Barmer HVDC Power Transmission Limited

A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi – 110 016

CIN : U42202DL2025GOI456212

Ref: PG_BHPTL/T-License/ **Dated: 29.09.2026**

To,

The Secretary,
Central Electricity Regulatory Commission,
7th Floor, Tower B, World Trade Centre,
Nauroji Nagar, New Delhi-110029

Subject: Petition under Section 14, 15, 79(1)(e) of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to Transmission License to Barmer HVDC Power Transmission Ltd. (a 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

Sir,

Three copies (1 original + 2 copies) of the petition for the above subject matter have been enclosed and e-filing has been done on CERC website. As per the public notice issued on 28.08.2010 by the Hon'ble Commission, the amount of Rs.1,00,000/- (Rupees One Lakh only) for filing the petition is being paid through NEFT/ RTGS and in accordance with the Regulations 12(2), Payment of Fees Regulations 2012, **Form-I** duly filled in against the aforementioned petition is also enclosed herewith.

Electronic Copies of the petition are being forwarded to the CTUIL (Nodal Agency) and to the Bid Process Coordinator and beneficiaries of the Northern & Western Regions, and Connectivity Grantees RE Generators at Barmer-II PS as furnished by CTUIL. The complete petition along with Annexures is posted on the website: www.powergrid.in/en/subsidiaries

Thanking You,

Yours faithfully,

(Sh. Rajesh Kumar Gupta)
Project In-charge
Barmer HVDC Power Transmission Ltd.
Email: regulatory@powergrid.in

Enclosures: As above

RAJESH KUMAR GUPTA

Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:07:25 +05'30'

BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

I. GENERAL HEADING

IN THE MATTER OF: -

Subject matter:

Petition under Section 14, 15, 79(1)(e) of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to Transmission License to Barmer HVDC Power Transmission Ltd. (a 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

PETITION NO.:

Barmer HVDC Power Transmission Ltd.
(A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

Registered office:
B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016

Address for Correspondence:
ED (Commercial & RC),
Power Grid Corporation of India Limited,
Floor No. 02, Tower-01, IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

2

BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION

NEW DELHI

PETITION NO. :.....

IN THE MATTER OF: -

Subject matter:

Petition under Section 14, 15, 79(1)(e) of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to Transmission License to **Barmer HVDC Power Transmission Ltd.** (a 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

Barmer HVDC Power Transmission Ltd.
(A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)
Registered office: B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016

Address for correspondence:

C/o ED (Commercial & RC),
Power Grid Corporation of India Limited,
Floor No. 02, Tower-01, IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

.....PETITIONER

VERSUS

Central Transmission Utility of India Ltd,

Floor No. 05th to 10th, Tower-01,
IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

& Ors.

.....RESPONDENT(S)

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FILED BY

(Sh. Rajesh Kumar Gupta)
Project In-charge,
Barmer HVDC Power Transmission Ltd.

Place: Barmer (Rajasthan)
Date: 29.09.2026

RAJESH KUMAR GUPTA
Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:09:49 +05'30'

BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

PETITION NO. :.....

IN THE MATTER OF: -

Subject Matter:

Petition under Section 14, 15, 79(1)(e) of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to Transmission License to **Barmer HVDC Power Transmission Ltd.** (a 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

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(A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)
Registered office: B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016

Address for correspondence:

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Power Grid Corporation of India Limited,
Floor No. 02, Tower-01, IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

... **PETITIONER**

VERSUS

Central Transmission Utility of India Ltd,

Floor No. 05th to 10th, Tower-01,
IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

& Ors.

... **RESPONDENT(S)**

To,

The Secretary
Central Electricity Regulatory Commission
New Delhi - 110029

Sir,

6

The petition filed under Section 14, 15, 79(1)(e) of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to the Transmission System being established by the **Barmer HVDC Power Transmission Ltd** (A 100% wholly owned subsidiary of Power Grid Corporation of India Limited) for which transmission charges are determined through transparent process of bidding in accordance with the guidelines issued by the Central Government, may please be registered.

Petitioner: Barmer HVDC Power Transmission Ltd.
(A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

Represented by (Sh. Rajesh Kumar Gupta)
Project In-charge
Barmer HVDC Power Transmission Ltd.

Place: Barmer (Rajasthan)
Date: 29.09.2026

RAJESH KUMAR GUPTA
Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:12:18 +05'30'

BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

PETITION NO. :.....

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Petition under Section 14, 15, 79(1)(e) of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to Transmission License to **Barmer HVDC Power Transmission Ltd.** (a 100% wholly owned subsidiary of Power Grid Corporation of India Limited)

MEMO OF APPEARANCE

Barmer HVDC Power Transmission Ltd.

..... PETITIONER

I, Sh. Rajesh Kumar Gupta, the Petitioner/~~Respondent~~ above named do hereby nominate/ appoint following officers to act, plead and appear on my/our behalf in the aforesaid matter.

1. Sh. Rajesh Kumar Gupta, Project In-charge
2. A Jagannath Rao, Chief General Manager
3. Ashish Agrawal, Sr. Dy. General Manager
4. Prashant Kumar, Dy. General Manager
5. Abhijit Daimari, Dy. General Manager

IN WITNESS WHEREOF I/~~We~~ have set and subscribed my/~~our~~ hands to this writing on this 29th day of September 2026.

FILED BY

(Sh. Rajesh Kumar Gupta)
Project In-charge,
Barmer HVDC Power Transmission Ltd.

RAJESH KUMAR GUPTA
Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:14:48 +05'30'

Place: Barmer (Rajasthan)
Date: 29.09.2026

BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

PETITION NO. :.....

IN THE MATTER OF

Subject matter:

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... PETITIONER

VERSUS

Central Transmission Utility of India Ltd,
Floor No. 05th to 10th, Tower-01,
IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003
& Ors.

.... RESPONDENT(S)

MEMO OF PARTIES

Barmer HVDC Power Transmission Ltd.
(A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)
Registered office: B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016
Address for correspondence:
C/o ED (Commercial & RC),

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Power Grid Corporation of India Limited,
Floor No. 02, Tower-01, IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

.... PETITIONER

VERSUS

1. **Central Transmission Utility of India Ltd,** (CTUIL)

   Floor No. 05th to 10th, Tower-01,
   IRCON International Tower,
   Plot No. 16, Institutional Area, Sector-32,
   Gurgaon-122003
   Email: ctu@ctuil.in

2. **REC Power Development and Consultancy Ltd. (REC PDCL)**

   Core 4, SCOPE Complex, 7, Lodhi Road,
   New Delhi -110 003 India

3. **Ajmer Vidyut Vitran Nigam Ltd. (AVVN)**

   Vidyut Bhawan, Panchsheel Nagar,
   Makarwali Road,
   Ajmer -305004, Rajasthan, India

   REPRESENTED BY ITS MANAGING DIRECTOR
   Email: CECOMAVVNL@GMAIL.COM

4. **JAIPUR VIDYUT VITRAN NIGAM LTD (JVVN)**

   Vidyut Bhawan, Janpath,
   Jyoti Nagar,
   Jaipur -302005, Rajasthan, India

   REPRESENTED BY ITS MANAGING DIRECTOR
   Email: ce.nppr@rvpn.co.in

5. **JODHPUR VIDYUT VITRAN NIGAM LTD (JdVVN)**

   New Power House, Industrial Area,
   Jodhpur -342003, Rajasthan, India

   REPRESENTED BY ITS MANAGING DIRECTOR
   Email: ce.nppr@rvpn.co.in

6. **Himachal Pradesh State Electricity Board Ltd.**

   Vidyut Bhawan,
   Shimla – 171004, Himachal Pradesh, India

10

REPRESENTED BY ITS CHAIRMAN & MD
Email: cmd@hpseb.in; mdhpseblshimla@gmail.com; xen.commercial.aldc@gmail.com; cecomm@hpseb.in

7. **Punjab State Power Corporation Ltd. (PSPCL)**

PSEB Head Office, The MALL,
Patiala – 147001, Punjab, India

REPRESENTED BY ITS CHAIRMAN CUM MANAGING DIRECTOR
Email: seisbpspcl@gmail.com; se-tech-comm@pspcl.in; director-commercial@pspcl.in; cmd-pspcl@pspcl.in

8. **Haryana Power Purchase Centre**

Shakti Bhawan, Sector 6,
Panchkula -134109, Haryana, India
REPRESENTED BY ITS Chief Engineer
Phone: 0172-2583728, 0172-2524273
Email: cehppc@uhbvn.org.in; cehppc@gmail.com

9. **Uttar Pradesh Power Corporation Ltd. (UPPCL)**

Shakti Bhawan, 14, Ashok Marg
Lucknow - 226 001, Uttar Pradesh, India

REPRESENTED BY ITS CHAIRMAN & MD
Email: spatcircle2010@gmail.com; chairman@uppcl.org; md@uppcl.org

10. **BSES Yamuna Power Ltd.**

B-Block, Shakti Kiran Building, 2nd Floor
Karkardooma, (Near Karkardooma Court)
Delhi – 110032, India

REPRESENTED BY ITS CEO & Head
Email: sameer.singh@relianceada.com

11. **BSES Rajdhani Power Ltd.**

BSES Bhawan, Nehru Place,
New Delhi -110019, India

REPRESENTED BY ITS CEO
Email: megha.bajpeyi@relianceada.com

12. **TATA POWER DELHI DISTRIBUTION LTD. (TPDDL)**

NDPL House, Hudson Lines
Kingsway Camp
Delhi-110 009, India

REPRESENTED BY ITS CEO
Email: anurag.bansal@tatapower-ddl.com

13. Chandigarh Power Distribution Limited (CPDL)

4th Floor, SCO 33, 34 & 35, SECTOR 34A,
Chandigarh – 160022, Chandigarh, India

REPRESENTED BY ITS CHAIRMAN
Email: shekhar.saklani@rpsg.in

14. Uttarakhand Power Corporation Limited (UPCL)

Victoria Cross Vijeyta Gabar Singh Urja Bhawan,
Kanwali Road, Balliwala Chowk,
Dehradun-248001, Uttarakhand, India
REPRESENTED BY ITS MANAGING DIRECTOR
Email: cgmupcl@yahoo.com; msrana@upcl.org; md@upcl.org

15. NORTH CENTRAL RAILWAY

DRM OFFICE, NAWAB YUSUF ROAD
PRAYAGRAJ, UTTAR PRADESH-211011

REPRESENTED BY CHIEF ELECTRICAL DISTRIBUTIONENGINEER
Email: srdeetrdald123@gmail.com
Ph **05322435267**

16. NEW DELHI MUNICIPAL COUNCIL (NDMC)

PALIKA KENDRA, SANSAD MARG,
NEW DELHI-110001

REPRESENTED BY CHAIRMAN
Email: ndmcsldc@gmail.com

17. JAMMU KASHMIR POWER CORPORATION LIMITED

220/66/33 kV Gladni SS SLDC Building, Narwal,
Jammu -180006, UT of Jammu & Kashmir, India

REPRESENTED BY ITS CHAIRMAN
Email: mdjkptcl1@gmail.com

12

18. **MP Power Management Company Ltd.**

ShaktiBhawan, Vidyut Nagar,
Rampur Jabalpur -482008, Madhya Pradesh, India.

REPRESENTED BY ITS MD
EMAIL: md@mppmcl.com; anurag.naik@mppmcl.com;
COMML.DEPTT@MPPMCL.COM; cgm.regulatory@mppmcl.com

19. **Maharashtra State Electricity Distribution Co. Ltd.**

PRAKASHGAD, PLOT NO G-9, A K MARG, BANDRA (EAST),
MUMBAI-400 051, Maharashtra, India

REPRESENTED BY ITS MD
EMAIL: CEPPMSEDCL@GMAIL.COM
CONTACT NO- 9833387967

20. **Gujarat Urja Vikas Nigam Limited,**

Sardar Patel Vidyut Bhavan,
Race Course,
Barmer (Rajasthan) -390 007, Gujarat, India

REPRESENTED BY ITS MD
EMAIL: DECSP.GUVNL@GEBMAIL.COM
CONTACT NO- 7069009628

21. **ELECTRICITY DEPARTMENT**

VIDYUT BHAWAN, GOVT. OF GOA,
PANAJI, GOA - 403 001

REPRESENTED BY ITS CHIEF ENGINEER (ELECTRICAL)
E-MAIL: CEE-ELEC.GOA@NIC.IN
CONTACT NO- 7350644000

22. **DNHDD POWER DISTRIBUTION CORPORATION LIMITED**

Vidyut Bhavan, 66 KV Road,
Near Secretariat, Amli,
Silvassa - 396230

REPRESENTED BY ITS SECRETARY (FIN.)
EMAIL- BHAVIKSHAH@TORRENTPOWER.COM
CONTACT NO- 9227758405

13

23. **CHHATTISGARH STATE POWER DISTRIBUTION COMPANY LIMITED**

P.O. SUNDER NAGAR,
Danganiya,
Raipur -492 013, Chhattisgarh, India

REPRESENTED BY ITS CHAIRMAN
EMAIL- CECOMCSEB@REDIFFMAIL.COM
CONTACT NO- 982618253

24. **Vismaya Five Renewables Private Limited**

613, 614A, 614B, 6th Floor, Magnum Global
Park, Tower 2, Golf Course Extension Road,
Sector 58,
Gurugram -122011, Haryana, India

Ph.: 8800917799, 9717855521
Email: vikram.malkotia@upcrenewables.in; alok.nigam@upcrenewables.in
Name: Shri Vikram Malkotia

25. **Adani Renewable Energy Two Limited**

5th Floor, CT Tower-1, Inspire Business Park,
Opp. Adani Corporate House, Nr. Vaishnodevi Circle, Khodiyar,
Ahmedabad -382421, Gujarat, India

Ph.: 9792972884, 6358951727
Email: diwakar.kumar@adani.com; ajay.talaviya@adani.com
Name: Shri Diwakar Kumar, Senior Manager

26. **Adani Renewable Energy Holding Four Limited**

5th Floor, CT Tower-1, Inspire Business Park,
Opp. Adani Corporate House, Nr. Vaishnodevi Circle, Khodiyar,
Ahmedabad -382421, Gujarat, India

Ph.: 9792972884, 6358951727
Email: diwakar.kumar@adani.com; ajay.talaviya@adani.com
Name: Shri Diwakar Kumar, Senior Manager

27. **ReNew Solar Power Private Limited**

138, ANSAL CHAMBER BIKA JI CAMA,
New Delhi – 110029, Delhi, India

Ph: 9555905077, 9873462717, 7838958791, 9542388443
Email: agam.kumar@renew.com; mohit.jain@renew.com;
solarbidding.gm@renew.com
Name: Shri Mohit Jain

14

28. **Amaresha Renawables India Project Private Limited**

613, 614A, 614B, 6th Floor, Magnum Global Park, Tower 2,
Golf Course Extension Road, Sector 58,
Gurugram -122011, Haryana, India

Ph.: 8800917799, 9717855521
Email: vikram.malkotia@upcrenewables.in; alok.nigam@upcrenewables.in
Name: Shri Vikram Malkotia

29. **Sprng Urja Private Limited**

A001, P5, Cyber City Pentagon,
Magarpatta,
Pune -411013, Maharashtra, India

Ph: 8149855176, 9545659577
Email: poorvapitke@sprngenergy.com; abhinavbhansali@sprngenergy.com;
Name: Shri Poorva Pitke

30. **Avaada Energy Private Limited**

C-11, Sector 65,
Noida, Uttar Pradesh,
NOIDA (Gautam Budh Nagar) - 201301, Uttar Pradesh, India

Ph: 9891063313, 7835004673
Email: angshuman.rudra@avaada.com; shipra.arora@avaada.com;
Name: Shri Angshuman Rudra

31. **NTPC Renewable Energy Limited**

NETRA Building, E-3, Ecotech-II, Udyog Vihar,
Greater Noida, PIN – 201306, Uttar Pradesh, India

Ph: 9650997835, 9650991792
Email: amanna@ntpc.co.in; ramprakash@ntpc.co.in; durgeshagarwal@ntpc.co.in;
Name: Shri Animesh Manna

32. **Sprng Renewable Resources Private Limited**

A001, P5, Cyber City Pentagon,
Magarpatta,
Pune -411013, Maharashtra, India

Ph: 8149855176, 9545659577
Email: poorvapitke@sprngenergy.com; abhinavbhansali@sprngenergy.com;
Name: Shri Poorva Pitke

15

33. **Green Infra Clean Solar Farms Limited**

5th Floor, Tower A, Building No. 7,
DLF Cybercity,
Gurgaon - 122002, Haryana, India

Ph: 9811392257, 8700379285, 9868165784
Email: mahesh.vipradas@sembcorp.com; connectivity.India@sembcorp.com; raman.gulati@sembcorp.com; dhir.singh@sembcorp.com;
Name: Mahesh Chandrakant Vipradas/ Shri Vivek Hooda

34. **WRNES Talegaon Power Transmission Limited**

C-105, Anand Niketan
New Delhi – 110021

Ph: 9810866555
Email: prashant.kumar1@adani.com
Name: Prashant Kumar

.... RESPONDENTS

FILED BY

(Sh. Rajesh Kumar Gupta)
Project In-charge
Barmer HVDC Power Transmission Ltd.

RAJESH KUMAR GUPTA
Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:17:29 +05'30'

Place: Barmer (Rajasthan)

Date: 29.09.2026

BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION

NEW DELHI

PETITION NO.:.....

IN THE MATTER OF

Subject matter:

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Central Transmission Utility of India Ltd,

Floor No. 05th to 10th, Tower-01,
IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

& Ors.

NOTARY CHENARAM CHOUDHARY ADVOCATE Regd. No. 407 CHOHTAN (BARMER)

.... RESPONDENT(S)

Affidavit verifying the Petition

I, Sh. Rajesh Kumar Gupta, son of Sh. PREM NARAYAN GUPTA, aged 58 years, Project In-Charge, presently residing at C-203, NYSA SKYDALE CHHANI, VADODRA - 391740 do hereby solemnly affirm and state as follows: -

ATTESTED
NOTARY
CHOHTAN (BARMER)
30/9/26

RAJESH KUMAR GUPTA

Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:19:38 +05'30'

1. That the deponent is the **Authorized Signatory** of **Petitioner**, **Company** and is well conversant with the facts and circumstances of the case and therefore competent to swear this affidavit.

2. That the accompanying Petition under Section **14, 15 & 79(1)(e)** of the Electricity Act, 2003, has been filed by my authorized representative/ nominated counsel under my instruction and content of the same are true and correct to the best of my knowledge and belief.

3. That the contents of Para **01 to 57** of the facts as mentioned in the Petition are true and correct based on my personal knowledge, belief and records maintained in the office and the contents of Para of the Petition are believed to be true on the legal advice received.

4. That the annexures annexed to the Petition are correct and true copies of the respective originals.

5. That the Deponent has not filed any other Petition or Appeal before any other forum or court of law with respect to the subject matter of the dispute.

DEPONENT

RAJESH KUMAR GUPTA
Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:21:40 +05'30'

Place: Barmer (Rajasthan)

Date: 29.09.2026

VERIFICATION

Verified at Barmer (Rajasthan) on 29th day of September, 2026 that the contents of my above noted affidavit are true and correct to my knowledge and no part of it is false and nothing material has been concealed therefrom.

NOTARY CHENARAM CHOUDHARY ADVOCATE Reg. No. 407 CHOHTAN (BARMER)

ATTESTED
NOTARY
CHOHTAN (BARMER)
30/9/26

DEPONENT

RAJESH KUMAR GUPTA
Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:23:39 +05'30'

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BEFORE THE CENTRAL ELECTRICITY REGULATORY COMMISSION

NEW DELHI

PETITION NO.:.....

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Registered office: B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016

Address for correspondence:

C/o ED (Commercial & RC),
Power Grid Corporation of India Limited,
Floor No. 02, Tower-01, IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

.... **PETITIONER**

VERSUS

Central Transmission Utility of India Ltd. (CTUIL),

Floor No. 05th to 10th, Tower-01,
IRCON International Tower,
Plot No. 16, Institutional Area, Sector-32,
Gurgaon-122003

& Ors.

.... **RESPONDENT(S)**

III. Petition

A. Background

1. The present petition is being filed by **Barmer HVDC Power Transmission Ltd.** ("**BHPTL**" / "**Applicant**" / "**Petitioner**") under Section 15 of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations,

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RAJESH KUMAR GUPTA

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Date: 2026.09.30 16:25:18 +05'30'

2024 seeking grant of a Transmission Licence to the petitioner for implementation of **Inter-State Transmission System** forming part of the "**Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6GW) [Barmer Complex] Barmer-II: 6GW(Solar) (LCC Configuration)**", ("**the Project/ Project**") under Tariff Based Competitive Bidding under Section 63 of the Act on a Build, Own, Operate and Transfer ("**BOOT**") basis.

(i) Brief background of the Petitioner

2. The Applicant/ Petitioner, i.e. **Barmer HVDC Power Transmission Ltd., ("BHPTL"/ "Applicant"/ "Petitioner")** is a company incorporated under the Companies Act, 2013 as a Special Purpose Vehicle (SPV) under the Tariff Based Competitive Bidding (TBCB) framework for the exclusive purpose of development, design, engineering, procurement, construction, ownership, operation and maintenance of the Project, and to providing Transmission Services.

3. The Petitioner was initially incorporated by **REC Power Development and Consultancy Ltd (REC PDCL)** as the SPV for implementation of the Project under the TBCB process. Pursuant to completion of the bidding process, **Power Grid Corporation of India Limited (POWERGRID)** emerged as the successful bidder and acquired 100% equity shareholding of the Petitioner. Accordingly, the Petitioner is presently a wholly owned subsidiary of POWERGRID, a Government of India Enterprise under the Ministry of Power.

(ii) Brief Background of the Respondent(s)

4. **Respondent No. 1, Central Transmission Utility of India Ltd.** ("**CTUIL**"), is a Government Company and has been notified by the Ministry of Power, Government of India, vide Gazette Notification dated 09.03.2021 as the Central Transmission Utility ("CTU") under Section 38 of the Electricity Act, 2003. CTUIL is responsible for discharging all functions of the CTU, including undertaking transmission of electricity through the Inter-State Transmission System, and planning and coordination relating to such system, as specified under the Act. CTUIL is also the Nodal Agency as per the RfP and TSA of the Project.

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5. **Respondent No. 2, REC Power Development and Consultancy Ltd. ("REC PDCL")**, as a wholly owned subsidiary of **REC Limited**, a Schedule-A, Maha Ratna Public Sector Enterprise under the Ministry of Power, Govt. of India. REC PDCL was appointed by the Government of India vide Gazette notification no. CG-DL-E-30082025-265828 dated 29-08-2025 as the BPC for selection of the TSP for the Project through the TBCB process.

6. **Respondent Nos. 3 to 33** are the Designated Inter-State Customers **(DICs)** and beneficiaries of the **Northern & Western Region and Connectivity Grantees RE Generators at Barmer-II PS as furnished by CTUIL,** in terms of Regulation 5(3) of the Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission Licence and Other Related Matters) Regulations, 2024.

7. **Respondent Nos. 34** is **M/s WRNES Talegaon Power Transmission Limited** to establish the "Network Expansion scheme in Western Region to cater Pumped Storage potential near Talegaon (Pune)" establishing 2X1500MVA, 765/400kV ICTs with 2X330MVAr, 765kV bus reactors and 2X125MVAr bus reactor at Substation near South of Kalamb along with LILO of Pine-III – Boisar-II 765kV D/c line.

(iii) Brief Background of the Project

8. The transmission scheme comprises of the transmission system for evacuation of RE (Solar) power from Barmer area in the state of Rajasthan (Rajasthan REZ Ph-IV Part-5: 6 GW).

9. This scheme is a part of transmission system for evacuation of RE power from 75GW of Renewable Energy Zones (REZs) identified by MNRE/ SECI in Rajasthan. Out of 75GW, evacuation of 13GW has been planned from Fatehgarh (5GW) and Barmer (8GW) complex. Transmission schemes for 9GW injection at Fatehgarh-IV PS and Barmer-I PS under Rajasthan REZ Ph-IV (Part-2: 5.5GW) and Rajasthan REZ Ph-IV (Part-4: 3.5GW) are under implementation. At present connectivity of about 6 GW capacity is already granted at Barmer-II PS and the present transmission scheme has been planned for evacuation of 6GW RE (Solar) injection at Barmer-II Pooling station.

10. This comprehensive transmission scheme includes the establishment of 400kV Barmer-II PS in Rajasthan along with 400 kV Barmer-II – Barmer-I D/c line and LILO

of both circuits of 400kV Fatehgarh-IV – Barmer-I D/c line at Barmer-II PS. The HVDC portion of the scheme includes establishment of ± 800kV, 6000MW Barmer- II(HVDC) [LCC] terminal station, ± 800kV, 6000MW, South Kalamb (HVDC) [LCC] terminal station along with Barmer-II – South Kalamb ±800kV HVDC Biploe Line.

For further dispersal of power, augmentation of South Kalamb S/s with 4 nos. of 765/400kV, 1500MVA ICTs is to be implemented. Further, 2 Nos. of Syncon units at 400kV level of Barmer-II PS are also being proposed as part of comprehensive scheme.

11. Above transmission scheme has been discussed and agreed in the 36th CMETS-NR meeting held on 15.01.2025 and 35th CMETS-WR meeting held on 07.02.2025, 53rd TCC & 78th NRPC meeting held on 16-17th Mar'25, 53rd TCC/53rd WRPC meeting held on 13th Mar'25. Further, the transmission scheme was agreed in 30th NCT meeting held on 30.05.25. Subsequently, Ministry of Power, Government of India, vide its Gazette Notification CG-DL-E-30082025-265828 dated 29.08.2025 has notified the implementation of transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through tariff based competitive bidding process route. All the relevant extracts of aforesaid meetings are enclosed and marked as **Annexure-1(Colly).**

12. Pursuant to the aforesaid recommendation of the Project by the National Committee on Transmission, Ministry of Power, Government of India, vide Gazette Notification no. CG-DL-E-30082025-265828 dated 29-08-2025 declared establishment of **"Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6GW) [Barmer Complex] Barmer-II: 6GW(Solar) (LCC Configuration)"** through tariff based competitive bidding process route and notified **REC Power Development and Consultancy Ltd.**, Core 4, SCOPE Complex, 7, Lodhi Road, New Delhi -110 003 India. **("REC PDCL"/ "Respondent No. 2")** as the Bid Process Coordinator ("**BPC**") for the purpose of selection of Bidder as Transmission Service Provider (TSP) to establish the Project through Tariff Based Competitive Bidding process on build, own, operate and transfer basis (BOOT). Copy of the said Gazette Notification is enclosed and marked as **Annexure-2.**

13. The details regarding Transmission Project for which the present transmission licence is sought and Scheduled Commercial Operation Date ("**SCOD**") are set out as below:

S. No.	Name of the Transmission Element	Schedule CoD
1	Establishment of 400/220kV, 6x500 MVA S/s at suitable location near Barmer (Barmer II Substation) along with 2x125 MVAr bus reactor **<u>Barmer-II PS – AIS</u>** • 400/220kV 500MVA ICTs- 6 Nos. • 400kV ICT bays- 6 Nos. • 220kV ICT bays- 6 Nos. • 125MVAr Bus Reactor-2 Nos. • 400kV Bus reactor bays- 2 Nos. • 400kV line bays– 4 Nos. (for RE interconnection) • 220kV line bays – 7 Nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220kV BC (2 Nos.) & TBC (2 Nos.) 400kV sectionaliser bay- 1 Set **<u>Future provisions (excl. scope of present scheme):</u>** ➢ 400kV line bays along with switchable line reactor – 6 ➢ 400kV line bays – 4 Nos. ➢ 400kV Bus Reactor along with bays: 1 No. ➢ 400/220kV ICT along with bays- 4 Nos. ➢ 400kV Sectionalization bays: 2 sets ➢ 220kV line bays for connectivity of RE Applications - 5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 Nos. of Syncon units* at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300MVAr, 4x125MVAr MSC, 2x125 MVAr MSR) along with 400kV bays (2 Nos.) *(1 No. of SynCon unit comprises dynamic support of +300MVAr/ -200MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum))	48 Months (23.09.2030)

2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS • 400kV line bays - 4 Nos. (at Barmer-II PS end)	
3	Barmer-II PS - Barmer-I PS 400kV D/c line (Quad) • 400kV line bays at Barmer-II PS – 2 Nos. • 400kV line bays at Barmer-I PS S/s – 2 Nos.	
4	Establishment of 6000MW, ±800kV Barmer-II (HVDC) [LCC] terminal station (4x1500MW) at a suitable location near Barmer-II substation • HVDC terminal station (±800kV, 3000MW (Bipole configuration) - 2 nos.)	54 Months (23.03.2031) (Bipole-1: 48 months (23.09.2030) Bipole-2: 54 months (23.03.2031)
5	Establishment of 6000MW, ±800kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500MW) at a suitable location near South of Kalamb • HVDC terminal station (±800kV, 3000MW (Bipole configuration) - 2 Nos.)	
6	±800kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) [with 100% reverse power capability]	48 Months (23.09.2030)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330MVAR, 765kV bus reactor & 2x125MVAR, 420kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below$ (2x1500MW HVDC Bipole-I to be terminated on 400kV Sec-I & 2x1500MW HVDC Bipole-II to be terminated on 400kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open) • 765/400kV 1500MVA ICTs- 4 Nos. • 765kV ICT bays- 4 Nos. • 400kV ICT bays- 4 Nos. • 330MVAr Bus Reactor-2 Nos. (at bus section II) • 765kV Bus reactor bays- 2 Nos. (at bus section II) • 125MVAr Bus Reactor-2 Nos. (at bus section II) • 400kV Bus reactor bays- 2 Nos. (at bus section II)	48 Months (23.09.2030)

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8	2 Nos. of Syncon units at 400kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum)) • Syncon units – 2 Nos. • 400kV line bays – 2 Nos.	48 Months (23.09.2030)
	# South Kalamb S/s establishment with 2x1500MVA, 765/400kV ICTs with 2x330MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under construction by M/s WRNES TPTL, a subsidiary of Adani Energy Solutions Limited). **$** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765kV Sectionalization bay: 2 sets & 400kV Sectionalization bay: 2 sets alongwith 2x330MVAR, 765kV bus reactor & 2x125MVAR, 420kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500 MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.]	

Scheduled COD (SCoD) for the overall Project: 23.03.2031 (Bipole-1: 48 months (23.09.2030), Bipole-2: 54 months (23.03.2031))

(iv) Proof of Service

14. It is most respectfully submitted that a copy of the complete petition along with annexures has been served upon the Respondents and proof of such service is enclosed as **Annexure-20** For any of the respondents not registered on the Commission's e-filing portal, service shall additionally be affected in accordance with the applicable CBR requirements.

(v) Status of the Petitioner

15. The Petitioner is a Company incorporated under the Companies Act, 2013 and is a 100% wholly owned subsidiary of Power Grid Corporation of India Ltd. The Certificate of Incorporation is enclosed as **Annexure-3**.

(vi) Brief description of important events, clearances relevant to the assets under consideration in the present Petition.

16. In furtherance of the aforesaid Government decisions, REC PDCL, in its capacity as the duly appointed BPC, issued the **Request for Proposal** dated **28.01.2026** ("**RfP**"), together with the Global Invitation and advertisements, inviting bids for development of the Project through the TBCB process in accordance with the TBCB Guidelines and the Guidelines for Encouraging Competition in Development of Transmission Projects issued by the Ministry of Power under Section 63 of the Act, as amended from time to time. Under the RfP, the successful bidder was required to acquire 100% of the equity shareholding of the Petitioner, being the SPV incorporated for the Project.

    Copy of relevant extract of **RfP** dated **28.01.2026** along with the Global Invitation and advertisements is annexed herewith and marked as **Annexure-4 (Colly).**

17. On **30.01.2026**, REC PDCL, in its capacity as the duly appointed BPC, formally **informed this Hon'ble Commission** of the initiation of the TBCB process for selection of the TSP for the Project, by issuance of a Global Invitation in National/ International newspapers in terms of the Standard Bidding Documents for TBCB Projects. A copy of the said letter is annexed herewith and marked as **Annexure-5**.

18. On the same date, i.e. **30.01.2026**, REC PDCL also formally **informed Ministry of Power** that the TBCB process for the Project had been initiated by issuance of the Global Invitation and RFP and requested Ministry of Power to publish the RFP notice and RFP documents on its website. A copy of the said letter is annexed herewith and marked as **Annexure-6**.

19. That a company under the Companies Act 2013 by the name "**Barmer HVDC Power Transmission Limited**" having its registered office at New Delhi has been incorporated on **30.09.2025** by **REC PDCL** as its wholly owned subsidiary to initiate the activities for execution of the Project and subsequently to act as Transmission

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Service Provider (TSP) after being acquired by the successful bidder selected through Tariff Based Competitive Bidding process. A copy of the Certificate of Incorporation is enclosed and marked as **Annexure-3** & a copy of the Memorandum (**MoA**) of Association is enclosed and marked as **Annexure-7** and Articles of Association (**AoA**) are enclosed and marked as **Annexure-8**.

20. On **02.03.2026**, in furtherance of the RfP and in accordance with Clause 1.6.2.1(5) of Section-I thereof, **REC PDCL** issued a letter to **POWERGRID** communicating the tentative Acquisition Price payable by the Selected Bidder for acquisition of 100% equity shareholding of the SPV, together with all its assets and liabilities. A copy of the letter dated 02.03.2026 issued by REC PDCL to POWERGRID is annexed herewith and marked as **Annexure-9.**

However, on **22.09.2026**, REC PDCL updated/ informed POWERGRID (Successful Bidder) to deposit acquisition price with following breakup before acquisition of the SPV:

S. No.	Particulars	Amount (INR)
1	Profession Fee of BPC #	17,70,00,000
2	Reimbursement of Cost incurred by BPC #	1,22,52,835
4	Share Capital of Barmer HVDC Power Transmission Limited	5,00,000
	Total	**18,97,52,835/-**

A copy of the letter dated 22.09.2026 issued by REC PDCL to POWERGRID is annexed herewith and marked as **Annexure-10.**

21. In furtherance of the RfP and in compliance with Clause 1.6.2.1 of Section-I thereof, which mandates the BPC to obtain **approval under Section 68** of the Act for laying of overhead transmission lines, the Petitioner (then wholly owned by REC PDCL) approached Ministry of Power for said approval. Thereafter, approval under Section 68 of the Electricity Act, 2003 was accorded, which is annexed herewith and marked as **Annexure-11**.

22. Pursuant to the Request for Proposal (RfP), POWERGRID submitted its Technical Bid and Initial Price Offer on **20.07.2026** in response to the Final RfP issued by the

Bid Process Coordinator (BPC) for selection of a Transmission Service Provider (TSP) through the Tariff Based Competitive Bidding (TBCB) process.

23. Subsequently, e-Reverse Auction for the Project was commenced on **20.08.2026** in accordance with the RfP and the TBCB Guidelines, wherein POWERGRID emerged as the Successful Bidder having quoted the lowest final quoted (uniform) Annual Transmission Charges.

24. After completion of the e-Reverse Auction and verification of the bid documents submitted by POWERGRID, the Bid Evaluation Committee ("**BEC**") constituted under the TBCB Bidding framework evaluated the bids in accordance with the "Tariff Based Competitive Bidding Guidelines for Transmission Service" and the "Guidelines for Encouraging Competition in Development of Transmission Projects" issued by the MoP under Section 63 of the Electricity Act, 2003.
Thereafter, on **25.08.2026**, the Bid Evaluation Committee issued its Certificate confirming the following: -

"It is certified that:

(a) the entire bid process has been carried out in accordance with the "Tariff based Competitive Bidding Guidelines for Transmission Service" and "Guidelines for encouraging competition in development of the Transmission Project" issued by Ministry of Power, Govt. of India under Section 63 of the Electricity Act, 2003 as amended from time to time.

(b) **M/s Power Grid Corporation of Inda Limited,** with lowest annual Transmission Charges of **Rs32,443.25** million per annum, emerged as the successful bidder after the conclusion of electronics reverse auction.

(c) The transmission charges of Rs 32,443.25 million discovered after electronic reverse auction is acceptable."

A copy of the Bid Evaluation Committee Certificate dated **25.08.2026** is annexed herewith and marked as **Annexure-12**.

25. Therefore, upon completion of the e-Reverse Auction and evaluation of bids in accordance with the RfP, REC PDCL issued the LoI to POWERGRID, declaring it as

the Successful Bidder for the Project under Clause 3.6.1 of Section-III of the RfP, with the Quoted Annual Transmission Charges of **Rs. 32,443.25** Million.

A copy of the **LoI** dated **02.09.2026** issued by REC PDCL to POWERGRID is annexed herewith and marked as **Annexure-13**.

26. On **17.09.2026**, Ministry of Power, Govt. of India (MoP) officially approved the sale and transfer of the project to the POWERGRID.

A copy of the **approval of MoP** dated 17.09.2026 to REC PDCL is annexed herewith and marked as **Annexure-14**.

27. As per the provisions under Clause 2.15.2 of Section-II of RfP and the Letter of Intent (LoI) issued to Power Grid Corporation of India Limited, within 10 days of issuance of Letter of Intent by the BPC, the Successful Bidder is required to inter-alia provide the Contract Performance Guarantee, execute Share Purchase Agreement & the Transmission Service Agreement and acquire the SPV.

On **22.09.2026**, REC PDCL **extended validity of LoI** issued to POWERGRID for "**Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6GW) [Barmer Complex] Barmer-II: 6GW(Solar) (LCC Configuration)**" till **23.09.2026**. Copy of letter is attached as **Annexure-15**.

28. On **23.09.2026**, in accordance with the RfP and the LoI, **REC PDCL**, **POWERGRID** and the **Petitioner** executed the SPA and in addition the TSA was signed between the **Petitioner** and **CTUIL**, pursuant to which 100% of the equity shareholding of the Petitioner stood transferred to **POWERGRID**, and the Petitioner became the duly appointed Transmission Service Provider ("**TSP**") for the Project. Copies of the SPA and TSA both dated **23.09.2026** are annexed herewith and marked as **Annexure-16** and **Annexure-17** respectively.

Accordingly, Power Grid Corporation of India Limited has acquired the **Barmer HVDC Power Transmission Limited** on **23.09.2026** after execution of the Share Purchase Agreement, Transmission Service Agreement and completing all procedural requirements specified in the RfP documents.

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29. Factual Matrixes or final timelines involved in the bidding process conducted by REC PDCL are as under:

Date	Event
28.01.2026	Publication of RfP
20.07.2026	Submission Technical & Price Bid (Online submission of Bid through electronic bidding portal)
20.08.2026	Commencement of e-Reverse Auction (Financial Bid – Final Offer) for the Qualified Bidders
02.09.2026	Selection of Successful Bidder and Issuance of LOI
23.09.2026	Validity of LoI extended vide letter dated 22.09.2026 till 23.09.2026
23.09.2026	Signing of Agreements and Transfer of SPV i.e. **Barmer HVDC Power Transmission Ltd.**

30. Further, **Clause 2.15.4 of Section-II of the RfP** required that, upon completion of the acquisition of the Petitioner by the Successful Bidder under the SPA, the Petitioner, as the duly appointed TSP, is required to apply to the Appropriate Commission for grant of a Transmission Licence within five (5) working days.

31. The present Petition is therefore being filed strictly in compliance with the said contractual and statutory requirement.

(vii) Proof of Eligibility

GROUNDS

Re. Compliance with Statutory Framework under the Act

32. The Petitioner submits that it is fully entitled, both in law and on facts, to be granted a transmission licence under Sections 14, 15 & 79(1)(e) of the Act. The Petitioner is the SPV incorporated exclusively for implementation of the Project and has been selected as the TSP pursuant to a TBCB process conducted under Section 63 of the Act.

33. Section 14 of the Act contemplates that a transmission licence shall be granted to any person who is duly authorised to establish, operate and maintain a transmission

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system. In the present case, the Petitioner derives its authority directly from the outcome of a statutorily governed competitive bidding process, conducted under Section 63 of the Act and implemented through the Govt. of India vide its Gazette CG-DL-E-30082025-265828 dated 29-08-2025. The Petitioner is therefore not merely an applicant, but the legally selected entity vested with the responsibility to execute the Project.

34. Further, Section 79(1)(e) of the Act vests this Hon'ble Commission with exclusive jurisdiction to grant licences for Inter State Transmission Systems. The Project, being part of Inter State transmission network, squarely falls within the territorial and subject matter jurisdiction of this Hon'ble Commission.

Re. Compliance with Tariff Based Competitive Bidding (TBCB) Framework

35. The Project has been awarded strictly in accordance with the TBCB Guidelines issued by the Ministry of Power, Govt. of India under Section 63 of the Act, pursuant to a transparent and competitive bidding process conducted by REC PDCL, the duly notified Bid Process Coordinator under the Govt. of India decision dated 29-08-2025.

36. The entire bidding process, including issuance of the RfP, conduct of e-reverse auction, declaration of POWERGRID as the successful bidder, and issuance of the Letter of Intent dated 02.09.2026, was carried out strictly in accordance with the RfP and the applicable TBCB Guidelines.

37. In accordance with Clause 1.5 of Section-I of the RfP Notification, the Petitioner SPV was acquired by POWERGRID pursuant to execution of the SPA dated 23.09.2026, and the TSA was simultaneously executed, thereby vesting all rights, obligations and project implementation responsibilities in the Petitioner as the TSP.

Re. Compliance with CERC Transmission Licence Regulations, 2024

38. **Regulation 5** of the Central Electricity Regulatory Commission (Procedure, Terms and Conditions for grant of Transmission Licence and other related matters) Regulations, 2024 requires that a petition for grant of transmission licence be made in **Form-I** and be accompanied by the prescribed affidavit and documents. The present Petition has been filed strictly in the said format.

A true copy of the duly completed Form-I, together with all enclosures thereto, is annexed herewith and marked as **Form-I**.

39. The Petitioner shall publish a notice of its petition for grant of licence in **Form-II** of the Transmission Licence Regulations in at least two leading daily digital newspapers, one in English language and another in the Indian language of the State or Union Territory where an element of the project or concerned transmission line is situated or proposed to be situated within 03 working days of filing the petition, inviting comments from the general public in compliance with Regulations 5(5) of the said Regulation.

40. The Petitioner is a project-specific SPV, fully owned and controlled by POWERGRID. The financial, technical and managerial capability of POWERGRID has already been evaluated and accepted by REC PDCL during the TBCB process and therefore stands conclusively established for the purposes of grant of licence.

41. Grant of the transmission licence will enable timely execution of the Project and is therefore squarely in public interest, grid security, and the objectives of the Act.

42. In accordance with Section 5(3) of the License Regulations, 2024 a copy of the present Petition is being simultaneously served upon CTUIL, being the nodal agency, for its comments and recommendations. A copy of the present petition is also being served upon REC PDCL, the Bid Process Coordinator, to enable it to place on record its confirmation in respect of the Tariff Based Competitive Bidding process undertaken for the Project.

43. That a copy of Application has also been marked to Designated ISTS Customers (DICs) and beneficiaries of the Northern & Western Regions and Connectivity Grantees at Barmer – II PS as informed by CTUIL as party to the Petition. If this Hon'ble Commission deems it necessary to implead any other party, then Petitioner shall implead such party as directed by this Hon'ble Commission.

44. The Petition along with annexures and enclosures has been hosted on the website of the Applicant i.e. www.powergrid.in/en/subsidiaries to facilitate access to the Petition by any person through the internet in compliance of Regulation 5(4) of the Transmission License Regulations, 2024.

45. The Applicant/Petitioner shall publish the requisite Notices in the newspapers as per the Transmission Licence Regulations and after publication of the same, the Applicant/ Petitioner shall place a copy of the said publications before this Hon'ble Commission.

46. In view of the above, it is humbly submitted that the Applicant/ Petitioner fulfils the eligibility criteria for grant of transmission licence as stipulated in Section 14 and 15 of the Act and the Transmission License Regulations and therefore, this Hon'ble Commission may kindly grant the prayers, as prayed for.

47. The present Petition is filed *bona fide* and in the interest of justice.

B. Detailed Petition

(i) **As per Form-I of the Central Electricity Regulatory Commission (Procedure, Terms and Conditions for grant of Transmission Licence and other related matters), Regulations, 2024**

48. Form-I as per the Regulation- 5(1) of CERC Licence Regulation, 2024 is attached with the present petition.

(ii) **JURIDICTION**

49. The Petitioner submits that this Hon'ble Commission has the requisite jurisdiction to entertain, hear and adjudicate the present Petition, as the Project constitutes an **Inter-State Transmission System (ISTS)** within the meaning of the Electricity Act, 2003 ("**Act**").

50. In terms of Sections 14, 15 and 79(1)(e) of the Act, this Hon'ble Commission is the **Appropriate Commission** empowered to grant transmission licences to entities engaged in Inter-State Transmission of electricity. The present Petition has been filed seeking the grant of a transmission licence in accordance with the provisions of Section 15 of the Act and the applicable regulations framed thereunder.

51. The Petitioner submits that the Project/ Transmission Scheme has been planned as an Inter-State Transmission System (ISTS) project by CTUIL, recommended by the NCT and approved by the Ministry of Power, Govt. of India. The Project comprises

of establishment of Sub-Stations, Transmission lines in the **State of Rajasthan, Gujarat & Maharashtra** forming an integral part of the ISTS. Accordingly, the Project falls within the ambit of inter-state transmission and is subject to regulatory and adjudicatory jurisdiction of this Hon'ble Commission under the provisions of the Act.

52. The present Petition is also maintainable under the provisions of the **Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission Licence and Other Related Matters) Regulations, 2024** ("Transmission Licence Regulations, 2024"), which prescribe the manner, form and procedure for grant of transmission licences by this Hon'ble Commission.

53. In view of the foregoing, the present Petition is fully maintainable and deserves to be considered by this Hon'ble Commission under the provisions of the Act read with the Transmission Licence Regulations, 2024.

C. Limitation

54. The Petitioner respectfully submits that the present Petition is within limitation and is maintainable under the provisions of the Electricity Act, 2003 and the applicable CERC Regulations. No part of the Petition is barred by limitation or any other provision of law.

D. PRAYERS

55. The Applicant/ Petitioner hereby humbly prays the Hon'ble Commission to:

(a) Grant a Transmission Licence under Sections 14, 15 & 79(1)(e) of the Electricity Act, 2003 in favour of the Applicant, **Barmer HVDC Power Transmission Ltd.**, to Build, Own, Operate and Transfer of the ***"Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6GW) [Barmer Complex] Barmer-II: 6GW(Solar) (LCC Configuration)"***, being the inter-state transmission system; and

(b) Direct issuance of the Transmission Licence in the prescribed Form-III of the Central Electricity Regulatory Commission (Procedure, Terms and Conditions for

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grant of Transmission Licence and other related matters) Regulations, 2024, subject to the general and specific conditions contained therein; and/or

(c) Condone any minor, inadvertent or procedural defects or omissions, if any, in the present Petition and permit the Applicant to place on record such additional documents, information or clarifications as this Hon'ble Commission may require from time to time in the interest of justice; and

(d) Pass such other order / orders, as may be deemed fit and proper in the facts and circumstances of the case.

IV. LIST OF ENCLOSURES

56. As per Index.

V. PROOF OF PAYMENT OF FEES FOR FILING OF THE PETITION

57. Details provided in Form-I as per Central Electricity Regulatory Commission (Payment of Fees) Regulation, 2012 is attached to this petition.

Barmer HVDC Power Transmission Ltd.
Petitioner

RAJESH KUMAR GUPTA
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Date: 2026.09.30 16:27:17 +05'30'

Represented by Sh. Rajesh Kumar Gupta
Project In-charge
Barmer HVDC Power Transmission Ltd.

Place: Barmer (Rajasthan)
Date: 29.09.2026

DECLARATION

The Petitioner(s) above named hereby solemnly declare(s) that nothing material has been concealed or suppressed and further declare(s) that the enclosures and typed set of material papers relied upon and filed herewith are true copies of original(s)/fair representation of the originals/ true translation thereof.

Verified at **Barmer (Rajasthan) on the 29th day of September, 2026.**

NOTARY CHENARAM CHOUDHARY ADVOCATE Reg. No. 407 CHOHTAN

ATTESTED
NOTARY
CHOHTAN (BARMER)

Petitioner

RAJESH KUMAR GUPTA
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Date: 2026.09.30 16:29:25 +05'30'

VERIFICATION

Verified at Barmer (Rajasthan) on 29th day of September, 2026 at Barmer (Rajasthan) that the contents of my above noted affidavit are true and correct to my knowledge and no part of it is false and nothing material has been concealed therefrom.

DEPONENT

RAJESH KUMAR GUPTA

Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:31:15 +05'30'

NOTARY
CHOHTAN (BARMER)
CHUNNARAM CHOUDHARY
ADVOCATE
Reg. No. 407

ATTESTED
NOTARY
CHOHTAN (BARMER)

36

FORM-I

1. Particulars of the Applicant

S. No.	Particulars	Details
1.	**Particulars of the Applicant**	
i	Name of the Applicant	**BARMER HVDC POWER TRANSMISSION LTD.**
Ii	Status: Individual/ Partnership firm/ Private Limited Company/ Public Limited Company	Public Limited Company
Iii	Address	B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016
Iv	Name, Designation & Address of the Contact Person	**Sh. Rajesh Kumar Gupta** Project In-Charge, Barmer HVDC Power Transmission Ltd. (100% wholly owned subsidiary of Power Grid Corporation of India Limited) C/o ED (Commercial & RC), Power Grid Corporation of India Limited, Floor No. 02, Tower-01, IRCON International Tower, Plot No. 16, Institutional Area, Sector-32, Gurgaon-122003
V	Contact Tele. No.	**7303090820**
vi	Fax No.	0124-2822062
vii	Email ID (s)	**regulatory@powergrid.in**
viii	Place of Incorporation / Registration	New Delhi, India
Ix	Year of Incorporation / Registration	**2025**
X	Following documents are to be enclosed:	
a.	Certificate of Registration	Enclosed as **Annexure-3**
b.	Copy of Power of Attorney of the signatory to commit the Applicant or its promoter	Enclosed as **Annexure-18**

2. Particulars of the Project for which license/ Amendment in license (list of existing elements and proposed addition/ deletion element in case) is being sought:

(a) Transmission Lines:

S. No.	Name (end-points location)	Voltage class (kV)	Length (kM)	Type (S/C or D/C)	Remarks
1	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS	**400kV**	~ 13 km (LILO length ~ 13 km)	**D/c**	Line length is mentioned as per BPC Survey Report
2	Barmer-II PS - Barmer-I PS 400kV D/c line (Quad)	**400kV**	~ 19 km	**D/c**	

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RAJESH KUMAR GUPTA

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3	±800kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) [with 100% reverse power capability]	**800kV**	~ 975 km	**Bipole**	

(b) Sub-stations:

S. No.	Name (location)	Voltage Level(s) (kV)	Transformer (Nos. & MVA Capacity)	Reactive/ Capacitive compensation (device with MVAR capacity)	No of Bays	Remark
1	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer II Substation) along with 2x125 MVAr bus reactor	400kV HVAC	400/220kV 500MVA ICTs- 6 Nos.	125MVAr Bus Reactor-2 Nos.	400kV ICT bays- 6 Nos. 220kV ICT bays- 6 Nos. 400kV line bays– 4 Nos. (for RE interconnection) 220kV line bays – 7 Nos. (for RE connectivity) 220kV Sectionalization bay: 1 set 220kV BC (2 Nos.) & TBC (2 Nos.) 400kV sectionaliser bay- 1 Set 400kV Bus reactor bays- 2 Nos. 400kV line bays - 4 Nos. (at Barmer-II PS end) 400kV line bays at Barmer-II PS – 2 Nos. 400kV line bays at Barmer-I PS S/s – 2 Nos.	for LILO of both ckts of 400kV Fatehgarh -IV PS - Barmer-I PS D/C line at Barmer-II PS for Barmer-II PS - Barmer-I PS 400kV D/c line (Quad)
2	**Future Space Provisions at Barmer-II PS**	400kV HVAC	400/220kV, 500MVA, ICTs – 4 Nos.		400kV ICT bays – 4 Nos. 220kV ICT bays – 4 Nos.	

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	(excl. scope of present scheme)				400kV line bays along with switchable line reactor – 6 400kV line bays – 4 Nos. 400kV Bus Reactor along with bays: 1 No. 400kV Sectionalization bays: 2 sets 220kV line bays for connectivity of RE Applications - 5 Nos. 220kV Sectionalization bay: 2 sets 220kV BC (2 Nos.) & TBC (2 Nos.) 2 Nos. of Syncon units* at 400kV level along with 2 nos. of 400kV bays STATCOM (2x±300MVAr, 4x125MVAr MSC, 2x125 MVAr MSR) along with 400kV bays (2 Nos.) *(1 No. of SynCon unit comprises dynamic support of +300MVAr/ -200MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum))	
3	Establishment of 6000MW, ±800kV Barmer-II (HVDC) [LCC] terminal station (4x1500MW) at a suitable location near Barmer-II substation	±800kV HVDC	HVDC terminal station (±800kV, 3000MW (Bipole configuration)- 2 nos.)			
4	Establishment of 6000MW, ±800kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500MW) at a suitable location near South of Kalamb	±800kV HVDC	HVDC terminal station (±800kV, 3000MW (Bipole configuration)- 2 Nos.)			
5	Augmentation of South Kalamb S/s# by	765kV & 400kV HVAC	765/400kV 1500MVA ICTs- 4 Nos.		765kV ICT bays- 4 Nos. 400kV ICT bays- 4 Nos.	

	4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330MVAR, 765kV bus reactor & 2x125MVAR, 420kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below$ (2x1500MW HVDC Bipole-I to be terminated on 400kV Sec-I & 2x1500MW HVDC Bipole-II to be terminated on 400kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)			330MVAr Bus Reactor-2 Nos. (at bus section II) 125MVAr Bus Reactor-2 Nos. (at bus section II)	765kV Bus reactor bays- 2 Nos. (at bus section II) 400kV Bus reactor bays- 2 Nos. (at bus section II)	
6	2 Nos. of Syncon units at 400kV level of Barmer-II PS (1 No. of SynCon unit	400kV HVAC		Syncon units – 2 Nos.	400kV line bays – 2 Nos.	

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	comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum))					
	# South Kalamb S/s establishment with 2x1500MVA, 765/400kV ICTs with 2x330MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under construction by M/s WRNES TPTL, a subsidiary of Adani Energy Solutions Limited). $ Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765kV Sectionalization bay: 2 sets & 400kV Sectionalization bay: 2 sets alongwith 2x330MVAR, 765kV bus reactor & 2x125MVAR, 420kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500 MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.]					

a) Remarks: Status whether the element is existing or proposed to be added or deleted.

- **Application is being filed for grant of a fresh license for addition of elements**

b) Scheduled COD: for overall Project 23.03.2031 (Bipole-1: 48 months (23.09.2030), Bipole-2: 54 months (23.03.2031))

c) Agreements with Identified Long-term transmission Customer or CTU for the Project, as applicable: CTU as Nodal Agency for the Project & Transmission Service Agreement (TSA) executed with CTUIL is enclosed as **Annexure-17** to the instant petition.

3. Quoted Transmission Charges in case of the project selected through the guidelines of competitive bidding and estimated completion cost of the project in other cases:

: Transmission charges **Rs.32,443.25** Million per annum

4. In case applicant has been selected in accordance with the competitive bidding guidelines, enclose:

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(a) Approval of Central Government as per Electricity (Transmission System Planning, Development and Recovery of Inter-state Transmission Charges) Rules, 2021	Copy of Gazette Notification is enclosed as **Annexure-2** to the petition
(b) Evaluation report (if made public) by the Bid Process Coordinator	Certificate of Bid Evaluation Committee as furnished by BPC is enclosed **Annexure-12** to the petition

5. List of documents enclosed:

a. Certificate of Registration, MoA & AoA

b. Certificate of Bid Evaluation Committee as furnished by BPC

c. Copy of Power of Attorney

RAJESH KUMAR GUPTA

Digitally signed by RAJESH KUMAR GUPTA
Date: 2026.09.30 16:35:45 +05'30'

Signature of the Applicant

Represented by **Sh. Rajesh Kumar Gupta**
Project In-charge
Barmer HVDC Power Transmission Ltd.

Place: Barmer (Rajasthan)

Date: 29.09.2026

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/36 **Date:** 24-02-2025

As per distribution list

Subject: 36th Consultation Meeting for Evolving Transmission Schemes in Northern Region-Minutes of Meeting

Dear Sir/Ma'am,

Please find enclosed the minutes of the 36th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 15th January 2025 (Wednesday) through virtual mode.

The minutes are also available at CTU website (www.ctuil.in)

Thanking you,

Yours faithfully,

(Partha Sarathi Das)
Sr. 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

Distribution List:

Chief Engineer (PSP&A – I) Central Electricity Authority Sewa Bhawan, R.K.Puram, New Delhi-110 066	**Member Secretary** Northern Regional Power Committee 18A, Shaheed Jeet Singh Sansanwal Marg, Katwaria Sarai, New Delhi – 110 016
Director (Power System) Solar Energy Corporation of India Ltd. D-3, 1st Floor, A wing, Religare Building, District Centre, Saket, New Delhi-110017	**Director** Ministry of New and Renewable Energy, Block 14, CGO Complex, Lodhi Road, New Delhi-110003
Director (SO) Grid Controller of India Limited (erstwhile Power System Operation Corporation Ltd.) 9th Floor, IFCI Towers, 61, Nehru Place, New Delhi-110 016	**Executive Director** Northern Regional Load Despatch Centre 18-A, Qutab Institutional Area, Shaheed Jeet Singh Sansanwal Marg, Katwaria Sarai, New Delhi– 110 016
Director (P & C) HPPTCL, Headoffice, Himfed Bhawan, Panjari, Shimla-171005 Himachal Pradesh	**Director(W&P)** UP Power Transmission Company Ltd. Shakti Bhawan Extn, 3rd floor, 14, Ashok Marg, Lucknow-226 001
Director (Technical) Punjab State Transmission Corporation Ltd. Head Office, The Mall, Patiala 147001, Punjab	**Director (Projects)** Power Transmission Corporation of Uttrakhand Ltd. Vidyut Bhawan, Near ISBT Crossing, Saharanpur Road, Majra, Dehradun.
Development Commissioner (Power) Power Development Department Grid Substation Complex, Janipur, Jammu	**Director (Technical)** Rajasthan Rajya Vidyut Prasaran Nigam Ltd. Vidyut Bhawan, Jaipur, Rajasthan-302005.
Member (Power) Bhakra Beas Management Board Sector-19 B, Madhya Marg, Chandigarh - 160019	**Superintending Engineer (Operation)** Electricity Circle, 5th Floor, UT Secretariat, Sector-9 D, Chandigarh - 161009
Director (Operations) Delhi Transco Ltd. Shakti Sadan, Kotla Road, New Delhi-110 002	**Director (Technical)** Haryana Vidyut Prasaran Nigam Ltd. Shakti Bhawan, Sector-6, Panchkula-134109, Haryana

Distribution List:

Executive Director (AM) POWERGRID Saudamini, Plot No.2, Power Grid Corporation Of India Limited, Near, August Kranti Marg, Sector 29, Gurugram, Haryana 122001	**Executive Director (Engg.-S/s)** POWERGRID Saudamini, Plot No.2, Power Grid Corporation Of India Limited, Near, August Kranti Marg, Sector 29, Gurugram, Haryana 122001
Shri Alok Nigam Ceo Vismaya Five Renewables Private Limited B-208 & 209 Pioneer Urban, Square,2nd Floor, Sector62, Air Force, Gurgaon, Haryana-122005 Ph.: 9717855521, 8800917799 Email: alok.nigam@upcrenewables.in; vikram.malkotia@upcrenewables.in;	**Shri Dhir Singh** Senior Manager (Project Development) Solarcraft Power India 17 Private Limited 109, First Floor, Rishabh IPEX Mall, IP Extension Patparganj, Delhi -110092 Ph.: 9993846698, 9999885815 Email: dhir.singh@blupineenergy.com; ashish.agarwal@blupineenergy.com;
Shri Tarunveer Singh Director Sunsure Solarpark Fourteen Private Limited 1101A-1107, 11th Floor, BPTP Park Centra, Jal Vayu Vihar, Sector 30, Gurugram, Haryana - 122001 Ph.: 8826798199, 9654495797, 7011136925, 9654495797 Email: tarunveer.singh@sunsure.in regulatory@sunsure.in tarun.rajput@sunsure.in	**Shri Angshuman Rudra** General Manager Avaada Rjbikaner Private Limited Avaada Rjsustainable Private Limited Avaada Energy Private Limited C-11, Sector-65, Gautam Buddha Nagar, Noida, Uttar Pradesh Ph.: 7835004673, 9891063313 Email: angshuman.rudra@avaada.com; Shipra.arora@avaada.com;
Shri K A Vishwanath AVP Project Development TEQ Green Power IX Private Limited DLF Square, 8th Floor, Jacaranda Marg, DLF Phase 2, Sector 25, Gurugram, Haryana-122002 Ph.: 9911917083, 9711486060, 7387097188 Email: ka.vishwanath@o2power.in; pe14@o2power.in;	**Shri Naveen Singh** Deputy Manager Junachay Wind Energy Private Limited Dharvi Kalan Wind Energy Private Limited Dangri Wind Energy Private Limited Inoxgfl Tower Sector 16A, plot no.17, Film City, Noida, Uttar Pradesh Ph.: 7985974023, 7861018307 Email: junachay.wind@inoxwind.com; rajas.acharya@inoxwind.com; naveen.singh1@inoxwind.com; dangri.wind@inoxwind.com;
Shri Yogesh Kumar Sanklecha Vice President Acme Gamma Urja Private Limited Acme Solar Holdings Limited ACME Heergarh Powertech Private Limited Plot No. 152, Sector-44, Gurugram, Haryana-122002 Ph.: 8744060601, 9911299514 Email: yogesh@acme.in; apradhan@acme.in;	**Shri Vikas Tiwary** Authorised Signatory Rohat Solar Park Private Limited Rays Power Infra Limited,6th floor, Imperia Mindspace, Golf Course Extension Road, Sector 62, Gurugram, Haryana -122001 Ph.: 7290035777, 9892419925 Email: rohat.solar@rayspowerinfra.com; vaibhav.roongta@rayspowerinfra.com;

Shri Harshit Gupta Head Regulatory Affairs Hexa Climate Solutions Private Limited 14th Floor, Vatika Business Park, Sohna Road, Gurugram, Haryana-122018 Ph.: 9958586072, 8527734155 Email: harshit.gupta@hexaclimate.com; saurabh.pandey@hexaclimate.com;	**Smt. Rasika Balchandra Ghongade** Ass Business Developer Enren-IV Energy Private Limited 6th Floor, Tower-2, Fountainhead, Pheonix Marketcity, Viman Nagar, Pune, Maharashtra-411014 Ph.: 8830868723, 7709375143 Email: saurabh.gupta@engie.com; vineet.pandey@engie.com;
Shri Mayank Mangla Authorised Signatory Aright Foods And Energy Private Limited L-11, Green Park Extension, New Delhi-110016 Ph.: 9013414900, 8130696120 Email: contracts@arightgreentech.com; sandeep@arightgreentech.com;	**Shri Mukund Sharadchandra Chandak** Director Unique Hytech Renewable Energy Private Limited Udb Landmark Cmplex A-6, Basant Bahar Colony, Gopalpura, Jaipur, Rajasthan Ph.: 9910204441, 9828323665 Email: varun.bhatnagar@ashokabuildcon.in; royprafull09@gmail.com;
Smt. Poorva Pitke Senior Manager Sprng Green Energy 4 Private Limited Upper Ground, Office A-001, Pentagon 5, Magarpatta City, Hadapsar Pune, Maharashtra- 411013 Ph.: 9545659577, 8149855176 Email: poorvapitke@sprngenergy.com; abhinavbhansali@sprngenergy.com;	**Shri Manoj Kumar Sharma** Vice President Azure Power Fifty One Private Limited DSC-304, Second Floor, DLF South Court, Saket District Centre, New Delhi -110017 Ph.: 9999786638, 8288085988 Email: manoj.sharma@azurepower.com; vishal.kumar@azurepower.com;
Shri Kura Ravi Kumar Addl GM PE Electrical NTPC Limited NTPC Bhawan, Scope Complex, 7 Institutional Area, Lodhi Road, Delhi Ph.: 9440909149, 9650996993 Email: kuraravikumar@ntpc.co.in; abhishekkhanna@ntpc.co.in;	**Shri Sandeep Sarwate** Addl. GM (Commercial-Transmission) Nuclear Power Corporation of India Limited Vikram Sarabhai Bhavan, 11-N-29, Anushaktinagar, Mumbai, Maharashtra- 400094 Ph.: 9869441211 Email: ssarwate@npcil.co.in; anil.jakhar@npcil.co.in;

response has been received till date. The bidders had not shown any interest in the above project due to a very challenging terrain as well as non-standard rating of transformer. Bidders had shown their apprehension for supply of transformer rating of 3x105MVA single phase units (315MVA) at higher altitude and it is learnt from their pre-bid meetings that supply of this type of transformer itself will take 21 months and further require considerable time for execution.

Considering the above challenges POWERGRID requested CTUIL to consider revising schedule with a fresh schedule project to 30 months from revised CTUIL OM. In view of the above developments, JKPTCL may review its requirement and completion schedule.

JKPTCL stated that Mirbazar capacity augmentation (475VA to 630MVA) will likely to come up by Mar'26. In addition Salal S/s is being implemented in TBCB with commissioning schedule of Mar'27, however ICT augmentation may be required by Mar'26 and POWERGRID can avail that time for ICT augmentation.

POWERGRID stated that they would require at least 30 months (24 months for supply and 6 months for execution) from revised OM date. CTU enquired about present bid status of augmentation of ICT. POWERGRID stated that present bid will be annulled and now in new bid, transformer supply and execution packages kept separately. CTU stated that with present bid status, it is envisaged that ICT would not be available before Aug'27. JKPTCL stated that with increased load of Mirbazar S/s, New Wanpoh ICTs may cater the load, however with their proposed Salal S/s, ICT augmentation is required with best effort schedule of Mar'27. CEA requested POWERGRID to expedite the implementation for reliable dispersal of power in J&K.

CTU stated that recently lot of developments & infrastructure activities were carried out in J&K and with above developments in roads, tunnels, bridges, there may be feasibility of transportation of 315MVA unit rather than 105MVA (Single phase) unit.

POWERGRID stated that Mar'27 implementation schedule is not feasible due to 3 months non working period in winters and therefore it is suggested that Jun'27 schedule may be kept for ICT augmentation. POWERGRID emphasized that single phase configuration may be considered at present as no three phase transformer yet transported through new infrastructure. CTU stated that there is issue in supply and delivery of single phase 105MVA units due to non standard size, therefore to expedite the implementation possibility of 315MVA transformer transportation on new infrastructure (tunnel/road/bridges) may be explored by POWERGRID and informed it within 1 month.

JKPTCL stated that they also faced issue of 3 months non working season in winters and therefore based on tendering issues in 105MVA unit as well as POWERGRID request for extension of commissioning of ICT augmentation, Jun'27 schedule may be kept for ICT augmentation.

G9. Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)

It was stated that Renewable Energy Zones (REZs) were identified by MNRE/SECI with a total capacity of 181.5 GW for likely benefits by the year 2030 in eight states, which includes 75GW REZ potential in Rajasthan comprising of 15 GW Wind and 60 GW Solar. In this

regard a Committee on Transmission Planning for RE was constituted by MOP for planning of the requisite Inter State Transmission System required for the targeted RE capacity by 2030 for which a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan evolved.

Details of schemes approved/Under Planning scheme as part of above is as under:

S.No	Transmission Scheme	RE Potential	Status
A	**Under Bidding/ Approved**		
1	Rajasthan REZ Ph-IV (Part-1 :7.7GW) (Bikaner Complex)	14 GW (Solar 14GW, BESS:6GW) Bikaner-II : 3.7GW Bikaner-III: 4GW	Under Implementation
2	Rajasthan REZ Ph-IV (Part-2 :5.5GW) (Jaisalmer/Barmer Complex)	5.5GW (Solar) Fatehgarh-IV: 4 GW Barmer-I: 1.5 GW	Under Implementation
3	Rajasthan REZ Ph-IV (Part-3 :6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-IV:6GW	Under Implementation
4	Rajasthan REZ Ph-IV (Part-4 :3.5GW) (Jaisalmer/Barmer Complex)	3.5 GW (Solar) Fatehgarh-IV: 1 GW Barmer-I: 2.5 GW	Under Implementation
5	Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex)	4 GW (Solar) Sirohi: 2 GW Nagaur: 2 GW	Under Bidding
B	**Planned/Under Planning**		
1	**Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)**	**6 GW (Solar)** **Barmer-II : 6GW**	**Timeframe : 2029 (HVDC)**
2	Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-V: 6 GW	Timeframe : 2030 (HVDC)
3	Rajasthan REZ Ph-V (Part-7 : 6GW) (Bhadla Complex)	6 GW (Solar) Bhadla-IV: 6 GW	

4	Rajasthan REZ Ph-V (Part-2 : 6GW) (Ramgarh Complex)	6 GW (Solar) Ramgarh-II: 6 GW	

A Joint study meeting was held on 09.05.24 with stakeholders in NR to deliberate & finalize the Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur] Complex, Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bhadla/Bikaner Complex).

In the above Joint study meeting, Grid-India observations on proposed transmission schemes as well as on All India Study files (2027 & 2029 time frame) were deliberated and same was also communicated by Grid-India vide their mail dated 09.05.24. It was decided in the meeting that comprehensive schemes discussed may be segregated in two phases (Phase-1: Transmission scheme for Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex) & Phase-2: Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bikaner Complex). Accordingly, Transmission scheme for Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex) was agreed in 30th CMETS-NR meeting held on 18.06.24.

Considering application received at Barmer-II PS, transmission scheme is evolved for as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) and being discussed in present meeting.

Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)

As part of Renewable Energy Zones (REZs) identified by MNRE/SECI with a total capacity of 75 GW REZs in Rajasthan, evacuation system for 13GW was planned at Fatehgarh (5GW) & Barmer (8GW) complex. Transmission scheme for Rajasthan REZ Ph-IV (Part-2:5.5GW) (Jaisalmer/Barmer Complex) was approved in 14th NCT meeting for injection at Fatehgarh-IV PS (4GW) & Barmer-I PS (1.5GW) in Rajasthan and also under implementation

For evacuation of power beyond 5.5GW from Fatehgarh-IV PS/Barmer-I PS, hybrid transmission system (EHVAC(3.5GW)+HVDC(6GW)) from Fatehgarh/Barmer complex was planned. EHVAC evacuation system comprises 3.5 GW capacity transmission system from Fatehgarh-IV/Barmer-I (thus making total planned capacity of 9GW (5.5GW+3.5GW)) was approved in 19th NCT meeting

In the joint study meeting held on 28.12.23 & 09.01.24, CTU stated that as per committee report Barmer-II PS was planned for 6GW RE potential (2GW BESS capacity) with 4GW evacuation capacity. In 27th CMETS-NR meeting held on 10.01.24, SECI informed that at present there is no clear visibility for RE projects with BESS before 2027 as award process will take time (1-2 years). In view of that 7.5 GW RE potential (solar) remains untapped due to non-materialisation of BESS capacity (Fatehgarh- IV:4GW+Barmer-I : 1.5GW+Barmer-II: 2GW). Accordingly, it was suggested that 2 GW additional RE potential may be considered for planning of transmission scheme from Barmer- II

PS. SECI informed that they will provide their inputs on enhancement of potential at Barmer- II PS (4GW to 6GW) in consultation with MNRE and RE developers. SECI may update on the same.

At present connectivity of about 6GW capacity is already granted at Barmer-II PS. Beyond that about 1.5 GW connectivity applications are granted and 2.7GW application received for connectivity at Barmer-III PS .

Based on earlier Grid India observation and recent planned scheme in other regions, studies files were modified for 2030 time frame. For evacuation of 6GW capacity from Barmer-II PS, HVDC system from Barmer-II PS is being planned comprises establishment of Barmer-II PS and HVDC line from Barmer-II PS to Western region (near South of Kalamb) as well as EHVAC system for injection of power at Barmer-II PS and onwards dispersal of power in Western region. Studies were carried out in 2030 time frame in for solar maximized scenario and shared on 22.11.24 with all constituents. Grid-India vide mail dated 11.12.24 provided their observation on All India files as well as on proposed transmission scheme (copy of Grid-India observations is enclosed in **Annexure-B1**). The main observation of Grid-India is as under :

- SCR & inertia requirement at Barmer-I PS
- Comparison of VSC and LCC technology
- Justification of termination of HVDC at South Kalamb
- Congestion in WR & SR-WR
- Inputs on load generation balance

Reply of Grid-India observations for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) is enclosed in **Annexure-B2.** As per discussion held in 25th NCT meeting on 28.11.24, both VSC & LCC technology are considered in the present proposal and to be discussed along with comparative analysis in NCT meeting. A comparative analysis of VSC and LCC technology (incl. Grid-India inputs) are as under:

Feature	LCC-HVDC	VSC-HVDC
Important parameters for technology adoption		
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons). The maximum reactive power required will be almost 60% of rated power	Capable of independent reactive power control. Generally, no external compensation needed. (with inbuilt STATCOM mode of operation)
Grid Strength Dependency	Strong AC systems at both rectifier and inverter end are necessary for commutation. may fail in weak grids (SCR > 2.5)	Strong AC systems are not necessary since there are no issues of commutation failures.

