with HVDC system in the radial manner. With the SynCon at this location, it will improve SCR, dynamic compensation as well as help the HVDC system to operate in a reliable manner. These four locations have been presently identified. CTU representative also said that convergence issues are being faced for future timeframe dynamics files for which discussion are being carried out with OEMs/Siemens (PSS/E) & IIT Mumbai. Therefore, a methodology has been adopted to identify optimal location for installation of SynCons in the interim.

6. MS NRPC said that this committee is setup for study and recommendation for setup for SynCon up to 2030. For system requirements, other technologies like STATCOM, E-STATCOM, SVC and Hybrid SynCon are evolving. All technologies have their pros and cons. This committee will only recommend location and capacity of SynCon up to 2030 based on study by CTUIL and CEA based on system requirements.
7. CE PSPA-I (CEA) said that wherever oscillations are observed in the system and SCR is low, committee should recommend SynCon there. In new system transmission system, which is being planned with huge RE zones in Rajasthan and no thermal capacity is in the vicinity, we should recommend new transmission system with STATCOM/SynCon so that STATCOM/SynCon can be made integral part of the system which is bid out. Wherever we are recommending SynCon in existing station, land requirement issue may come up as provisions may have not been kept for future. So whatever new substation we are planning, we can make STATCOM/SynCon as integral part of the transmission system. MS NRPC said that while planning for new transmission system during the approval at NCT level along with transmission line and substation either SynCon or STATCOM or any other technology may also be included at the time of approval of complete transmission system. CE PSPA-I said that STATCOM is already deliberated and approved at the NCT level and in a similar way SynCon can also be taken up.
8. MS NRPC asked BHEL for tentative requirement of Land for 300 MVAR system in Fatehgarh-I. BHEL stated that land requirement was already communicated to CTU and PowerGrid. MS NRPC asked BHEL representative to provide the land requirement of 300 MVAR SynCon to the Committee. BHEL representative confirmed for same. BHEL representative said that this committee should also deliberate how the project will be executed. First installation of SynCon may come only by 2027. Whether it will go as TBCB project or it will go as a pilot project.
9. CTU representative suggested that Pilot project can be taken up at Fatehgarh-I because it is an existing station and rest of the 3 sub-stations are under implementation in which Bhadla-III PS and Ramgarh PS will come first and Fatehgarh-IV PS (sec-2) will come after six months (approx.) after Bhadla-III PS and Ramgarh PS.
10. MS NRPC said if this committee agree for Fatehgarh-I as Pilot project then how the project will be funded or tariff will be recovered. MS NRPC asked view of committee members.
11. Andritz Hydro representative said that in the past, Transmission lines have been bid out as RTM or TBCB mechanism and now we are talking of first SynCon coming in existing substation that we have to see these as standalone elements in the existing system; therefore, we would see bidding process as separate package of SynCon along with auxiliaries. There are two ways for implementation. First is to order SynCon as investment, another way is as we see in Australian market, where there are service providers, and these service providers are the ones who set up the asset, they make all the investment and then

they charge on the basis of per MVAR per month. And in the both scenarios whether there is upfront payment during the construction of the project or both could be rationalised or socialised over the billing charges in that region. So, either full tender may be floated or SynCon as services can be implemented.

12. MS NRPC asked NRLDC whether it can be accommodated in our accounting system. One particular company is awarded L1, that company will be service provider and have to recover the amount in 20 or 25 years. NRLDC said that it is possible through bidding and NLDC has prepared some note which they can elaborate.
13. MS NRPC asked other committee members for suggestions. CE PSPA-I, CEA said that recently a scheme was under bidding and two STATCOMs are bid out under TBCB mechanism. Whatever is being followed for STATCOM, same can be followed for SynCon.
14. Hitachi rep. said instead specifying the machine size, specify by grid requirement at particular node (Short Circuit MVA and Inertia Requirement), to fulfil this OEM will give performance guarantee. Machine design and equipment selection may be left with OEM. NRLDC rep. said whether land requirement should also be mentioned. Hitachi rep. said footprint can be mentioned.
15. NLDC rep. presented a draft note [*subject to approval from NLDC*, attached at Annexure-II] on compensation mechanism for SynCon facilities. Whether the bidding would be combined bidding specifying system requirements like Reactive power, SCR or Inertial requirement or whether it would be a separate bidding for SynCon and STATCOMs because our understanding is that planning committee would decide whether SynCon at any location would be planned or whether STATCOM or any other reactive power compensation device would be planned and accordingly these devices would be bid out. Currently STATCOM at many locations have been planned. Previously, SVCs were also planned in similar manner. We are of understanding that SynCons would also be finalised in planning committee meeting itself instead of specifying generic system strength and inertial requirement and going for technology agnostic bid. In the initial stages, device would be finalised first by planning committee and accordingly bidding for particular device would be carried out. **MS NRPC said that for new transmission system, requirement of SynCon or STATCOM or any other device is already dealt during the planning of the new system. Mandate of this committee is only to see requirement of the SynCon in existing system.**
16. NLDC said regarding compensation for SynCon there can be two methodologies. Either we can consider SynCon as generating asset and then there is two-part tariff like Fixed Charge and Variable Charge. Another method is we can treat SynCon as transmission asset and compensation can be through monthly transmission charges. If we treat as generating asset, then SynCon will work as a reactive power compensation device and that reactive power exchange would depend on the voltage at the node at which it is connected and other settings suggested by the system operator in real-time and if voltages are within limits, then there might be many instances that no substantive reactive power exchanges with the grid would take place and therefore this methodology may need further deliberation. Therefore, we should go for second methodology and treat SynCon as transmission asset. There are suitable provisions in the relevant regulation for the same. The methodology is fairly simple similar to STATCOM, we can treat it as dynamic reactive power compensation device. The bidding can be done in similar manner as STATCOM. The planning requirements would be decided and based on that bidding could be carried out. The compensation mechanism can be kept fairly simple, based on monthly transmission charges that would be computed. As per Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020 it is mentioned *"Yearly Transmission Charges for static*

compensators (STATCOMs), static VAR compensators (SVCs), bus reactors, spare transformers, spare reactors and any other transmission element(s) located in the concerned region and identified by the Central Transmission Utility as being critical for providing stability, reliability and resilience in the grid." Based on this clause, SynCon could be considered as transmission asset and compensation would be considered under the regional component and Northern Regional entities would bear the cost for the same and as far as the active power consumption and losses in SynCon are considered, we can refer to IEGC 2023 regulations in which it is mentioned (the clause is currently for IBR) *"…(c) All the Inverter Based Resources (IBRs) covering wind, solar and energy storage shall ensure that they have the necessary capability, as per CEA Connectivity Standards, all the time including non-operating hours and night hours for solar. The active power consumed by these devices for purpose of providing reactive power support, when operating under synchronous condenser/night-mode, shall not be charged under deviations and shall be treated as transmission losses in the ISTS."* ***If we consider both the regulations, the SynCon can be considered as transmission asset and that would make compensation mechanism fairly simple.*** Going forward we can explore other methodologies based on experience from operating these devices. MS NRPC said that as we can see there are provisions regarding tariff recovery and also for compensation losses so this could be one option.

17. NTPC rep. asked, does the developer require a transmission license in case we are treating as SynCon as transmission element. NRLDC rep. said that it will be treated same as STATCOM. STATCOM developers are there in the market. Transmission licensees are owning that STATCOM. In similar way, transmission licensee will be owner of the SynCon and they will recover the cost through yearly tariff mechanism.
18. CE PSPA-I, CEA said that ownership would be decided by which mechanism the SynCon is bid out. If it is bid out through RTM to any utility then that utility will be the owner and if we go through TBCB bidding then whomsoever wins the bid, that utility (TSPs) will be owner. TSPs may further tie up with the developers/OEMs for the project. Andritz Hydro rep. asked who will do the tendering for SynCon. CE PSPA-I told that if the TBCB method is adopted and then tendering process would be carried out by Bid Process Coordinator (BPC). We have two BPC in the country as PFCCL and RECTPCL. MS NRPC said that after finalizing the report, this committee will send the report to CEA as per the mandate of committee with certain recommendations. After submission of report, CEA will examine and may put up for approval at appropriate level, may be at NCT level. After approval of NCT for certain capacity requirement at certain location through TBCB, then it will go for bidding by BPC. If this award goes to any TSP, then the TSP will be the owner. After that TSP will go for tendering. During the tendering process, all the OEMs would be bidding and the award for installation of SynCon may go to L1. MS NRPC asked CTUIL if any further studies required at CTU level for finalising locations as provided by CTUIL.
19. CTUIL rep. said if NRLDC can study at Fatehgarh-I like they have done for Fatehgarh-II then it will be clear if Fatehgarh -I is better choice than Fatehgarh-II or not. For future substation, we took criteria of low SCR as well as vulnerability of HVDC and no STATCOM installation is taken into consideration. But for pilot project, we can take a call for Fatehgarh-I vs Fatehgarh-II. NRLDC rep. said that Fatehgarh-I & Fatehgarh-II are radially connected and line length is also not very long. But carrying out complete studies for Fatehgarh-I will take a lot of time either we can go forward with the current study also and install SynCon at Fatehgarh-II or Fatehgarh-I also as study results will not change significantly as Fatehgarh-I & Fatehgarh-II are closely located. Whatever at Fatehgarh-II is going to affect at Fatehgarh-I whether it is fault level or inertia. So Fatehgarh-II would be better candidate for SynCon

installation. MS NRPC said that study may be carried out for both Fatehgarh-I and Fatehgarh-II and a clear recommendation may be given for first installation. MS NRPC said that NRLDC, NLDC, CTU & CEA may refine the proposal for SynCon installation. Initially, 3 or 4 locations may be recommended. This will be further examined at appropriate level in CEA/CTU. CTUIL may also confirm if land is available at probable locations. BHEL may give land requirement to committee and CTUIL. CTUIL may give refined proposal within fortnight.

20. Siemens rep. said as this will be first SynCon installation we should plan sufficient time as the requirement of SynCon is developed for the first time and there would be lot of issues for which clarifications may be needed. After installation of pilot project, we will be in a better position to see how much we can speed up. Second point is that as Siemens is onboarded in the committee from the fourth meeting, the proceeding of previous three meeting if can be shared, Siemens may provide input accordingly. NRLDC rep. said that minutes of previous meetings can be shared, however w.r.t. regarding tendering process and how much time will take and what methodology will be adopted. These issues may be decided by CEA and at that time OEM can give their comments. This committee can recommend only placement and requirement of SynCon based on CTU/NRLDC/NLDC/CEA study. MS NRPC said that this committee will recommend setup of SynCon in Northern region but requirement of SynCon may be on Pan-India basis. Based on experience in northern region, requirement of SynCon in other locations in the country may be assessed by CEA/CTUIL.
21. NRLDC said that they have taken modelling data based on the available literature and requested that BHEL and other OEM can provide modelling data so that results may be more accurate. CE PSPA-I, CEA asked OEMs if they are ready to provide the modelling data to NRLDC. BHEL said we can sign NDA but we would also be part of complete studies. CE PSPA-I, CEA said that NRLDC have also signed NDA and the studies file cannot be shared although results can be shared and any comments or feedback can be taken to finetune the results. CE PSPA-I, CEA said that if the modelling data is not provided, then we may go ahead with general data with which NRLDC/NLDC have made studies. Hitachi rep. said they have already provided PSSC files to CTU and PowerGrid for their studies and they are ready to help if any need arises.
22. Following points have emerged from the discussion of committee members:
    a. Committee shall recommend a pilot project of appropriate capacity in Rajasthan to be commission in year 2027 based on study of CTUIL, GRID INDIA & CEA.
    b. Committee shall also recommend future locations in the timeframe of Year 2028, 2029 & 2030.
    c. BHEL shall provide land requirement for capacity of 300 MVAR SynCon to Committee and CTU/NRLDC.
    d. OEMs shall provide modelling data to CTUIL/Grid India for study, if they agree.
    e. CTU, NRLDC, NLDC & CEA rep. shall discuss internally and may arrive on consensus on location and capacity of SynCons installation. CTUIL shall send fresh recommendations regarding capacity and location for SynCon for pilot project as well as for future timeframe based on the study by CTUIL/ GRID INDIA along with reasons to committee.
    f. Draft report after incorporation of inputs of CTU as well as other utilities shall be circulated among committee members and OEMs for their feedback.
    g. Report shall be finalised in the next meeting of committee.

MS NRPC said that after the incorporation of recommendation by CTU/NRLDC/NLDC in report, we may once again circulate the report among committee members and OEMs for inputs/suggestions.

MS NRPC thanked committee members and all other participants in the meeting. The meeting ended with vote of thanks to the Chair.

List of Participants

NRPC

1. Sh. V K Singh, Member Secretary ---- **In Chair**
2. Sh. Anzum Parwej, SE
3. Sh. Ravi Kant, EE

CEA

4. Sh. Ishan Sharan, CE
5. Sh. Kanhaiya Singh Kushwaha, Asst. Director

CTU

6. Sh. V. Thiagarajan, Sr. GM
7. Sh. Sandeep Kumawat

NLDC

8. Sh. Vivek Pandey, Sr. GM
9. Sh. Priyam Jain, Chief Manager
10. Sh. Aman Gautam, Manager

NRLDC

11. Sh. Bikash Kumar Jha, DGM
12. Sh. Gaurav Singh, Chief Manager
13. Sh. Gaurav Malviya, Manager

PSTCL

14. Sh. Nitin Kumar, Sr. XEN/Planning-1
15. Ms. Ranjana, AE/Planning-1

RVPNL

16. Sh. V. A. Kale, SE (P&P)
17. Dr. Om Prakash Mahela, EE (PP&D)

UPPTCL

18. Sh. Sanjeev Kumar Bahsker, SE

NTPC

19. Sh. Pankaj Kumar Gupta, GM
20. Sh. B S Jena, AGM
21. Sh. Suneet Mehta, DGM
22. SH. V R Bitra, DGM

BHEL

23. Sh. Manoj Kumar, AGM,
24. Ms. Asha Gupta, AGM
25. Sh. Vishal Naidu, DGM
26. Sh. Ranajit Dey, Sr. Manager
27. Sh. Dhanunjayudu Nasika

Special Invitee

Siemens

28. Sh. Ankit Pandey

Andritz Hydro

29. Sh. Avinash Thakur

Hitachi

30. Sh. P. Giridharan

<u>Proposed Compensation Mechanism for Synchronous Condenser Facilities</u>

Synchronous condensers are rotating dynamic reactive power compensation devices, primarily engaged in reactive power exchange with the grid. The exchange of active power by these devices is minimal, limited to covering active power losses.

Accordingly, the following compensation mechanisms for a synchronous condenser facility can be considered:

a) **Classification as an active power generating unit:** Implementing a two-part tariff (Fixed and Variable charges). Variable charges could be based on the reactive power exchanged with the grid.
b) **Classification as a transmission asset:** Compensating through monthly transmission charges.

The reactive power exchange of a synchronous condenser is dependent on the grid voltage. If the voltage remains within permissible limits, there might be extended periods of no reactive exchange of the SynCon with the grid. Therefore, the first compensation mechanism which is based on reactive power exchange may not be suitable at this stage and shall be explored in future after gaining sufficient experience of operation of these devices in the grid.

Given these considerations, synchronous condensers could be classified as transmission assets, with cost recovery through monthly transmission charges (regional component). The following clause from the CERC ISTS Transmission Charges regulation also supports this compensation mechanism:

Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020

Components and sharing of Regional Component (RC), Clause 6, 1 (b)

"Yearly Transmission Charges for static compensators (STATCOMs), static VAR compensators (SVCs), bus reactors, spare transformers, spare reactors and ***any other transmission element(s)*** *located in the concerned region and* ***identified by the Central Transmission Utility as being critical for providing stability, reliability and resilience in the grid****.*

Provided that where separate Yearly Transmission Charges are not available in respect of specific transmission elements, the Yearly Transmission Charges for such transmission elements shall be worked out and provided by the Central Transmission Utility, apportioning Yearly Transmission Charges approved by the Commission for the integrated project, based on indicative capital cost."

Additionally, it is proposed that the active power consumed by a Synchronous Condenser be treated as transmission losses within the ISTS and not be charged under deviations. The following clause in the CERC Indian Electricity Grid Code, 2023 regulation supports this proposal:

Reactive Power Management

39 (11) Any commercial settlement for reactive power shall be governed as per the regulatory framework specified in ***Annexure–4*** *until the same is separately notified as part of the CERC Ancillary Services Regulations.*

where Annexure-4 specifies that:

<u>Proposed Compensation Mechanism for Synchronous Condenser Facilities</u>

> *"…(c) All the Inverter Based Resources (IBRs) covering wind, solar and energy storage shall ensure that they have the necessary capability, as per CEA Connectivity Standards, all the time including non-operating hours and night hours for solar.* ***The active power consumed by these devices for purpose of providing reactive power support, when operating under synchronous condenser/night-mode, shall not be charged under deviations and shall be treated as transmission losses in the ISTS****."*

Classifying synchronous condensers as transmission assets would also align their bidding and compensation methodology with other similar technologies, such as STATCOMs and SVCs, thereby ensuring uniformity across different technologies.

It is also suggested that the availability computation of SynCon shall be on similar lines as specified for STATCOM in relevant regulations notified by respective commissions from time to time. The weightage factor shall be considered on pro-rata basis i.e. ratio of maximum available capacity / rated capacity of SynCon.

In future, the compensation mechanism for dynamic reactive power compensation devices shall also factor in their performance in real-time.

Annexure-VI

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

विषय: Minutes of 5th and final meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 10.12.2024 through Video Conference- reg.

महोदय/ महोदया,

5th and final meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region was held on 10.12.2024 through Video Conference. Minutes of the meeting is attached for kind information and necessary action.

This issues with the approval of MS, NRPC.

Signed by Anzum Parwej
Date: 17-12-2024 12:34:37

(अंजुम परवेज)
अधीक्षण अभियंता (प्रणाली अध्ययन)

To:

All Committee Members (Through Email)

OEMs (Through Email)

Copy for information to:

1. PSO to Member Secretary, NRPC

Minutes of 5th Meeting of the Committee to do futuristic analysis for requirement of Synchronous Condensers based on inertia considerations for Northern Region held on 10.12.2024 through Video Conference

At the outset, Member Secretary (MS) NRPC welcomed committee members and OEMs present in the meeting. List of participants attached at Annexure-I.

MS, NRPC stated that in the previous meeting, it was discussed that a draft report will be circulated between the committee members for their final comments and inputs and the report of committee shall be finalised in next meeting of committee. Comments from NRLDC, NLDC, M/s Andritz Hydro & M/s Hitachi have been received. MS, NRPC further stated that the report will be discussed chapter wise and if committee members have any further comments in the meeting, committee can discuss and appropriately incorporate in the report. MS NRPC directed EE, NRPC to proceed and show committee report chapter by chapter.

2. EE, NRPC presented the report chapter by chapter in the meeting. CTUIL representative made an observation that in the executive summary of report there should be brief conclusion of the report also. Committee members agreed to include a brief conclusion of report in executive summary. Comments by NRLDC/NLDC & M/s Andritz Hydro were generally agreed in principle by committee members barring few comments for which inputs were sought from committee members within 2-3 days. M/s Hitachi comments on the report were discussed however most of comments were mainly focusing on E-STATCOM.
3. RVPNL representative also said that state prospective should also be included in the report. MS NRPC requested to provide the input from RVPNL on state prospective within 2-3 days so that it can be appropriately included in report.

MS NRPC said that on receipt of such inputs, committee report shall be finalised and presented in the upcoming NRPC meeting and thereafter shall be submitted to CEA. MS NRPC thanked committee members and all other participants in the meeting.

The meeting ended with vote of thanks to the Chair.

*****

Annexure-I

List of Participants

NRPC

1. Sh. V K Singh, Member Secretary ---- **In Chair**
2. Sh. Anzum Parwej, SE
3. Sh. Ravi Kant, EE

CEA

4. Sh. Ishan Sharan
5. Sh. Kanhaiya Singh Kushwaha, Asst. Director

CTUIL

6. Sh. V. Thiagarajan, Sr. GM
7. Sh. Kashish Bhambhani, GM
8. Sh. Sandeep Kumawat, DGM

NLDC

9. Sh. Priyam Jain, Chief Manager

NRLDC

10. Sh. Bikash Kumar Jha, DGM
11. Sh. Gaurav Singh, Chief Manager
12. Sh. Gaurav Malviya, Manager

PSTCL

13. Sh. Nitin Kumar, Sr. XEN/Planning-1
14. Ms. Ranjana, AE/Planning-1

RVPNL

15. Sh. V. A. Kale, SE (P&P)
16. Dr. Om Prakash Mahela, EE (PP&D)

NTPC

17. Sh. Suneet Mehta, DGM
18. SH. V R Bitra, DGM

BHEL

19. Sh. Manoj Kumar, AGM,
20. Ms. Asha Gupta, AGM
21. Sh. Vishal Naidu, DGM
22. Sh. Ranajit Dey, Sr. Manager
23. Sh. Dhanunjayudu Nasika

<u>Special Invitee</u>

Siemens

24. Sh. Ankit Pandey

Andritz Hydro

25. Sh. Avinash Thakur

Hitachi

26. Sh. P. Giridharan

Annexure-VII

सत्यमेव जयते

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
तापीय परियोजना नवीनीकरण एवं आधुनिकीकरण प्रभाग
Thermal Project Renovation & Modernization Division

No.: CEA-TH-14-24/5/2022-TRM Division/235-335 Dated 20.01.2023

विषय: Renovation and Modernisation (R&M) of aged coal-fired Thermal Power Stations (TPS) - reg.

The Govt. of India is striving to provide affordable electricity on 24x7 basis to common citizen. However, the country is witnessing huge energy demand post pandemic which is projected to surge at all-time high in coming summer of 2023 and beyond. Therefore, the role of thermal fleets including old thermal units becomes crucial in order to support renewable integration.

Hon'ble minister in the meeting held on 06.12.2022 (**copy enclosed**) advised not to retire any thermal units and urged for carrying out R&M for life extension and improve the flexibility and reliability of thermal units considering the expected demand scenario and availability of capacity in future. It may be noted that about 15-16 GW of new thermal capacity is expected by December 2023. Accordingly, R&M for life extension is to be considered after December 2023. However, RLA and other pre-R&M/LE related preparatory works may be taken up in the meantime.

Therefore, it is advised to all power utilities not to retire any thermal units till 2030 and ensure the availability of units after carrying out R&M activities, if required.

बि मल्लिक 20/01/2023
(B C Mallick) / (बी सी मलिक)
CE (TPRM) / सीई (टीपीआरएम)

To:
As per the list.
Copy for information:

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2. Chairperson, CEA
3. Member (Thermal), CEA

To:

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No. 11/3/2022-Th-I
Government of India
Ministry of Power

Shram Shakti Bhawan, Rafi Marg,
New Delhi, dated 23th December, 2022

OFFICE MEMORANDUM

Sub: Minutes of the Meeting held under the Chairmanship of Hon'ble Minister of Power & NRE on 06.12.2022 at 03:30 PM to discuss Life Extension (LE) and Renovation and Modernization (R&M) of Coal Based Thermal Power Plants - Reg.

The undersigned is directed to forward herewith a copy of Minutes of the Meeting held under the Chairmanship of Hon'ble Minister of Power & NRE on **06.12.2022 at 03:30** PM at 2nd Floor, Shram Shakti Bhawan, Rafi Marg, New Delhi to discuss Life Extension (LE) and Renovation and Modernization (R&M) of Coal Based Thermal Power Plants.

Encl: As above

(Sunil Kumar Sah)
Under Secretary to the Government of India
Telefax: 23719710

To:

1. Chairman, CEA
2. CMD, NTPC Ltd.

Copy for information to:

PS to Hon'ble Miniser of Power & NRE /PS to Hon'ble MoS (Power & HI)/Sr. PPS to Secretary (P)/PPS to JS (Th)/ PS to Dir (Th), Ministry of Power

(Sunil Kumar Sah)
Under Secretary to the Government of India

Minutes of the meeting held under the Chairmanship of Hon'ble Minister of Power & NRE on 06.12.2022 to discuss Life Extension (LE) and Renovation and Modernization (R&M) of Coal Based Thermal Power Plants

List of Participants is given at **Annexure**.

2. At the outset, Secretary (Power) welcomed all the participants and apprised the agenda of the meeting. It was informed that Renovation & Modernization (R&M) is an important but neglected area. Various states are going for retirement and subsequent repurposing of their plants instead of opting for R&M in more efficient manner.

3. CMD, NTPC briefed about the R&M experience of GSECL's Wanakbori Thermal Power Station and NTPC's Ramagundam TPS.

4. Considering the expected demand scenario and availability of the capacity, Hon'ble Minister instructed not to retire any thermal Unit and urged to carry out R&M for life extension and improve the flexibility and reliability of the Units.

5. CEA made a presentation explaining objectives and guiding principles of R&M emphasizing that priority should be given to R&M and LE. It was agreed that CEA will take up with States and other Utilities for revisiting their plans for retirement/ re-purposing of thermal Units, if any.

6. Secretary (Power) asked CEA to prepare a scheme for LE and R&M and a phasing plan for the R&M of Units.

7. It was discussed that 15-16 GW of new thermal capacity is expected by December 2023. Accordingly, R&M for life extension is to be considered after December 2023. However, RLA and other pre-R&M / LE-related preparatory works are to be taken up.

8. Hon'ble Minister asked CEA to review the off-bar capacity Utility wise and take measures for bringing them on-bar.

The meeting ended with a vote of thanks to all the participants.

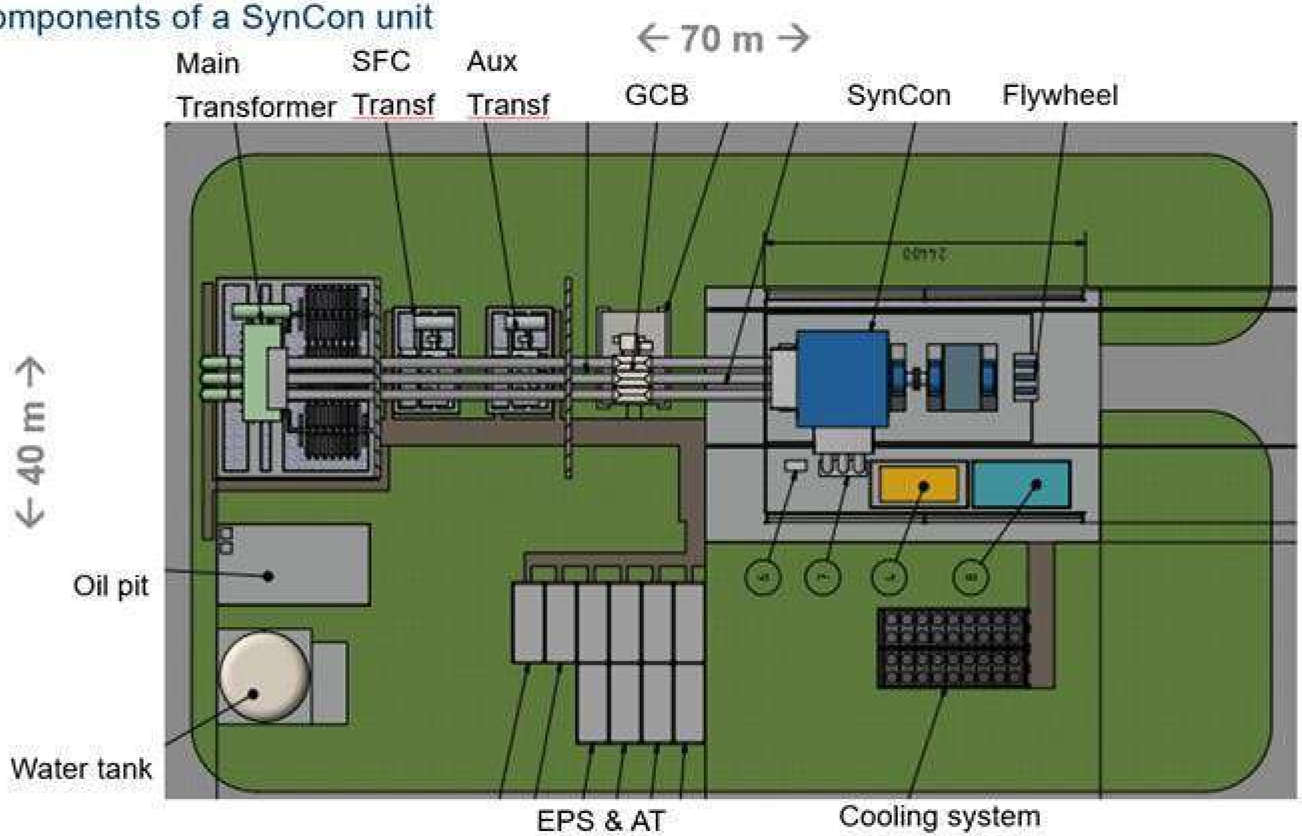
***

Annexure

List of Participants in the Meeting held under the Chairmanship of Hon'ble Minister of Power & NRE on 06.12.2022 to discuss Life Extension (LE) and Renovation and Modernization (R&M) of Coal Based Thermal Power Plants.