		Operates effectively in weak or even "islanded" grids.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs (<500 ms)	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing. DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec (for 1100 km)
Efficiency/Losses	Slightly higher efficiency in steady-state operation. Lower line and converter losses	Lower efficiency due to switching losses in IGBTs. Line losses are about 25-30% higher in VSC (for1000km)
Cost	Lower initial cost for converters, but higher for filters and compensators. Overall initial cost is lower in LCC technology.	Higher initial cost for converters, lower for ancillary components. Overall initial cost is higher in VSC technology.
Other technological Differences	**LCC-HVDC**	**VSC-HVDC**
Converter Technology	Uses semiconductors which are capable of withstanding voltage in both direction (Thyristor-based)	Uses semiconductors which are capable of blocking unidirectional voltage only (IGBT with antiparallel diodes or similar switching devices)
Direction of Current and power	Current flow is allowed in single direction. Power direction is changed by changing the voltage polarity.	Current flow can be bidirectional. Power direction is changed by changing the direction of current flow.
Switching Philosophy	Turned on by firing pulses but turn off with assistance of line voltage	Turned on and turn off can be controlled by firing pulses.
Power transfer capability	Thyristors have huge current carrying capability, huge amount of power transfer is possible using LCC technology	IGBTs have lesser current carrying capability and hence the power flow capable is limited.
Source	LCC appears like a current source to AC system (Inductive energy storage)	VSC appears like a voltage source to AC system (Capacitive energy storage)
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.

Area	The AC and DC yard of LCC are spread over a large area.	Area requirement is much lesser for the same power flow since there are no AC and DC filters
Harmonics	Harmonics are quite high. Harmonics are present both on the AC as well as DC side.; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Transformer size	Converter transformers are used which are heavier, bulkier and costlier.	Normal AC transformers could be used as there is no DC stress and harmonics in the secondary
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support. ability to maintain appropriate system parameters in different renewable generation scenarios
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Details of HVDC VSC configuration (Double Bipole with parallel DMR/ Parallel Bipole with parallel DMR) is enclosed in **Annexure B3**.

Grid-India in the meeting further reiterated that SCR of Barmer-II is on lower side even with considering 2 nos. of Syncon units. CTU stated that SCR of Barmer-II PS is about 3 which is under most pessimistic scenario with calculation methodology suggested by Grid-India, however in actual the SCR would be much higher. Additional as per our understanding and discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1 whereas for LCC technology is > 2.5. The SCR of

400kv Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in next 5-6 months.

Grid-India vide mail 22.01.25 as well as in the meeting highlighted the following advantages of VSC based HVDC.

- Strong AC systems may not be required as there are no issues of commutation failures and the HVDC operates effectively in weak or even "islanded" grids.
- Capable of providing black start services: One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations
- Minimal harmonics due to PWM-based control. Smaller filters required.
- Superior fault ride-through capability
- Can provide grid-forming services, voltage regulation, and frequency support i.e. ability to maintain appropriate system parameters in different renewable generation scenarios

Grid-India in the comments received on 22.01.25 (**copy enclosed in Annexure B4**) further emphasized that technically VSC based HVDC is a better alternative than LCC based HVDC keeping in view the low system strength at Barmer-II (SCR < 2.0 without SynCons and ~2.5 with SynCons) and the reactive power and oscillations issues already being faced in the complex. Grid -India further emphasized on control interaction studies, POD studies and filter arrangement modelling. Reply of Grid-India observations for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) is already enclosed in **Annexure-B2.**

Grid-India in the meeting stated that they do not have any major observation on revised cases, however there are minor observations on LGB which they will communicate in meanwhile time. Grid-India emphasis that space for STATCOMs & additional Syn Cons and to be kept at Barmer-II PS as part of future scope so that in case, LCC HVDC is approved and any operational issues are faced in future, additional syncon or STATCOM can be provided for system strengthening. CEA agreed on the proposed scheme for taken up in NCT meeting with both configurations (LCC/VSC). No other comments were received from stakeholders in the meeting. It was deliberated that the final decision regarding implementation of HVDC as LCC or VSC would be taken in NCT meeting.

Considering grant of connectivity to new RE generators/applicants in Barmer complex, following transmission scheme is agreed for evacuation of power from Rajasthan REZ Ph-IV (Part-5 : 6GW)

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar)

A. Alternative-1 : LCC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.)	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	400kV Barmer-II PS - Barmer-I PS D/c line (Quad)	Line Length – (~30 km) • 400 kV line bays at Barmer-II PS – 2 nos. • 400 kV line bays at Barmer-I PS S/s – 2 nos.
4	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800 kV Barmer-II (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
5	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400kV bus sectionaliser -2 nos. (1 Set) at South Kallamb (HVDC) station
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below. * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kallamb S/s & both 765kV & 400kV bus sectionalizers to be kept normally closed)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)
8	2 nos. of Syncon units at 400kV level of Barmer-II PS (1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) **** Value of inertia constat (H) shall be provided in RfP document.***	• Syncon units – 2 nos. • 400kv line bays – 2nos.

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kallamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II to be kept normally closed & between sections-II & III to be normally open. Further, 765kV sectionaliser between***

Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions. Further, all space provisions as per RfP document of South Kalamb S/s shall be kept while implementing this scheme].

B. Alternative-2: VSC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **<u>Future provisions (excl. scope of present scheme):</u>** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x+300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) ***(1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum). Value of inertia constat (H) shall be provided in RfP document).***	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ±600kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
		➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
4	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)
5	±600 kV HVDC Double Bipole line (2xD/c) (Quad Lapwing on same tower) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
6	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below. * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kallamb S/s & both 765kV & 400kV bus sectionalizers to be kept normally closed)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kallamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II to be kept normally closed & between sections-II & III to be normally open. Further, 765kV sectionaliser between***

Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions. Further, all space provisions as per RfP document of South Kalamb S/s shall be kept while implementing this scheme.]

G10. Power flow congestion to Delhi Ring Main unit through 400 kV Switchyard at 765/400KV Jhatikra substation

It was stated that Power flow congestion to Delhi Ring Main unit through 400 kV Switchyard at 765/400KV Jhatikra substation was deliberated in 224th OCC meeting held on 18.10.24. In the meeting, POWERGRID stated that 400 kV Bus at Jhatikra is sectionalised in 02 sections (Section-1 feeds load to Bamnauli/Dwarka S/s through 765/400 kV ICT-1&2, whereas Section-II feeds loads to Mundka S/s through 765/400 kV ICT-3&4)

POWERGRID further stated that maximum load recorded through both the sections in 2024 Summer peak is ~ 2500 MW (~ 4000 Amp). In case of breakdown of any tie bay across 400 kV switchyard, the power flow through remaining tie bay in section is 4000 Amps which is much higher than bay equipment rating of (3150 Amp). In order to overcome the situation, following three options were deliberated to relieve the congestion:

- Option 1:- Upgradation of rating of switchyard equipment of 400 kV tie bay at Jhatikra from 3150 to 4000 Amp.
- Option 2:- Provision of additional bus coupler in both sections of 400 kV buses to share the load in case of tie bay contingency.
- Option 3:-Considering time duration in implementation of above proposed solutions, direct coupling arrangement of 400 kV buses may be allowed from April-Oct'25 to cater smooth power transition to Delhi.

In the meeting, it was concluded that CTU to carry out detailed study in consultation with NRLDC on load congestion relieving measures at Jhatikara S/s including provision for upcoming ICTs at Jhatikra S/S and Narela S/s and submit the report to OCC forum.

Subsequently, in 225th OCC meeting held on 12.11.24, CTU informed that 765/400kV Jhatikra S/s has two separate 400 kV sections with two 1500 MVA ICTs in each section. If these sections are connected through sectionalizer, the loading relief observed (100-150MW) on each ICT) in the event of a contingency. CTU has requested Powergrid to confirm the availability of space for the bus sectionalizer and bay upgradation works. CTU has also asked NRLDC to provide the loading patterns for both the Jhatikra-Bamnauli and Jhatikra-Mundaka sections.

To resolve above issue, a meeting was held on 04.12.24 with POWERGRID officials for preliminary discussion on feasibility of various options to relieve congestion at Jhatikra S/s in short term as well as long term. Further a joint meeting was held on 11.12.2024 among CTUIL, NRPC, CEA, Grid-India & POWERGRID to deliberate on above congestion issues.

In the meeting POWERGRID stated that the primary issue is the heavy loading on the tie bays due to radial power feeding to Delhi. In the event of an outage of any line or one of the tie bays in either section, the load on the remaining tie bay in that section exceeds the

Annexure-A

List of Participants of 36th Consultation meeting for Evolving Transmission Schemes in NR held on 15.01.2025

CEA	
Shri Nitin Deswal	Deputy Director
SECI	
Shri Vineet Kumar	DGM
Grid India	
Shri Gaurav Malviya	Manager
Shri Ankur Gulati	
Shri Raj Kishan	
CTU	
Shri Shri V Thiagarajan	Sr. GM (CTUIL)
Shri K. K. Sarkar	Sr. GM (CTUIL)
Shri Kashish Bhambhani	GM (CTUIL)
Shri Sandeep Kumawat	DGM (CTU)
Shri Tej Prakash Verma	DGM (CTU)
Shri Mahendranath Malla	Ch. Manager (CTU)
Shri Pratyush Singh	Ch. Manager (CTU)
Shri Yatin Sharma	Manager (CTU)

Shri Madhusudan Meena	Engineer (CTU)
Shri Partha Sarathi Bhattacharya	ET
Shri Anshul Mahawar	ET

POWERGRID

Shri Somiran Das	Sr. GM
Shri Shafat Ahmad Wani	Sr. GM
Shri Ravendra Pal Singh Rana	GM
Shri Pradeep Kumar Chaurasia	Sr.DGM
Shri Rohit Kumar Jain	DGM
Shri Rakesh Kumar Gupta	Ch. Manager

DTL

Shri Dinesh Singh	Mgr. (T)SS & LM. Plg
Shri Niraj Sharma	

JKPTCL

Shri Vikas Anand	CE
Mr. Ehtisham Andrabi	

RVPNL

Smt Sona Shishodia	SE (P&P)

PTCUL

Shri Rakesh Kumar	SE
Shri Lalit Kumar	SE

UPPTCL

Shri Satyendra Kumar	SE

Connectivity/GNA Applicants

Shri Rajat Sangwan	Acme Gamma Urja Private Limited , ACME Solar Holdings Limited & ACME Heergarh Powertech Private Limited
Shri Rahul Kumar	Acme Gamma Urja Private Limited , ACME Solar Holdings Limited & ACME Heergarh Powertech Private Limited
Shri Ajay Peri	Aright Foods and Energy Private Limited
Shri Sandeep Jain	Aright Foods and Energy Private Limited
Shri Vineet Pandey	Enren-IV Energy Private Limited
Smt Rasika Balchandra Ghongade	Enren-IV Energy Private Limited
Shri Angshuman Rudra	Avaada Rjbikaner Private Limited, Avaada Rjsustainable Private Limited & Avaada Energy Private Limited
Shri Vishal Kumar	Azure Power Fifty One Private Limited
Shri Anshu Kumar	Hexa Climate Solutions Private Limited
Shri Rohit Ahuja	Hexa Climate Solutions Private Limited
Shri Harshit Gupta	Hexa Climate Solutions private Limited
Shri Rajas Acharya	Junachay Wind Energy Private Limited, Dharvi Kalan Wind Energy Private Limited & Dangri Wind Energy Private Limited
Smt Jyoti Thakur	Nuclear Power Corporation of India Limited
Shri Abhishek Khanna	NTPC Limited

Shri Sudhanshu Vishwakarma	Rohat Solar Park Private Limited & Rays Power Infra Limited
Shri Dhir Singh	Solarcraft Power India 17 Private Limited
Shri Chinmay Sirdeshmukh	Sprng Green Energy 4 Private Limited
Smt Poorva Pitke	Sprng Green Energy 4 Private Limited
Shri K A Vishwanath	Teq Green Power IX Private Limited
Shri Tushar Garg	Teq Green Power IX Private Limited
Shri Varun Bhatnagar	Unique Hytech Renewable Energy Private Limited
Mr Md Fahim Alam	Vismaya Five Renewables Private Limited

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6GW (Solar):

- LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS (~20km)
- Establishment of 2 nos. 3000 MW, ± 600 kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation
- 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal.
- 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
- Establishment of 2 nos. 3000 MW, ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb
- Establishment 2x1500MVA, 765/400kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor
- LILO of Pune-III – Boisar-II 765kV D/c line at South Kalamb with associated bays at South Kalamb S/s
- Installation of 1x240 MVAr switchable line reactor on each ckt at South Kalamb end of Boisar-II – South Kalamb 765 kV D/c line (formed after above LILO)
- ±600 kV HVDC Bipole line between Barmer-II (HVDC) & South Kalamb (HVDC) (with Dedicated Metallic Return) (capable to evacuate 6000MW) (1100 kms)

Grid-India Inputs:

1. In the scheme, the evacuation of 6000 MW is proposed from VSC HVDC link from Barmer-II (new) substation to South Kalamb (Murbad).

   It is mention here that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

   Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Without considering the contribution of RE getting connected	10788	23409
2.	Considering the contribution of RE getting connected	13560	29058

   - *Installed capacity considered at 220 kV level:* ***2000 MW***
   - *Installed capacity considered at 400 kV level:* ***4000 MW***
   - *SCR at 220 kV level – (10788/2000):* ***5.394***
   - *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***

Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. The suitable alternatives to add fault level as well as inertia like SynCon may be considered in such pockets. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection (and hence system strength) such as **Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame).** The HVDC may then be planned from such station to a suitable location.

2. Comparison of VSC and LCC based HVDC

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Thyristor-based	IGBT-based (or similar switching devices)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons).	Capable of independent reactive power control. Generally, no external compensation needed.
Grid Strength Dependency	Requires a strong AC grid for commutation. May fail in weak grids. (SCR > 3)	Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Harmonics	Produces significant harmonics; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing,
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support.
Efficiency/Losses	Slightly higher efficiency in steady-state operation.	Lower efficiency due to switching losses in IGBTs.
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Both LCC and VSC based HVDCs have certain advantages and disadvantages. While LCC based HVDC is not suitable for low system strength pockets, the reliability of VSC HVDC during DC line fault always depends on switching of AC side CB and it is possible that high stress is experienced by equipment during DC line fault. Since the length of this HVDC link is expected to be around 1100 kM, the chances of DC line fault owing to higher exposure may be of high probability. The Technical requirement for HVDC shall clearly specify that HVDC shall be designed with redundancy so that system shall be able to operate under transient fault conditions. These aspects shall be taken in due consideration while specifying the technical specification of the HVDC in the RfP.

3. Other inputs on the proposed HVDC scheme are as under:

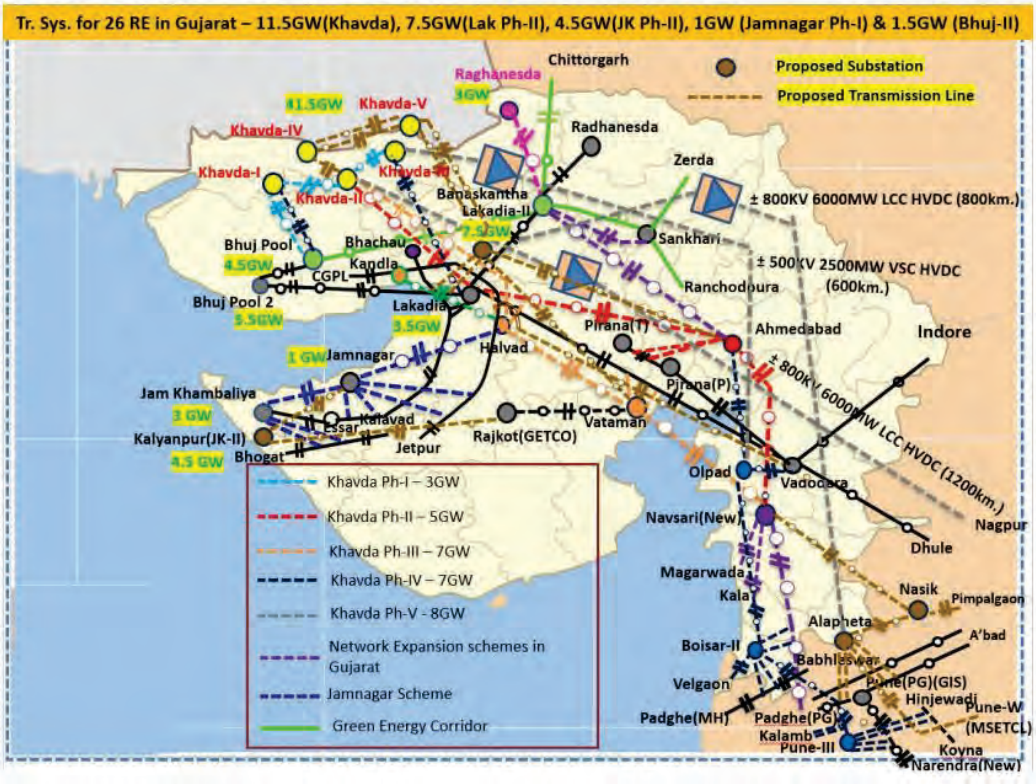
a) The rationale for terminating the HVDC in WR (Maharashtra) may be provided. Another HVDC from Khavda-V to Alephata (Maharashtra) is also terminating in the same area.

In the February solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region such as - 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C - are observed carrying power in the WR-to-SR direction. The all India level LGB may be reviewed.

Many 400 kV lines in Pune / Mumbai area are loaded beyond their permissible limits in the Sce-4 and Sce-7 cases e.g. 400 kV Kalwa- Estella S/C, 400 kV Pagdhe – Estella S/C, 400 kV Boisar-II - Pagdhe D/C etc.

Further, as highlighted in section on Load-Generation Balance below, the LGB of the case is subject to change with the proposed corrections which may lead to change in location of HVDC terminal.

b) Khavda (41.5 GW), Lakadia (3.5 GW & 7.5 GW), Raghanesda (3 GW), Bhuj (4.5 GW & 5.5 GW), Jamnagar (1 GW), Jam Khambaliya (3 GW & 4.5 GW) RE evacuation system is shown below



As per above planning, most of the above RE generation will be consumed in Maharashtra (MMR & Pune) area. Two major HVDC (± 800 kV, 6000 MW LCC HVDC from Khavda-II to Nagpur and ± 800 kV 6000 MW LCC HVDC (or ± 600 kV VSC) from Lakadia-II to Alepheta) links from Khavda complex to Maharashtra system are already planned.

c) Terminating of HVDC at South Kalamb (Murbad) may be reviewed as already two HVDCs are terminating in Maharashtra and distance between Alephata to Kalamb is less than 50 km.

d) Number of new In-STS S/s (Dolvi, Kandalgaon, Estella, Velgaon, Ambernath, Theur, Padghe-Split, Kalwa Split, Estella Coromandel etc.) in MMR & Pune area is considered. Therefore, constraints faced in the Mumbai/Pune area are not reflected much in study cases. Timely commissioning of In-STS in the Mumbai/Pune area is very essential. Inordinate delays in commissioning of In-STS are generally observed. Hence, remedial measures need to be mentioned for delays in commissioning of In-STS.

e) Currently, constraints are being observed in Southern part of Maharashtra (Kolhapur/Karad area) during high injection from SR to WR. Another scenario (i.e. high injection from SR to WR along with low generation in Khavda/NR area) to be studied for assessing the transmission constraints and identification of remedial measures.

f) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 non-compliant. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

g) As mentioned earlier, controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

h) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

i) As HVDC are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature-based overload capability** for the proposed HVDCs. Also, as VSC based HVDC is being proposed, it is understood that complete capacity in reverse direction is available.

j) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

4. **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

5. **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

   A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

6. Inputs on Load Generation Balance:

In base cases shared, demand of Rajasthan considered in scenario-4: Jul month(31GW) seems to be on higher side. Similarly, in scenario-7: Feb month (35.4GW) seems to be on very higher side. Powerfactor of load also to be revised according to practical values to get correct picture of any low voltage scenario.

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
CHANDIGARH	P	353.2	0.95	411.6	0.96
	Q	112.7		120	
J&K	P	4193.4	0.99	2840.6	0.96
	Q	615.8		828.5	
HIMACHAL	P	2395.4	0.99	1780.1	0.96
	Q	399		519.2	
PUNJAB	P	12742.1	0.99	17627.8	0.96
	Q	1903.2		5138.9	
HARYANA	P	12981.3	0.99	16580.6	0.96
	Q	1930.6		4836	
DELHI	P	6045.8	0.98	9367.3	0.96
	Q	1118.8		2864.4	
RAJASTHAN	P	35442.5	0.99	31266.8	0.96
	Q	4427.2		8839.5	
UP	P	26303.5	0.99	31161.5	0.96
	Q	3833.8		9088.8	
LADAKH	P	40.1	0.99	27.3	0.96
	Q	5.9		8	
UTTARAKHAND	P	2581.5	0.98	2955	0.96
	Q	504		844.5	
NR	P	103078.7	0.99	114018.5	0.96
	Q	14851		33087.7	

Feb Solar (Scenario - 7)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met during Solar Hours, Feb 2024 (MW)
1	NR	103722	146006	42284	116745	54890	63791
2	WR	112173	137614	25441	107050	68960	74167
3	SR	104357	90900	-13457	97440	60929	65591
4	ER	41435	17785	-23650	45752	19429	22745
5	NER	2902	2025	-877	5835	2013	2209
6	All India	366648	396728	x	334811	206123	221989

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

S. No.	State	Load (MW)	Gen (State+ Central) (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)	Peak Demand Met in Solar Hours, Feb 2024 (MW)
1	Rajasthan	35468	110783	25058	17000	18058
2	Gujarat	41433	71297	33964	19113	21258
3	Maharashtra	40627	30993	39891	27379	29821
4	MP	21288	23092	25596	14553	16885

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, # Export is considered positive**

June Solar (Scenario - 4)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in June 2024 (MW)	Peak Demand met during Solar Hours, June 2024 (MW)
1	NR	114849	156993	42144	116745	80252	91040
2	WR	108797	130420	21623	107050	64167	74882
3	SR	98015	95583	-2432	97440	48363	58488
4	ER	47997	14483	-33514	45752	27672	31436
5	NER	3706	3377	-329	5835	2467	3023
6	All India	375349	406220	x	334811	222917	244540

S. No.	State	Load (MW)	Gen. (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met in Feb 2024 (MW)
1	Rajasthan	31266	113355	25058	16199	18425
2	Gujarat	44908	76899	33964	21934	26054
3	Maharashtra	39589	29129	39891	23622	28715
4	MP	15757	18715	25596	11155	13828

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, #Export is considered positive**

- In both February solar and June Solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region—such as the 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C—are observed carrying power in the WR-to-SR direction

- Dispatch of Thermal Plants:

    - The thermal generation of some of the plants i.e. APL/CGPL has been backed down to very low levels (~35%).
    - Pit head plant: Talcher backed down to ~35% level
    - Pit head plant: V'chal backed down to ~34% level
    - Pit head plant: Korba backed down to ~34% level

  The tech minimum level considered in the case may be mentioned, and the generators' dispatch should be considered per merit order.

- The demand in Rajasthan and Gujarat is seen to be on a higher end than the figures from EPS. The reason for the high demand may be mentioned.

- Consideration of GH2 and other bulk consumer loads may be mentioned in the planning scheme itself, duly citing the uncertainty behind the assumptions and requirement of further transmission planning in case of delay/deferment of GH2/Bulk load projects.

  The production cost modelling studies duly factor in the RPO targets for each states, RE integration targets, flexibility requirements, merit order etc. Therefore, it is suggested that the study scenario may be finalized based on the output of the production cost modelling studies for the same timeframe. This LGB will itself indicate the paths/corridors along with the system augmentation is required.

7. Punjab internal generation considered in scenario-7 to be corrected:

Bus Number	Bus Name	Id	Area Num	Area Name	Zone Num	Zone Name	Code	VSched (pu)	In Service	PGen (MW)	PMax (MW)
132204	LEHRAMOHBT 220.00	T 1	13	PUNJAB	131	PB_STU	-2	1	1	52.5	210
132204	LEHRAMOHBT 220.00	T 2	13	PUNJAB	131	PB_STU	-2	1	1	52.5	210
132270	GOINDWALSB 220.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	67.5	270
132270	GOINDWALSB 220.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	67.5	270
132323	SPL_ROPAR 220.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
132323	SPL_ROPAR 220.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
132323	SPL_ROPAR 220.00	T 3	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
134401	TALWNDISABO4 400.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	165	660
134401	TALWNDISABO4 400.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	165	660
134406	RAJPURA_TH4 400.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	175	700
134406	RAJPURA_TH4 400.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	175	700

8. **Dynamic Simulation Studies –** With more than 100 GW solar generation and two HVDC terminals in Rajasthan in close vicinity, it is important that stability aspects are also studied in detail at the planning stage. The generation is also getting evacuated through large EHV lines and hence, transient stability analysis also becomes important. Therefore, it is suggested that the results of the dynamic simulation studies may be shared.

9. Bara TPS generation model to be corrected, same is modelled at 400kV whereas it is existing at 765kV level.

Annexure B2

Reply of Grid-India inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

Grid-India Inputs:

1. In the scheme, the evacuation of 6000 MW is proposed from VSC HVDC link from Barmer-II (new) substation to South Kalamb (Murbad).

   It is mention here that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

   Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Without considering the contribution of RE getting connected	10788	23409
2.	Considering the contribution of RE getting connected	13560	29058

   - *Installed capacity considered at 220 kV level:* ***2000 MW***
   - *Installed capacity considered at 400 kV level:* ***4000 MW***
   - *SCR at 220 kV level – (10788/2000):* ***5.394***
   - *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***

   Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. The suitable alternatives to add fault level as well as inertia like SynCon may be considered in such pockets. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection (and hence system strength) such as **Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame).** The HVDC may then be planned from such station to a suitable location.

CTU Reply :

As per our understanding and discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1 whereas for LCC technology is > 2.5.

Integration of RE power to other intermediate sub stations through EHVAC system i.e. Ajmer, Chittorgarh, Beawar, Rishabdeo etc. and its further evacuation through HVDC from intermediate substations is not feasible due to space constraint on above substations. SCR values of Barmer-II and South Kalaamb (Murbad) S/s is as below:

S. No.	Voltage level	Envisaged generation (MW)	Wo Considering additional Barmer-II-Barmer-I D/c line (present file)		With Considering additional Barmer-II-Barmer-I D/c line & Syncons (2 units*)	
			SCMVA (Considering no contribution from incident bus)	SCR	SCMVA (Considering no contribution from incident bus)	SCR
1.	Barmer-II (220kV)	2180	11510	5.27	12500	**5.75**
2.	Barmer-II (400kV)	(3812+2180) 5992	23290	3.88	29550	**4.95**
3	Murbad (400kV)	3000	26300 (13200)	8.7 (4.4)	26300 (13200)	**8.7 (4.4)**
3	Murbad Splt (400kV)	3000	13200	4.4	13200	**4.4**

1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) with Minimum H (natural) =4 s

From the table, it is envisaged that SCR at 400kV and 220kV level of Barmer-II PS is adequate for HVDC operation (LCC/VSC). The SCR of 400kv Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in next 2-3 months.

2 units of Syncons shall be considered with LCC technology alternative. Space provision of 2 units of SyCon shall be kept in VSC technology alternative as part of comprehensive scheme and taken up for implementation as per future requirement.

2. Comparison of VSC and LCC based HVDC

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Thyristor-based	IGBT-based (or similar switching devices)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons).	Capable of independent reactive power control. Generally, no external compensation needed.

Feature	LCC-HVDC	VSC-HVDC
Grid Strength Dependency	Requires a strong AC grid for commutation. May fail in weak grids. (SCR > 3)	Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Harmonics	Produces significant harmonics; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
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Efficiency/Losses	Slightly higher efficiency in steady-state operation.	Lower efficiency due to switching losses in IGBTs.
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

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CTU Reply : Comments are noted as part of agenda.

3. Other inputs on the proposed HVDC scheme are as under:

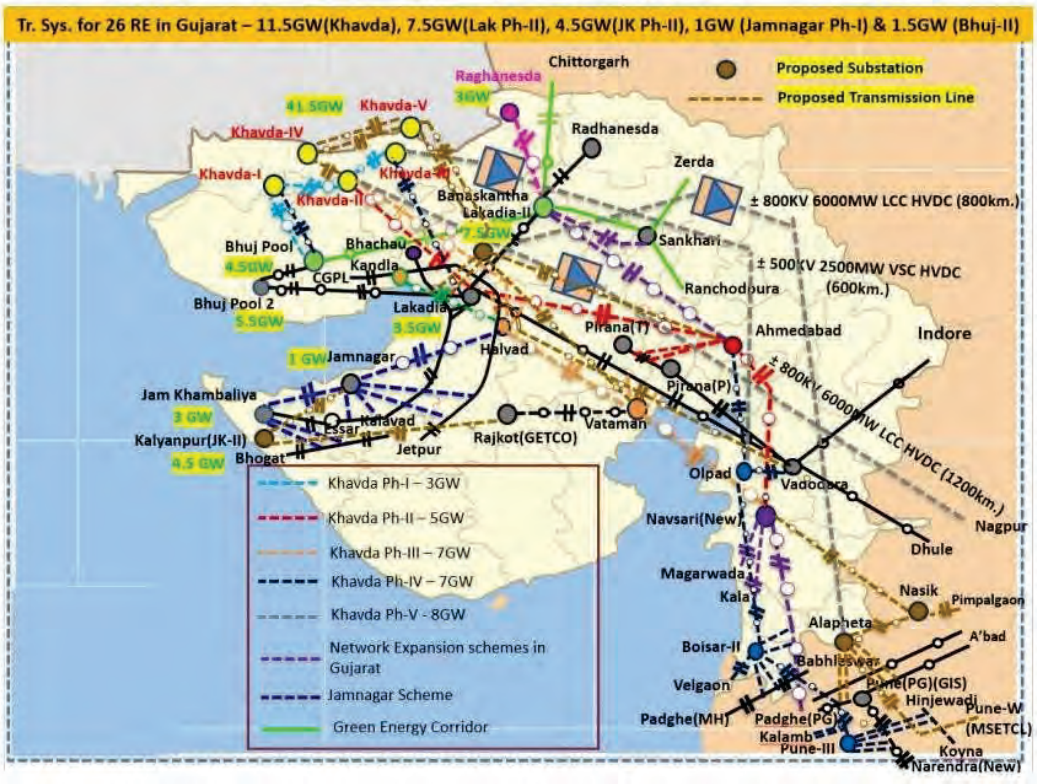
a) The rationale for terminating the HVDC in WR (Maharashtra) may be provided. Another HVDC from Khavda-V to Alephata (Maharashtra) is also terminating in the same area.

In the February solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region such as - 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C - are observed carrying power in the WR-to-SR direction. The all India level LGB may be reviewed.

Many 400 kV lines in Pune / Mumbai area are loaded beyond their permissible limits in the Sce4 and Sce-7 cases e.g. 400 kV Kalwa- Estella S/C, 400 kV Pagdhe – Estella S/C, 400 kV BoisarII - Pagdhe D/C etc.

Further, as highlighted in section on Load-Generation Balance below, the LGB of the case is subject to change with the proposed corrections which may lead to change in location of HVDC terminal.

b) Khavda (41.5 GW), Lakadia (3.5 GW & 7.5 GW), Raghanesda (3 GW), Bhuj (4.5 GW & 5.5 GW), Jamnagar (1 GW), Jam Khambaliya (3 GW & 4.5 GW) RE evacuation system is shown below



As per above planning, most of the above RE generation will be consumed in Maharashtra (MMR & Pune) area. Two major HVDC (± 800 kV, 6000 MW LCC HVDC from Khavda-II to Nagpur and ± 800 kV 6000 MW LCC HVDC (or ± 600 kV VSC) from Lakadia-II to Alepheta) links from Khavda complex to Maharashtra system are already planned.

c) Terminating of HVDC at South Kalamb (Murbad) may be reviewed as already two HVDCs are terminating in Maharashtra and distance between Alephata to Kalamb is less than 50 km.

d) Number of new In-STS S/s (Dolvi, Kandalgaon, Estella, Velgaon, Ambernath, Theur, Padghe-Split, Kalwa Split, Estella Coromandel etc.) in MMR & Pune area is considered. Therefore, constraints faced in the Mumbai/Pune area are not reflected much in study cases. Timely commissioning of In-STS in the Mumbai/Pune area is very essential. Inordinate delays in commissioning of In-STS are generally observed. Hence, remedial measures need to be mentioned for delays in commissioning of In-STS.

e) Currently, constraints are being observed in Southern part of Maharashtra (Kolhapur/Karad area) during high injection from SR to WR. Another scenario (i.e. high injection from SR to WR along with low generation in Khavda/NR area) to be studied for assessing the transmission constraints and identification of remedial measures.

CTU Reply (a) to (e): The Lakadia-II – Alephata HVDC has been terminated at a point parallel to the EHVAC network which emanates from Khavda area and traverses from North Gujarat to load centres in Maharashtra (Boisar-II/ Nasik/ Alephata/ Pune(GIS) / Pune-III). The HVDC system emanates from Lakadia-II (Central Gujarat) and terminates at Alephata

(parallel to AC network) and is expected to maintain a balanced power flows on the AC lines along with controllability as per requirement. The other HVDC link from NR to South Kalamb has been planned to complement PSPs in Talegaon / Data centre & other load requirement in the Neral area.

4. Further, the present files have been prepared considering Max RE injection in Gujarat & Rajasthan (which are contiguous pockets) so as to simulate worst case scenario as far as immediate evacuation of power is concerned. In case the generation is backed down in these pockets, it would represent a better load flow case.

CTU Reply : Scenario-4 & 7 is prepared considering Rajasthan (100% solar dispatch) and Gujarat (80% solar dispatch). One additional sensitivity case considering Rajasthan (90% solar dispatch) and Gujarat (100% solar dispatch) is also prepared & shared with agenda

5. Nevertheless, SR export scenario has also been prepared in consultation with SR constituents and was studied in detail in presence of GRID-INDIA on 22.11.2024 for Bijapur evacuation studies at Bangalore. The proposed system was found adequate in that scenario as well.

CTU Reply : Noted.

6. Regarding constraints in Mumbai/MMR region, timely commissioning of In-STS in the Mumbai/Pune area is very essential. MSETCL is being continuously requested to adhere to agreed upon time-lines as per review meetings carried out by CEA as well as in various CMETS-WR meetings by CTU as well as GRID-INDIA.

a) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 noncompliant. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

CTU Reply : No violation of N-1 compliance is observed in studies on the outage of 3000MW (one Bipole) of HVDC as per manual on transmission planning criteria 2023, however necessary augmentation works shall be taken up for implementation after detail deliberation with Grid-India/CEA/NRPC.

b) As mentioned earlier, controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

CTU Reply : Noted. To be taken care during finalization of RfP.

c) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

CTU Reply : Noted.

d) As HVDC are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature based overload capability** for the proposed HVDCs. Also, as VSC based HVDC is being proposed, it is understood that complete capacity in reverse direction is available.

CTU Reply : Noted. Matter shall be discussed during the meeting by our CTU-Engg Deptt. As per discussion in NCT meeting, both VSC & LCC technology are being discussed in present proposal. HVDC system shall be planned with 100% reverse power capability.

e) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

CTU Reply : Noted. To be discussed with OEMs during finalization of RfP to explore the possibility.

7. **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

CTU Reply : Noted.

8. **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

CTU Reply : Noted.

9. **<u>Inputs on Load Generation Balance:</u>**

In base cases shared, demand of Rajasthan considered in scenario-4: Jul month(31GW) seems to be on higher side. Similarly, in scenario-7: Feb month (35.4GW) seems to be on very higher side. Power factor of load also to be revised according to practical values to get correct picture of any low voltage scenario.

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
Chandigarh	P	353.2	0.95	411.6	0.96
	Q	112.7		120	
J&k	P	4193.4	0.99	2840.6	0.96

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
	Q	615.8		828.5	
Himachal	P	2395.4	0.99	1780.1	0.96
	Q	399		519.2	
Punjab	P	12742.1	0.99	17627.8	0.96
	Q	1903.2		5138.9	
Haryana	P	12981.3	0.99	16580.6	0.96
	Q	1930.6		4836	
Delhi	P	6045.8	0.98	9367.3	0.96
	Q	1118.8		2864.4	
Rajasthan	P	35442.5	0.99	31266.8	0.96
	Q	4427.2		8839.5	
Up	P	26303.5	0.99	31161.5	0.96
	Q	3833.8		9088.8	
Ladakh	P	40.1	0.99	27.3	0.96
	Q	5.9		8	
Uttarakhand	P	2581.5	0.98	2955	0.96
	Q	504		844.5	
NR	P	103078.7	0.99	114018.5	0.96
	Q	14851		33087.7	

Feb Solar (Scenario - 7)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met during Solar Hours, Feb 2024 (MW)
1	NR	103722	146006	42284	116745	54890	63791
2	WR	112173	137614	25441	107050	68960	74167
3	SR	104357	90900	-13457	97440	60929	65591
4	ER	41435	17785	-23650	45752	19429	22745
5	NER	2902	2025	-877	5835	2013	2209
6	All India	366648	396728	x	334811	206123	221989

S. No.	State	Load (MW)	Gen (State+ Central) (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)	Peak Demand Met in Solar Hours, Feb 2024 (MW)
1	Rajasthan	35468	110783	25058	17000	18058
2	Gujarat	41433	71297	33964	19113	21258
3	Maharashtra	40627	30993	39891	27379	29821
4	MP	21288	23092	25596	14553	16885

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, # Export is considered positive**

June Solar (Scenario - 4)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in June 2024 (MW)	Peak Demand met during Solar Hours, June 2024 (MW)
1	NR	114849	156993	42144	116745	80252	91040
2	WR	108797	130420	21623	107050	64167	74882
3	SR	98015	95583	-2432	97440	48363	58488
4	ER	47997	14483	-33514	45752	27672	31436
5	NER	3706	3377	-329	5835	2467	3023
6	All India	375349	406220	x	334811	222917	244540

S. No.	State	Load (MW)	Gen. (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met in Feb 2024 (MW)
1	Rajasthan	31266	113355	25058	16199	18425
2	Gujarat	44908	76899	33964	21934	26054
3	Maharashtra	39589	29129	39891	23622	28715
4	MP	15757	18715	25596	11155	13828

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, #Export is considered positive**

- In both February solar and June Solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region—such as the 765 kV Narendra New–Pune–III D/C and 765 kV Raichur– Solapur D/C—are observed carrying power in the WR-to-SR direction

- Dispatch of Thermal Plants:

    - The thermal generation of some of the plants i.e. APL/CGPL has been backed down to very low levels (~35%).
    - Pit head plant: Talcher backed down to ~35% level to Pit head plant: V'chal backed down to ~34% level
    - Pit head plant: Korba backed down to ~34% level

  The tech minimum level considered in the case may be mentioned, and the generators' dispatch should be considered per merit order.

CTU Reply : Files are modified to incorporate minimum 40% dispatch from thermal generating stations in WR as per merit order as well as load pf (0.95-0.97) in NR.

- The demand in Rajasthan and Gujarat is seen to be on a higher end than the figures from EPS. The reason for the high demand may be mentioned.

CTU Reply :

S.No	State	EPS demand (2030)-GW	Demand Considered in studies (GW)		
			Sc-4*	Sc-5	Sc-7*
1	Rajasthan	25.1	19.2	18	23.3
2	Gujarat	34	44.9	37.2	41.4

excl. 12GW lumped load at Ramgarh-II and Bhadla-IV for HVDC

CTU Reply – From the demand data, it is envisaged that demand in Rajasthan is in order. In Gujarat, about 60% of the projected Green Hydrogen Load by 2027-28 has been considered in studies [9250MW out of 15000MW (Kandla:3GW, MUL: 12GW)]. In case same does not materialize as planned, additional transmission system would be required. Further, other bulk consumer loads have also been considered in studies such as 3GW at Mundra(Navinal) S/s, 3.5GW at Jamnagar, etc.

- Consideration of GH2 and other bulk consumer loads may be mentioned in the planning scheme itself, duly citing the uncertainty behind the assumptions and requirement of further transmission planning in case of delay/deferment of GH2/Bulk load projects.

The production cost modelling studies duly factor in the RPO targets for each states, RE integration targets, flexibility requirements, merit order etc. Therefore, it is suggested that the study scenario may be finalized based on the output of the production cost modelling studies for the same timeframe. This LGB will itself indicate the paths/corridors along with the system augmentation is required.

CTU Reply – to be discussed in meeting

7. Punjab internal generation considered in scenario-7 to be corrected:

Bus Number	Bus Name	Id	PGen (MW)	PMax (MW)
132204	LEHRAMOHBT 220.00	T1	52.5	210
132204	LEHRAMOHBT 220.00	T2	52.5	210
132270	GOINDWALSB 220.00	T1	67.5	270
132270	GOINDWALSB 220.00	T2	67.5	270
132323	SPL_ROPAR 220.00	T1	52.5	210
132323	SPL_ROPAR 220.00	T2	52.5	210

132323	SPL_ROPAR 220.00	T3	52.5	210
134401	TALWNDISABO4 400.00	T1	165	660
134401	TALWNDISABO4 400.00	T2	165	660
134406	RAJPURA_TH4 400.00	T1	175	700
134406	RAJPURA_TH4 400.00	T2	175	700

CTU Reply : Corrected in Revised PSSE files (in Sc-7)

8. **Dynamic Simulation Studies –** With more than 100 GW solar generation and two HVDC terminals in Rajasthan in close vicinity, it is important that stability aspects are also studied in detail at the planning stage. The generation is also getting evacuated through large EHV lines and hence, transient stability analysis also becomes important. Therefore, it is suggested that the results of the dynamic simulation studies may be shared.

   CTU reply- In 30th CMETS-NR meeting, CTU requested that Grid-India may share present time frame converged dynamic file which will help to resolve convergence issues in dynamics file for 2027 timeframe w.r.t Generator models (conventional/RE) used by Grid-India. In the CMETS-NR meeting Grid-India stated that they are also facing convergence issues for present timeframe file and prepared dynamics file with some assumptions.

   It was agreed in the meeting that for preparation for planning stage dynamic file, CTU and Grid-India can work together to prepare load flow first w.r.t dynamics file and subsequent Dynamic data file (Dyr) shall be prepared with help of models available with Grid-India. CTU also stated that considering the severe convergence issues in dynamics file, it will be converged on truncated network specific to RE pockets in Rajasthan rather than to converge the file on All India level. In the meeting, NRLDC stated that for transient studies, truncated network modelling will be sufficient.

   Considering above, it is requested that a committee may be formed comprising members from CEA, CTUIL and Grid-India for preparation of planning horizon dynamics files.

9. Bara TPS generation model to be corrected, same is modelled at 400kV whereas it is existing at 765kV level.

   CTU Reply : Corrected in Revised PSSE files

Annexure-B3

HVDC VSC Configuration

- ***±600kV, 6 GW (Parallel Bipole with parallel DMR)***
- In this configuration, +ve Terminal of Pole-1 & 3 and -ve Terminal of Pole-2 & 4 shall be combined at the Gantry side and single +ve and -ve bundle conductor each shall be traversed on either side of the Tower along with parallel DMR.
- In this configuration, reliability of overall HVDC system shall be enhanced in comparison to Double Bipole with Parallel DMR configuration.
- Control & Protection design for co-ordinated control is complex and is offered only by one OEM (M/s SIEMENS) and is first of its kind in the world.

- ***600kV, 6 GW (Double Bipole with parallel DMR)***
- In this configuration, each Bipole shall have their independent bundle conductors on either side of the Tower along with parallel DMR.
- Control & Protection design for each Bipole control is simple and is offered by more than one OEM.

Note: DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6GW (Solar)

1. Grid-India representative mentioned that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Base Case	11510	23410
2.	Base Case + SynCons (2 units) (+300/-150 MVAR each unit)	12500	25300

- *Installed capacity considered at 220 kV level:* ***2000 MW***
- *Installed capacity considered at 400 kV level:* ***4000 MW***
- *SCR at 220 kV level – (11510/2000):* ***5.755***
- *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***
- *SCR at 400 kV level after SynCons – (25300/12000):* ***2.10 (HVDC capacity of 6000 MW also included)***

Grid-India representative further highlighted the following advantages of VSC based HVDC.

- Strong AC systems may not be required as there are no issues of commutation failures and the HVDC operates effectively in weak or even "islanded" grids.
- **Capable of providing black start services:** One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations
- Minimal harmonics due to PWM-based control. Smaller filters required.
- Superior fault ride-through capability
- Can provide grid-forming services, voltage regulation, and frequency support i.e. ability to maintain appropriate system parameters in different renewable generation scenarios

It was agreed that technically VSC based HVDC is a better alternative than LCC based HVDC keeping in view the low system strength at Barmer-II (SCR < 2.0 without SynCons and ~2.5 with SynCons) and the reactive power and oscillations issues already being faced in the complex.

The final decision regarding implementation of HVDC as LCC or VSC may be taken in the NCT meeting.

2. Following other points were also highlighted by Grid-India:

a) Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection. The HVDC may then be planned from such station to a suitable location.

b) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 non-compliance limits. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

c) Controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

d) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

e) As HVDCs are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature-based overload capability** for the proposed HVDC.

f) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

g) **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

h) **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

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/00/35th CMETS-WR

Date: 18.03.2025

As per distribution list

Subject: Minutes of the 35th Consultation Meeting for Evolving Transmission Schemes in Western Region held on 30.01.2025 & 07.02.2025 -reg.

Sir,

Please find enclosed the minutes of 35th Consultation Meeting for Evolving Transmission Schemes in Western Region held on 30.01.2025 & 07.02.2025 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,

(Partha Sarathi Das)
Sr. General Manager

Encl.: As stated above

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WRLDC informed the following points:-

- o N-1 non-compliance of 3x315 MVA, 400/220 kV Raipur ICTs are being observed during high demand period of Chhattisgarh. Presently same is being managed with implementation of Load Trimming Scheme (LTS).
- o 2x500 MVA, 400/220 kV Durg (Raipur PS) has been charged by Sept'24. However, commissioning of planned downstream In-STS network from 765/400/220 kV Durg (Raipur PS) S/s is getting delayed.
- o Therefore, 1 x 500 MVA ICT along with 400 kV & 220 kV bays at Raipur S/s is required for N-1 compliance of presently installed of 3x315 MVA, 400/220 kV Raipur ICTs and catering the future load growth in Raipur area.

After deliberations, ICT Augmentation at 400/220kV Raipur S/s was agreed with a schedule of 18 months from award:

- 400/220kV, 1x500MVA ICT (4th) at Raipur(PG) S/s along with associated bays at both ends

7. Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)

It was informed that Renewable Energy Zones (REZs) were identified by MNRE/SECI with a total capacity of 181.5 GW for likely benefits by the year 2030 in eight states, which includes 75GW REZ potential in Rajasthan comprising of 15 GW Wind and 60 GW Solar. In this regard a Committee on Transmission Planning for RE was constituted by MOP for planning of the requisite Inter State Transmission System required for the targeted RE capacity by 2030 for which a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan evolved.

Details of schemes approved/Under Planning scheme as part of above is as under:

S.No	Transmission Scheme	RE Potential	Status
A	**Under Bidding/ Approved**		
1	Rajasthan REZ Ph-IV (Part-1 :7.7GW) (Bikaner Complex)	14 GW (Solar 14GW, BESS:6GW) Bikaner-II : 3.7GW Bikaner-III: 4GW	Under Implementation
2	Rajasthan REZ Ph-IV (Part-2 :5.5GW) (Jaisalmer/Barmer Complex)	5.5GW (Solar) Fatehgarh-IV: 4 GW	Under Implementation

		Barmer-I: 1.5 GW	
3	Rajasthan REZ Ph-IV (Part-3 :6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-IV:6GW	Under Implementation
4	Rajasthan REZ Ph-IV (Part-4 :3.5GW) (Jaisalmer/Barmer Complex)	3.5 GW (Solar) Fatehgarh-IV: 1 GW Barmer-I: 2.5 GW	Under Implementation
5	Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex)	4 GW (Solar) Sirohi: 2 GW Nagaur: 2 GW	Under Bidding
B	**Planned/Under Planning**		
1	**Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)**	**6 GW (Solar)** **Barmer-II : 6GW**	**Timeframe : 2029 (HVDC)**
2	Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-V: 6 GW	Timeframe : 2030 (HVDC)
3	Rajasthan REZ Ph-V (Part-7 : 6GW) (Bhadla Complex)	6 GW (Solar) Bhadla-IV: 6 GW	
4	Rajasthan REZ Ph-V (Part-2 : 6GW) (Ramgarh Complex)	6 GW (Solar) Ramgarh-II: 6 GW	

Towards Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex), it may be noted that at present connectivity of about 6GW capacity is already granted at Barmer-II PS. Beyond that about 1.5 GW connectivity applications are granted and 2.7GW application received for connectivity at Barmer-III PS.

Based on earlier Grid India observation and recent planned scheme in other regions, studies files were modified for 2029 time frame. For evacuation of 6GW capacity from Barmer-II PS, HVDC system from Barmer-II PS has been planned. The scheme comprises establishment of Barmer-II PS and HVDC line from Barmer-II PS to Western region (near South of Kalamb) as well as EHVAC system for injection of power at Barmer-II PS and onwards dispersal of power in Western region. Studies were carried out in 2030 time frame in for solar maximized scenario and shared on 22.11.24 with all constituents. Grid-India vide mail dated 11.12.24 provided their observation on All India files as well as on proposed transmission scheme (copy of Grid-India observations is enclosed in **Annexure-B1**). The main observation of Grid-India is as under :

- SCR & inertia requirement at Barmer-I PS
- Comparison of VSC and LCC technology
- Justification of termination of HVDC at South Kalamb
- Congestion in WR & SR-WR
- Inputs on load generation balance

Reply of Grid-India observations for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) is enclosed in **Annexure-B2.** As per discussion held in 25th NCT meeting on 28.11.24, both VSC & LCC technology are considered in the present proposal and to be discussed along with comparative analysis in NCT meeting. A comparative analysis of VSC and LCC technology (incl. Grid-India inputs) are as under:

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Uses semiconductors which are capable of withstanding voltage in both direction (Thyristor-based)	Uses semiconductors which are capable of blocking unidirectional voltage only (IGBT with antiparallel diodes or similar switching devices)
Direction of Current and power	Current flow is allowed in single direction. Power direction is changed by changing the vsoltage polarity.	Current flow can be bidirectional. Power direction is changed by changing the direction of current flow.
Switching Philosophy	Turned on by firing pulses but turn off with assistance of line voltage	Turned on and turn off can be controlled by firing pulses.

Power transfer capability	Thyristors have huge current carrying capability, huge amount of power transfer is possible using LCC technology	IGBTs have lesser current carrying capability and hence the power flow capable is limited.
Source	LCC appears like a current source to AC system (Inductive energy storage)	VSC appears like a voltage source to AC system (Capacitive energy storage)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons). The maximum reactive power required will be almost 60% of rated power	Capable of independent reactive power control. Generally, no external compensation needed. (with inbuilt STATCOM mode of operation)
Grid Strength Dependency	Strong AC systems at both rectifier and inverter end are necessary for commutation. May fail in weak grids (SCR > 2.5)	Strong AC systems are not necessary since there are no issues of commutation failures. Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Area	The AC and DC yard of LCC are spread over a large area.	Area requirement is much lesser for the same power flow since there are no AC and DC filters
Harmonics	Harmonics are quite high. Harmonics are present both on the AC as well as DC side.; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Transformer size	Converter transformers are used which are heavier, bulkier and costlier.	Normal AC transformers could be used as there is no DC stress and harmonics in the secondary
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs (<500 ms)	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing. DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec (for 1100 km)

Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support. ability to maintain appropriate system parameters in different renewable generation scenarios
Efficiency/Losses	Slightly higher efficiency in steady-state operation. Lower line and converter losses	Lower efficiency due to switching losses in IGBTs. Line losses are about 25-30% higher in VSC (for1000km)
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Details of HVDC VSC configuration (Double Bipole with parallel DMR/ Parallel Bipole with parallel DMR) is enclosed in **Annexure B3**.

Considering grant of connectivity to new RE generators/applicants in Barmer complex, following transmission scheme was discussed and agreed in the 35th CMETS-NR held on 15.01.2025:

A. Alternative-1 : LCC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):**	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos.

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
	➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.)	• 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	400kV Barmer-II PS - Barmer-I PS D/c line (Quad)	Line Length – (~30 km) • 400 kV line bays at Barmer-II PS – 2 nos. • 400 kV line bays at Barmer-I PS S/s – 2 nos.
4	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800 kV Barmer-II (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
5	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
		➢ 400kV bus sectionaliser -2 nos. (1 Set) at South Kallamb (HVDC) station
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)
8	2 nos. of Syncon units at 400kV level of Barmer-II PS (1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) **** Value of inertia constant (H) shall be provided in RfP document.***	• Syncon units – 2 nos. • 400kv line bays – 2nos.

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].***

B. Alternative-2: VSC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units* at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x+300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) ***1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum). Value of inertia constant (H) shall be provided in RfP document***	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ±600kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
4	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)
5	±600 kV HVDC Double Bipole line (2xD/c) (Quad Lapwing on same tower) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
6	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below* (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.]***

In this respect, it may be noted that South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage.

From studies & as per discussions with MSETCL in a meeting amongst CEA, CTU & MSETCL on 22.01.2025, the following downstream lines were planned from South Kalamb S/s:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
Part A		
1	• Creation of New 765kV Bus Sections-II & III & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 set & 400 kV Sectionalization bay: 2 set alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III. 400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions. • Installation of 3x1500MVA, 765/400kV ICTs at South Kalamb S/s (400kV Sec-III & 765kV Section-III) • All space provisions on 400kV & 765kV Bus Sections-I & II of South Kalamb S/s as per RfP document of "Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune)" scheme shall be kept while implementing this scheme. TSP of Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune)" scheme shall provide necessary space free of cost for above bus extension / sectionalisation / augmentation works.	• 765/400 kV 1500 MVA ICTs- 3 nos. • 765 kV ICT bays- 3 no. (at bus section-III) • 400 kV ICT bays- 3 no (at bus section-III) • 330 MVAr Bus Reactor-2 nos. (at bus section-III) • 765 kV Bus reactor bays- 2 nos. (at bus section-III) • 125 MVAr Bus Reactor-2 nos. (at bus section-III) • 400 kV Bus reactor bays- 2 nos. (at bus section-III) • 765 kV Sectionalization bay: 2 sets • 400 kV Sectionalization bay: 2 sets
2	LILO of Nagothane – Padghe 400kV D/c line at South Kalamb	LILO route length~10km.
3	LILO of Pune(AIS) – Navi Mumbai 400kV line at South Kalamb	LILO route length~10km.
4	LILO of Pune(AIS) – Vikhroli 400kV line at South Kalamb	LILO route length~10km.
Part-B (Refer Note-2):		

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
5	Reconductoring of the balance line section of Pune(AIS) – Vikhroli 400kV line (upto LILO point of LILO of Lonikand-Kalwa 400kV line at Pune(AIS)) of Western Transco Power Ltd. (a subsidiary of AESL) with conductor having capacity of 2100MVA per ckt at nominal voltage*	1.707 km. reconductoring (under ownership of WTPL)
6	Upgradation of 400kV bay at Pune(AIS) of POWERGRID (associated with Pune(AIS) – Vikhroli 400kV line) of Western Transco Power Ltd. (a subsidiary of AESL) commensurate with the reconductoring capacity of 2100MVA per ckt at nominal voltage	Upgradation of the Complete Dia 6 (Vikroli Line Main Bay, Tie Bay & 315 MVA ICT3 Main Bay) to be carried out

*MSETCL shall reconductor the balance line portion from above LILO point upto Kalwa with conductor having capacity of 2100MVA per ckt at nominal voltage

Note:

1. As informed by MSETCL, LILO of Pune(AIS) – Kalwa 400kV line at Vikhroli has already been implemented by Kharghar Vikhroli Transmission Limited (under In-STS TBCB) with high capacity conductor.
2. As decided in the 26th NCT meeting held on 06.01.2025, all the reconductoring proposals will be deliberated in NCT along with cost breakup of Reconductoring portion and the developer who is awarded the scheme under RTM shall approach the appropriate commission in terms of the existing provisions of the regulations.
3. 1150MW PSP generation from Bhivpuri has been considered in studies. Same is considered to be operating in pumping mode in Solar Max scenario.

WRLDC informed the following points:-

- It is requested to review the MSETCL proposals at South Kalamb as STU proposed LILO's of existing lines at South Kalamb
- WRLDC advised for additional transmission system from South Kalamb to Maharashtra system instead of LILO's.
- Following constraints are being observed due to LILO
  - Increasing of fault levels
  - High loading on shorter sections

- Facilitation of long outages in Mumbai Metropolitan Region (MMR) is very difficult for making LILO's

After deliberations, the Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) was agreed. However, it was decided that the downstream lines planned from South Kalamb S/s shall be again reviewed in a separate meeting.

To further discuss the proposal a meeting was held on 12.02.2025 amongst CEA, CTU & MSETCL wherein MSETCL informed that the proposed downstream system is technically in order and is also physically feasible to implement.

Regarding WRLDC's concerns to implement new 400kV outlets instead of LILO's, it was informed that MSETCL is already implementing Padghe(M)-II – Kalwa(M)-II 400kV 2nd D/c (quad/HTLS) line and MSETCL was once again informed the critical requirement of the line. MSETCL assured to pursue its execution on fast track basis.

The fault levels at various 400kV buses in and around Mumbai / South Kalamb area was checked and found to be within limits.

From the load flow results, it was observed that loading on Vikhroli – South Kalamb 400kV line is seen to be on the higher side and is not N-1 compliant. Hence, it would be essential to reconductor the line with high capacity conductor as proposed above.

Although the HVDC would require minimum of 48 / 54 months for commissioning, the above downstream system from South Kalamb S/s may be implemented in reduced time-frame of 24 months as it would provide direct infeed of power into Mumbai area and would help increase ATC of the area. **After deliberations, the Downstream lines planned from South Kalamb S/s as proposed above were agreed with schedule of 24 months from award.**

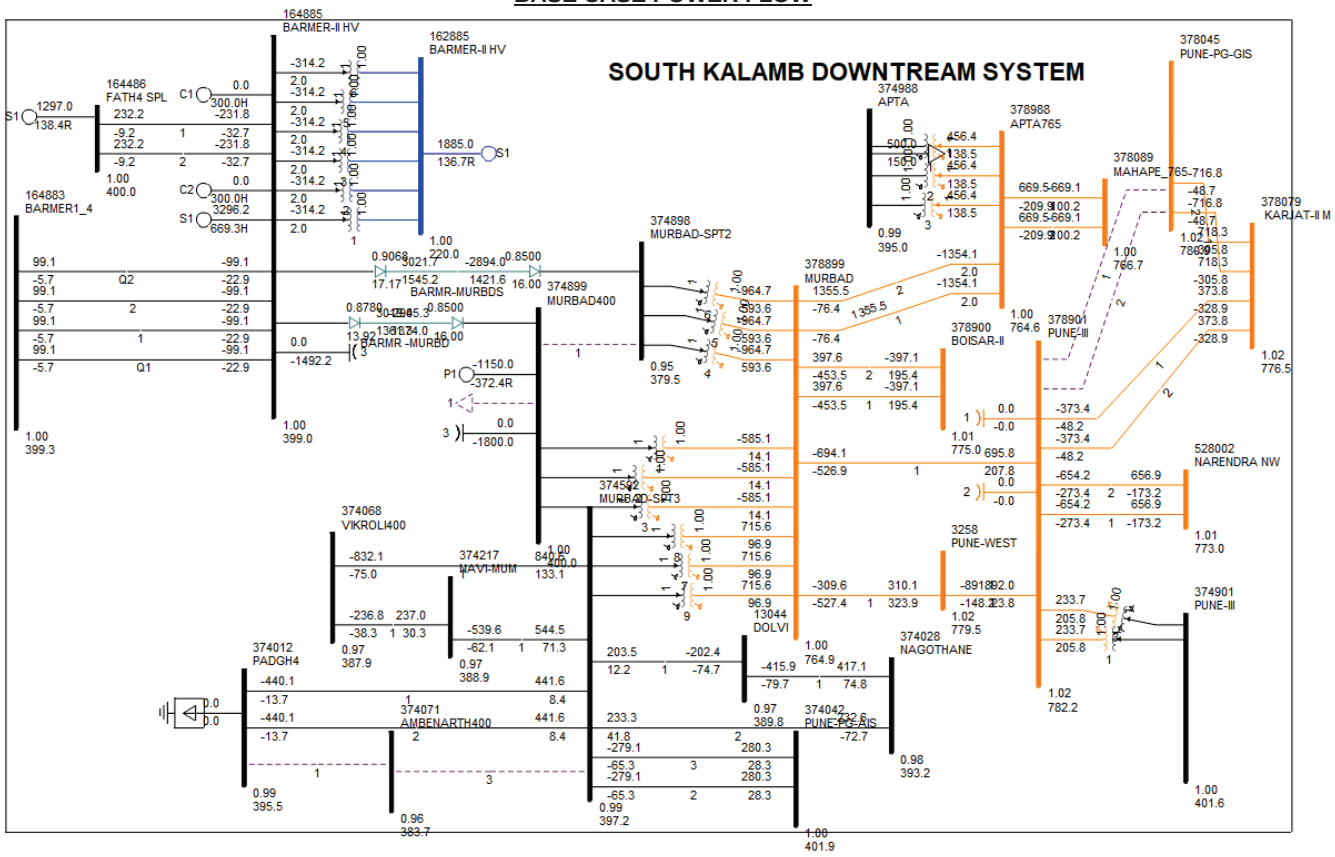
It was also deliberated that at present there are 02 (two) Nos. of 400/220kV, 315 MVA ICTs installed at 400kV Navi Mumbai GIS. In general, each ICT loading is more than 60 - 75 % of their ICT capacity majority of the time except during rainy season and off-peak hours. Keeping in view of high loading there is requirement of additional ICT of 500MVA capacity to cater the high demand on 220kV side at Navi Mumbai Sub-station. In view of the above, following scheme was agreed :

ICT Augmentation at 400/220kV Navi Mumbai S/s:

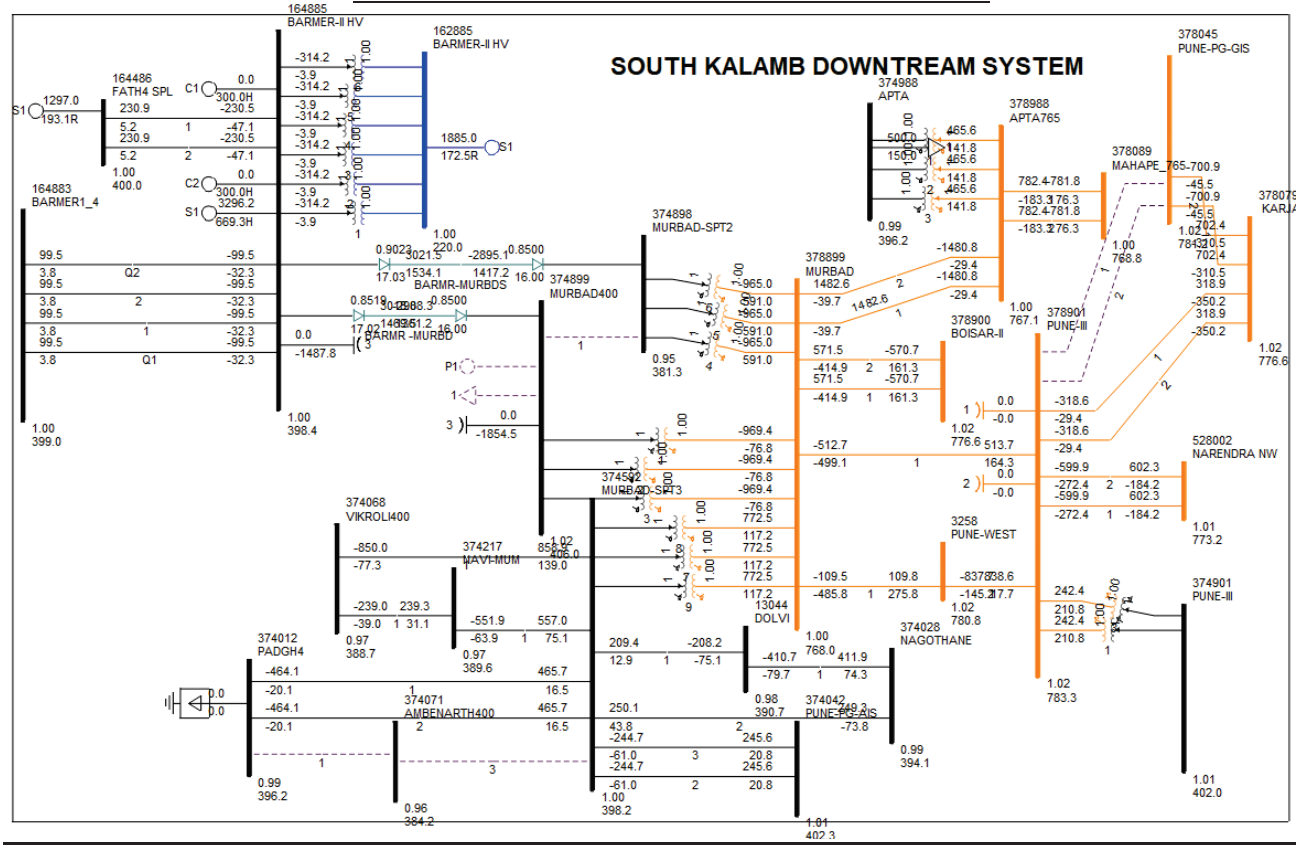
- Augmentation of transformation capacity at Navi Mumbai(PG) (GIS) S/s by 1x500MVA, 400/220kV ICT (3rd) along with associated GIS bays at both ends (to relieve overloading on Navi Mumbai 400/220kV ICTs)
- **Implementation time-frame: 21 Months**

From the studies, load flow pattern in Sc-4 (Summer Solar Max Scenario) is observed as under:

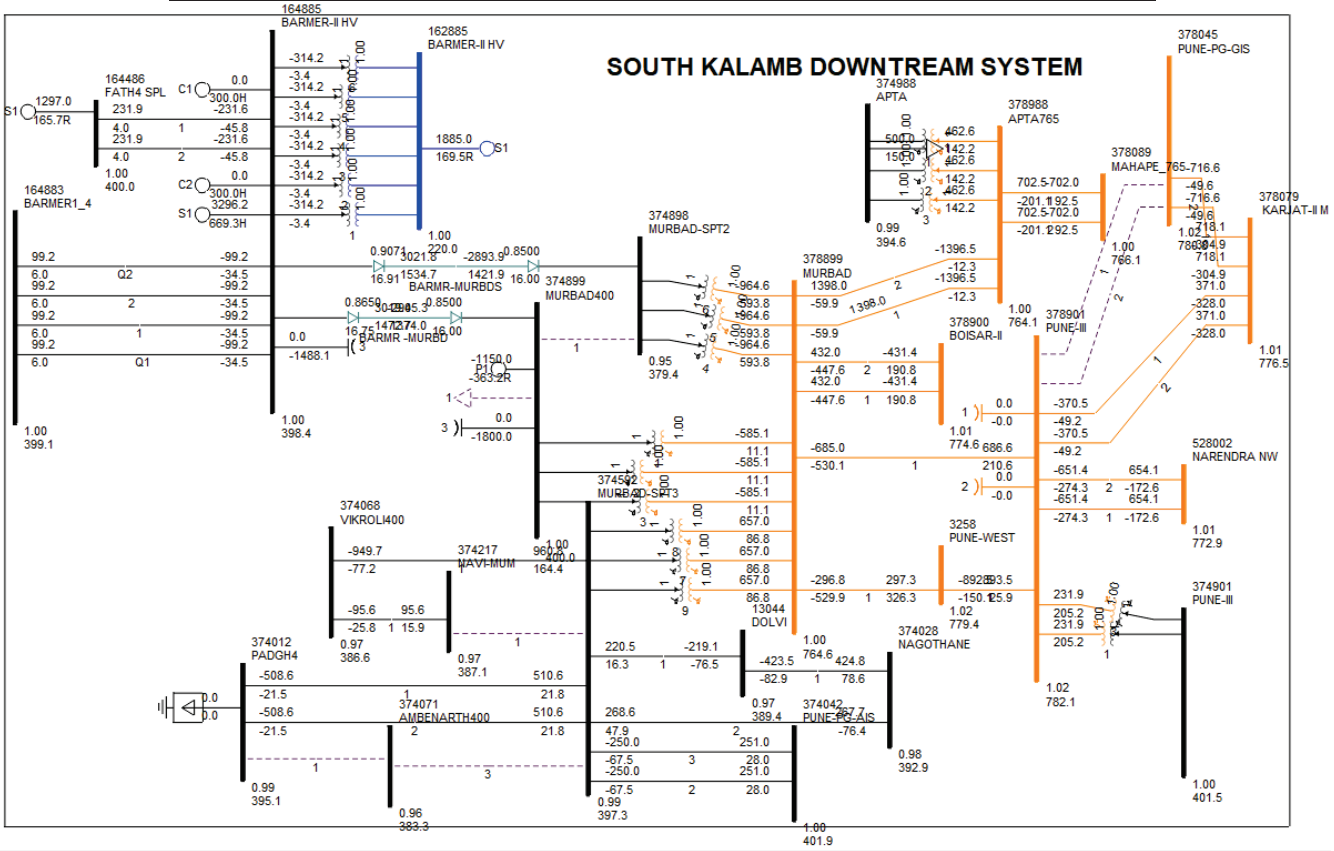
BASE CASE POWER FLOW



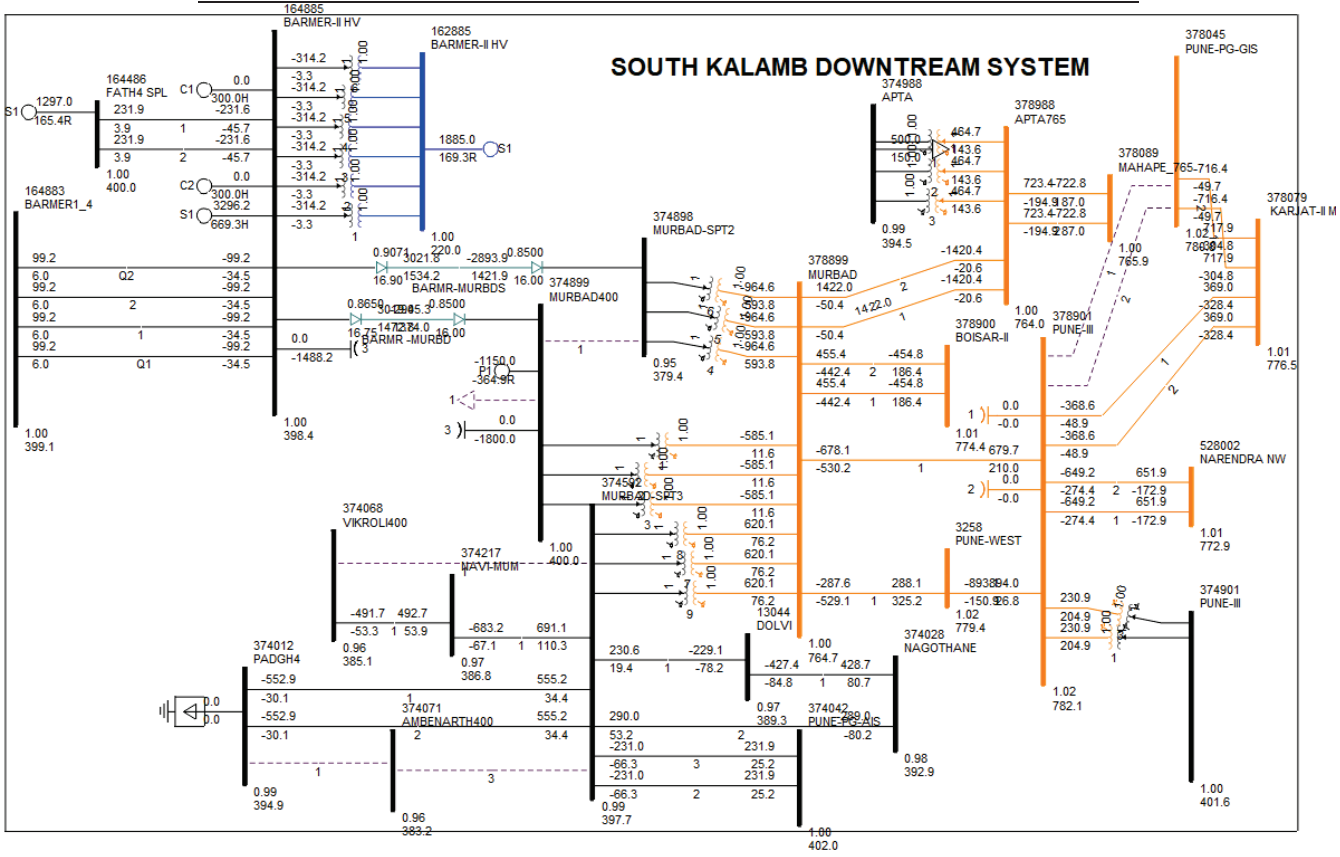
POWER FLOW WITH 1150MW PSP UNDER OUTAGE MODE



POWER FLOW WITH NAVI MUMBAI – SOUTH KALAMB 400kV LINE UNDER OUTAGE MODE



POWER FLOW WITH VIKHROLI – SOUTH KALAMB 400kV LINE UNDER OUTAGE MODE



Flag-I: List of Participants

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Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6GW (Solar):

- LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS (~20km)
- Establishment of 2 nos. 3000 MW, ± 600 kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation
- 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal.
- 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
- Establishment of 2 nos. 3000 MW, ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb
- Establishment 2x1500MVA, 765/400kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor
- LILO of Pune-III – Boisar-II 765kV D/c line at South Kalamb with associated bays at South Kalamb S/s
- Installation of 1x240 MVAr switchable line reactor on each ckt at South Kalamb end of Boisar-II – South Kalamb 765 kV D/c line (formed after above LILO)
- ±600 kV HVDC Bipole line between Barmer-II (HVDC) & South Kalamb (HVDC) (with Dedicated Metallic Return) (capable to evacuate 6000MW) (1100 kms)

Grid-India Inputs:

1. In the scheme, the evacuation of 6000 MW is proposed from VSC HVDC link from Barmer-II (new) substation to South Kalamb (Murbad).

   It is mention here that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

   Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Without considering the contribution of RE getting connected	10788	23409
2.	Considering the contribution of RE getting connected	13560	29058

   - *Installed capacity considered at 220 kV level:* ***2000 MW***
   - *Installed capacity considered at 400 kV level:* ***4000 MW***
   - *SCR at 220 kV level – (10788/2000):* ***5.394***
   - *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***

Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. The suitable alternatives to add fault level as well as inertia like SynCon may be considered in such pockets. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection (and hence system strength) such as **Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame).** The HVDC may then be planned from such station to a suitable location.

2. Comparison of VSC and LCC based HVDC

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Thyristor-based	IGBT-based (or similar switching devices)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons).	Capable of independent reactive power control. Generally, no external compensation needed.
Grid Strength Dependency	Requires a strong AC grid for commutation. May fail in weak grids. (SCR > 3)	Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Harmonics	Produces significant harmonics; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing,
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support.
Efficiency/Losses	Slightly higher efficiency in steady-state operation.	Lower efficiency due to switching losses in IGBTs.
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Both LCC and VSC based HVDCs have certain advantages and disadvantages. While LCC based HVDC is not suitable for low system strength pockets, the reliability of VSC HVDC during DC line fault always depends on switching of AC side CB and it is possible that high stress is experienced by equipment during DC line fault. Since the length of this HVDC link is expected to be around 1100 kM, the chances of DC line fault owing to higher exposure may be of high probability. The Technical requirement for HVDC shall clearly specify that HVDC shall be designed with redundancy so that system shall be able to operate under transient fault conditions. These aspects shall be taken in due consideration while specifying the technical specification of the HVDC in the RfP.

3. Other inputs on the proposed HVDC scheme are as under:

a) The rationale for terminating the HVDC in WR (Maharashtra) may be provided. Another HVDC from Khavda-V to Alephata (Maharashtra) is also terminating in the same area.

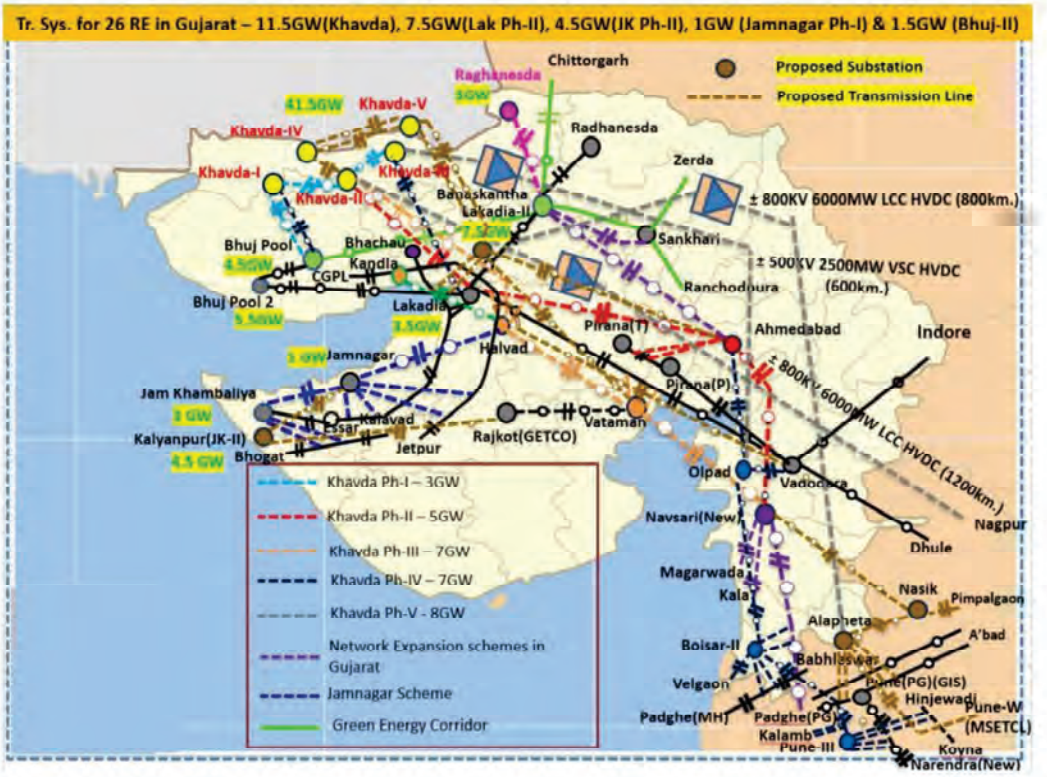
In the February solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region such as - 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C - are observed carrying power in the WR-to-SR direction. The all India level LGB may be reviewed.

Many 400 kV lines in Pune / Mumbai area are loaded beyond their permissible limits in the Sce-4 and Sce-7 cases e.g. 400 kV Kalwa- Estella S/C, 400 kV Pagdhe – Estella S/C, 400 kV Boisar-II - Pagdhe D/C etc.

Further, as highlighted in section on Load-Generation Balance below, the LGB of the case is subject to change with the proposed corrections which may lead to change in location of HVDC terminal.

b) Khavda (41.5 GW), Lakadia (3.5 GW & 7.5 GW), Raghanesda (3 GW), Bhuj (4.5 GW & 5.5 GW), Jamnagar (1 GW), Jam Khambaliya (3 GW & 4.5 GW) RE evacuation system is shown below

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme



As per above planning, most of the above RE generation will be consumed in Maharashtra (MMR & Pune) area. Two major HVDC (± 800 kV, 6000 MW LCC HVDC from Khavda-II to Nagpur and ± 800 kV 6000 MW LCC HVDC (or ± 600 kV VSC) from Lakadia-II to Alepheta) links from Khavda complex to Maharashtra system are already planned.

c) Terminating of HVDC at South Kalamb (Murbad) may be reviewed as already two HVDCs are terminating in Maharashtra and distance between Alephata to Kalamb is less than 50 km.

d) Number of new In-STS S/s (Dolvi, Kandalgaon, Estella, Velgaon, Ambernath, Theur, Padghe-Split, Kalwa Split, Estella Coromandel etc.) in MMR & Pune area is considered. Therefore, constraints faced in the Mumbai/Pune area are not reflected much in study cases. Timely commissioning of In-STS in the Mumbai/Pune area is very essential. Inordinate delays in commissioning of In-STS are generally observed. Hence, remedial measures need to be mentioned for delays in commissioning of In-STS.

e) Currently, constraints are being observed in Southern part of Maharashtra (Kolhapur/Karad area) during high injection from SR to WR. Another scenario (i.e. high injection from SR to WR along with low generation in Khavda/NR area) to be studied for assessing the transmission constraints and identification of remedial measures.

f) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 non-compliant. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

g) As mentioned earlier, controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

h) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

i) As HVDC are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature-based overload capability** for the proposed HVDCs. Also, as VSC based HVDC is being proposed, it is understood that complete capacity in reverse direction is available.

j) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

4. **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

5. **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

   A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

6. Inputs on Load Generation Balance:

In base cases shared, demand of Rajasthan considered in scenario-4: Jul month(31GW) seems to be on higher side. Similarly, in scenario-7: Feb month (35.4GW) seems to be on very higher side. Powerfactor of load also to be revised according to practical values to get correct picture of any low voltage scenario.

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
CHANDIGARH	P	353.2	0.95	411.6	0.96
	Q	112.7		120	
J&K	P	4193.4	0.99	2840.6	0.96
	Q	615.8		828.5	
HIMACHAL	P	2395.4	0.99	1780.1	0.96
	Q	399		519.2	
PUNJAB	P	12742.1	0.99	17627.8	0.96
	Q	1903.2		5138.9	
HARYANA	P	12981.3	0.99	16580.6	0.96
	Q	1930.6		4836	
DELHI	P	6045.8	0.98	9367.3	0.96
	Q	1118.8		2864.4	
RAJASTHAN	P	35442.5	0.99	31266.8	0.96
	Q	4427.2		8839.5	
UP	P	26303.5	0.99	31161.5	0.96
	Q	3833.8		9088.8	
LADAKH	P	40.1	0.99	27.3	0.96
	Q	5.9		8	
UTTARAKHAND	P	2581.5	0.98	2955	0.96
	Q	504		844.5	
NR	P	103078.7	0.99	114018.5	0.96
	Q	14851		33087.7	

Feb Solar (Scenario - 7)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met during Solar Hours, Feb 2024 (MW)
1	NR	103722	146006	42284	116745	54890	63791
2	WR	112173	137614	25441	107050	68960	74167
3	SR	104357	90900	-13457	97440	60929	65591
4	ER	41435	17785	-23650	45752	19429	22745
5	NER	2902	2025	-877	5835	2013	2209
6	All India	366648	396728	x	334811	206123	221989

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

S. No.	State	Load (MW)	Gen (State+ Central) (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)	Peak Demand Met in Solar Hours, Feb 2024 (MW)
1	Rajasthan	35468	110783	25058	17000	18058
2	Gujarat	41433	71297	33964	19113	21258
3	Maharashtra	40627	30993	39891	27379	29821
4	MP	21288	23092	25596	14553	16885

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, # Export is considered positive**

June Solar (Scenario - 4)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in June 2024 (MW)	Peak Demand met during Solar Hours, June 2024 (MW)
1	NR	114849	156993	42144	116745	80252	91040
2	WR	108797	130420	21623	107050	64167	74882
3	SR	98015	95583	-2432	97440	48363	58488
4	ER	47997	14483	-33514	45752	27672	31436
5	NER	3706	3377	-329	5835	2467	3023
6	All India	375349	406220	x	334811	222917	244540

S. No.	State	Load (MW)	Gen. (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met in Feb 2024 (MW)
1	Rajasthan	31266	113355	25058	16199	18425
2	Gujarat	44908	76899	33964	21934	26054
3	Maharashtra	39589	29129	39891	23622	28715
4	MP	15757	18715	25596	11155	13828

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, #Export is considered positive**

- In both February solar and June Solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region—such as the 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C—are observed carrying power in the WR-to-SR direction

- Dispatch of Thermal Plants:

    - The thermal generation of some of the plants i.e. APL/CGPL has been backed down to very low levels (~35%).
    - Pit head plant: Talcher backed down to ~35% level
    - Pit head plant: V'chal backed down to ~34% level
    - Pit head plant: Korba backed down to ~34% level

  The tech minimum level considered in the case may be mentioned, and the generators' dispatch should be considered per merit order.

- The demand in Rajasthan and Gujarat is seen to be on a higher end than the figures from EPS. The reason for the high demand may be mentioned.

- Consideration of GH2 and other bulk consumer loads may be mentioned in the planning scheme itself, duly citing the uncertainty behind the assumptions and requirement of further transmission planning in case of delay/deferment of GH2/Bulk load projects.

  The production cost modelling studies duly factor in the RPO targets for each states, RE integration targets, flexibility requirements, merit order etc. Therefore, it is suggested that the study scenario may be finalized based on the output of the production cost modelling studies for the same timeframe. This LGB will itself indicate the paths/corridors along with the system augmentation is required.

7. Punjab internal generation considered in scenario-7 to be corrected:

Bus Number	Bus Name	Id	Area Num	Area Name	Zone Num	Zone Name	Code	VSched (pu)	In Service	PGen (MW)	PMax (MW)
132204	LEHRAMOHBT 220.00	T 1	13	PUNJAB	131	PB_STU	-2	1	1	52.5	210
132204	LEHRAMOHBT 220.00	T 2	13	PUNJAB	131	PB_STU	-2	1	1	52.5	210
132270	GOINDWALSB 220.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	67.5	270
132270	GOINDWALSB 220.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	67.5	270
132323	SPL_ROPAR 220.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
132323	SPL_ROPAR 220.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
132323	SPL_ROPAR 220.00	T 3	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
134401	TALWNDISABO4 400.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	165	660
134401	TALWNDISABO4 400.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	165	660
134406	RAJPURA_TH4 400.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	175	700
134406	RAJPURA_TH4 400.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	175	700

8. **Dynamic Simulation Studies –** With more than 100 GW solar generation and two HVDC terminals in Rajasthan in close vicinity, it is important that stability aspects are also studied in detail at the planning stage. The generation is also getting evacuated through large EHV lines and hence, transient stability analysis also becomes important. Therefore, it is suggested that the results of the dynamic simulation studies may be shared.

9. Bara TPS generation model to be corrected, same is modelled at 400kV whereas it is existing at 765kV level.

Annexure B2

Reply of Grid-India inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

Grid-India Inputs:

1. In the scheme, the evacuation of 6000 MW is proposed from VSC HVDC link from Barmer-II (new) substation to South Kalamb (Murbad).

   It is mention here that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

   Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Without considering the contribution of RE getting connected	10788	23409
2.	Considering the contribution of RE getting connected	13560	29058

   - *Installed capacity considered at 220 kV level:* ***2000 MW***
   - *Installed capacity considered at 400 kV level:* ***4000 MW***
   - *SCR at 220 kV level – (10788/2000):* ***5.394***
   - *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***

   Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. The suitable alternatives to add fault level as well as inertia like SynCon may be considered in such pockets. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection (and hence system strength) such as **Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame).** The HVDC may then be planned from such station to a suitable location.

CTU Reply :

As per our understanding and discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1 whereas for LCC technology is > 2.5.

Integration of RE power to other intermediate sub stations through EHVAC system i.e. Ajmer, Chittorgarh, Beawar, Rishabdeo etc. and its further evacuation through HVDC from intermediate substations is not feasible due to space constraint on above substations. SCR values of Barmer-II and South Kalaamb (Murbad) S/s is as below:

S. No.	Voltage level	Envisaged generation (MW)	Wo Considering additional Barmer-II-Barmer-I D/c line (present file)		With Considering additional Barmer-II-Barmer-I D/c line & Syncons (2 units*)	
			SCMVA (Considering no contribution from incident bus)	SCR	SCMVA (Considering no contribution from incident bus)	SCR
1.	Barmer-II (220kV)	2180	11510	5.27	12500	**5.75**
2.	Barmer-II (400kV)	(3812+2180) 5992	23290	3.88	29550	**4.95**
3	Murbad (400kV)	3000	26300 (13200)	8.7 (4.4)	26300 (13200)	**8.7 (4.4)**
3	Murbad Splt (400kV)	3000	13200	4.4	13200	**4.4**

1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) with Minimum H (natural) =4 s

From the table, it is envisaged that SCR at 400kV and 220kV level of Barmer-II PS is adequate for HVDC operation (LCC/VSC). The SCR of 400kv Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in next 2-3 months.

2 units of Syncons shall be considered with LCC technology alternative. Space provision of 2 units of SyCon shall be kept in VSC technology alternative as part of comprehensive scheme and taken up for implementation as per future requirement.

2. Comparison of VSC and LCC based HVDC

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Thyristor-based	IGBT-based (or similar switching devices)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons).	Capable of independent reactive power control. Generally, no external compensation needed.

Feature	LCC-HVDC	VSC-HVDC
Grid Strength Dependency	Requires a strong AC grid for commutation. May fail in weak grids. (SCR > 3)	Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Harmonics	Produces significant harmonics; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing,
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support.
Efficiency/Losses	Slightly higher efficiency in steady-state operation.	Lower efficiency due to switching losses in IGBTs.
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Both LCC and VSC based HVDCs have certain advantages and disadvantages. While LCC based HVDC is not suitable for low system strength pockets, the reliability of VSC HVDC during DC line fault always depends on switching of AC side CB and it is possible that high stress is experienced by equipment during DC line fault. Since the length of this HVDC link is expected to be around 1100 kM, the chances of DC line fault owing to higher exposure may be of high probability. The Technical requirement for HVDC shall clearly specify that HVDC shall be designed with redundancy so that system shall be able to operate under transient fault conditions. These aspects shall be taken in due consideration while specifying the technical specification of the HVDC in the RfP.

CTU Reply : Comments are noted as part of agenda.

3. Other inputs on the proposed HVDC scheme are as under:

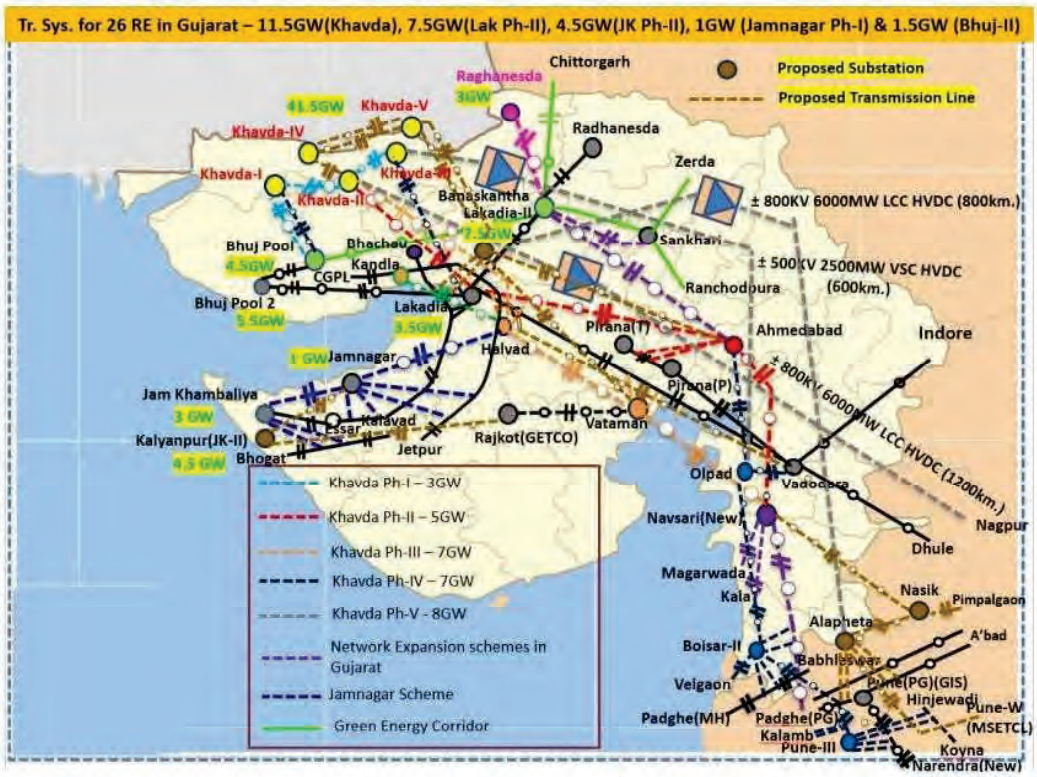
a) The rationale for terminating the HVDC in WR (Maharashtra) may be provided. Another HVDC from Khavda-V to Alephata (Maharashtra) is also terminating in the same area.

In the February solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region such as - 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C - are observed carrying power in the WR-to-SR direction. The all India level LGB may be reviewed.

Many 400 kV lines in Pune / Mumbai area are loaded beyond their permissible limits in the Sce4 and Sce-7 cases e.g. 400 kV Kalwa- Estella S/C, 400 kV Pagdhe – Estella S/C, 400 kV BoisarII - Pagdhe D/C etc.

Further, as highlighted in section on Load-Generation Balance below, the LGB of the case is subject to change with the proposed corrections which may lead to change in location of HVDC terminal.

b) Khavda (41.5 GW), Lakadia (3.5 GW & 7.5 GW), Raghanesda (3 GW), Bhuj (4.5 GW & 5.5 GW), Jamnagar (1 GW), Jam Khambaliya (3 GW & 4.5 GW) RE evacuation system is shown below



As per above planning, most of the above RE generation will be consumed in Maharashtra (MMR & Pune) area. Two major HVDC (± 800 kV, 6000 MW LCC HVDC from Khavda-II to Nagpur and ± 800 kV 6000 MW LCC HVDC (or ± 600 kV VSC) from Lakadia-II to Alepheta) links from Khavda complex to Maharashtra system are already planned.

c) Terminating of HVDC at South Kalamb (Murbad) may be reviewed as already two HVDCs are terminating in Maharashtra and distance between Alephata to Kalamb is less than 50 km.

d) Number of new In-STS S/s (Dolvi, Kandalgaon, Estella, Velgaon, Ambernath, Theur, Padghe-Split, Kalwa Split, Estella Coromandel etc.) in MMR & Pune area is considered. Therefore, constraints faced in the Mumbai/Pune area are not reflected much in study cases. Timely commissioning of In-STS in the Mumbai/Pune area is very essential. Inordinate delays in commissioning of In-STS are generally observed. Hence, remedial measures need to be mentioned for delays in commissioning of In-STS.

e) Currently, constraints are being observed in Southern part of Maharashtra (Kolhapur/Karad area) during high injection from SR to WR. Another scenario (i.e. high injection from SR to WR along with low generation in Khavda/NR area) to be studied for assessing the transmission constraints and identification of remedial measures.

CTU Reply (a) to (e): The Lakadia-II – Alephata HVDC has been terminated at a point parallel to the EHVAC network which emanates from Khavda area and traverses from North Gujarat to load centres in Maharashtra (Boisar-II/ Nasik/ Alephata/ Pune(GIS) / Pune-III). The HVDC system emanates from Lakadia-II (Central Gujarat) and terminates at Alephata

(parallel to AC network) and is expected to maintain a balanced power flows on the AC lines along with controllability as per requirement. The other HVDC link from NR to South Kalamb has been planned to complement PSPs in Talegaon / Data centre & other load requirement in the Neral area.

4. Further, the present files have been prepared considering Max RE injection in Gujarat & Rajasthan (which are contiguous pockets) so as to simulate worst case scenario as far as immediate evacuation of power is concerned. In case the generation is backed down in these pockets, it would represent a better load flow case.

CTU Reply : Scenario-4 & 7 is prepared considering Rajasthan (100% solar dispatch) and Gujarat (80% solar dispatch). One additional sensitivity case considering Rajasthan (90% solar dispatch) and Gujarat (100% solar dispatch) is also prepared & shared with agenda

5. Nevertheless, SR export scenario has also been prepared in consultation with SR constituents and was studied in detail in presence of GRID-INDIA on 22.11.2024 for Bijapur evacuation studies at Bangalore. The proposed system was found adequate in that scenario as well.

CTU Reply : Noted.

6. Regarding constraints in Mumbai/MMR region, timely commissioning of In-STS in the Mumbai/Pune area is very essential. MSETCL is being continuously requested to adhere to agreed upon time-lines as per review meetings carried out by CEA as well as in various CMETS-WR meetings by CTU as well as GRID-INDIA.

a) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 noncompliant. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

CTU Reply : No violation of N-1 compliance is observed in studies on the outage of 3000MW (one Bipole) of HVDC as per manual on transmission planning criteria 2023, however necessary augmentation works shall be taken up for implementation after detail deliberation with Grid-India/CEA/NRPC.

b) As mentioned earlier, controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

CTU Reply : Noted. To be taken care during finalization of RfP.

c) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

CTU Reply : Noted.

d) As HVDC are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature based overload capability** for the proposed HVDCs. Also, as VSC based HVDC is being proposed, it is understood that complete capacity in reverse direction is available.

CTU Reply : Noted. Matter shall be discussed during the meeting by our CTU-Engg Deptt. As per discussion in NCT meeting, both VSC & LCC technology are being discussed in present proposal. HVDC system shall be planned with 100% reverse power capability.

e) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

CTU Reply : Noted. To be discussed with OEMs during finalization of RfP to explore the possibility.

7. **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

CTU Reply : Noted.

8. **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

CTU Reply : Noted.

9. **<u>Inputs on Load Generation Balance:</u>**

In base cases shared, demand of Rajasthan considered in scenario-4: Jul month(31GW) seems to be on higher side. Similarly, in scenario-7: Feb month (35.4GW) seems to be on very higher side. Power factor of load also to be revised according to practical values to get correct picture of any low voltage scenario.

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
Chandigarh	P	353.2	0.95	411.6	0.96
	Q	112.7		120	
J&k	P	4193.4	0.99	2840.6	0.96

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
	Q	615.8		828.5	
Himachal	P	2395.4	0.99	1780.1	0.96
	Q	399		519.2	
Punjab	P	12742.1	0.99	17627.8	0.96
	Q	1903.2		5138.9	
Haryana	P	12981.3	0.99	16580.6	0.96
	Q	1930.6		4836	
Delhi	P	6045.8	0.98	9367.3	0.96
	Q	1118.8		2864.4	
Rajasthan	P	35442.5	0.99	31266.8	0.96
	Q	4427.2		8839.5	
Up	P	26303.5	0.99	31161.5	0.96
	Q	3833.8		9088.8	
Ladakh	P	40.1	0.99	27.3	0.96
	Q	5.9		8	
Uttarakhand	P	2581.5	0.98	2955	0.96
	Q	504		844.5	
NR	P	103078.7	0.99	114018.5	0.96
	Q	14851		33087.7	

Feb Solar (Scenario - 7)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met during Solar Hours, Feb 2024 (MW)
1	NR	103722	146006	42284	116745	54890	63791
2	WR	112173	137614	25441	107050	68960	74167
3	SR	104357	90900	-13457	97440	60929	65591
4	ER	41435	17785	-23650	45752	19429	22745
5	NER	2902	2025	-877	5835	2013	2209
6	All India	366648	396728	x	334811	206123	221989

S. No.	State	Load (MW)	Gen (State+ Central) (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)	Peak Demand Met in Solar Hours, Feb 2024 (MW)
1	Rajasthan	35468	110783	25058	17000	18058
2	Gujarat	41433	71297	33964	19113	21258
3	Maharashtra	40627	30993	39891	27379	29821
4	MP	21288	23092	25596	14553	16885

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, # Export is considered positive**

June Solar (Scenario - 4)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in June 2024 (MW)	Peak Demand met during Solar Hours, June 2024 (MW)
1	NR	114849	156993	42144	116745	80252	91040
2	WR	108797	130420	21623	107050	64167	74882
3	SR	98015	95583	-2432	97440	48363	58488
4	ER	47997	14483	-33514	45752	27672	31436
5	NER	3706	3377	-329	5835	2467	3023
6	All India	375349	406220	x	334811	222917	244540

S. No.	State	Load (MW)	Gen. (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met in Feb 2024 (MW)
1	Rajasthan	31266	113355	25058	16199	18425
2	Gujarat	44908	76899	33964	21934	26054
3	Maharashtra	39589	29129	39891	23622	28715
4	MP	15757	18715	25596	11155	13828

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, #Export is considered positive**

- In both February solar and June Solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region—such as the 765 kV Narendra New–Pune–III D/C and 765 kV Raichur– Solapur D/C—are observed carrying power in the WR-to-SR direction

- Dispatch of Thermal Plants:

  - The thermal generation of some of the plants i.e. APL/CGPL has been backed down to very low levels (~35%).
  - Pit head plant: Talcher backed down to ~35% level to Pit head plant: V'chal backed down to ~34% level
  - Pit head plant: Korba backed down to ~34% level

  The tech minimum level considered in the case may be mentioned, and the generators' dispatch should be considered per merit order.

CTU Reply : Files are modified to incorporate minimum 40% dispatch from thermal generating stations in WR as per merit order as well as load pf (0.95-0.97) in NR.

- The demand in Rajasthan and Gujarat is seen to be on a higher end than the figures from EPS. The reason for the high demand may be mentioned.

CTU Reply :

S.No	State	EPS demand (2030)-GW	Demand Considered in studies (GW)		
			Sc-4*	Sc-5	Sc-7*
1	Rajasthan	25.1	19.2	18	23.3
2	Gujarat	34	44.9	37.2	41.4

excl. 12GW lumped load at Ramgarh-II and Bhadla-IV for HVDC

CTU Reply – From the demand data, it is envisaged that demand in Rajasthan is in order. In Gujarat, about 60% of the projected Green Hydrogen Load by 2027-28 has been considered in studies [9250MW out of 15000MW (Kandla:3GW, MUL: 12GW)]. In case same does not materialize as planned, additional transmission system would be required. Further, other bulk consumer loads have also been considered in studies such as 3GW at Mundra(Navinal) S/s, 3.5GW at Jamnagar, etc.

- Consideration of GH2 and other bulk consumer loads may be mentioned in the planning scheme itself, duly citing the uncertainty behind the assumptions and requirement of further transmission planning in case of delay/deferment of GH2/Bulk load projects.

The production cost modelling studies duly factor in the RPO targets for each states, RE integration targets, flexibility requirements, merit order etc. Therefore, it is suggested that the study scenario may be finalized based on the output of the production cost modelling studies for the same timeframe. This LGB will itself indicate the paths/corridors along with the system augmentation is required.

CTU Reply – to be discussed in meeting

7. Punjab internal generation considered in scenario-7 to be corrected:

Bus Number	Bus Name	Id	PGen (MW)	PMax (MW)
132204	LEHRAMOHBT 220.00	T1	52.5	210
132204	LEHRAMOHBT 220.00	T2	52.5	210
132270	GOINDWALSB 220.00	T1	67.5	270
132270	GOINDWALSB 220.00	T2	67.5	270
132323	SPL_ROPAR 220.00	T1	52.5	210
132323	SPL_ROPAR 220.00	T2	52.5	210

132323	SPL_ROPAR 220.00	T3	52.5	210
134401	TALWNDISABO4 400.00	T1	165	660
134401	TALWNDISABO4 400.00	T2	165	660
134406	RAJPURA_TH4 400.00	T1	175	700
134406	RAJPURA_TH4 400.00	T2	175	700

CTU Reply : Corrected in Revised PSSE files (in Sc-7)

8. **Dynamic Simulation Studies –** With more than 100 GW solar generation and two HVDC terminals in Rajasthan in close vicinity, it is important that stability aspects are also studied in detail at the planning stage. The generation is also getting evacuated through large EHV lines and hence, transient stability analysis also becomes important. Therefore, it is suggested that the results of the dynamic simulation studies may be shared.

   CTU reply- In 30th CMETS-NR meeting, CTU requested that Grid-India may share present time frame converged dynamic file which will help to resolve convergence issues in dynamics file for 2027 timeframe w.r.t Generator models (conventional/RE) used by Grid-India. In the CMETS-NR meeting Grid-India stated that they are also facing convergence issues for present timeframe file and prepared dynamics file with some assumptions.

   It was agreed in the meeting that for preparation for planning stage dynamic file, CTU and Grid-India can work together to prepare load flow first w.r.t dynamics file and subsequent Dynamic data file (Dyr) shall be prepared with help of models available with Grid-India. CTU also stated that considering the severe convergence issues in dynamics file, it will be converged on truncated network specific to RE pockets in Rajasthan rather than to converge the file on All India level. In the meeting, NRLDC stated that for transient studies, truncated network modelling will be sufficient.

   Considering above, it is requested that a committee may be formed comprising members from CEA, CTUIL and Grid-India for preparation of planning horizon dynamics files.

9. Bara TPS generation model to be corrected, same is modelled at 400kV whereas it is existing at 765kV level.

   CTU Reply : Corrected in Revised PSSE files

HVDC VSC Configuration

- ***±600kV, 6 GW (Parallel Bipole with parallel DMR)***
- In this configuration, +ve Terminal of Pole-1 & 3 and -ve Terminal of Pole-2 & 4 shall be combined at the Gantry side and single +ve and -ve bundle conductor each shall be traversed on either side of the Tower along with parallel DMR.
- In this configuration, reliability of overall HVDC system shall be enhanced in comparison to Double Bipole with Parallel DMR configuration.
- Control & Protection design for co-ordinated control is complex and is offered only by one OEM (M/s SIEMENS) and is first of its kind in the world.

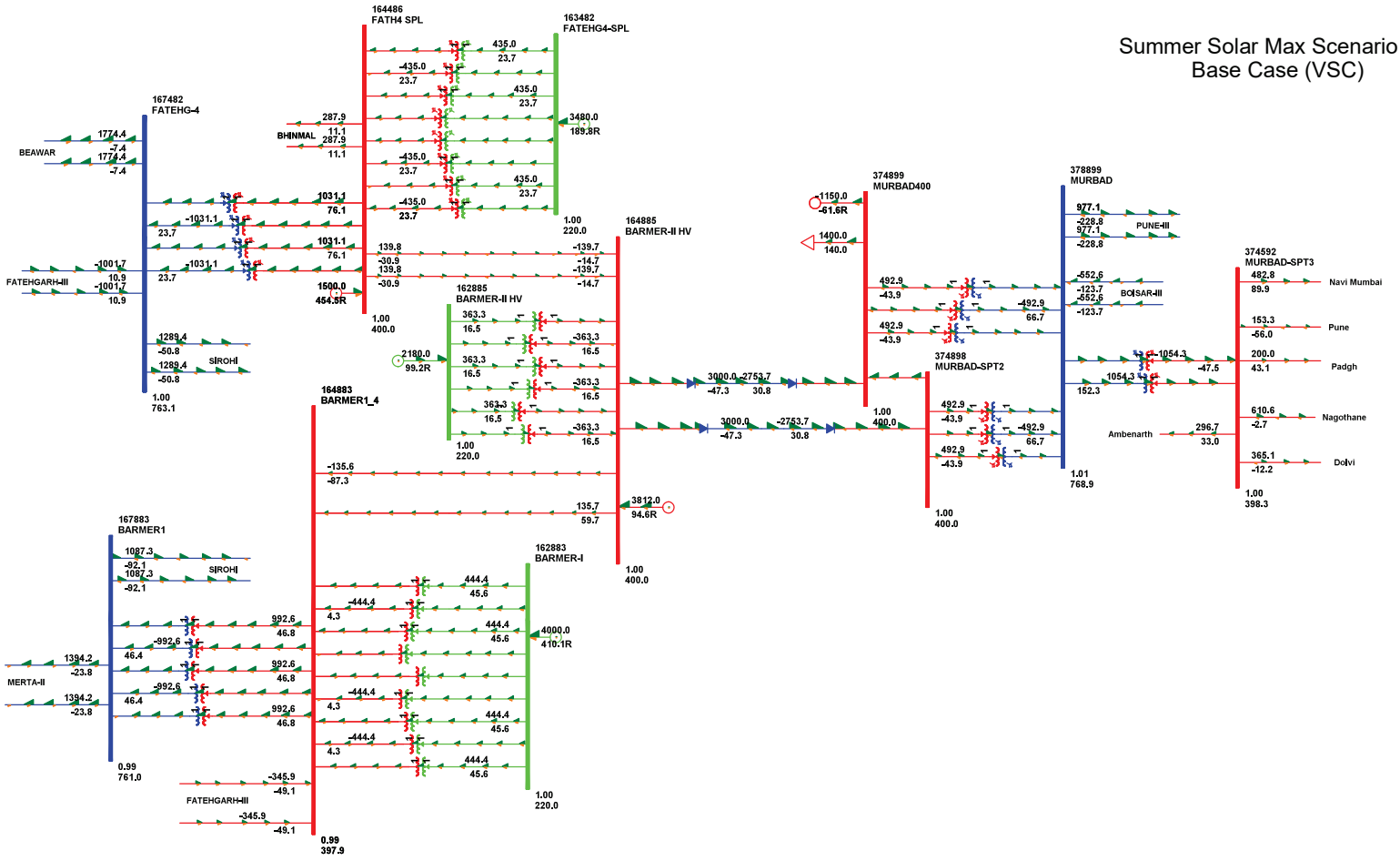
-

- ***600kV, 6 GW (Double Bipole with parallel DMR)***
- In this configuration, each Bipole shall have their independent bundle conductors on either side of the Tower along with parallel DMR.
- Control & Protection design for each Bipole control is simple and is offered by more than one OEM.

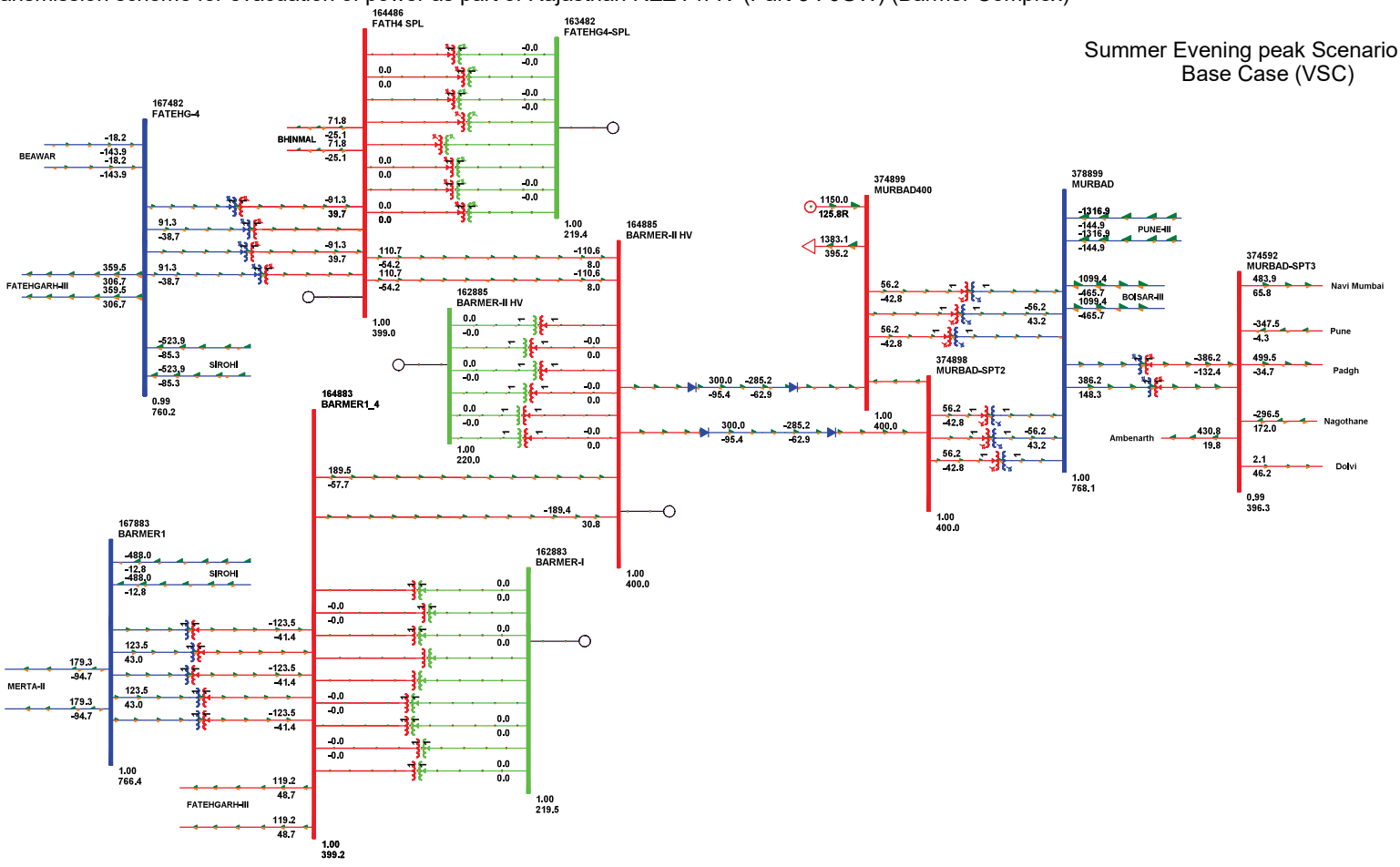
Note: DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec

Exhibit-4

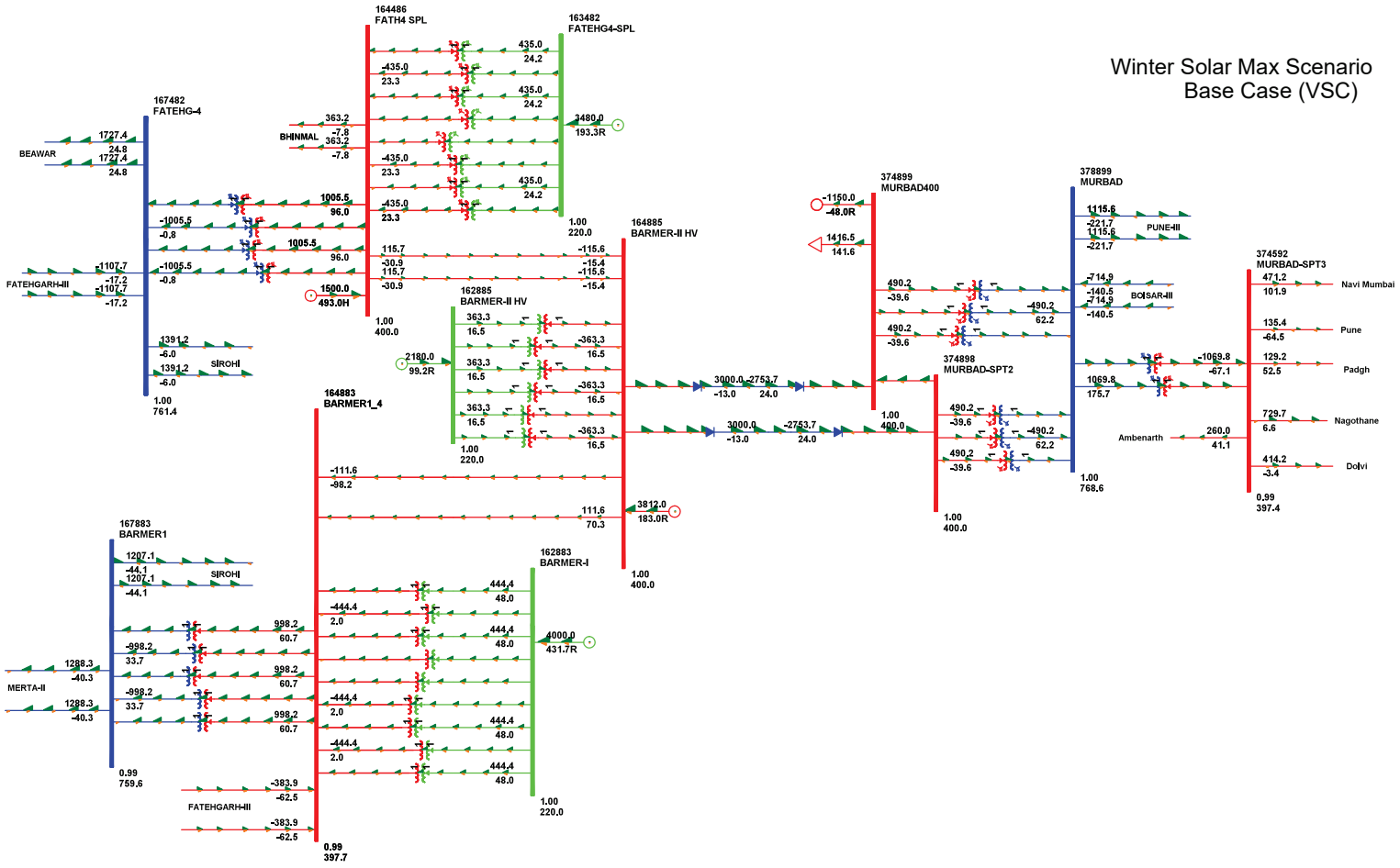
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



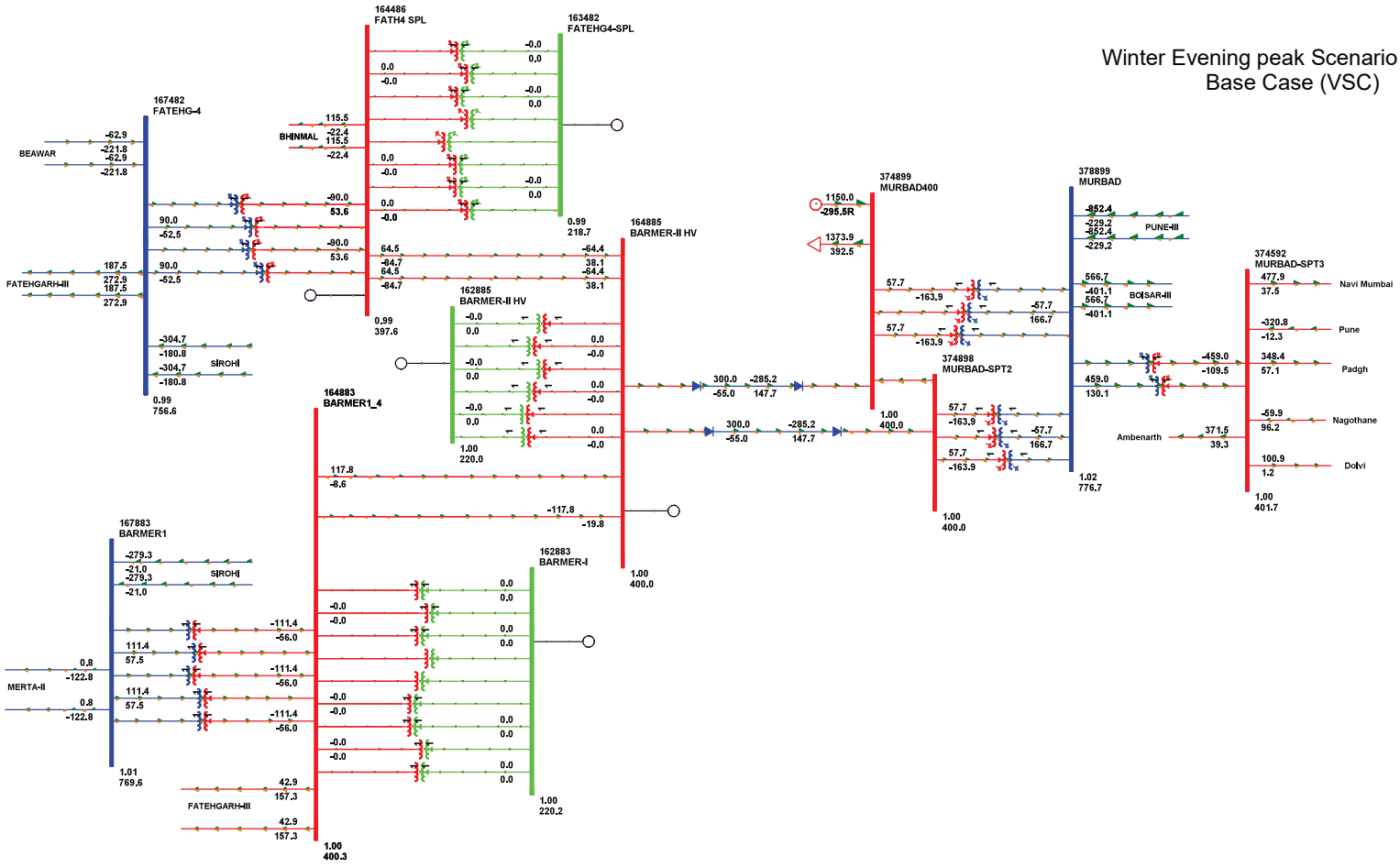
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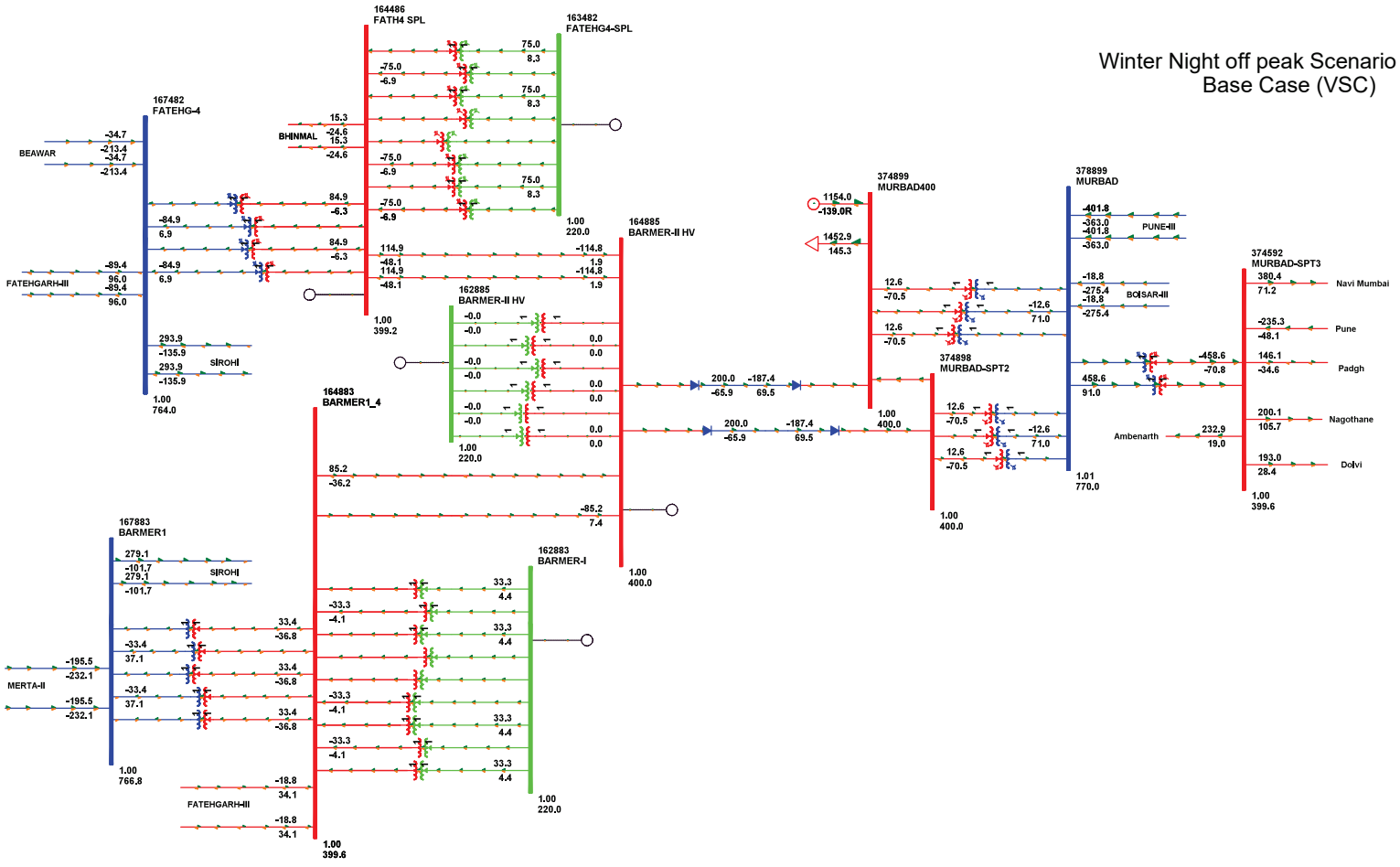
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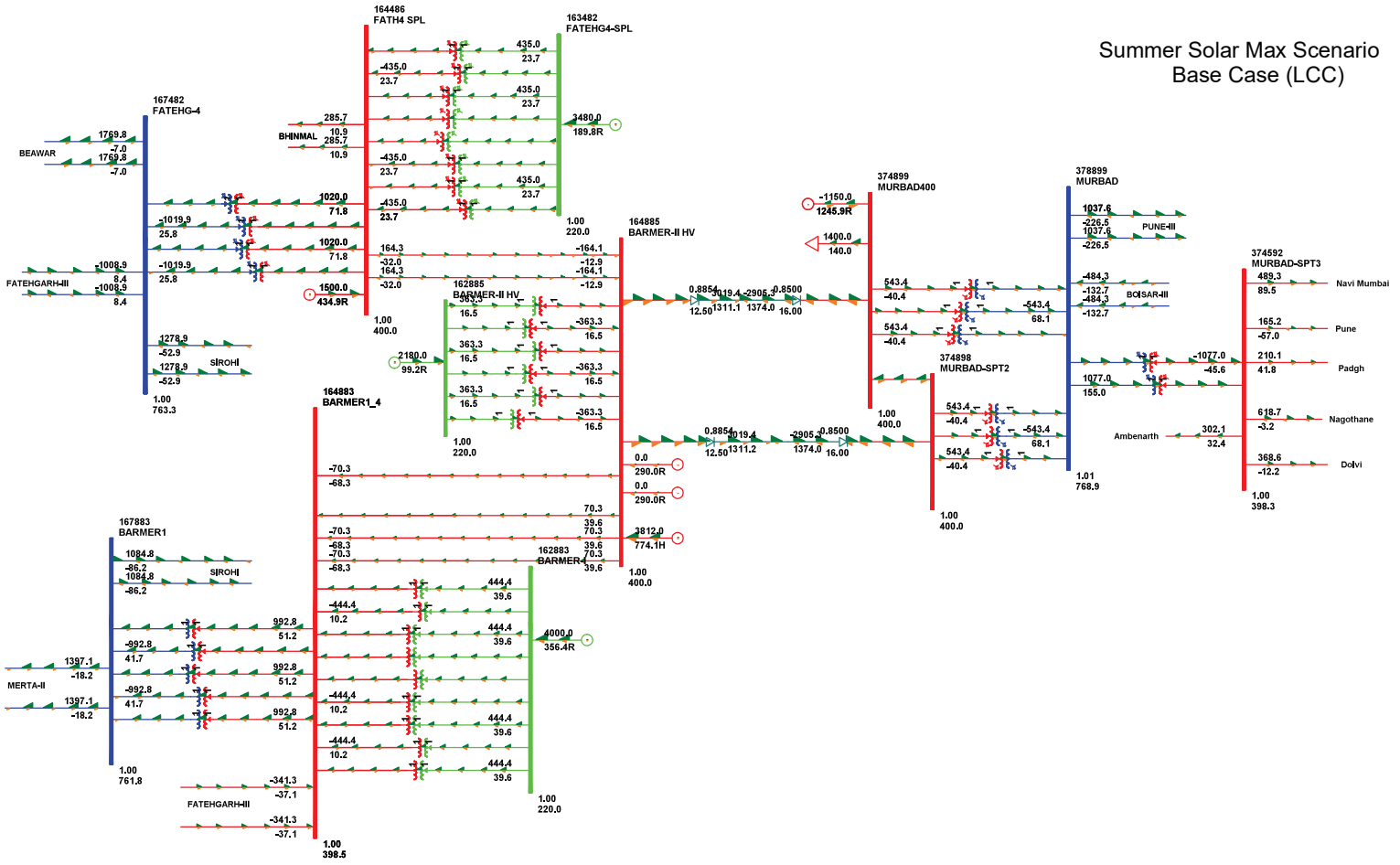
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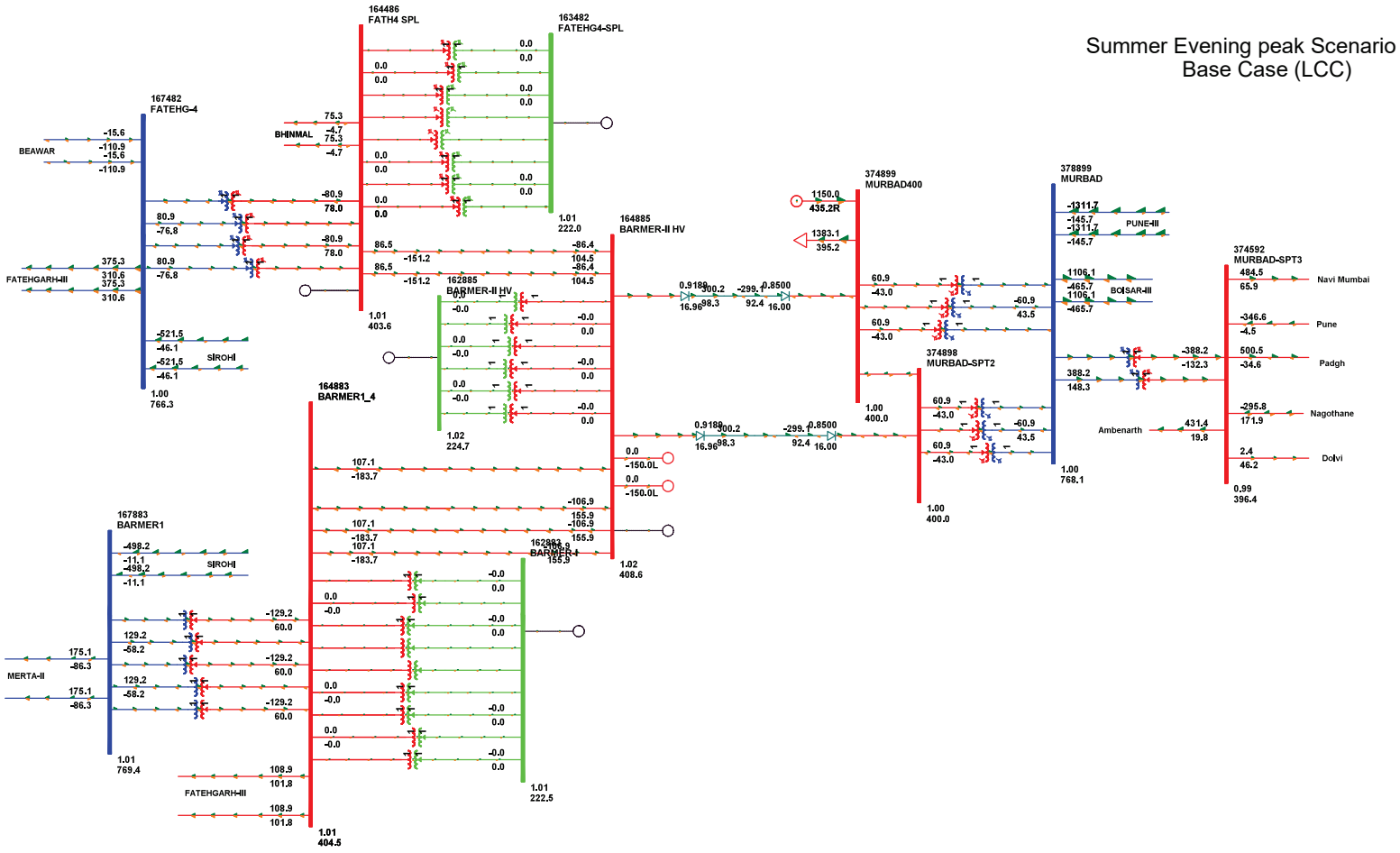
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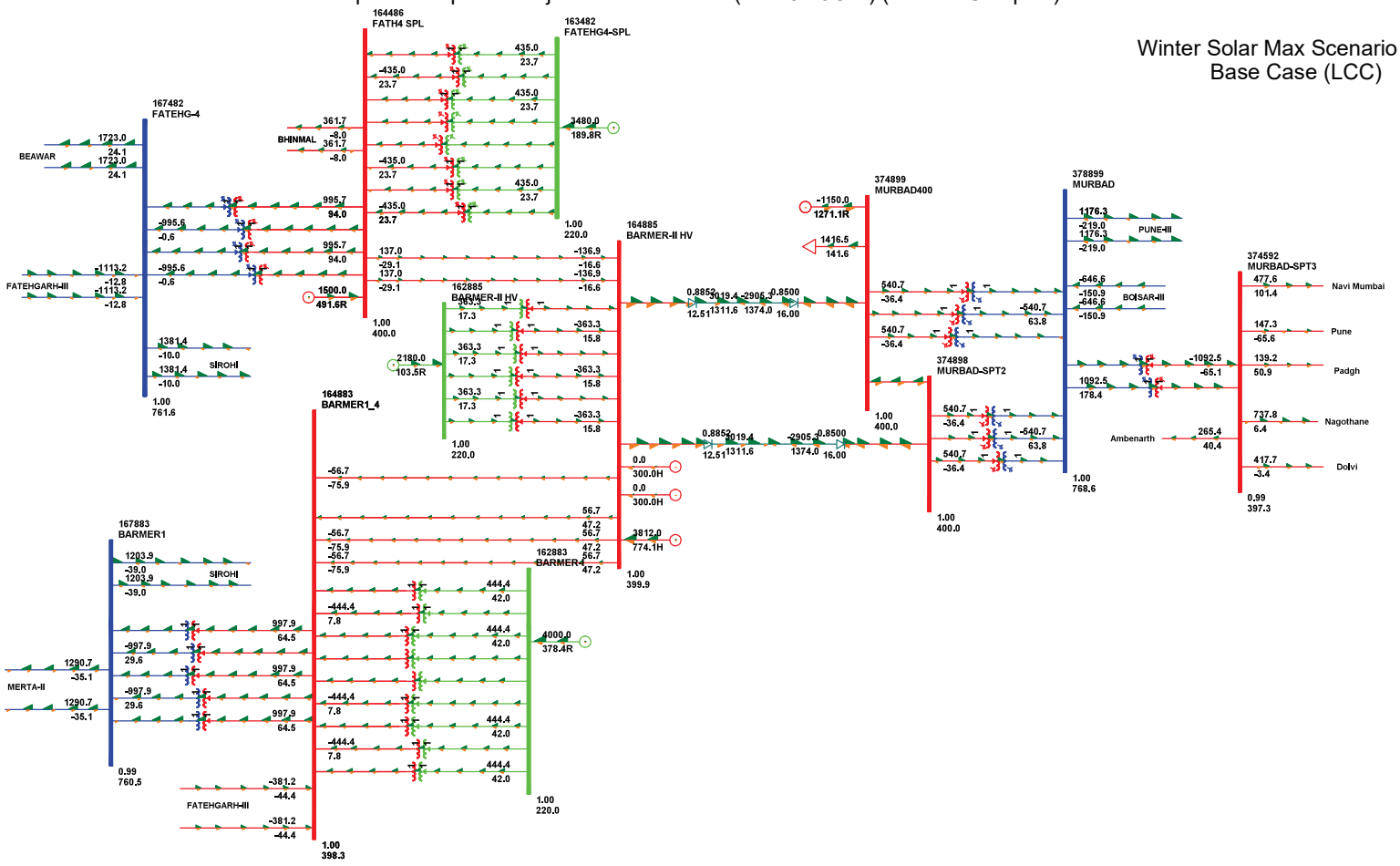
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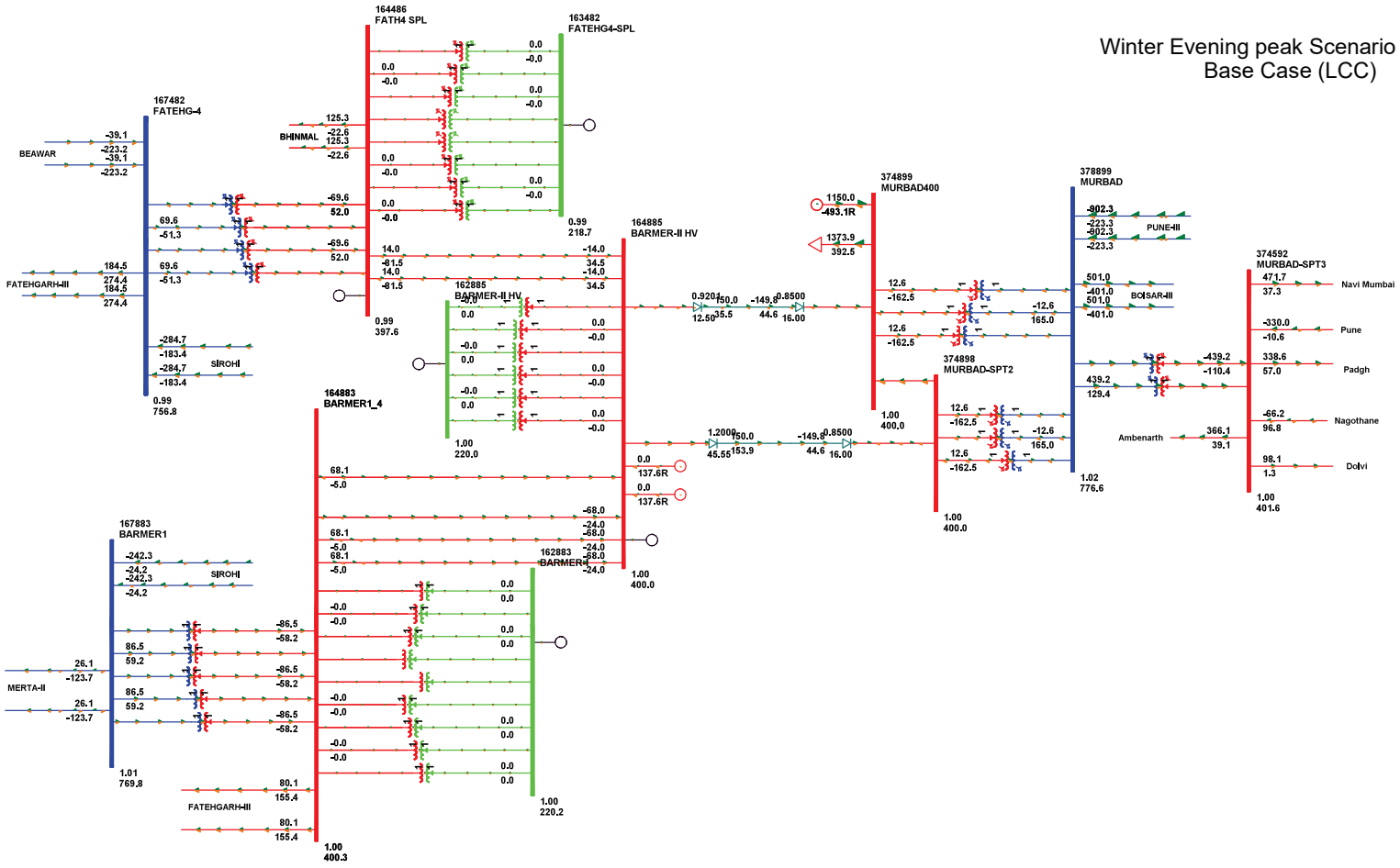
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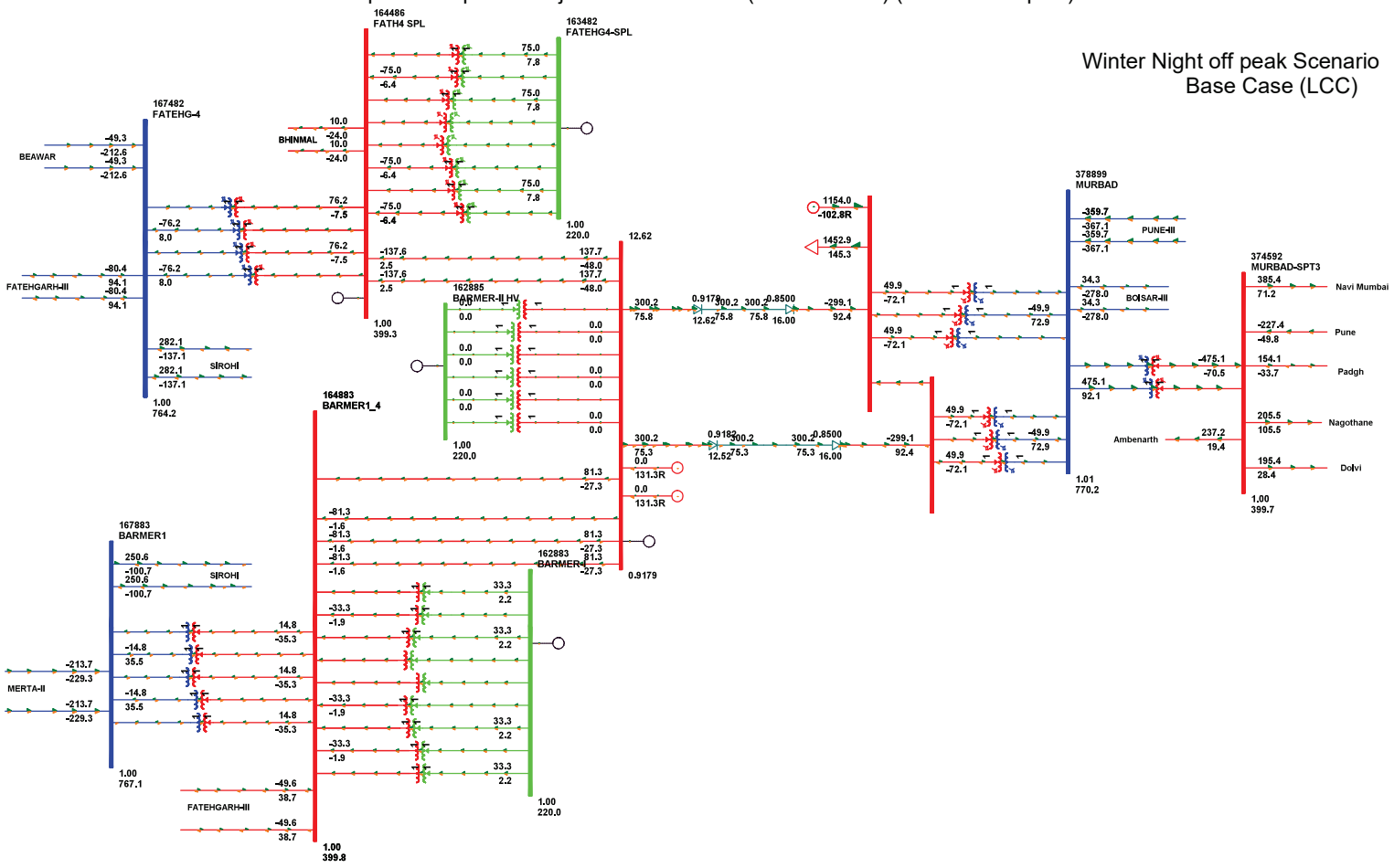
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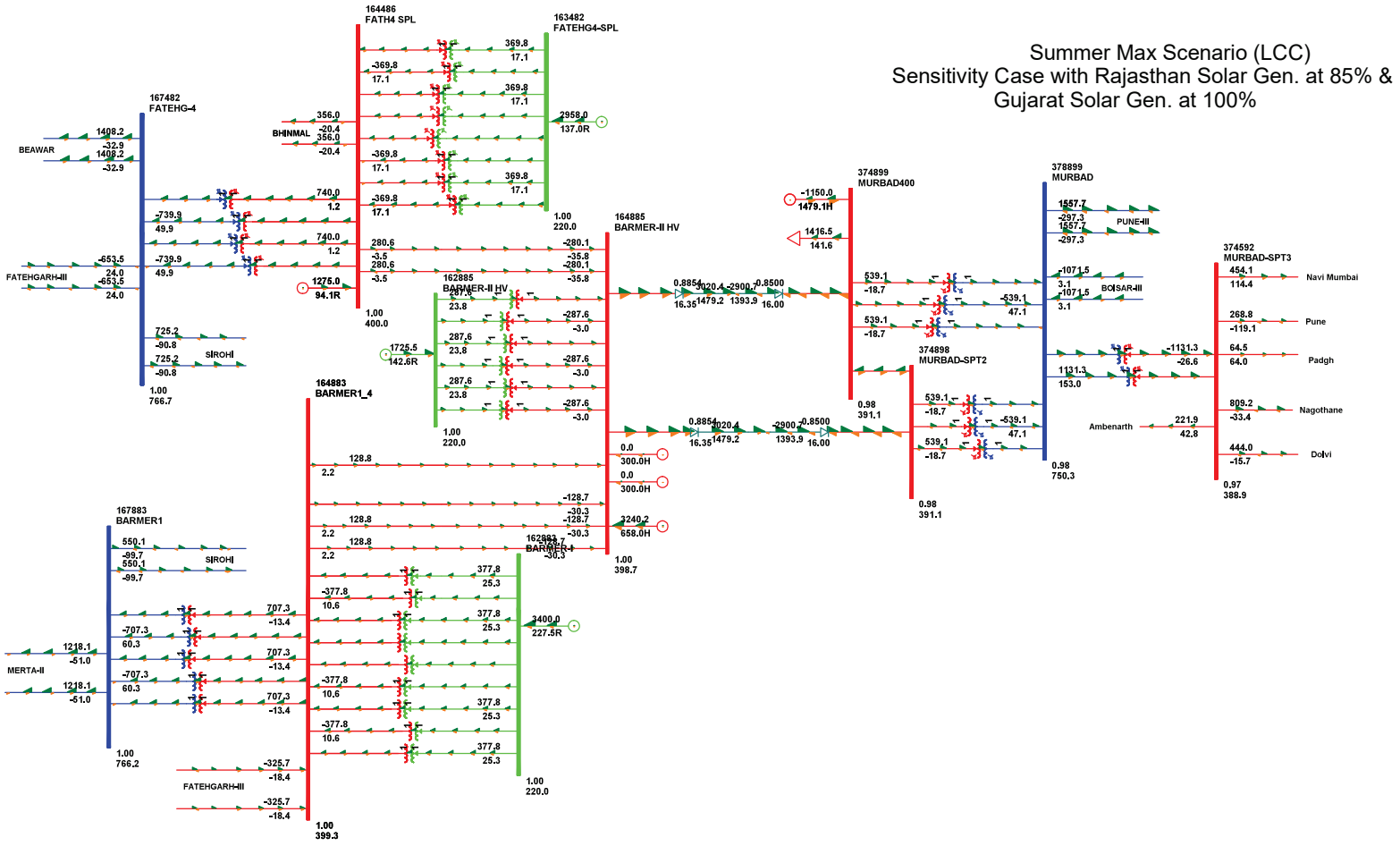
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Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



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

दिनांक: 15, अप्रैल 2025

सेवा में/To,
एनआरपीसी एवं टीसीसी के सभी सदस्य एवं विशेष आमंत्रित (संलग्न सूचीनुसार)
Members of NRPC & TCC & Special Invitees (As per List)

विषय: तकनीकी समन्वय समिति (टीसीसी) की 53 वीं और उत्तर क्षेत्रीय विद्युत समिति की 78 वीं बैठक का कार्यवृत।

Subject: MoM of 53rd Technical Co-ordination Committee (TCC) & 78th Northern Regional Power Committee (NRPC) –reg.