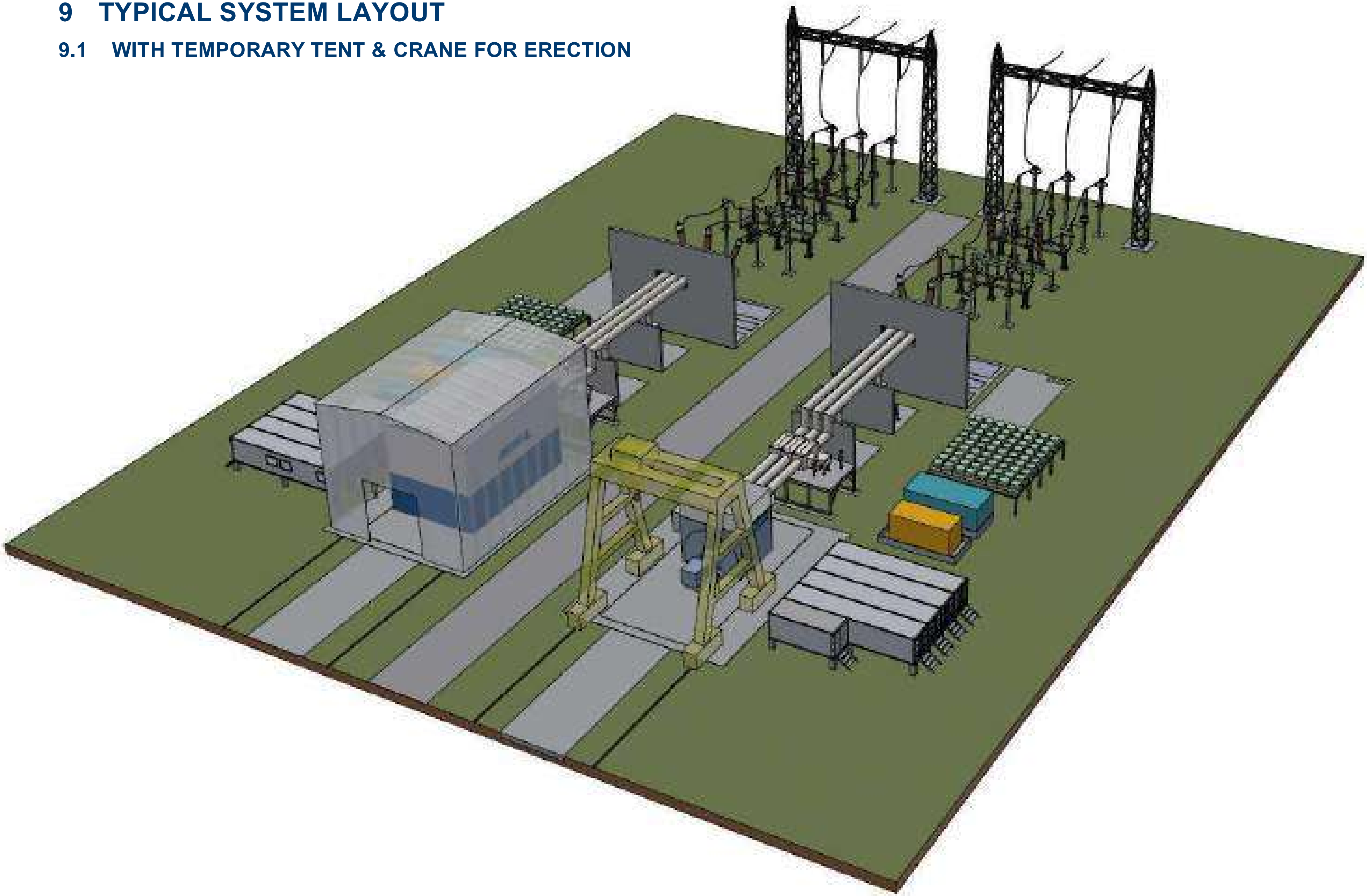
S. No	Name	Designation
Ministry of Power		
1	Shri Alok Kumar	Secretary
2	Shri Piyush Singh	Joint Secretary (Thermal)
3	Shri Satish Kumar	Director (Thermal)
4	Shri Sunil Kumar Sah	Under Secretary (Thermal)
CEA		
5	Shri Praveen Gupta	Member (Thermal)
6	Shri B C Mallick	Chief Engineer, TPR&M
7	Shri Pravir Kumar	Director, TPR&M
8	Shri Surender Kumar	Dy. Director, TPR&M
NTPC Ltd		
9	Shri Gurdeep Singh	CMD
10	Shri U K Bhattacharya	Director (Projects)
11	Shri Ramesh Babu	Director (Operations)
12	Shri M K Shrivastava	Executive Director (Engineering)
13	Shri A P Samal	General Manager
14	Shri Soumyajit Mukherjee	Addl General Manager
15	Shri Santosh Kumar V	Deputy General Manager

Main components of a SynCon unit

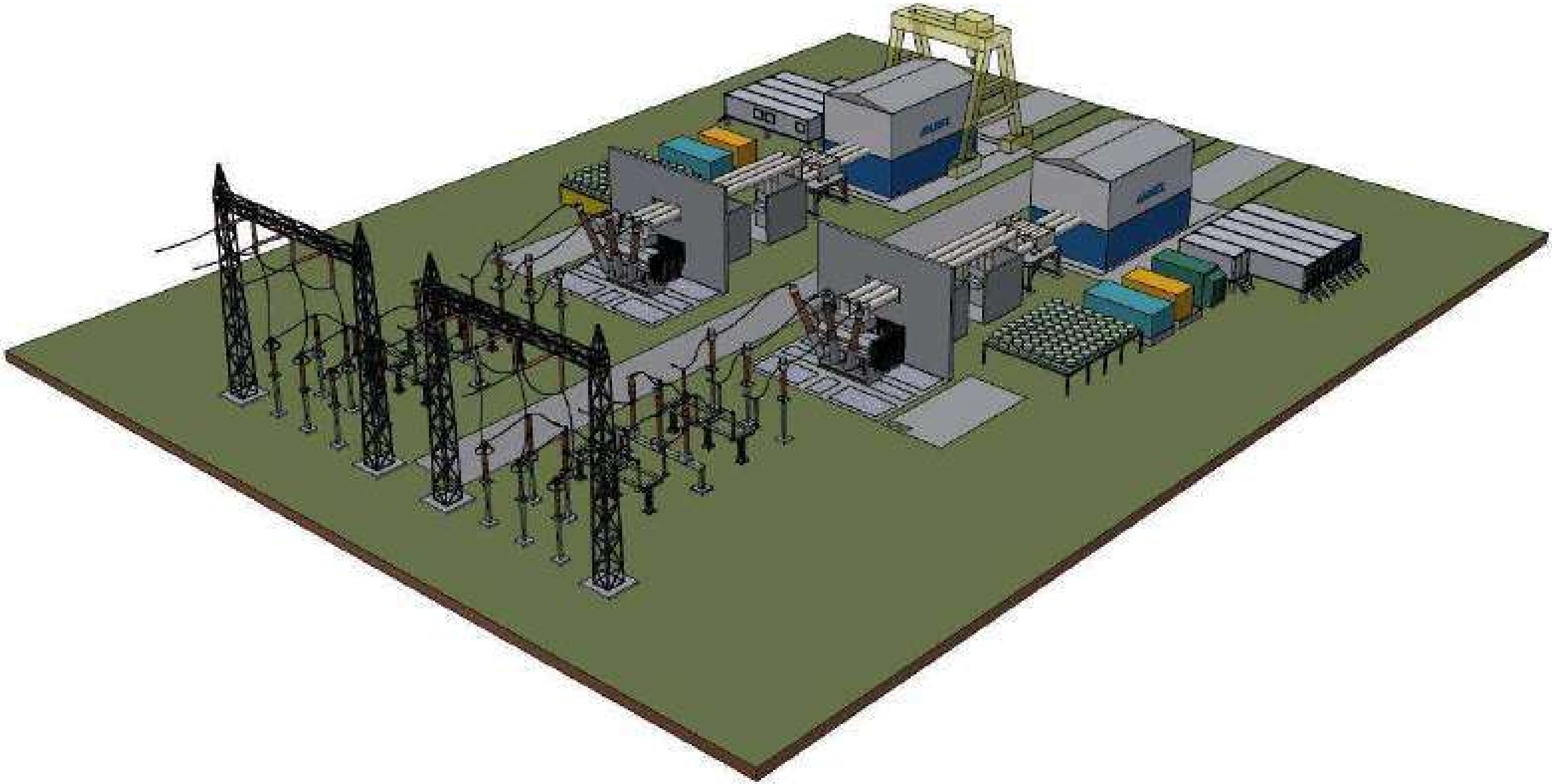


9 TYPICAL SYSTEM LAYOUT

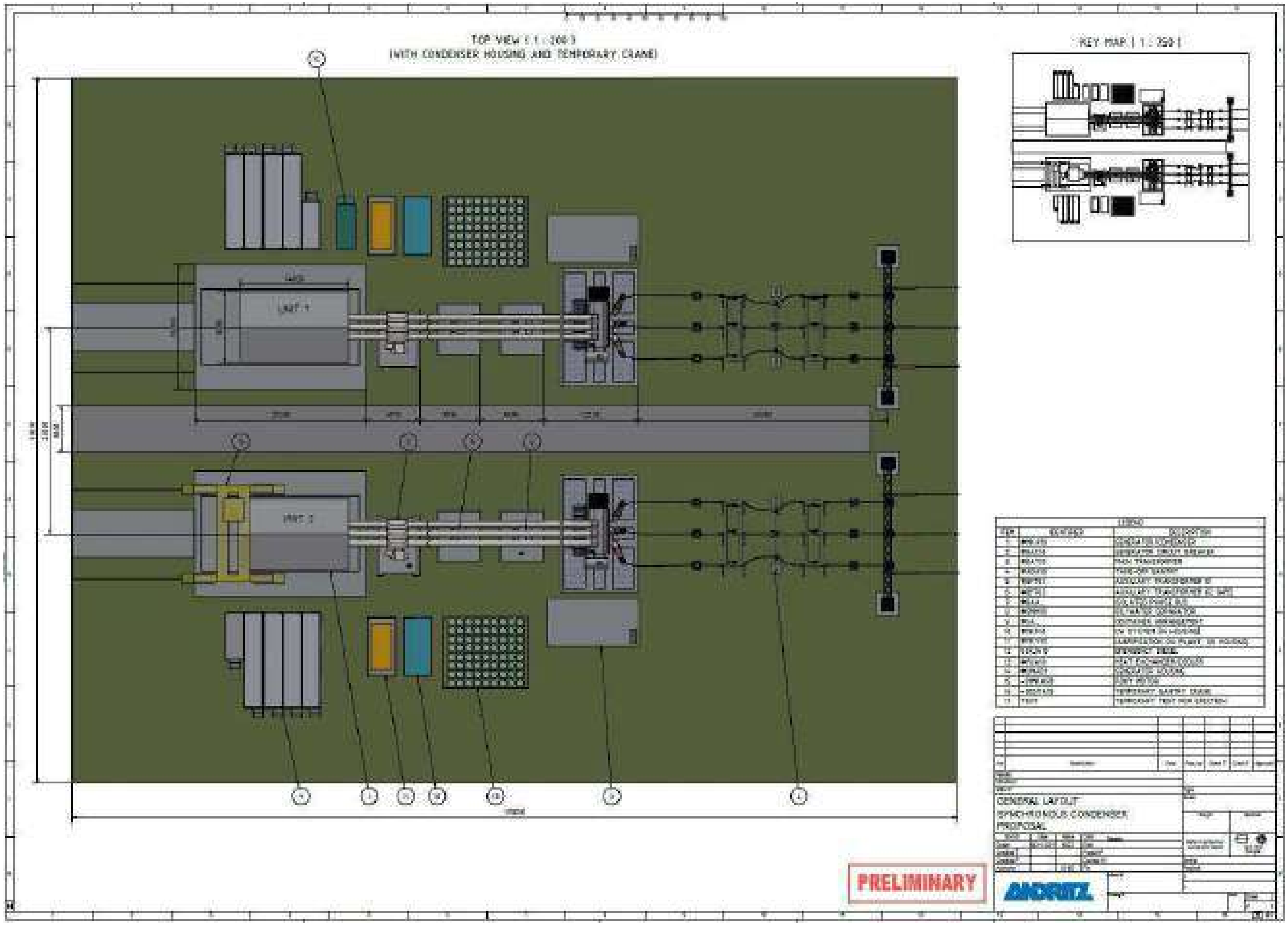
9.1 WITH TEMPORARY TENT & CRANE FOR ERECTION



9.2 WITH SYNCON HOUSING AND TEMPORARY CRANE



9.3 TOP VIEW


TOP VIEW
KEY MAP
UNIT 1
UNIT 2
GENERAL LAYOUT
SYNCHRONOUS CONDENSER
PROPOSAL
PRELIMINARY
ANDRITZ

Annexure-XXII

~~Annexure-IV 15th NPC~~

सत्यमेव जयते

भारत सरकार/Government of India

विद्युत मंत्रालय/Ministry of Power

केंद्रीय विद्युत प्राधिकरण/Central Electricity Authority

राष्ट्रीय विद्युत समिति प्रभाग/National Power Committee Division

सं./MTGS/SG/NPC/CEA/2024/ २११ दिनांक: 10.07.2024

सेवा में/To

(As per distribution list)

विषय: **Uniform Protection Protocol for the user of the grid** - reg.

Madam/Sir,

As per decision taken in 14th NPC meeting held on 03.02.2024, the Uniform Protection Protocol has been prepared after detailed deliberation in protection sub group of NPC and the same is attached herewith for your kind information and necessary action, please. The same will also be ratified in the next NPC meeting.

Encl: As above

सत्येंद्र 10.07.24

(सत्येंद्र कु. दोतान / Satyendra Kr. Dotan)
Director
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Distribution List

1. SE/EE from RPCs of concerned subgroup of NPC (Protection)
2. DGM (SO), NLDC/DGM (NERLDC)/DGM (WRLDC)/Mgr.(ERLDC)

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5. Member secretary, ERPC
6. Member secretary, NERPC

UNIFORM PROTECTION PROTOCOL

NATIONAL POWER COMMITTEE

CENTRAL ELECTRICITY AUTHORITY

Prepared in Compliance to

Clause 12(2) and Clause 13 of Central Electricity Regulatory Commission Indian Electricity Grid Code Regulations, 2023

July 2024

Chapters

UNIFORM PROTECTION PROTOCOL

1. Background

National Power Committee in its 14th meeting held at Bangalore under the chairmanship of Chairperson, CEA has decided that the protection subgroup of NPC may finalise a Uniform Protection Protocol and Uniform Protection Setting Procedure for all regions in consultation with RLDCs/GRID-India.

1.1. The Uniform Protection Protocol has been prepared in accordance with Clauses 12(2) & 13 of the Indian Electricity Grid Code, 2023 (IEGC 2023) notified by the Central Electricity Regulatory Commission.

1.1.1. **The clause 12(2) of the IEGC 2023:**

"There shall be a uniform protection protocol for the users of the grid:

a) for proper co-ordination of protection system in order to protect the equipment/system from abnormal operating conditions, isolate the faulty equipment and avoid unintended operation of protection system;

b) to have a repository of protection system, settings and events at regional level;

c) specifying timelines for submission of data;

d) to ensure healthiness of recording equipment including triggering criteria and time synchronization; and

e) to provide for periodic audit of protection system."

1.1.2. The clause 13 of the IEGC 2023:

"13. Protection protocol

(1) *All users connected to the integrated grid shall provide and maintain effective protection system having reliability, selectivity, speed and sensitivity to isolate faulty section and protect element(s) as per the CEA Technical Standards for Construction, the CEA Technical Standards for Connectivity, the CEA (Grid Standards) Regulations, 2010, the CEA Technical Standards for Communication and any other applicable CEA Standards specified from time to time.*

(2) *Back-up protection system shall be provided to protect an element in the event of failure of the primary protection system.*

(3) *RPC shall develop the protection protocol and revise the same, after review from time to time, in consultation with the stakeholders in the concerned region, and in doing so shall be guided by the principle that minimum electrical protection functions for equipment connected with the grid shall be provided as per the CEA Technical Standards for Construction, the CEA Technical*

Standards for Connectivity, the CEA Technical Standards for Communication, the CEA (Grid Standards) Regulations, 2010, the CEA (Measures relating to Safety and Electric Supply) Regulations, 2010, and any other CEA standards specified from time to time.

(4) *The protection protocol in a particular system may vary depending upon operational experience. Changes in protection protocol, as and when required, shall be carried out after deliberation and approval of the concerned RPC.*

(5) *Violation of the protection protocol of the region shall be brought to the notice of concerned RPC by the concerned RLDC or SLDC, as the case may be."*

1.2. The Uniform Protection Protocol of stipulates General Protection Philosophy of Protection System, Protection Schemes for Generators & various Transmission Elements in Power System, Protection Settings & their Coordination among entities, Disturbance Monitoring, Analysis and Reporting, Time Synchronization of Protection Systems, Protection Audit Plan, Performance of Protection Systems & Compliance Monitoring.

2. Applicability

The Uniform Protection Protocol shall be applicable to all Regional entities, State/Central/Private Generating Companies/ Generating Stations, SLDCs, RLDCs, CTU, STUs, Transmission Licensees and RPCs, connected at 220 kV (132 kV for NER) and above.

3. Definitions

Words and expressions used in this Uniform Protection Protocol are defined in the Act or any other regulations specified by the Central Commission or Central Electricity Authority shall, unless the context otherwise requires, have the meanings assigned to them under the Act or other regulations specified by the Central Commission, as the case may be.

4. General Philosophy of Protection System

4.1. Protection philosophy shall be in accordance with below mentioned objectives, design criteria and other details. However, protection design in a particular system may vary depending upon judgment and operational experience in the broad contours of the protection philosophy. Consideration must also be given to the type of equipment to be protected as well as the importance of this equipment to the system. Further, protection must not be defeated by the failure of a single component.

4.1.1. **Objectives**:

The basic objectives of any protection schemes should be to:

(i) Protect equipment~~s~~ from abnormal operating conditions.

(ii) Automatically isolate the faulty element.

(iii) Avoid unintended or misoperation of protection system.

(iv) Mitigate the effect of short circuit and other abnormal conditions in minimum possible time and area.

(v) Indicate the location and type of fault and

(vi) Provide effective tools to analyze the fault and decide remedial measures.

4.1.2. **Design Criteria:**

To accomplish the above objectives, the four design criteria for protection that should be considered are:

(i) fault clearance time/speed;
(ii) selectivity;
(iii) sensitivity and
(iv) reliability (dependability and security)

4.1.2.1. **Fault clearance time/speed**: It is defined as the time required to interrupt all sources supplying a faulted piece of equipment. In order to minimize the effect on customers and maintain system stability, Fault clearance time shall be as per CEA Grid Standard Regulations 2010, as amended to date.

4.1.2.2. **Selectivity:** Selectivity is the ability of the protective relaying to trip the minimum circuits or equipment to isolate the fault **.**To ensure Selectivity, coordination shall be ensured with the adjacent protection schemes including breaker failure, transformer downstream relays, generator protection and station auxiliary protection.

4.1.2.3. **Sensitivity**: Sensitivity demands that the relays be capable of sensing minimum fault conditions without imposing limitations on circuit or equipment capabilities. To ensure Sensitivity, the settings must be investigated to determine that they will perform correctly for the minimum fault current envisaged in the system, yet remain stable during transients and power swings from which the system can recover.

4.1.2.4. **Reliability**: Reliability is a measure of protective relaying systems certainly to trip when required (dependability) and not to trip falsely (Security). To ensure Reliability, two independent auxiliary direct current supplies shall be provided for Main-I and Main-II relays. The Main-I and Main-II relays should be from two different makes or operating with different algorithm. The CB´s shall have two independent trip coils and two independent trip circuits. Each protection device should trip at least one of them by independent auxiliary DC- supplies.

4.1.2.5. **Security**: To ensure Security, the protection shouldn't limit the maximum transmission capacity of the element. Distance protection in particular could cause spurious tripping due to specific grid conditions, in case of high load operation. Therefore, any special topologies must be known and considered for protection parameterization. For parallel Over Head Lines it is necessary to consider the rapid increase of load current in the healthy line when the faulty line trips and the protection operation must allow such conditions The load encroachment detection function of the relays must be used, when the highest distance zone resistance reach conflicts with the maximum transmitted load on the protected element.

4.2. All generating units shall have standard protection system to protect the units not only from faults within the units and within the Station but also from faults in sub-stations and transmission lines.

4.3. The generator, generator transformer, unit auxiliary transformer shall be provided with protection systems connected to two independent channels or groups, such that one channel or group shall always be available for any type of fault in the generator and these transformers;

4.4. Protection relays shall be configured in such a way that analog, digital and milli ampere input points shall not pick up due to stray voltages. All protection relays should enough spare input and output contacts for taking care of future expansions.

4.5. Protective relays shall be used to detect electrical faults, to activate the alarms and disconnect or shut down the faulted apparatus to provide for safety of personnel, equipment and system within shortest possible time.

4.6. Electrical faults shall be detected by the protective relays arranged in overlapping zones of protection.

4.7. The protection relays for the generators, motors, transformers and the transmission lines shall generally be of numerical type.

4.8. All relays used shall be suitable for operation with CTs secondary rated for one ampere or five amperes as per relevant Indian Standards or International Electrotechnical Commission or Institute of Electrical and Electronics Engineers standards.

4.9. Relevant Indian Standards or International Electrotechnical Commission or Institute of Electrical and Electronics Engineers standards shall be applied for protection of generators, transformers and motors.

5. Protection Schemes

The electrical protection functions for equipment connected with the grid shall be provided as per the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date, the CEA (Technical Standards for connectivity to the Grid) Regulations 2007 amended to date, the CEA (Technical Standards for Communication System in Power System Operation) Regulations 2020 amended to date, the CEA (Grid Standards) Regulations 2010 amended to date, the CEA (Measures relating to Safety and Electric Supply) Regulations 2023 amended to date, and any other CEA standards specified from time to time.

5.1. **Protection Scheme for Thermal Generating Units**

The electrical protection functions for generator, generator transformer, unit auxiliary transformer and station transformer of **coal or lignite based thermal generating stations, gas turbine based thermal generating stations, internal combustion (IC) engine based**

thermal generating stations shall be provided in accordance with but not limited to the list given in **SCHEDULE-I** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.

5.2. **Protection Scheme for Hydro Generating Units**

5.2.1. For the generating units with a rating of more than one hundred megawatt (100 MW), protection system shall be configured into two independent sets of protection (Group A and B) acting on two independent sets of trip coil fed from independent DC supplies, using separate sets of instrument transformers, and segregated cables of current transformers and voltage transformers.

5.2.2. The protection functions for Generator, Excitation Transformer, Generator, Transformer, Unit Auxiliary Transformer, and Station Auxiliary Transformer shall be provided in accordance with but not limited to the list given in SCHEDULE-IV of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date except for variable speed units which will have specialized protection functions.

5.3. **Protection Scheme for REGs/RHGS/BESS**

Protection Schemes for Renewable Energy (RE) Power Plants of Solar power generation, Wind power generation, Battery Energy Storage System (BESS) and Hybrid of these connected with grid at voltage level above 650 volts shall be in accordance with the Central Electricity Authority (Technical Standards for Construction of Renewable Energy Power Plants) Regulations, 2024 from the date as & when these regulations are notified).). As per Central Electricity Authority (technical Standards for Connectivity of the Distributed Generation Resources) amendment Regulations, 2019 regulation 11A-**Standards for charging station, prosumer, or a person connected or seeking connectivity to the electricity system**;-

(1) The applicant shall provide a reliable protection system to detect various faults and abnormal conditions and provide an appropriate means to isolate the faulty equipment or system automatically.
(2) The applicant shall ensure that fault of his equipment or system does not affect the grid adversely.
(3) The protective relays deployed for inverter protections in RE plants shall possess protections from AC/DC over current, over and under frequency and shall comply features like LVRT/HVRT **(as per CEA Technical Standards for Connectivity).**
(4) The protective relays deployed in RE plants shall be immune from conditions like phase jumps and sharp change in frequency during fault scenarios.
(5) The inverters and BESS in RE plants shall responds to abnormal conditions arises due to system faults within its operating margin in holistic manner.
(6) Protection settings of inverters/WTG shall be coordinated in such a way that it accounts for the voltage rise/drop between inverter/WTG terminal & Point of interconnection (POI). Overvoltage /under voltage trip settings should be configured accordingly.

(7) The protection settings of elements in collector system viz. transformers, cables etc. shall such that it allows RE plants to ensure the compliance of CEA standards at POI.
(8) Sub-cycle transients or measurement inaccuracy shall be factored while configuring the protection settings.

5.4. **Substations & Transmission Line**

5.4.1. All major protection relays for the Voltage levels 66 kV and above shall be of numerical type and communication protocol shall be as per IEC-61850.

5.4.2. Grouping of Protection systems for the voltage level 66 kV and above:

i. The protection circuits and relays shall be electrically and physically segregated into two groups each being independent and capable of providing uninterrupted protection even in the event of one of the protection group fails or taken out for maintenance.

ii. Interconnection between these two groups shall not generally be attempted. However, such interconnection shall be kept to the bare minimum, if found absolutely necessary.

5.4.3. The protections required in respect of transmission lines, transformers, reactors and bus bar protection and local breaker backup protection (breaker failure protection) but not limited to shall be in accordance with **SCHEDULE-V** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.

5.5. **HVDC Terminals/ Stations**

5.5.1. **Classical HVDC Terminals/ Stations**

i) HVDC system protection shall consist of two parts:

(A) AC side protection:

AC side protection function shall cover the zone for converter transformer, AC filters, shunt capacitors, shunt reactors, and bus bars. These protections shall generally follow the same philosophy as in a typical substation i.e. detection of fault by relay and tripping of circuit breaker.

(B) DC side protection:

DC side protection shall cover the zones consisting of the valve hall, DC switchyard including smoothing reactor and DC filters, DC line, DMR line / electrode line and ground electrode. The protection equipment shall be designed to be fail safe and shall ensure high security to avoid maloperation/ unwanted shutdown due to protection equipment failures. ii) Following a DC Line fault, the HVDC System shall have the facility to restart, one or more times, the faulted pole at a variable pre-selected DC voltage level(s), not below 80% of the nominal voltage rating. The DC transmission system shall be capable of recovery in a controlled and stable manner without commutation failures during recovery following ac and dc system faults. The post fault power order shall be equal to the pre-fault power order unless AC/ DC systems dictate otherwise.

ii) Protection system required in respect of Classical HVDC Terminals/ Stations but not limited to shall be in accordance with 13 (b) of Part A of SCHEDULE-VI of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.

iii) HVDC Stations shall have ensure the open line test (OLT) before charging of lines after DC faults.

iv) All HVDC stations should prioritize the protections with back up for DC line faults, Differential protections for DC yard equipment including converter valves, Filter protections, External block protections for problems like smoke detections, valve cooling etc. AC side protections and protection block for various controller maloperation issues.

5.5.2. **Voltage Source Converter (VSC) based HVDC Terminals/Stations**

i) The protection equipment shall be designed to be fail-safe and shall ensure high security to avoid mal-operation/ unwanted shutdown due to protection equipment failures.

ii) Protection system required in respect of Voltage Source Converter (VSC) based HVDC Terminals/ Stations but not limited to shall be in accordance with 8 (b) of Part B of **SCHEDULE-VI** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.

5.5.3 STATCOM: All STATCOM shall be having sensitive and fast acting protection system for coupling transformer, MSC, MSR, MV bus, VSC branches and valve hall.

i) The utility should redundancy for the protections like capacitor unbalance, Neutral displacement, cooling and temperature dependent protections all the time.

5.6. **Philosophy of Transmission Line Protection**

5.6.1. Transmission circuit construction can be considered in three main categories viz.: Overhead construction, Underground cable construction and Composite (overhead plus underground) construction. The requirements of overhead line and cable protection systems vary greatly, due to the exposure of transmission circuits to a wide variety of environmental hazards and are subjected to the wide variations in the format, usage and construction methodologies of transmission circuits. The type of protection signaling (tele- protection) or data communication systems required to work with the protection systems will also influence protection scheme requirements.

5.6.2. Transmission circuit Main protection is required to provide primary protection for the line and clear all type of faults on it within shortest possible time with reliability, selectivity and sensitivity. Transmission circuit back-up protection shall cater for failure of any main protection system to clear any fault that it is expected to clear. A protection function that offers back-up for most faults may also provide main protection for some fault conditions. Combinations of main and back-up protection systems should be used to address the main and application specific requirements for transmission circuits.

5.6.3. **Design Criterions:** While designing the scheme for protection of transmission lines following criteria shall be considered:

i) The systems applied must be capable of detecting all types of faults, including maximum expected arc resistance that may occur at any location on the protected line.

ii) The protection should be set not to trip under system transient conditions, which are not short circuits. Conversely where the short circuit current is low due to local grid conditions (weak network) or due to high resistance of the arc, this must be taken into consideration to trip the relay by using the most appropriate criterion, without jeopardizing the unwanted tripping during heavy load conditions.

iii) The design and settings of the transmission line protection systems must be such that, with high probability, operation will not occur for faults external to the line or under non-fault conditions.

iv) The over current protection for the transmission lines 220 kV and above voltage levels shall generally be in disabled condition.

5.6.4. **Reliability Criterions:**

i) **For transmission line having voltages at 220kV and above:** High speed Duplicated Main Protection (Main-I and Main-II) shall be provided. Main-I protection shall be carrier aided non-switched distance protection. Main-II protection shall be carrier aided non-switched distance protection, or phase segregated line differential protection. For very short line (less than 10 km), cable or combination of overhead line and cable, line differential protection with distance protection as backup (built-in Main relay or standalone) shall be provided mandatorily as Main-I and Main-II.
In addition to above, following shall also be provided:

a) Auto reclose relay (Standalone or as built-in function of Main-I & Main-II relay) suitable for 1 ph or 3 ph (with deadline charging and synchro- check facility) reclosure.

b) Inverse Definite Minimum Time (IDMT) directional E/F relay
(Standalone or as built-in function of Main-I & Main-II relay).

c) Inverse Definite Minimum Time (IDMT) Directional over current for 220 kV lines if Main-II is not provided.

Main Protection shall have following features:

a) The Main-I and Main-II protection shall be numerical relays of different makes or employ different fault detection algorithm.

b) Each distance relay shall protect four/five independent zones (three/four forward zones and one reverse zone). It shall be provided with carrier aided tripping through PLCC or OPGW/FOTE communication.

c) The relays should have sufficient speed so that they will provide the clearing times as defined in the CEA Grid Standards Regulations amended time to time.

d) The Main-I and Main-II relays shall be powered by two separate DC sources.

e) Both, Main-I and Main-II shall send initiation signal to Breaker Failure Relay / LBB Protection system.

f) Internal Directional Earth Fault function shall be set to trip the line in case of high resistance earth faults.

g) The Broken Conductor detection shall be used for alarm purpose only.

h) The internal overvoltage function shall be used to protect the line against over voltages. Two stage over voltage protection for the transmission lines (Stage-I as Voltage and Time graded & Stage-II @ 140% of Nominal Voltage with time delay 100ms) shall be implemented for the transmission lines of voltage levels 400kV and above. The OVR grading, Voltage and Time graded, for the Stage-I over voltage protection shall be as recommended by RPC/RLDC. The lines emanating from same substation shall be provided with pickup as well as time grading to avoid concurrent trippings. The overvoltage relay shall have better than 98% drop-off to pick-up ratio (the ratio of the limiting values of the characteristic quantity at which the relay resets and operates). For over voltage detection, though Ph-N voltage is preferable to Ph-to-Ph voltage, to achieve required discrimination for OVR grading on account of limitation imposed by voltage resolution of the relay, Ph-to-Ph voltage to be used for Over Voltage detection.

ii) **For transmission lines having voltages at 132kV/110kV:** There should be at least one carrier aided non-switched four/five zone distance protection scheme. Carrier aided zone protection may be optional for the radial feeders and feeders having intermittent loads In addition to this, another non switched/switched distance scheme or Inverse definite Minimum time(IDMT) directional over current and earth fault relays should be provided as back up. Main protection should be suitable for single or three phase tripping. Additionally, auto-reclose relay suitable for 1 ph or 3 ph (with dead line charging and synchro-check facility) reclosure shall be provided. In case of both line protections being Distance Protections, IDMT type Directional E/F relay (standalone or as built-in function of Main-I & Main-II relay) shall also be provided additionally.

5.6.5. Following types of protection scheme to be adopted to deal with faults on the lines:

i) **Distance Protection Scheme:** The scheme shall be based on the measuring the impedance parameters of the lines with basic requirements as below:

a) Each distance relay shall protect four/five independent zones (three/four forward zones and one reverse zone). It shall be provided with carrier aided tripping through PLCC or OPGW/FOTE) communication.

b) Each Distance Relay:

i. Shall include power swing detection feature for selectively blocking, as required.

ii. Shall include suitable fuse-failure protection to monitor all types of fuse failure and block the protection.

iii. Shall include load encroachment prevention feature like Load blinder.

iv. Shall include Out of Step trip function.

v. Distance relay as Main protection should always be complemented by Directional ground protection to provide protection for high resistive line faults.

vi. Shall be capable to protect the series compensated lines from voltage inversion, Week end infeed and current inversion phenomenon. Special measures must be taken to guard against these phenomenon.

ii) **Line Differential Protection**: The scheme shall be based on the comparing the electrical quantities between input and output of the protected system. Provided that:

a) Due to the fact that short lines (less than 10kM) and/or cables do not have enough electrical length, the current differential relay should always be used.

b) For Cables, at least a differential line protection shall be used in order to guarantee fast fault clearing while maintaining security. The reason being that there are many sources of errors associated to other protection principles, especially for ground faults in cables.

c) The differential protection shall have following requirements:

i. Line differential as Main-I with inbuilt backup Distance Protection shall be installed for all the lines irrespective of length (subject to technical limitations).

ii. Zone-I protection feature shall get automatically enabled in case of communication failure observed by the differential relay.

iii. The differential relays provided in 220 kV and above system must operate in less than 30 ms. RPC/RLDC may decide on differential protection on voltage level below 220 kV.

iv. The current differential protection should a reliable type (preferably digital). The protection should be of the segregate phase type, i.e. it should be able to detect the phase in fault and therefore for the case of single line-ground (SLG) faults to trip only the phase in fault (also to establish single phase A/R). The synchronization of the measured values is done via a communication system. The communication system for differential line protection should be based on fibre optic and any equipment should comply with the IEC 60834.

5.6.6. **Auto Reclosing**:

The single phase high speed auto-reclosure (HSAR) at 220 kV level and above (except for the composite feeders: overhead plus underground) shall be implemented, including on lines emanating from generating stations. If 3-phase auto reclosure is adopted in the application of the same on lines emanating from generating stations should be studied and decision taken on case to case basis. For 132 kV system, three phase auto-reclosure (TPAR) is optional. As per CEA construction standards for construction of electrical plants and lines regulation) 2022, 3 Phase A/R is optional for 132 KV system.

i) **AR Function Requirements:**

It shall have the following attributes:

a) Have single phase or three phase reclosing facilities.

b) Incorporate a facility of selecting single phase/three phase/single and three phase auto-reclose and non-auto reclosure modes.

c) Have facilities for selecting check synchronizing or dead line charging features.

d) Be of high speed single shot type

e) Suitable relays for SC and DLC should be included in the overall auto reclose scheme if three phase reclosing is provided.

f) Should allow sequential reclosing of breakers in one and half breaker or double breaker arrangement.

It may have the following attributes as well:

(1) Have a continuously variable single phase dead time.

(2) Have continuously variable three phase dead time for three phase reclosing.

(3) Have continuously variable reclaim time.

ii) **Scheme Special Requirements:**

a) Modern numerical relays (IEDs) have AR function as built-in feature. However, standalone AR relay or AR function of Bay control unit (BCU) for 220kV and above voltage lines may be used. For 132kV/110kV lines, AR functions built-in Main distance relay IED can be used.

b) Fast simultaneous tripping of the breakers at both ends of a faulty line is essential for successful auto-reclosing. Therefore, availability of protection signaling equipment is a pre-requisite.

c) Starting and Blocking of Auto-reclose Relays:

   Some protections start auto-reclosing and others block. Protections which start A/R are Main-I and Main-II line protections. Protections which block A/R are:

   i. Breaker Fail Relay
   ii. Line Reactor Protections
   iii. O/V Protection
   iv. Received Direct Transfer trip signals
   v. Busbar Protection
   vi. Zone 2/3 of Distance Protection
   vii. Carrier Fail Conditions
   viii. Circuit Breaker Problems.
   ix. Phase to Phase Distance Trip
   x. AR selection switch in OFF / Non-auto position
   xi. Logic AR OFF in SAS
   xii. Phase Distance Start (when Auto reclosure is in progress)

      When a reclosing relay receives start and block A/R impulse simultaneously, block signal dominates. Similarly, if it receives 'start' for 1-phase fault immediately followed by multi- phase fault the later one dominates over the previous one.

   xiii. Fault on reclaim time
   xiv. Fault on line charging
   xv. Pole discrepancy

iii) **Requirement for Multi breaker Arrangement:**

Following schemes shall be adhered to multi-breaker arrangements of one and half breaker or double breaker arrangement:

a) In a multi-Circuit Breaker (C.B.) arrangement one C.B. can be taken out of operation and the line still be kept in service. After a line fault only those C.Bs which were closed before the fault shall be reclosed.

b) In multi-C.B. arrangement it is desirable to have a priority arrangement so as to avoid closing of both the breakers in case of a permanent fault.

c) A natural priority is that the C.B. near the busbar is reclosed first. In case of faults on two lines on both sides of a tie C.B. the tie C.B. is reclosed after the outer C.Bs. The outer C.Bs. do not need a prioritizing with respect to each other.

iv) **Setting Criteria:**

Auto reclosing requires a dead time which exceeds the de-ionizing time. The circuit voltage is the factor having the predominating influence on the de-ionizing time. Single phase dead time of 1.0 sec. is recommended for 765 kV, 400 kV, 220 kV and 132 kV system. As per CEA construction standards for construction of electrical plants and lines regulation) 2022, 3 Phase A/R is optional for 132 KV system. Therefore, 132kV system may be included based on RPC/RLDC input. For the lines emanating from generating stations single-phase dead time upto 1.5 sec may be adopted.

a) According to IEC 62271-101, a breaker must be capable of withstanding the following operating cycle with full rated breaking current:

O - 0.3 s - CO - 3 min - CO

O- stands for Open

CO- stands for Close-Open

The rated operating cycle of the circuit breaker consisting of an opening, a holding time of 0.3 seconds, a CO cycle, a 3-minute wait, and another CO cycle.

The recommended operating cycle at 765 kV, 400 kV, 220 kV and 132 kV is as per the IEC standard. As per CEA construction standards for construction of electrical plants and lines regulation) 2022, 3 Phase A/R is optional for 132 KV system. Therefore, 132kV system may be included based on RPC/RLDC input. Therefore, reclaim time of 25 Sec. is recommended.

5.6.7. **Power Swing Blocking and Out of Step (OOS) Function**

Large interconnected systems are more susceptible to Power Swings in comparison to the erstwhile smaller standalone systems. Inter-area Power

Swings can be set up even due to some event in far flung locations in the system. During the tenure of such swings, outage of any system element may aggravate the situation and can lead to instability (loss of synchronism). It is hence extremely important that unwanted tripping of transmission elements need to be prevented, under these conditions. Distance protection relays demand special consideration under such a situation, being susceptible to undesirable misoperation during Power swings which may be recoverable or irrecoverable power swings. Following steps may be adopted to achieve above objective:

i) **Block all Zones except Zone-I**

This application applies a blocking signal to the higher impedance zones of distance relay and allows Zone 1 to trip if the swing enters its operating characteristic. Breaker application is also a consideration when tripping during a power swing. A subset of this application is to block the Zone 2 and higher impedance zones for a preset time (Unblock time delay) and allow a trip if the detection relays do not reset.

In this application, if the swing enters Zone 1, a trip is issued, assuming that the swing impedance entering the Zone-1 characteristic is indicative of loss of synchronism. However, a major disadvantage associated with this philosophy is that indiscriminate line tripping can take place, even for recoverable power swings and risk of damage to breaker.

ii) **Block All Zones and Trip with Out of Step (OOS) Function**

This application applies a blocking signal to all distance relay zones and order tripping if the power swing is unstable using the OOS function (function built in modern distance relays or as a standalone relay). This application is the recommended approach since a controlled separation of the power system can be achieved at preselected network locations. Tripping after the swing is well past the 180-degree position is the recommended option from CB operation point of view.

Normally relay is having Power Swing Un-block timer which unblocks on very slow power swing condition (when impedance locus stays within a zone for a long duration). Typically, the Power swing un-blocking time setting is 2sec.

However, on detection of a line fault, the relay has to be de-blocked.

Placement of OOS trip Systems

Out of step tripping protection (Standalone relay or built-in function of Main relay) shall be provided on all the selected lines. The locations where it is desired to split the system on out of step condition shall be decided based on system studies.

The selection of network locations for placement of OOS systems can best be obtained through transient stability studies covering many possible operating conditions. Based on these system studies, either of the option above may be adopted after the approval of PCSC of RPC.

While applying Power Swing Blocking (PSB) in the distance protection relay a few other important aspects also need to be considered:

- PSB function should not block if negative sequence or zero sequence currents are present. Once blocked, the PSB should unblock if negative sequence or zero sequence currents are detected. Power Swing is a balanced three phase phenomenon and unbalance can only occur in the case of an asymmetrical fault.
- It will be desirable that during tenure of PSB, the distance protection is capable of detecting a fault and tripping. If such a feature is not available in the relay, PSB should be unblocked after a time delay, corresponding to the half cycle period of the slowest expected Swing Frequency (usually 2s corresponding to the slowest swing frequency of 0.25Hz is considered as default), to avoid the protection remaining perpetually blocked.

5.7. **Transmission Relay Loadability**

Transmission Relay Loadability means the loading permitted in the transmission line by the relay including a security margin. The relay Loadability is to be arrived in such a way as far as possible not to interfere with system operator actions, while allowing for short-term overloads, with sufficient margin to allow for inaccuracies in the relays and instrument transformers. Transmission relay do not prematurely trip the transmission elements out-of-service and allow the system operators from taking controlled actions consciously to alleviate the overload.

5.7.1. Protective relay settings shall

i) Not limit transmission Loadability;

ii) Not interfere with system operators' ability to take remedial action to protect system reliability and;

iii) Be set to reliably detect all fault conditions and protect the electrical network from the faults.

5.7.2. The protective functions which could trip with or without time delay, on load current i.e. load responsive phase protection systems including but not limited to:

i) Phase distance.

ii) Out-of-step tripping.

iii) Switch-on-to-fault.

iv) Overcurrent relays.

v) Communications aided protection schemes including but not limited to:

- Permissive overreach transfer trip (POTT).
- Permissive under-reach transfer trip (PUTT).
- Directional comparison blocking (DCB).
- Directional comparison unblocking (DCUB).

vi) Phase overcurrent supervisory elements (i.e., phase fault detectors) associated with current based, communication-assisted schemes (i.e., pilot wire, phase comparison, and line current differential) where the scheme is capable of tripping for loss of communications.

5.7.3. Each Transmission Licensee and Generating Company, shall use any one of the following criteria for any specific circuit terminal to prevent its phase protective relay settings from limiting transmission system loadability while maintaining reliable protection of the Grid for all fault conditions. Relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees shall be evaluated.

i) For Distance protection relays of transmission lines, the Zone-3 shall prevent load encroachment, considering the following criteria:

a) Maximum load current (I_{max}) may be considered as 1.5 times the thermal rating of the line or 1.5 times the associated bay equipment current rating (the Minimum of the bay equipment individual rating) whichever is lower.

(The rating considered is approximately 15 minutes rating of the Transmission facility).

b) For setting angle for load blinder, a value of 30 degree may be adequate in most cases.

c) The Distance protection relays shall have provision for load blinder characteristic or load encroachment detection. ii) For Directional Overcurrent relays, wherever used in a transmission line (132/110 kV level), the following shall be adopted:

a) An overload alarm shall be set at 110% of the thermal rating of the line with sufficient delay. This alarm shall allow the operator to take corrective action.

b) The Directional Overcurrent relay shall allow the line to carry 1.2 times of the thermal rating of the associated line or bay equipment (whichever is lower) at least 10 minutes.

iii) For transformer protection relays the following shall be adopted:

- Set the definite time transformer overload relay atleast 105% of the transformer ratings with sufficient delay. It shall be wired for alarm purpose only to allow the operator to take corrective action. No tripping shall be issued from this relay.

- The back-up overcurrent relays shall use IDMT characteristics and be suitably coordinated with the upstream transmission network.
- Install supervision for the transformer using either a top oil or simulated winding hot spot temperature element. The alarm and trip settings for these relays shall be set by individual entities based on the manufacturer's recommendation.

Thermal ratings as specified in the prevailing CEA's Manual on Transmission Planning Criterion shall be used for above requirement.

6. *Protection Settings & Coordination*

The purpose is to ensure system protection is coordinated among the grid connected entities. The Protection systems coordination comprises the following:

i) *Each Transmission Licensee, Load Dispatch Centre (LDC) and Generating Company shall keep themselves familiarized with the purpose and limitations of Protection System schemes applied in its area of control.*

ii) *Each Transmission licensee shall coordinate its Protection System schemes with concerned transmission system, sub-transmission system and generators.*

iii) *Each Generating Company shall coordinate its Protection System schemes with concerned transmission system and station auxiliaries.*

iv) *Each Transmission Licensee and Generation Company shall be responsible for settings calculations for protection of elements under its ownership. It shall be the responsibility of the respective asset owner to obtain the inputs (adjacent line settings, infeed values etc.) from STU/Generating Company/ Transmission Licensee necessary for calculation of the settings.*

v) *STU/Generating Company/Transmission Licensee shall provide the infeed values/latest network model to the requesting entity, within 15 days of receipt of such a request from the entity.*

vi) *Each Generating Company and Transmission Licensee, for voltage levels 400kV and above and interstate lines, shall submit the protection settings as per the format prescribed, along with the calculation sheets, co-ordination study reports and input data, in advance, to RPC/RLDC for every new element to be commissioned. The mentioned information shall be submitted to the RPC/RLDC two months in advance for all the elements proposed to be commissioned. RPC shall furnish the approved settings within forty days from the date of submission of the settings by the entity.*

vii) *If required Protection Setting Sub Group (PSSG) may be constituted under PCSC in the RPCs with the expert members from all States & UTs, Major Transmission Licensee in the Region, Major Generating Company in the Region, Grid-India/RLDC & RPC Secretariat for analysing/reviewing the proposed protection settings of the new elements as well as changes in the existing protection settings, as arrived by the*

proposer as per the Chapter 6 of Uniform Protection Protocol. The PSSG recommended protection settings shall be ratified by PCSC of respective RPC.
Or
Any procedure that is finalized and approved by the Protection Sub-Committee of respective RPC.

viii) *The PCSC shall review the settings to ensure that they are properly coordinated with adjacent system and comply with the existing guidelines. The onus to prove the correctness of the calculated settings shall lie with the respective Transmission licensee/Generation Company. In case, the PCSC feels that the adjacent transmission system settings need to be changed, in view of the new element, it shall inform the concerned entity for revision of the existing settings.*

ix) *The PCSC of RPC shall review and approve the settings based on the inputs /report submitted by the entities.*

x) *The approved settings shall be implemented by the entity and proper record of the implemented settings shall be kept. The modern numerical relays have several settings for various features available in the relay. It shall be ensured that only the approved features and settings are enabled in the relay. No additional protection/setting shall be enabled without the prior approval of RPC.*

xi) *Each Transmission licensee and Generating Company shall co-ordinate the protection of its station auxiliaries to ensure that the auxiliaries are not interrupted during transient voltage decay.*

xii) *Any change in the existing protection settings, for voltage levels 400kV and above & interstate lines, shall be carried out only after prior approval from the RPC. The owner entity shall inform all the adjacent entities about the change being carried out.*

xiii) *In case of failure of a protective relay or equipment failure, the Generating Company and Transmission Licensee shall inform appropriate LDC/RLDC/RPC. The Generating Company and Transmission Licensee shall take corrective action as soon as possible.*

xiv) *Each Transmission Licensee shall coordinate Protection Systems on major transmission lines and interconnections with neighbouring Generating Company, Transmission Licensee and appropriate LDC.*

xv) *RPC in consultation with the RLDC & Regional entities shall undertake review of the protection settings, assess the requirement of revisions in protection settings and revise protection settings, from time to time and at least once in a year. The necessary studies in this regard shall be carried out by the RPC & RLDC. The modifications/changes, if any, in protection settings shall be advised to the respective users and STUs.*

xvi) *RPC shall maintain a centralized database and update the same on periodic basis in respect of their respective region containing details of relay settings for grid elements connected to 220 kV and above. RLDC also shall maintain such database. Respective Transmission licensee/Generating Company/Entities are responsible for ensuring to make available the implemented protection settings in the centralized database within fifteen days from the date of commissioning.*

xvii) *If System Protection Schemes(SPS) is recommended to be implemented by the appropriate forum/Sub-Committee of RPC on account of operational & system constraints, the same shall be implemented by the concerned Transmission licensee/Generating Company/Entities within the specified timelines.*

xviii) *IBR settings like phase jump, df/dt settings, over currents settings, over/under frequency, over/under voltage, LVRT/HVRT etc. for Solar, Wind & Battery Energy Storage System (BESS) etc. to be reviewed in protection subcommittee meetings.*

Note: - It was agreed in the meeting held on 28.06.2024 with members of protection Sub group of NPC that there is no need for preparation of separate uniform protection setting procedure. RPCs may develop an internal mechanism to ensure effective coordination among all grid-connected entities to achieve the required procedure. However, RPCs may refer the above Chapter 6 for the purpose of development of such internal mechanisms to review of the protection settings in consultation with the stakeholders of the respective region.

7. Disturbance Monitoring, Analysis and Reporting

The Purpose is to ensure that adequate disturbance data is available to facilitate Grid event analysis. The analysis of power system disturbances is an important function that monitors the performance of protection system, which can provide information related to correct behavior of the system, adoption of safe operating limits, isolation of incipient faults.

7.1. **The Disturbance Monitoring Requirements include the following:**

i) Each Transmission Licensee and Generating Company shall provide Sequence of Event (SOE) recording capability by installing Sequence of Event recorders or as part of another device, such as a Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU), Phasor Measurement Unit (PMU), a generator plants Digital (or Distributed) Control System (DCS) or part of Fault recording equipment.

This capability shall be provided at all substations and at locations to record all the events in accordance with CEA Grid Standard Regulations, 2010 amended to date. The following shall also be monitored at each location:

a) Transmission and Generator circuit breaker positions

b) Protective Relay tripping for all Protection Groups that operate to trip circuit breakers identified in (a) above.

c) Tele protection keying and receive

ii) In either case, a separate work station PC shall be identified to function as the event logger front end. The event logger work-station PC should be connected to UPS (Uninterrupted Power Supply).

The event logger signals shall include but not limited to

- All Circuit Breaker and isolator switching Operations
- Auxiliary supply (AC, DC and DG) supervision alarms
- Auxiliary supply switching signals
- Fire-fighting system operation alarms
- Operation signals (Alarm/Trip from all the protection relays.)
- Communication Channel Supervision Signals.
- Intertrip signals receipt and send.
- Global Positioning System (GPS) Clock healthiness.
- Control Switching Device healthiness (if applicable).
- RTU/Gateway PC healthiness
- PMU Healthiness
- All Circuit Breaker Supervision Signals.
- Trip Circuit Supervision Signals.

iii) Each Transmission Licensee/Generating Company/Users shall provide Disturbance recording capability for the following Elements at facilities:

- All transmission lines (Each line shall be provided with facility for distance to fault locator)
- Autotransformers or phase-shifters connected to busses.
- Shunt capacitors, shunt reactors.
- Individual generator line interconnections.
- Dynamic VAR Devices.
- HVDC terminals.
- Bus Bars
- Inverter and PPC
- Generators
- Statcom

iv) The Disturbance recording feature shall be enabled and configured in all the numerical relays installed. Disturbance recording system shall have minimum recording time of 3 seconds (0.5 seconds for pre-fault and 2.5 seconds for post fault).

v) Each Generating Company shall provide Disturbance recording capability for Generating Plants in accordance with Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date, the CEA (Technical Standards for connectivity to the Grid) Regulations 2007 amended to date.

vi) Each Transmission Licensee and Generating Company shall record for Faults, sufficient electrical quantities for each monitored Element to determine the following:

- Three phase-to-neutral voltages. (Common bus-side/line side voltages may be used for lines.)
- Three phase currents and neutral currents.
- Polarizing currents and voltages, if used (As applicable).
- Frequency (As applicable).
- Real and reactive power (As applicable).
- V sync(Synchronizing voltage) (For TPAR)
- Mutual compensation current(In case of parallel line)

The Minimum parameters to be monitored in the Fault record shall be specified by the PCSC of RPCs.

vii) Each Transmission Licensee and Generating Company shall provide Disturbance recording with the following capabilities:

- The Disturbance recorders shall have time synchronization and a standard format for recording analogue and digital signals (DR labels to be standardized as per the Report of FOLD Working Group - 3 on DR Parameter Standardization). The data files shall be capable of being viewed, read, and analyzed with a generic COMTRADE analysis tool as per the latest revision of IEEE Standard C37.111.
- Each Fault record duration and the trigger timing shall be settable and set for a minimum 3 second duration including 0.5 seconds for pre-fault and 2.5 seconds for post fault
- Each Fault recorder shall have sampling frequency of 1 kHz or better.
- Each Fault recorder shall be set to trigger for at least the following:

  Internal protection trip signals, external trigger input and additional triggers may be assigned as necessary.

viii) Each Transmission Licensee and Generating Company shall keep the recording instruments (disturbance recorder and event logger) in proper working condition and shall establish a maintenance and testing program for Disturbance Recorder (DR) that includes

- Maintenance and testing intervals and their basis.
- Summary of maintenance and testing procedures.
- Monthly verification of communication channels used for accessing records remotely (if the entity relies on remote access and the channel is not monitored to a control centre staffed around the clock, 24 hours a day, 7 days a week (24/7)).
- Monthly verification of time synchronization (if the loss of time synchronization is not monitored to a 24/7 control centre).
- Monthly verification of active analog quantities.
- A requirement to return failed units to service within 90 days. If a Disturbance Recorder (DR) will be out of service for greater than 90 days, the Transmission Licensee and Generating Company shall keep a record of efforts aimed at restoring the DR to service.

ix) The time synchronization of the disturbance recorders shall be corroborated with the PMU data or SCADA event loggers by RLDCs. RLDCs shall list out for Disturbance recorders which are non- compliant for discussion in PCSC meetings of RPCs.

x) Each Transmission Licensee and Generating Company shall submit the data files to the RLDCs conforming to the following format requirements:

- The data files shall be submitted in COMTRADE and PDF format.
- File shall have contained the name of the Relay, name of the Bay, station name, date, time resolved to milliseconds, event point name, status.

The DR archives shall be retained for a period of three years.

xi) A separate work-station PC, powered through UPS (Uninterrupted Power Supply) shall be identified with access to all the relays for extraction of DR. Auto Download facility shall be established for automatic extraction of the DR files to a location on the work- station PC.

xii) **Time Synchronization Equipment**

a) Time Synchronizing Equipment complete with antenna, all cables and processing equipment shall be provided to receive synchronizing pulse through Global Positioning System or Indian Regional Navigation Satellite System Navic compatible for synchronization of event logger, disturbance recorder, Phasor Measurement Units, and Supervisory Control and Data Acquisition System or Substation Automation System.

b) Each substation shall have time synch equipment to synchronize all the numerical relays installed. Before any extension work, the capability of the existing Time-sync equipment shall be reviewed to ensure the synchronization of upcoming numerical relays.

c) The status of healthiness of the time-sync device shall be wired as “Alarm” to SCADA and as an “Event” to Event Logger.

d) The time synch status of all the installed numerical relays and event logger shall be monitored monthly and recorded. The Monthly records for relays not in time-sync shall be reported to RLDCs and RPCs. This record shall be archived for a period of three years by each concerned agency.

e) Remedial action shall be taken by the concerned substation/ Protection department immediately to make the relays in time synchronization with reference to external time source.

f) All the new Grid elements/Bay extension shall have accurate and precise Time synchronization equipment.

7.2. **Disturbance Analysis and Reporting**

The Disturbance Analysis and Reporting shall be carried out in line with Central Electricity Authority (Grid Standards) Regulations, 2010, IEGC Grid Code Regulations 2023 and as per the revised SOP to address the Grid Disturbances (GDs)/Grid Incidents (GIs)/any other Protection Tripping’s approved in the Protection sub group of NPC which is being adopted in all region. (at **Annexure-I**)

8. Protection Audit Plan

The Protection Audit of the substations connected with ISTS system shall be carried out in line with the Central Electricity Authority (Grid Standards) Regulations, 2010,IEGC Grid Code Regulations 2023 and as per the approved SOP for Protection System Audit of the sub group of RPCs/NPC which is being adopted in all region. (at **Annexure-II**)

9. System Protection Schemes (SPS)

If System Protection Schemes(SPS) is recommended to be implemented by the appropriate forum/Sub-Committee of RPCs on account of operational & system constraints, the same shall be implemented by the concerned Transmission licensee/Generating Company/Entities within the specified timelines. The provisions related to SPS as mentioned in CEA regulations and CERC (IEGC) 2023 regulations and their amendments from time to time shall be followed.