महोदय/महोदया,

तकनीकी समन्वयन समिति (टीसीसी) की 53 वीं बैठक दिनाँक 16.03.2025 एवं उत्तर क्षेत्रीय विद्युत समिति की 78 वीं बैठक दिनांक 17.03.2025 को कोच्चि, केरल में आयोजित की गयी थी। बैठक का कार्यवृत संलग्न है। यहउ.क्षे.वि.स. की वेबसाइट (http://164.100.60.165/) पर भी उपलब्ध है।

53rd meeting of Technical Co-ordination Committee (TCC) was held on 16.03.2025 and 78th meeting of Northern Regional Power Committee (NRPC) was held on 17.03.2025 at Kochi, Kerala. MoM of the same is attached herewith. The same is also available on NRPC Sectt. Website (http://164.100.60.165/).

भवदीय
Yours faithfully

Signed by Vijay Kumar Singh
Date: 15-04-2025 14:25:21

(वी.के. सिंह)
(V.K. Singh)
सदस्य सचिव
Member Secretary

प्रतिलिपि:

1. Shri H. Rajesh Prasad, IAS, Chairperson, NRPC and Principal Secretary to Government, Power Development Department, J&K. (Email: jkpdd9@gmail.com)
2. Shri Rajiv Sood, Ex. Chairperson, NRPC and MD, HPPTCL (md.tcl@hpmail.in)

उत्तर क्षेत्रीय विद्युत समिति

NORTHERN REGIONAL POWER COMMITTEE

Minutes of

The 53rd meeting of Technical Coordination Committee &

The 78th meeting of

Northern Regional Power Committee

Date: 16th & 17th March 2025

Venue: Kochi, Kerala

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Total : INR 3,14,52,432

Say : INR 3.15 Crores

Cost has been calculated based on CPWD issued Plinth Area Rates (PAR) 2023 (cost indexing done up to 01.04.2024 as per CPWD circular dated 11.09.2024)

A.10.5 POWERGRID submitted the proposal for consideration of preliminary estimated cost of INR 3.15 crores (excluding GST) under ADD CAP 24-29 towards construction of additional quarters on the existing quarters at Sohawal and Shahjahanpur Substations under NR-III.

A.10.6 Forum accorded approval to the proposal of POWERGRID.

NRPC Deliberation

A.10.7 Forum concurred the deliberation held in the TCC meeting and gave consent on POWERGRID proposal.

Decision of Forum:

Forum accorded approval for construction of additional quarters on the existing quarters at Sohawal and Shahjahanpur S/s with preliminary estimated cost of INR 3.15 crores (excluding GST) under ADD CAP 24-29.

A.11 Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar) (agenda by CTUIL)

TCC Deliberation

A.11.1 CTUIL representative apprised that after deliberations, transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar) was agreed in the 36th CMETS-NR meeting held on 15.01.25 and 35th CMETS-WR meeting held on 30.01.25.

A.11.2 Further, CTUIL representative briefed the detailed scheme (attached as **Annexure-VI** of agenda) for the above transmission system.

A.11.3 He added that as per discussion held in 25th NCT meeting on 28.11.24, both VSC & LCC technology are being considered in the present proposal and will be discussed along with comparative analysis in NCT meeting for finalization of the scheme.

A.11.4 Dy. COO, CTUIL mentioned that in the CMETS meeting, CTUIL had proposed for LCC scheme however Grid-India suggested to go with VSC technology.

A.11.5 She added that implementation timeframe for LCC technology is less than VSC and cost is approximately 11,000 Cr. higher with VSC technology as compare to LCC.

A.11.6 MS, WRPC stated that WR constituents agreed for LCC technology during discussion held in last WRPC meeting.

A.11.7 MS, NRPC asked the views of NR constituents regarding the technology to be adopted for the scheme.

A.11.8 CTUIL proposed to adopt the LCC technology due to lesser implementation timeframe, less cost, possibility of overload capability, slightly higher efficiency in steady state operation.

A.11.9 NRLDC representative stated that generation evacuation has been planned through HVDC. Various advantages of VSC based HVDC over LCC based HVDC were highlighted in the meeting from NRLDC side:

- VSC HVDC is more effective under low SCR condition as SCR is falling below 2, when HVDC capability is also considered for SC MVA calculation.
- less commutation failure probability
- Capable of providing black start service
- Less harmonic injection, lower filter requirement
- Superior fault ride-through capability
- Can provide grid-forming services, voltage regulation, and frequency support
- One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations.
- There have been issues of continuous oscillations in the grid when SCR falls below 4 at major RE pooling stations such as Fatehgarh-II.

A.11.10 Finally, Forum agreed the proposal of CTUIL for transmission scheme for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar). Forum also noted the preference of CTUIL for LCC technology due to lesser implementation timeframe, less cost, possibility of overload capability, slightly higher efficiency in steady state operation. The advantage of VSC technology, though it is considerably costlier option, as suggested by NRLDC was also discussed.

A.11.11 Forum agreed that the decision on selection of technology between VSC and LCC will be taken in the NCT meeting.

NRPC Deliberation

A.11.12 Forum concurred the discussion held in the TCC meeting and approved the proposal of CTUIL regarding transmission lines scheme on technical ground.

Decision of Forum

Forum accorded approval to the proposal of CTUIL regarding transmission scheme for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar). Further, the technology to be adopted for HVDC system (VSC or LCC based) may be deliberated and decided in the NCT meeting.

A.12 Certification for Non-ISTS Lines carrying inter-state power as specified under Regulation 93 under CERC (Terms & conditions of Tariff) Regulation 2024 (agenda by JSW) & Consideration of Naitwar Mori HEP (60 MW) Transmission system as deemed ISTS scheme (agenda by SJVN)

TCC Deliberation

A.12.1 JSW vide letter dated 07.03.2025 submitted that JSW Energy (Kutehr) Ltd. is in final stage of construction of Kutehr HEP 240 MW in the Chamba District of Himachal Pradesh. COD of the project is expected very shortly around 1st week of May'2025.

Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar)

S. No.	Items	Details
1.	**Name of Scheme**	**Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar)**
2.	**Scope of the scheme**	Details of Transmission scheme (for VSC and LCC alternatives) are 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**	765/400/220kV Fatehgarh-IV PS (Sec-2) PS and Barmer-I PS are under implementation as part of Rajasthan REZ Ph-IV (Part-2 :5.5GW) scheme. 765/400/220kV Fatehgarh-IV PS(Sec-2) is being interconnected to Sirohi S/s (Under implementation), Beawar S/s (Under implementation) and Fatehgarh-III PS (Sec-2) (Under Implementation) at 765kV level and Bhinmal(PG) & Barmer-I PS (Under Implementation) at 400kV level. 765/400/220kV Barmer-I PS is being interconnected to Sirohi PS (Under Implementation) & Merta-II PS (Under Implementation) at 765kV level and Fatehgarh-III PS (Sec-2) PS & Fatehgarh-IV PS(Sec-2) PS (Under Implementation) at 400kV level. South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (Under bidding). Further, another network expansion scheme which includes Creation of New 765kV & 400kV Bus Sections-II & III through sectionalisation along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kallamb S/s with implementation timeframe of 24 months from effective date is required for dispersal of power from subject HVDC towards load centres in Maharashtra. (Under Approval)
5.	**Objective / Justification**	1. The present scheme comprises Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) 2. In the 36th CMETS-NR meeting held on 15.01.2025 It was deliberated that considering application received at Barmer-II PS, transmission scheme is evolved for as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) 3. As part of Renewable Energy Zones (REZs) identified by MNRE/SECI with a total capacity of 75 GW REZs in Rajasthan, evacuation system for 13GW was planned at Fatehgarh (5GW) & Barmer (8GW) complex. Transmission scheme for Rajasthan REZ Ph-IV (Part-2:5.5GW) (Jaisalmer/Barmer Complex) was approved in 14th NCT

S. No.	Items	Details
		meeting for injection at Fatehgarh-IV PS (4GW) & Barmer-I PS (1.5GW) in Rajasthan and also under implementation. 4. Further, for evacuation of power beyond 5.5GW from Fatehgarh-IV PS/Barmer-I PS, transmission system for 3.5GW was approved in 19th NCT meeting, thus making the total approved capacity of 9GW (5.5GW+3.5GW)) at Fatehgarh/Barmer complex. 5. In the joint study meeting held on 28.12.23 & 09.01.24, CTU stated that as per committee report Barmer-II PS was planned for 6GW RE potential (2GW BESS capacity) with 4GW evacuation capacity. In 27th CMETS-NR meeting held on 10.01.24, SECI informed that at present there is no clear visibility for RE projects with BESS before 2027 as award process will take time (1-2 years). In view of that 7.5 GW RE potential (solar) remains untapped due to non-materialisation of BESS capacity (Fatehgarh- IV:4GW+Barmer-I: 1.5GW+Barmer-II: 2GW). Accordingly, it was suggested that 2 GW additional RE potential may be considered for planning of transmission scheme from Barmer- II PS. 6. At present connectivity of about 6GW capacity is already granted at Barmer-II PS. Beyond that about 6 GW connectivity applications are granted/agreed for grant/received at Barmer-III PS. **7.** Based on earlier Grid India observation and recent planned scheme in other regions, studies files were modified for 2030 time frame. For evacuation of 6GW capacity from Barmer-II PS, HVDC system from Barmer-II PS is being planned comprises establishment of Barmer-II PS and HVDC line from Barmer-II PS to Western region (near South of Kalamb) as well as EHVAC system for injection of power at Barmer-II PS and onwards dispersal of power in Western region. Studies were carried out in 2030 time frame for solar maximized scenario and shared on 22.11.24 with all constituents. Grid-India vide mail dated 11.12.24 provided their observation on All India files as well as on proposed transmission scheme which were deliberated in detail in 36th CMETS-NR meeting. 8. As per discussion held in 25th NCT meeting on 28.11.24, both VSC & LCC technology are considered in the present proposal and to be discussed along with comparative analysis in NCT meeting. A comparative analysis of VSC and LCC technology (incl. Grid-India inputs) are enclosed in **Annexure-II.** 9. Grid-India in the 36th CMETS-NR meeting further reiterated that SCR of Barmer-II is on lower side even with considering 2 nos. of Syncon units. CTU stated that SCR of Barmer-II PS is about 3 which is under most pessimistic scenario with calculation methodology suggested by Grid-India, however in actual the SCR would be much higher. Additional as per our understanding and discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1 whereas for LCC technology is > 2.5. The SCR of 400kv Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in next 5-6 months.

S. No.	Items	Details
		10. Grid-India vide mail 22.01.25 as well as in the meeting highlighted the following advantages of VSC based HVDC: ➢ Strong AC systems may not be required as there are no issues of commutation failures and the HVDC operates effectively in weak or even "islanded" grids. ➢ Capable of providing black start services: One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations. ➢ Minimal harmonics due to PWM-based control. Smaller filters required. ➢ Superior fault ride-through capability ➢ Can provide grid-forming services, voltage regulation, and frequency support i.e. ability to maintain appropriate system parameters in different renewable generation scenarios 11. Grid-India further stated in their comments that technically VSC based HVDC is a better alternative than LCC based HVDC keeping in view the low system strength at Barmer-II (SCR < 2.0 without SynCons and ~2.5 with SynCons) and the reactive power and oscillations issues already being faced in the complex. Grid-India further emphasized on control interaction studies, POD studies and filter arrangement modelling. 12. Grid-India stated that space for Syn Con and STATCOMs to be kept at Barmer-II PS as part of future scope so that in case, LCC HVDC is approved and any operational issues are faced in future, additional syncon or STATCOM can be provided for system strengthening. CEA agreed on the proposed scheme for taken up in NCT meeting with both configurations (LCC/VSC). In the CMETS-NR It was deliberated that the final decision regarding implementation of HVDC as LCC or VSC would be taken in NCT meeting. 13. Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) was also deliberated and agreed in 35th CMETS-WR meeting held on 30.01.2025 (MOM awaited.) 14. Considering above deliberations and receipt of connectivity application in Barmer complex, Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) was agreed in 36th CMETS-NR & 35th CMETS-WR meeting.
6.	**Estimated Cost**	**A. For LCC technology: Rs 26,500 Cr** **B. For VSC technology: Rs 38,000 Cr**
7.	**Need of phasing, if any**	Not Applicable
8.	**Implementation timeframe**	54 months from allocation of project (Pole-1: 48 months, Pole-2: 54 months)

S. No.	Items	Details
9.	**System Study for evolution of the proposal**	Studies discussed and agreed in following meeting • 36th CMETS-NR meeting held on 15.01.25 (MOM attached in **Annexure-III**) • 35th CMETS-WR meeting held on 30.01.25 (MOM awaited**)** Load flow results is attached at **Exhibit-II**

Exhibit-I

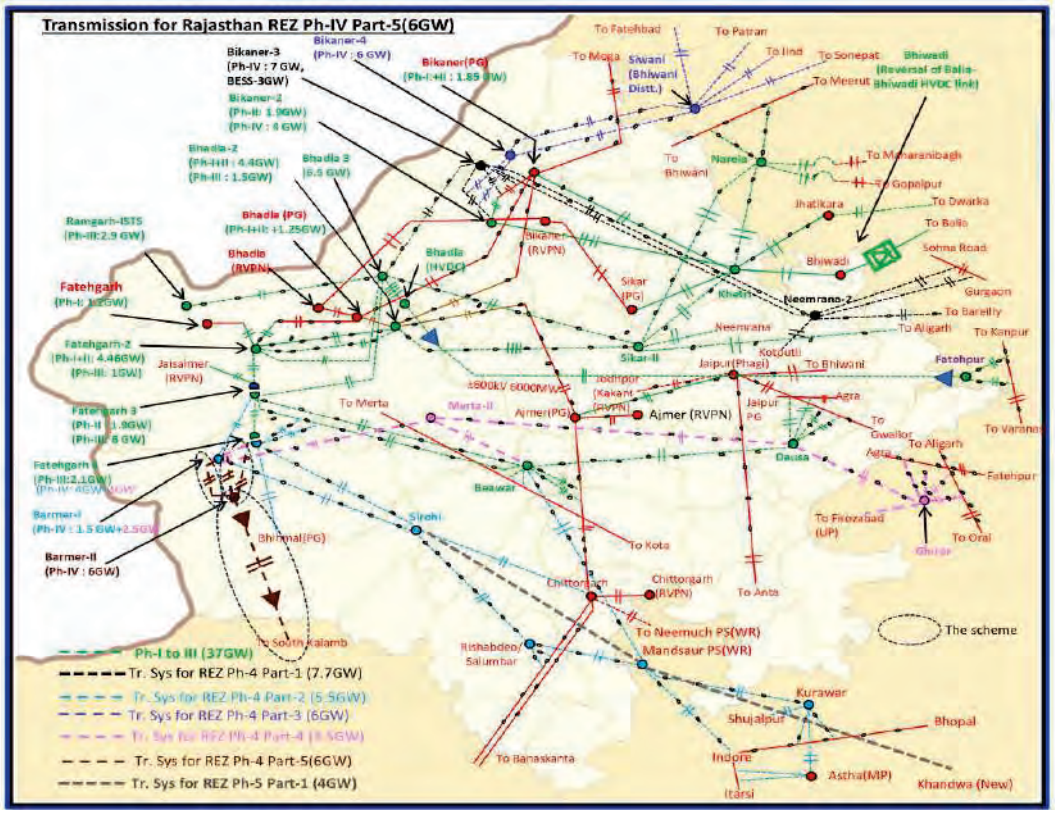


Fig : 1.Transmission system for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)

Annexure-I

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar)

A. Alternative-1 : LCC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor – 6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.)	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	400kV Barmer-II PS - Barmer-I PS D/c line (Quad)	Line Length – (~30 km) • 400 kV line bays at Barmer-II PS – 2 nos. • 400 kV line bays at Barmer-I PS S/s – 2 nos.
4	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800 kV Barmer-II (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
5	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400kV bus sectionaliser -2 nos. (1 Set) at South Kallamb (HVDC) station

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & both 765kV & 400kV bus sectionalizers to be kept normally closed)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)
8	2 nos. of Syncon units at 400kV level of Barmer-II PS (1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) **** Value of inertia constant (H) shall be provided in RfP document.***	• Syncon units – 2 nos. • 400kv line bays – 2nos.

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II to be kept normally closed & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].***

B. Alternative-2: VSC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **<u>Future provisions (excl. scope of present scheme):</u>** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units* at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x+300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) ***1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum). Value of inertia constant (H) shall be provided in RfP document***	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ±600kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
4	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)
5	±600 kV HVDC Double Bipole line (2xD/c) (Quad Lapwing on same tower) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
6	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below* (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & both 765kV & 400kV bus sectionalizers to be kept normally closed)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II to be kept normally closed & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.]***

Feature	LCC-HVDC	VSC-HVDC
Important parameters for technology adoption		
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons). The maximum reactive power required will be almost 60% of rated power	Capable of independent reactive power control. Generally, no external compensation needed. (with inbuilt STATCOM mode of operation)
Grid Strength Dependency	Strong AC systems at both rectifier and inverter end are necessary for commutation. May fail in weak grids (SCR > 2.5)	Strong AC systems are not necessary since there are no issues of commutation failures. Operates effectively in weak or even "islanded" grids.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs (<500 ms)	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing. DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec (for 1100 km)
Efficiency/Losses	Slightly higher efficiency in steady-state operation. Lower line and converter losses	Lower efficiency due to switching losses in IGBTs. Line losses are about 25-30% higher in VSC (for1000km)
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Other technological Differences	**LCC-HVDC**	**VSC-HVDC**
Converter Technology	Uses semiconductors which are capable of withstanding voltage in both direction (Thyristor-based)	Uses semiconductors which are capable of blocking unidirectional voltage only (IGBT with antiparallel diodes or similar switching devices)
Direction of Current and power	Current flow is allowed in single direction. Power direction is changed by changing the voltage polarity.	Current flow can be bidirectional. Power direction is changed by changing the direction of current flow.
Switching Philosophy	Turned on by firing pulses but turn off with assistance of line voltage	Turned on and turn off can be controlled by firing pulses.
Power transfer capability	Thyristors have huge current carrying capability, huge amount of power transfer is possible using LCC technology	IGBTs have lesser current carrying capability and hence the power flow capable is limited.
Source	LCC appears like a current source to AC system (Inductive energy storage)	VSC appears like a voltage source to AC system (Capacitive energy storage)
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Area	The AC and DC yard of LCC are spread over a large area.	Area requirement is much lesser for the same power flow since there are no AC and DC filters

Harmonics	Harmonics are quite high. Harmonics are present both on the AC as well as DC side.; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Transformer size	Converter transformers are used which are heavier, bulkier and costlier.	Normal AC transformers could be used as there is no DC stress and harmonics in the secondary
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support. ability to maintain appropriate system parameters in different renewable generation scenarios
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

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/36 **Date:** 24-02-2025

As per distribution list

Subject: 36th Consultation Meeting for Evolving Transmission Schemes in Northern Region-Minutes of Meeting

Dear Sir/Ma'am,

Please find enclosed the minutes of the 36th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 15th January 2025 (Wednesday) through virtual mode.

The minutes are also available at CTU website (www.ctuil.in)

Thanking you,

Yours faithfully,

(Partha Sarathi Das)
Sr. General Manager (CTU)

response has been received till date. The bidders had not shown any interest in the above project due to a very challenging terrain as well as non-standard rating of transformer. Bidders had shown their apprehension for supply of transformer rating of 3x105MVA single phase units (315MVA) at higher altitude and it is learnt from their pre-bid meetings that supply of this type of transformer itself will take 21 months and further require considerable time for execution.

Considering the above challenges POWERGRID requested CTUIL to consider revising schedule with a fresh schedule project to 30 months from revised CTUIL OM. In view of the above developments, JKPTCL may review its requirement and completion schedule.

JKPTCL stated that Mirbazar capacity augmentation (475VA to 630MVA) will likely to come up by Mar'26. In addition Salal S/s is being implemented in TBCB with commissioning schedule of Mar'27, however ICT augmentation may be required by Mar'26 and POWERGRID can avail that time for ICT augmentation.

POWERGRID stated that they would require at least 30 months (24 months for supply and 6 months for execution) from revised OM date. CTU enquired about present bid status of augmentation of ICT. POWERGRID stated that present bid will be annulled and now in new bid, transformer supply and execution packages kept separately. CTU stated that with present bid status, it is envisaged that ICT would not be available before Aug'27. JKPTCL stated that with increased load of Mirbazar S/s, New Wanpoh ICTs may cater the load, however with their proposed Salal S/s, ICT augmentation is required with best effort schedule of Mar'27. CEA requested POWERGRID to expedite the implementation for reliable dispersal of power in J&K.

CTU stated that recently lot of developments & infrastructure activities were carried out in J&K and with above developments in roads, tunnels, bridges, there may be feasibility of transportation of 315MVA unit rather than 105MVA (Single phase) unit.

POWERGRID stated that Mar'27 implementation schedule is not feasible due to 3 months non working period in winters and therefore it is suggested that Jun'27 schedule may be kept for ICT augmentation. POWERGRID emphasized that single phase configuration may be considered at present as no three phase transformer yet transported through new infrastructure. CTU stated that there is issue in supply and delivery of single phase 105MVA units due to non standard size, therefore to expedite the implementation possibility of 315MVA transformer transportation on new infrastructure (tunnel/road/bridges) may be explored by POWERGRID and informed it within 1 month.

JKPTCL stated that they also faced issue of 3 months non working season in winters and therefore based on tendering issues in 105MVA unit as well as POWERGRID request for extension of commissioning of ICT augmentation, Jun'27 schedule may be kept for ICT augmentation.

G9. Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)

It was stated that Renewable Energy Zones (REZs) were identified by MNRE/SECI with a total capacity of 181.5 GW for likely benefits by the year 2030 in eight states, which includes 75GW REZ potential in Rajasthan comprising of 15 GW Wind and 60 GW Solar. In this

regard a Committee on Transmission Planning for RE was constituted by MOP for planning of the requisite Inter State Transmission System required for the targeted RE capacity by 2030 for which a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan evolved.

Details of schemes approved/Under Planning scheme as part of above is as under:

S.No	Transmission Scheme	RE Potential	Status
A	**Under Bidding/ Approved**		
1	Rajasthan REZ Ph-IV (Part-1 :7.7GW) (Bikaner Complex)	14 GW (Solar 14GW, BESS:6GW) Bikaner-II : 3.7GW Bikaner-III: 4GW	Under Implementation
2	Rajasthan REZ Ph-IV (Part-2 :5.5GW) (Jaisalmer/Barmer Complex)	5.5GW (Solar) Fatehgarh-IV: 4 GW Barmer-I: 1.5 GW	Under Implementation
3	Rajasthan REZ Ph-IV (Part-3 :6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-IV:6GW	Under Implementation
4	Rajasthan REZ Ph-IV (Part-4 :3.5GW) (Jaisalmer/Barmer Complex)	3.5 GW (Solar) Fatehgarh-IV: 1 GW Barmer-I: 2.5 GW	Under Implementation
5	Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex)	4 GW (Solar) Sirohi: 2 GW Nagaur: 2 GW	Under Bidding
B	**Planned/Under Planning**		
1	**Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)**	**6 GW (Solar)** **Barmer-II : 6GW**	**Timeframe : 2029 (HVDC)**
2	Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-V: 6 GW	Timeframe : 2030 (HVDC)
3	Rajasthan REZ Ph-V (Part-7 : 6GW) (Bhadla Complex)	6 GW (Solar) Bhadla-IV: 6 GW	

4	Rajasthan REZ Ph-V (Part-2 : 6GW) (Ramgarh Complex)	6 GW (Solar) Ramgarh-II: 6 GW	

A Joint study meeting was held on 09.05.24 with stakeholders in NR to deliberate & finalize the Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur] Complex, Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bhadla/Bikaner Complex).

In the above Joint study meeting, Grid-India observations on proposed transmission schemes as well as on All India Study files (2027 & 2029 time frame) were deliberated and same was also communicated by Grid-India vide their mail dated 09.05.24. It was decided in the meeting that comprehensive schemes discussed may be segregated in two phases (Phase-1: Transmission scheme for Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex) & Phase-2: Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bikaner Complex). Accordingly, Transmission scheme for Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex) was agreed in 30th CMETS-NR meeting held on 18.06.24.

Considering application received at Barmer-II PS, transmission scheme is evolved for as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) and being discussed in present meeting.

Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)

As part of Renewable Energy Zones (REZs) identified by MNRE/SECI with a total capacity of 75 GW REZs in Rajasthan, evacuation system for 13GW was planned at Fatehgarh (5GW) & Barmer (8GW) complex. Transmission scheme for Rajasthan REZ Ph-IV (Part-2:5.5GW) (Jaisalmer/Barmer Complex) was approved in 14th NCT meeting for injection at Fatehgarh-IV PS (4GW) & Barmer-I PS (1.5GW) in Rajasthan and also under implementation

For evacuation of power beyond 5.5GW from Fatehgarh-IV PS/Barmer-I PS, hybrid transmission system (EHVAC(3.5GW)+HVDC(6GW)) from Fatehgarh/Barmer complex was planned. EHVAC evacuation system comprises 3.5 GW capacity transmission system from Fatehgarh-IV/Barmer-I (thus making total planned capacity of 9GW (5.5GW+3.5GW)) was approved in 19th NCT meeting

In the joint study meeting held on 28.12.23 & 09.01.24, CTU stated that as per committee report Barmer-II PS was planned for 6GW RE potential (2GW BESS capacity) with 4GW evacuation capacity. In 27th CMETS-NR meeting held on 10.01.24, SECI informed that at present there is no clear visibility for RE projects with BESS before 2027 as award process will take time (1-2 years). In view of that 7.5 GW RE potential (solar) remains untapped due to non-materialisation of BESS capacity (Fatehgarh- IV:4GW+Barmer-I : 1.5GW+Barmer-II: 2GW). Accordingly, it was suggested that 2 GW additional RE potential may be considered for planning of transmission scheme from Barmer- II

PS. SECI informed that they will provide their inputs on enhancement of potential at Barmer- II PS (4GW to 6GW) in consultation with MNRE and RE developers. SECI may update on the same.

At present connectivity of about 6GW capacity is already granted at Barmer-II PS. Beyond that about 1.5 GW connectivity applications are granted and 2.7GW application received for connectivity at Barmer-III PS .

Based on earlier Grid India observation and recent planned scheme in other regions, studies files were modified for 2030 time frame. For evacuation of 6GW capacity from Barmer-II PS, HVDC system from Barmer-II PS is being planned comprises establishment of Barmer-II PS and HVDC line from Barmer-II PS to Western region (near South of Kalamb) as well as EHVAC system for injection of power at Barmer-II PS and onwards dispersal of power in Western region. Studies were carried out in 2030 time frame in for solar maximized scenario and shared on 22.11.24 with all constituents. Grid-India vide mail dated 11.12.24 provided their observation on All India files as well as on proposed transmission scheme (copy of Grid-India observations is enclosed in **Annexure-B1**). The main observation of Grid-India is as under :

- SCR & inertia requirement at Barmer-I PS
- Comparison of VSC and LCC technology
- Justification of termination of HVDC at South Kalamb
- Congestion in WR & SR-WR
- Inputs on load generation balance

Reply of Grid-India observations for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) is enclosed in **Annexure-B2.** As per discussion held in 25th NCT meeting on 28.11.24, both VSC & LCC technology are considered in the present proposal and to be discussed along with comparative analysis in NCT meeting. A comparative analysis of VSC and LCC technology (incl. Grid-India inputs) are as under:

Feature	LCC-HVDC	VSC-HVDC
Important parameters for technology adoption		
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons). The maximum reactive power required will be almost 60% of rated power	Capable of independent reactive power control. Generally, no external compensation needed. (with inbuilt STATCOM mode of operation)
Grid Strength Dependency	Strong AC systems at both rectifier and inverter end are necessary for commutation. may fail in weak grids (SCR > 2.5)	Strong AC systems are not necessary since there are no issues of commutation failures.

		Operates effectively in weak or even "islanded" grids.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs (<500 ms)	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing. DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec (for 1100 km)
Efficiency/Losses	Slightly higher efficiency in steady-state operation. Lower line and converter losses	Lower efficiency due to switching losses in IGBTs. Line losses are about 25-30% higher in VSC (for1000km)
Cost	Lower initial cost for converters, but higher for filters and compensators. Overall initial cost is lower in LCC technology.	Higher initial cost for converters, lower for ancillary components. Overall initial cost is higher in VSC technology.
Other technological Differences	**LCC-HVDC**	**VSC-HVDC**
Converter Technology	Uses semiconductors which are capable of withstanding voltage in both direction (Thyristor-based)	Uses semiconductors which are capable of blocking unidirectional voltage only (IGBT with antiparallel diodes or similar switching devices)
Direction of Current and power	Current flow is allowed in single direction. Power direction is changed by changing the voltage polarity.	Current flow can be bidirectional. Power direction is changed by changing the direction of current flow.
Switching Philosophy	Turned on by firing pulses but turn off with assistance of line voltage	Turned on and turn off can be controlled by firing pulses.
Power transfer capability	Thyristors have huge current carrying capability, huge amount of power transfer is possible using LCC technology	IGBTs have lesser current carrying capability and hence the power flow capable is limited.
Source	LCC appears like a current source to AC system (Inductive energy storage)	VSC appears like a voltage source to AC system (Capacitive energy storage)
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.

Area	The AC and DC yard of LCC are spread over a large area.	Area requirement is much lesser for the same power flow since there are no AC and DC filters
Harmonics	Harmonics are quite high. Harmonics are present both on the AC as well as DC side.; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Transformer size	Converter transformers are used which are heavier, bulkier and costlier.	Normal AC transformers could be used as there is no DC stress and harmonics in the secondary
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support. ability to maintain appropriate system parameters in different renewable generation scenarios
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Details of HVDC VSC configuration (Double Bipole with parallel DMR/ Parallel Bipole with parallel DMR) is enclosed in **Annexure B3**.

Grid-India in the meeting further reiterated that SCR of Barmer-II is on lower side even with considering 2 nos. of Syncon units. CTU stated that SCR of Barmer-II PS is about 3 which is under most pessimistic scenario with calculation methodology suggested by Grid-India, however in actual the SCR would be much higher. Additional as per our understanding and discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1 whereas for LCC technology is > 2.5. The SCR of

400kv Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in next 5-6 months.

Grid-India vide mail 22.01.25 as well as in the meeting highlighted the following advantages of VSC based HVDC.

- Strong AC systems may not be required as there are no issues of commutation failures and the HVDC operates effectively in weak or even "islanded" grids.
- Capable of providing black start services: One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations
- Minimal harmonics due to PWM-based control. Smaller filters required.
- Superior fault ride-through capability
- Can provide grid-forming services, voltage regulation, and frequency support i.e. ability to maintain appropriate system parameters in different renewable generation scenarios

Grid-India in the comments received on 22.01.25 (**copy enclosed in Annexure B4**) further emphasized that technically VSC based HVDC is a better alternative than LCC based HVDC keeping in view the low system strength at Barmer-II (SCR < 2.0 without SynCons and ~2.5 with SynCons) and the reactive power and oscillations issues already being faced in the complex. Grid -India further emphasized on control interaction studies, POD studies and filter arrangement modelling. Reply of Grid-India observations for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) is already enclosed in **Annexure-B2.**

Grid-India in the meeting stated that they do not have any major observation on revised cases, however there are minor observations on LGB which they will communicate in meanwhile time. Grid-India emphasis that space for STATCOMs & additional Syn Cons and to be kept at Barmer-II PS as part of future scope so that in case, LCC HVDC is approved and any operational issues are faced in future, additional syncon or STATCOM can be provided for system strengthening. CEA agreed on the proposed scheme for taken up in NCT meeting with both configurations (LCC/VSC). No other comments were received from stakeholders in the meeting. It was deliberated that the final decision regarding implementation of HVDC as LCC or VSC would be taken in NCT meeting.

Considering grant of connectivity to new RE generators/applicants in Barmer complex, following transmission scheme is agreed for evacuation of power from Rajasthan REZ Ph-IV (Part-5 : 6GW)

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar)

A. Alternative-1 : LCC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.)	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	400kV Barmer-II PS - Barmer-I PS D/c line (Quad)	Line Length – (~30 km) • 400 kV line bays at Barmer-II PS – 2 nos. • 400 kV line bays at Barmer-I PS S/s – 2 nos.
4	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800 kV Barmer-II (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
5	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400kV bus sectionaliser -2 nos. (1 Set) at South Kallamb (HVDC) station
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below. * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kallamb S/s & both 765kV & 400kV bus sectionalizers to be kept normally closed)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)
8	2 nos. of Syncon units at 400kV level of Barmer-II PS (1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) ** Value of inertia constat (H) shall be provided in RfP document.*	• Syncon units – 2 nos. • 400kv line bays – 2nos.

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kallamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II to be kept normally closed & between sections-II & III to be normally open. Further, 765kV sectionaliser between***

Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions. Further, all space provisions as per RfP document of South Kalamb S/s shall be kept while implementing this scheme].

B. Alternative-2: VSC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x+300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) ***(1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum). Value of inertia constat (H) shall be provided in RfP document).***	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ±600kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
		➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
4	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)
5	±600 kV HVDC Double Bipole line (2xD/c) (Quad Lapwing on same tower) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
6	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below. * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kallamb S/s & both 765kV & 400kV bus sectionalizers to be kept normally closed)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kallamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II to be kept normally closed & between sections-II & III to be normally open. Further, 765kV sectionaliser between***

Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions. Further, all space provisions as per RfP document of South Kalamb S/s shall be kept while implementing this scheme.]

G10. Power flow congestion to Delhi Ring Main unit through 400 kV Switchyard at 765/400KV Jhatikra substation

It was stated that Power flow congestion to Delhi Ring Main unit through 400 kV Switchyard at 765/400KV Jhatikra substation was deliberated in 224th OCC meeting held on 18.10.24. In the meeting, POWERGRID stated that 400 kV Bus at Jhatikra is sectionalised in 02 sections (Section-1 feeds load to Bamnauli/Dwarka S/s through 765/400 kV ICT-1&2, whereas Section-II feeds loads to Mundka S/s through 765/400 kV ICT-3&4)

POWERGRID further stated that maximum load recorded through both the sections in 2024 Summer peak is ~ 2500 MW (~ 4000 Amp). In case of breakdown of any tie bay across 400 kV switchyard, the power flow through remaining tie bay in section is 4000 Amps which is much higher than bay equipment rating of (3150 Amp). In order to overcome the situation, following three options were deliberated to relieve the congestion:

- Option 1:- Upgradation of rating of switchyard equipment of 400 kV tie bay at Jhatikra from 3150 to 4000 Amp.
- Option 2:- Provision of additional bus coupler in both sections of 400 kV buses to share the load in case of tie bay contingency.
- Option 3:-Considering time duration in implementation of above proposed solutions, direct coupling arrangement of 400 kV buses may be allowed from April-Oct'25 to cater smooth power transition to Delhi.

In the meeting, it was concluded that CTU to carry out detailed study in consultation with NRLDC on load congestion relieving measures at Jhatikara S/s including provision for upcoming ICTs at Jhatikra S/S and Narela S/s and submit the report to OCC forum.

Subsequently, in 225th OCC meeting held on 12.11.24, CTU informed that 765/400kV Jhatikra S/s has two separate 400 kV sections with two 1500 MVA ICTs in each section. If these sections are connected through sectionalizer, the loading relief observed (100-150MW) on each ICT) in the event of a contingency. CTU has requested Powergrid to confirm the availability of space for the bus sectionalizer and bay upgradation works. CTU has also asked NRLDC to provide the loading patterns for both the Jhatikra-Bamnauli and Jhatikra-Mundaka sections.

To resolve above issue, a meeting was held on 04.12.24 with POWERGRID officials for preliminary discussion on feasibility of various options to relieve congestion at Jhatikra S/s in short term as well as long term. Further a joint meeting was held on 11.12.2024 among CTUIL, NRPC, CEA, Grid-India & POWERGRID to deliberate on above congestion issues.

In the meeting POWERGRID stated that the primary issue is the heavy loading on the tie bays due to radial power feeding to Delhi. In the event of an outage of any line or one of the tie bays in either section, the load on the remaining tie bay in that section exceeds the

Grid-India Inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6GW (Solar):

- LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS (~20km)
- Establishment of 2 nos. 3000 MW, ± 600 kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation
- 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal.
- 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
- Establishment of 2 nos. 3000 MW, ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb
- Establishment 2x1500MVA, 765/400kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor
- LILO of Pune-III – Boisar-II 765kV D/c line at South Kalamb with associated bays at South Kalamb S/s
- Installation of 1x240 MVAr switchable line reactor on each ckt at South Kalamb end of Boisar-II – South Kalamb 765 kV D/c line (formed after above LILO)
- ±600 kV HVDC Bipole line between Barmer-II (HVDC) & South Kalamb (HVDC) (with Dedicated Metallic Return) (capable to evacuate 6000MW) (1100 kms)

Grid-India Inputs:

1. In the scheme, the evacuation of 6000 MW is proposed from VSC HVDC link from Barmer-II (new) substation to South Kalamb (Murbad).

   It is mention here that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

   Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Without considering the contribution of RE getting connected	10788	23409
2.	Considering the contribution of RE getting connected	13560	29058

   - *Installed capacity considered at 220 kV level:* ***2000 MW***
   - *Installed capacity considered at 400 kV level:* ***4000 MW***
   - *SCR at 220 kV level – (10788/2000):* ***5.394***
   - *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***

Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. The suitable alternatives to add fault level as well as inertia like SynCon may be considered in such pockets. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection (and hence system strength) such as **Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame).** The HVDC may then be planned from such station to a suitable location.

2. Comparison of VSC and LCC based HVDC

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Thyristor-based	IGBT-based (or similar switching devices)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons).	Capable of independent reactive power control. Generally, no external compensation needed.
Grid Strength Dependency	Requires a strong AC grid for commutation. May fail in weak grids. (SCR > 3)	Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Harmonics	Produces significant harmonics; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing,
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support.
Efficiency/Losses	Slightly higher efficiency in steady-state operation.	Lower efficiency due to switching losses in IGBTs.
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Both LCC and VSC based HVDCs have certain advantages and disadvantages. While LCC based HVDC is not suitable for low system strength pockets, the reliability of VSC HVDC during DC line fault always depends on switching of AC side CB and it is possible that high stress is experienced by equipment during DC line fault. Since the length of this HVDC link is expected to be around 1100 kM, the chances of DC line fault owing to higher exposure may be of high probability. The Technical requirement for HVDC shall clearly specify that HVDC shall be designed with redundancy so that system shall be able to operate under transient fault conditions. These aspects shall be taken in due consideration while specifying the technical specification of the HVDC in the RfP.

3. Other inputs on the proposed HVDC scheme are as under:

a) The rationale for terminating the HVDC in WR (Maharashtra) may be provided. Another HVDC from Khavda-V to Alephata (Maharashtra) is also terminating in the same area.

In the February solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region such as - 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C - are observed carrying power in the WR-to-SR direction. The all India level LGB may be reviewed.

Many 400 kV lines in Pune / Mumbai area are loaded beyond their permissible limits in the Sce-4 and Sce-7 cases e.g. 400 kV Kalwa- Estella S/C, 400 kV Pagdhe – Estella S/C, 400 kV Boisar-II - Pagdhe D/C etc.

Further, as highlighted in section on Load-Generation Balance below, the LGB of the case is subject to change with the proposed corrections which may lead to change in location of HVDC terminal.

b) Khavda (41.5 GW), Lakadia (3.5 GW & 7.5 GW), Raghanesda (3 GW), Bhuj (4.5 GW & 5.5 GW), Jamnagar (1 GW), Jam Khambaliya (3 GW & 4.5 GW) RE evacuation system is shown below

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As per above planning, most of the above RE generation will be consumed in Maharashtra (MMR & Pune) area. Two major HVDC (± 800 kV, 6000 MW LCC HVDC from Khavda-II to Nagpur and ± 800 kV 6000 MW LCC HVDC (or ± 600 kV VSC) from Lakadia-II to Alepheta) links from Khavda complex to Maharashtra system are already planned.

c) Terminating of HVDC at South Kalamb (Murbad) may be reviewed as already two HVDCs are terminating in Maharashtra and distance between Alephata to Kalamb is less than 50 km.

d) Number of new In-STS S/s (Dolvi, Kandalgaon, Estella, Velgaon, Ambernath, Theur, Padghe-Split, Kalwa Split, Estella Coromandel etc.) in MMR & Pune area is considered. Therefore, constraints faced in the Mumbai/Pune area are not reflected much in study cases. Timely commissioning of In-STS in the Mumbai/Pune area is very essential. Inordinate delays in commissioning of In-STS are generally observed. Hence, remedial measures need to be mentioned for delays in commissioning of In-STS.

e) Currently, constraints are being observed in Southern part of Maharashtra (Kolhapur/Karad area) during high injection from SR to WR. Another scenario (i.e. high injection from SR to WR along with low generation in Khavda/NR area) to be studied for assessing the transmission constraints and identification of remedial measures.

f) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 non-compliant. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

g) As mentioned earlier, controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

h) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

i) As HVDC are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature-based overload capability** for the proposed HVDCs. Also, as VSC based HVDC is being proposed, it is understood that complete capacity in reverse direction is available.

j) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

4. **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

5. **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

   A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

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6. Inputs on Load Generation Balance:

In base cases shared, demand of Rajasthan considered in scenario-4: Jul month(31GW) seems to be on higher side. Similarly, in scenario-7: Feb month (35.4GW) seems to be on very higher side. Powerfactor of load also to be revised according to practical values to get correct picture of any low voltage scenario.

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
CHANDIGARH	P	353.2	0.95	411.6	0.96
	Q	112.7		120	
J&K	P	4193.4	0.99	2840.6	0.96
	Q	615.8		828.5	
HIMACHAL	P	2395.4	0.99	1780.1	0.96
	Q	399		519.2	
PUNJAB	P	12742.1	0.99	17627.8	0.96
	Q	1903.2		5138.9	
HARYANA	P	12981.3	0.99	16580.6	0.96
	Q	1930.6		4836	
DELHI	P	6045.8	0.98	9367.3	0.96
	Q	1118.8		2864.4	
RAJASTHAN	P	35442.5	0.99	31266.8	0.96
	Q	4427.2		8839.5	
UP	P	26303.5	0.99	31161.5	0.96
	Q	3833.8		9088.8	
LADAKH	P	40.1	0.99	27.3	0.96
	Q	5.9		8	
UTTARAKHAND	P	2581.5	0.98	2955	0.96
	Q	504		844.5	
NR	P	103078.7	0.99	114018.5	0.96
	Q	14851		33087.7	

Feb Solar (Scenario - 7)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met during Solar Hours, Feb 2024 (MW)
1	NR	103722	146006	42284	116745	54890	63791
2	WR	112173	137614	25441	107050	68960	74167
3	SR	104357	90900	-13457	97440	60929	65591
4	ER	41435	17785	-23650	45752	19429	22745
5	NER	2902	2025	-877	5835	2013	2209
6	All India	366648	396728	x	334811	206123	221989

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S. No.	State	Load (MW)	Gen (State+ Central) (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)	Peak Demand Met in Solar Hours, Feb 2024 (MW)
1	Rajasthan	35468	110783	25058	17000	18058
2	Gujarat	41433	71297	33964	19113	21258
3	Maharashtra	40627	30993	39891	27379	29821
4	MP	21288	23092	25596	14553	16885

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, # Export is considered positive**

June Solar (Scenario - 4)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in June 2024 (MW)	Peak Demand met during Solar Hours, June 2024 (MW)
1	NR	114849	156993	42144	116745	80252	91040
2	WR	108797	130420	21623	107050	64167	74882
3	SR	98015	95583	-2432	97440	48363	58488
4	ER	47997	14483	-33514	45752	27672	31436
5	NER	3706	3377	-329	5835	2467	3023
6	All India	375349	406220	x	334811	222917	244540

S. No.	State	Load (MW)	Gen. (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met in Feb 2024 (MW)
1	Rajasthan	31266	113355	25058	16199	18425
2	Gujarat	44908	76899	33964	21934	26054
3	Maharashtra	39589	29129	39891	23622	28715
4	MP	15757	18715	25596	11155	13828

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, #Export is considered positive**

- In both February solar and June Solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region—such as the 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C—are observed carrying power in the WR-to-SR direction

- Dispatch of Thermal Plants:

    - The thermal generation of some of the plants i.e. APL/CGPL has been backed down to very low levels (~35%).
    - Pit head plant: Talcher backed down to ~35% level
    - Pit head plant: V'chal backed down to ~34% level
    - Pit head plant: Korba backed down to ~34% level

  The tech minimum level considered in the case may be mentioned, and the generators' dispatch should be considered per merit order.

- The demand in Rajasthan and Gujarat is seen to be on a higher end than the figures from EPS. The reason for the high demand may be mentioned.

- Consideration of GH2 and other bulk consumer loads may be mentioned in the planning scheme itself, duly citing the uncertainty behind the assumptions and requirement of further transmission planning in case of delay/deferment of GH2/Bulk load projects.

  The production cost modelling studies duly factor in the RPO targets for each states, RE integration targets, flexibility requirements, merit order etc. Therefore, it is suggested that the study scenario may be finalized based on the output of the production cost modelling studies for the same timeframe. This LGB will itself indicate the paths/corridors along with the system augmentation is required.

7. Punjab internal generation considered in scenario-7 to be corrected:

Bus Number	Bus Name	Id	Area Num	Area Name	Zone Num	Zone Name	Code	VSched (pu)	In Service	PGen (MW)	PMax (MW)
132204	LEHRAMOHBT 220.00	T 1	13	PUNJAB	131	PB_STU	-2	1	1	52.5	210
132204	LEHRAMOHBT 220.00	T 2	13	PUNJAB	131	PB_STU	-2	1	1	52.5	210
132270	GOINDWALSB 220.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	67.5	270
132270	GOINDWALSB 220.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	67.5	270
132323	SPL_ROPAR 220.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
132323	SPL_ROPAR 220.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
132323	SPL_ROPAR 220.00	T 3	13	PUNJAB	131	PB_STU	2	1	1	52.5	210
134401	TALWNDISABO4 400.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	165	660
134401	TALWNDISABO4 400.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	165	660
134406	RAJPURA_TH4 400.00	T 1	13	PUNJAB	131	PB_STU	2	1	1	175	700
134406	RAJPURA_TH4 400.00	T 2	13	PUNJAB	131	PB_STU	2	1	1	175	700

8. **Dynamic Simulation Studies –** With more than 100 GW solar generation and two HVDC terminals in Rajasthan in close vicinity, it is important that stability aspects are also studied in detail at the planning stage. The generation is also getting evacuated through large EHV lines and hence, transient stability analysis also becomes important. Therefore, it is suggested that the results of the dynamic simulation studies may be shared.

9. Bara TPS generation model to be corrected, same is modelled at 400kV whereas it is existing at 765kV level.

Annexure B2

Reply of Grid-India inputs on Rajasthan REZ Ph-IV (Part-5 :6 GW) Barmer-II : 6GW (Solar) scheme

Grid-India Inputs:

1. In the scheme, the evacuation of 6000 MW is proposed from VSC HVDC link from Barmer-II (new) substation to South Kalamb (Murbad).

   It is mention here that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

   Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Without considering the contribution of RE getting connected	10788	23409
2.	Considering the contribution of RE getting connected	13560	29058

   - *Installed capacity considered at 220 kV level:* ***2000 MW***
   - *Installed capacity considered at 400 kV level:* ***4000 MW***
   - *SCR at 220 kV level – (10788/2000):* ***5.394***
   - *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***

   Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. The suitable alternatives to add fault level as well as inertia like SynCon may be considered in such pockets. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection (and hence system strength) such as **Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame).** The HVDC may then be planned from such station to a suitable location.

CTU Reply :

As per our understanding and discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1 whereas for LCC technology is > 2.5.

Integration of RE power to other intermediate sub stations through EHVAC system i.e. Ajmer, Chittorgarh, Beawar, Rishabdeo etc. and its further evacuation through HVDC from intermediate substations is not feasible due to space constraint on above substations. SCR values of Barmer-II and South Kalaamb (Murbad) S/s is as below:

S. No.	Voltage level	Envisaged generation (MW)	Wo Considering additional Barmer-II-Barmer-I D/c line (present file)		With Considering additional Barmer-II-Barmer-I D/c line & Syncons (2 units*)	
			SCMVA (Considering no contribution from incident bus)	SCR	SCMVA (Considering no contribution from incident bus)	SCR
1.	Barmer-II (220kV)	2180	11510	5.27	12500	**5.75**
2.	Barmer-II (400kV)	(3812+2180) 5992	23290	3.88	29550	**4.95**
3	Murbad (400kV)	3000	26300 (13200)	8.7 (4.4)	26300 (13200)	**8.7 (4.4)**
3	Murbad Splt (400kV)	3000	13200	4.4	13200	**4.4**

1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) with Minimum H (natural) =4 s

From the table, it is envisaged that SCR at 400kV and 220kV level of Barmer-II PS is adequate for HVDC operation (LCC/VSC). The SCR of 400kv Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in next 2-3 months.

2 units of Syncons shall be considered with LCC technology alternative. Space provision of 2 units of SyCon shall be kept in VSC technology alternative as part of comprehensive scheme and taken up for implementation as per future requirement.

2. Comparison of VSC and LCC based HVDC

Feature	LCC-HVDC	VSC-HVDC
Converter Technology	Thyristor-based	IGBT-based (or similar switching devices)
Reactive Power Requirements	Requires substantial reactive power compensation (e.g., Filter Banks, SVC, STATCOM, SynCons).	Capable of independent reactive power control. Generally, no external compensation needed.

Feature	LCC-HVDC	VSC-HVDC
Grid Strength Dependency	Requires a strong AC grid for commutation. May fail in weak grids. (SCR > 3)	Operates effectively in weak or even "islanded" grids.
Black Start Capability	Not suitable for black start without additional support.	Capable of providing black start services.
Harmonics	Produces significant harmonics; requires large filters.	Minimal harmonics due to PWM-based control. Smaller filters required.
Power Reversal	Possible. Requires changing DC polarity for power reversal.	Possible (seamless). Achieved by changing current direction without altering DC polarity.
Fault Ride-Through	Limited ability to ride through grid faults. May trip under disturbances.	Superior fault ride-through capability.
Network restart time during DC line faults	Less (depend on de-ionization time) in milli-secs	>1 sec (1.5 secs in case of HVDC Pugalur – Trichur for Line to Ground faults); highly dependent on AC side circuit breaker opening/reclosing,
Overload Capability	Possible (usually 10-20% for short durations).	Not available as standard, may be full converter rating (depends on standard rating vs extra overload expected)
Converter Footprint	Large, due to filters, reactive power compensators, and transformers.	Compact, as filters and external compensators are minimized.
Grid Support Functions	Limited (e.g., no independent voltage control).	Can provide grid-forming services, voltage regulation, and frequency support.
Efficiency/Losses	Slightly higher efficiency in steady-state operation.	Lower efficiency due to switching losses in IGBTs.
Cost	Lower initial cost for converters, but higher for filters and compensators.	Higher initial cost for converters, lower for ancillary components.
Bidirectional Power Flow	Achieved but with slower transition.	Seamless bidirectional power flow

Both LCC and VSC based HVDCs have certain advantages and disadvantages. While LCC based HVDC is not suitable for low system strength pockets, the reliability of VSC HVDC during DC line fault always depends on switching of AC side CB and it is possible that high stress is experienced by equipment during DC line fault. Since the length of this HVDC link is expected to be around 1100 kM, the chances of DC line fault owing to higher exposure may be of high probability. The Technical requirement for HVDC shall clearly specify that HVDC shall be designed with redundancy so that system shall be able to operate under transient fault conditions. These aspects shall be taken in due consideration while specifying the technical specification of the HVDC in the RfP.

CTU Reply : Comments are noted as part of agenda.

3. Other inputs on the proposed HVDC scheme are as under:

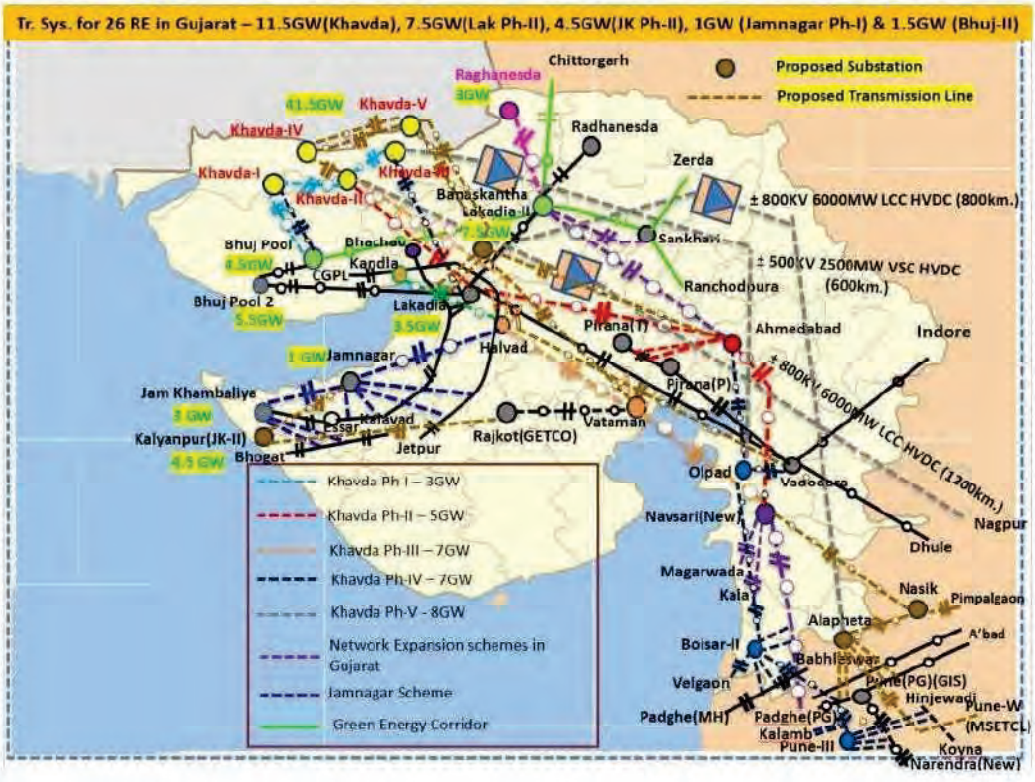
a) The rationale for terminating the HVDC in WR (Maharashtra) may be provided. Another HVDC from Khavda-V to Alephata (Maharashtra) is also terminating in the same area.

In the February solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region such as - 765 kV Narendra New–Pune–III D/C and 765 kV Raichur–Solapur D/C - are observed carrying power in the WR-to-SR direction. The all India level LGB may be reviewed.

Many 400 kV lines in Pune / Mumbai area are loaded beyond their permissible limits in the Sce4 and Sce-7 cases e.g. 400 kV Kalwa- Estella S/C, 400 kV Pagdhe – Estella S/C, 400 kV BoisarII - Pagdhe D/C etc.

Further, as highlighted in section on Load-Generation Balance below, the LGB of the case is subject to change with the proposed corrections which may lead to change in location of HVDC terminal.

b) Khavda (41.5 GW), Lakadia (3.5 GW & 7.5 GW), Raghanesda (3 GW), Bhuj (4.5 GW & 5.5 GW), Jamnagar (1 GW), Jam Khambaliya (3 GW & 4.5 GW) RE evacuation system is shown below



As per above planning, most of the above RE generation will be consumed in Maharashtra (MMR & Pune) area. Two major HVDC (± 800 kV, 6000 MW LCC HVDC from Khavda-II to Nagpur and ± 800 kV 6000 MW LCC HVDC (or ± 600 kV VSC) from Lakadia-II to Alepheta) links from Khavda complex to Maharashtra system are already planned.

c) Terminating of HVDC at South Kalamb (Murbad) may be reviewed as already two HVDCs are terminating in Maharashtra and distance between Alephata to Kalamb is less than 50 km.

d) Number of new In-STS S/s (Dolvi, Kandalgaon, Estella, Velgaon, Ambernath, Theur, Padghe-Split, Kalwa Split, Estella Coromandel etc.) in MMR & Pune area is considered. Therefore, constraints faced in the Mumbai/Pune area are not reflected much in study cases. Timely commissioning of In-STS in the Mumbai/Pune area is very essential. Inordinate delays in commissioning of In-STS are generally observed. Hence, remedial measures need to be mentioned for delays in commissioning of In-STS.

e) Currently, constraints are being observed in Southern part of Maharashtra (Kolhapur/Karad area) during high injection from SR to WR. Another scenario (i.e. high injection from SR to WR along with low generation in Khavda/NR area) to be studied for assessing the transmission constraints and identification of remedial measures.

CTU Reply (a) to (e): The Lakadia-II – Alephata HVDC has been terminated at a point parallel to the EHVAC network which emanates from Khavda area and traverses from North Gujarat to load centres in Maharashtra (Boisar-II/ Nasik/ Alephata/ Pune(GIS) / Pune-III). The HVDC system emanates from Lakadia-II (Central Gujarat) and terminates at Alephata

(parallel to AC network) and is expected to maintain a balanced power flows on the AC lines along with controllability as per requirement. The other HVDC link from NR to South Kalamb has been planned to complement PSPs in Talegaon / Data centre & other load requirement in the Neral area.

4. Further, the present files have been prepared considering Max RE injection in Gujarat & Rajasthan (which are contiguous pockets) so as to simulate worst case scenario as far as immediate evacuation of power is concerned. In case the generation is backed down in these pockets, it would represent a better load flow case.

CTU Reply : Scenario-4 & 7 is prepared considering Rajasthan (100% solar dispatch) and Gujarat (80% solar dispatch). One additional sensitivity case considering Rajasthan (90% solar dispatch) and Gujarat (100% solar dispatch) is also prepared & shared with agenda

5. Nevertheless, SR export scenario has also been prepared in consultation with SR constituents and was studied in detail in presence of GRID-INDIA on 22.11.2024 for Bijapur evacuation studies at Bangalore. The proposed system was found adequate in that scenario as well.

CTU Reply : Noted.

6. Regarding constraints in Mumbai/MMR region, timely commissioning of In-STS in the Mumbai/Pune area is very essential. MSETCL is being continuously requested to adhere to agreed upon time-lines as per review meetings carried out by CEA as well as in various CMETS-WR meetings by CTU as well as GRID-INDIA.

a) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 noncompliant. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

CTU Reply : No violation of N-1 compliance is observed in studies on the outage of 3000MW (one Bipole) of HVDC as per manual on transmission planning criteria 2023, however necessary augmentation works shall be taken up for implementation after detail deliberation with Grid-India/CEA/NRPC.

b) As mentioned earlier, controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

CTU Reply : Noted. To be taken care during finalization of RfP.

c) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

CTU Reply : Noted.

d) As HVDC are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature based overload capability** for the proposed HVDCs. Also, as VSC based HVDC is being proposed, it is understood that complete capacity in reverse direction is available.

CTU Reply : Noted. Matter shall be discussed during the meeting by our CTU-Engg Deptt. As per discussion in NCT meeting, both VSC & LCC technology are being discussed in present proposal. HVDC system shall be planned with 100% reverse power capability.

e) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

CTU Reply : Noted. To be discussed with OEMs during finalization of RfP to explore the possibility.

7. **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

CTU Reply : Noted.

8. **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

CTU Reply : Noted.

9. **<u>Inputs on Load Generation Balance:</u>**

In base cases shared, demand of Rajasthan considered in scenario-4: Jul month(31GW) seems to be on higher side. Similarly, in scenario-7: Feb month (35.4GW) seems to be on very higher side. Power factor of load also to be revised according to practical values to get correct picture of any low voltage scenario.

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
Chandigarh	P	353.2	0.95	411.6	0.96
	Q	112.7		120	
J&k	P	4193.4	0.99	2840.6	0.96

State		Scen7	Scen7 p.f.	Scen4	Scen4 p.f.
	Q	615.8		828.5	
Himachal	P	2395.4	0.99	1780.1	0.96
	Q	399		519.2	
Punjab	P	12742.1	0.99	17627.8	0.96
	Q	1903.2		5138.9	
Haryana	P	12981.3	0.99	16580.6	0.96
	Q	1930.6		4836	
Delhi	P	6045.8	0.98	9367.3	0.96
	Q	1118.8		2864.4	
Rajasthan	P	35442.5	0.99	31266.8	0.96
	Q	4427.2		8839.5	
Up	P	26303.5	0.99	31161.5	0.96
	Q	3833.8		9088.8	
Ladakh	P	40.1	0.99	27.3	0.96
	Q	5.9		8	
Uttarakhand	P	2581.5	0.98	2955	0.96
	Q	504		844.5	
NR	P	103078.7	0.99	114018.5	0.96
	Q	14851		33087.7	

Feb Solar (Scenario - 7)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met during Solar Hours, Feb 2024 (MW)
1	NR	103722	146006	42284	116745	54890	63791
2	WR	112173	137614	25441	107050	68960	74167
3	SR	104357	90900	-13457	97440	60929	65591
4	ER	41435	17785	-23650	45752	19429	22745
5	NER	2902	2025	-877	5835	2013	2209
6	All India	366648	396728	x	334811	206123	221989

S. No.	State	Load (MW)	Gen (State+ Central) (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)	Peak Demand Met in Solar Hours, Feb 2024 (MW)
1	Rajasthan	35468	110783	25058	17000	18058
2	Gujarat	41433	71297	33964	19113	21258
3	Maharashtra	40627	30993	39891	27379	29821
4	MP	21288	23092	25596	14553	16885

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, # Export is considered positive**

June Solar (Scenario - 4)

S. No.	Region	Load (MW)	Gen. (MW)	IR Exchange (MW) #	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in June 2024 (MW)	Peak Demand met during Solar Hours, June 2024 (MW)
1	NR	114849	156993	42144	116745	80252	91040
2	WR	108797	130420	21623	107050	64167	74882
3	SR	98015	95583	-2432	97440	48363	58488
4	ER	47997	14483	-33514	45752	27672	31436
5	NER	3706	3377	-329	5835	2467	3023
6	All India	375349	406220	x	334811	222917	244540

S. No.	State	Load (MW)	Gen. (MW)	20th EPS Peak Load in 2029-30 (MW)	Average Demand Met in Solar Hours in Feb 2024 (MW)*	Peak Demand met in Feb 2024 (MW)
1	Rajasthan	31266	113355	25058	16199	18425
2	Gujarat	44908	76899	33964	21934	26054
3	Maharashtra	39589	29129	39891	23622	28715
4	MP	15757	18715	25596	11155	13828

***Peak solar considered from 10:30 Hrs to 15:30 Hrs, #Export is considered positive**

- In both February solar and June Solar case, the Southern Region is importing power. Even in the June solar case, which represents a peak SR export scenario, key SR-WR lines planned for evacuating RE from the Southern Region—such as the 765 kV Narendra New–Pune–III D/C and 765 kV Raichur– Solapur D/C—are observed carrying power in the WR-to-SR direction

- Dispatch of Thermal Plants:

    - The thermal generation of some of the plants i.e. APL/CGPL has been backed down to very low levels (~35%).
    - Pit head plant: Talcher backed down to ~35% level to Pit head plant: V'chal backed down to ~34% level
    - Pit head plant: Korba backed down to ~34% level

  The tech minimum level considered in the case may be mentioned, and the generators' dispatch should be considered per merit order.

CTU Reply : Files are modified to incorporate minimum 40% dispatch from thermal generating stations in WR as per merit order as well as load pf (0.95-0.97) in NR.

- The demand in Rajasthan and Gujarat is seen to be on a higher end than the figures from EPS. The reason for the high demand may be mentioned.

CTU Reply :

S.No	State	EPS demand (2030)-GW	Demand Considered in studies (GW)		
			Sc-4*	Sc-5	Sc-7*
1	Rajasthan	25.1	19.2	18	23.3
2	Gujarat	34	44.9	37.2	41.4

excl. 12GW lumped load at Ramgarh-II and Bhadla-IV for HVDC

CTU Reply – From the demand data, it is envisaged that demand in Rajasthan is in order. In Gujarat, about 60% of the projected Green Hydrogen Load by 2027-28 has been considered in studies [9250MW out of 15000MW (Kandla:3GW, MUL: 12GW)]. In case same does not materialize as planned, additional transmission system would be required. Further, other bulk consumer loads have also been considered in studies such as 3GW at Mundra(Navinal) S/s, 3.5GW at Jamnagar, etc.

- Consideration of GH2 and other bulk consumer loads may be mentioned in the planning scheme itself, duly citing the uncertainty behind the assumptions and requirement of further transmission planning in case of delay/deferment of GH2/Bulk load projects.

The production cost modelling studies duly factor in the RPO targets for each states, RE integration targets, flexibility requirements, merit order etc. Therefore, it is suggested that the study scenario may be finalized based on the output of the production cost modelling studies for the same timeframe. This LGB will itself indicate the paths/corridors along with the system augmentation is required.

CTU Reply – to be discussed in meeting

7. Punjab internal generation considered in scenario-7 to be corrected:

Bus Number	Bus Name	Id	PGen (MW)	PMax (MW)
132204	LEHRAMOHBT 220.00	T1	52.5	210
132204	LEHRAMOHBT 220.00	T2	52.5	210
132270	GOINDWALSB 220.00	T1	67.5	270
132270	GOINDWALSB 220.00	T2	67.5	270
132323	SPL_ROPAR 220.00	T1	52.5	210
132323	SPL_ROPAR 220.00	T2	52.5	210

132323	SPL_ROPAR 220.00	T3	52.5	210
134401	TALWNDISABO4 400.00	T1	165	660
134401	TALWNDISABO4 400.00	T2	165	660
134406	RAJPURA_TH4 400.00	T1	175	700
134406	RAJPURA_TH4 400.00	T2	175	700

CTU Reply : Corrected in Revised PSSE files (in Sc-7)

8. **Dynamic Simulation Studies –** With more than 100 GW solar generation and two HVDC terminals in Rajasthan in close vicinity, it is important that stability aspects are also studied in detail at the planning stage. The generation is also getting evacuated through large EHV lines and hence, transient stability analysis also becomes important. Therefore, it is suggested that the results of the dynamic simulation studies may be shared.

   CTU reply- In 30th CMETS-NR meeting, CTU requested that Grid-India may share present time frame converged dynamic file which will help to resolve convergence issues in dynamics file for 2027 timeframe w.r.t Generator models (conventional/RE) used by Grid-India. In the CMETS-NR meeting Grid-India stated that they are also facing convergence issues for present timeframe file and prepared dynamics file with some assumptions.

   It was agreed in the meeting that for preparation for planning stage dynamic file, CTU and Grid-India can work together to prepare load flow first w.r.t dynamics file and subsequent Dynamic data file (Dyr) shall be prepared with help of models available with Grid-India. CTU also stated that considering the severe convergence issues in dynamics file, it will be converged on truncated network specific to RE pockets in Rajasthan rather than to converge the file on All India level. In the meeting, NRLDC stated that for transient studies, truncated network modelling will be sufficient.

   Considering above, it is requested that a committee may be formed comprising members from CEA, CTUIL and Grid-India for preparation of planning horizon dynamics files.

9. Bara TPS generation model to be corrected, same is modelled at 400kV whereas it is existing at 765kV level.

   CTU Reply : Corrected in Revised PSSE files

HVDC VSC Configuration

- ***±600kV, 6 GW (Parallel Bipole with parallel DMR)***
- In this configuration, +ve Terminal of Pole-1 & 3 and -ve Terminal of Pole-2 & 4 shall be combined at the Gantry side and single +ve and -ve bundle conductor each shall be traversed on either side of the Tower along with parallel DMR.
- In this configuration, reliability of overall HVDC system shall be enhanced in comparison to Double Bipole with Parallel DMR configuration.
- Control & Protection design for co-ordinated control is complex and is offered only by one OEM (M/s SIEMENS) and is first of its kind in the world.

-

- ***600kV, 6 GW (Double Bipole with parallel DMR)***
- In this configuration, each Bipole shall have their independent bundle conductors on either side of the Tower along with parallel DMR.
- Control & Protection design for each Bipole control is simple and is offered by more than one OEM.

Note: DC line Fault recovery time in VSC is of about ~1.5 to 1.8 Sec

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6GW (Solar)

1. Grid-India representative mentioned that Barmer-II is a new substation which will be connected only to 400 kV Fatehgarh-IV PS and Barmer-I PS via LILO of 400kV Fatehgarh-IV PS - Barmer-I PS D/C. This connectivity means that Barmer-II would be a radial/hanging station with low system strength.

Fault level at Barmer-II:

S. No.	Cases	Fault level (MVA) – 220 kV	Fault level (MVA) – 400 kV
1.	Base Case	11510	23410
2.	Base Case + SynCons (2 units) (+300/-150 MVAR each unit)	12500	25300

- *Installed capacity considered at 220 kV level:* ***2000 MW***
- *Installed capacity considered at 400 kV level:* ***4000 MW***
- *SCR at 220 kV level – (11510/2000):* ***5.755***
- *SCR at 400 kV level – (23409/12000):* ***1.95 (HVDC capacity of 6000 MW also included)***
- *SCR at 400 kV level after SynCons – (25300/12000):* ***2.10 (HVDC capacity of 6000 MW also included)***

Grid-India representative further highlighted the following advantages of VSC based HVDC.

- Strong AC systems may not be required as there are no issues of commutation failures and the HVDC operates effectively in weak or even "islanded" grids.
- **Capable of providing black start services:** One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations
- Minimal harmonics due to PWM-based control. Smaller filters required.
- Superior fault ride-through capability
- Can provide grid-forming services, voltage regulation, and frequency support i.e. ability to maintain appropriate system parameters in different renewable generation scenarios

It was agreed that technically VSC based HVDC is a better alternative than LCC based HVDC keeping in view the low system strength at Barmer-II (SCR < 2.0 without SynCons and ~2.5 with SynCons) and the reactive power and oscillations issues already being faced in the complex.

The final decision regarding implementation of HVDC as LCC or VSC may be taken in the NCT meeting.

2. Following other points were also highlighted by Grid-India:

a) Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may not be ideal. The inertia of the system around Barmer-II station is also expected to be very low, AC system feeding to HVDC from such weak network may witness stability related issues. It is proposed that RE capacity may be **pooled to a nearby station** which has adequate interconnection. The HVDC may then be planned from such station to a suitable location.

b) On the outage of a 3000/6000 MW poles of HVDC Barmer – II – South Kalamb, the loading of 765/400 kV ICTs and other elements nearby Barmer – I is seen to be nearing N-1 non-compliance limits. Accordingly, the solar developers coming up at Barmer-II may be advised now itself to commission their generation in synch with HVDC system.

c) Controller interaction studies may be carried out to identify the potential interaction issues in the complex or the same may be included in the project technical specifications with specific mention of involvement of CTUIL/GRID-INDIA in such studies with HVDC executing agency.

d) The feature of power oscillation damping is also important in case of HVDC and shall be suitably added in specifications. The provision of tuning of POD based on measurement data may also be specified.

e) As HVDCs are planned for bulk evacuation of RE power, the outage of single or both poles of the HVDC may lead to curtailment in RE generation. This curtailment may be avoided/minimized by specifying the continuous and transient **ambient temperature-based overload capability** for the proposed HVDC.

f) Filter arrangement modelling at HVDC terminal (in case of LCC) at Barmer – II to be checked. Keeping in view the low SCR/fault level, as mentioned earlier by GRID-INDIA, the filter sizing shall be granular to avoid wide voltage variations during switching.

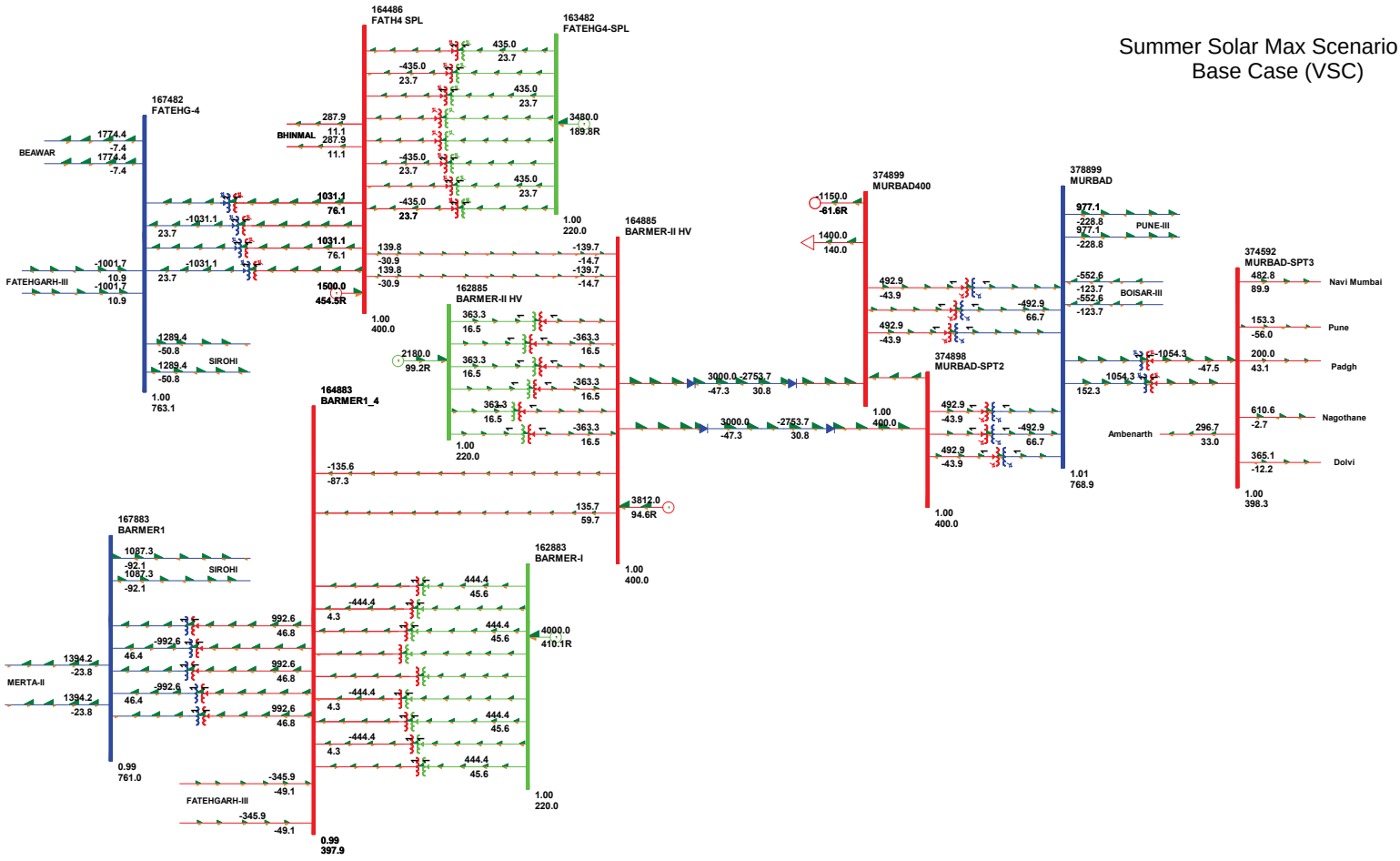
g) **Addition of BESS:** In the 500 GW RE Transmission Report by CEA, ~22.5 GW BESS was planned at different pooling stations in NR (Rajasthan). However, so far, the BESS capacity addition has not taken place as per the plan. Planning of the envisaged BESS capacity as a generation resource could help in optimizing the transmission being planned for RE evacuation in Rajasthan and will also provide necessary flexibility support during the non-solar hours.

h) **Planning of Bulk Loads in the Rajasthan RE complex:** It is suggested that CTUIL shall provide necessary recommendations to the MOP for planning of bulk loads such as electrolyzers, data centers etc. in the Rajasthan RE complex. This would help in local consumption of RE generation and would significantly reduce the requirement of transmission while also providing necessary damping (load side).

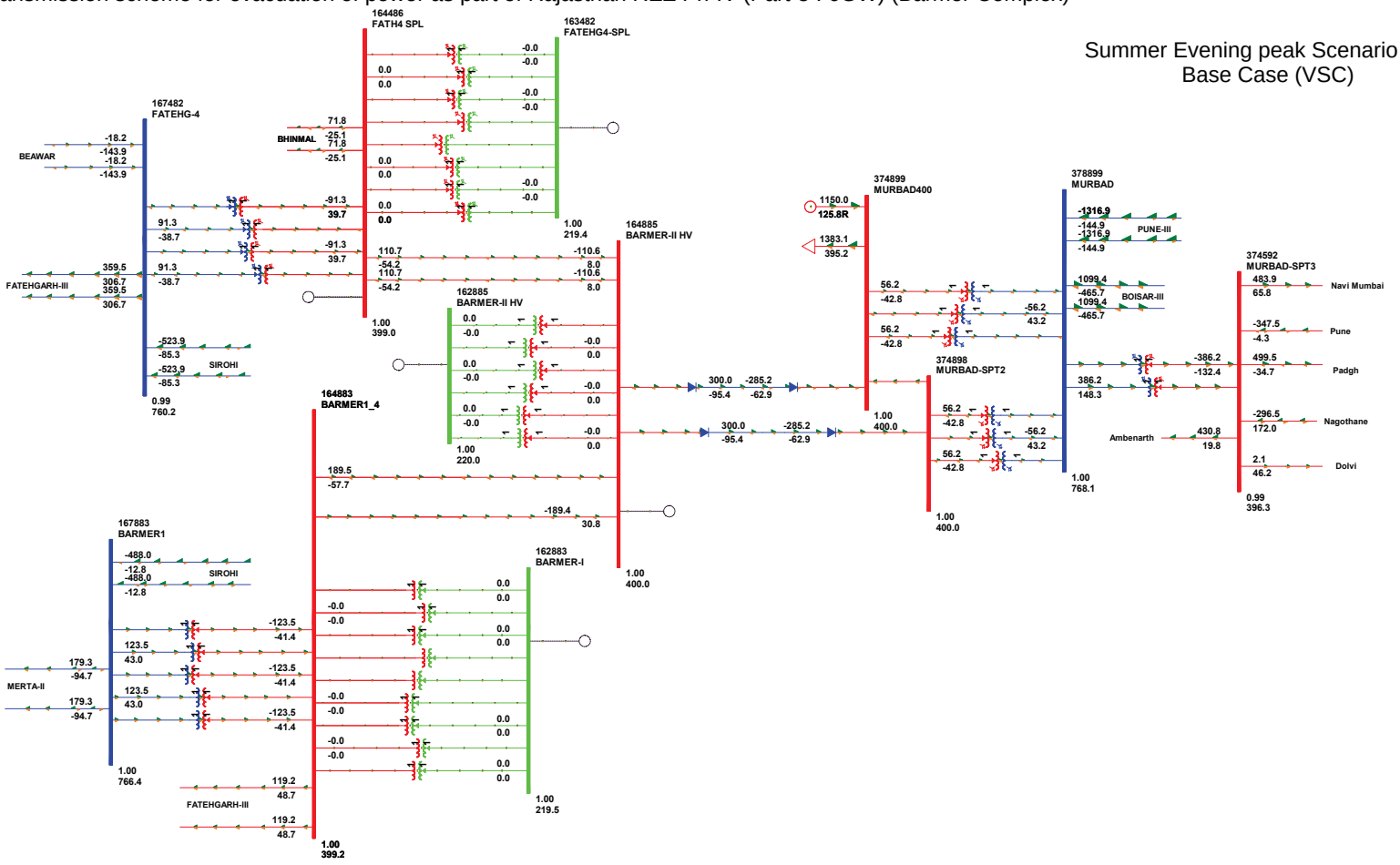
A sample study with cost benefit analysis may be carried out by CTUIL in this regard for discussion at higher level.

Exhibit-II

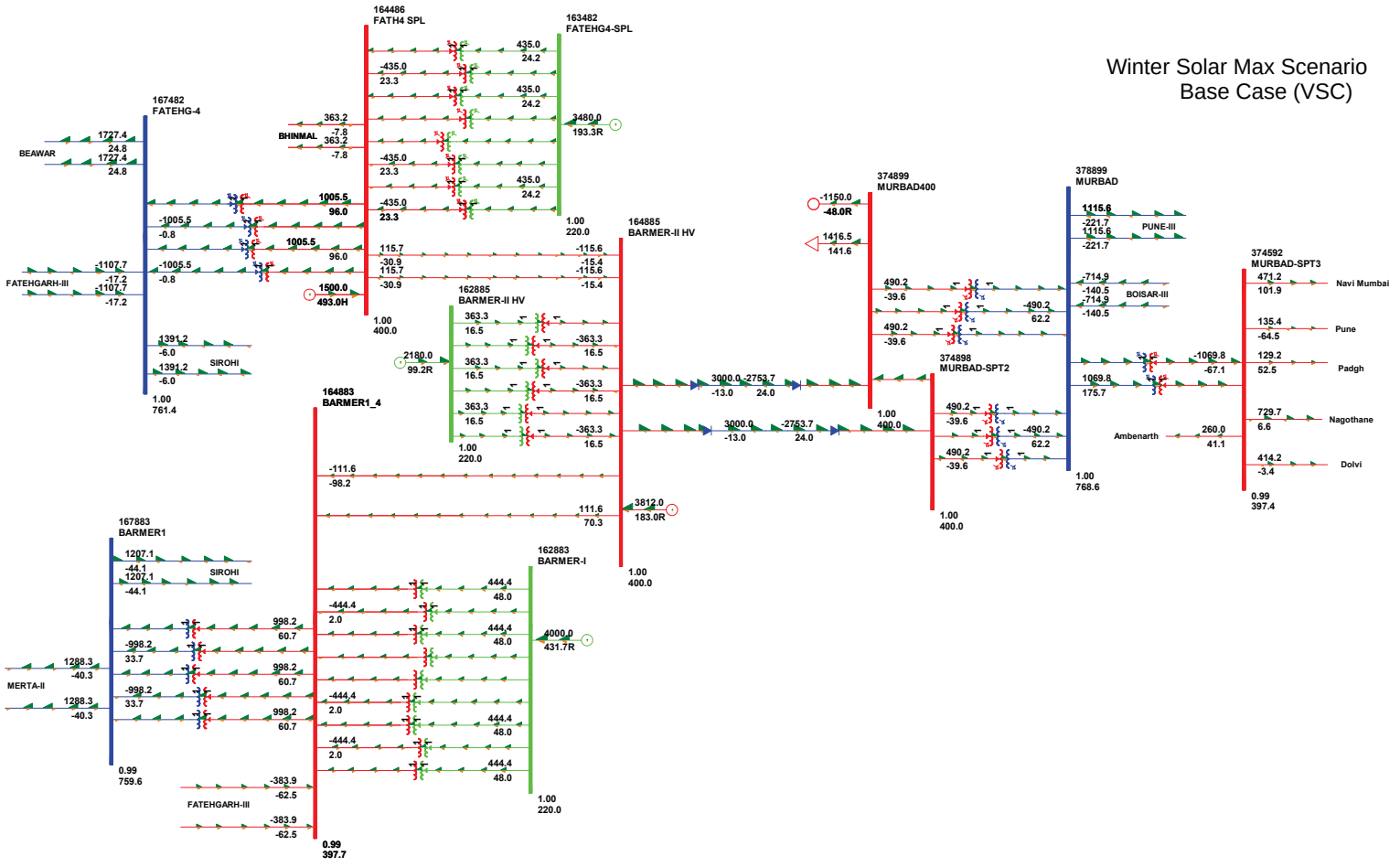
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



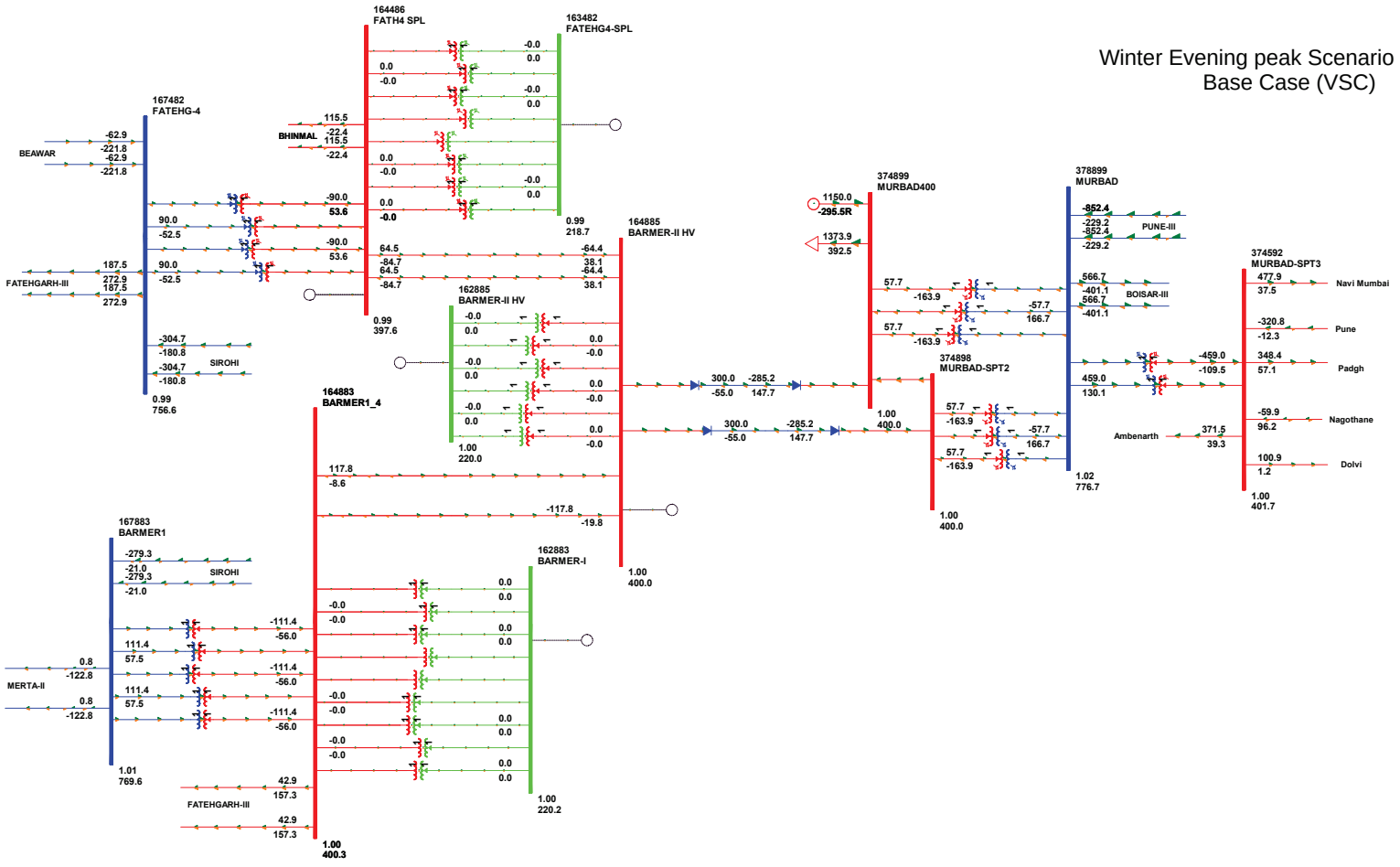
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



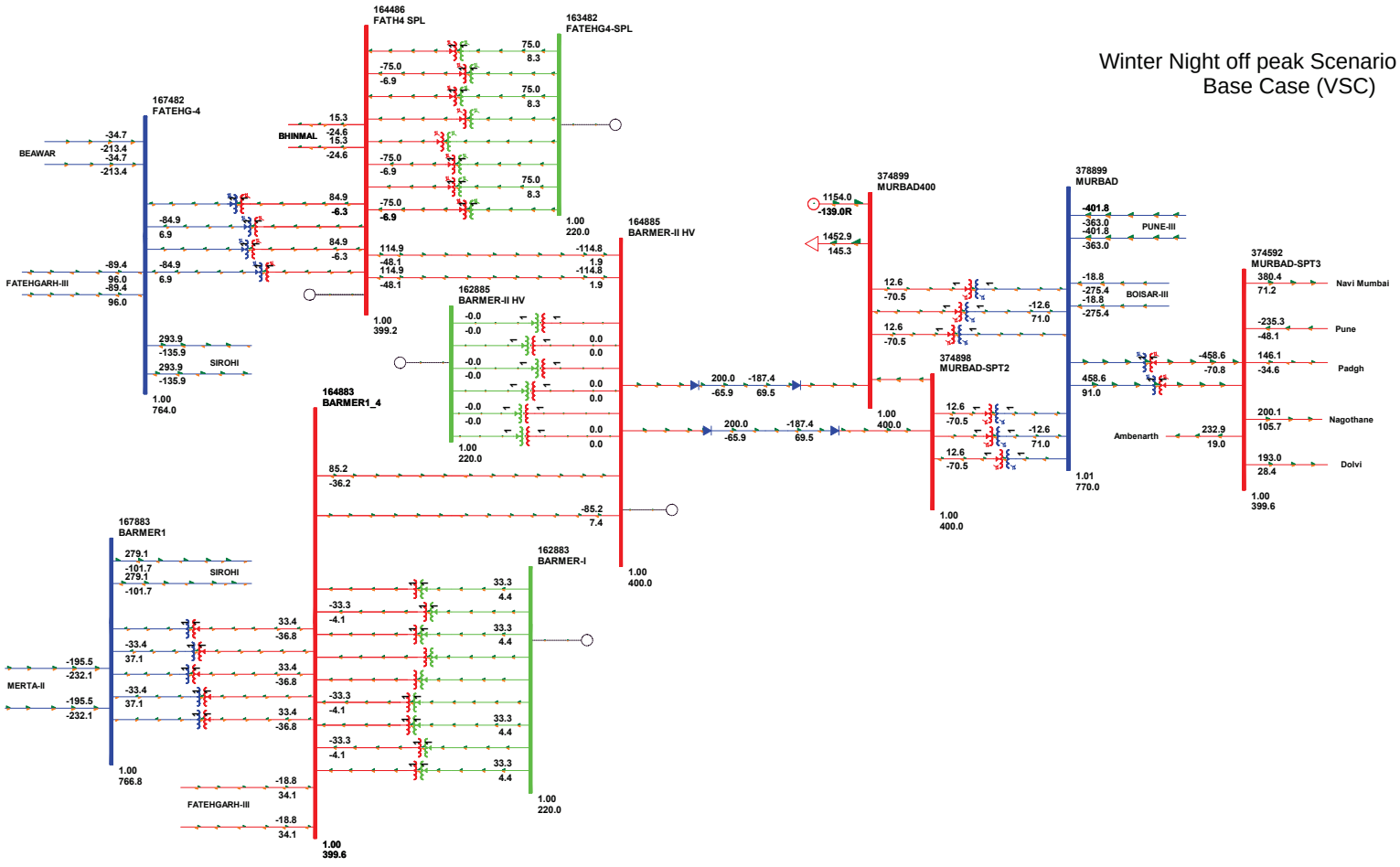
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



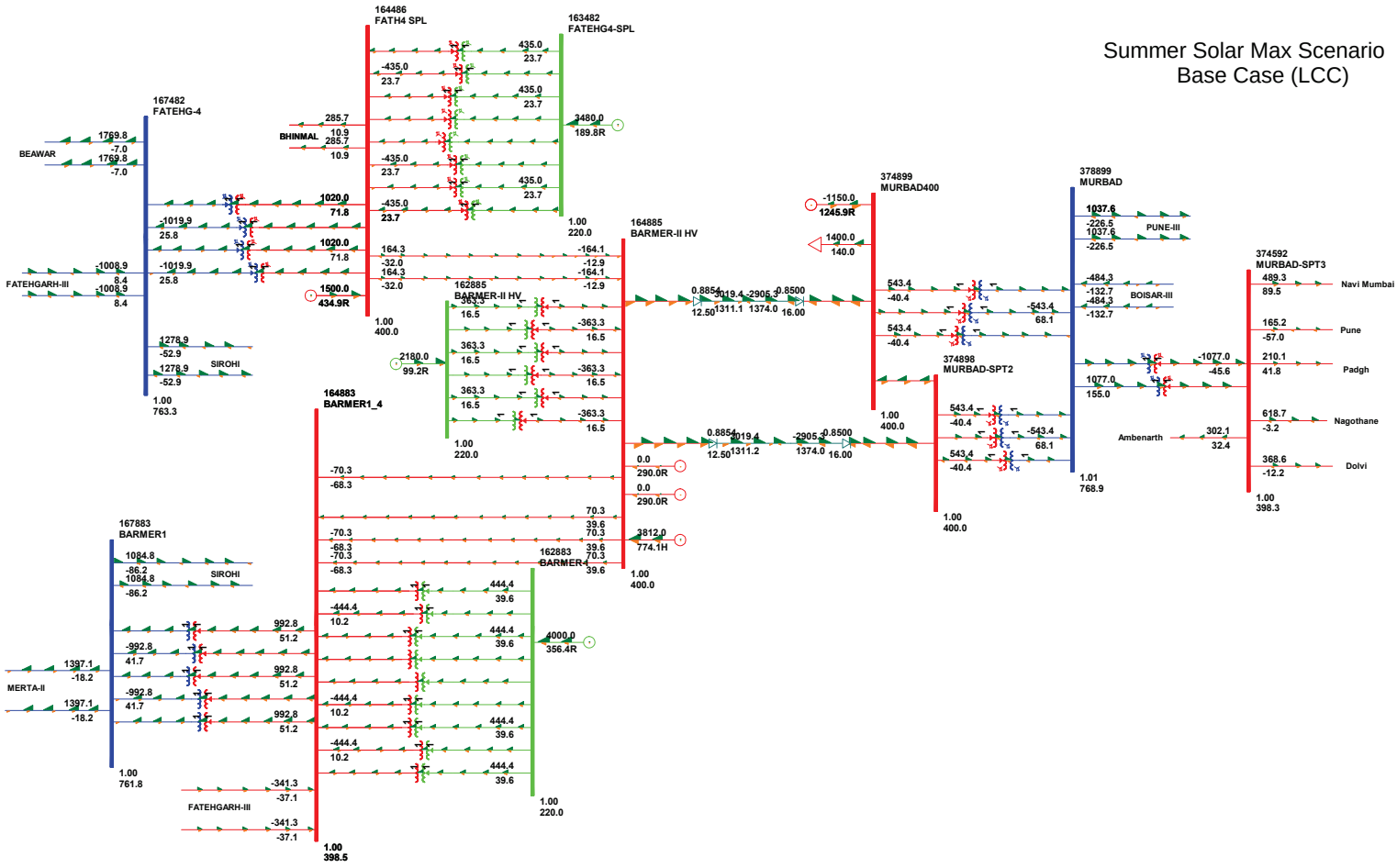
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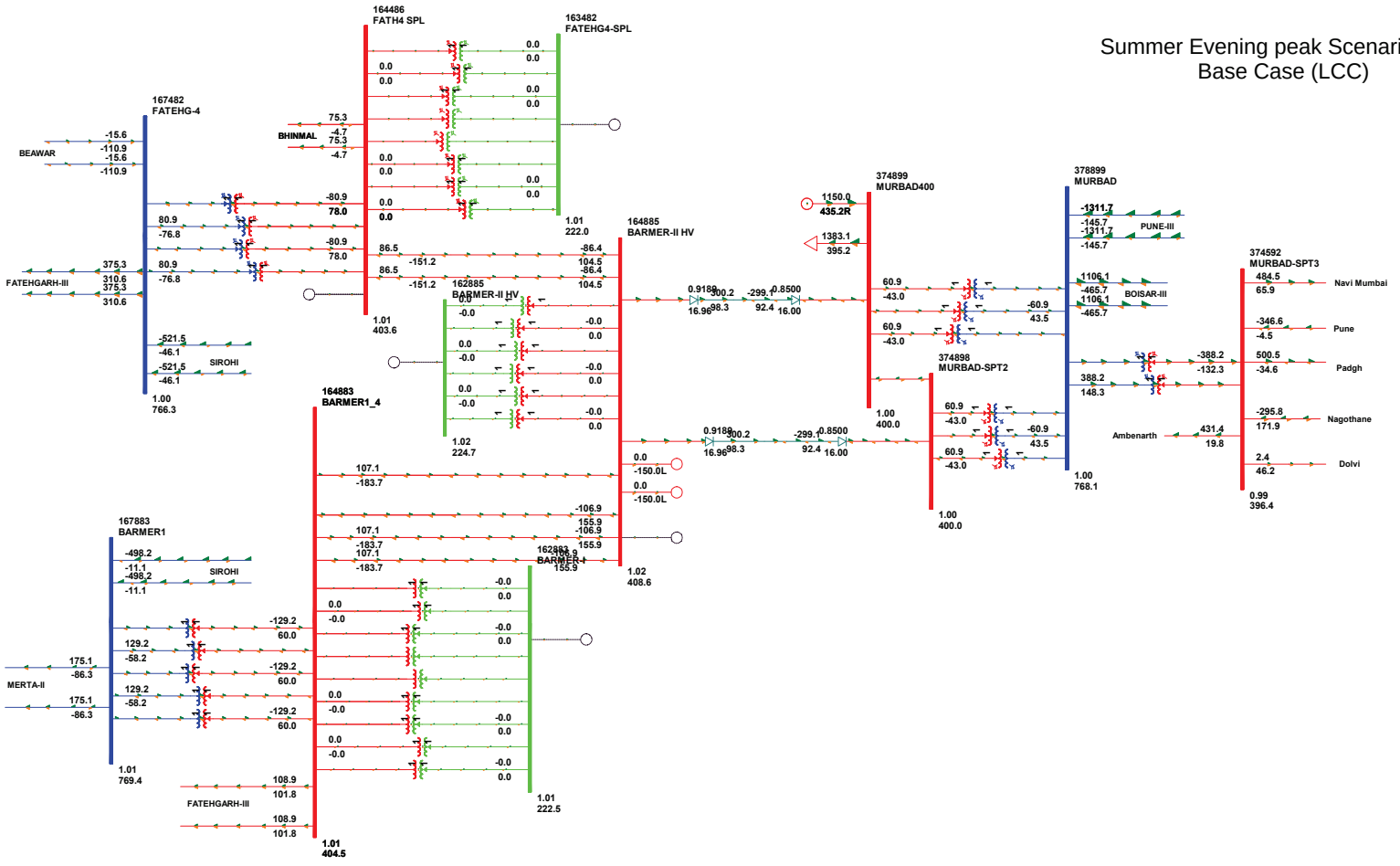
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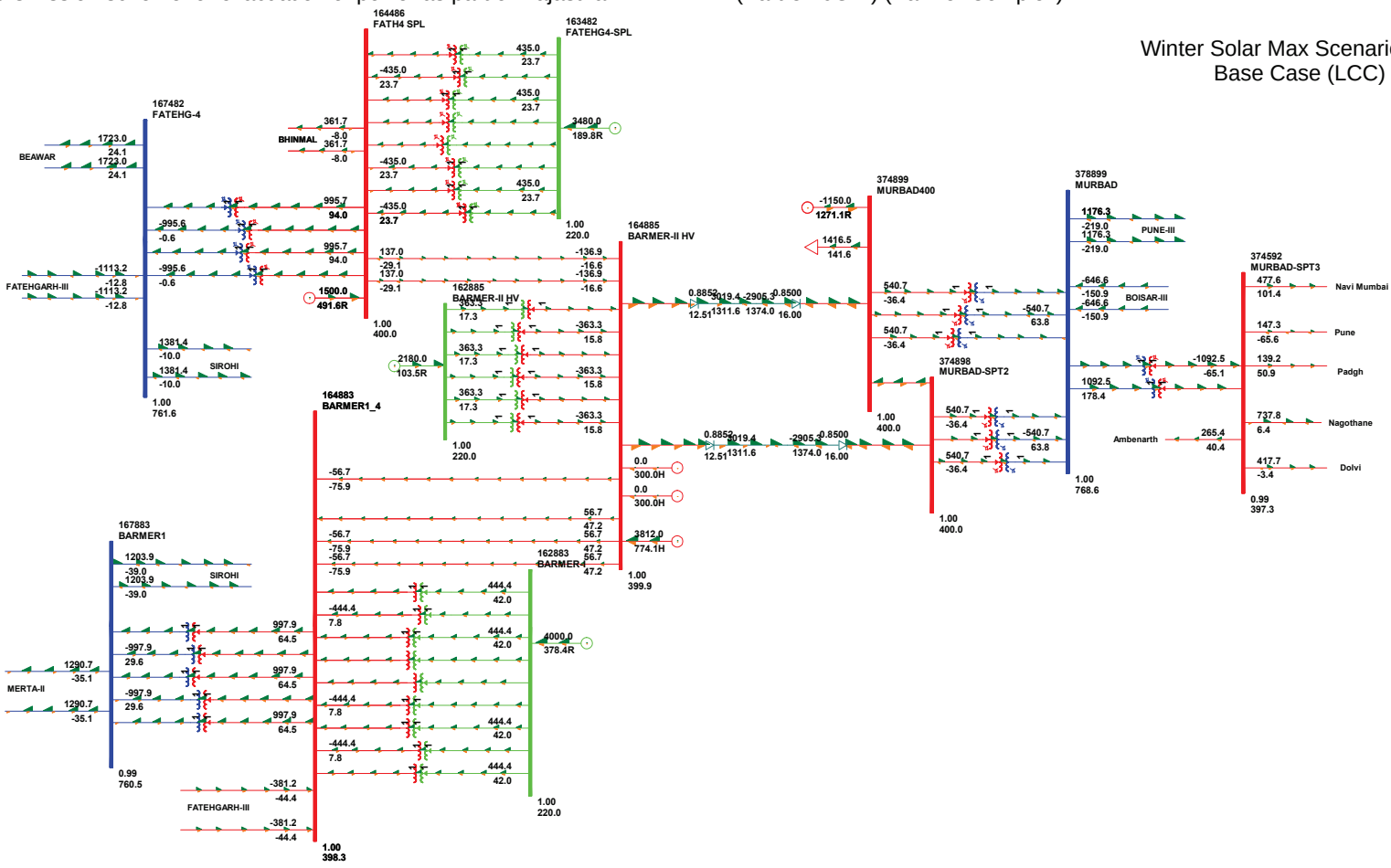
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



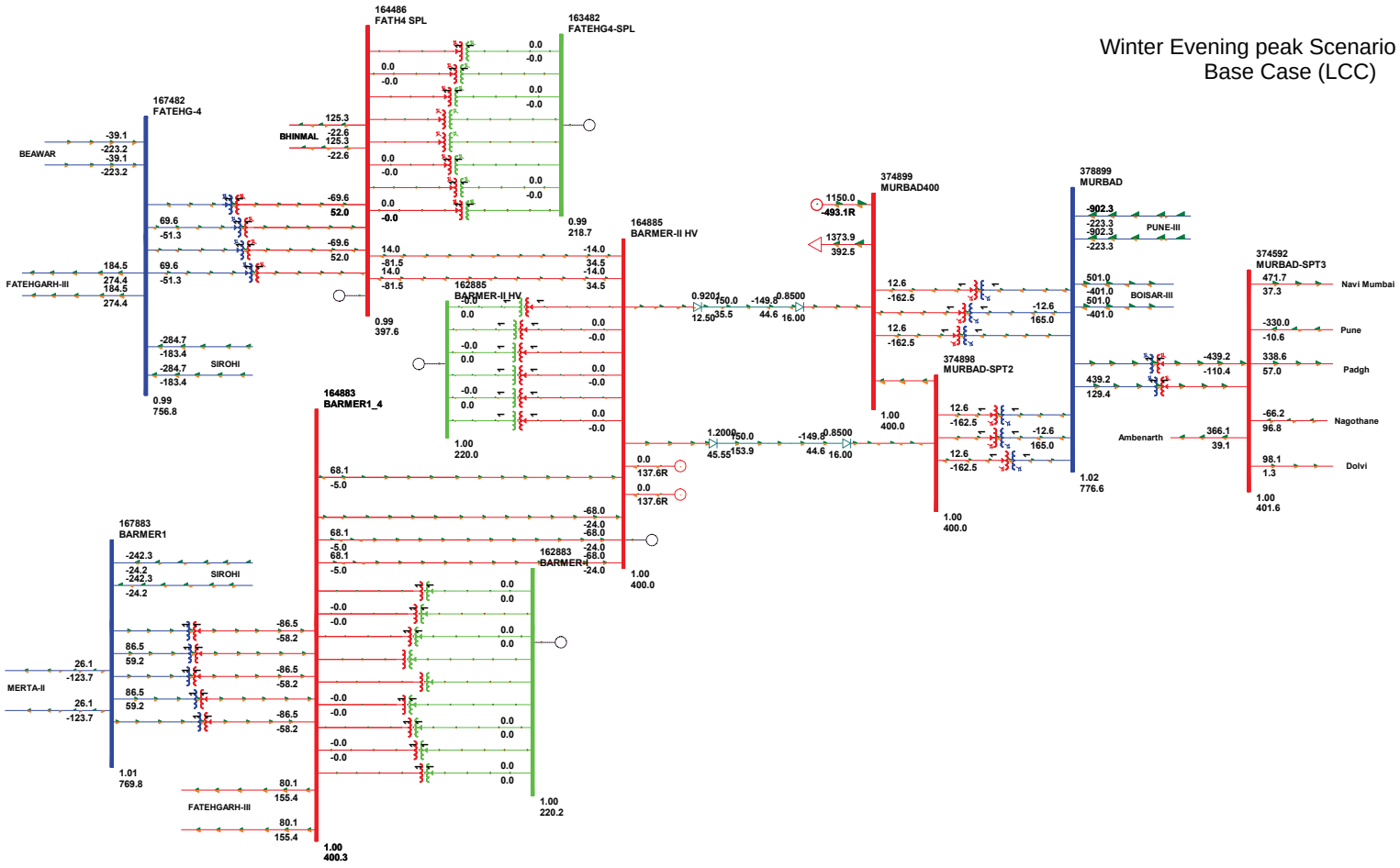
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



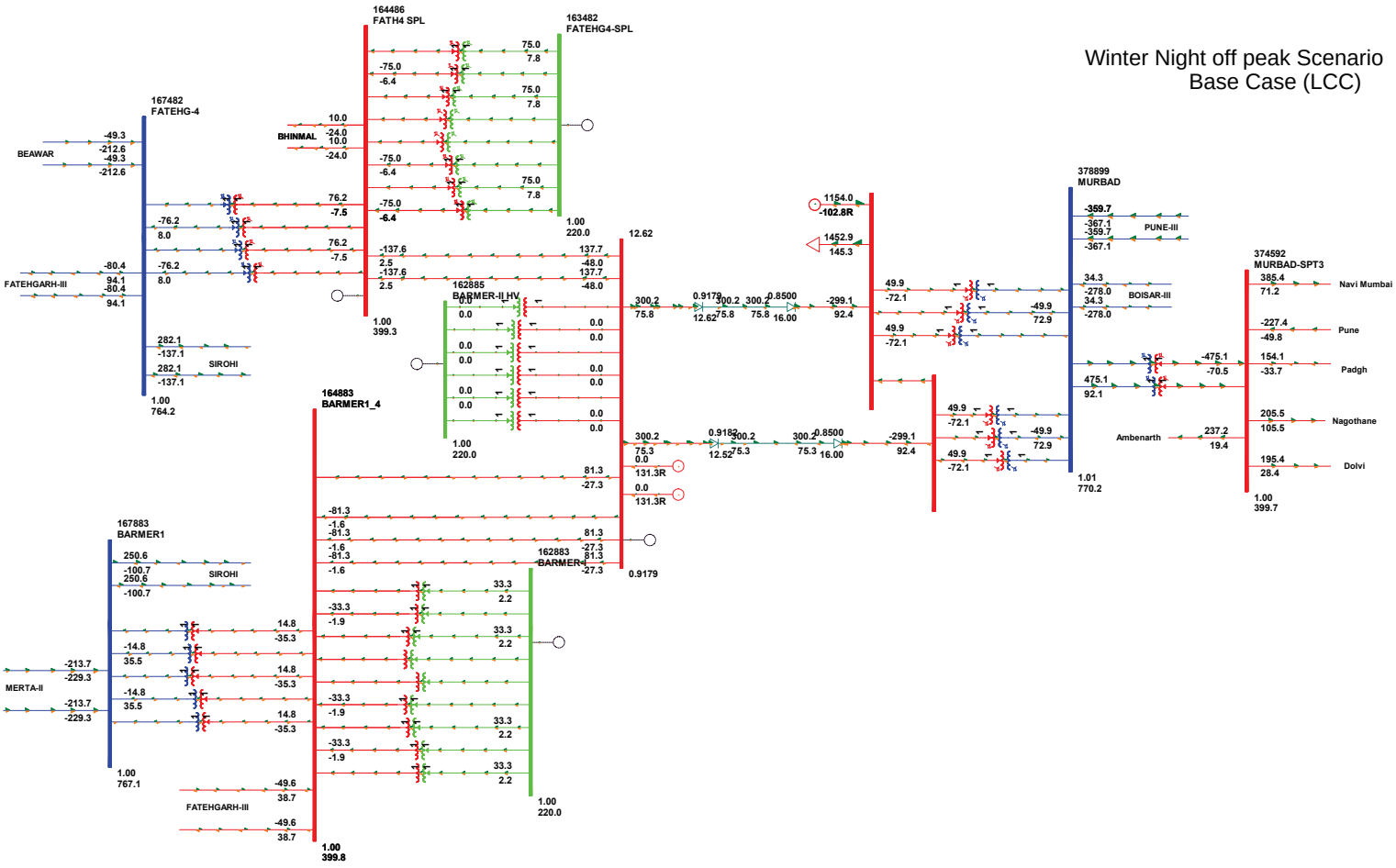
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



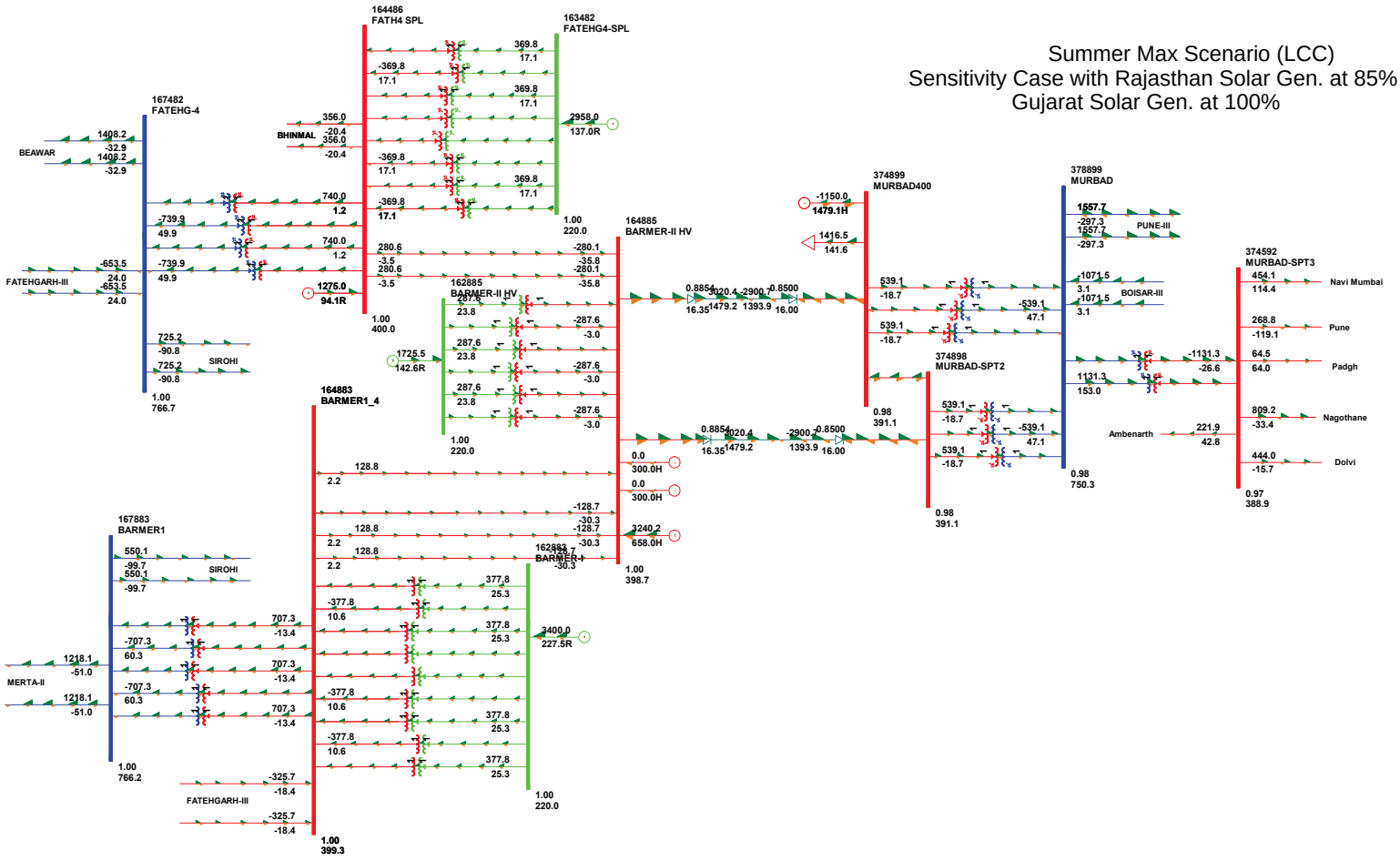
Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)



भारतसरकार
Government of India
केंद्रीयविद्युत्प्राधिकरण
Central Electricity Authority
पश्चिमक्षेत्रीयविद्युत्समिति
Western Regional Power Committee
एफ-3,एमआईडीसीक्षेत्र, अंधेरी (पूर्व), मुंबई- 400 093
F-3, MIDC Area, Andheri (East), Mumbai - 400 093
Website : www.wrpc.gov.in E-mail : as-wrpc@nic.in

No.: WRPC/53rd WRPC Mtg/Minutes/2025/8032-8147 Date: 25.03.2025

To,

(As per enclosed list)
(संलग्न सूची के अनुसार)

Sub: Minutes of 53rd meeting of Western Regional Power Committee (WRPC)-reg.
विषय: पश्चिमी क्षेत्रीय विद्युत समिति (डब्ल्यूआरपीसी) की 53वीं बैठक का कार्यवृत्त- तत्संबंधी।

Sir/ Madam,
महोदय/महोदया,

कृपया 13 मार्च, 2025 को वीडियो कॉन्फ्रेंसिंग के माध्यम से आयोजित 53वीं तकनीकी समन्वय समिति (टीसीसी) बैठक और 53वीं पश्चिमी क्षेत्रीय विद्युत समिति (डब्ल्यूआरपीसी) बैठक के कार्यवृत्त संलग्न देखें।

यह भी सूचित किया जाता है कि उपरोक्त बैठक का कार्यवृत्त डब्ल्यूआरपीसी वेबसाइट: wrpc.gov.in पर उपलब्ध है।

Please find enclosed herewith the Minutes of the 53rd Technical Coordination Committee (TCC) meeting and the 53rd Western Regional Power Committee (WRPC) Meeting held on 13th March, 2025 via video conferencing.

It is also intimated that the Minutes of above meeting is available on the WRPC website: wrpc.gov.in

Yours faithfully,

(Deepak Sharma)
Executive Engineer, WRPC

Encl.: As above

WRPC Members List 2024-25			
S. No.	**Organisation**	**Details**	**Contact Details**
1	Central Electricity Authority	Shri Hemant Jain Member (GO&D), Central Electricity Authority, Sewa Bhavan, R.K. Puram, New Delhi-110 066	Tel. 011-26104217 Fax. 011-26108834 Email: member.god@cea.nic.in
2	Chhattisgarh Transco	Shri R.K. Shukla Managing Director, CSPTCL, 2nd Floor, Vidyut Seva Bhavan, P.O.: Sunder Nagar, Danganiya, Raipur: 492 013 (CG)	Tel. 0771-2574500, 2574300 Fax. 0771-2262141 E-mail: mdtransco@cspc.co.in mdtransco.cg@gmail.com
3	Chhattisgarh Genco	Shri Sanjiv Kumar Katiyar, Managing Director, CSPGCL, P.O.Sunder Nagar, Danganiya, Raipur: 492 013 (CG)	Tel. 0771-2574400, 0771- 4066962 Fax. 0771-2262741 E-mail: mdgenco@cspc.co.in
4	Chhattisgarh Discom	Shri Bhim Singh Kanwar, Managing Director- CSPDCL , 3rd Floor, Vidyut Sewa Bhawan, Danganiya, Raipur (CG): 492 013	Tel. 0771-2574200-PA E-mail :mddiscom@cspc.co.in, mddiscom@gmail.com
5	Chhattisgarh SLDC	Shri K.S.Manothiya , E.D.(LD), SLDC Building, CSPTCL, P.O.Sunder Nagar, Danganiya, Raipur: 492 013 (CG)	Tel. 0771-2574172 Fax. 0771-2574174 E-mail:- celdcg@sldccg.com mddiscom@cspc.co.in ksmanothiyayks@gmail.com
6	Gujarat Genco (GSECL)	Shri Somes Bandyopadhyay Managing Director, Gujarat State Electricity Corp. Ltd., Vidyut Bhavan, Race Course, Vadodara: 390 007 (Guj.)	Tel. No.: (0265) 2342491 Fax No.: (0265) 2344734 E-Mail : md.gsecl@gebmail.com
7	Gujarat Transco	Shri Upendra Pande MD, GETCO, 9th floor, Sardar Patel Vidyut Bhawan, Race Course, Vadodara: 390 007	Tel. 0265-2353085, Fax 0265- 2338152, 2337918 Email: md.getco@gebmail.com
8	Gujrat Discom (Rotational - Uttar Guj)	Shri Arun Mahesh Babu, IAS Managing Director, UGVCL, Mehsana 384 001 (Guj.)	Tel. 02762 222097 Fax. E-mail: md@ugvcl.com ea@ugvcl.com
9	Gujarat SLDC	Shri. Kanti Bhuva Chief Engineer (LD), SLDC, Load Dispatch Centre, 132 kV S/S Premises, Gotri, Vadodara: 390 021	Tel. 0265 -2353171 , 2352103 Fax 0265 -2352019 , 2356469 E-mail: celd@gebmail.com
10	M.P. Transco	Shri Sunil Tiwari Managing Director, M.P.Power Transmission Co. Ltd. Shakti Bhavan, Rampur, Jabalpur: 482 008	Tel. 0761-2661234, Fax 0761-2664141 Email:- md@mptransco.nic.in
11	M.P.Genco.	Shri. Manjieet Singh, Managing Director, M.P. Power Gen. Com. Ltd. Shakti Bhavan, Viduyt Nagar,Rampur, Jabalpur: 482 008	Tel. 0761-2666150 Fax 0761-2665661 membergen@yahoo.com
12	MP Discom (MPPashimKVVCL - Rotational)	Shri Sachin Talewar, Director Technical, M.P. Paschim Kshetra Vidyut Vitran Comp. Ltd., GPH Compound, Polo Ground, Indore 452007	Tel. E-mail:- directortechnicalwz@gmail.com
13	M.P. SLDC	Shri. Prdeep Sachan, Chief Engineer(LD), State Load Dispatch Centre, Nayagaon, Jabalpur: 482 008	Tel. 0761-2702740 Fax 0761-2970119,2664343 Email: ce.sldc@mptransco.nic.in
14	Maharashtra Transco	Shri Dinesh Waghmare, IAS, CMD, MSETCL, Prakashganga, Plot No.C-19, E-Block, Bandra Kurla Complex, Bandra (East), Mumbai – 400051.	Tel. 022-26591253, 26598595 26598588 Fax 022- 26598595 Email: md@mahatransco.in Fort Fax No.22610063

15	Maharashtra Genco	Dr. P. Anbalagan, IAS CMD, MSPGCL, Prakashgad, 2nd Floor, Plot No G-9, Bandra (East), Mumbai: 400 051	Tel. 022-26476231 Fax 022-26471060, 26581400 E-mail : md@mahagenco.in
16	Maharashtra Discom.	Shri Lokesh Chandra, IAS ACS, CMD, MSEDCL. Prakashgad, 6th Floor, Plot No G-9, Bandra (East), Mumbai: 400 051	Tel. 022-26474644 Fax 26478672 Fort.Tel.22619499 Fax.22650741 Email: md@mahadiscom.in mdmsedcl@gmail.com
17	Maharashtra SLDC	Shri Shashank Jewalikar Executive Director, Load Dispatch Centre, Kalwa Thane Belapur Rd., P.O.- Airoli, Navi Mumbai:400 708	Tel. 27601931/2937(O) Fax 022-27601769 E-mail:edmsebholding@gmail.com
18	Goa	Shri Stephen Fernandes Chief Electrical Engineer, Goa Electricity Department, Vidyut Bhawan, 3rd floor, Panaji – Goa: 403 001.	Tel. 0832-2224680 Fax.0832-2426986 E-mail: cee-elec.goa@nic.in aeipm@yahoo.com
19	UT of Daman & Diu and Dadra & Nagar Haveli	Shri Arun T. , IAS, Secretary (Power), Vidyut Bhavan, Near 66 kV Sub-Station, Kachigam, Daman 396 215	Tel. No.: 0260- 2231803 / secretarypower2020@gmail.com
20	Central Govt. Genco. (NTPC)	Shri Jaikumar Srinivasan Director (Finance), National Thermal Power Corp. Ltd., NTPC Bhavan, SCOPE Complex, 7 Institutional Area, Lodhi Road, New Delhi 110 003	Tel. 011-24360461 Email: df@ntpc.co.in
21	Central Govt. Genco. (NPCIL)	Shri Choudhary Nitin Ramchandra Outstanding Scientist,ED (Commercial), Nuclear Power Corp. of India Ltd., 12 N 24, 12th floor, North Wing, Vikram Sarabhai Bhawan,Anushakti Nagar, Mumbai: 400 094.	Tel. 022-25993330 Fax 022- 25993332 E-mail : df@npcil.co.in
22	C.T.U.	Shri Ashok Pal COO, CTUIL, Plot No.2, Sector – 29, Near Iffco Chowk, Gurgaon- 122 001 (Haryana).	pcgarg@powergrid.in coo-ctu@ctuil.in
23	Powergrid	Sh. Naveen Srivastava Director (Operations), PGCIL, "Saudamini", Plot No.2, Sector – 29, Near Iffco Chowk, Gurgaon- 122 001 (Haryana).	Tel. 0124-2571801 Fax 0124-2571802 E-mail: naveensrivastava@powergrid.in
24	National LDC	Shri S. C. Saxena Director (Market Operation) NLDC, Grid Controller of India Limited B-9, Qutab Industrial Area, Katwaria Sarai, New Delhi-110 016	Tel.011-26852583, 40234651 011-26524525, 011-40234652 011-26852843 , Fax 011-26536901 E-mail:- scsaxena@grid-india.in
25	Regional LDC	Shri V. Balaji Executive Director, Grid Controller of India Limited, WRLDC, F-3, MIDC Area, Marol, Andheri (East), Mumbai: 400 093	Tel. 022-28202691 Fax 022-28202630 Email: vbalaji@grid-india.in
26	Other Gencos- more than 1000MW (Trombay- TATA Power)	Shri Ashish Khanna, President - Generation Business, TATA Power, Bombay House, 24 Homi Modi Street, Mumbai 400 001	Tel No. 022-6665 8282 Fax No. 022 6665 8801 Email: goleml@tatapower.com
27	Other Gencos. - more than 1000 MW (RGPPL)	Sh. Santosh Kumar Takhele, CEO, Ratnagiri Gas & Power Pvt.Ltd , Jubilee Tower, 5th Floor, B35-B36 ,Sector -1, Noida. 201 301(U.P)	Tel. 02359- 241073 Fax Email : sktakhele@ntpc.co.in hod-onm.nhdc@nhdcl.com

28	Other Gencos. - more than 1000 MW (NHDC)	Shri Rajeev Jain, MD NHDC Ltd., NHDC Parisar, Shyamala Hills, Bhopal – 462 013(M.P.)	Landline- 0755-4030001 Fax:- 0755-4030003 Email ID:- mdnhdc@nhdcl.com
29	Other Gencos- more than 1000MW (Torrent Power)	Shri Jigish Mehta Executive Director, Torrent Power Gen. Ltd., Sugen Mega Power Project, Off National Highway No.8,Taluka Kamrej, Dist Surat – 394155 (Gujarat).	Tel. 02621-261165 E-mail: jigishmehta@torrentpower.com
30	Other Gencos. - more than 1000 MW (Adani Power Ltd)	Shri Jayadeb Nanda, COO (O&M) Adani Power Ltd, 1st Floor, South Wing, Adani Corporate House, Shantigram, S.G.Highway, Ahmedabad – 382421(Gujarat).	Tel.079-25558818 Fax.079-25557176 E-mail : jayadeb.nanda@adani.com
31	Other Gencos- more than 1000MW (JSW Energy Ltd)	Shri Jyotiprakash Panda, Head Regulatory & Power Sale M/s.JSW Energy Ltd., JSW Centre Bandra Kurla Complex, Bandra (East), Mumbai 400 051	Tel.011-48178700 Fax.011-48178740 E-mail: jyotiprakash.panda@jsw.in
32	Other Gencos-more than 1000MW (Jindal Power Ltd)	Shri Chhavi Nath Singh, ED & Plant Head , Jindal Power Limited, P.O.Tamnar, District:Raigarh, Chhattisgarh – 496 107.	Tel. 07767-302002 Fax .07767-281995 E-mail:- cn.singh@jindalpower.com
33	Other Gencos- More than 1000 MW (Rattan India Power Ltd)	Sh. Baliram Jadhav VP & Station Head, RattanIndia Power Ltd., Plot No.D2 & D2, Part Additional Industrial Area, Nandgaonpeth, Amravati	E-mail: baliram.jadhav@rattanindia.com amit.panchalwar@rattanindia.com
34	Other Gencos - more than 1000MW (Jaypee Nigrie STPR)	Shri Vinod Sharma President & Plant Head, Jaypee Nigrie Super Thermal Power Project, Village & PO: Nigrie, Tahsil: Deosar, Distt:Singrauli (MP)-486889.	E-mail: vinod1.sharma@jalindia.co.in
35	Other Gencos. More than 1000 MW (D.B.Power Ltd)	Shri Manu Namboothiri, Chief Operating Officer, D.B.Power Ltd., Village : Badadhra, Block & Tehsil : Dabhra, Dist : Janjgir, Champa, Chhattisgarh : 495695.	E-mail:- manu.namboothiri@dbpower.in
36	Other Gencos. More than 1000 MW (KSK Mahanadi Power Co.Ltd.)	G P Rao Project Head, KSK Mahanadi Power Co.Ltd.,Akaltara (Nariyara) TPP, Dist:Bilaspur, Chhattisgarh – 495552.	Tel. Fax. E-mail : gprao@ksk.co.in
37	Other Gencos. More than 1000 MW (MB Power (MP)Ltd)	Sh. Abhishek Gupta Vice President – Thermal, MB Power(Madhya Pradesh)Ltd 239,Okhla Industrial Estate, Phase III, New Delhi -110020.	Tel.011-47624215 Fax.011-47624229 E-mail : abhishekgupta@hpppl.in satyendra.singh@hpppl.in
38	Other Gencos. More than 1000 MW (Sasan UMPP)	Shri Subrata Ghosh Project Head,Sasan UMPP, Sasan Power Ltd., Vill: Siddikhurd, P.O.Tiyra, The: Sasan, st:Waidhan,Singroli, Madhya Pradesh – 486 886.	Tel: 78223 05035 Fax: 7822 - 3025087 E-mail: subrata.ghosh@relianceada.com
39	Other Gencos. More than 1000 MW (RKM POWER Gen.)	Shri S.K Bhatnagar, Director & Plant Head, R.K.M. Powergen Pvt. Ltd., No.14, Dr. Giriappa Road, T. Nagar, Chennai 600 017	Tel. No.: 044-66291000 (Gen.No.) Fax : 044 -28158243 / 66291100 E-Mail: shailendra.bhatnagar@rkm.in
40	Other Gencos - more than 1000MW Adani Green Energy	Mr. Chaitanya Prasad Sahu, CEO, Adani Green Energy, Adani Corporate House, Shantigram, Near Vaishnodevi Circle, S.G. Highway, Ahmedabad 382 421 (Guj.)	Email ID: chaitanya.sahoo@adani.com

41	Other Gencos - more than 1000MW Inox Wind Limited	Sh. Manoj Dixit, Head Power Management , Inox Wind Limited, INOXGFL Towers, 17, Setor-16A, Noida-201 301 (UP)	Email:- manojdixit@gfl.co.in
42	Other Gencos - more than 1000MW GIPCL	Sh. P. S. Goyal, General Manager, (RE-O&M), GIPCL, Ranoli, Vadodara Gujarat-391350	Email ID: psgoyal@gipcl.com
43	Other Gencos - more than 1000MW Bharat Aluminium Company Limited (BALCO)	Vikash Agarwal, Bharat Aluminium Company Limited (BALCO) Balco Nagar, Parsabhata Gate, Chattisgarh dist- Korba Korba-495684	north.aluminium@vedanta.co.in
44	Other Gencos - more than 1000MW Renew Power	Mr. Sunil Barnwal General Manager - CO Head, B2B India Business. (Through Mail)	sunil.barnwal@renew.com
45	Other Gencos - more than 1000MW Avaada Energy	Shri Rajesh Bihari Dwivedi CEO, Avaada Energy,406, 4th Floor, Hubtown Solaries,N.S. Phadke Road, Andheri East, Mumbai - 400 069	avaada@avaada.com
46	Other Gencos Under 1000MW (Rotational) ACB(India) Ltd.	Shri H.M. Jain Director, ACB (Inidia) Limited, 7th Floor, Office Tower, Ambience Mall, NH-8, Gurugram 122 002 (Haryana)	Tel. No.: 0124 2719000 Fax No.: 0124 2719185 E-Mail : harinder.jain@acbindia.com, acbpower@acbindia.com
47	Pvt. Distribution Company (Rotational)	Shri R.D. Patsute, Chief Engineer (Regulatory), The Brihan Mumbai Electric Supply & Transport Undertaking, 1st Floor, Annex Bldg. Colaba Mumbai 400 001	Email: cerc@ bestundertaking.com 022-22799565
48	Private Transmission Licensee – (Rotational)	Shri Nitish Ranjan, AVP, CWRTL 3rd Floor, South Wing, Adani Corporate house, Shantigram S.G.Highway, Ahmedabad 382 421 (Guj.)	Email- nitesh.ranjan@adani.com
49	Member Secretary, WRPC	Shri Deepak Kumar, MemberSecretary, WRPC, F-3, MIDC Area, Marol, Andheri(E), Mumbai -400093.	Tel. 022-28221636 Fax 022-28370193 Email : ms-wrpc@nic.in
SPECIAL INVITEE			
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2	MS SRPC	Shri Acit Singh Member Secretary, SRPC, Bengaluru	Tel: 080-22259343 Email: mssrpc@yahoo.com
3	MS NERPC	Shri K. B. Jagtap Member Secretary, NERPC, Shillong	Fax: 0364-2534040 Email: ms-nerpc@gov.in
4	MS NRPC	Sh. V. K. Singh Member Secretary, NRPC, New Delhi	Fax: 011-26868528, 26865206 Email: msnrpc1@yahoo.com ms-nrpc@nic.in
5	NPC-CEA	Smt. Rishika Sharan, Chief Engineer , National Power Committee(NPC), 3rd Floor, NRPC Building,CEA, 18-A, SJSS Marg, Katwaria Saria, New Delhi.-110 016	Tel.No.011-26562022 E-mail : cenpccea@gmail.com; rishika_sh@yahoo.com
6	GUVNL	Shri Jaiprakash Shivahare, Gujarat Urja Vikas Nigam Ltd, Sardar Patel Vidyut Bhawan, Race Course, Vadodara: 390 007.	E-mail:- coacom@gebmail.com

7	MPPMCL	Shri Shailendra Janardan CGM(Commercial), MPPMCL Shakti Bhawan, Rampur, Jabalpur.488 008	0761- Email: comml.deptt@mppmcl.com mdofmppmcl@gmail.com shailendra.janardan@mppmcl.com

		TCC Member List 2024-25	
S.NO.	**Organization**	**Name, Designation & Address of Member**	**Contact Details**
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17	Maharashtra Discom.	Shri. Yogesh Madhukar Gadkari Director (Commercial) (I/C), MSEDCL, Prakashgad, 6th Floor, Plot No G-9, Bandra (East), Mumbai: 400 051	Tel. 022-26476743 Fax.26472976 Fort office Tel.022-22619277 Email:- directorcommsedcl@gmail.com
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19	Goa	Shri Shri Stephen Fernandes Chief Electrical Engineer, Goa Electricity Department, Vidyut Bhawan, 3rd floor, Panaji – Goa: 403 001.	Tel. 0832-2224680 Fax.0832-2426986 E-mail: cee-elec.goa@nic.in aeipm@yahoo.com
20	UT of Daman & Diu and Dadra & Nagar Haveli	Shri C.A. Parmar, Chief Engineer- DNHPDCL, Room No. 312, 3rd floor, Vidhyut Bhavan, 66 kV Road, Near Secretariat, Amali, Silvassa: 396 230	Tel. 0260-2406558 Email: caparmar1956@gmail.com
21	(a). Central Sector Genco. (NTPC WR-I)	Shri Kamlesh Soni Regional Executive Director (WR-I, HQ) NTPC LTD WR HQ-I, 2nd floor, Samrudhi Venture Park, Marol, Andheri(E), Mumbai-400 093	Phon No. 022-28306326 Email Id :-kamleshsoni@ntpc.co.in
22	(b). Central Sector Genco. (NTPC WR-II)	Sh. Pradipta Kumar Mishra, Regional Executive Director (WR-II), NTPC Ltd., Plot No. 87, Sector -24, Atal Nagar, Naya Raipur Chhattisgarh 492 018	Tel. 022-28227762 Fax. 022-28259364 E-mail: pradipta@ntpc.co.in
23	Central Govt. Genco. (NPCIL)	Shri Sandeep Sarwate, ACE (E & T), Nuclear Power Corp. of India Ltd, 9-N-33,Vikram Sarabhai Bhavan, Anushakti Nagar, Mumbai:400 094	Tel. 022-25991902 Fax.022- 25557890 E-mail:- ssarwate@npcil.co.in.

24	C.T.U.	Shri Ashok Pal COO, CTUIL, Plot No.2, Sector – 29, Near Iffco Chowk, Gurgaon- 122 001 (Haryana).	pcgarg@powergrid.in coo-ctu@ctuil.in
25	Powergrid WR-I	Shri S Subramanian Executive Director, (WR-I), POWERGRID, Sampriti Nagar, Nari Ring Road, Nagpur -440 026	Tel. 0712-2641470 Fax.0712-2641471 E-mail:- subbu@powergrid.in
26	Powergrid WR-II	Shri Rajesh Kumar Executive Director(WR-II) PGCIL, Regional Head Quarters, Plot No. 54, Opp- Ambe Vidhyalay, Sama Sawali Rd., Vadodara 390 008	Tel. 0265-2487594 Fax. 0265-2488564 rajesh.kumar2@powergrid.in
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28	Regional LDC	Shri V.Balaji, Executive Director, Grid Controller of India, WRLDC. F-3, MIDC Area, Marol, Andheri (East), Mumbai: 400 093	Tel. 022-28202691 Fax 022-28202630 Email: vbalaji@grid-india.in
29	Other Gencos. - more than 1000 MW (Tata Power-Trombay)	Shri Devanand Pallikuth Head - PSCC The Tata Power Company Ltd., Power System Control Centre, Trombay Thermal Power Station-A, Mahul Road, Chembur, Mumbai – 400 074.	Tel.67175371 Fax.67175385 E-mail: p.devanand@tatapower.com
30	Other Gencos. - more than 1000 MW (RGPPL)	Shri Santosh Kumar Takhele, CEO, Ratnagiri Gas & Power Pvt.Ltd , P.O.- Anjanvel, 415 634 (MH)	Tel. 02359- 241073 Fax Email : sktakhele@ntpc.co.in
31	Other Gencos. - more than 1000 MW (NHDC)	Sh. Sandeep Kumar Jain General Manager (O & M), NHDC Ltd., NHDC Office Complex, Shyamala Hills, Bhopal – 462013(M.P.)	Tel.0755-40300090 Email: skjain_nhdc@rediffmail.com hod-onm.nhdc@nhdcl.com
32	Other Gencos – more than 1000MW (Torrent Power Surat)	Shri Ambarish Modha General Manager (O), Sugen Mega Power Project, Off National Highway No.8,Taluka - Kamrej, District : Surat – 394 155	Tel.02621-261000/261663 Fax.02621-661151 E-mail: sugenoperations@torrentpower.com sugenschedule@torrentpower.com
33	Other Gencos – more than 1000MW (Adani Power Ltd.)	Shri Manoj K Taunk, Asso. Vice President (Protection & Metering), Adani Power Ltd, 1st Floor, South Wing, Adani Corporate House Shantigram,S.G.Highway, Ahmedabad – 382421(Gujarat).	Tel.079- 25557400 Fax.079- 25557176 E-mail:- manoj.taunk@adani.com
34	Other Gencos- more than 1000MW (JSW Energy Ltd.)	Shri Peddanna Ramayanam, M/s.JSW Energy Ltd., JSW Centre,Bandra Kurla Complex, Bandra (E), Mumbai 400 051	Tel.022- 42862041, 42868128 Fax. 022-4286 3000 Mobile. E-mail: peddanna.ramayanam@jsw.in
35	Other Gencos- more than 1000MW (Jindal Power Ltd.)	Shri Ajit Kumar Rai, A.V.P. –Power Control Jindal Power Limited, P.O.Tamnar, District:Raigarh, Chhattisgarh – 496 107.	Tel.07767-302112 E-mail:- ajitrai@jindalpower.com

36	Other Gencos- More than 1000 MW (Rattan India Power Ltd.)	Shri Baliram Jadhav VP & Station Head RattanIndia Power Ltd., Power No.D2 & D2 Part Additional Industrial Area, Nandgaonpeth, Amravati -444 901.	E-mail: baliram.jadhav@rattanindia.com amit.panchalwar@rattanindia.com
37	Other Gencos.- More than 1000 MW (Jaypee Nigrie)	Shri Navin Tinguria Vice President, Jaypee Nigrie Super Thermal Power Project, Village & PO: Nigrie, Tahsil: Deosar, Distt:Singrauli (MP)-486889.	E-mail: navin.tinguria@jalindia.co.in
38	Other Gencos. More than 1000 MW (D.B.Power Ltd.)	Sh. Manu Namboothiri, D.B.Power Ltd., Village : Badadhra, Block & Tehsil : Dabadhra, Dist : Janjgir, Champa, Chhattisgarh : 495695.	manu.namboothiri@dbpower.in
39	Other Gencos. More than 1000 MW (KSK Mahanadi Power Co.Ltd.)	Shri G. P. Rao Project Head), KSK Mahanadi Power Co.Ltd., Akaltara (Nariyara) TPP Dist:Bilaspur, Chhattisgarh – 495552.	E-mail:- gprao@ksk.co.in
40	Other Gencos. More than 1000 MW (MB Power (MP)Ltd)	Shri Rahul S.Sharma, GM - Business Development, MB Power(Madhya Pradesh)Ltd 239,Okhla Industrial Estate, Phase III, New Delhi -110020	Tel.011-47624100 Extn.496 E-mail:- Sharma.rahul@hpppl.in
41	Other Gencos. More than 1000 MW (Sasan UMPP.)	Shri Prakash Chandra Upadhyay Operation Head, Sasan UMPP, Sasan Power Ltd., Vill: Siddikhurd, P.O.Tiyra, The: Sasan, Dist:Waidhan,Singroli, Madhya Pradesh – 486 886.	E-Mail: Prakash.c.upadhyay@relianceada.com
42	Other Gencos. More than 1000 MW (RKM Power Gen. Pvt. Ltd.)	Shri S.K Bhatnagar, Head Operations, R.K.M. Powergen Pvt. Ltd., No.14, Dr. Giriappa Road, T. Nagar, Chennai 600 017	Tel. No.: 044-66291000 (Gen.No.) Fax : 044 -28158243 / 66291100 E-Mail: shailendra.bhatnagar@rkm.in
43	Other Gencos - more than 1000MW Adani Green Energy	Mr. Rajesh Kumar Gupta, Associate VP, Adani Green Energy Adani Corporate House, Shantigram, Near Vaishnodevi Circle, S.G. Highway, Ahmedabad 382 421 (Guj.)	Email ID: rajesh.gupta@adani.com
44	Other Gencos - more than 1000MW Inox Wind Ltd.	Sh. Rajas Ranjan Acharya, General Manager (Power Evacuation) , Inox Wind Limited, INOXGFL Towers, 17, Setor-16A, Noida-201301 (UP)	Email:- rajas.acharya@inoxwind.com
45	Other Gencos - more than 1000MW GIPCL	Sh. S. Mani, Addl. General Manager (Commercial & Legal) , GIPCL, Ranoli, Vadodara Gujarat-391350	Email ID: svmani@gipcl. Com
46	Other Gencos - more than 1000MW Bharat Aluminium Company Limited (BALCO)	Vikash Agarwal, Bharat Aluminium Company Limited (BALCO) Balco Nagar, Parsabhata Gate, Chattisgarh dist- Korba Korba-495684	north.aluminium@vedanta.co.in
47	Other Gencos - more than 1000MW Renew Power	Mr. Sunil Barnwal General Manager - CO Head, B2B India Business. (Through Mail)	sunil.barnwal@renew.com

48	Other Gencos - more than 1000MW Avaada Energy	Shri Vivek Kumar Jain CEO, Avaada Energy,406, 4th Floor, Hubtown Solaries,N.S. Phadke Road, Andheri East, Mumbai - 400 069	Vivek.jain@avaada.com avaada@avaada.com
49	Other Gencos Under 1000MW (Rotational - ACB (India)Ltd.	Shri G. Sambasiva Rao Vice President (Power), ACB (India) Ltd., Regional Headquarters, Village: Chakabura, Post: Jawali, Tehsil: Kathghora, Distt.: Korba (CG) 495 445	Tel. No.: 07759 - 285321 E-mail: Sambasiva.Rao@acbindia.com acbpower@acbindia.com
50	Other Gencos - more than 1000MW Pvt. Distribution Company (Rotational)	Shri R.D. Patsute, Chief Engineer (Regulatory) The Brihan Mumbai Electric Supply & Transport Undertaking, 1st Floor, Annex Building, Colaba, Mumbai 400 001	Email: cerc@ bestundertaking.com 022-22799565
51	Private Transmission Licensee – (Rotational)	Shri Abhishek Kukreja, Lead-O&M, CWRTL 3rd Floor, South Wing, Adani Corporate house, Shantigram S.G.Highway, Ahmedabad 382 421 (Guj.)	Email- abhishek.kukreja@adani.com
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भारत सरकार

Government of India

केन्द्रीय विद्युत प्राधिकरण

Central Electricity Authority

पश्चिम क्षेत्रीय विद्युत समिति, मुंबई

Western Regional Power Committee, MUMBAI

तक.सम.स. / प.क्षे.वि.स.

की दिनांक 13 मार्च 2025 को

वीडियो कॉन्फ्रेंसिंगके माध्यम से

आयोजित 53वीं बैठक का कार्यवृत्त

Minutes of 53rd Meeting of TCC/WRPC

held on 13th March 2025 via

Video Conferencing

Minutes of the 53rd WRPC Meeting

The 53rd meeting of WRPC was held on 13th March 2025 through online mode. The list of participants is enclosed at Annexure I.

As the chairperson of WRPC has yet to be appointed, MS WRPC proposed the name of Shri Hemant Jain, Member (GO&D), CEA, to chair the meeting. The members agreed.

Member (GO&D), CEA welcomed all the participants and requested MS WRPC to take up the agenda items.

Item No. 1: New ISTS proposals costing more than 500 Crores.

(CTUIL)

CTUIL has proposed the following network expansion scheme for implementation under ISTS:

Sl. No.	Items	Details
1.	Name of Scheme	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6GW (Solar)
2.	Scope of the scheme	Details of Transmission scheme (for VSC and LCC alternatives) are enclosed in **Annexure-1.1**.
3.	Depiction of the scheme on Transmission Grid Map	Attached at **Exhibit-I**.
4.	Upstream/downstream system associated with the scheme	765/400/220 kV Fatehgarh-IV PS (Sec-2) PS and Barmer-I PS are under implementation as part of Rajasthan REZ Ph-IV (Part-2 :5.5 GW) scheme. 765/400/220 kV Fatehgarh-IV PS(Sec-2) is being interconnected to Sirohi S/s (Under implementation), Beawar S/s (Under implementation) and Fatehgarh-III PS (Sec-2) (Under Implementation) at 765 kV level and Bhinmal (PG) & Barmer-I PS (Under Implementation) at 400 kV level. 765/400/220 kV Barmer-I PS is being interconnected to Sirohi PS (Under Implementation) & Merta-II PS (Under Implementation) at 765 kV level and Fatehgarh-III PS (Sec-2) PS & Fatehgarh-IV PS(Sec-2) PS (Under Implementation) at 400kV level. South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor along with LILO of Pune-III – Boisar-II 765 kV D/c line (Under bidding).

Sl. No.	Items	Details
		Further, another network expansion scheme which includes Creation of new 765 kV & 400 kV Bus Sections-II & III through sectionalisation along with ICT augmentation (3x1500 MVA, 765/400 kV ICTs) at Bus Section -III at both 765 kV & 400 kV levels along with downstream 400 kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date is required for dispersal of power from subject HVDC towards load centres in Maharashtra. (Under Approval).
5.	Objective / Justification	The present scheme comprises Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5: 6GW) (Barmer Complex) In the 36th CMETS-NR meeting held on 15.01.2025, it was deliberated that considering the applications received at Barmer-II PS, transmission scheme is evolved as part of Rajasthan REZ Ph-IV (Part-5: 6GW) (Barmer Complex) As part of Renewable Energy Zones (REZs) identified by MNRE/SECI with a total capacity of 75 GW REZs in Rajasthan, evacuation system for 13 GW was planned at Fatehgarh (5 GW) & Barmer (8 GW) complex. Transmission scheme for Rajasthan REZ Ph-IV (Part-2:5.5GW) (Jaisalmer/Barmer Complex) was approved in 14th NCT meeting for injection at Fatehgarh-IV PS (4 GW) & Barmer-I PS (1.5 GW) in Rajasthan and also under implementation. Further, for evacuation of power beyond 5.5 GW from Fatehgarh-IV PS/Barmer-I PS, transmission system for 3.5GW was approved in 19th NCT meeting, thus making the total approved capacity of 9 GW (5.5 GW+3.5 GW) at Fatehgarh/Barmer complex. In the joint study meeting held on 28.12.2023 & 09.01.2024, CTU stated that as per the committee report, Barmer-II PS was planned for 6 GW RE potential (2 GW BESS capacity) with 4 GW evacuation capacity. In 27th CMETS-NR meeting held on 10.01.2024, SECI informed that at present there is no clear visibility for RE projects with BESS before 2027 as award process will take time (1-2 years). In view of that, 7.5 GW RE potential (solar) remains untapped due to non-materialisation of BESS capacity (Fatehgarh- IV:4 GW + Barmer-I: 1.5 GW + Barmer-II: 2 GW). Accordingly, it was suggested that 2 GW additional RE potential may be considered for planning of transmission scheme from Barmer- II PS. At present, connectivity of about 6 GW capacity is already granted at Barmer-II PS. Beyond that, about 6 GW connectivity applications are granted/agreed for grant/received at Barmer-III PS.