10. Performance Monitoring of the Protection Systems

10.1. Users/Entities shall submit the following protection performance indices of previous month to RPCs and RLDCs on monthly basis for 220 kV (132 kV in case of NER) and above by 15th of the subsequent month and the same shall be reviewed in the ensuing PCSC meeting of RPCs.

a) The Dependability Index defined as

$$D = \frac{N_C}{(N_C + N_F)}$$

Where, N_C is the number of correct operations at internal power system faults and N_F is the number of failures to operate at internal power system faults.

b) The Security Index defined as

$$S = \frac{N_C}{(N_C + N_U)}$$

Where, N_C is the number of correct operations at internal power system faults and is the number of unwanted operations.

c) The Reliability Index defined as

$$R = \frac{N_C}{(N_C + N_I)}$$

Where, N_C is the number of correct operations at internal power system faults and N_I is the number of incorrect operations and is the sum of N_F and N_U

10.2. Users/Entities shall furnish the reasons for performance indices less than unity of individual element wise protection system to the RPC and action plan for corrective measures. The action plan will be followed up regularly in the PCSC Meetings.

11. Compliance Monitoring

11.1. The Uniform Protection Protocol shall be reviewed as and when required, in consultation with the stakeholders by Protection Sub Group of NPC after discussion in respective RPC.

11.2. Violation of the Uniform Protection Protocol shall be brought to the notice of RPCs by the RLDCs or concerned SLDC, as the case may be.

11.3. In case any User/Entity fails to comply with the Uniform Protection Protocol or fails to undertake remedial action identified by the PCSC of RPCs within the specified timelines, the RPCs would approach the Commission with all relevant details for suitable directions.

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2.

Revised Final Standard Operating Procedure (SOP) to address the Grid Disturbances (GDs)/Grid Incidents (GIs)/any other Protection Trippings

1. Immediately following an event (grid disturbance/incidence as defined in the CEA (Grid Standards) Regulations 2010 and subsequent amendment in the system, the concerned user/entity or SLDC shall inform to the RLDC through voice message.
2. Written flash report shall be submitted to RLDC and SLDC by the concerned user/entity within the time line specified in **Table 8** below, as per the IEGC, 2023.
3. In compliance of IEGC, 2023, All the Users, STU/SLDC are required to furnish the following information in respect of Grid Occurrences(GD/GI) within the time line specified in **Table 8** below, to RLDC/ RPC:
   (i) First Information Report (FIR)
   (ii) Event Logger (EL) output
   (iii) Disturbance Recorder (DR) output
   (iv) Trip event analysis report-TR (with pre and post fault system conditions)
   (v) Data Acquisition System (DAS)
4. RLDC shall report the event (grid disturbance or grid incidence) to CEA, RPC and all regional entities within twenty-four (24) hours of receipt of the flash report.
5. After a complete analysis of the event, the user/entity shall submit a detailed report in the case of grid disturbance or grid incidence within one (1) week of the occurrence of event to RLDC and RPC.
6. Based on the above detailed report submitted to RLDC by the entities, RLDC shall Categorize Grid Occurrences into grid incidents (GIs) and grid disturbance (GDs) based on criteria as per the CEA (Grid Standards) Regulations 2010 and subsequent amendment. RLDC shall also submit the Auto Reclosure (A/R) failure events, PLCC related events, any other protection related events to RPCs on monthly basis.
7. RLDCs and NLDC (for events involving more than one region) shall prepare a draft report of each grid disturbance or grid incidence including simulation results and analysis along with associated PMU plots of appropriate resolution, which shall be discussed and finalized at the Protection sub-committee/sub-group of RPC as per the timeline specified in **Table-8** below.

TABLE 8 : REPORT SUBMISSION TIMELINE

Sr. No.	Grid Event^ (Classification)	Flash report submission deadline (users/ SLDC)	Disturbance record and station event log submission deadline (users/ SLDC)	Detailed report and data submission deadline (users/ SLDC)	Draft report submission deadline (RLDC/ NLDC)	Discussion in protection committee meeting and final report submission deadline (RPC)
1	GI-1/GI-2	8 hours	24 hours	+7 days	+7 days	+60 days
2	Near miss **event**	8 hours	24 hours	+7 days	+7 days	+60 days
3	GD-1	8 hours	24 hours	+7 days	+7 days	+60 days
4	GD-2/GD-3	8 hours	24 hours	+7 days	+21 days	+60 days
5	GD-4/GD-5	8 hours	24 hours	+7 days	+30 days	+60 days

^*The classification of Grid Disturbance (GD)/Grid Incident (GI) shall be as per the* CEA Grid Standards.

(**The above table is as per the IEGC 2023**)

8. RPCs shall circulate all the GDs, GIs, near miss events, A/R events, PLCC mal-operation events, any other protection related event etc. along with the Agenda for Protection Co-Ordination Sub-Committee (PCSC) of RPCs. PCSC meetings are to be held in every month.
9. The implementation of the recommendations of the final report shall be monitored by the protection sub-committee of the RPC. Tripping portals deployed for reporting of the GDs & GIs on RLDCs portal, shall also have compliances reporting of PCSC recommendations on this portal. NLDC shall disseminate the lessons learnt from each event to all the RPCs for necessary action in the respective regions.
10. Constituents/entities shall furnish the following details to RPCs/RLDCs in respect of all the grid occurrences for analysis:

    a) Detailed analysis of the events
    b) SLD or equivalent pictorial representation clearly showing:
        i. Location of fault with distance
        ii. Fault details with type & relay indications
        iii. CT/PT/CVT rating details with location
        iv. Bus-bar arrangement/ Configuration of feeders and other information related to the ratings of the information required for analysis of the disturbance.
        v. CB positions (OPEN/ CLOSE) before and after fault
        vi. Isolator & Earth-switch positions (OPEN/CLOSE)
        vii. Voltage, frequency & power flows with direction at the time of fault
    c) Output of Event logger & Disturbance recorder
    d) Remedial Action(s) taken
    e) Relay setting details

HVDC Station Disturbance : Any additional data such as HVDC transient fault record, switchyard equipment and any other relevant station data required for carrying out analysis of an event by RPC, NLDC, RLDC and SLDC shall be furnished by the users including RLDC and SLDC, as the case may be, within forty- eight (48) hours of the request. All users shall also furnish high-resolution analog data from various instruments including power electronic devices like HVDC, FACTS, renewable generation (inverter level or WTG level) on the request of RPCs, NLDC, RLDCs or SLDCs.

Generating Station Disturbance: Generating Station shall furnish high-resolution analog data from various instruments including AVR response, PSS response required for analysis of disturbance.

11. The respective entities (for which the Grid occurrence is placed in the PCSC agenda) shall present the Grid Occurrence which shall cover all related aspects such as:

    a) Antecedent conditions,
    b) Bus-configuration,
    c) Reasons of GD/ GI occurrence,
    d) Relevant Diagrams showing location of the fault,
    e) Bus bar arrangement/configuration of feeders and other connected equipment with proper CB positions (OPEN/ CLOSE) at the time of occurrence of the fault,
    f) Type of protections operated,
    g) Substantiation of the protections operated by relevant DRs & ELs,
    h) Reasons for protection systems mal-operation/non-operation,
    i) Remedial measures taken/ proposed, etc.

12. In respect of failure or Non-operation of A/R events, PLCC mal-operation events, any other protection related event as given in the PCSC agenda the concerned entities, shall furnish the reasons along with remedial action taken to RPCs/RLDCs. The same would be analyzed by the PCSC.
13. In the PCSC meetings, all the GDs, GIs, near miss events, A/R non-operation/mal-operation, PLCC mal-operations, other protection related trippings/events as circulated in the agenda shall be analyzed in detail by the PCSC forum and conclude the suitable recommendations to avoid the recurrence of such incidents in the future.
14. The action plan by the entities shall be furnished to RPC for implementation of the PCSC recommendations along with the timelines.
15. The implementation of the PCSC recommendations shall be followed up in the monthly PCSC meetings of RPC.
16. When grid disturbances or grid incidents occurred at major/critical substations and at substations that affected critical/essential/strategic loads, a Protection System Analysis Group (PSAG) shall be constituted consisting of the members from RPC, NLDC, RLDC, PGCIL, a Protection Expert from the region along with the Entity under whose jurisdiction GD/GI occurred to analyze the GD/GI in detail by visiting the respective substation/substations physically and conducting the meetings. PSAG would finalize the remedial actions and recommendations after deliberations and detailed analysis. The progress of implementation of the PSAG shall be followed up in the monthly PCSC Meetings.
17. If grid disturbance or grid incident is due to operational issue or transmission constraint/inadequacy, Grid-India shall share feedback to CTU or respective STU.

18. In case any user/entity fails to undertake remedial action identified by the RPC within the specified timelines as decided by PCSC of RPC, the concerned RPC may approach the Commission with all relevant details for suitable directions.
19. A date depository of the event as maintained by the RLDC shall be accessible to every entity and the entity shall upload all the relevant documents on the RLDC portal of trippings.

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Revised Standard Operating procedure for Third Party Protection System Audit

A protection system audit is a review and evaluation of the protection systems of a substation with an objective to verify whether required protection systems have been put in place at station by the concerned utility, and to recommend suitable measures to provide for the same.

Ministry of Power, had constituted a Committee under the Chairmanship of Chairperson CEA to examine the grid disturbances on the 30th and the 31st July 2012. One of important recommendation of the committee was conducting of extensive audit of protection system. List of sub-stations where protection audit is to be undertaken on priority basis was prepared and audited across the country. This was the beginning of protection audit across the country and large number of important 400 and 220kV substations were audited.

Keeping in view the importance of Protection System Audit, Standard Operating Procedure has been prepared for the reference purpose. It will provides a step-by-step guide for RPCs to follow during the audit process.

1. All users shall conduct third party protection audit of each sub-station at 220 kV and above (132 kV and above in NER) once in five years or earlier as advised by the respective RPC.

2. After analysis of any event, each RPC shall identify a list of substations / and generating stations where third-party protection audit is required to be carried out and accordingly advise the respective users to complete third party audit within three months.

3. Third Party Protection Audit shall be carried out by the third party designated agencies in line with the IEGC Regulations 2023 or by the audit teams constituted by RPCs with the members from other states (at least two) who opt for the RPC coordinated third party protection audit.

4. The third-party protection audit report shall contain information sought in the format as per IEGC 2023 and its further amendments.

5. Annual audit plan for the next financial year shall be submitted by the users to their respective RPC by 31st October. The users shall adhere to the annual audit plan and report compliance of the same to their respective RPC.

6. **Criteria for choosing substations for third party protection audit:**

The following criteria are generally applied during choosing a substation for protection audit.

i. Substations/ Generating (SS/ GS) stations with frequent grid incidences or frequent maloperations or any grid occurrence in any substation which affected supply to large number of substations and caused significant load loss. In this case, third-party protection audit may be carried out within three months or as decided in the Protection sub-Committee Meeting of the RPC.

ii. Important 400kV and 765kV substations (SS) / Generating stations (GS) including newly commissioned SS/ GS. In this case, third-party protection audit may be carried out at a frequency decided in the Protection sub-Committee Meetings of respective RPCs.

7. **Protection audit Procedure:**

i. After identification of stations for protection audit, the same is communicated to the owner utility seeking nomination of one nodal officer for each Station.

ii. The nodal officer shall provide the details of substation for preparation of protection audit format (in line with IEGC and subsequent amendments).

iii. Meanwhile nominations shall be sought from all utilities to form regional teams for audit. Regional teams comprising of engineers from various utilities /utility (other than the team of host State) of the region shall be formed based on the no. of SS to be audited. (Each team may consists of 3 or 4 engineers from utilities other than the host utility and at the maximum a team will be able to audit 3 to 4 stations in 7-9 days or so)

iv. Once the team details and list of stations to be audited is finalised the details of nodal officers, team members , list of stations to be audited by each team is shared to all for further coordination regarding planning and conduction of audit.

v. Based on the inputs received from nodal officer regarding the list of elements in the substation to be audited, protection audit formats shall be prepared by RPC (in line with IEGC) and circulated to nodal officer. The nodal officer along-with the substation engineers shall fill the audit format and furnish the same along-with various attachments sought as part of the audit format within a week or so. List of attachments shall be given in the covering page of audit format.

vi. In case, other entity's bays /equipment are existing in the substation to be audited, the entity shall furnish all the details of its equipment to the Audit Team/Agency and the other entity shall be available during the Protection Audit.

vii. The filled in audit format along-with the received annexures shall then forwarded to the audit team by the nodal officer and any further clarification regarding the format or attachments shall be taken up by the audit team with the nodal officer under intimation to RPC.

viii. The SS/ GS shall be audited based on the data filled in audit format checking for compliance of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 & CEA (Measures relating to Safety and Electric Supply) Regulations, 2010, CERC regulations and amendments to the same, approved guidelines of RPC, best practices in industry, report of the Task Force on Power System Analysis Under Contingencies and as per the "Model Setting Calculations For Typical IEDs Line Protection Setting Guide Lines Protection System Audit Check List Recommendations For Protection Management Sub-Committee on Relay/Protection Under Task Force For Power System Analysis Under Contingencies" etc.

ix. After conduct of audit, the shortcomings observed in the audit shall be discussed in detail with the nodal officer and substation engineers and recommendations are finalised.

x. The filled in audit format along-with the recommendations and attachments shall be finalised and final protection audit report RPC (in line with IEGC) shall be compiled.

xi. The audit team shall check the criteria for activation/archival of DR, as decided in the respective Protection sub-Committees of RPC.

xii. Final protection audit report shall be discussed in Protection Coordination Committee and recommendations may be accepted/deleted/modified as per the scope of audit and compliance of various regulations/guidelines etc.

xiii. The recommendations of all SS audited shall be inserted into audit recommendations database and update regarding recommendations shall be sought from respective utilities.

xiv. Action plan for rectification of deficiencies detected, if any, shall be submitted to the respective RPC and RLDC and monthly progress will be submitted.

xv. The travel expense from place of duty to Substation/Generating Station to be audited shall be borne by respective Auditor (Parent Organisation). The expense for boarding, lodging any travel of the team during the audit period shall be borne by the organisation owning the Substation/Generating Station.

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Annexure-XXIII

2024-25

Proposal

Programme on International Best Practices in Energy Transition for Senior Electricity Utility Officials in India

(With Study Tour to Europe)

for

POWERGRID

and

NRPC

Submitted by

asci
Leadership through Learning

Administrative Staff College of India, Bella Vista, Raj Bhavan Road,
Hyderabad – 500 082

Dec 2024

Contents

Background

Energy transition refers to the shift from traditional fossil fuel-based energy systems to more sustainable and renewable sources such as solar, wind, hydropower, and nuclear energy. The transition also involves advancements in energy efficiency, electrification of the economy, new fuels, and decarbonization across all sectors, including industry, transportation, and heating.

Europe is leading this transition through bold policies, investments, and regulations that aim to make the continent carbon-neutral by 2050. These efforts are focused on increasing the share of renewable energy (RE) in the electricity mix, reducing greenhouse gas emissions, and investing in grid infrastructure to manage increasing demand for clean energy. Europe's experience in this field offers valuable lessons for countries like India, which are also navigating the complexities of energy transition, grid stability, and increasing renewable energy penetration.

Accordingly, Administrative Staff College of India along with POWERGRID has designed the training programme for Senior officials of electricity utilities in India on Energy Transition, with an international learning visit to select European Union (EU) countries to show case the best practices in this specific area. This proposal has been prepared by ASCI for POWERGRID with the support of Northern Regional Power Committee (NRPC).

Administrative Staff College of India (ASCI) has been a long-term training partner of the Ministry of Power and POWERGRID, and has been at the forefront of capacity building and research initiatives of power sector reforms in the Country. This program titled "***International Best Practices in Energy Transition with Study tour to Europe***" has been specially designed to meet the needs of top electricity officials of Electricity Utilities in India. The programme comprises a two days component at POWERGRID Academy of Leadership, Manesar **OR** ASCI, Hyderabad followed by a 7-day study tour (exclusive of travel to and from India), to show case international best practices in Energy Transition.

Programme Objectives

The programme is designed to meet the needs of top officials of electricity utilities in India to understand, Europe's energy transition journey that is built on three primary pillars:

1. **Decarbonization**: Reducing carbon emissions through the phasing out of coal, oil, and natural gas while increasing reliance on renewable energy sources.
2. **Renewable Energy Integration**: Successfully integrating large-scale **wind, solar**, and **hydropower** into the energy mix, creating challenges and solutions for grid stability and energy storage.

3. **Hydrogen Development**: Exploring **green hydrogen** as an alternative fuel source for hard-to-decarbonize sectors like **industry** and **transportation**.

European countries have implemented robust regulatory frameworks, including market integration, energy storage, and the development of smart grids. The role of Transmission System Operators (TSOs) and Distribution System Operators (DSOs) is central in ensuring the integration of renewable energy into grids while maintaining reliability and flexibility.

Programme Design and Overview

The following is the proposed programme design keeping in view the over-arching objective of the programme. The **7-day international study tour** will provide a detailed understanding of:

- **Energy Transition Frameworks**: Policies and strategies for renewable energy integration and decarbonization.
- **Energy Markets**: The functioning of the electricity market in Europe, including the roles of **TSOs** and **DSOs**.
- **Hydrogen Economy**: The development of **green hydrogen** and its integration into national energy systems.
- **Renewable Energy Penetration**: The European experience of achieving high penetration of **wind, solar**, and **hydropower** into the grid.

The tour will include **site visits**, **workshops**, and **discussions** with energy policymakers, experts, utilities, and industry leaders in each country to deepen participants' understanding of these issues.

Tentative International Study Tour (7 days – exclusive of travel)

Day 0: Saturday – Departure from New Delhi

- **Departure:** Fly from respective cities such as - New Delhi/ Hyderabad India.

Day 1: Sunday – Arrival in Amsterdam

- **Arrival:** Land at Schiphol Airport, Amsterdam
- **Introduction to the Energy Transition Program**
- **Overnight Stay:** Amsterdam.

Day 2: Monday – Shell Energy Transition Campus Amsterdam & TenneT (Arnhem)

- **Morning:**
  - **Visit to Shell Energy Transition Campus Amsterdam:**
    - Tour Shell's Research and Development Hub.

        - Discussions on energy transition, energy storage, MW scale charging infrastructure, hydrogen economy, and renewable energy technologies.
        - Explore innovations in renewable energy systems and energy storage.
- **Afternoon:**
    - **Visit to TenneT (Arnhem) – an European TSO:**
        - Insights into high-voltage electricity transmission networks.
        - The role of TenneT in integrating offshore wind energy and managing cross-border electricity flows.
- **Overnight Stay:** Amsterdam.

Day 3: Tuesday – Travel to Cologne & Visit TÜV Rheinland

- **Morning:**
    - Depart from Amsterdam to Cologne by coach.
    - **Visit to TÜV Rheinland:**
        - Learn about TÜV Rheinland's role in certification, inspection, and testing services for renewable energy technologies, grid compliance, and energy efficiency standards.
        - Discussions on best practices in certification for renewable energy systems.
- **Afternoon:**
    - Depart to Frankfurt (approx. 3-4 hours by coach).
- **Overnight Stay:** Frankfurt.

Day 4: Wednesday – Renewable Energy & TSO/DSO Technical Visits in Frankfurt

- **Morning:**
    - **Renewable Energy Projects:**
        - Visit solar energy projects or industry facilities (e.g., SolarWorld or SMA Solar Technology) to understand large-scale solar installations and energy storage systems.
        - Discuss integration challenges of renewable energy into the grid.

- **Afternoon:**
  - **TSO/DSO Technical Visits:**
    - Meet with Transmission System Operators (TSOs) like 50Hertz or Amprion to discuss grid management and the integration of renewables.
    - Learn about Distribution System Operators' (DSOs) role in managing local grids.
- **Overnight Stay:** Frankfurt.

Day 5: Thursday – Travel to Freiburg & Visit Fraunhofer ISE, Evening Travel to Zurich

- **Morning:**
  - Depart for Freiburg (approx. 3.5-4 hours by coach).
  - Visit Fraunhofer ISE, a leader in solar energy, energy storage, and energy-efficient building technologies.
  - Participate in discussions on innovations in solar systems and storage.
- **Afternoon:**
  - Depart for Zurich (approx. 3-4 hours by coach).
- **Overnight Stay:** Zurich.

Day 6: Friday – Swissgrid Headquarters & Sightseeing in Zurich

- **Day Visit**
  - Visit Swissgrid Headquarters:
    - Learn about Switzerland’s electricity transmission network.
    - Discuss grid stability, supply-demand balancing, and renewable energy integration.
- **Overnight Stay:** Zurich.

Day 7: Saturday – Visit to advanced Hydropower plant near Mt. Titlis & Return to Zurich

- **Morning:**
  - Visit to Hydro plant near Mt. Titlis,
- **Afternoon:**
  - Return to Zurich for the evening.
  - Session on Key Learnings and Reflections and farewell dinner

- **Overnight Stay:** Zurich.

Day 8: Sunday – Departure from Zurich

- **Morning:** Check out from hotel and transfer to Zurich Airport.

Other Potential Industry Visits in Europe

1. **RWE AG**
    - **Focus:** RWE is a leading energy company in Germany, focusing on the transformation to renewable energy through solar and wind energy initiatives.
    - **Visit Highlights:** Discussions on how RWE is meeting global decarbonization targets and integrating renewable energy into the grid.
2. **E.ON SE**
    - **Focus:** E.ON focuses on smart grid technologies, decentralized energy solutions, and the integration of renewable energy into distribution systems.
    - **Visit Highlights:** Insights into customer-centric energy services and innovations in energy efficiency.

Venue and Duration

The Phase I of the programme will be conducted at PAL Manesar **OR** ASCI Campus for Two (2 days) days with four (4) sessions of 90 minutes each, on each day. The participants are expected to arrive one day before the commencement of the programme.

The Phase I programme in India would be followed by Phase II which is a study tour of 7 days (exclusive of travel) to gain insights into global best practices in Energy Transition in the European Union.

The dates for the Programme would be decided based on mutual consultation between POWERGRID and ASCI. The seasonal conditions and other concerns such as local holidays may be taken into account when finalizing the dates and venue for the study tour.

Programme Fee

The programme fee will be,

- Rs 6,24,000 plus GST per participant for international component of 7 days, for a minimum of 15 participants in a batch, and
- Rs 1,50,000 plus GST per batch for Indian component at Manesar of 2 days, for a minimum of 15 participants per batch.

The quoted programme fee has been arrived at, based on a total of 60 participants in 4 batches of 15 participants each. If the numbers change, the program fee assessment will have to be revisited.

The fee for the study tour component of the programme is worked out based on the selection of the options provided below such as:

- Economy class air tickets
- Boarding and Accommodation and other land arrangements including airport transfers
- Tuition Fees, Training Kit with Bag, Travel Bag
- Coach transfers
- Visa Charges
- Tickets (if any) to official engagements
- ASCI Alumni Membership

The fee would NOT include:

- Per diems payable to the participants. The per diems would be used by the participants towards food and other incidental expenditure
- Medical insurance for the travel – this can be arranged by the travel agent on a chargeable basis by each participant.
- Any other expenditure which is not specified as included in the programme fee
- Any sightseeing expenses / visits to any shows by individual participants or accompanying guests are not included.
- Coach transfer, boarding and accommodation, flight tickets, visa charges, other land arrangements, for accompanying guests have to be borne by the respective participants.

Programme Andragogy

The programme will be delivered through lectures, group discussions, case studies and site visits.

Faculty

Administrative Staff College of India has been conducting programmes on power sector management, reforms and restructuring for executives in power utilities, companies and senior officials in electricity regulatory commissions. Apart from select faculty from ASCI, guest speakers would be invited to deliver lectures. The following ASCI faculty would direct and anchor the programme:

Sr. No	Name	Designation	Centre
1	Prof. Rajkiran V Bilolikar	Professor and Director	Center for Energy Studies (CES)
2	Amartya Awasthi	Assistant Professor	CES
3	Pavan Kumar Parnandi	Assistant Professor	CES
4	Other Guest Faculty	Power Sector Professionals/ Officers in Government	Power Sector

Deliverables

1) Phase I: 2-day programme in India for a minimum of 15 participants
2) Phase II: Study tour to European Union for 7 days (exclusive of travel)
3) Programme kit which includes reading material, soft copy all presentations and any other material distributed in the class for each programme
4) List of faculty with their contact numbers
5) ASCI alumni membership for all the participants
6) Programme Director’s Report on the programme including Consolidated Academic Feedback including that of Study Tour

Annexure I: About the Administrative Staff College of India

Administrative Staff College of India (ASCI) is one of the leading institutions in providing training, research and consultancy services to government, industry and international agencies in different disciplines of management. Established in 1956, as a result of the enterprising collaborative initiative of the corporate world and the government, ASCI prides itself on being the first and foremost institution for practicing managers occupying decision making positions at functional and policy levels in government, industries and service sectors in India and abroad. The College has an interdisciplinary team of 50 highly qualified practicing experts in various functional and sectoral areas. Till date over 2, 00,000 Indian and overseas participants have participated in ASCI's residential programs spanning five decades. It has successfully completed over 750 large-scale research projects for national and international organizations in various fields.

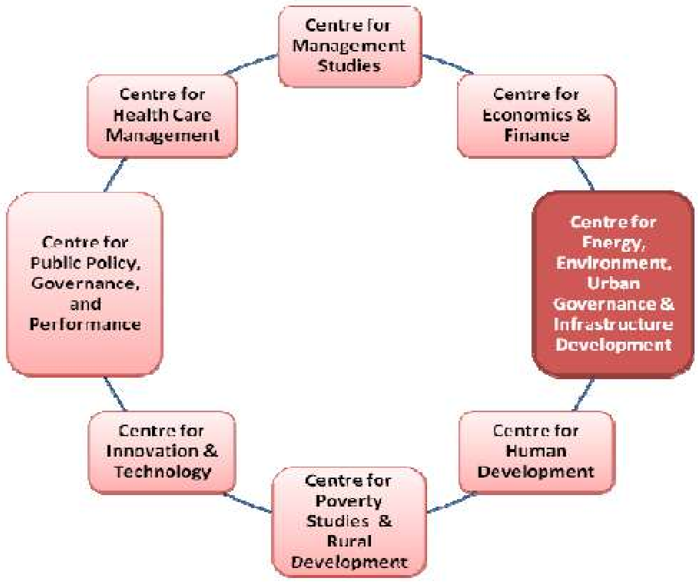
Core Activities

For the past 55 years, ASCI's activities have spanned Research, Training, and Advocacy.

<u>ASCI – Overall Activities</u>

ASCI has an interdisciplinary team of 50 highly qualified practicing experts in various functional and sectoral areas such as Governance, Public Policy, Urban Governance, Environment, Public Management, Finance, Strategic Management, Capacity Building, Procurement, ICT, etc. They bring with them a unique combination of field research expertise, practical implementation expertise and skills for dissemination of reform management approaches. It benefits from the experience of several retired senior officers of the rank of secretary to Govt. of India who is associated with ASCI. The following is the academic structure of ASCI:

ASCI Structure



The college has collaborations with national and international consultancies, NGOs, CBOs and academic institutions with expertise in various sectoral areas. ASCI can draw large number of partnerships that it has built over a period of time to bring appropriate expertise. ASCI have systems in place to quickly hire staff on a temporary engagement basis not only at its headquarters but in various states to complete projects in time and within budget.

Annexure II: CVs of Programme Directors

Prof. Rajkiran Bilolikar:

Prof. Bilolikar has been working in various capacities since last 14 years on Energy Conservation and Energy Efficiency in Buildings, Electricity Distribution Management, Techno economic feasibility studies, Regulatory affairs of Electricity Industry, Tariff analysis, Annual Performance analysis of Power utilities, IT application development in utilities and Renewable projects in India.

Government of Andhra Pradesh appointed Mr. Bilolikar as member of Technical Committee formed by GoAP to look into the implementation aspects of Energy Conservation Building Code. Mr Bilolikar played a key role in the mandatory compliance framework in the states of Andhra Pradesh and Telangana. Apart from that he was involved in advising GoAP in bifurcating power sector, O&M planning of 1200 MW of Singareni Thermal Power Plant, Study of ICT usage in Customer Relationship Management in India, Sri Lanka and Bangladesh, Asset Valuation of MPECS etc.

Prior to joining ASCI he was heading the Energy Team in Andhra Pradesh Technical Consultancy Organization Limited, Hyderabad. There, he worked on UNDP-GEF Project on CO2 emission reduction program in steel re-rolling industry, BEE-SME project in different clusters like Ice making, Rice milling, Sponge iron and Refractories.