Sl. No.	Items	Details
		Based on earlier Grid India observation and recent planned scheme in other regions, study files were modified for 2030 time frame. For evacuation of 6 GW capacity from Barmer-II PS, HVDC system from Barmer-II PS is being planned comprises establishment of Barmer-II PS and HVDC line from Barmer-II PS to Western region (near South of Kalamb) as well as EHVAC system for injection of power at Barmer-II PS and onward dispersal of power in Western region. Studies were carried out in the 2030-time frame for solar maximized scenario and shared on 22.11.2024 with all constituents. Grid-India vide mail dated 11.12.2024 provided their observation on all India files as well as on the proposed transmission scheme, which were deliberated in detail in 36th CMETS-NR meeting. As per discussion held in 25th NCT meeting on 28.11.2024, both VSC & LCC technology are considered in the present proposal and to be discussed along with comparative analysis in NCT meeting. A comparative analysis of VSC and LCC technology (incl. Grid-India inputs) is enclosed in **Annexure-1.2**. Grid-India in the 36th CMETS-NR meeting further reiterated that SCR of Barmer-II is on the lower side even with considering 2 nos. of Syncon units. CTU stated that SCR of Barmer-II PS is about 3, which is under the most pessimistic scenario with calculation methodology suggested by Grid-India, however, in actual the SCR would be much higher. Additionally, as per CTU understanding and their discussion with OEMs in earlier HVDC packages, minimum SCR requirement for HVDC operation for VSC technology is >1, whereas for LCC technology is > 2.5. The SCR of 400 kV Barmer-II PS will further improve with future interconnection planned for Barmer-III PS (HVDC) with Barmer-II PS in the next 5-6 months. Grid-India vide mail 22.01.2025 as well as in the meeting highlighted the following advantages of VSC based HVDC: • Strong AC systems may not be required as there are no issues of commutation failures and the HVDC operates effectively in weak or even "islanded" grids. • Capable of providing black start services: One LCC HVDC (Bhadla3-Fatehpur) is under implementation, having one VSC HVDC would help to harness advantages of both configurations. • Minimal harmonics due to PWM-based control. Smaller filters are required. • Superior fault ride-through capability.

Sl. No.	Items	Details
		• Can provide grid-forming services, voltage regulation, and frequency support, i.e. ability to maintain appropriate system parameters in different renewable generation scenarios. Grid-India further stated in their comments that technically VSC based HVDC is a better alternative than LCC based HVDC keeping in view the low system strength at Barmer-II (SCR < 2.0 without SynCons and ~2.5 with SynCons) and the reactive power and oscillations issues already being faced in the complex. Grid-India further emphasized on control interaction studies, POD studies and filter arrangement modelling. Grid-India stated that space for Syn Con and STATCOMs is to be kept at Barmer-II PS as part of future scope so that in case LCC HVDC is approved and any operational issues are faced in future, additional syncon or STATCOM can be provided for system strengthening. CEA agreed on the proposed scheme for taken up in NCT meeting with both configurations (LCC/VSC). In the CMETS-NR, it was deliberated that the final decision regarding implementation of HVDC as LCC or VSC would be taken in NCT meeting. The transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5: 6 GW) (Barmer Complex) was also deliberated and agreed in 35th CMETS-WR meeting held on 07.02.2025 (MOM awaited). Considering the above deliberations and receipt of connectivity application in Barmer complex, the Transmission scheme for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5: 6 GW) (Barmer Complex) was agreed in 36th CMETS-NR & 35th CMETS-WR meeting. As far as WR portion is concerned, the HVDC link is terminating in WR at South Kalamb S/s. The South Kalamb S/s is being established with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor along with LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage. From studies & as per discussions held with MSETCL in a meeting amongst CEA, CTU & MSETCL on 22.01.2025 & in 35th CMETS-WR held on 07.02.2025, the downstream lines are planned from South Kalamb S/s as per details at **Annexure-III**. The same shall facilitate reliable dispersal of power getting pooled at South Kalamb S/s.

Sl. No.	Items	Details
6.	Estimated Cost	For LCC technology: Rs 26,500 Cr. For VSC technology: Rs 38,000 Cr.
7.	Need of phasing, if any	Not Applicable
8.	Implementation timeframe	54 months from the allocation of project (Pole-1: 48 months, Pole-2: 54 months)
9.	System Study for evolution of the proposal	Studies discussed and agreed in the following meeting: • 36th CMETS-NR meeting held on 15.01.2025 (MOM attached in **Annexure-IV**) • 35th CMETS-WR meeting held on 07.02.2025 (MOM awaited) • Load flow results are attached at **Exhibit-II** (for NR) and **Exhibit-III** (for WR)

3. In line with MoP office order no. 15/3/2018-Trans-Pt (5) dated 28.10.2021 regarding reconstitution of NCT, views of RPC are required for proposals costing more than Rs. 500 Crores before consideration by National Committee on Transmission. Further, Para 6 (3A) & Para 11 of MoP Gazette dated 03.12.2021 on resolution for establishment of WRPC stipulates the following:

> *"3A- To provide views on the inter-state transmission system planned by CTU within 45 days of receipt of the proposal by the concerned RPC. The views of RPC will be considered by National Committee on Transmission for sending their recommendation to Ministry of Power for approval of new inter-state transmission system."*

WRPC may like to discuss/approve.

53rd WRPC Discussions:

CTUIL representative explained the above agenda.

MS WRPC enquired about the total RE potential identified in the Rajasthan area and the timelines planned for different phases of development. CTUIL stated that MNRE has identified RE potential of around 115 GW and the development plan is spread over four phases. The phase-I of 8.9 GW has already been commissioned. The phase-2 of 8.2 GW has been partly commissioned & is planned to be commissioned completely by June 2025. The phase-3 of 20 GW capacity shall commence progressively from April 2025 till

February 2026 and phase 4 of 75 GW capacity from December 2025 till December 2030 (15 GW is under implementation). CTUIL added that an additional potential of 55 GW has also been identified in this area by MNRE.

PGCIL stated that MSETCL has undertaken upgradation of their downstream network and enquired whether they are also required to upgrade their upstream network and equipment. They also requested to share with them the loading scenario with the implementation of this scheme. CTUIL replied that the load flow study results and loading scenario with the implementation of the scheme have already been enclosed as annexure and PGCIL may check it.

SE(P) WRPC stated that, as has been brought out in the agenda, under the most pessimistic scenario, the SCR at Barmer end is about 3 and therefore, it is sufficient to avoid commutation failure in HVDC LCC system. The advantages of the VSC HVDC system, such as minimal harmonics, superior fault ride-through capability and voltage regulation, can be achieved through cheaper alternatives such as STATCOM & syncons. The main advantage of VSC technology is its capability to provide black start facility at Rajasthan REZ. The capability of providing black start services is most suitable for offshore wind farms, however, the Rajasthan REZ is an onshore facility and it is already connected with other AC interconnections. Further, there may be a low probabilistic opportunity of black start to the Kallam area due to the intermittent nature of RE generation at the other end (Rajasthan REZ). CTUIL stated that all the aspects involved in the choice of technology would be discussed and decided by NCT.

PGCIL stated that they also feel that the utilization of the advantages of this technology needs to be studied and also, there are limited suppliers of VSC-based HVDC systems. PGCIL further stated that they shall provide their views on the choice of whether to go with LCC or VSC technology for HVDC after consulting their Engineering team. MS WRPC stated that as there may be a delay in this consultation process, PGCIL may submit their views directly to NCT.

MS WRPC further enquired CTUIL regarding the plan for downstream network and the timelines of implementation. CTUIL replied that LILO of Nagothane – Padghe 400 kV D/c line at South Kalamb, LILO of Pune(AIS) – Navi Mumbai 400 kV line at South Kalamb, LILO of Pune(AIS) – Vikhroli 400 kV line at South Kalamb, LILO of Pune(AIS) – Vikhroli 400 kV line at South Kalamb and upgradation of 400 kV bay at Pune(AIS) of

POWERGRID (associated with Pune(AIS) – Vikhroli 400 kV line) of Western Transco Power Ltd. (a subsidiary of AESL) commensurate with the reconductoring capacity of 2100 MVA per ckt at nominal voltage has also been planned. MSETCL supplemented that they have already included the above LILO lines (implementation schedule 2027-28) in their STU plan matching with the CTU plan (South Kalamb implementation schedule Jan 2028).

Member (GO&D) stated that the transmission scheme proposed by CTUIL should be viewed holistically since the transmission network should be ready before the RE generation commissioning.

WRPC approved the schemes and recommended for taking it up at NCT along with their above observations for further deliberations.

Item No. 2: Nomination for National Committee on Transmission (NCT).

Ministry of Power, vide its letter dated 18.02.2025 (**Annexure-2.1**), has issued amendment in the composition of the National Committee on Transmission (NCT). The composition of NCT is now as follows:

1. Chairperson, CEA - Chairman
2. Member (Power System), CEA - Member
3. Member (Economic & Commercial), CEA - Member
4. Joint Secretary level officer looking after transmission in M/o of New & Renewable Energy, Govt. of India - Member
5. Director (Trans), M/o Power, Govt. of India - Member
6. Chief Operating Officer, Central Transmission Utility - Member
7. CMD, GRID-INDIA - Member
8. Advisor (Energy), NITI Aayog - Member
9. Two Experts from Power Sector to be nominated by MoP* - Members
10. **Nominee of each of the five Regional Power Committees (RPCs) – Member**
11. Chief Engineer (from Power System Wing), CEA - Member Secretary

*Will be nominated for a maximum period of two years from the date of their nomination.

2. The Terms of Reference (ToR) of the NCT and other conditions remain same as mentioned in this Ministry's Office Order No. 15/3/2018-Trans-Pt (5) dated 28.10.2021 (**Annexure-2.2**).

3. In view of the above amendment issued by MoP, an appropriate nomination from WRPC to NCT is to be decided.

53rd WRPC Discussions:

MS WRPC explained the agenda and stated that in the recent amendment of the NCT composition, MoP has also included representatives of each of the five Regional Power Committees (RPCs). He proposed that the Chairperson TCC from WRPC may be the representative of NCT from WRPC and Member Secretary, WRPC may be the alternate member in the absence of TCC Chairperson.

WRPC agreed to the above.

****

Exhibit-I

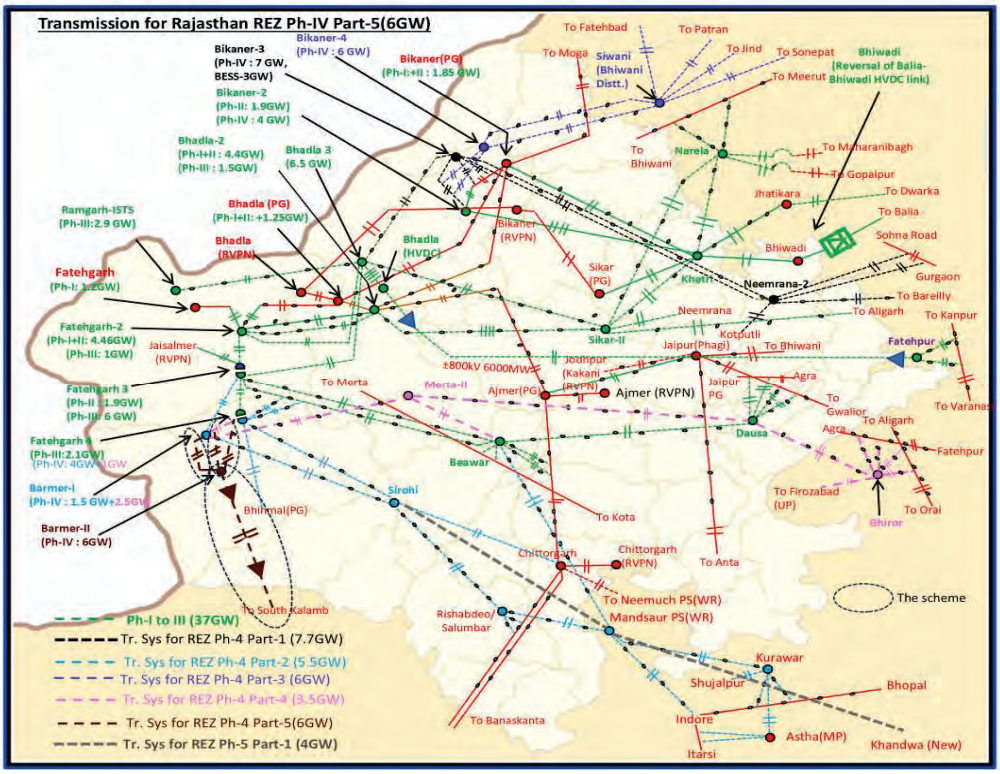


Fig: 1. Transmission system for evacuation of power as part of Rajasthan REZ Ph-IV (Part-5: 6 GW) (Barmer Complex)

Annexure-IA

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II : 6GW (Solar)

A. Alternative-1 : LCC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor – 6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.)	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	400kV Barmer-II PS - Barmer-I PS D/c line (Quad)	Line Length – (~30 km) • 400 kV line bays at Barmer-II PS – 2 nos. • 400 kV line bays at Barmer-I PS S/s – 2 nos.
4	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800 kV Barmer-II (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
5	Establishment of 2 nos. 3000 MW (Bipole configuration), ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400kV bus sectionaliser -2 nos. (1 Set) at South Kallamb (HVDC) station

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below * (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)
8	2 nos. of Syncon units at 400kV level of Barmer-II PS (1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum) **** Value of inertia constant (H) shall be provided in RfP document.***	• Syncon units – 2 nos. • 400kv line bays – 2nos.

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].***

B. Alternative-2: VSC Configuration

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **<u>Future provisions (excl. scope of present scheme):</u>** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 nos. ➢ 400 kV Bus Reactor along with bays: 1 no. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 nos. of Syncon units* at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x+300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) ***1 no. of SynCon unit comprises dynamic support of +300MVAr/-150MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum). Value of inertia constant (H) shall be provided in RfP document***	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 nos. • 400 kV ICT bays- 6 no. • 220 kV ICT bays- 6 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 400kv line bays– 4 nos. (for RE interconnection) • 220KV line bays – 7 nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.)
2	LILO of both ckts of 400kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 20 km (LILO length ~ 20 km) • 400 kV line bays-4 nos. (at Barmer-II PS end)
3	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ±600kV Barmer-II (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. ➢ 400kV bus sectionaliser -2 nos. (1 Set) at Barmer-II (HVDC) station
4	Establishment of 2 nos. 3000 MW (Double Bipole configuration), ± 600kV South Kalamb S/s (HVDC) [VSC] terminal station (2x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 600 kV, 3000 MW (Double Bipole configuration)- 2nos.)
5	±600 kV HVDC Double Bipole line (2xD/c) (Quad Lapwing on same tower) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) (1100kms) [with 100% reactive power capability]	Line Length – (~1100 km)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
6	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II which will be established under a different network expansion scheme in WR as per details given below* (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)	• 765/400 kV 1500 MVA ICTs- 4 nos. • 765 kV ICT bays- 4 no. • 400 kV ICT bays- 4 no • 330 MVAr Bus Reactor-2 nos. (at bus section-II) • 765 kV Bus reactor bays- 2 nos. (at bus section-II) • 125 MVAr Bus Reactor-2 nos. (at bus section-II) • 400 kV Bus reactor bays- 2 nos. (at bus section-II)

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line is presently under bidding stage).

**** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.]***

Downstream lines planned from South Kalamb S/s

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
Part A		
1	• Creation of New 765kV Bus Section-III & 400kV Bus Section-III through 765 kV Sectionalization bay: 1 set & 400 kV Sectionalization bay: 1 set alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III. 400kV Sectionaliser between Sections-II & III to be kept normally open and 765kV sectionaliser between Sections-II & III shall be kept normally closed. The 400kV sectionaliser can be closed under contingency conditions. • Installation of 3x1500MVA, 765/400kV ICTs at South Kalamb S/s (400kV Sec-III & 765kV Section-III)	• 765/400 kV 1500 MVA ICTs- 3 nos. • 765 kV ICT bays- 3 no. (at bus section-III) • 400 kV ICT bays- 3 no (at bus section-III) • 330 MVAr Bus Reactor-2 nos. (at bus section-III) • 765 kV Bus reactor bays- 2 nos. (at bus section-III) • 125 MVAr Bus Reactor-2 nos. (at bus section-III) • 400 kV Bus reactor bays- 2 nos. (at bus section-III) • 765 kV Sectionalization bay: 1 set • 400 kV Sectionalization bay: 1 set
2	LILO of Nagothane – Padghe 400kV D/c line at South Kalamb	LILO route length~10km.
3	LILO of Pune(AIS) – Navi Mumbai 400kV line at South Kalamb	LILO route length~10km.
4	LILO of Pune(AIS) – Vikhroli 400kV line at South Kalamb	LILO route length~10km.
Part-B (Refer Note-2):		
5	Reconductoring of the balance line section of Pune(AIS) – Vikhroli 400kV line (upto LILO point of LILO of Lonikand-Kalwa 400kV line at Pune(AIS)) of Western Transco Power Ltd. (a subsidiary of AESL) with conductor having capacity of 2100MVA per ckt at nominal voltage*	1.707 km. reconductoring (under ownership of WTPL)
6	Upgradation of 400kV bay at Pune(AIS) of POWERGRID (associated with Pune(AIS) – Vikhroli 400kV line) of Western Transco Power Ltd. (a subsidiary of AESL) commensurate with the reconductoring capacity of 2100MVA per ckt at nominal voltage	Upgradation of the Complete Dia 6 (Vikroli Line Main Bay, Tie Bay & 315 MVA ICT3 Main Bay) to be carried out (as informed by POWERGRID)

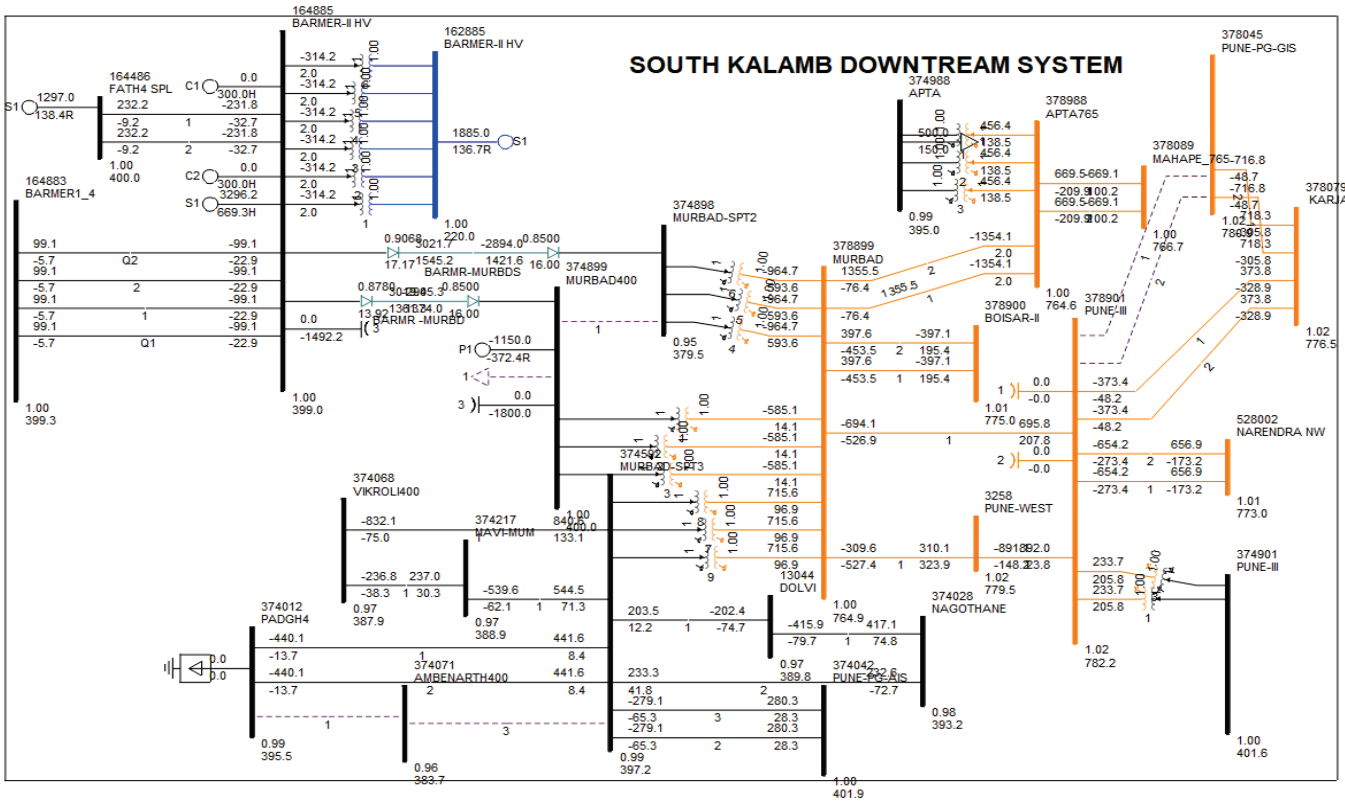
**MSETCL shall reconductor the balance line portion from above LILO point upto Kalwa with conductor having capacity of 2100MVA per ckt at nominal voltage*

Note:

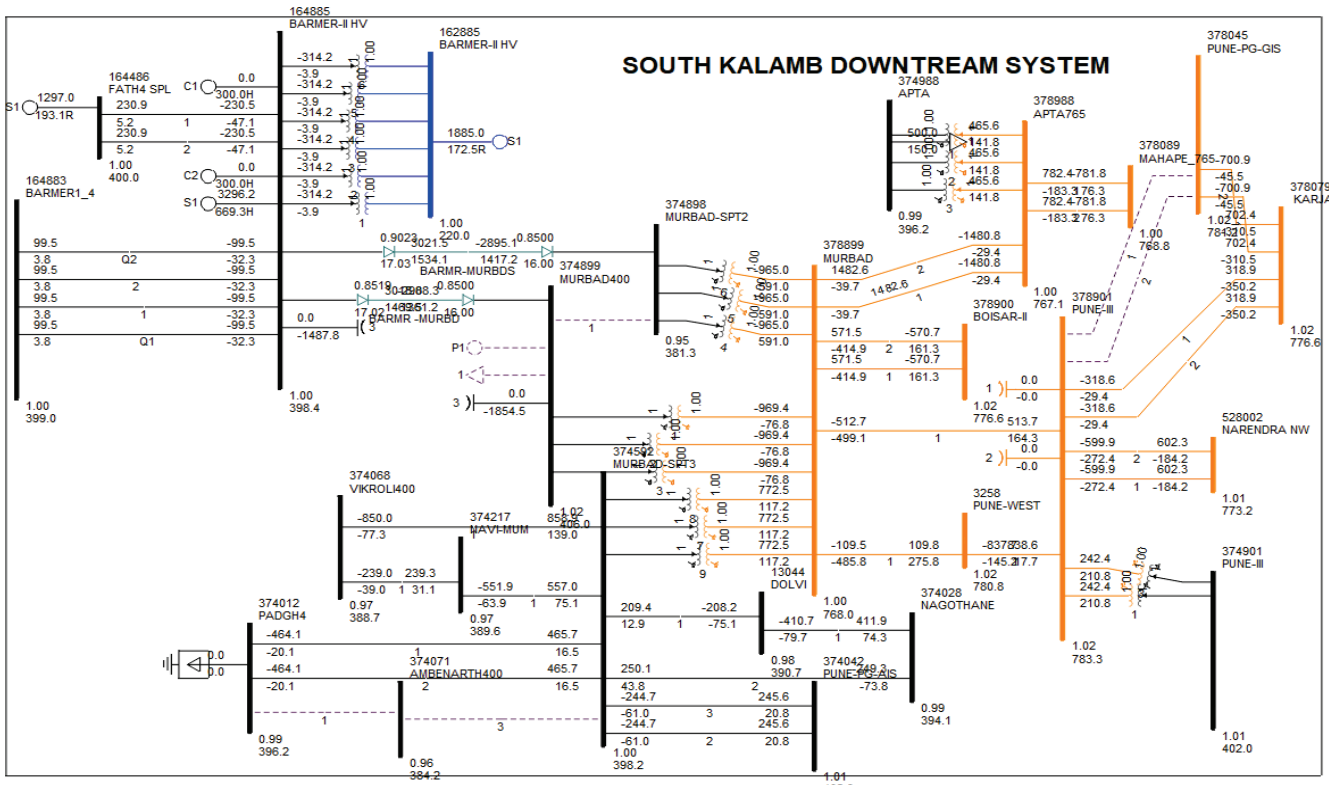
1. As informed by MSETCL, LILO of Pune(AIS) – Kalwa 400kV line at Vikhroli has already been implemented by Kharghar Vikhroli Transmission Limited (under In-STS TBCB) with high capacity conductor.

2. As decided in the 26th NCT meeting held on 06.01.2025, all the reconductoring proposals will be deliberated in NCT along with cost breakup of Reconductoring portion and the developer who is awarded the scheme under RTM shall approach the appropriate commission in terms of the existing provisions of the regulations.

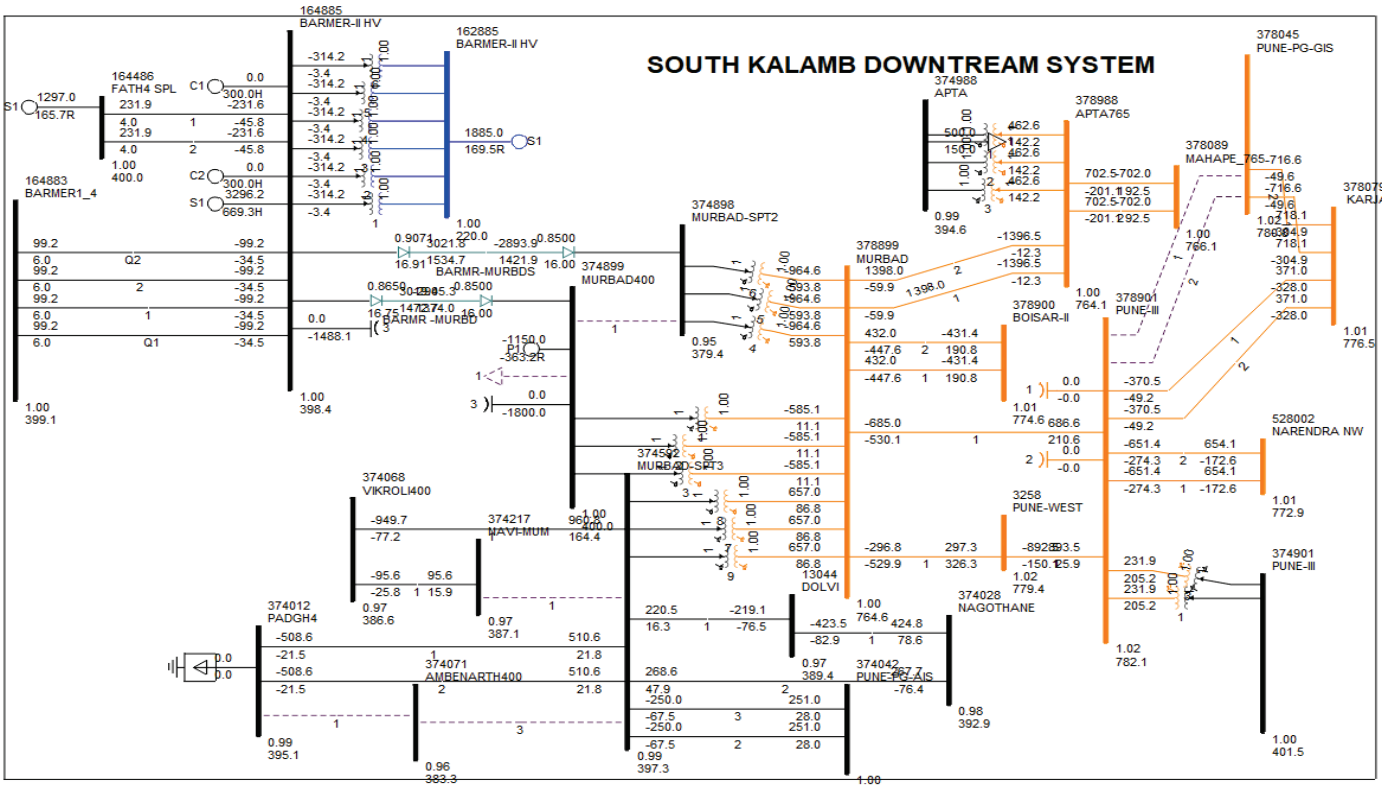
BASE CASE POWER FLOW



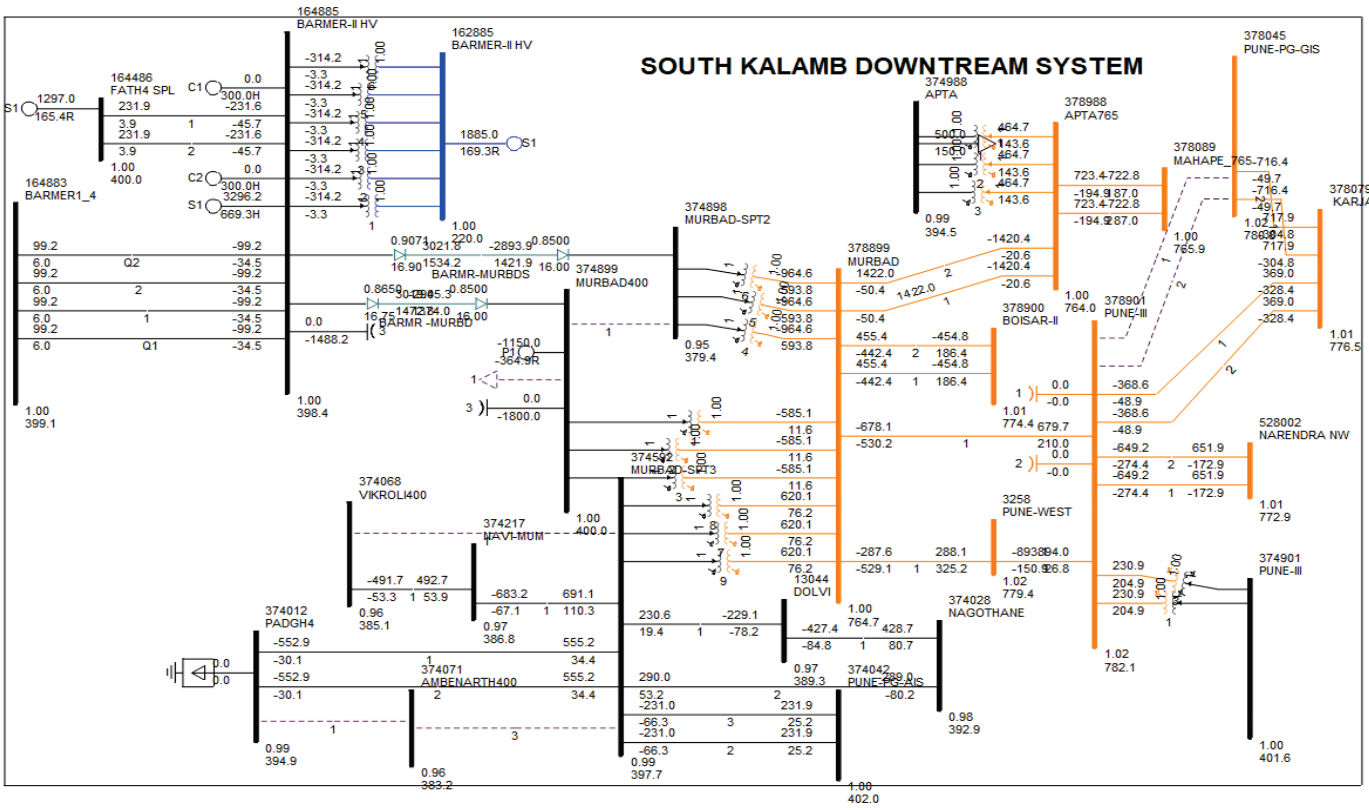
POWER FLOW WITH 1150MW PSP UNDER OUTAGE MODE



POWER FLOW WITH NAVI MUMBAI – SOUTH KALAMB 400kV LINE UNDER OUTAGE MODE



POWER FLOW WITH VIKHROLI – SOUTH KALAMB 400kV LINE UNDER OUTAGE MODE



सत्यमेव जयते

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

सेवा में /To

As per list of Addresses

विषय: ट्रांसमिशन पर राष्ट्रीय समिति (एनसीटी) की तीसवीं बैठक की कार्यवृत्त ।

Subject: Minutes of the 30th Meeting of the National Committee on Transmission (NCT)-reg.

महोदया (Madam) / महोदय (Sir),

The 30th meeting of the National Committee on Transmission (NCT) was held on 30th May, 2025 at New Delhi. The minutes of the meeting are attached herewith.

भवदीय / Yours faithfully

25.6.2025

(बी.एस.बैरवा / B.S. Bairwa)
मुख्य अभियन्ता एवं सदस्य सचिव,(एन.सी.टी.)/
Chief Engineer & Member Secretary (NCT)

प्रतिलिपि / Copy to:

Joint Secretary (Trans), Ministry of Power, New Delhi

List of Addresses:

1.	Chairperson, Central Electricity Authority Sewa Bhawan, R.K. Puram, New Delhi – 110 066.	2.	Member (Power Systems), Central Electricity Authority Sewa Bhawan, R.K. Puram, New Delhi – 110 066.
3.	Member (Economic & Commercial), Central Electricity Authority Sewa Bhawan, R.K. Puram, New Delhi – 110 066.	4.	Director (Trans), Ministry of Power Shram Shakti Bhawan, New Delhi-110001.
5.	Sh, Abhay Bakre, Mission Director, MNRE Atal Akshay Urja Bhawan Opposite CGO Complex gate No. 2, Lodhi Road, New Delhi – 110003	6.	Chief Operating Officer, CTUIL, Floors Nos. 5-10, Tower 1, Plot Nos. 16, IRCON International Tower, Institutional Area, Sector 32, Gurugram, Haryana - 122001.
7.	Sh. Rajnath Ram, Adviser (Energy), NITI Aayog, Parliament Street, New Delhi – 110 001.	8.	CMD, Grid Controller of India, B-9 (1st Floor), Qutub Institutional Area, Katwaria Sarai, New Delhi – 110016
9.	Sh. Ravinder Gupta Expert Member (power System)	10	Chairperson, TCC& Managing Director, JKPTCL, Office of Managing Director, Grid Station Complex, Janipur, Jammu/ PDD Complex Bemina Srinagar- 190010
11.	Member Secretary , Western Region Power Committee Plot No F-3, Opposite SEEPZ Complex, MIDC Area Marol, Andheri (East), Mumbai- 400 093	12.	Shri Shivdas.S, Chairperson (TCC) and Director (Transmission, System Operation & Planning), KSEBL Vydyuthi Bhavanam, Pattom, Thiruvananthapuram, Kerala- 695004
13.	Sh. Sabyasachi Roy, Director (Operations), WBSETCL	14.	Chairperson , North Eastern Region Power Committee Hon'ble Minister of Power, Govt. of Assam, Guwahati – 781 006

Special Invitee

1. Chief Engineer (PCD), CEA
2. CEO, RECPDCL
3. CEO, PFCCL

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Minutes of the 30th meeting of National Committee on Transmission

1 Confirmation of the minutes of the 29th meeting of National Committee on Transmission.

1.1 The minutes of the 29th meeting of NCT held on 17.04.2025 were issued on 05.05.2025 vide CEA letter Nos. CEA-PS-12-13/3/2019-PSPA-II.

1.2 CTUIL vide email dated 05.05.2025 informed that the scheme "Augmentation of 2x500 MVA (7th & 8th), 400/220 kV ICTs along with 220 kV Sectionalizer bay (1 set), 220 kV BC (1 No.) bay and 220 kV TBC (1 No.) bay at Bikaner IV PS" was allocated for implementation under RTM mode through "Bikaner A Power Transmission Limited". The company has changed its name to 'POWERGRID Bikaner IV Transmission Limited" vide MoCA certificate dated 05.03.2025. CTUIL requested to change the name of the implementing agency in the minutes of 29th NCT meeting.

1.3 Accordingly, it was agreed that the name of the implementing agency in para 3.4.4 of the minutes of 29th NCT meeting may be read as "POWERGRID Bikaner IV Transmission Limited (a 100% wholly owned subsidiary of POWERGRID)" instead of 'Bikaner A Power Transmission Limited (a 100% wholly owned subsidiary of POWERGRID)'.

1.4 With the above clarification, the minutes were confirmed.

2 Status of the transmission schemes noted/approved/recommended to MoP in the 29th meeting of NCT:

2.1 Members noted the status of transmission schemes approved/recommended in the 29th meeting of NCT as given below.

Sr. No	Name of the Transmission Scheme	Noted/ Recommended/ Approved	Mode of Implementation	BPC	Award/ Gazette notification
1.	Inter-Regional Strengthening between SR Grid and ER Grid	Recommended	TBCB	PFFCL	Informed to MoP vide letter dated 05.05.2025. Gazette notified on 21.05.2025
2.	Inter-Regional Strengthening between SR Grid and WR Grid	Recommended	TBCB	RECPDCL	
3.	Augmentation of 2x500 MVA (7th & 8th), 400/220 kV ICTs along with 220 kV Sectionalizer bay (1 set), 220 kV BC (1 No.) bay and 220 kV TBC (1 No.) bay at Bikaner-IV PS	Approved	RTM	Not applicable	Informed to CTUIL vide letter dated 05.05.2025 CTUIL awarded the projects to the implementing agency on 05.05.2025
4.	OPGW laying work on 132 kV Dharamnagar	Approved	RTM	Not	

Sr. No	Name of the Transmission Scheme	Noted/ Recommended/ Approved	Mode of Implementation	BPC	Award/ Gazette notification
	Dullavcherra and 132 kV Dullavcherra-Halaikandi line			applicable	

2.2 Status of transmission schemes where modifications was suggested/approved in 29th NCT meeting:

S. Nos.	Scheme where modifications was suggested	Status
1	Transmission system for proposed Green Hydrogen/Green Ammonia projects in Tuticorin area and the "Transmission system for proposed Green Hydrogen/Green Ammonia projects in Kakinada area, Madhya Pradesh (Phase-I)	Informed to BPCs vide letter dated 05.05.2025
2.	Redundant Communication for Salal (NHPC) station	Informed to CTUIL vide letter dated 05.05.2025
3.	Redundant Communication for Tuticorin GIS (PG) Substation	
4.	OPGW replacement on 132kV Kahilipara-Umiam Stg. III-Umiam Stg. I - NEHU link & OPGW on 132kV Sarusajai -Umtru line & UGFO NERLDC Guwahati to Kahilipara for backup NERLDC	
5.	OPGW replacement on 132kV Nehu-Neigrihms-Khliehriat Ckt-1 & UGFO from Tower 25 of 132kV Nehu-Mawlyndep line to NERLDC Shillong	
6.	OPGW installation on 765 kV FatehpurVaranasi S/c line and 765 kV Fatehpur-Sasaram S/c line (proposed to be LILOed at New Prayagraj)	
7.	Supply and installation of OPGW on existing 765 kV Gwalior-Satna S/c Line which is proposed to be LILOed at Karera (near Datiya) S/s under TBCB Project namely "Western Region Expansion Scheme XXXIII (WRESXXXIII): Part B"	

3 Modifications in the earlier approved/notified transmission schemes

3.1 Implementation of "Augmentation of 1x500 MVA, 400/230 kV ICT (7th) at Tuticorin-II GIS Sub-station" awarded under RTM Mode to POWERGRID

3.1.1 Representative from CTUIL stated that the transmission scheme "Augmentation of 1x500MVA, 400/230kV ICT (7th) at Tuticorin-II GIS Substation" was approved for implementation under RTM through POWERGRID by NCT in its 28th meeting held on 06.03.2025. CTUIL vide letter dated 21.03.2025 intimated to POWERGRID to process with the implementation of above scheme in line with the NCT.

He further mentioned that this transmission scheme has been approved as Associated Transmission System (ATS).CTU has granted / received applications for grant connectivity to 03 nos. of applicants considering augmentation of 1x500MVA, 400/230kV ICT (7th) at Tuticorin-II GIS Substation as ATS. Applicants are required to submit consent for

implementation of transmission schemes as ATS and followed by Conn-BG2 (towards cost of ATS) on pro-rata basis of the connectivity quantum. In case the applicant(s) fails to submit the Connectivity Bank Guarantees, the grant of connectivity is liable to be revoked and augmentation of ICT (7^{th}) may not be required. Applicant(s) still have timeline for submission of Consent for implementation of 7^{th} ICT as ATS and submission of Conn-BG2. CTUIL has already requested POWERGRID to keep implementation of the scheme "on Hold" till further communications from CTUIL.

3.1.2 Members noted the same.

3.2 DPR Project cost variation in "Augmentation of Transformation capacity at Bhuj-II PS (GIS)" awarded under RTM

3.2.1 Chief Engineer (PSPA-II), CEA stated that the scheme was agreed in the 16^{th} meeting of NCT held on 30.11.2023 under TBCB route with estimated cost of Rs. 428 crores and implementation timeframe of 21 months. As single bid was received despite multiple bidding attempts by the BPC, in the 27^{th} meeting of NCT held on 06.02.2025, NCT approved the implementation of the scheme "Augmentation of Transformation capacity at Bhuj-II PS (GIS)" under RTM mode to POWERGRID Bhuj Transmission Limited with an estimated cost of Rs. 428 Cr.

3.2.2 Representative from CTUIL mentioned that POWERGRID vide letter dated 05.05.2025 has intimated CTUIL that the DPR cost of the project "Augmentation of transformation capacity at Bhuj-II PS (GIS)" as Rs. 486.02 Cr. (December'24 price level) and requested to convey approval/ratification of NCT for the revised project cost/DPR cost in line with CERC directives and procedure issued to be followed by CTUIL for the projects costing < Rs. 100 Cr. in case variation of DPR cost is beyond 10% of CTUIL's estimated cost as per para No. 4.4. of minutes of the 26^{th} meeting of NCT dated 30.01.2025.

3.2.3 Member (E&C), CEA stated that POWERGRID may approach CERC for any variation in the cost and NCT may not take up the matter of cost variation.

3.2.4 Chairperson, CEA mentioned that the scheme was approved by the NCT in its 27^{th} meeting held in February'2025 without any revision of the cost provided in 16^{th} meeting of NCT held in November'2023. CTUIL was directed to revise the tentative cost of the scheme on present price level and intimate the same to NCT.

4 New Transmission Schemes:

4.1 North Eastern Region Expansion Scheme-XXIII (NERES-XXIII)

4.1.1 Representative of CTUIL stated that Pasighat (Arunachal Pradesh) – Roing (POWERGRID) – Tezu (POWERGRID) – Namsai (POWERGRID) 132 kV S/c on D/c corridor is owned by POWERGRID. Pasighat (Arunachal Pradesh) S/s is of DoP, Arunachal Pradesh and Roing, Tezu & Namsai substations are part of ISTS and owned by POWERGRID.

4.1.2 Representative of CTUIL further stated that additional industrial demand of about 100 MW (1st - 35MW and 2nd - 65MW) is expected at Niglok (Arunachal Pradesh) S/s. Niglok (Arunachal Pradesh) is connected to Napit/New Pasighat and Likbali substations of DoP, Arunachal Pradesh. POWERGRID, NERLDC and DoP, Arunachal Pradesh had mentioned that owing to hilly and difficult terrain conditions in Arunachal Pradesh, 2nd circuit stringing of Roing – Tezu – Namsai 132 kV S/c on D/c line also needs to be taken up for reliable power supply in the area. Moreover, various new HEPs are coming up in Arunachal Pradesh in these areas which require construction power as well. Thus, keeping in view upcoming industrial demand, regular demand growth in eastern Arunachal Pradesh, and to improve reliability of 132 kV system (predominantly S/c), it was agreed to take up 2nd circuit stringing of various intra-state [Gerukamukh – Likabali – Niglok – Pasighat (New)] and ISTS lines [Pasighat (Arunachal Pradesh) – Roing (POWERGRID) – Tezu (POWERGRID) – Namsai (POWERGRID)]**..**

4.1.3 CTUIL informed that the scheme was awarded to POWERGRID for implementation under RTM mode vide CTU OM dated 14-06-2024 with an estimated cost of Rs.73.47 Cr. Further, POWERGRID vide letter dated 14-01-2025, requested CTUIL for reviewing the approved project cost due to higher DPR cost (Rs. 200.15 Cr.) mainly due to RoW compensation. CTUIL has done the revised costing based on September 2024 Price level which works out to be ₹ 117.65 Cr.

4.1.4 NCT expressed concern over the time gap of 7 months' between the award of the scheme to POWERGRID and POWERGRID's letter to CTUIL informing higher project cost. NCT opined that this time gap should be minimum. It was also opined that there may not be implications of RoW as there is stringing of second circuit only on the existing line with double circuit towers.

4.1.5 After deliberations, NCT directed CTUIL to obtain clarification from POWERGRID regarding RoW compensation and verify the difference in the cost calculation. The agenda with revised cost (at latest price level) to be put before NCT in the next meeting.

4.2 **MoU between the Government of Rajasthan and Government of UAE for development of 60 GW RE Projects in the State of Rajasthan.**

4.2.1 Chief Engineer (PSPA-I), CEA stated that Government of UAE has signed a MoU with the Ministry of New and Renewable Energy, Government of India on 09.01.2024 for investment in RE capacity in India. To further this ultra-investment, a MoU was also signed between the Government of Rajasthan and Government of UAE dated 22.10.2024 for development of 60 GW RE Projects in the State of Rajasthan.

4.2.2 He further mentioned that RVPN has submitted to MNRE that additional 60 GW RE envisaged under MoU with UAE is huge quantum and cannot be consumed in the State of Rajasthan alone, hence, RVPN has requested to plan necessary transmission system for evacuation of power from 60 GW RE Projects of UAE in Rajasthan under ISTS.

4.2.3 Chairperson, CEA stated that the locations of 60 GW generation haven't been mentioned by Rajasthan. Further, as it can be evacuated only through HVDC system, it is getting difficult to identify the landing points. It was mentioned that out of 36 GW RE capacity planned to be integrated to Intra state network in Rajasthan, connectivity of around 24 GW has been granted, accordingly, development of remaining 12 GW RE capacity in Intra State may be done under this 60 GW MoU.

4.2.4 After deliberations, NCT opined that MNRE may further examine/assess the feasibility of the 60 GW generation in Rajasthan, and provide the inputs to NCT.

4.3 Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar)

4.3.1 Representative from CTUIL stated that in the 29th meeting of National committee on Transmission (NCT) held on 17.04.25, agenda for Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) was deliberated and it was decided that CTUIL shall carry out a life-time cost-benefit analysis of BESS vis-à-vis proposed HVDC transmission schemes and present the same in the forthcoming NCT meeting.

4.3.2 CTUIL carried out a cost comparison analysis of HVDC transmission system vis-à-vis 6000 MW BESS for 4 Hrs (1 Cycle per day), i.e., 24000 MWh considering the following assumptions for BESS cost estimation:

1) Recent Bid Value of GUVNL (April'25) for 500MW/2Hrs/2 Cycles per day cost of Rs 2,80,000/MW/Month (without any VGF) is taken as reference cost.
2) Useful life of BESS is considered 12 Years. '2' Replenishments during 35 Years Life (i.e., 3 life cycles).
3) After 12 Years, BESS cost is considered as 80% of recent bid value and after 24 Years, BESS cost is considered as 60% of recent bid value cost.
4) Round Turn Efficiency of 85%.
5) Degradation factor at the end of each year is 2.5%

The Cost Comparison of BESS, vis -a vis LCC and VSC HVDC is as follows:

SI. No	Technology	Capacity	Apprx. Cost (in cr.)
1	LCC HVDC	±800kV, 6000MW, Parallel Bipole along with associated EHVAC system	24,974
2	VSC HVDC	±600kV, 6000 MW, Double Bipole along with associated EHVAC system	36,044
3	BESS	24000MWh, 6000 MW for 4 Hrs	59,721*

		(1 Cycle per day)	

*Capital cost for BESS is calculated considering NPV @ 9.25% (as per CERC notified Discount rate for computation of levelized transmission charges dated April 2, 2024)

4.3.3 Grid-India shared the following observations on the cost benefit analysis of BESS carried out by CTUIL:

a. The balance of system (BoS) cost (for BESS with higher number of hours) should be considered only one-time in the monthly charges
b. The Net Present Value (NPV) of the first and second replacements of BESS has been determined by CTUIL only for the 12-year and 24-year milestones, respectively—i.e. the capital outlays at those future points have been considered. Instead, these replacement costs should be discounted back to the base valuation date (time zero) when computing their NPV.

4.3.4 Grid-India stated that as per an independent cost-benefit analysis carried out by Grid-India the capital cost of 6000 MW x 4 hour BESS (1 cycle per day, 9.25% discount rate and useful life of 12 years) comes out to be competitive with respect to the estimated cost of VSC based HVDC. The BESS would also provide arbitrage benefits to the Discom(s).

4.3.5 Grid-India further highlighted the following advantages of BESS over proposed HVDC schemes:

- The gestation period of BESS is much lower than the gestation period of HVDC systems which will facilitate faster integration of RE.
- With the rapid addition of solar generation, managing high grid frequency during solar hours is becoming increasingly challenging. Thermal generators are being backed down to technical minimum levels to the extent possible. Restriction on RE generation is also being required on certain days to control high frequency. Inadequate generation flexibility, currently, is a major challenge.
  BESS can alleviate the generation flexibility challenge and enhance grid stability. Therefore, prioritizing BESS deployment in regions like the Rajasthan RE complex offers a more cost-effective, and timely solution for integrating renewable energy into the grid.

4.3.6 On the LCC based HVDC alternative, Grid-India stated that the short circuit ratio (SCR) at Barmer-II has been observed to be low (<2.5) in the planning studies. As per CEA Connectivity Standards, the minimum SCR at point of interconnection of RE shall be greater than five. Further, CEA's Manual on Transmission Planning Criteria states that the minimum SCR at the terminals of LCC based HVDC converter stations shall be greater than three.

4.3.7 Considering that Barmer-II would be a radial station with low system strength, evacuating 6000 MW capacity via HVDC from this substation may be looked into. Stability related issues are already being faced in the Rajasthan RE complex and this system may also

witness similar stability challenges. Grid-India proposed that the RE capacity may be pooled to a nearby station with high fault level such as Chittorgarh (SCMVA at 400 kV - ~34000 MVA in current time-frame). The HVDC may then be planned from such station to a suitable location.

4.3.8 CTU stated that drawl transmission system for absorption of power from Barmer-II HVDC is already identified through 765/400kV South Kalamb S/s in Western region, which has been planned to cater to drawl requirement of Mumbai area and also for upcoming PSPs in Talegaon area. At present considering the RE potential as well as RE applications received in Rajasthan RE complex, more nos. of HVDCs (each of 6GW) are envisaged. As landing point for drawl of power from envisaged HVDCs is yet to be identified, some HVDC transmission schemes may be avoided with BESS as an alternative. However, detailed deliberation on optimal location of BESS as well as cost-benefit analysis comparing BESS and HVDC is required. Further, landing point of another HVDC from a Lakadia area to Alephata/ Pune has similarly been identified to cater to demand in the Pune area.

4.3.9 CTU stated that with proposed scheme SCR of Barmer-II PS is about 5, however in case both HVDC and RE capacity contribution considered for SCR calculation, SCR value comes out to be about 2.5. The SCR of 400kV Barmer-II PS may further improve with future interconnection planned in Barmer complex as well as with integration of SynCons, if required.

4.3.10 CTU further stated that integration of RE power to other intermediate sub stations through EHVAC system i.e. Ajmer, Chittorgarh, Beawar, Rishabdeo etc. and its further evacuation through HVDC from intermediate substations is not feasible due to space constraint in the above substations.

4.3.11 NCT opined that as this HVDC system has already been agreed by RPCs, the same may be taken up for implementation. However, looking into the huge RE potential in Rajasthan, BESS may be considered along with RE potential to be developed subsequently.

4.3.12 After deliberations, the transmission scheme “Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)” was recommended to be implemented under TBCB mode as follows:

Sl. No.	**Name of the scheme and tentative implementation timeframe**	**Estimated Cost (₹ Crore)**	**Remarks**
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration) Tentative implementation timeframe: 54 months from allocation of project (Pole-1: 48 months, Pole-2: 54 months	24,974	Recommended for implementation under TBCB by RECPDCL

4.3.13 Detailed scope of the scheme is given below:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactor –6 ➢ 400 kV line bays –4 Nos. ➢ 400 kV Bus Reactor along with bays: 1 No. ➢ 400/220 kV ICT along with bays-4 Nos. ➢ 400 kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -5 Nos. ➢ 220kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 Nos. of Syncon units* at 400kV level along with 2 nos. of 400kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) *****1 No. of SynCon unit comprises dynamic support of +300MVAr/-200MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum)) (Value of inertia (MW-secs) shall be provided in RfP document)**	Barmer-II PS - AIS • 400/220 kV 500 MVA ICTs- 6 Nos. • 400 kV ICT bays- 6 Nos. • 220 kV ICT bays- 6 Nos. • 125 MVAr Bus Reactor-2 Nos. • 400 kV Bus reactor bays- 2 Nos. • 400kv line bays– 4 Nos. (for RE interconnection) • 220KV line bays – 7 Nos. (for RE connectivity) • 220kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 400kV sectionaliser bay- 1 Set
2	LILO of both ckts of 400 kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	Line Length ~ 10 km (LILO length ~ 10 km) • 400 kV line bays-4 Nos. (at Barmer-II PS end)
3	400 kV Barmer-II PS - Barmer-I PS D/c line (Quad)	Line Length – (~30 km) • 400 kV line bays at Barmer-II PS – 2 Nos. • 400 kV line bays at Barmer-I PS S/s – 2 Nos.
4	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2nos.) ➢ 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
		power to HVDC terminal. ➢
5	Establishment of 6000 MW, ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb	HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos.)
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) [with 100% reverse power capability]	Line Length – (~900 km)
7	Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below* (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & 765kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)	• 765/400 kV 1500 MVA ICTs- 4 Nos. • 765 kV ICT bays- 4 Nos. • 400 kV ICT bays- 4 Nos. • 330 MVAr Bus Reactor-2 Nos. (at bus section-II) • 765 kV Bus reactor bays- 2 Nos. (at bus section-II) • 125 MVAr Bus Reactor-2 Nos. (at bus section-II) • 400 kV Bus reactor bays- 2 Nos. (at bus section-II)
8	2 Nos. of Syncon units at 400kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300MVAr/-200MVAr (Minimum) & Short circuit contribution at PCC of 1200MVA (Minimum)) (Value of inertia (MW-secs) shall be provided in RfP document) **	• Syncon units – 2 Nos. • 400 kv line bays – 2 Nos.

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage).

** Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open.*

Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].

***The above are as per discussions with OEMs and the under-excitation limit is as considered by the committee 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*

4.3.14 NCT further directed CTUIL to:

(i). Prepare specifications to enable technology agnostic bidding of HVDC systems in future, and present the same to NCT.

(ii). Carry out detailed cost-benefit analysis comparing BESS and HVDC alternatives, including the modalities for bidding out BESS projects and present the same to NCT.

5 Communication schemes:

5.1 OPGW installation on existing 400 kV Sikar (PG) – Agra (PG) D/c line (owned by PG) which is proposed to be LILO at 400 kV GSS Kumher (RRVPN)

5.1.1 Representative of CTUIL stated that LILO of existing 400 kV Sikar-Agra D/c line is proposed at 400 kV GSS Kumher (RRVPN) under Intra-State by RVPNL. On the LILO portion RVPNL is installing OPGW, however on main line i.e. 400kV Sikar – Agra D/c OPGW is not available as per the inputs received from POWERGRID

5.1.2 He further stated that to meet data, voice & protection requirements between Agra, Sikar & Kumher Substations after LILO, OPGW needs to be installed over the 400 kV Sikar-Agra D/c line (386 Km) which is proposed to be LILO at 400 kV GSS Kumher (RVPN).

5.1.3 After deliberations, the communication scheme “OPGW installation (48F) on existing 400 kV Sikar (PG) – Agra (PG) D/c line (owned by PG) which is proposed to be LILO at 400 kV GSS Kumher (RRVPN)” was approved for implementation under RTM route as mentioned below:

5.1.4 Summary of the scheme is given below:

Sl. No.	Name of the scheme and tentative implementation timeframe	Estimated Cost (₹ Crore)	Remarks
1.	OPGW installation (48F) on existing 400 kV Sikar (PG) – Agra (PG) D/c line (owned by PG) which is proposed to be LILO at 400 kV GSS Kumher (RRVPN) Tentative implementation timeframe: Matching time frame with transmission scheme of “LILO of one circuit of 400kV Sikar – Agra D/c (Quad Moose) line at 400 kV GSS Kumher (6.5 ckm) along with 80 MVAR, 420 kV switchable line reactor at Kumher end of Sikar – Kumher 400 kV section”	26.49	Approved under RTM through POWERGRID

5.1.5 Detailed scope of the scheme is given below:

Sl. No.	Scope of the scheme
1	Supply and Installation of 48 Fiber OPGW on existing 400 kV Sikar (PG) – Agra (PG) D/c line (owned by PG) **(386 km)** including Repeater which is proposed to be LILO at 400 kV GSS Kumher (RRVPN) including FOTE at Sikar S/s (PG) & Agra S/s (PG). **Total OPGW - 386 kms.** **Total FOTE – 2 Nos.** **Repeater- 1 No.**

5.2 **OPGW installation on existing 220 kV Chittorgarh (RVPN)-RAPP B (NPCIL) D/c Line (owned by PG) which is proposed to be LILO at RRVPNLs 220 kV GSS Begun (Chittorgarh)**

5.2.1 Representative of CTUIL stated that LILO of both circuits of 220 kV D/c Chittorgarh-RAPP-B lines has been proposed for creation of 220 kV GSS Begun (Chittorgarh) under Intra-State scheme by RVPNL. On the LILO portion RVPNL is installing OPGW, however as per the inputs received from POWERGRID, OPGW is not available on 220 kV Chittorgarh-RAPP B D/c Line

5.2.2 He further stated that to meet data, voice & protection requirements between Chittorgarh, RAPP-B & Begun Substations after LILO, OPGW needs to be installed over the 220 kV Chittorgarh-RAPP B D/c line (130 kms) which is proposed to be LILO at 220 kV GSS Begun (Chittorgarh) of RRVPNL.

5.2.3 After deliberations, the communication scheme "OPGW installation (48F) on existing 220 kV Chittorgarh (RVPN)-RAPP B (NPCIL) D/c Line (owned by PG) which is proposed to be LILO at RRVPNLs 220 kV GSS Begun (Chittorgarh)" was approved for implementation under RTM route as mentioned below:

5.2.4 Summary of the scheme is given below:

Sl. No.	Name of the scheme and tentative implementation timeframe	Estimated Cost (₹ Crore)	Remarks
1.	OPGW installation (48F) on existing 220 kV Chittorgarh (RVPN)-RAPP B (NPCIL) D/c Line (owned by PG) which is proposed to be LILO at RRVPNL's 220 kV GSS Begun (Chittorgarh) Tentative implementation timeframe: Matching time frame with transmission scheme of "LILO of 220 kV Chittorgarh-RAPP B D/c Lines at RVPNs proposed 220 kV GSS Begun (Chittorgarh)"	8.55	Approved under RTM through POWERGRID

5.2.5 Detailed scope of the scheme is given below:

Sl. No.	Scope of the scheme
1	Supply and Installation of 48 Fiber OPGW on existing 220 kV Chittorgarh (RRVPNL)-RAPP B (NPCIL) D/c Line (owned by PG) (**130 kms.**) which is proposed to be LILO at RVPNs 220 kV GSS Begun (Chittorgarh) including FOTE at Chittorgarh S/s (RRVPNL) & RAPP B station (NPCIL). **Total OPGW - 130 kms.** **Total FOTE – 2 Nos.**

5.3 **Transmission system Replacement of Coriant make FOTE at Alusteng, Drass, Kargil, Khalsti, Leh S/s**

5.3.1 The agenda was withdrawn by CTUIL.

5.4 **Scheme for laying of OPGW on ISTS lines in Eastern Region**

5.4.1 Representative of CTUIL stated that, OPGW on below mentioned lines have been installed & commissioned by POWERGRID during the period 2004- 2005. The links were commissioned by POWERGRID telecom dept (PDT).

a) 400kV Prayagraj (Allahabad)–Sasaram (214.42 km)
b) 400kV Farakka –Sagardighi II -Jeerat (304.16 km)
c) 400kV Indravati-Rengali-Talcher (377.31 km)
d) 400kV Malda - Purnea & 400kV Purnea -Binaguri (367.36 km)
e) 400kV Binagauri-Bongaigaon (239.81 km)

These links are being utilized for sensitive and critical grid management data to RLDC/NLDC from sub-stations and SLDCs

5.4.2 Representative from CTUIL informed that the concerned OPGW lines have been in service for over 15 years and are experiencing frequent interruptions, necessitating their replacement. It was further mentioned that to ensure continuity of data communication and avoid service disruptions during the replacement process, the new OPGW is proposed to be laid by replacing the earth wire on the second peak of the tower. After implementation of the above scheme the present ULDC and POWERTEL traffic shall be shifted on newly laid OPGW. The existing OPGW link shall continue to serve as earth wire and any utilization of the fibers of existing OPGW shall be done with prior intimation to CEA and CTU.

5.4.3 Chairperson, CEA enquired about the methodology adopted for determining the replacement of OPGW lines. He further asked whether Grid-India has observed any disruption of due to communication link failure.

5.4.4 Grid-India clarified that due to automatic rerouting of data through alternate communication links, service disruptions may not be evident, and not all OPGW failures may be detectable at their end.

5.4.5 Chairperson, CEA stated that CTUIL has recently commissioned the Unified Network Management System (UNMS), which should provide comprehensive visibility into such communication links. He directed CTUIL to monitor link-loss events and assess the continued usability of the existing fibre. He further stated that some mechanism for ascertaining the requirement for replacement of OPGW after completion of its useful life needs to be formulated. He further suggested that international best practices may be adopted while doing performance checks of these communication links.

5.4.6 After deliberations, NCT directed CTUIL to carry out detailed study as mentioned above and bring comprehensive agenda in the NCT.

6 Status of the bids under process by BPCs

6.1 The BPCs (RECPDCL and PFCCL) have made presentations on the status of under bidding schemes. Summary of the same is given below:

S.No.	Region(s)	RECPDCL	PFCCL
1.	LoI issued and SPV to be transferred	01	03
2.	Bids Under Evaluation	00	02
3.	RfP issued and bids to be submitted	05	07
4.	RfP yet to be issued	02	01
5.	RfP bid submission on hold	01	00
	TOTAL	**09**	**13**

6.2 Members noted the status of the schemes under bidding.

***

Summary of the deliberations of the 30th meeting of NCT held on 30th May, 2025

I. Modification in the earlier approved/notified transmission schemes:

1. DPR Project cost variation in "Augmentation of Transformation capacity at Bhuj-II PS (GIS)" awarded under RTM

Member (E&C), CEA stated that POWERGRID may approach CERC for any variation in the cost and NCT may not take up the matter of cost variation.