Mr Rajkiran is a former employee of Maharashtra State Electricity Board. He was involved in ‘High voltage distribution system’ and ‘Single phasing system’ in Maharashtra State Electricity Distribution Company Limited. Thereafter he worked with ABPS Infrastructure advisory services, Mumbai and Enzen Global Solutions Private Limited, Bangalore. He worked with clients like, MERC, Suzlon Energy, Adani Power, UNDP, BEE and MNRE. He also has to his credit a number of papers presented at seminars and conferences.

Annexure-XXIV

Northern Regional Power Committee			
Centralized database of protection settings at RPCs for compliance of IEGC 2023			
Details of Substation & Relays for elements of 220 kV and above in Northern Region			
Sr. No.	**Utility**	**Details**	
		No. of Substation/Generating Station	**No. of Relays**
	Transmission		
1	UPPTCL	194	4198
2	DTL	46	1387
3	HPPTCL	12	255
4	RVPN	143	7226
5	HVPN	90	2340
6	PTCUL	14	261
7	PSTCL	111	4523
8	JKPTCL	3	61
9	PGCIL	96	9172
10	Ghatampur Transmission Limited	0	29
11	Obra-C Badaun Transmission Ltd. (OBTL)	2	66
12	Western U.P. Power Transmission Co. Ltd	15	356
13	Adani Transmission (ATL, BKTL, FBTL)	7	205
14	INDIGRID	5	246
	Generation		
15	UPRVUNL (Obra, Anpara-C, Anpara-D)	6	327
16	UJVNL	2	44
17	RVUNL	11	566
18	HPSEB (Generation & Transmission)	10	400
19	IPGCL	1	42
20	HPPCL	1	25
21	HPGCL	3	135
22	PSPCL	3	115
23	SJVN	2	64
24	NPL	1	46
25	NPCIL	5	122
26	NTPC (Rihand, Unchahar, Dadri)	7	437
27	BBMB (Generation & Transmission)	24	1078
28	NHPC	13	298
29	THDC	5	405
30	NUPPL Ghatampur	2	113
31	Prayagraj Power Generation Co. Ltd.	2	97
32	Meja Urja Nigam Private Limited (400KV, 2x660	1	88
33	Rosa Power Supply Company Ltd	2	77
34	JAYPEE VISHNUPRAYAG HYDRO - ELECTRIC PLA	1	14
35	ALAKNANDA HYDRO POWER COMPANY LIMITE	1	50
36	Adani Power Ltd. Kawai (2X660 MW)	1	57
37	Lalitpur Power Generation Company Limited	2	114
38	AD Hydro Substation	1	24
39	GREENKO	1	25
40	Aravali Power Company Pvt. Ltd	1	66
41	Apraava Energy Private Limited	1	12
42	Talwandi Sabo Power Ltd.	1	45
43	Lanco Anpara Power Ltd (Anpara-C)	2	118
44	JSW Energy Ltd. (KWHEP)	1	44
	Renewable Energy		
45	ABC RENEWABLE ENERGY	1	15
46	ACME	2	32
47	Adani	16	251
48	CLEAN SOLAR POWER	2	28
49	EDEN RENEWABLE	1	9
50	TATA POWER RENEWABLE	1	32
51	THAR SURYA 1	1	8
52	TATA POWER Green Energy Ltd.	1	32
53	AMPlus Solar GRIAN Energy Pvt Ltd	1	20
A	**Total**	**878**	**35800**
B	**Assumption for addition as data is not received from few utilities (10%)**	87	3580
C	**Grand Total**	**965**	**39380**

Scope of work for Centralized Database containing details of relay settings for grid elements connected to 220 kV and above

Scope of software shall be broadly as below for all elements in Northern Region connected to 220 kV and above voltage level:

A. **Protection Settings Database Management System.**
B. **Protection Setting Calculation and Study Tool.**
C. **Repository of DR/EL and analysis.**
D. **Application of protection settings by utilities and its approval by NRPC.**
E. **Reporting of performance indices by utilities.**
F. **Repository of protection audit reports.**

A. Protection Settings Database Management System

1. To create facility to store all types of relay settings of all power system elements (connected to 220 kV and above in Northern Region such as lines, cable, ICT, Reactor/Capacitor, generator, GT, STATCOM/SVC, FSC/TCSC, HVDC) in one system irrespective of the manufacturer and relay type and controlled access to users.
2. Complete modeling of elements with relevant system parameters **based on data received from utilities** for transmission lines, generators, transformers, reactors, substation layouts, and associated protective relays in the substations. The model should include CT, PT, Isolator, Breaker and other bay equipment's ratings along with rating of the BUS and the type of conductor used for the BUS. The modeling should be done as per bus-breaker philosophy instead of node-oriented model.
3. Creation of necessary relay templates of all make and model existing in grid. **Template for electro-mechanical relay shall also be required to be created. Users shall have option to provide settings of electro-mechanical relay.**
4. Option to users to upload relay setting files (downloaded from relay) directly.
5. To capture the life cycle of protection settings and template.
6. To create an interface with Protection Setting Calculation and Study Tool.

7. To provide Role based access control.
8. Building the entire Northern region network data for load flow and fault calculation, Protection database and substation SLD preparation.
9. Hardware setup and software package capable of meeting the above objectives. Associated servers for installation and Deployment of application and database software along with standard Operating System –With Main and Back up.
10. Work flow Management.
11. Availability of historical fault data for predicting nature of fault.
12. The tool should be capable of analyzing, storing, and handling all fault records (Disturbance record, Event Logger, COMTRADE files, etc.) for a minimum period of prescribed years; and the updated database to be used for fault analysis should be permanently available.
13. Reports:
    a. Feature to generate reports as per user requirement.
    b. User can generate report in standard format like .xls, .pdf.
14. History log: All user activities such as user operations, data management, template management, configuration management and workflow shall be logged to track the user activities.
15. Import and Export: There shall be an option to import template and data from any third party application in standard formats like .xml and .xls
16. Relay characteristics curve can be drawn from the setting data.
17. Provision to attach documents to relay template and relay data can be made available. Option to accept setting data as per the audit and verify/compare the field setting with protection database setting and generate error report.
18. Provision to store and retrieve audit reports.
    c. Provision to store and retrieve relay tripping incidence report.
    d. Facility to store and retrieve setting guidelines as per various committees.
    e. Automatic Reconciliation Tool should be available which will generate automatic reconciliation requests for relay settings in the database.
    f. Up-to-date application guides and user manuals of all relays is a part of the relay library.
19. A user-friendly interface with features such as
    a) Web based System.

b) Role based access control
c) Flexible customization of user roles, grants, actions from Master control panel
d) User Access Monitor
e) Relay Template Management
f) Create\Edit\Delete relay templates
g) Viewing relay template
h) Locking and Unlocking templates
i) Copy & Edit templates from the existing template
j) Import and Export templates
k) Relay Data management
l) Create\Edit\Delete relay data
m) Viewing relay data
n) Locking and Unlocking relay data
o) Copy & Edit relay data from the existing data
p) Import and Export relay data

20. Built with standard relays library data for different manufacturers, including but not restricted to the following protection features:

i. **Transmission Line & cable (including compensated):**
Distance, over current, earth fault, over voltage, Line Differential protection.

ii. **Power Transformer:**
Differential Protection, Under Impedance protection, Over fluxing Protection, Thermal Overload Protection, Low Impedance Restricted Earth Fault Protection, High Impedance Restricted Earth Fault Protection, back-up over current (Directional/ Non-Directional) and earth fault protection (Directional/ Non-Directional).

iii. **Shunt Reactors:**
Differential protection, Restricted Earth Fault, Back Up Protection (Impedance / overcurrent)

iv. **Generator:**
Differential Protection, Stator Earth Fault Protection (Both 95% and 100% protection), Inter – Turn Differential Protection, Backup impedance, Voltage Controlled O/C, Negative Sequence, Field Failure,

Reverse Power/Low forward Power, Pole Slipping, Overload, Over voltage, Under Frequency, Dead Machine, Rotor Earth Fault, Over Fluxing.

v. **Generator Transformer/ Unit Auxiliary Transformer:**

Differential Protection, Back up Earth Fault Protection, Back up over current, Restricted Earth Fault.

vi. **HVDC:**

- Converter Protection: Valve Short Circuit Protection, DC Differential Protection, DC Harmonic Protection, DC Under voltage Protection, DC Overvoltage Protection, AC Over voltage Protection, AC Under voltage Protection, AC Voltage Stress Protection of Converter, Group Differential Protection, Bridge Differential Protection, Overcurrent Protection, Sub-Synchronous Resonance Protection, AC Valve Winding Ground Fault Supervision,
- DC Filter Protection: Capacitor Differential Over current Protection, Capacitor Unbalance Supervision, Inverse Overcurrent Time Protection, DC Filter Differential Protection,
- DC Line Protection: Travelling Wave Front Protection, Under voltage Sensing Protection, Under voltage Operation Protection, DC Line Differential Protection, AC-DC Conductor Contact Protection.
- Electrode Line Protection: Electrode Bus Differential Protection, Electrode Current Balance Protection, Electrode Over Current Protection, Electrode line open circuit Over voltage Protection, Station Ground Overcurrent Protection, Open Conductor Electrode Line Protection
- DC Busbar Protection: HV Side DC Bus bar Differential Protection, Neutral Side DC Busbar Differential Protection, DC Differential Backup Protection, Valve Protection
- Converter Transformer Protection: differential protection, high impedance, restricted earth fault protection, ground earth fault overcurrent protection, thermal overload protection, over-fluxing protection, directional definite time / inverse-time overcurrent protection and directional earth fault overcurrent protection.

- AC Filter Sub-bank Protection (Shunt/Capacitor/Resistor): Differential, overcurrent, overload, unbalance supervision, Zero Sequence Overcurrent.

vii. **STATCOM:**

- Transformer Protection: Differential protection, REF protection, Directional Overcurrent protection, Ground Overcurrent, over flux protection, Transformer mechanical trips.
- STATCOM (MV) Bus protection: Bus Differential protection, Ground over current protection, used with neutral Grounding Transformer, Under/ Over Voltage protection, Over voltage (Open Delta) protection.
- STATCOM Branch Protection: Differential protection and/or O/C protection, Ground over current protection , Valve Overcurrent protection (in Controls), DC overvoltage protection (in Controls)
- MSR/TCR Branch Protection: Differential protection, Ground over current protection, Reactor branch unbalance protection, Thermal Overload protection.
- MSC/TSC Branch Protection: Differential protection, Ground over current protection, Capacitor Overvoltage (Using current signal) protection, Capacitor unbalance protection, over current protection.
- Harmonic Filter Protection: Ground over current protection, Capacitor Overload (Using current signal) protection, over current protection, Neutral Voltage shift.
- Auxiliary Transformer Protection: Over current, open delta voltage protection.

viii. **SVC:**

- Coupling Transformer (HV & MV) Protection: Differential protection, REF protection, Directional Overcurrent protection, Ground Overcurrent, over flux protection, Transformer mechanical trips.
- SVC Bus Bar protection: Bus Differential protection, Ground over current protection, used with neutral Grounding Transformer, Under/ Over Voltage protection, Over voltage (Open Delta) protection.

- TCR Protection: Differential protection, Ground over current protection, Reactor branch unbalance protection, Thermal Overload protection.
- TSC Protection: Differential protection, Ground over current protection, Capacitor Overvoltage (Using current signal) protection, Capacitor unbalance protection, over current protection.
- Harmonic Filter Protection: Differential protection, Ground over current protection, Capacitor Overvoltage (Using current signal) protection, Capacitor unbalance protection, over current protection, Neutral Voltage shift.
- Auxiliary Transformer Protection: Over current, open delta voltage protection.

ix. **FSC & TCSC:** Capacitor unbalance, Capacitor overload, Line current supervision, MOV overload, MOV short term energy protection, MOV high current protection, MOV high temperature protection, MOV failure protection, Flashover to platform protection, Spark Gap protection, Trigger circuit supervision, Sub-harmonic protection, Pole disagreement protection, Bypass switch failure protection,

x. **BUSBAR & LBB**: Differential protection, Beaker Failure Protection

21. Protection Settings Database Management System shall be suitable for integration with other portals, software of protection. It shall be able to integrate any third party application to share data between protection database management software and calculation engine/tool and vice versa.
22. Training of utilities.
23. AMC.

B. Protection Setting Calculation and Study Tool.

This module shall be capable of giving recommendation of Protection Setting for protections of elements as mentioned under point no. 20 of para A. Calculation Tool should be capable of performing the following:

1. Relay co-ordination for power system elements. Co-ordination check shall be conducted for relays of all make.
2. Primary/back-up relay pairs generation.
3. Fault calculation will be a part of relay co-ordination program.

4. Transparent Fault calculation results.
5. Simulation engines for protection co-ordination, power flow analysis, fault calculation, transient stability studies, electromagnetic transient analysis, and protection relay operation post-mortem analysis. There should be features to study low frequency oscillations, 3rd zone tripping, PSS tuning support and Voltage collapse prediction feature.
6. The protection calculation tool should be capable of interacting with the relay data in the database.
7. Tool for simulating the performance/ behavior of the protection system under all possible normal and abnormal operating conditions of the power system, including effect of changing one or more parameter setting of the relays.
8. Diagnostics Tool for verifying proper coordination among various protective relays.
9. Computation of critical clearing time.
10. Plotting Log-Log grid and graphs.
11. Option to check existing relay settings with respect to field or vice versa.
12. Computation of Out of Step Tripping Protection Settings.
13. Display of sequence operation of relays with respect to tripping time.
14. Switching status for all relays elements from the screen.
15. Association of relays to power system elements.
16. Disturbance analysis can be done on mapping of disturbances files with corresponding relay.
17. It shall have standard power system components and relay symbols.
18. Automatic computation of zone setting for distance protection.
19. Feature for viewing existing and newly computed relay settings.
20. Pre-loaded standard relay curves.
21. Directional and non-directional feature for relays.
22. Overload factor, unbalance factor and discrimination time (user defined/selectable) for each relay.
23. Inbuilt discrimination time calculator for grading of relays.
24. Facility to model the back-up protection settings of generating units / GTs.

C. Repository of DR/EL and analysis.

a) Platform for upload of DR/EL by utilities and access to all.

b) Tracking of non-compliance in uploading.
c) Tool for analysis of DR/EL.
d) Tool shall be integrated with outage portal of NRLDC so that it can capture details of outages of elements automatically from NRLDC portal so that users can upload DR, EL, FIR, tripping report, analysis report.

D. Application of protection settings by utilities and its approval by NRPC.

a) Platform for application of protection setting by utilities.
b) Hierarchical role for scrutiny and approval of setting by NRPC.
c) Intimation of approval of settings by NRPC.
d) Intimation of implementation of settings by utilities.

E. Reporting of performance indices by utilities.

a) Platform for reporting of performance indices by utilities.
b) Feature for scrutiny and intimation of errors to utilities by NRPC.
c) Recording of justification note for non-compliance.

F. Repository of protection audit reports.

a) Platform for reporting of internal and external audit report of all utilities.
b) Tracking non-compliance and next due date.
c) Web-based Checklist for protection audit should be made available for Constituents to self-auditing.

*****

Annexure-XXVI

सत्यमेव जयते

उत्तर क्षेत्रीय विद्युत समिति

NORTHERN REGIONAL POWER COMMITTEE

Procedure for Approval of Protection Settings in Northern Region

(In reference to regulation 14 of IEGC 2023)

Version: 1.0

(Approved in 75th NRPC meeting held on 28.08.2024)

August, 2024

A. Procedure in case of new element charging

1. ISTS users shall submit the protection settings to NRPC and NRLDC for every new element to be commissioned one month in advance through mail.
   In case of intrastate elements, users shall submit the protection settings to NRPC and concerned SLDC for every new element to be commissioned one month in advance through mail.
2. NRLDC based on the above information and the First Time Charging (FTC) request by user through Outage Management System (OMS) portal of NRLDC, shall allow integration of new element in the system as per NRLDC FTC procedure with the prevailing practice to avoid any delay in charging of the new element. The settings shall be treated as provisional arrangement till approval in PSC (Protection Sub-Committee).
   In case of intrastate elements, SLDC shall allow integration of new element in the system. This shall be treated as provisional arrangement till approval in PSC.
3. NRLDC/SLDCs may ask any other relevant data/information from concerned utilities during scrutiny of settings.
4. Users will be responsible for any revision in settings of the existing element required due to charging of new element. The settings shall be treated as provisional arrangement.
5. The concerned utility shall put up the agenda for getting final approval in next PSC.
6. NR PSC will review and approve the final settings based on the inputs submitted by the utility. In case of any change required in final protection settings of the new element than the provisional one, as decided by the committee, the same shall be implemented within 7 days by the concerned utility.
7. Utility shall intimate to NRPC Secretariat and NRLDC/SLDC (as applicable) within fortnight after implementation of settings for record in regional protection settings database.

B. Procedure in case of revision of settings of any existing element (without any changes in network configuration):

1. Any change in the existing protection settings shall be carried out only after prior approval from PSC Forum of NRPC.
2. The concerned utility (both ISTS and intrastate) shall put up an agenda regarding any changes required in existing protection settings due to integration of new element in the existing system or otherwise, in PSC.
3. Utility shall intimate to NRLDC/SLDC (as applicable) and NRPC about the changes implemented in protection system or protection settings within 15 days of such changes.

*****

Annexure-XXVII

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

दिनांक: 12.12.2024

Subject: Implementation of Centralized Database for Protection Settings in Northern Region under PSDF-reg

Reference is invited to implementation of Centralized Database for Protection Settings in Northern Region by POWERGRID as discussed and approved in 48th TCC & 70th NRPC meeting (held on 17-18 Nov 2023).

Thereafter, the modalities were discussed in meeting held on date **08.01.2024** at 11:00 HRS at NRPC Secretariat, Katwaria Sarai, New Delhi. MoM is **attached** for reference. As per decision of above meeting, details asked by POWERGRID are as below:

S.N.	Tentative number of substations (220 kV and above in Northern Region)	Tentative number of relays	Tentative number of licenses of protection calculation tool
1*	965	39380	87

**Final numbers shall be freezed in upcoming TCC/NRPC meeting.*

It is pertinent to mention that PSDF fund that was stopped for disbursement till now, has been recently opened as per information received from NLDC vide letter dated 04.12.2024. Accordingly, it is planned to get approval of this project in upcoming 52nd TCC/ 77th NRPC (scheduled on 27-28 December 2024) for grant of PSDF fund.

In view of above, POWERGRID is requested to submit cost estimate and draft DPR (for PSDF approval) so that approval can be taken in upcoming TCC/ NRPC meeting.

Signed by Reeturaj Pandey
Date: 12-12-2024 16:24:54

ऋतुराज पाण्डेय
उप निदेशक (संरक्षण)

सेवा में,

CGM(I/C), AM, CC POWEGRID, Gurgaon (thirumalareddy@powergrid.in)

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

Date: 08.02.2024

Subject: Minutes of meeting to discuss modalities of tendering for Centralized Database for Protection Settings in Northern Region-reg.

उत्तरी क्षेत्र में सुरक्षा सेटिंग्स के लिए केंद्रीकृत डेटाबेस के लिए निविदा पर विचार-विमर्श करने के लिए 08.01.2024 को 11:00 बजे एनआरपीसी सचिवालय, कटवारिया सराय, नई दिल्ली में आयोजित बैठक के कार्यवृत संलग्न है ।

Kindly find attached minutes of meeting held on 08.01.2024 at 11:00 Hrs. at NRPC Secretariat, Katwaria Sarai, New Delhi to deliberate on tendering for Centralized Database for Protection Settings in Northern Region.

Signed by D. K. Meena
Date: 09-02-2024 16:34:48
Reason: Approved

डी.के.मीना
अधीक्षण अभियंता (संरक्षण)

सेवा में,

1. ED, NR-1, POWEGRID
2. ED, NRLDC

<u>Minutes of meeting held on 08.01.2024 at 11:00 HRS at NRPC Secretariat, Katwaria Sarai, New Delhi to deliberate on tendering for Centralized Database for Protection Settings in Northern Region.</u>

MS, NRPC welcomed all participants from POWERGRID and NRLDC. List of participants is attached in **Annexure-I**.

1. EE (P), NRPC apprised that 48th TCC & 70th NRPC meeting (held on 17-18 Nov 2023) has approved scope of centralized database portal to be done under PSDF. POWERGRID has also been decided as implementing agency.
2. MS, NRPC asked POWERGRID regarding preparedness for tendering and DPR for PSDF.
3. POWERGRID informed that standard tender documents for similar projects are readily available with them and only technical specifications are left for finalization. He asked about implementation mode of the same.
4. MS, NRPC highlighted that as per CERC, it is mandated in IEGC regulation to maintain a centralized database. After getting draft DPR from POWERGRID, NRPC Secretariat will approach for PSDF grant.
5. EE (P), NRPC stated that DPR shall contain estimate of project. Therefore, if required, POWEGRID may arrange EOI for this project.
6. POWERGRID conveyed that they will get quotation from known vendors and accordingly, draft DPR for PSDF grant shall be prepared having details of cost estimate, and consultancy charges of POWERGRID.
7. EE (P), NRPC desired to know the inputs required from NRPC to prepare draft DPR and tender documents by POWERGRID. He also suggested to identify server location.
8. POWERGRID replied that no. of Substations, relay, and licenses are required. Physical location of server shall be at NRPC Secretariat.
9. NRLDC representative suggested to have remote server for the same.
10. EE (P), NRPC suggested that data is crucial, therefore, POWERGRID may consider backup server also either physical or cloud in tender document.
11. EE (P), NRPC stated that as per approved scope of centralized database portal, it is to be integrated with NRLDC tripping portal also so that DR/EL can be uploaded against tripping occurred.

12. NRLDC representative informed that their tripping portal has details of ISTS lines only. Details of tripping of state control area is available with states only. Therefore, all states shall have to be streamlined separately with this portal depending upon the size of their transmission system.
13. POWERGRID informed that after getting all substations details from NRPC, DPR can be submitted by their side within a week.
14. POWERGRID asked for the scope of relay settings. He added that generic template may be preferred as there are several types of relays which may lead to complexity if specific template is modelled.
15. EE (P), NRPC added that the tender document shall cover all scopes clearly.
16. It was decided that after discussion in the 215th OCC meeting (scheduled on 12.01.2024), NRPC shall finalize approximate no. of licenses, substations, relays and shall send to the POWERGRID by end of January 2024.
17. Subsequently, POWERGRID agreed to submit the draft DPR and draft tender document to NRPC Secretariat by 1st week of February, 2024.

Meeting ended with a vote of thanks to the chair.

Annexure-I

NRPC Participants:

1. Sh. V.K. Singh, Member Secretary
2. Sh. D.K. Meena, SE (O)
3. Sh. Reeturaj Pandey, EE (P)
4. Sh. Lokesh Agrawal, AEE (P)

POWERGRID Participants:

1. Sh. Manoj Kumar Jha, Senior GM
2. Sh. Sandeep Yadav, Chief Mgr.

NRLDC Participants:

1. Sh. Gaurav Malviya, Mgr.

same. The details of spare ICT and spare bus reactor unit were not intimated by UPPTCL in the 38th SCM.

A.13.3. Representative of NRLDC informed that the cited matter was discussed in the 67th NRPC meeting and 214th OCC meeting of NRPC, wherein M/s UPPTCL was advised to take up the matter with Chief Engineer, PSPA Division, CEA for resolution of the issue.

A.13.4. MS, NRPC asked UPPTCL to confirm to CEA the details of 765 kV Bays (701, 702, 703, 705, 706), spare ICT and spare bus reactor implemented by PMSTL at Meerut substation.

A.14. Demolition and reconstruction of residential/ non-residential buildings in the substation premises at Ballbhgarh, Bassi, Mandola under RHTL and Hisar Sub Station under MBTL system through Additional Capitalization in Tariff Block 2019-24. (Agenda by Powergrid-NR1)

A.14.1. Representative of Powergrid NR-1 informed that Ballbhgarh, Bassi, Mandola and Hisar Sub-stations have completed 30 years of service life. Residential/ non-residential buildings in these substation premises are in dilapidated and non-liveable condition. Therefore, Powergrid has proposed to demolish and reconstruct quarters and Non-residential building (Transit Camp & Recreational Centre) at above stations after demolition of old and dilapidated quarters and old non-residential buildings.

A.14.2. He further informed that reconstruction of dilapidated township of Vijayawada Sub-station under ACE for 2019- 24 tariff period was approved by SRPC on same ground.

A.14.3. MS, NRPC stated that as the work is to be carried out through additional capitalization, the consent of states would be required. He suggested that structural assessment of these projects may be carried out by an appropriate agency, such as NCCBM. Subsequently, the proposal may be taken up for approval in the NRPC meeting.

A.15. Concern regarding imposition of shutdown charges by Rajasthan Rajya Vidut Prasaran Nigam Limited, Jaisalmer of their transmission lines for construction activities by POWERGRID, contrary to CERC Regulation. (Agenda by Powergrid-NR1)

A.15.1. Representative of Powergrid and RVPN informed that the issue has been resolved.

A.15.2. Representative of RVPN informed that a clarification has been issued by RVPN stating not to raise any transmission charges for RVPN power line crossings by 100 percent wholly owned subsidiaries of Powergrid on a reciprocal basis.

A.16. Frequent faults in 220kV lines of UPPTCL connected to POWERGRID, GIS

Annexure-XXIX

Centre for Construction Development & Research
National Council for Cement and Building Materials
(Under the Administrative Control of Ministry of Commerce & Industry, Govt. of India)
34 Km Stone, Delhi-Mathura Road (NH-2), Ballabgarh - 121004, Haryana, India

निर्माण विकास एवं अनुसंधान केन्द्र
राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद्
(भारत सरकार के वाणिज्य एवं उद्योग मंत्रालय के प्रशासनिक शासनाधीन)
34 कि.मी. स्टोन, दिल्ली मथुरा रोड़ (एन. एच.–2) बल्लबगढ़–121004, हरियाणा, भारत

(ISO 9001 : 2015)

• दूरभाष / Phone : +91-0129-2666758 (D), 2666622
• ई.मेल / E-mail : cdrb@ncbindia.com, nccbm@ncbindia.com • वेब / Web: ncbindia.com

स्पीडपोस्ट / ई–मेल

संदर्भ:सीडीआर / एसपी–6751
9 **दिसंबर** 2024

श्री एस के सिंह
वरिष्ठ डीजीएम,
इंडिया लिमिटेड का पावर ग्रिड कॉर्पोरेशन,
पावर ग्रिड कॉर्पोरेशन इंडिया लिमिटेड,
400/220 केवी सब स्टेशन
समयपुर, बल्लबगढ़, फ़रीदाबाद, हरियाणा, 121004
ईमेल- s.k.singh@powergrid.in

11/12/24

(द्वारा : श्री पी.एन. ओझा, संयुक्त निदेशक एवं एचओसी-सीडीआर)

Sub: Condition assessment of Residential Quarters of Type-B (14 nos.), Type-C (4 nos.), Type-D (1 no), Transit Camp and Recreation Centre at PGCIL 400/220kv Ballabgarh Substation, Near Samaypur, Faridabad. (Reg. Final Report)

श्रीमान,

उपरोक्त विषय के संदर्भ मे अंतिम रिपोर्ट की तीन प्रतियां संलग्न कर रहे है। कृपया रिपोर्ट प्राप्ति के बाद सूचित करे।

धन्यवाद!

भवदीय
राष्ट्रीय सीमेंट एवं भवन सामग्री परिषद
नितिन चौधरी 9/12/24
नितिन चौधरी
समूह प्रबंधक और प्रोग्राम लीडर
निर्माण विकास एवं अनुसंधान केंद्र

संलग्न : अंतिम रिपोर्ट

HYDERABAD UNIT
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CONDITION ASSESSMENT OF RESIDENTIAL QUARTERS OF TYPE-B (14 Nos.), TYPE-C (4 Nos.), TYPE-D (1 No.), TRANSIT CAMP AND RECREATION CENTRE OF BALLABHGARH

For

POWER GRID CORPORATION OF INDIA LIMITED

FINAL REPORT
CDR/SP-6751
DECEMBER 2024

Centre for Construction Development and Research
NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
34 Km Stone, Delhi-Mathura Road, NH-2, Ballabgarh – 121004 (Haryana)

REPORT

CONDITION ASSESSMENT OF RESIDENTIAL QUARTERS OF TYPE-B (14 NOS.), TYPE-C (4 NOS.), TYPE-D (1 NO.), TRANSIT CAMP AND RECREATION CENTRE OF BALLABHGARH

For

POWER GRID CORPORATION OF INDIA LIMITED

CDR/SP-6751
DECEMBER 2024
FINAL REPORT

Centre for Construction Development and Research
NATIONAL COUNCIL FOR CEMENT AND BUILDING MATERIALS
34 Km Stone, Delhi-Mathura Road, NH-2, Ballabgarh – 121 004 (Haryana)

Prepared By	**Kunal Gupta**	Kunal Gupta 02/12/24
Checked By	**Mantu Gupta**	Mantu 02/12/24
Approved By	**Nitin Chowdhary**	2/12/24

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	Version: Final	

INDEX

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1.0 INTRODUCTION

PGCIL had approached National Council for Cement and Building Materials (NCCBM) to undertake the work of "Condition Assessment of Residential Quarters of Type-B (14 nos.), Type-C (4 nos.), Type-D (1 no.), Transit Camp and Recreation Centre at PGCIL 400/220kv Ballabgarh Substation, Near Samaypur, Faridabad. Consequently, preliminary site inspection was carried out by NCCBM officials on 18th April 2024 to define the scope of work for the condition assessment of these structures. Based on the preliminary site inspection, NCCBM had submitted the proposal for the condition assessment vide our letter No. Ref. CDR/SP-6280/SAR-370 dated 19th April 2024. Further, PGCIL had issued Letter of Award (LoA) No. N1/C&M/24-25/ST-PAC basis/ LoA/24-108133/01 dated 2nd July 2024.