Chairperson, CEA mentioned that the scheme was approved by the NCT in its 27th meeting held in February'2025 without any revision of the cost provided in 16th meeting of NCT held in November'2023. CTUIL was directed to revise the tentative cost of the scheme on present price level and intimate the same to NCT

II. ISTS Transmission schemes, costing greater than ₹ 500 Crore, recommended by NCT to MoP under TBCB:

The ISTS transmission schemes recommended by NCT to MoP are given below:

Sl. No.	Name of Transmission Scheme	Implementation Mode	Tentative Implementation timeframe	BPC	Estimated Cost (₹ Crs.)
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)	TBCB	54 months from allocation of project (Pole-1: 48 months, Pole-2: 54 months	RECPDCL	24,974

The broad scope of the above ISTS schemes to be notified in Gazette of India is as given below:

Sl. No.	Name of Scheme & Tentative implementation timeframe	Broad Scope	Bid Process Coordinator
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration) **Implementation Timeframe:** 54 months from allocation of project (Pole-1: 48 months, Pole-2: 54 months	i. Establishment of 400/220kV, 6x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor ii. LILO of both ckts of 400 kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS iii. 400 kV Barmer-II PS - Barmer-I PS D/c line (Quad) iv. Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC]	RECPDCL

			terminal station (4x1500 MW) at a suitable location near Barmer-II substation v. Establishment of 6000 MW, ± 800kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb vi. ±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000MW) [with 100% reverse power capability] vii. Augmentation of South Kalamb S/s# by 4x1500MVA, 765/400kV ICTs (3 on 400kV & 765kV Section-II & 1 No. on 400kV & 765kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II. viii. 2 Nos. of Syncon units at 400 kV level of Barmer-II PS **(Detailed scope as approved by 30th NCT and subsequent amendments thereof)**	

III. Communication schemes approved by NCT

Sl. No.	Name of Transmission Scheme	Implementation Mode	Tentative Implementation timeframe	Implementing Agency	Estimated Cost (Rs. Crs)
1.	OPGW installation (48F) on existing 400 kV Sikar (PG) – Agra (PG) D/c line (owned by PG) which is proposed to be LILO at 400 kV GSS Kumher (RRVPN)	RTM	Matching time frame with transmission scheme of "LILO of one circuit of 400kV Sikar – Agra D/c (Quad Moose) line at 400 kV GSS Kumher (6.5 ckm) along with 80 MVAR, 420 kV switchable line reactor at Kumher end of Sikar – Kumher 400 kV section"	POWER GRID	26.49
2.	OPGW installation (48F) on existing 220 kV Chittorgarh (RVPN)-RAPP B (NPCIL) D/c Line	RTM	Matching time frame with transmission scheme of "LILO of 220 kV	POWER GRID	8.55

	(owned by PG) which is proposed to be LILO at RRVPNLs 220 kV GSS Begun (Chittorgarh)		Chittorgarh-RAPP B D/c Lines at RVPNs proposed 220 kV GSS Begun (Chittorgarh)"		

Annexure-I

List of participants of the 30th meeting of NCT

CEA:

1. Sh. Ghanshyam Prasad, Chairperson, CEA & Chairman, NCT
2. Sh. Ajay Talegaonkar, Member (E&C)
3. Sh. A. Balan, Member (PS)
4. Sh. Ishan Sharan, Chief Engineer (PSPA-I)
5. Sh. S.K. Maharana, Chief Engineer (PCD)
6. Sh. B. S. Bairwa, Chief Engineer (PSPA-II)
7. Sh. Rahul Raj, Director (PSPA-II)
8. Sh. Farooque Iqbal, Director (PSPA-II)
9. Sh. Pranay Garg, Deputy Director (PSPA-II)
10. Sh. Nitin Deswal, Deputy Director (PSPA-I)
11. Sh. Manish Kumar Verma, Assistant Director (PSPA-II)

MoP:

1. Sh. Om Kant Shukla, Director (Trans.)

RPCs:

1. Sh. K.B. Jagtap, MS (NERPC)
2. Sh. V. K. Singh, MS (NRPC)
3. Smt. Raheela Wani, MD, JKPTCL
4. Sh. P D Lone, SE, WRPC
5. Sh. N.S. Mondal, MS (ERPC)
6. Director (Transmission), KSEBL

MNRE:

1. Sh. Abhay Bakre, Mission Director (NGHM)

SECI:

1. Sh. Vineet Kumar, DGM
2. Sh. R. K. Agarwal, Consultant

NITI AYOG:

1. Sh. Manoj Kumar Upadhyay, Dy. Adviser

CTUIL:

1. Sh. Ashok Pal, COO
2. Ms. Manju Gupta, Dy. COO
3. Sh. K.K. Sarkar, Sr. GM
4. Sh. Shiv Kumar Gupta, Sr. DGM
5. Sh. P.S. Das, Sr. GM
6. Ms. Nutan Mishra, Sr. GM
7. Sh. Sandeep Kumawat, DGM
8. Sh. VMS Prakash Y, DGM
9. Sh. Ajay Dahiya, DGM

10. Sh. Malla Mahendra, Chief Manager
11. Sh. Pratyush Singh, Chief Manager

GRID India:

1. Sh. S.C. Saxena, CMD
2. Sh. Rajiv Porwal, Director (SO)
3. Sh. Vivek Pandey, CGM (SO)
4. Sh. Priyam Jain, Chief Manager (SO)

RECPDCL

1. Sh. Anil Kumar Parela, Chief Manager

PFCCL

1. Sh. Naveen Phougat, GM
2. Sh. Deepak Kumar, Dy. Manager

Expert Member

1. Sh. Ravinder Gupta, Ex Chief Engineer, CEA

रजिस्ट्री सं. डी.एल.- 33004/99 REGD. No. D. L.-33004/99

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असाधारण
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (ii)
PART II—Section 3—Sub-section (ii)

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विद्युत मंत्रालय

अधिसूचना

नई दिल्ली, 28 अगस्त, 2025

का.आ. 3965(अ).— विद्युत अधिनियम, 2003 (2003 की सं. 36) की धारा 63 के अंतर्गत परिचालित दिशा-निर्देशों के पैरा 3 के उप-पैरा 3.2 द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए, केन्द्र सरकार, राष्ट्रीय पारेषण समिति की 30वीं बैठक की सिफारिशों पर, संबंधित बोली-प्रक्रिया समन्वयक (बीपीसी) के विवरण के साथ टीबीसीबी मोड के अंतर्गत निम्नलिखित पारेषण स्कीमों को अधिसूचित करती है: -

क्रम सं.	पारेषण स्कीम का नाम एवं कार्यक्षेत्र
1.	राजस्थान आरईजेड चरण-IV (भाग-5:6 गीगावाट) [बाड़मेर कॉम्प्लेक्स] बाड़मेर-II: 6 गीगावाट (सौर) (एलसीसी संरचना) से विद्युत की निकासी के लिए पारेषण प्रणाली संभावित कार्यान्वयन की समय-सीमा: परियोजना के आवंटन से 54 माह (पोल-1: 48 माह, पोल-2: 54 माह)

बीपीसी: आरईसी पावर डेवलपमेंट एंड कंसल्टेंसी लिमिटेड

कार्यक्षेत्र:

क्रम सं.	*पारेषण तत्व का विवरण*	*कार्य का कार्यक्षेत्र (सबस्टेशन का प्रकार/कंडक्टर क्षमता/किमी/बे की संख्या आदि)*
1.	बाड़मेर (बाड़मेर-II सबस्टेशन) के निकट उपयुक्त स्थान पर 2x125 एमवीएआर बस रिएक्टर के साथ 400/220 केवी, 6x500 एमवीए एस/एस की स्थापना भावी प्रावधान (वर्तमान स्कीम के कार्यक्षेत्र को छोड़कर): ➢ स्विचेबल लाइन रिएक्टर के साथ 400 केवी लाइन बे - 6 ➢ 400 केवी लाइन बे- 4 ➢ बे के साथ 400 केवी बस रिएक्टर: 1 ➢ बे के साथ 400/220 केवी आईसीटी- 4 ➢ 400 केवी सेक्शनलाइजेशन बे: 2 सेट ➢ नवीकरणीय ऊर्जा के आवेदनों की कनेक्टिविटी के लिए 220 केवी लाइन बे - 5 ➢ 220 केवी सेक्शनलाइजेशन बे: 2 सेट ➢ 220 केवी बीसी (2) और टीबीसी (2) दो ➢ 400 केवी के 2 बे के साथ 400 केवी स्तर पर 2 सिंकोन यूनिट* ➢ स्टैटकॉम (2x+300 एमवीएआर, 4x125 एमवीएआर एमएससी, 2x125 एमवीएआर एमएसआर) के साथ 400 केवी बे (2) ➢ *(1 सिंकोन यूनिट में +300 एमवीएआर/-200 एमवीएआर (न्यूनतम) का डायनेमिक सपोर्ट और 1200 एमवीए (न्यूनतम) के पीसीसी पर शॉर्ट सर्किट का योगदान शामिल है) (जड़त्व का मान (मेगावाट-सेकंड) आरएफपी दस्तावेज़ में प्रदान किया जाएगा)**	• बाड़मेर-।। पीएस - एआईएस • 400/220 केवी 500 एमवीए आईसीटी- 6 • 400 केवी आईसीटी बे- 6 • 220 केवी आईसीटी बे- 6 • 125 एमवीए बस रिएक्टर- 2 • 400 केवी बस रिएक्टर बे- 2 • 400 केवी लाइन बे- 4 (आरई इंटरकनेक्शन के लिए) • 220 केवी लाइन बे- 7 (आरई कनेक्टिविटी के लिए) • 220 केवी सेक्शनलाइजेशन बे: 1 सेट • 220 केवी बीसी (2) और टीबीसी (2) • 400 केवी सेक्शनलाइजर बे- 1 सेट
2.	बाडमेर-II पीएस पर 400 केवी फतेहगढ़-IV पीएस - बाड़मेर-I पीएस के दोनों सर्किट का एलआईएलओ	• लाइन की लंबाई ~ 10 किमी (एलआईएलओ की लंबाई ~ 10 किमी) • 400 केवी लाइन बे- 4 (बाड़मेर-।। पीएस छोर पर)
3.	400 केवी बाड़मेर-II पीएस - बाड़मेर-I	• लाइन की लंबाई ~30 किमी

		पीएस डी/सी लाइन (क्वाड)	• बाड़मेर-II पीएस पर 400 केवी लाइन बे- 2 • बाड़मेर-I पीएस एस/एस पर 400 केवी लाइन बे - 2
	4.	बाड़मेर-II सबस्टेशन के निकट उपयुक्त स्थान पर 6000 मेगावाट, ± 800 केवी बाड़मेर-II (एचवीडीसी) [एलसीसी] टर्मिनल स्टेशन (4x1500 मेगावाट) की स्थापना	• एचवीडीसी टर्मिनल स्टेशन (± 800 केवी, 3000 मेगावाट (बाइपोल विन्यास)- 2) • एचवीडीसी टर्मिनल को विशेष रूप से सहायक विद्युत आपूर्ति के लिए 400/33 केवी, 2x50 एमवीए ट्रांसफार्मर
	5.	कलंब के दक्षिण के निकट उपयुक्त स्थान पर 6000 मेगावाट, ± 800 केवी दक्षिण कलंब एस/एस (एचवीडीसी) [एलसीसी] टर्मिनल स्टेशन (4x1500 मेगावाट) की स्थापना	• एचवीडीसी टर्मिनल स्टेशन (± 800 केवी, 3000 मेगावाट (बाइपोल अभिविन्यास)- 2)
	6.	बाड़मेर-II (एचवीडीसी) और दक्षिण कलंब (एचवीडीसी) के बीच ±800 केवी एचवीडीसी बाइपोल लाइन (हेक्सा लैपविंग) (समानांतर डेडिकेटेड मेटालिक रिटर्न के साथ) (6000 मेगावाट विद्युत निकासी करने में सक्षम) [100% रिवर्स पावर क्षमता के साथ]	• लाइन की लंबाई ~900 किमी
	7.	सेक्शन-II पर 2x330 एमवीएआर, 765 केवी बस रिएक्टर और 2x125 एमवीएआर, 420 केवी बस रिएक्टर के साथ 4x1500 एमवीए, 765/400 केवी आईसीटी द्वारा दक्षिण कलंब एस/एस# का संवर्धन (400 केवी और 765 केवी सेक्शन-II पर 3 और 400 केवी और 765 केवी सेक्शन-I पर 1)। सेक्शन-II की स्थापना नीचे दिए गए विवरण के अनुसार डब्ल्यूआर में एक अलग नेटवर्क विस्तार स्कीम के अंतर्गत की जाएगी* (2x1500 मेगावाट एचवीडीसी बाइपोल-I को 400 केवी सेक्शन-I पर समाप्त किया जाएगा और 2x1500 मेगावाट एचवीडीसी बाइपोल-II को दक्षिण कलांब एस/एस के 400 केवी सेक्शन-II पर समाप्त किया जाएगा और 765 केवी बस सेक्शनलाइजर को सामान्य रूप से बंद रखा जाएगा और 400 केवी बस सेक्शनलाइजर को सामान्य रूप से खुला रखा जाएगा)	• 765/400 केवी 1500 एमवीए आईसीटी- 4 • 765 केवी आईसीटी बे - 4 • 400 केवी आईसीटी बे - 4 • 330 एमवीएआर बस रिएक्टर- 2 (बस सेक्शन-II पर) • 765 केवी बस रिएक्टर बे- 2 (बस सेक्शन-II पर) • 125 एमवीएआर बस रिएक्टर- 2 (बस सेक्शन-II पर) • 400 केवी बस रिएक्टर बे- 2 (बस सेक्शन- II पर)

	8.	बाड़मेर-II पीएस के 400 केवी स्तर पर 2 सिंकोन यूनिट (1 सिंकोन यूनिट में +300 एमवीएआर-/ 200 एमवीएआर का (न्यूनतम) डायनेमिक सपोर्ट और1200 एमवीए के (न्यूनतम) पीसीसी पर शॉर्ट सर्किट का योगदान शामिल है) (जड़त्व का मान (मेगावाट-सेकंड) आरएफपी दस्तावेज़ में प्रदान किया जाएगा)**	• सिंकोन यूनिट- 2 • 400 केवी लाइन बे- 2
		# पुणे-III - बोइसर-II 765 केवी डी/सी लाइन (वर्तमान में बोली चरण के अधीन) के एलआईएलओ के साथ, 2x1500 एमवीए, 765/400 केवी आईसीटी के साथ 2x330 एमवीएआर, 765 केवी बस रिएक्टर और 2x125 एमवीएआर, 420 केवी बस रिएक्टर सहित दक्षिण कलंब एस/एस की स्थापना । * नेटवर्क विस्तार स्कीम: 765 केवी सेक्शनलाइजेशन बे के माध्यम से नए 765 केवी और 400 केवी बस सेक्शन-II और III का निर्माण: 2 सेट और 400 केवी सेक्शनलाइज़ेशन बे: सेक्शन-III पर 2x330 एमवीएआर, 765 केवी बस रिएक्टर और 2x125 एमवीएआर, 420 केवी बस रिएक्टर के साथ 2 सेट का प्रस्ताव किया जा रहा है, साथ ही बस सेक्शन-III पर 765 केवी और 400 केवी दोनों स्तरों पर आईसीटी वृद्धि (3x1500 एमवीए, 765/400 केवी आईसीटी) के साथ-साथ दक्षिण कलंब एस/एस से बस सेक्शन-III पर डाउनस्ट्रीम 400 केवी लाइनें प्रभावी तिथि से 24 माह की कार्यान्वयन समय सीमा के साथ प्रस्तावित की जा रही हैं। [सेक्शन-I और II के बीच तथा सेक्शन-II और III के बीच 400 केवी सेक्शनलाइजर सामान्य रूप से खुला रहेगा। इसके अलावा, सेक्शन-I और II के बीच तथा II और III के बीच 765 केवी सेक्शनलाइजर सामान्य रूप से बंद रखा जाएगा। 400 केवी सेक्शनलाइजर को आकस्मिक परिस्थितियों में बंद किया जा सकता है।] **उपर्युक्त जानकारी ओईएम के साथ हुई चर्चा के अनुसार है और एनआरपीसी के सदस्य सचिव की अध्यक्षता में गठित समिति द्वारा अंडर-एक्साइटेशन सीमा विचारित है, इस समिति में सीईए, एनएलडीसी, एनआरएलडीसी, एनटीपीसी, भेल, सीटीयू और एसटीयू के सदस्य शामिल हैं, जो उत्तरी क्षेत्र के लिए जड़त्व संबंधी विचारों के आधार पर भविष्य में सिंक्रोनस कंडेनसर की आवश्यकता का विश्लेषण करेंगे।		

2. बोली प्रक्रिया समन्वयक की नियुक्ति, विद्युत मंत्रालय द्वारा इस संबंध में जारी और समय-समय पर संशोधित दिशानिर्देशों में निर्धारित शर्तों के अध्यधीन होगी।

3. बीपीसी तकनीकी विकल्पों के माध्यम से मार्ग के अधिकार (आरओडब्ल्यू) की चौड़ाई में कमी की गणना के लिए सीईए की समिति की रिपोर्ट दिनांक 24.09.2024 के अनुसार आरओडब्ल्यू अनुकूलन सुनिश्चित करेंगे।

4. इसके अलावा, मार्ग को पीएम गति शक्ति पोर्टल पर सत्यापन और भौतिक सर्वेक्षण के बाद ही अंतिम रूप दिया जाना चाहिए।

[फा. सं. 15/3/2018- ट्रांस- भाग(4)]

नाओरेम इंद्रकुमार सिंह, अवर सचिव (पारेषण)

MINISTRY OF POWER

NOTIFICATION

New Delhi, the 28th August, 2025

S.O. 3965(E).— In exercise of the powers conferred by sub-para 3.2 of Para 3 of the Guidelines circulated under Section 63 of the Electricity Act, 2003 (No. 36 of 2003), the Central Government, on the recommendations of 30th meeting of National Committee on Transmission, hereby notifies the following transmission scheme under TBCB mode, with details of respective Bid-Process Coordinator (BPC): -

<table>
<tr><th>Sl No.</th><th>Name & Scope of the Transmission Scheme</th></tr>
<tr><td>1.</td><td>
Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)

Tentative implementation timeframe: 54 months from allocation of project (Pole-1: 48 months, Pole-2: 54 months)

BPC: REC Power Development and Consultancy Limited

Scope:
<table>
<tr><th>Sl. No.</th><th>Description of Transmission Element</th><th>Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)</th></tr>
<tr><td>1.</td><td>Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor

<u>Future provisions (excl. scope of present scheme):</u>
➢ 400 kV line bays along with switchable line reactor – 6
➢ 400 kV line bays – 4 Nos.
➢ 400 kV Bus Reactor along with bays: 1 No.
➢ 400/220 kV ICT along with bays- 4 Nos.
➢ 400 kV Sectionalization bays: 2 sets
➢ 220 kV line bays for connectivity of</td><td>• Barmer-II PS – AIS
• 400/220 kV 500 MVA ICTs- 6 Nos.
• 400 kV ICT bays- 6 Nos.
• 220 kV ICT bays- 6 Nos.
• 125 MVAr Bus Reactor-2 Nos.
• 400 kV Bus reactor bays- 2 Nos.
• 400 kV line bays– 4 Nos. (for RE interconnection)
• 220 kV line bays – 7 Nos. (for RE connectivity)
• 220 kV Sectionalization bay: 1 set
• 220 kV BC (2 Nos.) & TBC (2 Nos.)
• 400 kV sectionaliser bay- 1 Set</td></tr>
</table>
</td></tr>
</table>

		RE Applications - 5 Nos. ➢ 220 kV Sectionalization bay: 2 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 2 Nos. of Syncon units* at 400 kV level along with 2 nos. of 400 kV bays ➢ STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) *(1 No. of SynCon unit comprises dynamic support of +300 MVAr/ -200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum)) (Value of inertia (MW-secs) shall be provided in RfP document)**	
2.		LILO of both ckts of 400 kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS	• Line Length ~ 10 km (LILO length ~ 10 km) • 400 kV line bays- 4 Nos. (at Barmer-II PS end)
3.		400 kV Barmer-II PS - Barmer-I PS D/c line (Quad)	• Line Length ~30 km • 400 kV line bays at Barmer-II PS – 2 Nos. • 400 kV line bays at Barmer-I PS S/s – 2 Nos.
4.		Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation	• HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 nos.) • 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal
5.		Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb	• HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos.)
6.		±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	• Line Length ~900 km
7.		Augmentation of South Kalamb S/s# by 4x1500 MVA, 765/400 kV ICTs (3 on 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below* (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Sec-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Sec-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400 kV bus sectionalizer to be kept normally open)	• 765/400 kV 1500 MVA ICTs- 4 Nos. • 765 kV ICT bays- 4 Nos. • 400 kV ICT bays- 4 Nos. • 330 MVAr Bus Reactor-2 Nos. (at bus section-II) • 765 kV Bus reactor bays- 2 Nos. (at bus section-II) • 125 MVAr Bus Reactor-2 Nos. (at bus section-II) • 400 kV Bus reactor bays- 2 Nos. (at bus section-II)
8.		2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum)) (Value of	• Syncon units – 2 Nos. • 400 kV line bays – 2 Nos.

	inertia (MW-secs) shall be provided in RfP document)**		
	# South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor alongwith LILO of Pune-III – Boisar-II 765 kV D/c line (presently under bidding stage). * Network Expansion Scheme: Creation of New 765 kV & 400 kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500 MVA, 765/400 kV ICTs) at Bus Section -III at both 765 kV & 400 kV levels alongwith downstream 400 kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400 kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765 kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400 kV sectionalisers can be closed under contingency conditions.]. ** The above are as per discussions with OEMs and the under-excitation limit is as considered by the committee 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		

2. The appointment of the Bid Process Coordinator is subject to the conditions laid down in the Guidelines issued by Ministry of Power in this regard, amended from time to time.

3. BPCs shall ensure RoW optimization as per the CEA's Committee report dated 24.09.2024 for calculation of reduction of Right of Way (RoW) Width through Technological Options.

4. Further, the route must be finalised after validation on PM Gati Shakti portal and physical survey.

[F. No. 15/3/2018- Trans- Part(4)]

NAOREM INDRAKUMAR SINGH, Under Secy. (Transmission)

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सत्यमेव जयते

GOVERNMENT OF INDIA
MINISTRY OF CORPORATE AFFAIRS

Central Registration Centre

Certificate of Incorporation

[Pursuant to sub-section (2) of section 7 and sub-section (1) of section 8 of the Companies Act, 2013 (18 of 2013) and rule 18 of the Companies (Incorporation) Rules, 2014]

I hereby certify that BARMER HVDC POWER TRANSMISSION LIMITED is incorporated on this THIRTY day of SEPTEMBER TWO THOUSAND TWENTY FIVE under the Companies Act, 2013 (18 of 2013) and that the company is Company limited by shares

The Corporate Identity Number of the company is **U42202DL2025GOI456212**

The Permanent Account Number (PAN) of the company is **AAOCB0010A***

The Tax Deduction and Collection Account Number (TAN) of the company is **DELB31164A***

Given under my hand at Manesar this THIRTY day of SEPTEMBER TWO THOUSAND TWENTY FIVE

Certification signature by DS MINISTRY OF CORPORATE AFFAIRS , CRC MANESAR 2 <ROC.CRC@MCA.GOV.IN>, Validity Unknown

Digitally signed by
DS MINISTRY OF CORPORATE AFFAIRS , CRC MANESAR 2
Date: 2025.09.30 14:22:07 IST

Satish Kumar

Assistant Registrar of Companies/ Deputy Registrar of Companies/ Registrar of Companies

For and on behalf of the Jurisdictional Registrar of Companies

Registrar of Companies

Central Registration Centre

Disclaimer: This certificate only evidences incorporation of the company on the basis of documents and declarations of the applicant(s). This certificate is neither a license nor permission to conduct business or solicit deposits or funds from public. Permission of sector regulator is necessary wherever required. Registration status and other details of the company can be verified on mca.gov.in

Mailing Address as per record available in Registrar of Companies office:

BARMER HVDC POWER TRANSMISSION LIMITED

CORE-4, SCOPE COMPLEX, 7, LODHI ROAD, Lodi Road, New Delhi, South Delhi- 110003, Delhi

*as issued by Income tax Department

SINGLE STAGE REQUEST FOR PROPOSAL DOCUMENT

FOR

SELECTION OF BIDDER AS TRANSMISSION SERVICE PROVIDER THROUGH TARIFF BASED COMPETITIVE BIDDING PROCESS

TO

ESTABLISH INTER-STATE TRANSMISSION SYSTEM

FOR

TRANSMISSION SYSTEM FOR EVACUATION OF POWER FROM RAJASTHAN REZ PH-IV (PART-5: 6 GW) [BARMER COMPLEX] BARMER-II: 6 GW (SOLAR) (LCC CONFIGURATION)

ISSUED BY

REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)

Registered Office:
Core-4, SCOPE Complex,
7, Lodhi Road, New Delhi – 110 003
Email: vijay.kulkarni@recpdcl.in & tbcb@recpdcl.in

28.01.2026

REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)
Core-4, SCOPE Complex,
7, Lodhi Road, New Delhi – 110 003

Request for Proposal Document for selection of Bidder as Transmission Service Provider through tariff based competitive bidding process to establish Inter-State Transmission system for "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" is issued by REC Power Development and Consultancy Limited.

This RFP document is issued to -

M/s. _____

_____

_____

_____

_____

Chief Executive Officer,
REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)

Email: …….

Place: ……

Date: ……

Signature: ……

REQUEST FOR PROPOSAL NOTIFICATION

REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)
Core-4, SCOPE Complex,
7, Lodhi Road, New Delhi – 110 003

1. Ministry of Power, Government of India vide its notification no. 3860 [F No. 15/03/2018-Trans- Part(4)] dated 29.08.2025 has notified REC Power Development and Consultancy Limited (RECPDCL) to be the Bid Process Coordinator (BPC) for the purpose of selection of Bidder as Transmission Service Provider (TSP) to establish Inter-State transmission system for "**Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)**" through tariff based competitive bidding process.

2. REC Power Development and Consultancy Limited (hereinafter referred to as BPC) hereby invites all prospective Bidders for issue of Request for Proposal (RFP) for selection of Bidder as Transmission Service Provider (TSP) on the basis of international competitive bidding in accordance with the "Tariff Based Competitive Bidding Guidelines for Transmission Service" and "Guidelines for Encouraging Competition in Development of Transmission Projects" issued by Government of India, Ministry of Power under section – 63 of The Electricity Act, 2003 and as amended from time to time. The responsibility of the TSP would be to establish the following Inter-State Transmission System - **Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)** (hereinafter referred to as 'Project') on build, own, operate & transfer basis and to provide transmission service:

Sl. No.	Scope of the Transmission Scheme	Scheduled COD in months from Effective Date
1.	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor Barmer-II PS – AIS • 400/220 kV 500 MVA ICTs- 6 Nos. • 400 kV ICT bays- 6 Nos. • 220 kV ICT bays - 6 Nos. • 125 MVAr Bus Reactor-2 Nos. • 400 kV Bus reactor bays- 2 Nos. • 400 kV line bays– 4 Nos. (for RE interconnection) • 220 KV line bays – 7 Nos. (for RE connectivity) • 220 kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 400 kV Sectionaliser bay- 1 Set **Future provisions (excl. scope of present scheme):** • 400 kV line bays along with switchable line reactor –6 • 400 kV line bays –4 Nos. • 400 kV Bus Reactor along with bays: 1 No. • 400/220 kV ICT along with bays-4 Nos. • 400 kV Sectionalization bays: 2 sets • 220 kV line bays for connectivity RE Applications -5 Nos. • 220 kV Sectionalization bay: 2 sets • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 2 Nos. of Syncon units* at 400 kV level along with 2 Nos. of 400 kV bays • STATCOM (2x ± 300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) *1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))	54 months from allocation of project (Bipole-1: 48 months, Bipole-2: 54 months)
2.	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS • 400 kV line bays- 4 Nos. (at Barmer-II PS end)	
3.	Barmer-II PS - Barmer-I PS 400 kV D/C line (Quad) • 400 kV line bays at Barmer-II PS – 2 Nos. • 400 kV line bays at Barmer-I PS– 2 Nos.	

4.	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation • HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos • 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal.	
5.	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb • HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos.)	
6.	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	
7.	Augmentation of South Kalamb S/s[#] by 4x1500 MVA, 765/400 kV ICTs (3 Nos. 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below[$] (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open) • 765/400 kV 1500 MVA ICTs- 4 Nos. • 765 kV ICT bays- 4 Nos. • 400 kV ICT bays- 4 Nos. • 330 MVAr Bus Reactor-2 Nos. (at bus section-II) • 765 kV Bus reactor bays- 2 Nos. (at bus section-II) • 125 MVAr Bus Reactor-2 Nos. (at bus section-II) • 400 kV Bus reactor bays- 2 Nos. (at bus section-II)	
8.	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum)) • Syncon units – 2 Nos. • 400 kV line bays – 2 Nos.	

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAr, 765 kV bus reactor and 2x125 MVAr, 420 kV bus reactor along with LILO of Pune-III – Boisar-

II 765 kV D/C line (presently under construction by M/s WRNES TPTL, a subsidiary of Adani Energy Solutions Limited).

$ Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAr, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].

3. The TSP shall ensure that design, construction and testing of all equipment, facilities, components and systems of the Project shall be in accordance with the provisions of the Transmission Service Agreement and applicable Rules/ Regulations, Orders and Guidelines issued by the Central Government.

4. **Transmission License**: The TSP shall obtain the Transmission License from the Commission.

5. **Bidding Process:** The Transmission Service Provider shall be selected through tariff based competitive bidding process for the Project based on meeting stipulated Qualification Requirements prescribed in Clause 2.1 of Section 2 of RFP and the lowest Quoted Transmission Charges discovered from Final Offers quoted during the e-reverse bidding. The selection of the TSP shall be subject to it obtaining Transmission License from the Commission, which, after expiry, may be further extended by such period as deemed appropriate by the Commission under powers vested with it to amend the conditions of the Transmission License.

   The entire bidding process shall be conducted on electronic platform created by MSTC Limited.

   The Bid shall be a single stage two envelope bid comprising the Technical Bid and the Financial Bid. The Bidders shall submit the Bid online through the electronic bidding platform. In addition to the online submission, the Bidder with lowest Final Offer will be required to submit original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B before issuance of LoI. There shall be no physical submission of the Financial Bid.

   The Technical Bid shall be opened first and the Financial Bid of only the bidders who have qualified in the Technical Bid shall be opened. The Financial Bid will comprise of two rounds. In the first round the Initial Offer of the responsive bids would be opened and Quoted Transmission Charges of Initial Offer shall be ranked on the basis of ascending order. The Bidders, in the first fifty per cent of the ranking (with any fraction rounded off to higher integer) or four Bidders, whichever is higher, shall qualify for participating in the electronic reverse auction stage and submit their Final Offer.

6. The objective of the bidding process is to select a Successful Bidder pursuant to this RFP, who shall acquire one hundred percent (100%) of the equity shares of Barmer HVDC Power Transmission Limited along with all its related assets and liabilities as per the provisions of

the Share Purchase Agreement, at the Acquisition Price to be intimated by the BPC, twenty (20) days prior to the Bid Deadline.

The Barmer HVDC Power Transmission Limited, of which one hundred percent (100%) equity shares will be acquired by the Selected Bidder, shall be responsible as the TSP, for ensuring that it undertakes ownership, financing, development, design, engineering, procurement, construction, commissioning, operation and maintenance of the Project, and to provide Transmission Service as per the terms of the RFP Project Documents.

The TSP shall ensure transfer of all project assets along with substation land, right of way and clearances to CTU or its successors or an agency as decided by the Central Government after 35 years from COD of project at zero cost and free from any encumbrance and liability. The transfer shall be completed within 90 days after 35 years from COD of project failing which CTU shall be entitled to take over the project assets Suo moto.

7. **Commencement of Transmission Service**: The Bidder shall have to commence Transmission Service in accordance with the provisions of the Transmission Service Agreement.

8. **Transmission Charges**: The Transmission Charges shall be payable by the Designated ISTS Customers in Indian Rupees through the CTU as per Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations as amended from time to time. Bidders shall quote the Transmission Charges as per the pre-specified structure, as mentioned in the RFP.

9. **Issue of RFP document:** The detailed terms and conditions for qualification and selection of the Transmission Service Provider for the Project and for submission of Bid are indicated in the RFP document. All those interested in purchasing the RFP document may respond in writing to Chief Executive Officer, **vijay.kulkarni@recpdcl.in**& tbcb@recpdcl.in at the address given in para 12 below with a non-refundable fee of Rs. 5,00,000/- (Rupees Five Lakh Only) or US$ 7,000 (US Dollars Seven Thousand Only) plus GST @18%, to be paid latest by 27.01.2026 via electronic transfer to the following Bank Account:

Bank Name, Address & Branch	ICICI Bank 9A, Phelps Building, Inner Circle, Connaught Place, New Delhi-110001
Bank Account Name	REC Power Development & Consultancy Limited
Bank Account No	000705041275
Bank IFSC Code No	ICIC0000007

Immediately after issuance of RFP document, the Bidder shall submit the Pre-Award Integrity Pact in the format as prescribed in Annexure B, which shall be applicable for and during the bidding process, duly signed on each page by any whole-time Director/ Authorized Signatory, duly witnessed by two persons, and shall be submitted by the Bidder in two (2) originals in a separate envelope, duly superscripted with Pre-Award Integrity Pact. The Bidder shall submit the Pre-Award Integrity Pact on non-judicial stamp paper of Rs. 100/- each duly purchased from the National Capital Territory of Delhi. In case the Bidder is in a consortium, the Pre-Award Integrity Pact shall be signed and submitted by each member of the Consortium separately.

The RFP document shall be issued to the Bidders on any working day from 28.01.2026 to 30.03.2026 between 1030 hours (IST) to 1600 hours (IST). The BPC, on written request and against payment of the above mentioned fee by any Bidder shall promptly dispatch the RFP document to such Bidder by registered mail/ air mail. BPC shall, under no circumstances, be held responsible for late delivery or loss of documents so mailed.

10. **Receipt and opening of Bid:** The Bid must be uploaded online through the electronic bidding platform on or before 1600 hours (IST) on 01.04.2026 Technical Bid will be opened by the Bid Opening Committee on the same day at 1630 hours (IST) in the office of Central Electricity Authority, in the online presence of Bidders' representatives who wish to attend. If the Bid Deadline is a public holiday at the place of submission of Bid, it shall be opened on the next working day at the same time and venue. In addition to the online submission, the Bidder with lowest Final Offer will be required to submit original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B before issuance of LoI. Bidders meeting the Qualification Requirements, subject to evaluation as specified in Clause **3.2** to **3.4** shall be declared as "Qualified Bidders" and eligible for opening of Initial Offer.

11. The RFP document is not transferable. BPC reserves the right to reject all Bids and/or annul the process of tariff based competitive bidding for selection of Bidder as TSP to execute the Project without assigning any reason. BPC shall not bear any liability, whatsoever, in this regard.

12. **Nodal person for enquiries and clarifications**

All correspondence and clarification in respect of RFP document shall be addressed to:

Chief Executive Officer,
REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)
REC Corporate Head Quarter,
D Block, Plot No. I – 4,
Sec – 29 Gurugram – 122 001
Email: vijay.kulkarni@recpdcl.in & tbcb@recpdcl.in

DISCLAIMER

1. This Request for Proposal (RFP) document is not an agreement or offer by the BPC to the prospective Bidders or to any other party. The purpose of this RFP document is to provide interested parties with information to assist the formulation of their Bid. The RFP document is based on material and information available in public domain.

2. This RFP, along with its Annexure, is not transferable and the information contained therein are to be used only by the person to whom it is issued. It may not be copied or distributed by the recipient to third parties (other than in confidence to the recipient's professional advisors). In the event that the recipient does not continue with its involvement in the Project in accordance with this RFP, this RFP must be kept confidential.

3. While this RFP has been prepared in good faith, neither the BPC nor its employees or advisors/consultants make any representation or warranty expressed or implied as to the accuracy, reliability or completeness of the information contained in this RFP. The Bidders shall satisfy themselves, on receipt of the RFP document, that the RFP document is complete in all respects. Intimation of any discrepancy shall be given to this office immediately. If no intimation is received from any Bidder within ten (10) days from the date of issue of this RFP document on or before the date & time mentioned in this RFP, it shall be considered that the issued document, complete in all respects, has been received by the Bidders.

   This bidding process is in accordance with the Bidding Guidelines issued by Ministry of Power, Government of India under Section 63 of the Electricity Act, 2003. Revisions or amendments in these Bidding Guidelines may cause the BPC to modify, amend or supplement this RFP document, including the RFP Project Documents to be in conformance with the Bidding Guidelines.

4. This RFP document includes statements, which reflect various assumptions arrived at by BPC in order to give a reflection of current status in the RFP. These assumptions should not be entirely relied upon by Bidders in making their own assessments. This RFP document does not purport to contain all the information each Bidder may require and may not be appropriate for all persons. It is not possible for BPC to consider the investment objectives, financial situation and particular needs of each party who reads or uses this RFP document. Certain Bidders may have a better knowledge of the Project than the others. Each Bidder should conduct its own investigations and analysis and should check the accuracy, reliability and completeness of the information in this RFP document and obtain independent advice from appropriate sources.

5. Neither BPC nor their employees or consultants make any representation or warranty as to the accuracy, reliability or completeness of the information in this RFP document.

6. Neither BPC, its employees nor its consultants will have any liability to any Bidder or any other person under the law of contract, tort, the principles of restitution or unjust enrichment or otherwise for any loss, expense or damage which may arise from or be incurred or suffered in connection with anything contained in this RFP document, any matter deemed to form part of this RFP document, the award of the Project, the information supplied by or on behalf of BPC or its employees, any consultants or otherwise arising in any way from the qualification process for the said Project.

7. By participating in the bidding process, each of the Bidder shall have acknowledged and

accepted that it has not been induced to enter into such agreement by any representation or warranty, expressed or implied, or relied upon any such representation or warranty by or on behalf of BPC or any person working in the bidding process.

8. BPC may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement this RFP document. Such updations, amendments or supplements, if any, will however be circulated to the Bidders not later than 15 days prior to the last date for submission of Bid.

9. Each Bidder unconditionally agrees, understands and accepts that the BPC reserves the rights to accept or reject any or all Bids without giving any reason. Neither the BPC nor its advisers shall entertain any claim of any nature, whatsoever, including without limitations, any claim seeking expenses in relation to the preparation of Bids.

10. This RFP may be withdrawn or cancelled by the BPC at any time without assigning any reasons thereof. BPC further reserves the right, at its complete discretion to reject any or all of the Bids without assigning any reasons whatsoever.

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DEFINITIONS

Any capitalized term, used but not defined in this RFP, shall have the meaning ascribed to such term in the RFP Project Documents, or the Bidding Guidelines, in that order. In absence of availability of definitions in the foregoing references, the capitalized terms shall be interpreted in accordance with the Electricity Act 2003, Grid Code or any other relevant electricity law, rule or regulation prevalent in India, as amended or re-enacted from time to time, in that order.

The following terms are defined for use in this RFP:

"Acquisition Price" shall have the same meaning as defined in the Share Purchase Agreement;

"Affiliate" shall mean a company that either directly or indirectly

i. controls or
ii. is controlled by or
iii. is under common control with

a Bidding Company (in the case of a single company) or a Member (in the case of a Consortium) and "**control**" means ownership by one entity of at least twenty six percent (26%) of the voting rights of the entity. As an illustration a chart is annexed hereto as Annexure – 12;

"Bid" shall mean Technical Bid and Financial Bid (Initial Offer and Final Offer) submitted by the Bidder, in response to this RFP, in accordance with the terms and conditions thereof;

"Bidder" shall mean either a single company (including its permitted successors and legal assigns) or a Consortium of companies (including its permitted successors and legal assigns) submitting a Bid in response to this RFP. Any reference to the Bidder includes Bidding Company, Bidding Consortium/ Consortium, Member in a Bidding Consortium and Lead Member of the Bidding Consortium jointly and severally, as the context may require;

"Bidding Company" shall refer to such single company (including its permitted successors and legal assigns) that has submitted a Bid for the Project;

"Bidding Consortium/ Consortium" shall refer to a group of companies (including their permitted successors and legal assigns) that has collectively submitted a Bid for the Project;

"Bidding Guidelines" shall mean the "Tariff Based Competitive-Bidding Guidelines for Transmission Service" and "Guidelines for Encouraging Competition in Development of Transmission Projects" issued by Government of India, Ministry of Power under Section – 63 of Electricity Act as amended from time to time;

"Bid Bond" shall mean the unconditional and irrevocable Bank Guarantee or unconditional and irrevocable Insurance Surety Bond issued by Insurance Company (authorized by Insurance Regulatory and Development Authority of India) or Payment on Order Instrument for Rupees Two Hundred Eighty-Six Crore Forty Lakhs (Rs. 286.40 Crore) only, to be submitted along with the Technical Bid by the Bidder under Clause 2.11 of this RFP, as per the format prescribed in Annexure 14 (for Bank Guarantee) or Annexure 14A (for Insurance Surety Bond) or Annexure 14B (for Payment on Order)**;**

"Bid Deadline" shall mean the last date and time for submission of online Bid in response to

this RFP, specified in Clause 2.7.1;

"Bid Process Coordinator or BPC" shall mean a person or its authorized representative as notified by the Government of India, responsible for carrying out the process for selection of Bidder who will acquire Transmission Service Provider;

"CEA" shall mean the Central Electricity Authority constituted under Section - 70 of the Electricity Act;

"Commission" or "CERC" shall mean the Central Electricity Regulatory Commission of India constituted under Section-76 of The Electricity Act, 2003 and any successors and assigns;

"Conflict of Interest" A Bidder shall be considered to be in a Conflict of Interest with one or more Bidders in the same bidding process if they have a relationship with each other, directly or through a common company, that puts them in a position to have access to information about or influence the Bid of another Bidder.

Provided that if two or more bidders in the bidding process have formed a Joint Venture Company or Consortium to execute another project, the Bidders will not be considered to have Conflict of Interest;

"Commercial Operation Date (COD)" shall mean the date as per Article 6.2 of the Transmission Service Agreement;

"Consents, Clearances, Permits" shall mean all authorizations, licenses, approvals, registrations, permits, waivers, privileges, acknowledgements, agreements, or concessions required to be obtained from or provided by any concerned authority for the development, execution and performance of Project including without any limitation on the construction, ownership, operation and maintenance of the transmission lines and/or sub-stations;

"Contract Performance Guarantee" shall have the meaning as per Clause 2.12 of this RFP;

"Contract Year" shall mean the period beginning on the Scheduled COD, and ending on the immediately succeeding March 31 and thereafter each period of 12 months beginning on April 1 and ending on March 31 provided that:

(i) the last Contract Year shall end on the last day of the term of the Transmission Service Agreement;

"CTU/Central Transmission Utility" shall have same meaning as defined in the Electricity Act, 2003;

"Designated ISTS Customers" or "DICs" shall have the meaning as ascribed in Regulation 2(l) of Central Electricity Regulatory Commission (Sharing of inter-State Transmission Charges and Losses) Regulation 2020 and as amended or modified from time to time;

"Effective Date" shall have the meaning as ascribed thereto in the Transmission Service Agreement;

"Element" shall mean-each Transmission Line or each circuit of the Transmission Lines (where there are more than one circuit) or each bay of the Sub-station or switching station or HVDC terminal

or inverter station of the Project, including ICTs, Reactors, SVC, FSC, etc. forming part of the ISTS which will be owned, operated and maintained by the concerned ISTS Licensee, and which may have a separate scheduled COD as per Schedule 2 of the Transmission Service Agreement and may have a separate percentage for recovery of Transmission Charges on achieving COD as per Schedule 5 of the Transmission Service Agreement;

"Final Offer" shall mean the Quoted Transmission Charges, required to be submitted as part of the Financial Bid on the electronic bidding platform during the e-reverse bidding stage. In case, no Final Offer is received during the e-reverse bidding stage then the lowest "Initial Offer" shall be deemed to be the Final Offer**;**

"Financial Bid" shall mean the Initial Offer and Final Offer, containing the Bidder's Quoted Transmission Charges, as per the format at Annexure – 21 of this RFP**;**

"Financially Evaluated Entity" shall mean the company which has been evaluated for the satisfaction of the financial requirement set forth in Clause **2.1.3** hereof;

"Government" shall mean the Central Government;

"Grid Code" / "IEGC" or **"State Grid Code"** shall mean the Grid Code specified by the Central Commission under clause (h) of sub-section (1) of Section 79 of the Electricity Act and/or the State Grid Code as specified by the concerned State Commission referred under clause (h) of sub-section (1) of Section 86 of the Electricity Act as applicable;

"Infrastructure sector" shall mean such sectors notified by Department of Economic Affairs in its Gazette Notification no. 13/1/2017-INF dated 14th November, 2017 and as amended from time to time;

"Initial Offer" shall mean the Quoted Transmission Charges, required to be submitted as part of the Financial Bid on the electronic bidding platform along with the Technical Bid**;**

"Inter State Generating Station" or "ISGS" shall mean a Central / other generating station in which two or more states have shares and whose scheduling is to be coordinated by the Regional Load Despatch Centre;

"Inter-State Transmission System" shall have same meaning as defined in the Electricity Act, 2003;

"Lead Member of the Bidding Consortium" or "Lead Member" shall mean a company who commits at least twenty six percent (26%) equity stake in the Project, meets the technical requirement as per Clause 2.1.2 and so designated by other Member(s) in Bidding Consortium;

"Letter of Intent" or "LoI" shall mean the letter to be issued by the BPC to the Bidder, who has been identified as the selected bidder, for award of the Project to such Bidder;

"Member in a Bidding Consortium/Member" shall mean each company in the Bidding Consortium;

"MOP" shall mean the Ministry of Power, Government of India;

"MOEF" shall mean the Ministry of the Environment and Forests, Government of India;

"National Committee on Transmission" shall mean the committee constituted by the Ministry of Power, Government of India in terms of the "Guidelines for Encouraging Competition in Development of Transmission Projects", as notified from time to time;

"Nodal Agency" shall mean CTU, which shall execute and implement the Transmission Service Agreement (TSA);

Provided that while taking major decisions, CTU shall consult CEA on technical matters and any other matter it feels necessary.

"Parent Company" shall mean an entity that holds at least twenty six percent (26%) of the paid - up equity capital directly or indirectly in the Bidding Company or in the Member in a Bidding Consortium, as the case may be;

"Payment on Order Instrument" shall mean Letter of Undertaking from Indian Renewable Energy Development Agency Limited (IREDA) or Power Finance Corporation Limited (PFC) or REC Limited (REC) [the three non banking financial institutions under Ministry of New & Renewable Energy (MNRE)/ Ministry of Power (MoP)], to pay in case situation of default of Transmission Service Provider (TSP) in terms of tender conditions/ Power Purchase Agreement (PPA) arises. Such Letter(s) will have same effect as that of a Bank Guarantee issued by any public sector bank. Such "Payment on Order instrument" would have terms and conditions similar to that of any Bank Guarantee given by any public sector bank and would promise to pay the Nodal Agency on demand within stipulated time. TSPs can seek such Letter(s) by offering due security to the above-mentioned three non-banking financial institutions mentioned above (IREDA, PFC & REC). Nodal Agency shall not accept the instrument of 'Letter of Undertaking' as described above or in any other form, from any other non-banking financial institutions or bank, except IREDA, PFC & REC.

"Qualification Requirements" shall mean the qualification requirements as set forth in Section-2, Clause 2.1 of this RFP;

"Quoted Transmission Charges" shall mean the quoted single annual Transmission Charges submitted online through the electronic bidding platform by the Bidder as part of its Financial Bid as per the format in Annexure – 21 of this RFP;

"RFP" shall mean Request for Proposal document along with all schedules, formats, annexure and RFP Project Documents attached hereto, issued by BPC for tariff based competitive bidding process for selection of bidder who will acquire the TSP through e-reverse bidding to execute the Project, and shall include any modifications, amendments or alterations or clarifications thereto;

"RFP Project Documents" shall mean the following documents to be entered into in respect of the Project, by the parties to the respective agreements:

a. Transmission Service Agreement (TSA),
b. Share Purchase Agreement,
c. Agreement(s) required, if any, under Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations as amended from time to time and
d. Any other agreement, as may be required;

"Scheduled COD" shall have the meaning as ascribed hereto in Clause 2.6 of this RFP;

"Statutory Auditor" shall mean the auditor appointed under the provisions of the Companies Act, 1956 / Companies Act, 2013 (as the case may be) or under the provisions of any other applicable governing law;

"Share Purchase Agreement" shall mean the agreement amongst REC Power Development and Consultancy Limited, Barmer HVDC Power Transmission Limited and the Successful Bidder for the purchase of one hundred (100%) per cent of the shareholding of the Barmer HVDC Power Transmission Limited for the Acquisition Price, by the Successful Bidder on the terms and conditions as contained therein;

"Successful Bidder" or **"Selected Bidder"** shall mean the Bidder selected pursuant to this RFP to acquire one hundred percent (100%) equity shares of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities, which will be responsible as the TSP to establish the Project on build, own, operate and transfer basis as per the terms of the Transmission Service Agreement and other RFP Project Documents;

"Survey Report" shall mean the report containing initial information regarding the Project and other details provided as per the provisions of Clause 1.6.2.1.1 of this RFP;

"Technical Bid" shall mean the bid submitted online through the electronic bidding platform, containing the documents as listed out in Clause 2.5.2 of this RFP;

"Technically Evaluated Entity" shall mean the company which has been evaluated for the satisfaction of the technical requirement set forth in Clause 2.1.2 hereof;

"Transmission Charges" shall mean the Final Offer quoted by Selected Bidder and adopted by the Commission, and as computed in terms of the provisions of Schedule 4 of the TSA, payable to the ISTS Licensee by the Designated ISTS Customers, and collected / disbursed by the CTU, as per Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations as amended from time to time;

"Transmission License" shall mean the license granted by the Commission in terms of the relevant regulations for grant of such license issued under the Electricity Act, 2003;

"Transmission Service Agreement" or **"TSA"** shall mean the agreement entered into between Nodal Agency and the TSP, pursuant to which the TSP shall build, own, operate and transfer the Project and make available the assets of the Project on a commercial basis;

"Transmission Service Provider" or "TSP" shall mean Barmer HVDC Power Transmission Limited which has executed the Transmission Service Agreement and which shall be acquired by the Selected Bidder;

"Ultimate Parent Company" shall mean an entity which owns at least twenty six percent (26%) equity in the Bidding Company or Member of a Consortium, (as the case may be) and in the Technically Evaluated Entity and/or Financially Evaluated Entity (as the case may be) and such Bidding Company or Member of a Consortium, (as the case may be) and the Technically Evaluated Entity and/or Financially Evaluated Entity (as the case may be) shall be under the direct control or indirectly under the common control of such entity.

SECTION – 1

INTRODUCTION

SECTION 1

1. INTRODUCTION

1.1 Ministry of Power, Government of India vide its notification no. 3860 [F No. 15/03/2018-Trans- Part(4)] dated 29.08.2025 has notified REC Power Development and Consultancy Limited to be the Bid Process Coordinator (BPC) for the purpose of selection of Bidder as Transmission Service Provider (TSP) to establish Inter-State transmission system for "**Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)"** through tariff based competitive bidding process.

The BPC hereby invites Bids from all prospective Bidders in accordance with this Request for Proposal (RFP) to select prospective Transmission Service Provider (TSP) in accordance with the "Tariff Based Competitive-Bidding Guidelines for Transmission Service" and "Guidelines for Encouraging Competition in Development of Transmission Projects" issued by Government of India, Ministry of Power under Section – 63 of the Electricity Act. The BPC shall select the Bidder having the prescribed technical and financial capability to become TSP and be responsible for establishing the Project in the state(s) of Rajasthan. The TSP will make the Project available against payment of Transmission Charges, as adopted by the Commission, payable to the TSP, as per Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations as amended from time to time.

1.2 The TSP will be required to establish the following Inter State Transmission System for "**Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)"** (hereinafter referred to as 'Project') on build, own, operate and transfer basis, and to provide transmission service.

Sl. No.	Scope of the Transmission Scheme	Scheduled COD in months from Effective Date
1.	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor Barmer-II PS – AIS • 400/220 kV 500 MVA ICTs- 6 Nos. • 400 kV ICT bays- 6 Nos. • 220 kV ICT bays - 6 Nos. • 125 MVAr Bus Reactor-2 Nos. • 400 kV Bus reactor bays- 2 Nos. • 400 kV line bays– 4 Nos. (for RE interconnection) • 220 KV line bays – 7 Nos. (for RE connectivity) • 220 kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 400 kV Sectionaliser bay- 1 Set **Future provisions (excl. scope of present scheme):** • 400 kV line bays along with switchable line reactor –6 • 400 kV line bays –4 Nos. • 400 kV Bus Reactor along with bays: 1 No. • 400/220 kV ICT along with bays-4 Nos. • 400 kV Sectionalization bays: 2 sets • 220 kV line bays for connectivity RE Applications -5 Nos. • 220 kV Sectionalization bay: 2 sets • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 2 Nos. of Syncon units* at 400 kV level along with 2 Nos. of 400 kV bays • STATCOM (2x ± 300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) *1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))	54 months from allocation of project (Bipole-1: 48 months, Bipole-2: 54 months)
2.	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS • 400 kV line bays- 4 Nos. (at Barmer-II PS end)	
3.	Barmer-II PS - Barmer-I PS 400 kV D/C line (Quad) • 400 kV line bays at Barmer-II PS – 2 Nos. • 400 kV line bays at Barmer-I PS– 2 Nos.	

4.	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation • HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos • 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal.	
5.	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb • HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos.)	
6.	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	
7.	Augmentation of South Kalamb S/s[#] by 4x1500 MVA, 765/400 kV ICTs (3 Nos. 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below[$] (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open) • 765/400 kV 1500 MVA ICTs- 4 Nos. • 765 kV ICT bays- 4 Nos. • 400 kV ICT bays- 4 Nos. • 330 MVAr Bus Reactor-2 Nos. (at bus section-II) • 765 kV Bus reactor bays- 2 Nos. (at bus section-II) • 125 MVAr Bus Reactor-2 Nos. (at bus section-II) • 400 kV Bus reactor bays- 2 Nos. (at bus section-II)	
8.	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum)) • Syncon units – 2 Nos. • 400 kV line bays – 2 Nos.	

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAr, 765 kV bus reactor and 2x125 MVAr, 420 kV bus reactor along with LILO of Pune-III – Boisar-

II 765 kV D/C line (presently under construction by M/s WRNES TPTL, a subsidiary of Adani Energy Solutions Limited).

$ Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAr, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].

1.3 Project Description

The transmission scheme comprises of the transmission system for evacuation of RE (Solar) power from Barmer area in the state of Rajasthan (Rajasthan REZ Ph-IV Part-5: 6 GW).

This scheme is a part of transmission system for evacuation of RE power from 75 GW of Renewable Energy Zones (REZs) identified by MNRE/SECI in Rajasthan. Out of 75 GW, evacuation of 13 GW has been planned from Fatehgarh (5 GW) and Barmer (8 GW) complex. Transmission schemes for 9 GW injection at Fatehgarh-IV PS and Barmer-I PS under Rajasthan REZ Ph-IV (Part-2: 5.5 GW) and Rajasthan REZ Ph-IV (Part-4: 3.5 GW) are under implementation. At present connectivity of about 6 GW capacity is already granted at Barmer-II PS and the present transmission scheme has been planned for evacuation of 6 GW RE (Solar) injection at Barmer-II Pooling station.

This comprehensive transmission scheme includes the establishment of 400 kV Barmer-II PS in Rajasthan along with 400 kV Barmer-II – Barmer-I D/c line and LILO of both circuits of 400 kV Fatehgarh-IV – Barmer-I D/c line at Barmer-II PS. The HVDC portion of the scheme includes establishment of ± 800 kV, 6000 MW Barmer-II(HVDC) [LCC] terminal station, ± 800 kV, 6000 MW, South Kalamb (HVDC) [LCC] terminal station along with Barmer-II – South Kalamb ±800 kV HVDC Biploe Line. For further dispersal of power, augmentation of South Kalamb S/s with 4 nos. of 765/400 kV, 1500MVA ICTs is to be implemented. Further, 2 Nos. of Syncon units at 400kV level of Barmer-II PS are also being proposed as part of comprehensive scheme.

Above transmission scheme has been discussed and agreed in the 36th CMETS-NR meeting held on 15.01.2025 and 35th CMETS-WR meeting held on 07.02.2025, 53rd TCC & 78th NRPC meeting held on 16-17th Mar'25, 53rd TCC/53rd WRPC meeting held on 13th Mar'25. Further, the transmission scheme was agreed in 30th NCT meeting held on 30.05.25. Subsequently, Ministry of Power, Government of India, vide its Gazette Notification CG-DL-E-30082025-265828 dated 29.08.2025 has notified the implementation of transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through tariff based competitive bidding process route.

1.4 Transmission Grid Map

Transmission Grid Map indicating the location of the Project is enclosed as Annexure 18

of this RFP for information and reference of the Bidders.

1.5 The objective of the bidding process is to select a Successful Bidder pursuant to this RFP, who shall acquire one hundred percent (100%) of the equity shares of Barmer HVDC Power Transmission Limited along with all its related assets and liabilities as per the provisions of the Share Purchase Agreement, at the Acquisition Price to be intimated by the BPC, twenty (20) days prior to the Bid Deadline.

The Barmer HVDC Power Transmission Limited, of which one hundred percent (100%) equity shares will be acquired by the Selected Bidder, shall be responsible as the TSP, for ensuring that it undertakes ownership, financing, development, design, engineering, procurement, construction, commissioning, operation and maintenance of the Project, and to provide Transmission Service as per the terms of the RFP Project Documents.

The TSP shall ensure transfer of all project assets along with substation land, right of way and clearances to CTU or its successors or an agency as decided by the Central Government after 35 years from COD of project at zero cost and free from any encumbrance and liability. The transfer shall be completed within 90 days after 35 years from COD of project failing which CTU shall be entitled to take over the project assets Suo moto.

1.6 Brief Scope of Work

1.6.1 Scope of Transmission Service Provider

The TSP's scope of work for the Project shall comprise, but not necessarily be limited to the following:

1.6.1.1 Establishment, operation and maintenance of the Project on build, own, operate and transfer basis and completion of all the activities for the Project, including survey, detailed project report formulation, arranging finance, project management, necessary Consents, Clearances and Permits (way leave, environment & forest, civil aviation, railway/ road/ river/ canal/ power crossing/ PTCC, etc.), land compensation, design, engineering, equipment, material, construction, erection, testing & commissioning. Further, the actual location of Greenfield Substation (Switching Station or HVDC Terminal or lnverter Station) in the scope of TSP:

- For a Generation Pooling Substation shall not be beyond 3 Km radius of the location proposed by the BPC in their Survey Report.
- For Load Serving Substation within the scope of TSP shall not be beyond 5 Km radius of the location proposed by the BPC in their Survey Report
- For an intermediate Substation shall not be beyond 10 Km radius of the location proposed by the BPC in their Survey Report.

1.6.1.2 The TSP shall ensure that design, construction and testing of all equipment, facilities, components and systems of the Project shall be in accordance with Transmission Service Agreement and applicable Rules/ Regulations, Orders and Guidelines issued by the Central Government.

1.6.1.3 The TSP shall ensure timely completion of entire scope of Project in all respects and its operation and maintenance, as shall be specified in the RFP documents.

1.6.1.4 The TSP shall seek Transmission License from the Commission, as per the provisions of the Electricity Act and regulations made thereunder.

1.6.1.5 The TSP shall seek approval under Section 164 of Electricity Act, from CEA after acquisition of Barmer HVDC Power Transmission Limited. The approval shall be granted by CEA generally within 30 days but in no case later than 45 days from the date of receipt of application (complete in all aspects).

1.6.2 **Scope of Bid Process Coordinator (BPC)**

BPC's scope of work is briefly outlined hereunder:

1.6.2.1 The BPC has initiated development of the Project and shall be responsible for the tasks in this regard as specified hereunder:

1. Provide to the Bidders a Survey Report for the Project at least forty five (45) days prior to the Bid Deadline. The Survey Report shall include the suggested route with approximate route length, type of terrain likely to be encountered and its likely implication in terms of Right of Way (ROW), statutory clearances, location of substations or converter stations and land area to be acquired for the substation or converter station.

2. To obtain approval for laying of overhead transmission lines under Section 68 of Electricity Act, from the Government at least twenty (20) days prior to Bid Deadline.

3. To initiate acquisition of land for location specific substations, switching stations or HVDC terminal or inverter stations, if required.

4. To initiate process of seeking forest clearance, if required

5. The BPC shall intimate to the Bidders, the Acquisition Price payable by the Selected Bidder to the REC Power Development and Consultancy Limited for the acquisition of one hundred percent (100%) of the equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities at least twenty (20) days prior to the Bid Deadline.

6. The BPC shall ensure issuance of all finalized RFP Project Documents, at least fifteen (15) days prior to the Bid Deadline.

   Provided that for any delay in meeting the above obligations of the BPC within the specified time period above, the Bid Deadline as per Clause 2.7.1 shall be extended on a day for day basis.

1.6.2.2 The details and documents as may be obtained by the BPC/ project specific SPV in relation to the Project shall be handed over to the TSP on an as-is-where-is basis, so that it may take further actions to obtain Consents, Clearances and Permits.

1.7 All costs (including direct and indirect) incurred by the BPC/ project specific SPV in connection with the activities concerning the Project shall be recovered from the TSP, which shall be included in the Acquisition Price.

1.8 The Project is required to be completed progressively in accordance with the schedule

prescribed in this RFP.

1.9 A company under the Companies Act, 2013 by the name Barmer HVDC Power Transmission Limited has been incorporated to initiate the activities for execution of the Project. The said company shall be acquired by the successful Bidder as per terms and conditions as may be prescribed in RFP.

1.10 The Ministry of Power and the appropriate state government(s) shall provide their support to the TSP, on best endeavor basis, in enabling the TSP to develop the Project.

1.11 All Bidders are required to submit their Bid in accordance with the instructions set forth in this RFP.

1.12 Once the Successful Bidder is selected, the details and documents as may be obtained by the BPC/ project specific SPV in relation to the Project, shall be handed over to the Successful Bidder on as is where basis, so that it may take further actions to obtain all necessary Consents, Clearances and Permits and the TSP shall not be entitled for any extensions in the Scheduled COD of the Project except as provided for in the TSA.

1.13 The assets of the Project shall be made available on a commercial basis as per the terms and conditions of the Transmission Service Agreement and Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations as amended from time to time.

SECTION - 2

INFORMATION AND INSTRUCTIONS FOR BIDDERS

SECTION – 2

2. INFORMATION AND INSTRUCTIONS FOR BIDDERS

2.1 Qualification Requirements

2.1.1 The Bidder should be a company duly incorporated under the relevant laws (Bidding Company) or a Consortium of companies (Bidding Consortium) with one of the companies acting as the Lead Member of the Bidding Consortium. The Bidder shall be selected on meeting the Qualification Requirements specified in Section 2 of this RFP, as demonstrated by the Bidder's Technical Bid and the lowest Quoted Transmission Charges discovered from Final Offers quoted during the e-reverse bidding. A Bidding Consortium can participate in the bidding process for the Project if any Member of the Consortium has purchased the RFP document for such Project. Bidder who agree and undertake to procure the products associated with the Transmission System as per provisions of Public Procurement (Preference to Make in India) orders issued by Ministry of Power vide orders No. 11/5/2018 - Coord. dated 28.07.2020 as amended vide order No. A1/2021- FSC-Part(5) dated 16.11.2021 and No.: P45021/2/2017-PP (BE-II)-Part-4 Vol.II dated 19.07.2024 issued by Ministry of Power for transmission sector, as may be further amended from time to time read with Department for Promotion of Industry and Internal Trade (DPIIT) orders in this regard, shall be eligible hereunder. Further, it is clarified that Procuring Entity as defined in orders shall deemed to have included Selected Bidder and/ or TSP.

Besides, Department of Expenditure, Ministry of Finance in suppression of OMs issued vide Order (Public Procurement No 1) bearing File No. 6/18/2019-PPD dated 23.07.2020, Order (Public Procurement No 2) bearing File No. 6/18/2019-PPD dated 23.07.2020 and Order (Public Procurement No. 3) bearing File No. 6/18/2019-PPD, dated 24.07.2020, Office Memorandum (OM) No. F.18/37/2020-PPD dated 08.02.2021, OM No. F.12/1/2021- PPD(Pt.) dated 02.03.2021, OM No. F.7/10/2021-PPD dated 08.06.2021 and Order (Public Procurement No 4) bearing File No. F.7/10/2021-PPD dated 23.02.2023 as amended from time to time, have issued directions regarding public procurement from a bidder of a country, which shares land border with India are also applicable.

2.1.2 **Technical requirement to be met by the Bidding Company or Lead Member of Bidding Consortium**

The Bidder must fulfill any one of the following technical requirements:

(i) Experience of development of projects in the Infrastructure Sector in the last ten (10) years with aggregate capital expenditure of not less than Rs**. 14,320 Crore** or equivalent USD (calculated as per provisions in Clause 3.4.1**).** However, the capital expenditure of at least one project shall not be less than **Rs. 2,864 Crore** or equivalent USD (calculated as per provisions in Clause 3.4.1).

For this purpose, capital expenditure incurred on projects that have been commissioned/completed at least seven (7) days prior to Bid Deadline shall be considered. The capital expenditure discussed above shall be as capitalized and reflected in the audited books of accounts of the Technically Evaluated Entity. In case a clearly identifiable part of a project has been put into commercial operation, the capital expenditure on such part of the project shall be considered.

The Technically Evaluated Entity must have either executed such projects itself or must have held directly or indirectly at least twenty six percent (26%) of the shareholding in the company that has executed the project(s) from the date of financial closure of the project(s) till the time of commissioning/completion of such project(s).

OR

(ii) Experience in construction of project in infrastructure sector: The Technically Evaluated Entity should have received aggregate payments not less than Rs. **14,320** Crore or equivalent USD (calculated as per provisions in Clause 3.4.1) from its client(s) for construction works fully completed during the last ten (10) financial years. However, the payment received from at least one project shall not be less than Rs. **2,864** Crore or equivalent USD (calculated as per provisions in Clause 3.4.1).

For this purpose, payments received on projects that have been commissioned/ completed at least seven (7) days prior to Bid Deadline shall be considered. Further only the payments (gross) actually received, during such ten (10) financial years shall qualify for purposes of computing the technical capacity. For the avoidance of doubt, construction works shall not include cost of land, supply of goods or equipment except when such goods or equipment form part of a turn-key construction contract/ EPC contract for the project. Further, in cases where different individual contracts are signed between same entities for the same project, the cumulative payments received under such individual contracts shall be considered for meeting the qualification requirement.

The Technically Evaluated Entity may be the Bidding Company or the Lead Member of a Consortium or an Affiliate or Parent of such Bidding Company or the Lead Member, as the case may be.

Bidders shall furnish documentary evidence duly certified by authorized signatory of the Bidder who has been issued Power of Attorney in support of their technical capability as defined in Clause 2.1.2 of this RFP.

2.1.3 **Financial requirement to be met by the Bidding Company/Bidding Consortium**

2.1.3.1 The Bidder must fulfill following financial requirements:

A. Networth:

Networth should be not less than Rs**. 5,728 Crore** or equivalent USD (calculated as per provisions in Clause 3.4.1**)** computed as the Networth based on unconsolidated audited annual accounts (refer to Note below) of any of the last three (3) financial years as provided in Clause 2.2.3, immediately preceding the Bid Deadline. Also, the Networth of any of the last three (3) financial years should not be negative.

Note: Audited consolidated annual accounts of the Bidder may be used for the purpose of financial criteria provided the Bidder has at least 26% equity in each company whose accounts are merged in the audited consolidated accounts and provided further that the financial capability of such companies (of which accounts are being merged in the

consolidated accounts) shall not be considered again for the purpose of evaluation of the Technical Bid. Bidders shall furnish prescribed Annexure 7 (A) duly certified by authorized signatory of the Bidder who has been issued Power of Attorney and the Statutory Auditor and separate computation sheet for Networth duly certified by Statutory Auditor in support of their financial capability as defined in Clause 2.1.3 of this RFP.

2.1.3.2 The Networth shall be computed in the following manner by the Bidder:

A. Networth

=	Equity share capital
Add:	Reserves
Subtract:	Revaluation Reserves
Subtract:	Intangible Assets
Subtract:	Miscellaneous expenditures to the extent not written off and carry forward losses

2.1.3.3 If the Technical Bid is submitted by a Bidding Consortium the financial requirement shall be met individually and collectively by all the Members in the Bidding Consortium. The financial requirement to be met by each Member of the Bidding Consortium shall be computed in proportion to the equity commitment made by each of them for investment in the Project.

2.1.4 The Bidder may seek qualification on the basis of technical and financial capability of its Parent and/ or its Affiliate(s) for the purpose of meeting the Qualification Requirements. However, in the case of the Bidder being a Consortium, the Lead Member has to meet the technical requirement on its own or by seeking the technical capability of its Parent and/or its Affiliate(s). Authorization for use of such technical or financial capability shall have to be provided from its Parent and/or Affiliate(s) as per Annexure 9. The technical and financial capability of a particular company/ particular project, including its Parents and/or Affiliates, shall not be used directly or indirectly by more than one Bidder/ Member of a Bidding Consortium/ Bidding Company. However, development and construction experience of a particular project may be used by more than one company.

The determination of the relationship of Parent or Affiliate with the Bidding Company or with the Member of the Bidding Consortium, including the Lead Member, shall be on the date at the most seven (7) days prior to the last date of submission of the Bid. Documentary evidence to establish such relationship shall be furnished by the Bidder along with the Technical Bid.

If the Technically Evaluated Entity and/or Financially Evaluated Entity is an entity other than the Bidding Company or a Member in a Bidding Consortium, the Bidding Company or Member relying on such Technically Evaluated Entity and/or Financially Evaluated Entity will have to submit a legally binding undertaking supported by a board resolution from the Technically Evaluated Entity and/or Financially Evaluated Entity or its Ultimate Parent Company, that all the equity investment obligations of the Bidding Company or the Member of the Consortium shall be deemed to be equity investment obligations of the Technically Evaluated Entity and/or Financially Evaluated Entity or its Ultimate Parent Company, and in the event of any default the same shall be met by such evaluated entity or by or the Ultimate Parent Company. The Bidding Company or the Consortium Member shall have to provide information and documents relating to its relationship with such

Technically Evaluated Entity and/or Financially Evaluated Entity including details about the equity shareholding between them as per Annexure 7(C).

2.1.5 A Bidder shall submit only one Bid in the same bidding process, either individually as Bidding Company or as a Member of a Bidding Consortium (including the Lead Member). It is further clarified that any of the Parent/ Affiliate/Ultimate Parent of the Bidder/ Member in a Bidding Consortium shall not separately participate directly or indirectly in the same bidding process. Further, if any Bidder is having a Conflict of Interest with other Bidders participating in the same bidding process, the Bids of all such Bidders shall be rejected.

2.1.6 Notwithstanding anything stated above, BPC reserves the right to verify the authenticity of the documents submitted for meeting the Qualification Requirements and request for any additional information and documents. BPC reserves the right at its sole discretion to contact the Bidder's bank and project references and verify the Bidder's information and documents for the purpose of bid evaluation.

2.1.7 The Qualified Bidder(s) will be required to continue to maintain compliance with the Qualification Requirements throughout the bidding process and till execution of the Transmission Service Agreement. Where the Technically Evaluated Entity and/or the Financially Evaluated Entity is not the Bidding Company or a Member in a Bidding Consortium, as the case may be, the Bidding Company or Member shall continue to be an Affiliate of the Technically Evaluated Entity and/or Financially Evaluated Entity till the execution of the Transmission Service Agreement. Failure to comply with the aforesaid provisions shall make the Bid liable for rejection at any stage.

2.1.8 The Selected Bidder will be required to continue to maintain compliance with the Qualification Requirements till the COD of the Project. Where the Technically Evaluated Entity and/or the Financially Evaluated Entity is not the Bidding Company or a Member in a Bidding Consortium, as the case may be, the Bidding Company or Member shall continue to be an Affiliate of the Technically Evaluated Entity and/or Financially Evaluated Entity till the COD of the Project. Failure to comply with the aforesaid provisions shall be dealt as per provisions of Transmission Service Agreement.

2.1.9 On the Bid Deadline, for the Bidder to be eligible to participate in the bidding process:

a. the Bidder & any of its Affiliate including any Consortium Member & any of its Affiliate, their directors or key personnel should not have been barred or included in the blacklist by any government agency or authority in India, the government of the jurisdiction of the Bidder or Members where they are incorporated or the jurisdiction of their principal place of business, any international financial institution such as the World Bank Group, Asian Development Bank, African Development Bank, Inter-American Development Bank, Asian Infrastructure Investment Bank etc or the United Nations or any of its agencies; or

b. the Bidder & any of its Affiliate including any Consortium Member & any of its Affiliate or their directors should not have been convicted of any offence in India or abroad.

In case any investigation is pending against the Bidder, including any Consortium Member or Affiliate, or CEO or any of the directors/ manager/key managerial personnel of the

Bidder /Consortium /Member or their Affiliates, full details of such investigation including the name of the investigating agency, the charge/offence for which the investigation has been launched, name and designation of persons against whom the investigation has been launched and other relevant information should be disclosed while submitting the Bid.

The Bidders shall confirm the above though a notarized affidavit as per Annexure 22.

2.2 Submission of Bid by the Bidder

2.2.1 The information and documents in Technical Bid will be submitted by the Bidder as per the formats specified in Section – 4 (Formats for RFP) of this document

2.2.2 Strict adherence to the formats wherever specified, is required. Wherever, information has been sought in specified formats, the Bidder shall refrain from referring to brochures/ pamphlets. Non-adherence to formats and/ or submission of incomplete information may be a ground for declaring the Technical Bid as non-responsive. Each format has to be duly signed and stamped by the authorized signatory of Bidder.

2.2.3 The Technical Bid shall contain unconsolidated/consolidated audited annual accounts (consisting of unabridged Balance Sheet, Profit and Loss Account, profit appropriation account, Auditors Report, etc.), as the case may be, of Bidding Company or each Member in Consortium including Lead Member or the Financially Evaluated Entity for the last three (3) financial years immediately preceding the last date for submission of Bid for the purpose of calculation of Networth.

In case the annual accounts for the financial year immediately preceding the Bid Deadline is not audited, the Bidder shall give declaration in this regard duly certified by its statutory auditor. In such a case, the Bidder shall provide the audited annual accounts for the three (3) financial years preceding the financial year as above for which the annual accounts have not been audited.

2.2.4 Bid submitted by a Bidding Consortium:

2.2.4.1 The Technical Bid shall contain a legally enforceable Consortium Agreement entered amongst the Members in the Bidding Consortium, designating one of the Members to be the Lead Member (as per Annexure 6). There shall be only one Lead Member which shall continue to hold twenty six percent (26%) equity in the TSP and cannot be changed upto one (1) year from the Commercial Operation Date (COD) of the Project. Each Member in Bidding Consortium shall duly sign the Consortium Agreement making it liable for raising the required funds for its respective equity investment commitment as specified in the Consortium Agreement. In absence of Consortium Agreement, the Technical Bid will not be considered for evaluation and will be rejected.

Provided that the Lead Member of the Bidding Consortium will be required to be liable to the extent of 100% of the total proposed commitment of equity investment of the Bidding Consortium i.e. for both its own equity contribution as well as the equity contribution of other Members.

Provided further that the Consortium Agreement shall not be amended without the explicit approval of the BPC.

The Lead Member of the Consortium will be the single point of contact for the purposes of the bid process before the date of signing of Share Purchase Agreement. Settlement of any dispute amongst the Consortium Members shall not be the responsibility of the BPC and/or the CTU and the BPC and/or the CTU shall not bear any liability whatsoever on this account.

2.2.4.2 The Lead Member should designate at the most two persons to represent the Consortium in its dealings with the BPC. The person(s) designated by the Lead Member should be authorized through a Power of Attorney (as per Annexure 3) to perform all tasks including, but not limited to providing information, responding to enquiries, signing of Technical Bid on behalf of the Consortium, etc. The Bidding Consortium shall provide board resolutions from their respective Boards for committing their respective portion of equity requirement for the Project. Additionally, the Lead member shall provide a Board resolution committing to make good any shortfall in the equity for the project, in case of any member not meeting its equity commitment.

2.2.4.3 The Technical Bid should also contain signed Letter of Consent (as per Annexure 2) from each Member in Consortium confirming that the entire Technical and Financial Bids has been reviewed and each element of the Technical and Financial Bids is agreed to by them including investment commitment for the Project.

In addition, the Technical Bid should also contain Board Resolution from each Member of the Consortium other than the Lead Member in favour of their respective authorized representatives for executing the POA, Consortium Agreement and signing of the requisite formats.

2.2.5 Bid submitted by a Bidding Company

2.2.5.1 The Bidding Company should designate at the most two persons to represent the Bidding Company in its dealings with BPC. The person(s) should be authorized to perform all tasks including, but not limited to providing information, responding to enquiries, signing of Technical and Financial Bids etc. The Bidding Company should submit, along with Technical Bid, a Power of Attorney (as per Annexure 3), authorizing the signatory of the Technical and Financial Bids. The Bidding Company shall submit the board resolution committing 100% of equity requirement for the Project, in the Technical Bid.

2.3 Clarifications & Pre-Bid Meeting

2.3.1 The Bidders may seek clarifications or suggest amendments to the RFP by sending an email to the BPC at the email id indicated in Clause 2.14 within the date and time mentioned in Clause 2.7.2. For any such clarifications or amendments, the Bidders should adhere to the format as per Annexure – 19.

2.3.2 Only those Bidders or their authorized representatives, who have purchased the RFP documents are invited to attend the pre-bid meeting(s), which will take place on date as specified in Clause 2.7.2, or any such other date as notified by the BPC. The time and address of this would be intimated later.

2.3.3 The purpose of the pre-bid meeting will be to clarify any issues regarding the RFP, including in particular, issues raised in writing by the Bidders as per the provisions of

Clause 2.3.1.

2.3.4 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

2.3.5 The BPC is not under any obligation to entertain / respond to suggestions made or to incorporate modifications sought for.

2.3.6 In case Bidders need any further clarifications not involving any amendments in respect of final RFP, they should ensure that request for such clarification is submitted through e-mail to the BPC at least ten (10) days prior to the Bid Deadline as mentioned in Clause 2.7.1. The BPC may issue clarifications only, as per its sole discretion, which is considered reasonable by it. Any such clarification issued shall be sent to all the Bidders to whom the RFP has been issued. Clarifications sought after this date shall not be considered in any manner and shall be deemed not to have been received. There shall be no extension in Bid Deadline on account of clarifications sought as per this clause 2.3.6.

2.4 Amendment of RFP

2.4.1. At any time before the timeline mentioned in Clause 2.7.1, the BPC may, for any reason, whether at its own initiative or in response to clarifications requested by any Bidder modify or amend the RFP, including the timelines specified in Clause 2.7.2 by issuance of addendum/modification/errata and/or revised document. Such document shall be notified in writing through a letter or fax or e-mail to all the entities to which the RFP has been issued and shall be binding on them. In order to ensure that Bidders have reasonable time to take the modification into account in preparing their Bid, or for any other reasons, BPC may at its discretion, extend the due date for submission of Bid. Late receipt of any addendum/modification/errata and/or revised document will not relieve the Bidder from being bound by that modification.

2.4.2. All modifications shall become part of the terms and conditions of this RFP. No interpretation, revision or communication regarding this RFP is valid, unless made in writing.

2.4.3. The amendment to the RFP shall be notified to all the Bidders through the electronic bidding platform and shall be binding on them.

2.5 The Bidding Process

The entire bidding process shall be conducted on electronic bidding platform created by MSTC Limited. The Bid shall comprise of the Technical Bid and the Financial Bid. The Bidders shall submit the Technical Bid & Financial Bid through the electronic bidding platform. In addition to the online submission, the Bidder with lowest Final Offer will be required to submit original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B before issuance of LoI. There shall be no physical submission of the Financial Bid.

Evaluation of Technical Bid will be carried out considering the information and documents furnished by the Bidders as required under this RFP. This step would involve responsiveness check, technical and financial evaluation of the details/ documents furnished by the Bidding Company / Bidding Consortium in support of meeting the Qualification Requirements. Bidders meeting the Qualification Requirements, subject to

evaluation as specified in Clause **3.2** to **3.4** shall be declared as "Qualified Bidders" and eligible for opening of Initial Offer. The BPC shall also upload the list of all Qualified Bidders and Non-Qualified Bidders on the bidding portal along with the reasons for non-qualification. Also, the Financial Bids of Qualified Bidders shall be opened after at least 24 hours from the date of declaration of the Technically Qualified Bidders.

The Financial Bid will comprise of two rounds. In the first round the Initial Offer (submitted online along with the Technical Bids) of the responsive bids would be opened and Quoted Transmission Charges of Initial Offer shall be ranked on the basis of ascending order for determination of the Qualified Bidders as provided in Section-III of RFP. The Qualified Bidders, in the first fifty per cent of the ranking (with any fraction rounded off to higher integer) or four Qualified Bidders, whichever is higher, shall qualify for participating in the electronic reverse auction stage and submit their Final Offer.

Provided however, in case only one Bidder remains after the evaluation of Technical Bid as per Clause 3.2, 3.3 and Clause 3.4, the Initial Offer of such Bidder shall not be opened and the matter shall be referred to the Government.

Provided that in the event the number of qualified Technical Bids is between two and four, then each of the qualified Bidder shall be considered as "Qualified Bidders".

Provided that in the event of identical Quoted Transmission Charges discovered from the Initial Offer having been submitted by one or more Bidders, all such Bidders shall be assigned the same rank for the purposes of determination of Qualified Bidders. In such cases, all the Qualified Bidders who share the same rank till 50% of the rank (with any fraction rounded off to higher integer) determined above, shall qualify to participate in the electronic e-reverse auction stage. In case 50% of the ranks (with any fraction rounded off to higher integer) is having less than 4 (four) Bidders and the rank of the fourth (4^{th}) Bidder is shared by more than one (1) Bidder, then all such Bidders who share the rank of the fourth (4^{th}) Bidder shall qualify to participate in the electronic reverse auction.

The applicable ceiling for electronic reverse bidding shall be the lowest Quoted Transmission Charges discovered from the Initial Offer received from the Qualified Bidders. The Qualified Bidders shall be permitted to place their Final Offer on the electronic bidding platform, which is lower than zero point two five (0.25) % of the prevailing lowest Quoted Transmission Charges.

The initial period for conducting the e-reverse bidding should be 2 hours which will be extended by 30 minutes from the last received bid time, if the bid is received during the last 30 minutes of the scheduled or extended bid time. Subsequently, it will be extended again by 30 minutes from the latest received bid time.

The technical details with respect to access to such electronic platform are provided in Annexure-A (Technical Details with respect to electronic reverse auction).

In case of any technical clarification regarding access to the electronic reverse auction platform or conduct of the auction process, the Bidders may contact MSTC Limited directly at the address provided in Annexure-A.

2.5.1 Bid Formats

The Bids in response to this RFP will be submitted online through the electronic bidding platform by the Bidders in the manner provided in Clause 2.9. The Bids shall comprise of the following:

2.5.2 Technical Bid comprising of:

1. Covering Letter (as per prescribed format enclosed as **Annexure 1**);

2. Letter of Consent from Consortium Members in **Annexure 2;**

3. Power of attorney issued by the Bidding Company or the Lead Member of the Consortium, as the case may be, in favour of the person signing the Bid, in the format attached hereto as **Annexure 3**.