Accordingly, NCCBM had started the condition assessment work with the following mutually agreed scope of work between PGCIL and NCCBM:

Scope of work:

i) Detailed visual inspection of the subject structures. This will involve recording the visual observations regarding the structural and non-structural components of the buildings along with the details of apparent signs of distress observed in the RCC members/brick wall. The results of the detailed visual inspection will be supported and supplemented with photographs wherever possible.

ii) Conducting investigation using Non-Destructive testing and laboratory testing of in-situ samples collected from site. This will involve the following:

a) Determination of equivalent cube compressive strength (if feasible) of concrete in RCC members of the super structure using concrete core extraction & testing technique as per IS 456:2000 & IS 516 (Part 4): 2018. For this, concrete cores of 60 mm diameter will be extracted. The locations from which the concrete cores are extracted will be decided by NCCBM team deputed for assessment in coordination with representatives of PGCIL. In case extraction of intact concrete cores suitable for compressive strength testing appears to be difficult due to reasons such as breakage, washing out of cores, etc., during the process of extraction, same will be recorded and reported in the report.

b) Carry out Ultra Sonic Pulse Velocity (UPV) testing of concrete in RCC members as per IS 516 (Part 5/Sec 1): 2018 to assess the quality of concrete. The UPV testing shall be carried out at points which are accessible and on well prepared concrete surfaces. The test will be done by cross probing method where two opposite faces of the member are readily accessible at the same time. Wherever only one face of the RCC member is readily accessible at a time, the test will be done by surface probing method.

c) Measurement of the depth of carbonation front IS 516 (Part 5/Sec 3): 2021 on the extracted concrete cores and/or other in-situ samples of concrete.

d) Half Cell Potential test as per IS 516 (Part 5/Sec 2): 2021 to determine the likely corrosion condition of reinforcement bars in few selected and safely accessible RCC members.

e) Surface electrical resistivity test on concrete using four-point Wenner Probe Technique in few selected and safely accessible members.

f) Laboratory testing on in-situ samples of joining mortar in the brick wall collected from the site to determine sulphate content. These samples will be collected from safely accessible locations.

g) Laboratory testing on in-situ samples of bricks for determination of Compressive Strength, Efflorescence & water absorption. The sample of 10 bricks from each type of structure will be collected.

h) Chemical analysis of hardened concrete samples in the laboratory. This will involve evaluation of chlorides, sulphates and pH of the concrete.

i) Determining the extent of distress in RCC slabs and brick walls based on the above investigation and arriving at conclusions and recommendations regarding further action to be taken.

j) Report covering (a) to (i) above.

2.0 DESCRIPTION OF STRUCTURE & DATA/DOCUMENT PROVIDED BY SPONSOR

PGCIL 400/220kv Ballabgarh Substation, Near Samaypur, Faridabad has residential Quarters of Type-B (14 nos.), Type-C (4 nos.), Type-D (1 no.), Transit Camp (1 no.) and Recreation Centre (1 no.). All the structures are single storied buildings. D-Type Quarter contains one garage and one servant quarter too. All the buildings were load bearing structures having brick masonry walls and RCC slabs. Two RCC columns were observed below long projection in D-Type Quarter.

It was informed by the PGCIL representatives on the day of site inspection, the construction of B-type, C-Type & D-Type Quarters is around 1988 and of Transit camp & Recreation Centre around 1997-1998. The data regarding the grade of concrete used, concrete mix design, type & grade of steel, structural & architectural drawings were not made available by PGCIL Ballabhgarh representative.

3.0 CONDITION ASSESSMENT METHODOLOGY

The methodology adopted for condition assessment covers following three parts:

Visual Observations covering visual inspection, recording & photography of apparent visible condition of the structure and categorizing the various RCC members based on the visible state of distress.

Site Investigation & Sampling covers identification of sample RCC members by random sampling technique and onsite NDT testing such as UPV testing, Concrete Cover Measurement, Core extraction, Half Cell Potential Measurement, Electrical Resistivity measurement, etc.

Laboratory Investigation covers testing of concrete core strength, grinding of concrete cores for further chemical testing i.e. to determine the chloride content, sulphate content & pH.

Based on the visual observations, site investigation and laboratory testing results, the conclusion is derived to define the root cause of distress in the structure.

3.1 Visual Observations:

To collect data of apparent distress in RCC (Reinforced Cement Concrete) members of, the visual observation survey was carried out during the site visit conducted on 18th March 2024. During visual observation, any apparently visible signs of deterioration in concrete members have been considered as a sign of distress. Distress in any RCC structures/members occurs due to various reasons like carbonation induced corrosion and chloride induced corrosion, over-loading, settlement etc. and may result into reduction in service life of the structure. Generally, distress in concrete manifests itself in many forms such as cracking, spalling of concrete, corrosion of reinforcement steel, seepage etc. During the visit, these signs/if any were looked out for and the recorded details are given in section 4.1 of this report. The photographs indicating the distress observed and on-site testing conducted are shown in Annexure-I.

3.2 Ultrasonic Pulse Velocity (UPV) Testing as per IS 516 (Part 5/Sec 1):2018

UPV is a non-destructive evaluation method for assessing the concrete quality grading; density, homogeneity and uniformity. Basic principle of UPV method is given below.

In this method, an ultrasonic pulse of longitudinal vibrations is produced by an electro-acoustical transducer which is held in contact with one surface of the concrete member under test. When the pulse is induced into the concrete from a transducer, it undergoes multiple reflections at the boundaries of the different material phases within the concrete. A complex system of stress waves is developed which includes longitudinal (compression) waves. The receiving transducer detects the onset of the longitudinal waves, which is the fastest. After traversing a known path length of the member, the pulse of vibrations is converted into an electric signal by a second electro-acoustical transducer, and an electric timing circuit enables the transit time of the pulse to be measured, from which the pulse velocity is calculated.

The Ultrasonic Pulse Velocity in concrete is mainly related to its density and modulus of elasticity. This in turn depends upon the materials and mix proportions used in making concrete as well as methods of placing, compaction and curing of concrete. If the concrete is not thoroughly compacted, or if there is segregation of concrete during placing or there are internal cracks or flaws, the pulse velocity will be lower, although the same materials and mix proportions are used.

There are three methods of conducting UPV test depending upon availability of faces of RCC members in the structure. One is cross-probing (or direct-probing), in which the transducers are held on two opposite faces of the RCC members. If the opposite face is not available, then transducers are held on adjacent faces of the RCC member, this method is known as ‘semi-direct probing’ technique. If the opposite faces are not available, then transducers are held on same face of the RCC member. This method is known as ‘surface probing’ technique involving transmission of Ultrasonic Pulse through the concrete surface. Surface probing in general gives lower pulse velocity than in case of cross probing and depending on number of parameters, the difference could be of the order of about 0.5 km/s.

The underlying principle of assessing the concrete quality grading from UPV method is that, comparatively higher pulse velocities are obtained when the 'quality' of concrete in terms of density, homogeneity and uniformity is good. In case of concrete of poorer quality, lower velocities are obtained.

On this basis, guidelines have been evolved for characterizing the concrete quality grading in structures in terms of ultrasonic pulse velocity. Such guideline is given in Table A, which is reproduced from IS 516 (Part 5/Sec 1): 2018 (Amendment No. 1 dated November 2019).

TABLE A

VELOCITY CRITERIA FOR CONCRETE QUALITY GRADING (reproduced from Table 1 of IS 516 (Part 5/Sec 1):2018) [UPV by cross probing method]

SI. No.	Average Value of Pulse Velocity by Cross Probing Km/s	Concrete Quality Grading
i) For concrete (≤ M 25):		
a)	Above 4.50	Excellent
b)	3.50 - 4.50	Good
c)	Below 3.50	Doubtful[1)]
ii) For concrete (> M 25):		
a)	Above 4.50	Excellent
b)	3.75 - 4.50	Good
c)	Below 3.75	Doubtful[1)]
[1)] In case of 'Doubtful quality', it may be necessary to carry out additional tests.		

For the present investigation, accessible RCC members were selected to conduct the UPV test. After removing plaster etc., the surface of the RCC members were thoroughly cleaned and smoothened with carborundum/grinding stone. The RCC members were then divided in parts at suitable grid spacing and UPV measurements were taken on the grid points marked by cross probing/surface probing technique depending on accessibility of opposite faces of RCC members using UPV Tester PUNDIT (Portable Ultrasonic Non-Destructive Digital Indicative Tester) Lab of make PROCEQ. Grease was used as coupling medium between the transducer face and the concrete surface.

3.3 Concrete Core Testing as per IS 516 (Part 4): 2018

Concrete cores of 60-mm diameter were obtained from different structural members identified, to estimate equivalent cube compressive strength of the structure. Equivalent cube strength does not indicate 28 days' standard cube strength rather it represents the in-situ cube strength and is compared vis-à-vis strength used in design calculation with safety of the structure under load in mind.

There are a number of parameters, which influence the measured compressive strength. Such parameters include size (diameter) of the specimen, length-to-diameter ratio, direction of drilling, method of capping, drilling operations, moisture conditions of cores at the time of testing etc. Many of these parameters have been standardized.

The second set of variables relates to the intrinsic difference that exists between the concrete in structure and in standard laboratory-controlled specimens, the core specimens representing the former. Such intrinsic differences are due to inherent differences that may occur in mixing constituents, degree of compaction, extent of curing and temperature condition in two cases. The procedure for sampling, preparing, testing and calculating the equivalent compressive strength with corrections are given in IS 516 (Part 4):2018.

The Clause 17.4.3 of **IS 456:2000** (Code of Practice for Plain and Reinforced Concrete) consider that concrete in the area represented by a core test is acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has a strength less than 75 percent.

3.4 Concrete Cover Study

Concrete cover, in reinforced Concrete, is the least distance between the surface of embedded and the outer surface of the Concrete

The concrete cover must have a minimum thickness for three main reasons:

- To protect the steel reinforcement bars (rebars) from environmental effects to prevent their corrosion;
- To protect the reinforcement bars from fire, and;
- To give reinforcing bars sufficient embedding to enable them to be stressed without slipping.

The premature failure of corroded steel reinforcements and the expansion of the iron corrosion products around the rebars are amongst the main causes of the concrete degradation. A sufficient thickness of concrete cover is required in order to slow down the electrochemical process in concrete towards the rebar. The minimum concrete cover will depend on the environmental conditions encountered and must be thicker when the concrete is also exposed to moisture and chloride.

For a longitudinal reinforcing bar in a Column nominal cover shall in any case not be less than 40 mm or less than the diameter of such bar as per clause 26.4.2.1 of IS 456:2000. For footing, minimum cover shall be 50mm as per clause 26.4.2.2 of IS 456:2000.

Minimum values for the nominal cover of normal weight aggregate concrete which should be provided to all reinforcement including links depending on exposure condition are specified in Table 16 of IS 456:2000 which is reproduced as Table-B below:

Table B: Nominal Cover to Meet Durability Requirements

(IS 456:2000; Table 16; Clause 26.4.2)

Exposure	Nominal concrete cover in mm not less than
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

Note:

a. For main reinforcement up to 12 mm diameter bars for mild exposure the nominal cover maybe reduced by 5mm.

b. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by +10mm & 0 mm.

c. For exposure condition severe and very severe reduction of 5 mm maybe made where concrete grade is M35 and above.

d. For a longitudinal main reinforcing bar in a column nominal cover shall in any case not be less than 40 mm, or less than the diameter of such bar as per clause 26.4.2.1 of IS 456: 2000.

Measurement of thickness of concrete cover provided to reinforcing bars was carried out at site by using an electromagnetic cover meter (Profoscope of Make-Proceq) at site on safe & accessible locations. Profoscope detects the reinforcing bars and mesh, to measure their cover depth. The instrument is based on the magnetic technique and is calibrated for different purposes.

3.5 Carbonation Test as per IS 516 (Part 5 / Sec 3):2021

Carbonation is the formation of calcium carbonate ($CaCO_3$) by chemical reactions in concrete. When CO_2 penetrates into the hardened concrete, it reacts with Portlandite [Portlandite is a mineral formed during the curing of concrete, calcium hydroxide $Ca(OH)_2$ in the presence of moisture forming $CaCO_3$]. The rate of carbonation depends mainly on the relative humidity, the concentration of CO_2, the penetration pressure and the temperature of the environment where concrete is placed.

As carbon dioxide enters the concrete from the environment, it reacts with calcium hydroxide present in the concrete and depending upon the concrete quality grading it reduces the alkalinity of the pore fluids, thereby de-passivating ferric oxide layer on reinforcing bar which in turn initiates the process of corrosion in reinforcement.

To determine the depth of carbonation, concrete is exposed and sprayed with a pH indicator (solutions of 1% phenolphthalein in 70% ethyl alcohol). The demarcation between the region, which turns into magenta (dark pink colour) and the region showing no change in colour indicate the carbonation front.

The procedure for measurements is given in IS 516 (Part 5/Sec 3):2021.

3.6 Half-Cell Potential (HCP) Measurements as per IS 516 (Part 5/Sec 2):2021

This test method is based on IS 516 (Part 5 /Sec 2): 2021, which covers the estimation of electrical Half Cell Potential of uncoated reinforcing steel, to determine corrosion activity using reference electrode copper; copper sulphate half-cell. It is not possible to expose all the reinforcements in the structural element and observe the extent of corrosion. So, this method has been very convenient to assess the condition of the entire length of a member by exposing a portion of the reinforcement at a suitable location, which measures the half-cell potential on the entire length, by placing the reference electrode on the wet concrete surface.

The Half-Cell Potential measurement is based on the principle that corrosion, being an electro-chemical process, induces certain voltage in the reinforcement steel that is corroding. The wetting of the concrete is required to make the portion between the concrete surface and the reinforcing bar as electrolytes.

The obtained values of test results are compared with criteria given in IS 516: (Part 5/Sec 2): 2021 to find the condition of corrosion in reinforcement steel. The criteria for corrosion status are reproduced in Table C.

TABLE C

Criteria for Corrosion Condition of Rebar in Concrete for Copper – Copper Sulphate Half-Cells [ACCORDING TO IS 516 (Part 5/Sec 2): 2021]

Potentials over an Area	Likely Corrosion Condition
> –200mV or less negative than –200mV	Low (there is a greater than 90 percent probability that no reinforcing steel corrosion is occurring in that area at the time of measurement)
– 200mV to – 350mV	Corrosion activity of the reinforcing steel in that area is uncertain
<–350mV or more negative than –350mV	High (there is a greater than 90 percent probability that reinforcing steel corrosion is occurring in that area at the time of measurement)
< – 500mV	Severe corrosion

3.7 Electrical Resistivity measurement

Concrete resistivity is geometrical independent material property that indicates the ratio between the applied voltage and resulting current in a unit Cell. The resistivity of concrete impacts the current flow between the cathodic and anodic regions of the concrete. The higher the concrete resistivity, the lower the current flowing between anodic and cathodic areas will be, and therefore lower the corrosion risk. The Proceq® RESI™ Resistivity Meter permits a rapid and non-destructive measurement of the concrete quality grading with respect to its resistivity.

The Proceq® RESI™ Resistivity Meter i.e. a four-point Wenner probe resistivity meter is used for in-situ measurement of electrical resistivity in concrete. It uses a probe with four terminals set up in a linear array with a fixed distance between the probes. The two outer probes are for the introduction of the current, whereas the two center electrodes are the voltage measurement points. When the probe touches the concrete surface, the electronic control unit circulates the test current and measures the potential between the inner points. The electronic contact is made of foam pads, which are to be saturated with water preliminarily for electrical conductivity.

During the field investigation, electrical Resistivity testing was conducted using Proceq® RESI™ type Resistivity meter at identified safely accessible locations as selected by the NCB team deputed for Condition assessment.

Interpretation of Resistivity measurements from the Wenner four-probe system has been cited when referring to de-passivated steel (Langford and Broomfield, 1987)

Interpretation of Resistivity measurements with regard to corrosion risk for OPC concrete from the Table-2 of RILEM TC 154-EMC: Test Methods for on-site measurement of resistivity of concrete.

TABLE D

Risk of corrosion of reinforcement associated with concrete resistivity for 20°C and OPC Concrete	
Concrete Resistivity (kΩ -cm)	**Risk of corrosion**
<10	High
10-50	Moderate
50-100	Low
>100	Negligible

3.8 Chemical Analysis of Concrete Samples

Corrosion of reinforcing steel due to chlorides in concrete is one of the most common environmental attacks that lead to deterioration of concrete structures. Whenever there is chloride in concrete there is an increased risk of corrosion of embedded metal. Chloride content is then expressed in kg per cubic meter of concrete and compared with the values of limits of chloride contents of concrete (**Table 7 of IS 456:2000**).

Sulphates (SO_3) are present in most cements and in some aggregates; excessive amounts of water-soluble sulphate from these or other mix constituents can cause expansion and disruption of concrete. To prevent it, **IS 456:2000 clause-8.2.5.3** states that the total water-soluble sulphate content of the concrete mix, expressed as SO_3, **should not exceed 4 percent by mass of the cement** in the mix. The sulphate content should be calculated as the total from the various constituents of the mix.

The pH value of the concrete should be above 12.5 as desirable for alkaline environment around reinforcing steel to render it un-corroded. A reduction in the pH value of concrete indicates loss of passive layer around the reinforcement which protects the steel from distress.

For analyzing Chloride content, Sulphate (SO_3) content and pH of concrete, concrete cores were sliced into different layers and grinded into fine powder (passing 150μ IS: Sieve) and then tested as per IS:14959 Part (2) & IS:4032.

Note: Taking a conservative estimate of cement content in the mix as 300 kg/m^3 (for M25 grade of concrete which is the minimum grade for RCC under "Moderate" exposure as specified in IS 456:2000) and density of concrete as 2400 kg/m^3 is taken for the calculation of Chloride and Sulphate content.

3.9 Chemical Analysis of Brick Mortar Samples

From the cement mortar sample collected from brick masonry taken through random sampling from the load bearing walls at site, the sulphate content determined through chemical analysis of sample. Excessive amounts of water-soluble sulphate can cause expansion and disruption of joining mortar in brick walls.

Based on the seismic zone IV [as per IS 1893 (Part 1): 2016] and Importance Factor 1 (as per Table 8 of IS 1893 (part 1): 2016), the building category will be determined as per Table 2 of IS 4326: 2013. On the basis of the category of the building approximate mix proportion of cement to sand in mortar is given in Table 3 of IS 4326: 2013 is considered for further calculation. The results of mortar sample are compared with the requirement given in Table 3 of IS 4326: 2013. As the PGCIL Ballabhgarh lies in zone IV so as per Table 3 of IS 4326: 2013, the brick masonry of mortar mix 1:4 is considered.

Table 3 Recommended Mortar Mixes (Clauses 8.1.2.1 and 8.2.6)

S. No	Category of Construction	Proportion of Cement-Lime-Sand
1	A	M_2 (Cement-sand 1: 6) or M_3 (Lime-cinder: 1: 3) or richer
2	B, C	M_2 (Cement-lime-sand 1: 2: 9 or Cement-Sand 1: 6) or richer
3	D, E	H2 (Cement-sand 1: 4) or M1 (Cement-Lime-Sand 1: 1: 6) or richer

3.10 Test Results of Burnt Clay Bricks

The bricks samples taken from brick masonry walls through random sampling of different types of quarters at site. The brick sample collected are tested for compressive strength, water absorption and efflorescence as per IS:3495: 2019.

4.0 RESULTS AND DISCUSSION

4.1 Visual Observations

Visual observations along with photographs showing the distress during the field investigation are attached as Annexure-I. Detailed visual observations are given below:

B - Block: In type -B, Quarters B33, B2, B28, B21, B18 & B16 were visually inspected and the observations are given under:

1. An external view of B-21 quarter (ref Fig.1).
2. Spalling of concrete was observed in the slab of many rooms, mostly in Quarters – B33, B32 & B18. (ref Fig. 2 & 3)
3. Seepage spots were observed on the brick wall of almost all quarters. (ref Fig.4)
4. Spalling of concrete was observed with exposed corroded steel rebars from the corner of projected RCC member. (ref Fig.5)
5. Delamination of concrete from slab of quarter B18 was observed & seems that it is about to fall. (ref Fig.6)

6. Cracks were visible on the soffit of slab surface of quarter B21. (ref Fig.7)

C – Block: In type-C, Quarters C8, C5 & C1 were visually inspected and the observations given under:

7. An external view of C-1 quarter. (ref Fig. 8)
8. Spalling of concrete was observed with exposed corroded steel rebar, from the soffit of outer projected RCC member (chajja) of C5 quarter. (ref Fig. 9)
9. Seepage spots were observed on the ceiling surface, walls of almost all quarters. (ref Fig.10 &11)
10. Cracks were visible in the walls at many locations. (ref Fig.12)

D – Block: In type-C, Quarters D1 & D2 were visually inspected and the observations given under:

11. An external view of D-1 quarter. (ref Fig.13)
12. Heavy spalling of concrete was observed with exposed corroded steel rebar from the slab of servant quarter D-2. (ref Fig.14)
13. Seepage spots were observed on walls of quarter D-1(ref Fig.15)
14. Delamination of the slab concrete observed in quarter D-1. (ref Fig.16)

Transit Camp/ Guest House

15. An external view of Transit Camp. (ref Fig.17)
16. Minor cracks were observed at the frontal beam of Transit Camp. (ref Fig.18)
17. Seepage spots were observed on walls. (ref Fig.19 & 20)
18. Cracks were observed in brick wall. (ref Fig. 21)

Recreation Centre

19. An internal view of Recreation center. (ref Fig.22)
20. Seepage spots were observed on the walls, slab at many locations. (ref Fig.23 &24)

Few Photographs of Site Testing

21. During the Concrete Core extraction from the beam of transit camp. (ref Fig.25)
22. During the Half Cell test performing on RCC Column. (ref Fig.26)
23. During the UPV test performing on slab of quarters. (ref Fig.27)
24. During the UPV test performing on terrace slab of quarters. (ref Fig.28)
25. Measurement of carbonation depth on extracted concrete core. (ref Fig.29)

4.2 Ultrasonic Pulse Velocity Testing (UPV)

The UPV testing was conducted on accessible & randomly identified 13 nos. RCC members (8 Slabs, 3 Columns, & 2 Beams) of Quarters of PGCIL Ballabhgarh. The results of the UPV test values obtained on these RCC members are given in **Annexure-II.** The obtained UPV test results were used to determine the concrete quality grading considering M25 grade of concrete as per Table-A of this report (M25 is the minimum grade for RCC under "Moderate" exposure as specified in IS 456:2000).

Slabs: UPV testing by surface probing method was carried at 8 locations**.** In slabs obtained Mean Pulse Velocity (UPV test) value by surface probing is varying from **1.94 km/s** to **3.96 km/s** i.e. concrete quality grading is mentioned in the tables (based on equivalent cross probing values by increasing the surface probing values by 0.5 km/s for values ≥ 3.0 km/s as per IS 516 (Part 5/Sec 1): 2018).

Method of Test	**Locations (refer Annexure-II)**	**Mean Pulse Velocity obtained (km/s)**	**Mean Pulse Velocity made equivalent to cross probing by adding 0.5 km/sec for values ≥ 3.0 km/s in obtained results**	**Concrete Quality Grading as per IS 516 (Part 5/Sec 1): 2018**
Surface Probing Method	(refer S.No.1) Terrace Slab (C8 - Quarter)	2.74	-	**Doubtful**
		2.62	-	**Doubtful**
		2.82	-	**Doubtful**
	(refer S.No.2) Terrace Slab (C5 - Quarter)	3.38	**3.88**	Good
		3.46	**3.96**	Good
		3.32	**3.82**	Good
	(refer S.No.3) Terrace Slab (B18 - Quarter)	2.99	-	**Doubtful**
		2.99	-	**Doubtful**
		3.02	**3.52**	Good
	(refer S.No.4) Terrace Slab (B28 - Quarter)	3.09	**3.59**	Good
		2.92	-	**Doubtful**
		3.03	**3.53**	Good
	(refer S.No.5) Terrace Slab (B33 - Quarter)	3.43	**3.93**	Good
		3.36	**3.86**	Good
		3.40	**3.90**	Good
	(refer S.No.11) Ceiling Slab (C12 - Quarter)	2.02	-	**Doubtful**
		2.10	-	**Doubtful**
		2.16	-	**Doubtful**
	(refer S.No.12) Ceiling Slab (B21 - Quarter)	2.12	-	**Doubtful**
		2.17	-	**Doubtful**
		2.22	-	**Doubtful**
	(refer S.No.13) Ceiling Slab (Servant Quarter D-2)	1.94	-	**Doubtful**
		1.95	-	**Doubtful**

Columns: UPV testing by cross probing method was carried at 3 locations of columns. In Columns obtained average UPV test value by cross probing is varying from 3.38km/s to 3.92km/**s** i.e. concrete quality grading is discussed as follows:

Method of Test	**Locations (refer Annexure-II)**	**Mean Pulse Velocity obtained (km/s)**	**Average Value of Pulse Velocity (km/s)**	**Concrete Quality Grading as per IS 516 (Part 5/Sec 1): 2018**
Cross Probing Method	(refer S.No.6,) Column (D1- Quarter)	-	3.38	**Doubtful**
	(refer S.No.7,) Column C2 (Recreation Center)	-	3.92	Good
	(refer S.No.8,) Column C1(Recreation Center)	-	3.73	Good

Beams: UPV testing by cross probing method was carried at 2 locations of beams. In Beams obtained average UPV test value by cross probing is **3.27 km/s** i.e. concrete quality grading is discussed as follows:

Method of Test	Locations (refer Annexure-II)	Mean Pulse Velocity obtained (km/s)	Average Value of Pulse Velocity (km/s)	Concrete Quality Grading as per IS 516 (Part 5/Sec 1): 2018
Cross Probing Method	(refer S.No.9,) Beam B2 (Transit Camp)	-	3.27	**Doubtful**
	(refer S.No.10,) Beam B1 (Transit Camp)	-	3.27	**Doubtful**

Based on the UPV test results, the overall concrete quality grading in identified (13 nos.) RCC members (8 Slabs, 3 Columns & 2 Beams) of Quarters of PGCIL Ballabhgarh. On perusal of these test results, it is observed that out of 13 locations, the quality grading of concrete is **'Good'** in four members (2 Slabs & 2 Columns) and in rest nine RCC members (6 Slabs, 1 Column & 2 Beams) is in **Doubtful** category**.**

4.3 Concrete Core Testing

24 nos. concrete cores samples were extracted from eight locations of Quarters of PGCIL Ballabhgarh RCC members (2 Columns, 1 Beam & 5 Slabs) to determine the equivalent cube compressive strength. The testing was done as per IS 516 (Part 4): 2018 at NCCBM Ballabgarh laboratory. Test results received are given in Table-1.

In absence of data regarding grade of concrete, the equivalent cube strength of concrete cores has been compared with the requirement for M25 grade of concrete which is the minimum grade for RCC under "Moderate" exposure condition as specified in IS 456:2000.

Columns: The average equivalent cube compressive strength of two RCC Columns is varying from **16.16 N/mm^2 to 18.38 N/mm^2** (refer Table-1). The concrete strength of columns is **not satisfactory** as the average as well as individual cube strength of cores is less than the minimum required for M25 grade of concrete i.e. the average strength should not be less than 21.25 N/mm^2 and no individual core strength be less than 18.75 N/mm^2.

Beam: The average equivalent cube compressive strength of one RCC Beam is **11.75 N/mm^2** (refer Table-1). The concrete strength of beam is **not satisfactory** for average as well as for individual strength of M25 grade of concrete.

Slabs: The average equivalent cube compressive strength of five RCC Slabs is varying from **11.58 N/mm^2 to 18.12 N/mm^2** (refer Table-1). The concrete strength of slabs is **not satisfactory** for average as well as for individual strength of M25 grade of concrete in all the tested slabs.

- The compressive strength of all cores is not **satisfactory** for strength of **M25** grade of concrete.

4.4 Concrete Cover Study

The concrete cover depth to steel rebars (from outer most reinforcement) in randomly identified RCC members of Quarters of PGCIL Ballabhgarh on 12 RCC members (consisting of 3 Columns, 2

Beams, & 7 Slabs) is measured with an Electromagnetic Cover meter/Ferro-scanner and a measuring tape/scale in the places where reinforcement steel is exposed and accessible for direct measurement. The measured concrete covers are compared with the minimum criteria for “moderate” exposure given in Table-B of this report. The concrete cover (As shown in Table 2) obtained on the RCC members is as follows:

Columns: The average concrete cover measured using Profoscope on 3 RCC columns is varying from **37 mm to 41 mm** (from outer most reinforcement). The concrete cover measured in columns is not satisfactory at two locations out of three locations for moderate exposure and fire resistance as per IS 456:2000.

Beams: The average concrete cover measured on 2 Beams is varying from **29 mm to 35 mm** (from outer most reinforcement). The concrete cover measured is found satisfactory at one location out of two locations for moderate exposure as per IS 456:2000.

Slabs: The average concrete cover measured using Profoscope on 7 RCC Slabs is varying from **17 mm to 32 mm** (from outer most reinforcement). The concrete cover measured is found **not satisfactory in six slabs** for moderate exposure as per IS 456:2000.

4.5 Carbonation Test

The Carbonation depth was measured on the extracted concrete cores from the RCC members of Quarters of PGCIL Ballabhgarh. The depth of carbonation, measured from outer surface of 8 randomly identified RCC members (consisting of 2 Columns, 1 Beam, & 5 Slabs) are given in Table-2.

Column: The depth of carbonation determined on the extracted concrete cores from RCC Columns is varying from **19mm to 60 mm.** The depth of carbonation is less than provided concrete cover in the column except one column.

Beam: The depth of carbonation determined on the extracted concrete cores from RCC Beam is **50 mm**. The depth of carbonation is more than provided concrete cover in the tested Beam.

Slabs: The depth of carbonation determined on the extracted concrete cores from soffit of RCC slab is varying from **10 mm to 13 mm** in two slabs **& Nil** in three slabs**.** The depth of carbonation is less than provided concrete cover in all the tested slabs.

- The depth of carbonation measured in 8 (2 Columns, 1 Beams, & 5 Slabs) locations of RCC members is found **more** than provided cover in 2 locations (i.e.1 column & 1 beam).

4.6 Half Cell Potential Measurements

Half-cell potential measurements, using copper electrode-copper sulfate Half-Cell technique, were taken at site to ascertain the corrosion of reinforcement steel in RCC members. The measurements were done on 13 randomly identified RCC members (3 Columns, 2 Beam, & 8 Slabs) of Quarters of PGCIL Ballabhgarh. Test results are given in Table 3 and the same is compared with corrosion criteria as per IS 516 (Part 5/Sec 2): 2021 (also reproduced in Table C of this report)**.**

Annexure-B.I

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

REMINDER-I

DEMAND LETTER

No. NRPC /AS/NRPC Fund/2024-25/333 Date:5.07.2024

To,
Chief Engineer,
Office of Chief Engineer,
PDD, Choglamsar, Leh
UT of Ladakh

Subject: Contribution towards NRPC Fund for the year 2024-25 by the Constituents- regarding.

Sir,

This has reference to NRPC letter Ref. CEA-GO-17-16(68)/7/2024-NRPC dated 10.04.2024 wherein contribution of sum of Rs, 12 lakh was sought for meeting annual expenditure of NRPC secretariate for FY 2024-25. It was also mentioned that beyond 30th June, 1 % simple interest shall be levied on the contribution amount.

In this regard, it is informed that contribution amount has not been received from your organisation till date. In view of late payment, the contribution amount of Rs 12 lakh for has been revised to Rs 12.12 lakhs (Rupees Twelve Lakhs Twelve Thousand Only). To avoid further levy of penalty charges, it is requested to expedite the process for clearance of aforementioned contribution amount.

Payment can be made via Demand Draft in favour of "NRPC Fund". The contribution can also be deposited in any CBS branch of Punjab National Bank or through RTGS in the account named "NRPC Fund" (A/c No. 3083000105096078) under intimation to us. The IFS Code is PUNB0308300.

It is requested to kindly make above payment and send confirmation mail at ms-nrpc@nic.in after making due payment along with receipt at the earliest.

This issues with approval of Member Secretary, NRPC.

Priyanka 5/07/24
(प्रियंका पटेल)
(Priyanka Patel)
नोडल ऑफिसर-एन आर पी सी फण्ड
Nodal Officer NRPC Fund

सत्यमेव जयते

विजय कुमार सिंह
सदस्य सचिव

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय समिति
Northern Regional Power Committee

अर्ध शासकीय पत्र सं.
D.O. No.
NRPC/SER/310/2024-25/393 – 395

दिनांक :
Date :
12th August, 2024

Dear Shri Malik Ji,

As you are aware that the Northern Regional Power Committee (NRPC) was constituted vide Government of India's Resolution dated 25.05.2005 and subsequent Amendments dated 29.11.2005 and 09.05.2008. Further, as per Government of India, Ministry of Power's letter dated 23.02.2006, the activities of RPCs are to be fully financed by the constituent members (copy enclosed). For this purpose, NRPC constituent members are required to pay annual contribution as decided in NRPC meetings from time to time.

2. In 72nd NRPC meeting held on 30.03.2024 at Lucknow, NRPC members agreed to contribute a sum of Rs.12 lakhs per member as annual contribution towards NRPC Secretariat for FY 2024-25. It was also decided that if the payment is delayed beyond 30.06.2024, simple interest @ 1% per month has to be levied on late payment.

3. In this regard, I would like to refer a Demand Letter CEA-GO-17-16(68)/7/2024-NRPC dated 10.04.2024 (copy enclosed) sent by NRPC office through which contribution amount of Rs.12 lakhs for FY 2024-25 was sought from UT of Ladakh. Subsequently, a reminder vide letter No.NRPC/AS/NRPC Fund/2024-25/333 dated 05.07.2024 was also sent from NRPC Secretariat (copy enclosed). But contribution amount has not been received in NRPC fund till date. Due to delay in payment, the contribution amount has been revised to Rs.12,24,000/- (including late payment charges up to August, 2024) for FY 2024-25. To avoid further levy of penalty charges, the process of clearance of contribution amount has to be expedite. The payment could be made through Demand Draft drawn in favour of "NRPC Fund" or through RTGS in the Bank account named "NRPC Fund" (A/c No. 3083000105096078 RTGS/NEFT Code: PUNB0308300).

4. I request you to please look into the matter and issue directions to the concerned officers to take necessary action to expedite the payment of aforementioned contribution amount at the earliest for smooth functioning of NRPC Secretariat.

Yours sincerely,

12/08/2024
(Vijay Kumar Singh)

Shri Vikram Singh Malik, IAS
Administrative Secretary, PDD
Civil Secretariat Leh,
UT of Ladakh

Copy to:
1. Chief Engineer (R&R), Ministry of Power, New Delhi
2. Chief Engineer, PDD, Choglamsar, Leh, UT of Ladakh

Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi-110001
Telephone No. 23715507; FAX NO. 23717519

Date: February 23, 2006

To
The Chairperson
Central Electricity Authority,
Sewa Bhawan, R.K.Puram,
New Delhi.

(Attention: Shri Ajit Singh, Under Secretary)

Subject: **Establishment of Regional Power Committees under the provisions of the Electricity Act, 2003 - matter regarding.**

Sir,

I am directed to refer to your letter No. 1/2/2005-PP (CEA), dated 13.07.2005 on the subject mentioned above and to say that consequent on setting up of Regional Power Committees (RPCs) under the aegis of the Electricity Act,2003 in place of the erstwhile Regional Electricity Boards, the matter relating to administrative and financial set up of the RPCs has been considered by the Ministry in consultation with the Central Electricity Authority and the Internal Finance Wing of the Ministry.

2. The President is pleased to declare the Member Secretaries of the Regional Power Committees (RPCs) as 'Head of Department' under SR 2(10) of the Fundamental & Supplementary Rules. They shall exercise all the powers of Heads of Department under General Financial Rules,1963, subject to the observance of instructions and restrictions contained in the Delegation of Financial Power Rules, 1978 and such other Rules and Orders issued by the Central Government from time to time applicable to 'Head of Departments'.

3. Further, with the approval of the Competent Authority in the Ministry of Power, it has been decided that, henceforth, the functioning of the RPCs shall be regulated as per the following arrangement

   (a) Member Secretaries of the Regional Power Committees (RPCs) will be under the administrative and financial control of the Chairman of the respective Regional Power Committee (RPCs) for all matters including sanction of leave, tour etc. of the Member Secretary.

(b) The Annual confidential Report of the Member Secretaries of the Regional Power Committees (RPCs) shall be initiated by the respective Chairman of the Regional Power Committee (RPCs) and shall be reviewed by the Chairperson, Central Electricity Authority.

(c) The activities of the Regional Power Committees (RPCs) will be fully financed by the constituent Members with effect from 01.04.2006 and the Central Electricity Authority will take immediate steps in this regard.

(d) The manpower for the Secretariat of the Regional Power Committees (RPCs) shall continue to be provided by the Central Electricity Authority.

4. This issues with the concurrence of the Internal Finance Wing vide their diary No. 7657/JSFA06, dated 16.02.2006.

Yours faithfully,
Sd/-
(R.C.Arora)
Under Secretary to the Government of India
Tel No. 2371-9637

Copy to:

1. Member Secretary of All Regional Power Committees
2. Controller of Accounts, Ministry of Power.
3. Secretary, CEA/US(Vig),CEA
4. Director (R & R)/ US(Trans),Ministry of Power.
5. Finance/Budget/ V & S Desk, Ministry of Power.

Sd/-
(R.C.Arora)
Under Secretary to the Government of India
Tel No. 2371-9637

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

DEMAND LETTER

No. NRPC /AS/NRPC Fund/2024-25 Date: 10.04.2024

To,
Chief Engineer,
Office of Chief Engineer,
PDD, Choglamsar, Leh
UT of Ladakh

Subject: Contribution towards NRPC Fund for the year 2024-25 by the Constituents-regarding.

Sir,

As you are aware that activities of RPCs are financed by their constituent members in compliance with MoP direction vide letter no. A-60016/59/2005 Adm-I dtd. 23.02.2006.

Kind reference is invited to decisions of the 72nd meeting of NRPC held on 30.03.2024 at Lucknow, wherein NRPC members agreed to contribute a sum of Rs.12 Lakh per member as contribution towards annual expenditure of NRPC secretariat for F.Y. 2024-25. It was also decided that the amount shall be deposited in NRPC fund by 30.06.2024. It was agreed that late payment i.e payment after due date of 30.06.2024 would attract simple interest @ 1% per month (payment made during month would also invite 1% interest).

Accordingly, being member of NRPC forum for FY 2024-25, you are requested to make above payment of Rs.12 lakh before 30.06.2024 positively.

Payment can be made via Demand Draft in favour of "NRPC Fund". The contribution can also be deposited in any CBS branch of Punjab National Bank or through RTGS in the account named "NRPC Fund" (A/c No. 3083000105096078) under intimation to us. The IFS Code is PUNB0308300.

It is requested to kindly make above payment and send confirmation mail at ms-nrpc@nic.in after making due payment along with receipt at the earliest.

This issues with approval of Member Secretary, NRPC.

Priyanka 10/04/2024

(प्रियंका पटेल)
(Priyanka Patel)
नोडल ऑफिसर-एन आर पी सी फण्ड
Nodal Officer NRPC Fund

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
उत्तर क्षेत्रीय विद्युत समिति
Northern Regional Power Committee

REMINDER-I

DEMAND LETTER

No. NRPC /AS/NRPC Fund/2024-25/333 Date: 5.07.2024

To,
Chief Engineer,
Office of Chief Engineer,
PDD, Choglamsar, Leh
UT of Ladakh

Subject: Contribution towards NRPC Fund for the year 2024-25 by the Constituents- regarding.

Sir,

This has reference to NRPC letter Ref. CEA-GO-17-16(68)/7/2024-NRPC dated 10.04.2024 wherein contribution of sum of Rs, 12 lakh was sought for meeting annual expenditure of NRPC secretariate for FY 2024-25. It was also mentioned that beyond 30th June, 1 % simple interest shall be levied on the contribution amount.

In this regard, it is informed that contribution amount has not been received from your organisation till date. In view of late payment, the contribution amount of Rs 12 lakh for has been revised to Rs 12.12 lakhs (Rupees Twelve Lakhs Twelve Thousand Only). To avoid further levy of penalty charges, it is requested to expedite the process for clearance of aforementioned contribution amount.

Payment can be made via Demand Draft in favour of "NRPC Fund". The contribution can also be deposited in any CBS branch of Punjab National Bank or through RTGS in the account named "NRPC Fund" (A/c No. 3083000105096078) under intimation to us. The IFS Code is PUNB0308300.

It is requested to kindly make above payment and send confirmation mail at ms-nrpc@nic.in after making due payment along with receipt at the earliest.

This issues with approval of Member Secretary, NRPC.

Priyanka 5/07/24
(प्रियंका पटेल)
(Priyanka Patel)
नोडल ऑफिसर-एन आर पी सी फण्ड
Nodal Officer NRPC Fund

Tel. : 20861332,20861331
E-Mail: deleeev.cpwd@nic.in

Annexure-B.III

कार्यपालक अभियंता
वी–मण्डल, के० लो० नि० वि०
ईस्ट ब्लॉक–3, तल–5,
आर.के.पुरम्, नई दिल्ली–110066

Executive Engineer
V-Division, CPWD
East Block-3, Level -5
R.K.Puram, ND - 110066

भारत सरकार GOVERNMENT OF INDIA
केन्द्रीय लोक निर्माण विभाग Central Public Works Department

सं० डीबी / अनुमान/ वी मं/2024–2025 /2953 दिनांक 10/10/2024

सेवा में

Superintending Engineer
Northern Regional Power Committee,
18-A, Shaheed Jeet Singh Marg,
Katwaria Sarai, New Delhi-110016 .

सं./No. 989
दिनांक/Date 16/10/2024

विषयः निक्षेप कार्यो का निष्पादनः– **Replacement of OLD Sewerline System with new one, revamping of UG water tank and other Misc. Civil Works in NRPC Staff qtrs and office block at Shaheed jeet singh marg, Qutub Institutional area, New Delhi**

अनुमानित लागत रू. **97,45,100/-**

उपर्युक्त कार्य केन्द्रीय लोक निर्माण विभाग द्वारा के0लो0नि0वि0 संहिता के पैरा 118–119 के अधीन निम्नलिखित के अनुसार निक्षेप कार्य के रूप में किया जा सकता है:

1 कार्य को निष्पादन हेतु लिए जाने से पहले कार्यार्थी विभाग को के0लो0नि0वि0 द्वारा परिकलित कार्य की पूरी अनुमानित लागत जमा करानी होंगी। इस जमा राशि के लिये के0लो0नि0वि0 द्वारा कार्यार्थी विभाग को कोई ब्याज नही दिया जाएगा।

2 कार्यार्थी विभाग के0लो0नि0वि0 को भूमि स्थल का खाली कब्जा देगा। के0लो0नि0वि0 अपेक्षित होने पर मौजूदा भवनों/ढॉचों के ढहाने/निपटान करने की जिम्मेदारी ले सकता है।

3 के0लो0नि0वि0 कार्य को अनुमानित लागत के भीतर पूरा करने के लिये बाध्य नही है। यदि अतिरिक्त निधि कि आवश्यकता होगी तो वह कार्यार्थी विभाग को उपलब्ध करानी होगी। अपेक्षित होने पर आवश्यक संशोधित अनुमान प्रस्तुत कर दिया जाएगा।

4 उक्त कार्य की संविदा के प्रचालन के संबंध में कोई विवाद होने पर वह संविदा करार में दिए गये उपबंध के अनुसार मध्यस्थम् के अधीन होगा। के0लो0नि0वि0 यथासंभव मध्यस्थम कार्यवाही का प्रतिवाद करेगा और मध्यस्थ के पंचाट की यथोचित प्राधिकारी द्वारा जांच करवायेगा। के0लो0नि0वि0 में उस पंचाट को स्वीकार करने या उससे न्यायालय में चुनौती देने के लिये सक्षम प्राधिकारी का निर्णय कार्यार्थी विभाग पर बाध्यकारी होगा।

5 निक्षेप कार्य के संबंध में न्यायालय, अधिकरण द्वारा घोषित की जा सकने वाली या मध्यस्थम् के पंचाट द्वारा घोषित सभी राशियों का भुगतान करने के लिये निधि कार्यार्थी विभाग द्वारा तत्काल उपलब्ध करायी जाएगी, भले ही वह न्यायालय, अधिकरण या मध्यस्थ के समस्त पार्टी हो या ना हो। इस प्रकार के भुगतान कार्य के निष्पादन हेतु ठेकेदारों के किए गए भुगतान के अलावा होंगें।

Pl discuss.
SE (Comm)
16/10/24

AE(S)
Ravi Kant
07/11/2024

Pl. prepare agenda note.
AEE(S)

Contd.. 2

Sanction latter

6 कार्यार्थी विभाग से प्रशासनिक अनुमोदन/व्यय स्वीकृति (ए/ए और ई/एस) मिलने के बाद के0लो0नि0वि0 विभिन्न विस्तृत वास्तुकीय आरेख और सेवा योजना /नक्शे आदि/ तैयार करेगा और उन्हें सभी स्थानीय निकायों को प्रस्तुत करेगा जिनका निर्माण कार्य शुरू करने से पहले अनुमोदन लेना आवश्यक होगा। स्थानीय निकाय स्वतंत्र संगठन होते हैं और उन पर के0लो0नि0वि0 का कोई नियंत्रण नही होता। ये स्थानीय निकाय योजनाओं को अनुमोदित करने में समय लगाते हैं। इस प्रकार के अनुमोदन लेने के लिये अपेक्षित समय को अनुमान में उल्लिखित निर्माण के समय में शामिल नही किया गया है। हॉलांकि के0लो0नि0वि0 इस प्रकार के अनुमोदन में यथाशीध्र प्राप्त करने का पूरा प्रयास करेगा तथापि कार्यार्थी विभाग के लिये भी यह आवश्यक होगा कि वह स्थानीय निकायों से शीध्र अनुमोदन प्राप्त करने के लिये प्रयास करें।

7 के0लो0नि0वि के पास इस कार्य में निवेश करने के लिये अपनी कोई धन–राशि नही है। अतः कार्यार्थी को यह सुनिश्चित करना चाहिये कि इस कार्य के निष्पादन के लिये कि0लो0नि0वि0 के पास प्रर्याप्त धन राशि उपलब्ध रहे। यदि कार्यार्थी विभाग तथा अपेक्षित धन राशि उपलब्ध कराने में असफल रहता है तो के0लो0नि0वि के लिये कार्य को निलंबित करना/छोडना आवश्यक हो सकता है। ऐसी स्थिति में कार्यार्थी विभाग कार्य को बंद करने/छोडने के कारण होने वाले सभी परिणामों तथा मुआवजे/नुकसान के लिये किये जाने वाले ठेकेदारों के दावों के लिये पूरी तरह जिम्मेदार होगा।

8 कार्यार्थी विभाग के0लो0नि0वि0 के (क) ठेकेदारों को मजदूरों के लिए झोपडियॉ बनाने के लिए निःशुल्क स्थान उपलब्ध कराने, (ख) ठेकेदारें के सामान और मजदूरों के कार्य स्थल पर आवागमन के लिये निर्बाध रास्ता उपलब्ध कराते, (ग) कार्य के निष्पादन के लिए सामान्य प्रकारों के भुगतान पर बिजली का कनैक्शन उपलब्ध कराने, (ध) संबंधित विद्युत बोर्ड/प्राधिकरण से विद्युत लोड की मंजूरी दिलवाने और लोड दिलवाने में सहायता करेगा।

9 यदि धन राशि किस्तों में जमा कराई जाएगी तो ऐसे मामलों में समय पर धन राशि न मिलने के कारण कार्य में होने वाले किसी विलंब, नुकसान काम बंद करने, मुआवजे/नुकसान आदि के लिए ठेकेदारों द्वाराकिए जाने वाले दावों के लिए के0लो0नि0वि0 जिम्मेदार नही होगा।

10 इस कार्य के लिए चैक "Executive Engineer, "V" Division, CPWD, New Delhi" के नाम पर भेजने का कष्ट करें।

11 उक्त प्रारम्भिक अनुमान केवल एक वर्ष तक की अवधि हेतु वैध है, यदि एक वर्ष की अवधि के दौरान उक्त प्रारम्भिक अनुमान हेतु प्रषासनिक अनुमोदन एंव व्यय स्वीकृति जारी नही की जाती है तो ग्राहक विभाग को नया मांग पत्र देना होगा।

अनुरोध है कि उपर्युक्त स्वीकृति से अद्योहस्ताक्षरी को सूचित करने का प्रबन्ध करें जिससे आगे की कार्यवाही कर सके।

संलग्नः उपरोक्तानुसार

भवदीय

कार्यपालक अभियंता

प्रतिलिपि :

1 सहायक अभियंता ए/वी मंडल, के0 लो0 नि0 वि0, नई दिल्ली ।

कार्यपालक अभियंता

HISTORY

Name of work: - Replacement of OLD Sewerline System with new one, revamping of UG water tank and other Misc. Civil Works in NRPC Staff qtrs and office block at Shaheed jeet singh marg, Qutub Institutional area, New Delhi.

Funds:-

Major Head	Minor Head	Detailed Head

This preliminary cum detailed estimate framed by Er. Vishwa Mohan Shukla, Assistant Engineer - 2/V and checked by Er. V.K. Meena, Executive Engineer, "V" Division, CPWD for the probable cost of Rs. 97,45,100/- including 3% Cost index, 3.94% for ESI & EPF and 5% contingencies.

REPORT

HISTORY:- This preliminary cum detailed estimate amounting to **Rs. 97,45,100/-** i/c 5% contingencies has been framed to cover the probable cost of the above cited work for accord of A/A & E/S of the competent authority.

Requisition has been received through mail dated -30/07/2024 from NRPC Authority, for the submission of estimate. This estimate has been finally prepared after discussion with client at site.

Design & Scope:- The following provision have been made in the estimate:-

1. Providing and laying in position cement concrete (1:2:4) & (1:5:10)
2. Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure in cement mortar 1:6.
3. Providing and fixing 18 mm thick granite stone in kitchen platform, vanity counter etc.
4. Providing and fixing Ist quality ceramic glazed wall tiles.
5. Providing and fixing Fiber Glass Reinforced plastic (FRP) Door Frames.
6. 30 mm thick Glass Fibre Reinforced Plastic (FRP) panelled door shutter.
7. P&F Structural steel work in single section
8. Steel work in built up section tubular finished welded type tube.
9. 40 mm thick dressed stone flooring.
10. Providing and laying glazed Vitrified tiles 600x600mm.
11. Providing and fixing on wall face unplasticised Rigid PVC rain water pipes.
12. Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes 15mm.
13. Granite stone work gang saw cut (polished and machine cut) of thickness 18 mm for wall lining.

Specifications: -		The work shall be executed as per CPWD specifications 2019 with upto date correction slips.
Rate	:-	DSR 2023 / Market Rates.
W.C. Staff	:-	Shall be met out from contingencies
Cost	:-	**Rs. 97,45,100/-**
Method	:-	Through contract after Call of tender.
T & P	:-	Shall be arranged by the Contractor.
Land	:-	Available
Time	:-	04 Months after award of work..

Assistant Engineer(P)

Executive Engineer
"V" Division, CPWD

ABSTRACT OF COST

N/W Replacement of OLD Sewerline System with new one, revamping of UG water tank and other Misc. Civil Works in NRPC Staff qtrs and office block at Shaheed jeet singh marg, Qutub Institutional area, New Delhi.

Sl. No.	DSR code 2023	DESCRIPTION OF ITEM	QUANTITY	UNIT	RATE	AMOUNT
1	2.6	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and for all lift, as directed by Engineer-incharge.				
1.1	2.6.1	All kinds of soil	152.00	cum	177.50	26980.00
2	2.1	Excavating trenches by mechinical / manual means of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, for all depth, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m :				
2.1	2.10.1	All kinds of soil				
2.1.1	2.10.1.2	Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia	152.00	mtr	352.15	53527.00
3	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 and for all lift.	51.00	cum	196.00	9996.00
4	4.1	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth levei :				
4.1	4.1.3	1:2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal size derived from natural sources)	31.00	cum	7878.50	244234.00
4.2	4.1.8	1:4:8 (1 Cement : 4 coarse sand (zone-III) derived from natural sources : 8 graded stone aggregate 40 mm nominal size derived from natural sources)	12.00	cum	6812.00	81744.00
4.3	4.1.10	1:5:10 (1 cement : 5 coarse sand (zone-III) derived from natural sources : 10 graded stone aggregate 40 mm nominal size derived from natural sources)	41.00	cum	6518.60	267263.00
5	4.3	Centering and shuttering including strutting, propping etc. and removal of form work for :				
5.1	4.3.2	Retaining walls, return walls, walls (any thickness) including attached pilasters, buttresses, plinth and string courses fillets, kerbs and steps etc.	18.00	sqm	842.50	15165.00
6	5.2	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, piers, abutments, posts and struts etc. above plinth level up to floor five level, excluding cost of centering, shuttering, finishing and reinforcement :				
6.1	5.2.2	1:1.5:3 (1 cement : 1.5 coarse sand(zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources)	3.00	cum	10852.95	32559.00

(2)

7	5.22	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.				
7.1	5.22.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	471.00	kg	107.85	50797.00
8	6.4	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in :				
8.1	6.4.2	Cement mortar 1:6 (1 cement : 6 coarse sand)	5.00	cum	9105.95	45530.00
9	8.2	Providing and fixing 18 mm thick gang saw cut, mirror polished, premoulded and prepolished, machine cut for kitchen platforms, vanity counters, window sills, facias and similar locations of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing of edges to give high gloss finish etc. complete at all levels.				
9.1	8.2.3	Granite stone slab of all colour and texture except black, Cherry/Ruby red				
9.1.1	8.2.3.1	Area of slab upto 0.50 sqm	27.00	sqm	4170.70	112609.00
9.1.2	8.2.3.2	Area of slab over 0.50 sqm	10.00	sqm	3848.70	38487.00
10	8.31	Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS: 15622 (thickness to be specified by the manufacturer), of approved make, in all colours, shades except burgundy, bottle green, black of any size as approved by Engineer-in-Charge, in skirting, risers of steps and dados, over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm, including pointing in white cement mixed with pigment of matching shade complete.	223.00	sqm	1267.95	282753.00
11	9.2	Providing and fixing ISI marked flush door shutters conforming to IS : 2202 (Part I) decorative type, core of block board construction with frame of 1st class hard wood and well matched teak 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters.				
11.1	9.20.1	35 mm thick including ISI marked Stainless Steel butt hinges with necessary screws	2.00	sqm	3473.85	6948.00
12	9.88	Providing and fixing chromium plated brass 100 mm mortice latch and lock with 6 levers and a pair of lever handles of approved quality with necessary screws etc. complete.	32.00	each	998.35	31947.00
13	9.121	Providing and fixing Fiber Glass Reinforced plastic (FRP) Door Frames of cross-section 90 mm x 45 mm having single rebate of 32 mm x 15 mm to receive shutter of 30 mm thickness. The laminate shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. Door frame laminate shall be 2mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame.	62.00	mtr	570.95	35399.00
14	9.122	Providing and fixing to existing door frames.				

3

14.1	9.122.1	30 mm thick Glass Fibre Reinforced Plastic (FRP) panelled door shutter of required colour and approved brand and manufacture, made with fire - retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate forforming hollow rails and styles, with wooden frame and suitable blocks of seasoned wood inside at required places for fixing of fittings, cast monolithically with 5 mm thick FRP laminate for panels conforming to IS: 14856, including fixing to frames.	32.00	sqm	3720.75	119064.00
15	10.1	Structural steel work in single section, fixed with or without connecting plate, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	596.00	kg	117.35	69941.00
16	10.2	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	144.00	kg	133.70	19253.00
17	10.16	Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete.				
17.1	10.16.1	Hot finished welded type tubes	200.00	kg	194.40	38880.00
18	10.25	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.				
18.1	10.25.2	In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works	80.00	kg	172.60	13808.00
19	10.29	Providing & fixing fly proof wire gauze to windows, clerestory windows & doors with M.S. Flat 15x3 mm and nuts & bolts complete.				
19.1	10.29.2	Stainless steel (grade 304) wire gauze of 0.5 mm dia wire and 1.4 mm aperture on both sides	69.00	sqm	1133.55	78215.00
20	11.20	Chequerred precast cement concrete tiles 22 mm thick in footpath & courtyard, jointed with neat cement slurry mixed with pigment to match the shade of tiles, including rubbing and cleaning etc. complete, on 20 mm thick bed of cement mortar 1:4 (1 cement: 4 coarse sand).				
20.1	11.20.1	Light shade pigment using white cement	50.00	sqm	1402.00	70100.00
21	11.29	40 mm thick fine dressed stone flooring over 20 mm (average) thick base of cement mortar 1:5 (1 cement : 5 coarse sand), including pointing with cement mortar 1:2 (1 cement : 2 stone dust) with an admixture of pigment to match the shade of stone.				
21.1	11.29.1	Red sand stone	274.00	sqm	1526.05	418138.00

(9)

22	11.41A	Providing and laying Vitrified tiles in floor in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS:15622, of approved brand & manufacturer, in all colours and shade, laid on 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) jointing with grey cement slurry @3.3 kg/sqm including grouting the joints with white cement and matching pigments etc. The tiles must be cut with the zero chipping diamond cutter only . Laying of tiles will be done with the notch trowel, plier, wedge, clips of required thickness, leveling system and rubber mallet for placing the tiles gently and easily.				
22.1	11.41A.3	Glazed Vitrified tiles Matt/Antiskid finish of size				
22.1.1	11.41A.3.1	Size of Tile 600 x 600 mm	32.00	sqm	1464.85	46875.00
23	11.53	Providing and fixing Glass mossaic tiles on finished plain wall surface of size 20 mm x 20 mm x 4 mm in all colour, design , fixing in customize design as per direction of Engineerin- Charge. The glass mosaic tiles to be fixed on the wall surface with the help of approved adhesive applied at the rate of 2.5 kg per sqm and grouting of the same. The rate is inclusive of all operation, material and required pattern approved by Engineer-in-Charge:	84.00	sqm	3891.15	326857.00
24	11.55	Providing and laying flamed finish Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing, curing and polishing etc. all complete as specified and as directed by the Engineer-in-Charge :				
24.1	11.55.1	Flamed finish granite stone slab Jet Black, Cherry Red, Elite Brown, Cat Eye or equivalent.	199.00	sqm	3186.70	634153.00
25	12.41	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion, (i) Single socketed pipes.				
25.1	12.41.2	110 mm diameter	112.00	mtr	377.40	42269.00
26	12.42	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion.				
26.1	12.42.1	Coupler				
26.1.1	12.42.1.2	110 mm	24.00	each	136.15	3268.00
26.2	12.42.5	Bend 87.5°				
26.2.1	12.42.5.2	110 mm bend	10.00	each	150.35	1504.00

27	12.43	Providing and fixing unplasticised -PVC pipe clips of approved design to unplasticised - PVC rain water pipes by means of 50x50x50 mm hard wood plugs, screwed with M.S. screws of required length, including cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand) and making good the wall etc. complete.				
27.1	12.43.2	110 mm	32.00	each	371.30	11882.00
28	13.5	15 mm cement plaster on rough side of single or half brick wall of mix:				
28.1	13.5.2	1:6 (1 cement: 6 coarse sand)	233.00	sqm	395.35	92117.00
29	13.21	Extra for providing and mixing water proofing material in cement plaster work in proportion recommended by the manufacturers.	25.00	per bag of 50kg cement used in the mix	22.10	553.00
30	13.100	Painting with aluminium paint of approved brand and manufacture to give an even shade:				
30.1	13.100.1	One or more coats on old work	261.00	sqm	96.00	25056.00
31	13.114	Melamine polishing on wood work (one or more coat).	147.00	sqm	138.10	20301.00
32	13.75	Repair to plaster of thickness 12 mm to 20 mm in patches of area 2.5 sqm and under, including cutting the patch in proper shape, raking out joints and preparing plastering the wall surface with white cement based polymer modified self curing mortar, including disposal of rubbish, all complete as per the direction of Engineer-In-Charge.	80.00	sqm	133.55	10684.00
33	15.2	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge.				
33.1	15.2.1	Nominal concrete 1:3:6 or richer mix (including equivalent design mix)	32.00	cum	2434.25	77896.00
34	15.3	Demolishing R.C.C. work manually/ by mechanical means including stacking of steel bars and disposal of unserviceable material within 50 metres lead as per direction of Engineer - in- charge.	6.00	cum	3551.25	21308.00
35	15.5	Extra for cutting reinforcement bars manually/ by mechanical means in R.C.C. or R.B. work (Payment shall be made on the cross sectional area of R.C.C. or R.B. work) as per direction of Engineer-in-charge.	24.00	sqm	1147.20	27533.00
36	15.7	Demolishing brick work manually/ by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer-in-charge.				
36.1	15.7.4	In cement mortar	1.75	cum	2060.20	3605.00
37	15.12	Dismantling doors, windows and clerestory windows (steel or wood) shutter including chowkhats, architrave, holdfasts etc. complete and stacking within 50 metres lead :				
37.1	15.12.2	Of area beyond 3 sq. metres	8.00	each	502.75	4022.00
38	15.17	Dismantling steel work in single sections including dismembering and stacking within 50 metres lead in:				
38.1	15.17.2	Channels, angles, tees and flats	706.00	kg	2.30	1624.00

39	15.23	Dismantling tile work in floors and roofs laid in cement mortar including stacking material within 50 metres lead.				
39.1	15.23.1	For thickness of tiles 10 mm to 25 mm	6.00	sqm	73.40	440.00
40	15.25	Dismantling stone slab flooring laid in cement mortar including stacking of serviceable material and disposal of unserviceable material within 50 metres lead.	274.00	sqm	266.45	73007.00
41	15.42	Dismantling C.I. or asbestos rain water pipe with fittings and clamps including stacking the material within 50 metres lead :				
41.1	15.42.1	75 to 80 mm dia pipe	336.00	mtr	75.70	25435.00
41.2	15.42.2	100 mm dia pipe	112.00	mtr	78.00	8736.00
42	15.51	Dismantling of road gully chamber of various sizes including C.I. grating with frame including stacking of useful materials near the site and disposal of unserviceable materials within 50 metres lead including refilling the excavated gap.	24.00	each	958.75	23010.00
43	15.56	Dismantling old plaster or skirting raking out joints and cleaning the surface for plaster including disposal of rubbish to the dumping ground within 50 metres lead.	405.00	sqm	54.65	22133.00
44	15.60	Disposal of building rubbish / malba / similar unserviceable, dismantled or waste materials by mechanical means, including loading, transporting, unloading to approved municipal dumping ground or as approved by Engineer-in-charge, beyond 50 m initial lead, for all leads including all lifts involved.	400.00	cum	263.95	105580.00
45	16.83	Taking out existing CC interlocking paver blocks from footpath/ central verge, including removal of rubbish etc., disposal of unserviceable material to the dumping ground, for which payment shall be made separately and stacking of serviceable material within 50 metre lead as per direction of Engineer-in-Charge.	50.00	sqm	131.75	6588.00
46	16.84	Laying old cement cocrete interlocking paver blocks of any design/ shape laid in required line, level, curvature, colour and pattern over and including 50 mm thick compacted bed of coarse sand, filling the joints with fine sand etc. all complete as per the direction of Engineer-in-charge. (Old CC paver blocks shall be supplied by the department free of cost).	25.00	sqm	402.95	10074.00
47	16.91	Providing and laying factory made chamfered edge Cement Concrete paver blocks in footpath, parks, lawns, drive ways or light traffic parking etc, of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50 mm thick compacted bed of sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand. complete all as per direction of Engineer-in-Charge.				
47.1	16.91.1	60 mm thick cement concrete paver block of M-35 grade with approved colour, design & pattern.	25.00	sqm	1045.65	26141.00

48	17.31	Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.	2.00	each	1607.95	3216.00
49	17.35	Providing and fixing soil, waste and vent pipes :				
49.1	17.35.1	100 mm dia				
49.1.1	17.35.1.2	Centrifugally cast (spun) iron socket & spigot (S&S) pipe as per IS: 3989	731.00	mtr	1180.75	863128.00
50	17.36	Providing and filling the joints with spun yarn, cement slurry and cement mortar 1:2 (1 cement : 2 fine sand) in S.C.I./ C.I. Pipes :				
50.1	17.36.2	100 mm dia pipe	303.00	each	198.15	60039.00
51	17.37	Providing and fixing M.S. holder-bat clamps of approved design to Sand Cast iron/cast iron (spun) pipe embedded in and including cement concrete blocks 10x10x10 cm of 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), including cost of cutting holes and making good the walls etc. :				
51.1	17.37.1	For 100 mm dia pipe	254.00	each	362.85	92164.00
52	17.38	Providing and fixing bend of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.				
52.1	17.38.1	100 mm dia				
52.1.1	17.38.1.2	Sand cast iron S&S as per IS - 3989	81.00	each	705.20	57121.00
53	17.41	Providing and fixing double equal junction of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete :				
53.1	17.41.1	100x100x100x100 mm				
53.1.1	17.41.1.2	Sand cast iron S&S as per IS - 3989	7.00	each	1103.10	7722.00
54	17.43	Providing and fixing single equal plain junction of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.				
54.1	17.43.1	100x100x100 mm				
54.1.1	17.43.1.2	Sand cast iron S&S as per IS - 3989	90.00	each	925.70	83313.00
55	17.56	Providing and fixing terminal guard :				
55.1	17.56.1	100 mm				
55.1.1	17.56.1.2	Sand cast iron S&S as per IS - 3989	49.00	each	506.00	24794.00
56	17.61	Cutting chases in brick masonry walls for following diameter sand cast iron/ centrifugally cast (spun) iron pipes and making good the same with cement concrete 1:3:6 (1 cement : 3 coarse sand :6 graded stone aggregate 12.5 mm nominal size), including necessary plaster and pointing in cement mortar 1:4 (1 cement : 4 coarse sand) :				
56.1	17.61.1	100 mm dia	30.00	mtr	713.20	21396.00

57	18.8	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer in Charge. Concealed work, including cutting chases and making good the walls etc.				
57.1	18.8.1	15 mm nominal dia Pipes	32.00	mtr	497.80	15930.00
58	18.77	Cutting holes up to 15x15 cm in R.C.C. floors and roofs for passing drain pipe etc. and repairing the hole after insertion of drain pipe etc. with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), including finishing complete so as to make it leak proof.	40.00	each	452.00	18080.00
59	19.1	Providing, laying and jointing glazed stoneware pipes class SP-1 with stiff mixture of cement mortar in the proportion of 1:1 (1 cement : 1 fine sand) including testing of joints etc. complete :				
59.1	19.1.4	250 mm diameter	10.00	mtr	1505.60	15056.00
60	19.4	Providing and fixing square-mouth S.W. gully trap class SP-1 complete with C.I. grating brick masonry chamber with water tight C.I. cover with frame of 300 x 300 mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design:				
60.1	19.4.1	100x100 mm size P type				
60.1.1	19.4.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5	5.00	each	2707.65	13538.00
61	19.5	Dismantling of old S.W. pipes including breaking of joints and bed concrete stacking of useful materials near the site within 50 m lead and disposal of unserviceable materials into municipal dumps :				
61.1	19.5.2	150 mm diameter	152.00	mtr	98.45	14964.00
62	19.6	Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :				
62.1	19.6.3	250 mm dia. R.C.C. pipe	152.00	mtr	899.80	136770.00
63	19.7	Constructing brick masonry manhole in cement mortar 1:4 (1 cement : 4 coarse sand) with R.C.C. top slab with 1:1.5:3 mix (1 cement : 1.5 coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size), foundation concrete 1:4:8 mix (1 cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) finished with floating coat of neat cement and making channels in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) finished with a floating coat of neat cement complete as per standard design :				

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63.1	19.7.1	Inside size 90x80 cm and 45 cm deep including C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover and frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) :				
63.1.1	19.7.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5	11.00	each	12770.55	140476.00
64	19.8	Extra for depth for manholes :				
64.1	19.8.1	Size 90x80 cm				
64.1.1	19.8.1.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5	4.00	mtr	8825.40	35302.00
65	19.24	Dismantling of manhole including R.C.C. top slab, C.I. cover with frame, including stacking of useful materials near the site and disposal of unserviceable materials within 50 m lead as per direction of Engineer-incharge				
65.1	19.24.1	Rectangular manhole 90x80 cm and 45 cm deep	11.00	each	2540.85	27949.00
66	19.25	Extra for depth of manholes dismantled :				
66.1	19.25.1	Rectangular manhole 90x80 cm and beyond 45 cm depth	5.00	mtr	2045.50	10228.00
67	19.27	Constructing brick masonry road gully chamber 50x45x60 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) including 500x450 mm pre-cast R.C.C. horizontal grating with frame complete as per standard design :				
67.1	19.27.1	With common burnt clay F.P.S. (non modular) bricks of class designation 7.5	10.00	each	5957.90	59579.00
68	24.2	Providing and fixing double scaffolding system (cup lock type) on the exterior side of building/structure, upto 25 metre height, above ground level, including additional rows of scaffolding in stepped manner as per requirement of site, made with 40 mm dia M.S. tube, placed 1.5 metre centre to centre, horizontal & vertical tubes joint with cup & lock system with M.S. Tubes, M.S. tube challis, M.S. clamps and staircase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for execution of work of cleaning and/ or pointing and/ or applying chemical and removing it thereafter. The scaffolding system shall be stiffened with bracings, runners, connecting with the building etc, wherever required, if feasible, for inspection of work at required locations with essential safety features for the workmen etc., complete as per directions and approval of Engineer-in-charge. Note:- (1) The elevational area of the scaffolding shall be measured for payment purpose. (2) The payment will be made once only for execution of all items for such works.	76.00	sqm	338.25	25707.00
69	26.28	Chipping of unsound/weak concrete material from slabs, beams, columns etc. with manual Chisel and/ or by standard power driven percussion type or of approved make including tapering of all edges, making square shoulders of cavities including cleaning the exposed concrete surface and reinforcement with wire brushes etc. and disposal of debris for all lead and lifts all complete as per direction of Engineer-In-Charge				
69.1	26.28.2	50 mm average thickness	13.00	sqm	256.35	3333.00

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69.2	26.28.3	25 mm average thickness	13.00	sqm	126.75	1648.00
70	26.31	Providing, mixing and applying bonding coat of approved adhesive on chipped portion of RCC as per specifications and direction of Engineer- In-charge complete in all respect.				
70.1	26.31.1	SBR Polymer (@10% of cement weight) modified cementitious bond coat @ 2.2 kg cement per sqm of surface area mixed with specified proportion of approved polymer	26.00	sqm	141.20	3671.00
71	26.32	Providing, mixing and applying SBR polymer (of approved make) modified Cement mortar in proportion of 1:4 (1 cement: 4 graded coarse sand with polymer minimum 2% by wt. of cement used) as per specifications and directions of Engineer-in-charge. Note: Measurement and payment: The pre-measurement of thickness shall be done just after the surface preparation is completed and Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument and/or the 75 mm size cube crushing strength at the end of 28 days to be not less than 30 N/Sqmm2).				
71.1	26.32.2	25 mm average thickness in 2 layers.	13.00	sqm	587.35	7636.00
71.2	26.32.3	50 mm average thickness in 3 layers.	13.00	sqm	1174.70	15271.00
72	NS	Granite stone work gang saw cut (polished and machine cut) of thickness 18 mm for wall lining (veneer work), backing filled with a grout of average 12 mm thick in cement mortar 1:3 (1 cement : 3 coarse sand), including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) with an admixture of pigment to match the marble shade (To be secured to the backing by means of cramps, which shall be paid for separately).Area of slab upto 0.50 sqm (a) 18mm thick polished granite stone slab jet black, cherry red, elite brown, cat Eye or equivalent	347.00	sqm	8032.00	2787104.00
						8361123.00
		Modified Estimated cost after using correction factor on DSR 2023 on account of GST @ 0.973 OM No.158/SE(TAS)/GST/2024/02-E dated 08/08/2024				8135373.00
					Add 3% Cost Index	244061.00
					Total of A	**8379434.00**
		Sub-Head- B				
73	NS	Providing and fixing Wall Hung WC With UF Soft close seat Cover, Hinges, Accessories Set, Size: 360x585x415mm (Brand:-Jaquar (OPS-WHT-15951UF) or Equivalent make as approved by Engineer-in-charge.	16.00	each	16877.90	270046.00
74	NS	Providing and fixing Single piece concealed cistern body (Front or Top Actuation) with installation kit & "P-Type" drain pipe connection set for Wall hung WC (Without flush control plate) Brand:-Jaquar (JCS-WHT-2431P) or Equivalent make as approved by Engineer-in-charge.	16.00	each	4437.05	70993.00
75	NS	Providing and fixing Control Plate Opal (Brand:-Jaquar (JCP-CHR-152415) or Equivalent make as approved by Engineer-in-charge.	16.00	each	1193.35	19094.00

76	NS	Providing ,lifting & fixing MS Sheet 3 mm thick for covering RCC water tank complete as per direction of Engineer-in-charge.	566.00	Kg	373.75	211543.00
77	NS	Credit for dismantled S.C.I/C.I 75 mm to 100 m	493.00	kg	-22.00	-10846.00
78	NS	Credit for dismantaling and taking away dismentaled Steel work.	500.00	kg	-22.00	-11000
					Total of B	**549830.00**
		Total of A+B				**8929264.00**
		Add 3.94 % EPF ESI				**351813.00**
		Total				**9281077.00**
		Add contingencies @ 5%				**464054.00**
		Total				**9745131.00**
					Say	**9745100.00**

Asstt. Engineer(P)
"V" Division, CPWD

Executive Engineer
"V" Division, CPWD

Annexure-B.IV

NORTHERN REGIONAL POWER COMMITTEE

AUDIT REPORT

Consolidated Receipt & Payment Account

EDITION: 2023-2024

Shaheed Jeet Singh Marg, Qutab Institutional Area, New Delhi, 110016

GGPS & ASSOCIATES

CHARTERED ACCOUNTANTS

CA INDIA

Registered Office: 306, Fourth Floor Westend Mall, District Centre, Near Hyatt Centric Janakpuri, New Delhi-110058 Tel. 91-9711077487
Website: www.ggps.co.in
Email: gaurav.ca2010@gmail.com

INDEPENDENT AUDITOR'S REPORT

Audit Report

To the Member Secretariat of Northern Regional Power Committee

Report on the Consolidated Receipt and Payment Account

We have audited the accompanying consolidated receipt and payment account of **Northern Regional Power Committee** for the year ended **31st March 2024**, which is prepared under the responsibility of the management. Our responsibility is to express an opinion on this consolidated receipt and payment account based on our audit.

Management's Responsibility for the Consolidated Receipt and Payment Account

The management is responsible for the preparation and fair presentation of this consolidated receipt and payment account in accordance with the applicable financial reporting framework. This includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of the consolidated receipt and payment account, ensuring that it is free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on the consolidated receipt and payment account based on our audit. We conducted our audit in accordance with auditing standards generally accepted in India and applicable auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the consolidated receipt and payment account is free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the consolidated receipt and payment account. The procedures selected depend on our judgment, including the assessment of the risks of material misstatement of the consolidated receipt and payment account, whether due to fraud or error. In making those risk assessments, we consider internal control relevant to the entity's preparation of the consolidated receipt and payment account in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on

GGPS & ASSOCIATES FRN 032945N Chartered Accountants the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the consolidated receipt and payment account.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the consolidated receipt and payment account of Northern Regional Power Committee for the year ended 31st March 2024 is prepared, in all material respects, in accordance with the applicable financial reporting framework and reflects a true and fair view of the receipts and payments of the organization during the year.

1. Cash System of accounting is followed by the management.
2. There were no cash transactions or expenditures recorded as having been used by the management in the course of operations for the period under review.
3. The accounting transactions are not maintained using standard accounting software. We believe that implementing accounting software would strengthen the organization's internal controls and facilitate more reliable financial reporting in the future.

For GGPS & ASSOCIATES

Chartered Accountants

(Firm Registration No. 032345N)

GGPS & ASSOCIATES * Chartered Accountants * FRN 032345N

Gaurav Gupta

CA Gaurav Gupta

(Partner)

Membership No. 524688

Place: New Delhi

Date: 04-12-2024

UDIN: 24524688BKARMY7215

Northern Regional Power Committee

Shaheed Jeet Singh Marg, Qutab Institutional Area, New Delhi, 110016

Consolidated Receipt & Payment Account

For the Period Ended 01.04.2023 to 31.03.2024

Payment Received	Amount (In Rs.)	Expenditure	Amount (In Rs.)
Opening Balance	37998713	Expenditure incurred by NRPC	36408413
Contribution for the Year 2023-24	60120000	GST	171572
Interest	1330454	TDS	117408
Grid Controller of India Limited (Reimbursement of Utility Bills)	11836314	Medical Treatment	441310
		Office Expenses (stationery and Others)	1488188
		Utility Bill Payments	15155562
		Upkeep Housekeeping	4044197
		Professional Services	935840
		Fire Fighting	202881
		IT Services	984004
		PAO CEA Licence Fees	169040
		ICT (Information computer, Telecommunication Equipment's)	3246615
		Other Revenue Expenditure	242414
		Domestic Travel Expenses	869827
		Rent Rates & Taxes for Land & Building	416812
		Minor civil and electrical works	15459998
		Digital Equipment	219936
		Leasing of Vehicles	1339999
		Closing Balance	29371465
Total	**111285481**	**Total**	**111285481**

GGPS & ASSOCIATES
FRN 032345N
Chartered Accountants

Annexure-B.V

SHP – THE NEED FOR A LEVEL PLAYING FIELD

Dec 2024

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SHP - Higher Transmission Costs for Interstate Sale of Power

1. Generating stations > 50 MW eligible for grant of connectivity by CTU*
2. SHP not eligible for CTU connectivity and therefore need to connect to STU / DISCOM
3. SHP have to pay additional Transmission Charges and Losses of DISCOM / STU in addition to GNA charges and losses of CTU

** CERC (Connectivity and General Network Access to the Inter State Transmission System) Regulation 2022 para-4.*

SHP - Quantification of Higher Transmission Charges

Transmission Charges up to State Periphery	Rs/unit
CTU connected	0.00
STU connected	0.11 – 0.23
DISCOM connected	1.22 - 2.08

Sn	Particulars	UoM	Himachal Pradesh			Uttarakhand			Sikkim			J&K		
1	Project inter-connection		ISTS	STU	DISCOM	ISTS	STU	DISCOM	ISTS	STU	DISCOM	ISTS	STU	DISCOM
2	Voltage	kV		110kV	11kV		110kV	33kV		110kV	33kV		110kV	33kV
3	Tr. Charges													
	- Wheeling charges	Rs/Unit	0.00	0.00	1.57	0.00	0.00	0.67	0.00	0.54		0.00	0.00	0.00
	- STU charges	Rs/Unit	0.00	0.07	0.07	0.00	0.16	0.16	0.00	0.00	0.00	0.00	0.07	0.07
	- Total	Rs/Unit	0.00	0.07	1.64	0.00	0.16	0.82	0.00	0.54		0.00	0.07	0.07
4	Tr. Losses													
	- Wheeling Loss	%	0.00%	0.00%	8.00%	0.00%	0.00%	13.00%	0.00%	13.59%		0.00%	0.00%	26.00%
	- STU loss	%	0.00%	0.75%	0.75%	0.00%	1.40%	1.40%	0.00%	0.00%	0.00%	0.00%	3.15%	3.15%
	- Total		0.00%	0.75%	8.75%	0.00%	1.40%	14.40%	0.00%	13.59%		0.00%	3.15%	29.15%
	Value of losses @ Rs 5/Unit	Rs/Unit	0.00	0.04	0.44	0.00	0.07	0.72	0.00	0.68		0.00	0.16	1.46
6	Transmission cost	Rs/unit	0.00	0.11	2.08	0.00	0.23	1.54	0.00	1.22		0.00	0.23	1.53

SHP – Suggested Policy Intervention for Parity in Transmission Charges

1. Grant of connectivity to CTU by SHP generators may be infeasible / fraught with technical issues

2. Therefore, the issue of higher Transmission Charges by SHP can be resolved by adding the Transmission Charges/ Losses borne by interstate SHP generators to the GNA Pool charges

3. A separate line item of Transmission Charges/ Losses paid by interstate SHP generators with data provided by State SLDC's / STU can be added to the GNA Pool

One Nation One Grid One Transmission Charge

All Inter State generators on equal footing and pay one Transmission Charge

SHP – CTU Transmission Charges in Parity with Solar and Wind

1. The waiver of CTU charges applicable for scheduling power under GNA, GNA_{RE} T-GNA, and T-GNA_{RE} for Solar and Wind generators*

2. SHP is not eligible for waiver of CTU charges

3. Payment of CTU charges on the transaction makes power expensive as compared to Solar and Wind power

4. SHP bears an extra CTU charges of ~Rs 0.65 – Rs 0.70 per unit

** CERC (Sharing of Inter State Transmission Charges and Losses) (First Amendment) Regulation 2023 para-11(4)*

SHP – Suggested Policy Intervention for Parity in CTU Transmission Charges

1. Waiver of CTU charges on the interstate flow of SHP power bringing at par with Solar and Wind power

SHP - Separate category of SHP RPO

Price of other RE Power sources (Tenders in FY 2022-23 & FY 2023-24):

Sn	Source	Estm PLF	Life	Capacity	Price at State periphery (Rs/unit)		
		%	Years	MW	High	Low	W. Avg.
1	Solar	22-25	25	6235	3.93*	2.49	2.63
2	Wind	32-34	25	830	3.58	2.84	3.06
3	Hybrid	40-50	25	2190	3.35	2.53	2.98
4	RTC	85	25	200	4.25	3.99	4.12
5	Peak power	-	-	450	6.68	4.38	4.95
6	C&I hybrid+	52-75	25	1574	4.05	3.55	3.77
7	Total			11479	3.92	2.77	3.00

*Floating solar + Market offering data

CERC determined ex-bus price of SHP (5-25 MW) is **Rs 5.82 per unit** in FY 2024-25.

SHP – Suggested Policy Intervention - Separate category of SHP RPO

- Solar, when more expensive than SHP, was promoted by introduction of Solar RPO
- Similarly, Wind is promoted by creating a separate Wind RPO
- Large Hydro also enjoys promotions by way of separate HPO
- SHP RPO is not categorised separately and clubbed with other RPO’s
- Given the differential cost of generation creation of a separate SHP RPO would provide a demand growth from the consumers/Discom

SHP- Higher DSM charges as compared to Solar and Wind

1. Generation from SHP, Solar and Wind project are depended on weather conditions and beyond the control of the generator

2. The current DSM regulations provides liberalized treatment for Solar and Wind project whereas the provisions for SHP are similar to Thermal (which has peaking capacity and predictable generation pattern)

3. Thus leading to levy of Higher DSM charge placing limitation on interstate sale of power

SHP – Comparison of Higher DSM Charges

Sn	Particulars	Solar/Wind	SHP	Disadvantage to SHP
1	Calculation of deviation	The difference in actual v/s scheduled injection is divided by the Available capacity to arrive at Deviation	The difference in actual v/s scheduled injection is divided by the Scheduled generation to arrive at Deviation.	Higher % of deviation as the base number for dividing the deviation in Solar/wind is higher.
2	Under injection	• Up to 10% deviation - Zero • 10% - 15% – 10% of contract rate. • Beyond 15% - 50% of contract rate.	• Up to 10% deviation - reference rate of charge • 10% -15% deviation – normal rate of charge • Beyond 15% - 110% of normal rate of charge	SHP witnesses frequent variations in generation due to river discharge. Thus leading to DSM charges at higher rate with small variation also as against solar which are exempted up to 10% variation.
3	Over injection	The generator shall be paid as under for over injection • Up to 10% deviation - @ contract rate • 10%-15% - 90% of the contract rate	The generator shall be paid as under for over injection • Up to 10% deviation - @ Reference rate charges.	A substantial loss to SHP in case the deviation exceeds 10%. The power will be treated as dumped and no revenue will accrue to generator. Whereas solar and wind are getting benefit up to 15% of deviation.

SHP – Suggested Policy Intervention for Parity in Levy of DSM Charges

1. The treatment of deviation charges for ROR generator should be in line with the methodology applied for other infirm sources of power like a generating station based on Solar or Wind

2. The provisions of DSM regulation for SHP should be in parity with Solar & Wind

SHP – Scheduling Fees and Suggested Policy Intervention

1. For each application of schedule to SLDC, an amount of Rs 5000 is required to be paid as application fees to NLDC and Rs 5000 per application for SLDC (HPSLDC).

2. Due to variation in energy the generators are required to vary their schedule within the day. The said scheduling charges are adding to the cost of SHP

3. The charges for scheduling may be levied on a monthly basis as against current practice of each application

Conclusion

SHP needs a level playing field to be competitive and to survive

Thank You