   Additionally, in case of a Bidding Consortium, the power of attorney in favour of the Lead Member issued by the other Members of the Consortium shall be provided in as per format attached hereto as **Annexure 4**. Further, the Lead Member shall furnish Board resolution(s) from each Member of the Consortium other than the Lead Member in favour of their respective authorized representatives for executing the POA and signing of the requisite formats.

   Provided that in the event the Bidding Company or the Lead Member of the Consortium or any Member of the Bidding Consortium, as the case may be, is a foreign entity, it may issue Board resolutions in place of power of attorney for the purpose of fulfilling these requirements.

4. Bidder's composition and ownership structure in **Annexure 5**

5. Format for Authorization submitted in Non-Judicial stamp paper duly notarized as per **Annexure 5** from the Bidding Company / each Member of the Consortium authorizing the BPC to seek reference from their respective bankers & others.

6. In case of Bidding Consortium, the Consortium Agreement shall be provided in as per format attached hereto as **Annexure 6**

7. Format of Qualification Requirement (**Annexures 7A, 7B, 7C and 7D)**

8. Bidders Undertakings and details of equity investment in Project (as per prescribed formats 1 and 2 of **Annexure 8**);

9. Authorization from Parent / Affiliate of Bidding Company / Member of Bidding Consortium whose technical / financial capability has been used by the Bidding Company / Member of Bidding Consortium **(Annexure 9)**.

10. Undertaking from the Technically / Financially Evaluated Entity(ies) **OR** Undertaking from the Ultimate Parent Company, for total equity investment commitment, in the prescribed format in **Annexure – 10**, to meet any shortfall in the equity investment by the Selected Bidder in the Barmer HVDC Power Transmission Limited.

    Note: The effective Equity holding of the Selected Bidder in the Barmer HVDC

Power Transmission Limited, as specified in Clause 2.5.8.1 shall be computed as per the provisions of Clause 2.5.8.3 of this RFP.

Provided further, in case the Bidding Company or Member of a Consortium, (as the case may be) holds at least twenty six percent (26%) equity in such Technically/ Financially Evaluated Entities, whose credentials have been considered for the purpose of meeting the Qualification Requirements as per the RFP, no such Undertaking shall be required from the Technically / Financially Evaluated Entities.

11. Board resolutions, as per prescribed formats enclosed as Annexure – 11, duly certified by the Company Secretary or any Whole-time Director / Manager (supported by a specific Board Resolution), as applicable to the Bidder and mentioned hereunder,

    (a) Board resolution from the Bidding Company (and any investing Affiliate / Parent Company / Ultimate Parent Company) committing one hundred percent (100%) in aggregate of the equity requirement for the Project - Format-1 of **Annexure 11**;

    (b) Board resolutions from each of the Consortium Member of the Bidding Consortium (and any investing Affiliate / Parent Company / Ultimate Parent Company) together committing to one hundred percent (100%) in aggregate of equity requirement for the Project, in case Bidder is a Bidding Consortium - Format-1 of **Annexure 11**;

    (c) In either of the cases as in (a) or (b) above as applicable, Board resolutions as per Format 2 of **Annexure 11** for total equity investment commitment from the Technically / Financially Evaluated Entity(ies) whose technical / financial credentials had been considered for the purpose of meeting Qualification Requirements as per the RFP

    OR

    Board resolutions as per Format 2 of **Annexure 11** from the Parent Company or the Ultimate Parent Company for total equity investment commitment.

    Provided that such Board resolutions, as specified in (a) or (b) or (c) above, in case of a foreign entity, shall be supported by an unqualified opinion issued by an independent legal counsel practicing in the relevant country, stating that the Board resolutions are in compliance with the applicable laws of the respective jurisdictions of the issuing company and the authorizations granted therein are true and valid.

    For clarity sake, illustrations identifying which Board Resolution shall be applicable in typical cases are provided in **Annexure 11A**.

12. Format for Illustration of Affiliates at the most seven (7) days prior to Bid Deadline, duly certified by Company Secretary and supported by documentary evidence **(Annexure 12)**.

    Certified copy of the Register of Members / Demat Account Statement, Share Certificate, Annual Return filed with ROC etc. submitted as documentary evidence along with **Annexure 12.**

13. Disclosure as per **Annexure 13** regarding participation of any related companies in this bidding process.

14. Bid Bond, as per the prescribed format at **Annexure 14** or **Annexure 14A** or **Annexure 14B;**

15. Checklist for Technical Bid submission requirements as per **Annexure 16**.

16. Last three (3) financial years' unconsolidated / consolidated audited annual accounts / statements, as the case may be, of the Financially Evaluated Entity / Technical Evaluated Entity

17. Unconsolidated audited annual accounts of both the TEE and the Bidding Company/Lead member, as applicable, for the financial years in which financial closure was achieved and the financial year in which the said project was completed / commissioned.

18. Copy of the Memorandum and Articles of Association and certificate of incorporation or other organizational document (as applicable), including their amendments, certified by the Company Secretary of Bidding Company or each Member in case of a Consortium including Lead Member.

19. For each project listed in Annexure 7(D), certified true copy of the certificates of final acceptance and / or certificates of good operating performance duly issued by owners or clients for the project, duly signed by duly signed by authorized signatory.

In addition to the online submission of above formats through the electronic platform, the Bidder with lowest Final Offer will be required to submit original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B before issuance of LoI. In case, there is a discrepancy between the online submission and physical documents, the bid would be out rightly rejected and the bidder shall be construed to have engaged in the fraudulent practice as defined in Clause 2.19.3 with consequences as mentioned in Clause 2.19.2.

2.5.3 Financial Bid (as per prescribed format at Annexure-21)

Financial Bid shall comprise of: (i) the Initial Offer; and (ii) the Final Offer. The Initial Offer is required to be submitted along with the Technical Bid. It is hereby clarified that the Financial Bid will comprise of two rounds. In the first round the Initial Offer of the responsive bids would be opened and Quoted Transmission Charges of Initial Offer shall be ranked on the basis of ascending order for determination of the Qualified Bidders as provided in Section-III of RFP.

In accordance with clause 2.5 of this RFP, the qualified Bidders shall be eligible to participate in the electronic reverse auction and submit their Final Offer.

The applicable ceiling for electronic reverse bidding shall be the lowest Quoted Transmission Charges discovered from the Initial Offer received from the Qualified Bidders. The Qualified Bidders shall be permitted to place their Final Offer on the

electronic bidding platform, which is lower than zero point two five (0.25) % of the prevailing lowest Quoted Transmission Charges.

The initial period for conducting the e-reverse bidding should be 2 hours which will be extended by 30 minutes from the last received bid time, if the bid is received during the last 30 minutes of the scheduled or extended bid time. Subsequently, it will be extended again by 30 minutes from the latest received bid time.

The Bidders shall inter-alia take into account the following while preparing and submitting the Initial Offer and Final Offer of Financial Bid:-

a. The Bidders shall quote single annual Quoted Transmission Charges for a period of 35 years commencing from the Scheduled COD of the Project.

b. The Quoted Transmission Charges as per the format at Annexure-21 shall be inclusive of all charges and no exclusions shall be allowed. The Bidders shall take into account all costs including capital and operating, statutory taxes, duties, levies. Availability of the inputs necessary for operation and maintenance of the Project should be ensured by the TSP at the Project site and all costs involved in procuring the inputs (including statutory taxes, duties, levies thereof) at the Project site must be included in the Quoted Transmission Charges.

c. Annexure 21 duly digitally signed by authorized signatory.

2.5.4 Wherever information has been sought in specified formats, the Bidders shall fill in the details as per the prescribed formats and shall refrain from referring to any other document for providing any information required in the prescribed format.

2.5.5 Transmission Charges

2.5.5.1. The Transmission Charges shall be specified in the Transmission Service Agreement and shall be payable to the TSP in Indian Rupees only. The Bidders shall quote single Transmission Charges as per the format at Annexure – 21.

2.5.5.2. The Transmission Charges of the Selected Bidder shall be inserted in Schedule 5 of the Transmission Service Agreement.

2.5.6 Bidders may note that:

a) All the information and documents in Bid shall be submitted in English language only.

b) Bidders shall mention the name, designation, telephone number, fax number, email address of the authorized signatory and complete address of the Bidder in the covering letter.

c) All pages of the Bid submitted shall be initialed and stamped by the authorized signatory on behalf of the Bidder.

d) A Bidder shall submit only one Bid in the same bidding process, either individually as Bidding Company or as a Member of a Bidding Consortium.

e) The technical and financial capability of a particular company / particular project (Parent and/ or Affiliate) shall not be used directly or indirectly by more than one Bidder/ Member of a Bidding Consortium including Lead Member / Bidding Company.

f) This Request for Proposal (RFP) document is not transferable. The RFP document and the information contained therein is for the use only by the Bidder to whom it is issued. It may not be copied or distributed by the recipient to third parties (other than in confidence to the recipient's professional advisors). In the event that the recipient does not continue with its involvement in the Project, this RFP document must be kept confidential.

g) Though adequate care has been taken while preparing this RFP document, the Bidder shall satisfy himself that the document is complete in all respects. Intimation of any discrepancy shall be given to the BPC immediately. If no intimation is received from any Bidder within ten (10) days from the date of issue of RFP document, it shall be considered that the RFP document is complete in all respects and has been received by the Bidder.

h) Bids submitted by the Bidder and opened on scheduled date and time as stipulated in this RFP shall become the property of the BPC and BPC shall have no obligation to return the same to the Bidder.

i) If any Bidder conceals any material information or makes a wrong statement or misrepresents facts or makes a misleading statement in its Bid, in any manner whatsoever, the BPC reserves the right to reject such Bid or cancel the Letter of Intent, if issued. If such event is discovered after the Effective Date, consequences specified in Transmission Service Agreement shall apply.

j) If for any reason the Bid of the Bidder with the lowest Quoted Transmission Charges is not selected or Letter of Intent issued to such Selected Bidder is cancelled or such Bidder withdraws its Bids, the BPC may:-

   i. Invite all the remaining Bidders to revalidate or extend their respective Bid Security, as necessary, and match the Bid of the Bidder with the lowest Quoted Transmission Charges (the "second round of bidding") with following cases:

      - If in the second round of bidding, only one Bidder matches the Bid of the Bidder with lowest Quoted Transmission Charges, it shall be the Selected Bidder.

      - If two or more Bidders match the Bid of the Bidder with the lowest Quoted Transmission Charges in the second round of bidding, then the Bidder whose Quoted Transmission Charges was lower as compared to other Bidder(s) in the first round of bidding shall be the Selected Bidder. For example, if the third and fifth lowest Bidders in the first round of bidding offer to match the Bid of the Bidder with lowest Quoted Transmission Charges in the second round of bidding, the said third lowest Bidder shall be the Successful Bidder.

      - In the event that no Bidder offers to match the Bid of the Bidder with the lowest Quoted Transmission Charges in the second round of bidding, the BPC may, in its discretion, invite fresh Bids (the "third round of bidding") from all Bidders

except the Bidder which quoted the lowest Quoted Transmission Charges in the first round of bidding. In case the Bidders are invited for the third round of bidding to revalidate or extend their Bid Security, as necessary, and offer fresh Bids, they shall be eligible for submission of fresh Bids provided, however, that in such third round of bidding only such Bids shall be eligible for consideration which are lower than the Quoted Transmission Charges of the second lowest Bidder in the first round of bidding; or;

ii. Annul the bid process; or

iii. Take any such measure as may be deemed fit in the sole discretion of the BPC[1]

k) The BPC may, at its sole discretion, ask for additional information / document and/or seek clarifications from a Bidder after the Bid Deadline, inter alia, for the purposes of removal of inconsistencies or infirmities in its Bid. However, no change in the substance of the Quoted Transmission Charges shall be sought or permitted by the BPC.

l) Non submission and/or submission of incomplete data/ information required under the provisions of RFP shall not be construed as waiver on the part of BPC of the obligation of the Bidder to furnish the said data / information unless the waiver is in writing.

m) Bidders shall familiarize itself with the procedures and time frames required to obtain all Consents, Clearances and Permits.

n) All Bidders are required to ensure compliance with the standards and codes mentioned in Clause 1.6.1.2.

o) BPC reserves the right to reject all Bids and/or annul the process of tariff based competitive bidding for selection of Bidder as TSP to execute the Project without assigning any reason. BPC shall not bear any liability, whatsoever, in this regard.

p) Foreign companies submitting the Bid are required to follow the applicable law in their country for execution of POA, Consortium Agreement and affixation of Common Seal (wherever required) and in such cases, their Bid should be supported by an unqualified opinion issued by an independent legal counsel practicing in the relevant country, stating that execution of such POA, Consortium Agreement and the authorizations granted therein are true and valid. Foreign companies executing POA outside India shall necessarily pay the adequate stamp charges in India as per the provisions of Stamp Act.

2.5.7 Bidders to inform themselves fully

2.5.7.1. The Bidders shall make independent enquiry and satisfy themselves with respect to all the required information, inputs, conditions and circumstances and factors that may have any effect on his Bid. Once the Bidders have submitted their Bids, the Bidders shall be deemed to have inspected and examined the site conditions (including but not limited to its surroundings, its geological condition and the adequacy of transport facilities to the site), the laws and regulations in force in India, the transportation facilities available in India, the grid conditions, the adequacy and conditions of roads, bridges, railway sidings,

[1] **BPC shall record reasons for the same.**

ports, etc. for unloading and/or transporting heavy pieces of material and has based its design, equipment size and fixed its price taking into account all such relevant conditions and also the risks, contingencies and other circumstances which may influence or affect the transmission of power. Accordingly, each Bidder acknowledges that, on being selected as Successful Bidder and on acquisition of one hundred percent (100%) of the equity shares of the Barmer HVDC Power Transmission Limited, the TSP shall not be relieved from any of its obligations under the RFP Project Documents nor shall the TSP be entitled to any extension in Scheduled COD mentioned in this RFP or financial compensation for any reason whatsoever.

2.5.7.2. In their own interest, the Bidders are requested to familiarize themselves with all relevant laws of India, including without limitation, the Electricity Act 2003, the Income Tax Act 1961, the Companies Act, 1956 / Companies Act, 2013 (as the case may be), Environment Protection Act 1986 and Forest (Conservation) Act, 1980, the Customs Act, the Foreign Exchange Management Act, Land Acquisition Act, 1894, the Indian Telegraph Act 1885, Labor & Employment Laws of India, [Insurance Act] the regulations/standards framed by the Commissions and CEA, all other related acts, laws, rules and regulations prevalent in India, as amended from time to time.

In addition to the above, the Bidders are required to familiarize themselves with all relevant technical codes and standards, including but not limited to the Grid Code / State Grid Code, Central Electricity Authority (Installation and Operations of Meters) Regulations, 2006, Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007, Central Electricity Regulatory Commission Grant of Connectivity, Long-term Access and Medium - Term Open Access in Inter-State Transmission and related matters) Regulations, 2009, Central Electricity Authority (Technical Standards for construction of Electrical Plants and Electric Lines) Regulation, 2010, Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020, Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020 and other relevant Rules/ Regulations/ Guidelines issued by the Central Government, the CERC and the CEA and amendments thereof.

The BPC shall not entertain any request for clarifications from the Bidders regarding the above laws / acts / rules / regulations / standards. Non-awareness of the same shall not be a reason for the Bidder to request for extension in Bid Deadline. The Bidders undertake and agree that, before submission of their Bid, all such factors as generally brought out above, have been fully investigated and considered while submitting their Bids.

2.5.7.3. The Survey Report has been prepared in good faith, and on best endeavor basis. Neither BPC & Nodal Agency nor their employees or advisors/consultants make any representation or warranty, express or implied, or accept any responsibility or liability, whatsoever, in respect of any statements or omissions made in the Survey Report, or the accuracy, completeness or reliability of information contained therein, and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of such Survey Report, even if any loss or damage is caused to the Bidders by any act or omission on their part.

2.5.7.4. Bidders shall make best efforts and carry out its own due diligence upon survey report provided by BPC and shall consider all possible techno-commercial factors before submission of Bid. Bidders may also visit the route of the Transmission Lines associated

with the Project and the surrounding areas and obtain / verify all information which they deem fit and necessary for the preparation of their Bid. Bidders may also carry out required surveys and field investigation for submission of their Bid. Bidders may also opt for any other route and is not bound to follow the route suggested in survey report provided by BPC.

2.5.7.5. Failure to investigate, examine and to inspect site or subsurface conditions fully shall not be grounds for a Bidder to alter its Bid after the Bid Deadline nor shall it relieve a Bidder from any responsibility for appropriately eliminating the difficulty or costs of successfully completing the Project.

2.5.7.6. The Selected Bidder shall obtain all necessary Consents, Clearances and Permits as required. The Bidders shall familiarize itself with the procedures and time frame required to obtain such Consents, Clearances and Permits.

2.5.7.7. The technical requirements of integrated grid operation are specified in the Indian Electricity Grid Code (IEGC). The Bidders should particularly acquaint themselves with the requirements of connection conditions, operating code for regional grids, scheduling and dispatch instructions/codes, etc. The Bidders are also advised to fully familiarize themselves with the real time grid conditions in the country. Information regarding grid parameters such as voltage and frequency is available on the websites of Regional / State Load Despatch Centers.

2.5.8 Minimum Equity holding/Equity Lock-in

2.5.8.1. (a) The aggregate equity share holding of the Selected Bidder, in the issued and paid up equity share capital of Barmer HVDC Power Transmission Limited shall not be less than Fifty one percent (51%) up to a period of (1) one year after COD of the Project;

(b) In case the Selected Bidder is a Bidding Consortium, then any Member (other than the Lead Member) of such Bidding Consortium shall be allowed to divest its equity as long as the other remaining Members (which shall always include the Lead Member) hold the minimum equity specified in (a) above.

(c) If equity is held by the Affiliates, Parent Company or Ultimate Parent Company, then subject to the second proviso of this Clause 2.5.8.1 (c), such Affiliate, Parent Company or Ultimate Parent Company shall be permitted to transfer its shareholding in Barmer HVDC Power Transmission Limited to another Affiliate or to the Parent Company / Ultimate Parent Company. If any such shareholding entity, qualifying as an Affiliate / Parent Company / Ultimate Parent Company, is likely to cease to meet the criteria to qualify as an Affiliate / Parent Company / Ultimate Parent Company, the shares held by such entity shall be transferred to another Affiliate / Parent Company / Ultimate Parent Company.

Provided that in case the Lead Member or Bidding Company is holding equity through Affiliate/s, Ultimate Parent Company or Parent Company, such restriction shall apply to such entities.

Provided further, that the aggregate equity share holding of the Bidding Consortium or a Bidding Company in the issued and paid up equity share capital of Barmer HVDC Power Transmission Limited shall not be less than fifty one percent (51%) up to a period of one (1) year after COD of the Project and the lead Member of the Consortium shall

have the equity share holding not less than twenty six percent (26%). In case the Selected Bidder is a Bidding Consortium, then any Member (other than the Lead Member) of such Bidding Consortium shall be allowed to divest its equity as long as the other remaining Members (which shall always include the Lead Member) hold the minimum equity specified in (a) above.

(d) All transfer(s) of shareholding of Barmer HVDC Power Transmission Limited by any of the entities referred to above, shall be after prior written intimation to the Nodal Agency.

2.5.8.2. The Selected Bidder may invest in the equity share capital of Barmer HVDC Power Transmission Limited through its Affiliate(s) or Ultimate Parent Company or Parent Company. Details of such investment will have to be specified in the Technical Bid as per Format 2 of Annexure 8 of the RFP. If the Selected Bidder so invests through any Affiliate(s) or Ultimate Parent Company or Parent Company, the Selected Bidder shall be liable to ensure that minimum equity holding/lock-in limits specified in Clause 2.5.8.1 and as computed as per the provisions of Clause 2.5.8.3 are still maintained.

2.5.8.3. For computation of effective Equity holding, the Equity holding of the Selected Bidder or its Ultimate Parent Company in such Affiliate(s) or Parent Company and the equity holding of such Affiliate (s) or Ultimate Parent Company in Barmer HVDC Power Transmission Limited shall be computed in accordance with the example given below:

If the Parent Company or the Ultimate Parent Company of the Selected Bidder A directly holds thirty percent (30%) of the equity in Barmer HVDC Power Transmission Limited then holding of Selected Bidder A in Barmer HVDC Power Transmission shall be thirty percent (30%);

If Selected Bidder A holds thirty percent (30%) equity of the Affiliate and the Affiliate holds fifty percent (50%) equity in Barmer HVDC Power Transmission Limited, then for the purposes of ascertaining the minimum equity/equity lock-in requirements specified above, the effective holding of Bidder A in Barmer HVDC Power Transmission Limited shall be fifteen percent (15%), (i.e., 30%* 50%);

2.5.8.4. The provisions as contained in this Clause 2.5.8 and Article 19.1 of the Transmission Service Agreement shall override the terms of the Consortium Agreement submitted by the Bidder as part of the RFP.

2.6 Project Schedule

2.6.1. All Elements of the Project are required to be commissioned progressively as per the schedule given in the following table;

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
1	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor	54 months from allocation of project (Bipole-1: 48 months, Bipole-2: 54 months)	100%	All the elements of the scheme are required to be commissioned simultaneously as their utilization is dependent on each other.
2	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS			
3	Barmer-II PS - Barmer-I PS 400 kV D/C line (Quad)			
4	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation			
5	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb			
6	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]			

7	Augmentation of South Kalamb S/s[#] by 4x1500 MVA, 765/400 kV ICTs (3 Nos. 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below[$] (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)			
8	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))			

The payment of Transmission Charges for any Element irrespective of its successful commissioning on or before its Scheduled COD shall only be considered after successful commissioning of the Element(s) which are pre-required for declaring the commercial operation of such Element as mentioned in the above table.

Scheduled COD for overall Project: 54 months from allocation of project (Bipole-1: 48 months, Bipole-2: 54 months)

Note: List of Element(s) along with the critical Element(s) to be provided by CEA

2.7 Due dates

2.7.1. The Bidders should submit the Bids online through the electronic bidding platform before the Bid Deadline i.e. on or before 1600 hours (IST) on 01.04.2026. In addition to the online submission, the Bidder with lowest Final Offer will be required to submit original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B before issuance of LoI.

2.7.2. Important timelines are mentioned below:

Date	Event
28.01.2026	Issuance of RFP
17.02.2026	Submission of written clarifications/amendments, if any, on the RFP / RFP Project Documents by Bidders so as to reach BPC by 1700 hours. Such written clarifications/amendments shall be in the format provided in Annexure-20.
19.02.2026	Pre-Bid meeting(s)
09.03.2026	Issue of written clarifications and revised RFP documents
17.03.2026	Issue of final RFP Project Documents
01.04.2026	Submission of Bid (Online submission of Bid through electronic bidding portal)
01.04.2026	Opening of Technical Bid
09.04.2026	Short listing and announcement of Qualified Bidders on bidding portal
13.04.2026	Opening of Financial Bid - Initial Offer
14.04.2026	Electronic reverse auction (Financial Bid – Final Offer) for the Qualified Bidders.
17.04.2026	Submission of original hard copies of Annexure 3, Annexure 4, Annexure 6, as applicable and Annexure 14/14A/4B by the bidder with lowest Final Offer
22.04.2026	Selection of Successful Bidder and issue of LOI
04.05.2026	Signing of RFP Project Documents and transfer of Barmer HVDC Power Transmission Limited

2.7.3. To enable BPC to meet the schedule, all Bidders are expected to respond expeditiously during the bidding process. If any milestone/activity falls on a day which is not a working day or which is a public holiday then the milestone/activity shall be achieved/ completed on the next working day.

2.8 Validity of the Bid

2.8.1. The Bid shall remain valid for a period of one hundred and eighty (180) days from the Bid Deadline. The BPC reserves the right to reject any Bid which does not meet aforementioned validity requirement.

2.8.2. The BPC may solicit the Bidders' consent for an extension of the period of validity of the Bid. The request and the response, thereafter, shall be in writing. In the event any Bidder refuses to extend its Bid validity as requested by the BPC, the BPC shall not be entitled to invoke the Bid Bond. A Bidder accepting the BPC's request for validity extension shall not be permitted to modify its Bid and such Bidder shall, accordingly, extend the validity of the Bid Bond as requested by the BPC within seven (7) days of such request, failing which the Bid shall not be considered as valid.

2.9 Method of Submission

2.9.1. Both the Technical and Financial Bids duly filled in, all formats and supporting shall be scanned and uploaded online through electronic bidding platform in the manner specified in Annexure A

2.9.2. It may be noted that Technical Bid shall not contain any information/document relating to Financial Bid. If Technical Bid contains any such information/documents, the BPC shall not be responsible for premature opening of the Financial Bid.

All pages of the Bid, except for the Bid Bond (Annexure 14/14A/14B) and any other document executed on non-judicial stamp paper, forming part of the Bid and corrections in the Bid, if any, must be signed by the authorized signatory on behalf of the Bidder. It is clarified that the same authorized signatory shall sign all pages of the Bid. However, any published document submitted in this regard shall be signed by the authorized signatory at least on the first and last page of such document.

2.9.3. No change or supplemental information to a Bid already submitted will be accepted after the Bid Deadline, unless the same is requested for by the BPC as per Clause 2.5.6 (k).

Provided that a Bidder shall always have the right to withdraw / modify its Bid before the Bid Deadline. No Technical Bid or Initial Offer shall be modified, substituted or withdrawn by the Bidder on or after the Bid Deadline.

2.10 Preparation cost

2.10.1. The Bidders shall be responsible for all the costs associated with the preparation of the Bid and participation in discussions and attending pre-bid meetings, and finalization and execution of the RFP Project Documents (other than the TSA), etc. BPC shall not be responsible in any way for such costs, regardless of the conduct or outcome of the process of tariff based competitive bidding for selection of Bidder as TSP as per Bidding Guidelines.

2.10.2. The cost of this RFP is Rupees Five Lakh Only (Rs. 5,00,000) or U.S. Dollar Seven Thousand Only (US$ 7,000) plus GST as per applicable rate, which shall be non-refundable. This amount shall be paid via electronic transfer to the following Bank Account:

Bank Name, Address & Branch	ICICI Bank 9A, Phelps Building, Inner Circle, Connaught Place, New Delhi-110001
Bank Account Name	REC Power Development & Consultancy Limited
Bank Account No	000705041275
Bank IFSC Code No	ICIC0000007

Immediately after issuance of RFP document, the Bidder shall submit the Pre-Award Integrity Pact in the format as prescribed in Annexure B, which shall be applicable for and during the bidding process, duly signed on each page by any whole-time Director / Authorized Signatory, duly witnessed by two persons, and shall be submitted by the Bidder in two (2) originals in a separate envelope, duly superscripted with Pre-Award Integrity Pact. The Bidder shall submit the Pre-Award Integrity Pact on non-judicial stamp paper of Rs. 100/- each duly purchased from the National Capital Territory of Delhi. In case the Bidder is in a consortium, the Pre-Award Integrity Pact shall be signed and submitted by each member of the Consortium separately.

2.11 Bid Bond

2.11.1. Each Bidder shall submit the Bid accompanied by Bid Bond issued by any of the Banks listed

in Annexure-17. The Bid Bond shall be valid for a period of thirty (30) days beyond the validity of the Bid.

2.11.2. Subject to the provisions of Clause 2.15.5, the Bid Bond may be invoked by the BPC or its authorized representative, without any notice, demure, or any other legal process upon occurrence of any of the following:

- Bidder withdraws during the period of Bid Validity as specified in this RFP or as extended by mutual consent of the respective Bidder(s) and the BPC
- Failure to execute the Share Purchase Agreement as per the provisions of Clause 2.15.2; or
- Failure to furnish the Contract Performance Guarantee as per Clause 2.12; or
- Failure to acquire one hundred percent (100%) equity shares of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities, in accordance with the provisions of Clause 2.15.2; or
- Failure to comply with the provisions of Clause 2.15.5 and Clause 2.15.6, leading to annulment of the award of the Project.
- Bidders submitting any wrong information or making any misrepresentation in their Bid as mentioned in Clause 2.5.6.

Intimation of the reasons of the invocation of the Bid Bond shall be given to the Selected Bidder by the BPC within three (3) working days after such invocation.

2.11.3. The Bid Bond of the Selected Bidder shall be returned on submission of the Contract Performance Guarantee as per Clause 2.12 and the relevant provisions of the Transmission Service Agreement.

2.11.4. The Bid Bond of all the Bidders, whose Bids are declared non-responsive, shall be returned within a period of thirty (30) days after the date on which the Financial Bids are opened.

2.11.5. The Bid Bond of all unsuccessful Bidders shall be returned and released by the BPC on the same day on which the Barmer HVDC Power Transmission Limited is transferred to the Selected Bidder. The Bid Bond of the Successful Bidder shall be returned on submission of Contract Performance Guarantee as per Clause 2.12 of this RFP and the provisions of the Transmission Service Agreement.

2.12 Contract Performance Guarantee

2.12.1. Within ten (10) days from the date of issue of the Letter of Intent, the Selected Bidder, on behalf of the TSP, will provide to the Nodal Agency the Contract Performance Guarantee for an amount of Rs. 716 Crore (Rupees Seven Hundred and Sixteen Crore Only). The Contract Performance Guarantee shall be initially valid for a period up to three (3) months after the Scheduled COD of the Project and shall be extended from time to time to be valid for a period up to three (3) months after the COD of the Project and thereafter shall be dealt with in accordance with the provisions of the

Transmission Service Agreement. The Contract Performance Guarantee shall be issued by any of the banks listed in Annexure-17 as per format given at Annexure- 15 or any of the insurance companies authorized by Insurance Regulatory and Development Authority of India as per format given at Annexure – 15 A or PFC/ REC/ IREDA as per Payment on Order Instrument format given at Annexure -15B.

2.12.2. In case the Selected Bidder is unable to obtain the Contract Performance Guarantee for the total amount from any one bank specified in Annexure-17, the Selected Bidder may obtain the same from not more than three (3) banks specified in Annexure-17.

2.13 Opening of Bids

2.13.1. Technical Bid will be opened by the Bid Opening Committee as per the following time schedule and in the office of Central Electricity Authority, in the online presence of Bidders' representatives who wish to attend:

Opening of Envelope (Technical Bid): 1630 hours (IST) on 01.04.2026

or such other dates as may be intimated by BPC to the Bidders.

In the event of any of above dates falling on a day which is not a working day or which is a public holiday, then the bids shall be opened on the next working day at the same venue and time.

Opening of Initial Offer: Initial Offer shall be opened by the Bid Opening Committee in presence of the Bid Evaluation Committee at 1630 hours (IST) on 13.04.2026 in the office of CEA.

2.13.2. The following information from each Bid will be read out to all the Bidders at the time of opening of Technical Bid:

- Name of the Bidding Company / Consortium Members in case of Bidding Consortium.

Information to be provided after opening of Initial Offer:

Only the lowest Initial Offer (s) shall be communicated to all the Qualified Bidders to participate in the e-reverse bidding process. During the e-reverse bidding process only the lowest prevailing bid should be visible to all the bidders on the electronic platform.

2.14 Enquiries

Written clarifications on the RFP and other RFP Project Documents as per Clause 2.3 and 2.4 may be sought from:

Chief Executive Officer,
REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)
REC Corporate Head Quarter,
D Block, Plot No. I – 4,
Sec – 29 Gurugram – 122 001

Email: vijay.kulkarni@recpdcl.in & tbcb@recpdcl.in

2.15 Other Aspects

2.15.1. The draft of the Transmission Service Agreement has been attached to this RFP. In addition to above, the following documents have also been attached to this RFP:

a) Share Purchase Agreement

When the drafts of the above RFP Project Documents are provided by the BPC, these RFP Project Documents shall form part of this RFP as per Formats – 1 & 2 of Annexure 20.

Upon finalization of the RFP Project Documents after incorporating the amendments envisaged in Clause 2.4 of this RFP, all the finalized RFP Project Documents shall be provided by BPC to the Bidders at least fifteen (15) days prior to the Bid Deadline.

The Transmission Service Agreement and Share Purchase Agreement shall be signed in required number of originals so as to ensure that one (1) original is retained by each party to the Agreement(s) on the date of transfer of SPV.

2.15.2. Within ten (10) days of the issue of the Letter of Intent, the Selected Bidder shall:

a) provide the Contract Performance Guarantee in favour of the Nodal Agency as per the provisions of Clause 2.12;

b) execute the Share Purchase Agreement and the Transmission Service Agreement;

c) acquire, for the Acquisition Price, one hundred percent (100%) equity shareholding of Barmer HVDC Power Transmission Limited from REC Power Development and Consultancy Limited, who shall sell to the Selected Bidder, the equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities;

Stamp duties payable on purchase of one hundred percent (100%) of the equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities, shall also be borne by the Selected Bidder.

Provided further that, if for any reason attributable to the BPC, the above activities are not completed by the Selected Bidder within the above period of ten (10) days as mentioned in this Clause, such period of ten (10) days shall be extended, on a day for day basis till the end of the Bid validity period.

2.15.3. After the date of acquisition of the equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities, by the Selected Bidder,

i. the authority of the BPC in respect of this Bid Process shall forthwith cease and any actions to be taken thereafter will be undertaken by the Nodal Agency,

ii. all rights and obligations of Barmer HVDC Power Transmission Limited, shall be of the TSP,

iii. any decisions taken by the BPC prior to the Effective Date shall continue to be binding on the Nodal Agency and

iv. contractual obligations undertaken by the BPC shall continue to be fulfilled by the TSP.

v. Further, the TSP shall execute the Agreement(s) required, if any, under Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations as amended from time to time.

2.15.4. Within five (5) working days of the issue of the acquisition of the SPV by the Successful Bidder, the TSP shall apply to the Commission for grant of Transmission License and make an application to the Commission for the adoption of Transmission Charges, as required under Section – 63 of The Electricity Act 2003.

2.15.5. If the Selected Bidder / TSP fails or refuses to comply with any of its obligations under Clauses 2.15.2, 2.15.3 and 2.15.4, and provided that the other parties are willing to execute the Share Purchase Agreement and REC Power Development and Consultancy Limited is willing to sell the entire equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities, to the Selected Bidder, such failure or refusal on the part of the Selected Bidder shall constitute sufficient grounds for cancellation of the Letter of Intent. In such cases, the BPC / its authorized representative(s) shall be entitled to invoke the Bid Bond of the Selected Bidder.

2.15.6. If the TSP fails to obtain the Transmission License from the Commission, it will constitute sufficient grounds for annulment of award of the Project.

2.15.7. The annulment of award, as provided in Clauses 2.15.5 and 2.15.6 of this RFP, will be done by the Government on the recommendations of National Committee on Transmission. However, before recommending so, National Committee on Transmission will give an opportunity to the Selected Bidder / TSP to present their view point.

2.15.8. The annulment of the award, under Clause 2.15.5 or 2.15.6 of this RFP, shall be sufficient grounds for blacklisting the bidder, whose award has been annulled, for a period of five years or more, as decided by the National Committee on Transmission, provided that the blacklisting shall be done only after giving the bidder an opportunity for showing cause.

2.16 Confidentiality

2.16.1. The parties undertake to hold in confidence this RFP and RFP Project Documents and not to disclose the terms and conditions of the transaction contemplated hereby to third parties, except:

a) to their professional advisors;

b) to their officers, contractors, employees, agents or representatives, financiers, who need to have access to such information for the proper performance of their activities;

c) disclosures required under Law, without the prior written consent of the other parties of the concerned agreements.

Provided that the TSP agrees and acknowledges that the Nodal Agency may at any time, disclose the terms and conditions of the RFP and RFP Project Documents to any person, to the extent stipulated under the Law or the Bidding Guidelines.

2.17 Right of the BPC to reject any Bid

BPC reserves the right to reject all or any of the Bids/ or cancel the RFP without assigning any reasons whatsoever and without any liability.

2.18 Non submission and/or submission of incomplete data/ information required under the provisions of RFP shall not be construed as waiver on the part of BPC of the obligation of the Bidder to furnish the said data / information unless the waiver is in writing.

2.19 Fraudulent and Corrupt Practices

2.19.1. The Bidders and their respective officers, employees, agents and advisers shall observe the highest standard of ethics during the Bid process and subsequent to the issue of the LoI Notwithstanding anything to the contrary contained herein, or in the LoI, the BPC shall reject a Bid, withdraw the LoI, as the case may be, without being liable in any manner whatsoever to the Bidder, if it determines that the Bidder has, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice in the Bid process. In such an event, the BPC shall forfeit the Bid Bond, without prejudice to any other right or remedy that may be available to the BPC hereunder or otherwise.

2.19.2. Without prejudice to the rights of the BPC under Clause 2.19.1 hereinabove and the rights and remedies which the BPC may have under the LoI, if a Bidder is found by the BPC to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice during the Bid process, or after the issue of the LoI, such Bidder & its Affiliates shall not be eligible to participate in any tender or RFP issued by any BPC for an indefinite period from the date such Bidder is found by the BPC to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practices, as the case may be.

2.19.3. For the purposes of this Clause 2.19, the following terms shall have the meaning hereinafter respectively assigned to them:

a) **"corrupt practice"** means (i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bid process (for avoidance of doubt, offering of employment to or employing or engaging in any manner whatsoever, directly or indirectly, any official of the BPC who is or has been associated or dealt in any manner, directly or indirectly with the Bid process or the LoI or has dealt with matters concerning the Transmission Service Agreement or arising there from, before or after the execution thereof, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the BPC,

shall be deemed to constitute influencing the actions of a person connected with the Bid Process); or (ii) engaging in any manner whatsoever, whether during the Bid Process or after the issue of the LoI or after the execution of the Transmission Service Agreement, as the case may be, any person in respect of any matter relating to the Project or the LoI or the Transmission Service Agreement, who at any time has been or is a legal, financial or technical adviser of the BPC in relation to any matter concerning the Project;

b) **"Fraudulent practice"** means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bid process;

c) **"Coercive practice"** means impairing or harming, or threatening to impair or harm, directly or indirectly, any person or property to influence any person's participation or action in the Bid process;

d) **"undesirable practice"** means (i) establishing contact with any person connected with or employed or engaged by the BPC with the objective of canvassing, lobbying or in any manner influencing or attempting to influence the Bid process; or (ii) having a Conflict of Interest; and

e) **"Restrictive practice"** means forming a cartel or arriving at any understanding or arrangement among Bidders with the objective of restricting or manipulating a full and fair competition in the Bid process.

SECTION - 3

EVALUATION OF THE TECHNICAL AND FINANCIAL BID

SECTION 3

1. EVALUATION OF BID

3.1. The evaluation process of Technical Bid comprises the following five steps:

Step I – Responsiveness check
Step II- Compliance with submission requirements
Step III– Evaluation of Technical Bids
Step IV– Evaluation of Financial Bids
Step V – Bidder Selection

3.2. STEP I – Responsiveness check

The Technical Bid submitted by the Bidder shall be initially scrutinized to establish "Responsiveness". Subject to clause 2.5.6 (k), any of the following conditions shall cause the Technical Bid to be "Non-responsive":

a) Technical Bid that are incomplete.

b) Technical Bid not signed by authorized signatory and / or stamped in the manner indicated in this RFP.

c) All pages of the Technical Bid submitted but not initialed by the authorized signatories on behalf of the Bidder.

d) Technical Bid not including the covering letter as per Annexure 1.

e) Technical Bid submitted by a Bidding Consortium not including the Consortium Agreement.

f) Technical Bid contains material inconsistencies in the information and documents submitted by the Bidder, affecting the Qualification Requirements.

g) Bidder submitting or participating in more than one Bid either as a Bidding Company or as a Member of Bidding Consortium.

h) More than one Member of the Bidding Consortium or a Bidding Company using the credentials of the same Parent/Affiliate.

i) Information not submitted in formats specified in the RFP.

j) Applicable Board resolutions, or any other document, as provided in Clause 2.5.2, not being submitted;

k) Bid not accompanied by a valid Bid Bond;

l) Non submission of power of attorney, supported by a Board resolution;

m) Bid validity being less than that required as per Clause 2.8 of this RFP;

n) Bid not containing Format-1 (Bidders' Undertakings) of Annexure-8;

o) Bidder having Conflict of Interest

p) The Bidder has not submitted a disclosure as per Annexure 13.

q) Bidders delaying in submission of additional information or clarifications sought by the BPC.

r) If the Bidder makes any misrepresentation as specified in Clause 3.7.

s) Bid being conditional in nature.

t) More than one Member of the Bidding Consortium or a Bidding Company using the credentials of the same Parent/Affiliate.

3.3. STEP II - Compliance with submission requirements

Each Bidder's Technical Bid shall be checked for compliance with the submission requirements set forth in this RFP before the evaluation of Technical Bid is taken up. Annexure 16 and Annexure 11A shall be used to check whether each Bidder meets the stipulated requirements.

3.4. STEP III -Evaluation of Technical Bid

Evaluation of Technical Bid will be carried out considering the information and documents furnished by the Bidders as required under this RFP. This step would involve technical and financial evaluation of the details/ documents furnished by the Bidding Company / Bidding Consortium in support of meeting the Qualification Requirements

3.4.1. Interpolation of financial data.

For the Qualification Requirements data provided by the Bidders in foreign currency, equivalent rupees of Networth will be calculated using bills selling exchange rates (card rate) USD/INR of State Bank of India prevailing on the date of closing of the accounts for the respective financial year as certified by their Banker.

For the purpose of calculating the aggregate capital expenditure/construction experience of the projects completed/ commissioned where such projects are executed outside India and capital expenditure is denominated in foreign currency, bills selling exchange rates (card rate) USD/INR of State Bank of India prevailing on the date of closing of the financial year in which the projects were completed and as certified by their Banker shall be considered.

For the projects executed in the current financial year bills selling (card rate) USD/INR of State Bank of India prevailing on seven (7) days prior to the last date of submission of Technical Bid and as certified by their Banker shall be considered.

For currency other than USD, Bidders shall convert such currency into USD as per the exchange rates certified by their Banker prevailing on the relevant date and used for such conversion. Such Bidders shall submit necessary certification from their Banker for the exchange rate used in the conversation.

If the exchange rate for any of the above dates is not available, the rate for the immediately available previous day shall be taken into account.

3.4.2. Bidders meeting the Qualification Requirements, subject to evaluation as specified in Clauses 3.2 to 3.4 shall be declared as Qualified Bidders and eligible for opening of Initial Offer.

3.4.3. The BPC shall upload the list of all Qualified Bidders and Non-Qualified Bidders on the bidding portal along with the reasons for non-qualification.

3.5. STEP IV - Evaluation of Financial Bids

3.5.1. The Bids which have been found Qualified by the BPC, based on the Steps I to III as specified above in Clauses 3.2.to 3.4, shall be opened and Quoted Transmission Charges of such Initial Offer shall be ranked on the basis of the ascending Initial Offer submitted by each Qualified Bidder.

Based on such ranking of the Qualified Bidders, in the first fifty per cent of the ranking (with any fraction rounded off to higher integer) or four Qualified Bidders, whichever is higher, shall qualify for participating in the electronic reverse auction.

Provided however, in case only one Bidder remains after the Evaluation of Technical Bid (Steps 1 to III) as per Clause 3.2 to 3.4, the Initial Offer of such Bidder shall not be opened and the matter shall be referred to the Government.

Provided that in the event the number of Qualified Bidders is between two and four, then each of the responsive Bidder shall be considered as Qualified Bidders.

Provided that in the event of identical Quoted Transmission Charges discovered from the Initial Offer having been submitted by one or more Bidders, all such Bidders shall be assigned the same rank for the purposes of determination of Qualified Bidders. In such cases, all Qualified Bidders who shares the same rank till 50% of the rank (with any faction rounded off to higher integer) determined above, shall qualify to participate in the electronic reverse auction stage. In case 50% of the rank is having less than four (4) Bidders and the rank of the fourth (4^{th}) Bidder is shared by more than one Bidder, then all such all such Bidders who share the rank of the fourth Bidder shall qualify to participate in the electronic reverse auction.

3.5.2. The Financial Bids comprising of both Initial Offer and Final Offer submitted by the Bidders shall be scrutinized to ensure conformity with the provisions of Clause 2.5.3 of this RFP. Any Bid not meeting any of the requirements as per Clause 2.5.3 of this RFP may cause the Bid to be considered "Non-responsive", at the sole decision of the BPC. Financial Bid not in conformity with the requirement of SI. No. (c) of Clause 2.5.3 of this RFP shall be rejected.

3.5.3 The Bidders shall quote the single annual Quoted Transmission Charges as specified in the format at Annexure – 21.

3.6. STEP V - Bidder Selection

3.6.1. The prevailing lowest Quoted Transmission Charges discovered from Final Offers shall only be displayed during the e-reverse bidding and the Bidder quoting such Final Offer will always remain anonymous during the e-reverse bidding. The Bidder with the prevailing lowest Quoted Transmission Charges discovered from Final Offers at the close of the scheduled or extended period of e-reverse bidding as mentioned in clause 2.5 shall be declared as the Successful Bidder, subject to verification of the original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B. The Letter of Intent shall be issued to such Successful Bidder in two (2) copies.

However, if no bid is received during the e-reverse bidding stage then the Bidder with lowest quoted initial transmission charges ("Initial Offer") during e-bidding stage shall be declared as the Successful Bidder, subject to verification of the original hard copies of Annexure 3, Annexure 4 (if applicable), Annexure 6 (if applicable) and Annexure 14/14A/14B. The Letter of Intent shall be issued to such Successful Bidder in two (2) copies.

In case, there is a discrepancy between the online submission and physical documents, the bid would be out rightly rejected and the bidder shall be construed to have engaged in the fraudulent practice as defined in Clause 2.19.3 with consequences as mentioned in Clause 2.19.2. Further, in such a case, the provisions of Clause 2.5.6 (j) shall apply.

3.6.2. The Selected Bidder shall unconditionally accept the LoI, and record on one (1) copy of the LoI, "Accepted unconditionally", under the signature of the authorized signatory of the Successful Bidder and return such copy to the BPC within seven (7) days of issue of LoI.

3.6.3. If the Successful Bidder, to whom the Letter of Intent has been issued, does not fulfill any of the conditions specified in Clauses 2.15.2, 2.15.3 and Clause 2.15.4, then subject to Clause 2.15.5, the BPC reserves the right to annul the award of the Project and cancel the Letter of Intent. Further, in such a case, the provisions of Clause 2.5.6 (j) shall apply.

3.6.4. The BPC, in its own discretion, has the right to reject all Bids if the Quoted Transmission Charges are not aligned to the prevailing prices.

3.7. Misrepresentation by the Bidder

If the Bidder conceals any material information or makes a wrong statement or misrepresents facts or makes a misleading statement in the Technical Bid or Bid, as the case may be, in any manner whatsoever, in order to create circumstances for the acceptance of its Technical Bid/Bid, the BPC reserves the right to reject such Technical Bid/Bid, and/ or cancel the Letter of Intent, if issued. Further, in case Letter of Intent is cancelled, consequences as per provisions of the RFP shall follow.

3.8. Disposition of Technical Bid

3.8.1. Technical Bid found to be Non-responsive as per Clause **3.2,** due to any of the following conditions, shall be liable for rejection.

- Technical Bid that is incomplete.
- Technical Bid not signed by authorized signatory and / or stamped in the manner indicated in this RFP.
- All pages of the Technical Bid submitted but not initialed by the authorized signatories on behalf of the Bidder.

- Technical Bid not including the covering letter as per Annexure 1.
- Technical Bid contains material inconsistencies in the information and documents submitted by the Bidder, affecting the Qualification Requirements.
- Information not submitted in formats specified in the RFP.
- The Bidder has not submitted a disclosure as per Annexure 13**.**
- Bidders delaying in submission of additional information or clarifications sought by the BPC.

3.8.2. Technical Bid found to be Non-responsive as per Clause **3.2,** due to any of the following conditions, shall be rejected.

- Technical Bid not received by the scheduled date and time.
- Technical Bid submitted by a Bidding Consortium not including the Consortium Agreement.
- Bidder submitting or participating in more than one response either as a Bidding Company or as a Member of Bidding Consortium.
- More than one Member of the Bidding Consortium or a Bidding Company using the credentials of the same Parent/Affiliate.
- Technical Bid having Conflict of Interest.
- If the Bidder makes any misrepresentation as specified in Clause **3.7.**

3.9. BPC reserves the right to interpret the Bid in accordance with the provisions of this RFP document and make its own judgment regarding the interpretation of the same. In this regard, BPC shall have no liability towards any Bidder and no Bidder shall have any recourse to BPC with respect to the qualification process.

BPC shall evaluate Bid using the process specified in Clause 3.1 to 3.6, at its sole discretion. BPC's decision in this regard shall be final and binding.

SECTION - 4

ANNEXURES FOR BID

आरईसी पावर डेवलपमेंट एंड कंसल्टेंसी लिमिटेड

(आरईसी लिमिटेड के पूर्ण स्वामित्व की सहायक कंपनी)

वैश्विक आमंत्रण (इलेक्ट्रॉनिक बोली के माध्यम से)

टैरिफ के जरिए प्रतियोगिता बोली (टीबीसीबी) प्रक्रिया के माध्यम से 01 (एक) अंतर-राज्यीय पारेषण परियोजना के निर्माण, स्वामित्व, प्रचालन और हस्तांतरण (बीओओटी) आधारित पारेषण सेवा प्रदाता के चयन के लिए

आरईसी पावर डेवलपमेंट एंड कंसल्टेंसी लिमिटेड, नई दिल्ली, भारत (आरईसी लिमिटेड के पूर्ण स्वामित्व की सहायक कंपनी - एक महारत्न केंद्रीय सार्वजनिक उपक्रम) नीचे उल्लिखित पारेषण परियोजना की स्थापना हेतु टी.बी.सी.बी. के अंतर्गत निर्माण, स्वामित्व, प्रचालन और हस्तांतरण (बूट) के आधार पर प्रस्ताव हेतु अनुरोध (आरएफपी) एक चरण दो लिफाफे वाली प्रक्रिया के तहत प्रस्ताव आमंत्रित करता है। इच्छुक बोलीदाता कृपया हमारी वेबसाइट्स www.recindia.nic.in तथा www.recpdcl.in पर 28.01.2026 से उपलब्ध "प्रस्ताव हेतु अनुरोध" (आरएफपी) अधिसूचना तथा आरएफपी दस्तावेज़ का अवलोकन करे।

बोलीदाता, आरएफपी दस्तावेज सभी कार्य दिवसों में 10:30 बजे (भा.मा.स) से 16:00 बजे (भा.मा.स) के बीच (28.01.2026 से प्रस्ताव जमा करने की तिथि से एक दिन पहले तक) हमारी वेबसाइट्स www.recindia.nic.in और www.recpdcl.in पर उपलब्ध परियोजना के आरएफपी दस्तावेज में दिए गए विवरण के अनुसार अप्रतिदेय गैर-वापसी योग्य शुल्क (₹5,00,000/- (पांच लाख रुपए केवल) या $7000 (यूएस डालर सात हजार केवल) + 18% जीएसटी) के भुगतान पर प्राप्त कर सकते है।

आरएफपी दस्तावेज हमारी वेबसाइट्स www.recindia.nic.in तथा www.recpdcl.in से भी डाउनलोड किया जा सकता है। तथापि, ऐसे मामले में इच्छुक पार्टी आरएफपी दस्तावेज में दिए गए विवरण के अनुसार अप्रतिदेय गैर-वापसी योग्य शुल्क (₹5,00,000/- (पांच लाख रुपए केवल) या $7000 (यूएस डालर सात हजार केवल) + 18% जीएसटी) का अलग से भुगतान करने पर ही आरएफपी के उत्तर में प्रस्ताव जमा कर सकते हैं। सर्वे रिपोर्ट एवं आरएफपी दस्तावेजों के स्पष्टीकरण उन्हीं बोलीदाताओं को जारी किया जाएगा, जिन्होंने अपेक्षित शुल्क का भुगतान करके आरएफपी दस्तावेज प्राप्त किया या खरीदा है। इस सन्दर्भ में महत्वपूर्ण समय-सीमा इस प्रकार है:

क्रम. सं.	परियोजना का नाम	स्पष्टीकरण मंगवाने की अंतिम तिथि	आरएफपी के उत्तर में प्रस्ताव जमा की अंतिम तिथि	आरएफपी प्रस्ताव खोलने का विवरण
1.	राजस्थान आरईजेड चरण-IV (भाग-5: 6 गीगावाट)[बाड़मेर कॉम्प्लेक्स] बाड़मेर-II: 6 गीगावाट (सौर)(एलसीसी संरचना) से विघुत की निकासी के लिए पारेषण प्रणाली	17.02.2026	01.04.2026, 1500 बजे तक (भा.मा.स)	01.04.2026 को 1530 बजे (भा.मा.स)

बोली में सभी शुद्धिपत्र, अनुशेष, संशोधन, समय बढ़ाना आदि हमारी वेबसाइट्स www.recindia.nic.in तथा www.recpdcl.in पर होस्ट किए जाएंगे। नवीनतम जानकारी के लिए हमारी वेबसाइट का नियमित रूप से अवलोकन करते रहे।

नोट: आरईसीपीडीसीएल के पास बिना कोई कारण बताए तथा बिना किसी बाध्यता के बोली प्रक्रिया को रद्द या संशोधित करने का अधिकार सुरक्षित है। यह कोई पेशकश नहीं है।

मुख्य कार्यपालक अधिकारी
आरईसी पावर डेवलपमेंट एंड कंसल्टेंसी लिमिटेड
कोर - 4, स्कोप कॉम्प्लेक्स, लोधी रोड, नई दिल्ली - 110003, भारत

बोली प्रक्रिया समन्वयक
REC Power Development
आरईसी पावर डेवलपमेंट एंड कंसल्टेंसी लिमिटेड

पहलकर्ता
विघुत मंत्रालय
भारत सरकार

पहलकर्ता भागीदार
केंद्रीय विघुत प्राधिकरण

ऊर्जा ही जीवन है, इसे बचाएं। Give a missed call on toll free number 18002003004 to get our Apps

REC POWER DEVELOPMENT AND CONSULTANCY LIMITED

(A wholly owned subsidiary of REC Ltd.)

GLOBAL INVITATION (Through e-bidding Only)

FOR SELECTION OF TRANSMISSION SERVICE PROVIDER THROUGH TARIFF BASED COMPETITIVE BIDDING (TBCB) PROCESS ON BUILD, OWN, OPERATE AND TRANSFER (BOOT) BASIS FOR 01 (ONE) INTER – STATE TRANSMISSION PROJECT

REC Power Development and Consultancy Limited, New Delhi, India (a wholly owned subsidiary of REC Limited, a Maharatna Central Public Sector Undertaking) invites proposal for setting up of the below mentioned transmission project through TBCB process on Build, Own, Operate and Transfer (BOOT) basis following single stage two envelope process of "Request for Proposal (RFP)". Interested bidders may refer to the Request for Proposal (RFP) notifications and RFP documents available on our websites www.recpdcl.in & www.recindia.nic.in w.e.f. 28.01.2026.

The bidders may obtain the RFP documents on all working days between 10:30 hours (IST) to 16:00 hours (IST) from 28.01.2026 to one day prior to bid submission date on payment of non-refundable fee of Rs. 5,00,000/- (Rupees Five Lakh Only) or US$ 7000 (US Dollars Seven Thousand Only) + 18% GST as per details provided in the RFP document available on the websites www.recpdcl.in & www.recindia.nic.in.

The Request for Proposal (RFP) documents can also be downloaded from our websites www.recpdcl.in & www.recindia.nic.in, however, in such cases interested parties can submit Response to RFP only on submission of non-refundable fee of Rs. 5,00,000/-(Rupees Five Lakh Only) or US$ 7000 (US Dollars Seven Thousand Only) + 18% GST as per details provided in the RFP document. The survey report & clarifications to RFP document shall be issued to those bidders, who have obtained/purchased RFP documents by paying requisite fee. The important timelines in this regard are as follows:

Sr. No.	Name of Project	Last Date for seeking clarifications	Last Date for submission of Response to RFP	Details of Opening of Response to RFP
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)	17.02.2026	01.04.2026 up to 1500 Hrs (IST)	01.04.2026 at 1530 Hrs (IST)

All corrigenda, addenda, amendments, time extensions, etc. to the RFP will be hosted on our websites www.recpdcl.in & www.recindia.nic.in. Bidders should regularly visit our websites to keep themselves updated.

Note: RECPDCL reserves the right to cancel or modify the process without assigning any reason and without any liability. This is not an offer.

Chief Executive Officer
REC Power Development and Consultancy Ltd.
Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003, India

Bid Process Coordinator
REC Power Development and Consultancy Limited

An Initiative of
Ministry of Power
Government of India

Initiative Partner
Central Electricity Authority

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REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited, a 'Maharatna CPSE'
under Ministry of Power, Govt. of India)

REC Power Development

संदर्भ संख्या:आरईसीपीडीसीएल/टीबीसीबी/बाड़मेर-II(एचवीडीसी)/2025-26/4862 दिनांक: 30.01.2026

सेक्रेटरी,
केन्द्रीय विद्युत विनियामक आयोग,
6वीं, 7वीं और 8वीं मंजिल, टावर-बी, वर्ल्ड ट्रेड सेंटर
नौरोजी नगर, तीसरा नई दिल्ली – 110029

Subject: Global Invitation for selection of Transmission Service Provider to establish Transmission system for the project namely "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5:6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" **-Copy of RFP documents.**

महोदय,

Kind reference is invited to the Gazette Notification No.3860 [F.No. 15/3/2018-Trans-Part (4)] dated 29.08.2025, issued by Ministry of Power, Government of India wherein REC Power Development and Consultancy Limited has been appointed as Bid Process Coordinator (BPC) for selection of bidder as Transmission Service Provider to establish Inter-State transmission projects on Build, Own, Operate & Transfer (BOOT) basis.

In this regard, we would like to intimate that the RFP process for the subject cited project has been initiated by way of Global Invitation in National/International newspapers i.e. Hindustan Times Package & Financial Times Package on 28.01.2026. The important timelines in this regard are as below. :-

Sr. No.	Name of the Project	Last date of RFP Purchase	Last date for submission of response to RFP
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5.6GW) [Barmer complex] Barmer-II: 6 GW (Solar) (LCC Configuration)	31.03.2026	01.04.2026 up to 1500 Hrs (IST)

The RfP notification and RfP document for the above project has also been uploaded on our websites www.recindia.nic.in and www.recpdcl.in.

In this regard, copy of Request for Proposal (RfP), Transmission Service Agreement (TSA) and Share Purchase Agreement (SPA) along with copies of newspaper notification of the subject project are enclosed herewith for your kind information and reference please.

धन्यवाद,

भवदीय,

(विजय कुलकर्णी)
वरिष्ठ महाप्रबंधक एवं विभागाध्यक्ष (टी & डी)

संलग्न: जैसा कि ऊपर बताया गया है

D-Block, REC World Headquarter, Plot No. I-4, Sector-29, Gurugram, (Haryana) - 122001.
E-mail: co@recpdcl.in | Tel.: 0124-4441300 | www.recpdcl.in | CIN No. RECPDCL-U40101DL2007GOI165779 GST No. 06AADCR7399K1ZP

संदर्भ संख्या:आरईसीपीडीसीएल/टीबीसीबी/बाड़मेर-II(एचवीडीसी)/2025-26/4863-A दिनांक: 30.01.2026

निदेशक (पीजी डेस्क)
ऊर्जा मंत्रालय,
श्रमशक्ति भवन, रफी मार्ग,
नई दिल्ली-110001

Subject: Global Invitation for selection of Transmission Service Provider to establish Transmission system for the project namely "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5:6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" **-Copy of RFP documents.**

महोदय,

Kind reference is invited to the Gazette Notification No.3860 [F.No. 15/3/2018-Trans-Part (4)] dated 29.08.2025, issued by Ministry of Power, Government of India wherein REC Power Development and Consultancy Limited has been appointed as Bid Process Coordinator (BPC) for selection of bidder as Transmission Service Provider to establish Inter-State transmission projects on Build, Own, Operate & Transfer (BOOT) basis.

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In this regard, copy of Request for Proposal (RfP), Transmission Service Agreement (TSA) and Share Purchase Agreement (SPA) along with copies of newspaper notification of the subject project are enclosed herewith for your kind information and reference please.

धन्यवाद,

भवदीय,

(विजय कुलकर्णी)
वरिष्ठ महाप्रबंधक एवं विभागाध्यक्ष (टी & डी)

संलग्न: जैसा कि ऊपर बताया गया है

Form No. INC-33

e-MOA (e-Memorandum of Association)
[Pursuant to Schedule I (see Sections 4 and 5) to the Companies Act, 2013)]



Form language

(•) English ( ) Hindi

Refer instruction kit for filing the form

*All fields marked in * are mandatory*

*** Table applicable to company as notified under schedule I of the Companies Act, 2013**

(A - MEMORANDUM OF ASSOCIATION OF A COMPANY LIMITED BY SHARES
B - MEMORANDUM OF ASSOCIATION OF A COMPANY LIMITED BY GUARANTEE AND NOT HAVING A SHARE CAPITAL
C - MEMORANDUM OF ASSOCIATION OF A COMPANY LIMITED BY GUARANTEE AND HAVING A SHARE CAPITAL
D - MEMORANDUM OF ASSOCIATION OF AN UNLIMITED COMPANY AND NOT HAVING SHARE CAPITAL
E - MEMORANDUM OF ASSOCIATION OF AN UNLIMITED COMPANY AND HAVING SHARE CAPITAL)

A - MEMORANDUM OF ASSOCIATION OF A COMPANY LIMITED BY SHARES

Table A/B/C/D/E

1 The name of the company is

BARMER HVDC POWER TRANSMISSION LIMITED

2 The registered office of the company will be situated in the State of

Delhi

3 (a) The objects to be pursued by the company on its incorporation are:

1.To plan, promote and develop an integrated and efficient power transmission system network in all its aspects including planning, investigation, research, design and engineering, preparation of preliminary, feasibility and definite project reports, construction, operation and maintenance of transmission lines, sub-stations, load dispatch stations and communication facilities and appurtenant works, coordination of integrated operation of regional and national grid system, execution of turn-key jobs for other utilities/organizations and wheeling of power in accordance with the policies, guidelines and objectives laid down by the Central Government from time to time.
2. To study, investigate, collect information and data, review operation, plan, research, design and prepare Report, diagnose operational difficulties and weaknesses and advise on the

remedial measures to improve, undertake development of new and innovative product connected with business of the Company as well as modernize existing EHV, HV lines and Sub-Stations.
3.To act as consultants, technical advisors, surveyors and providers of technical and other services to Public or Private Sector enterprises engaged in the planning, investigation, research, design and preparations of preliminary, feasibility and definite project reports, manufacture of power plant and equipment, construction, generation, operation and maintenance of power transmission system from power generating stations and projects, transmission and distribution of power.
4.To plan, promote, develop, erect and maintain, operate and otherwise deal in Telecommunication networks and services in all its aspects including planning, investigation, research, design and engineering, preparation of preliminary, feasibility and definite project reports: to purchase, sell, import, export, assemble, manufacture, install, commission, maintain, operate commercially whether on own or along with other, on lease or otherwise. These networks and for such purposes to set up and/ or install all requisite communications facilities and other facilities including fibre optic links, digital microwave links, communication cables, other telecommunication means, telephone and other exchanges, co-axial stations, microwave stations, repeater stations, security system databases, billing systems, subscriber management systems and other communication systems whether consisting of sound, visual impulse, or otherwise, existing or that may be developed or invented in the future and to

	manufacture, purchase, sell, import, export, assemble, take or give on lease/rental/subscription basis or by similar means or otherwise deal in all components and other support and ancillary hardware and software systems, accessories, parts and equipments etc. used in or in connection with the operation of the above communication systems and networks including to deal with telecommunication operations or directly with the general public, commercial companies or otherwise.
(b) *Matters which are necessary for furtherance of the objects specified in clause 3(a) are	1.To obtain license, approvals and authorization from Governmental Statutory and Regulatory Authorities, as may be necessary to carry out and achieve the Objects of the Company and connected matters which may seem expedient to develop the business interests of the Company in India and abroad. 2.To enter into any arrangement with the Government of India or with any State Government or with other authorities/ commissions, local bodies or public sector or private sector undertakings, Power Utilities, Financial Institutions, Banks, International Funding Agencies and obtain such charters, subsidies, loans, advances or other money, grants, contracts, rights, sanctions, privileges, licenses or concessions whatsoever (whether statutory or otherwise) which the Company may think it desirable to obtain for carrying its activities in furthering the interests of the Company or its members. 3.To enter into any agreement, contract or any arrangement for the implementation of the power generation, evacuation, transmission and distribution system and network with Power/ Transmission Utilities, State Electricity Boards, Vidhyut Boards, Transmission

Companies, Generation Companies,
Licensees, Statutory bodies, other organizations (whether in Private, Public or Joint Sector Undertaking) and bulk consumers of power etc.
4.To secure the payments of money, receivables on transmission and distribution of electricity and sale of fuel, as the case may be, to the State Electricity Boards, Vidyut Boards, Transmission Utilities, Generating Companies, Transmission Companies, Distribution Companies, State Governments, Licensees, statutory bodies, other
organizations (whether in Private, Public or Joint Sector Undertaking) and bulk consumers of power etc. through Letter of Credits/ESCROW and other security documents.
5.To coordinate with the Central Transmission Utility of electricity generated by it under the relevant provisions of Electricity Act 2003 and any amendments thereto.
6.Subject to provisions of Sections 73, 74, 179, 180 & 186 and other applicable provisions of the Companies Act, 2013 and rules made thereunder and subject to other laws or directives, if any, of SEBI/RBI, to borrow money in Indian rupees or foreign currencies and obtain foreign lines of credits/ grants/ aids etc. or to receive money or deposits from public for the purpose of the Company's business in such manner and on such terms and with such rights, privileges and obligations as the Company may think fit. The Company may issue bonds/ debentures whether secured or unsecured; bills of exchange, promissory notes or other securities, mortgage or charge on all or any of the immovable and movable properties, present or future and all or any of the uncalled capital for the time being of the Company as the

Company may deem fit and
To repay, redeem or pay off any such securities or charges.
7.To lend money on property or on mortgage of immovable properties or against Bank guarantee and to make advances of money against future supply of goods and services on such terms as the Directors may consider necessary and to invest money of the Company in such manner as the Directors may think fit and to sell, transfer or to deal with the same.
8.To own, possess, acquire by purchase, lease or otherwise rights, title and interests in and to, exchange or hire real estate, equipment, Transmission lines, lands, buildings, apartments, plants, equipment, machinery, fuel blocks and hereditaments of any tenure or descriptions situated in India or abroad or any estate or interest therein and any right over or connected with land so situated and turn the same to account in any manner as may seem necessary or convenient for the purpose of business of the Company and to hold, improve, exploit, reorganize,
manage, lease, sell,
exchange or otherwise dispose of the whole or any part thereof.
9.Subject to applicable provisions of Companies Act, 2013, to subscribe for, underwrite, or otherwise acquire, hold, dispose of and deal with the shares, stocks, debentures or other securities and titles of indebtedness or the right to participate in profits or other similar documents issued by any Government authority, Corporation or body or by any company or body of persons and any option or right in respect thereof.
10.To create any depreciation fund, reserve fund, sinking fund, insurance fund, gratuity, provident fund or any other fund, for depreciation or for repairing, improving extendingor

maintaining any of the properties of the Company or for any other purposes whatsoever conducive to the interests of the Company.

11.To acquire shares, stocks, debentures or securities of any company carrying on any business which this Company is entitled to carry on or acquisition of undertaking itself which may seem likely or calculated to promote or advance the interests of the Company and to sell or dispose of or transfer any such shares, stocks or securities and the acquired undertaking.

12.To enter into partnership or into any agreement for joint working, sharing or pooling profits, joint venture, amalgamation, union of interests, co-operation, reciprocal concessions or otherwise or amalgamate with any person or company carrying on or engaged in or about to carry on or engaged in any business or transaction in India or abroad which the Company is authorized to carry on or engage in any business undertaking having objects identical or similar to, as are being carried on by this Company.

13.To establish and maintain agencies, branch offices and local agencies, to procure business in any part of India and world and to take such steps as may be necessary to give the Company such rights and privileges in any part of the world as deemed proper in the interest of the Company.

14.To promote and undertake the formation of any institution or Company or subsidiary company or for any aforesaid objects intended to benefit the Company directly or indirectly and to coordinate, control and guide their activities.

15(a).To negotiate and enter into agreements and contracts with domestic and foreign companies,

persons or other organizations, banks and financial institutions, in relation to the business of the Company including that of technical know-how, import, export, purchase or sale of plant, machinery, equipment, tools, accessories and consumables, financial assistance and for carrying out all or any of the objects of the Company.
15(b). To negotiate and enter into
agreements and contracts for execution of turnkey jobs, works, supplies and export of plant, machinery, tools and accessories etc.
16.Upon and for the purpose of any issue of shares, debentures or any other securities of the Company, to enter into agreement with intermediaries including brokers, managers of issue/commission agents and underwriters and to provide for the remuneration of such persons for their services by way of payment in cash or issue of shares, debentures or other securities of the Company or by granting options to take the same or in any other manner as permissible under the law.
17.To enter into contracts of indemnity and get guarantee and allocations for the business of the Company.
18.To make arrangements for training of all categories of employees and to employ or otherwise engage experts, advisors, consultants etc. in the interest of achieving the Company's objects.
19.To promote conservation and protection of electricity from theft, safety of life and to protect environments including air, land and water etc.
20.To pay and provide for the remuneration, amelioration and welfare of persons employed or formerly employed by
the Company and their families providing for pension, allowances, bonuses, other payments or by creating for the

purpose from time to time the Provident Fund, Gratuity and other Funds or Trusts. Further to undertake building or contributing to the building or houses, dwellings or chawls by grants of money, or by helping persons employed by the Company to effect or maintain insurance on their lives by contributing to the payment of premium or otherwise and by providing or subscribing or contributing towards educational institutions, recreation, hospitals and dispensaries, medical and other assistance as the Company may deem fit.

21.To ensure any rights, properties, undertakings, contracts, guarantees or obligations or profits of the Company of every nature and kind in any manner with any person, firm, association, institution or company.

22.To distribute among members of the Company dividend including bonus shares out of profits, accumulated profits or funds and resources of the Company in any manner permissible under law.

23.To institute, conduct, defend, compound or abandon any legal proceedings by or against the Company or its officers or otherwise concerning the affairs of the Company and also to compound and to allow time for payment or satisfaction of any debts or recovery due, claims or demands by or against the Company and to refer any claims or demands by or against the Company or any differences arising in execution of contracts to conciliation and arbitration and to observe, comply with and/or challenge any awards preliminary, interim or final made
in any such arbitration.

24.To pay
out of the funds of the Company all costs, charges, expenses and preliminary and

incidental to the promotion, formation, establishment and registration of the Company or other expenses incurred in this regard.
25.Subject to provisions of Sections 181, 182 & 183 of Companies Act, 2013 to contribute money or otherwise assist to charitable, benevolent, religious, scientific national, defense, public or other institutions or objects or purposes.
26.To open an account or accounts with any individual, firm or company or with any bank bankers or shroofs and to pay into and withdraw money from such account or accounts.
27.To accept gifts, bequests, devises and donations from members and others and to make gifts to members and others of money, assets and properties of any kind.
28.To carry out all or any of the objects of the company and do all or any of the above things in any part of the world and either as principal, agent, contractor or trustee or otherwise and either alone or in conjunction with others.
29.To negotiate and/or enter into agreement and contract with individuals, companies, corporations, foreign or Indian, for obtaining or providing technical, financial or any other assistance for carrying on all or any of the objects of the Company and also for the purpose of activating, research, development of projects on the basis of know-how and/or financial participation and for technical collaboration, and to acquire or provide necessary formulate and patent rights for furthering the objects of the company.
30.To aid peculiarly or otherwise, any association, body or movement having for its object the solution, settlement or surmounting of industrial or labour problems or trouble or

the promotion of industry or trade.
31.Subject to the provisions of Companies Act, 2013 or any amendment or re-enactment thereof in the event of winding up to distribute among the members in specie any property of the Company or any proceeds of sale on disposal of any property in accordance with the provisions of the Act.
32.To do all such other things as may be deemed incidental or conducive to the attainment of the above Objects or any of them and to carry on any business which may seem to the Company capable of being conveniently carried in connection with any of the Company's Objects or calculated directly or indirectly to enhance the value of or render profitable any of the Company's property or rights.
33.To establish, provide, maintain and conduct or otherwise subsidies research laboratories and experimental workshops for scientific, technical or researches, experiments and to undertake and carry on directly or in collaboration with other agencies scientific and technical research experiments and tests of all kinds and to process, improve and invent new products and their techniques of manufacture and to promote, encourage, reward in every manner studies and research, scientific and technical investigations and inventions of any kind that may be considered likely to assist, encourage and promote rapid advances in technology, economies, import substitution or any business which the Company is authorized to carry on.
34.Subject to provisions of the Companies Act, 2013, to evolve scheme for restructuring or arrangement, to amalgamate or merge or to enter into partnership or into any consortium or arrangement for

sharing of profits, union of interests, co-operation, joint venture with any Person or Persons, partnership firm/firms, or company or companies carrying on or engaged in any operation capable of being conducted so conveniently in cooperation with the business of the Company or to benefit the Company or to the activities for which the Company has been established.

35.To apply for purchase, or otherwise acquire any trade marks, patents, brevets, inventions, licenses, concessions and the like, conferring any exclusive or nonexclusive or limited rights to use, or any secret or other information as to any invention which may be capable of being used for any of the purposes of the Company, or the acquisition of which may benefit the Company and to use, exercise, develop or grant licenses in respect of or otherwise turn to account the property, rights or information so acquired.

36.To sell, dispose or hive off an undertaking of the Company or any part thereof for such consideration as the Company may think fit and in particular for shares, debentures or securities of any other association, corporation or company.

37.To sell, improve, manage, develop, exchange, loan, lease or let, under-lease, sub - let, mortgage, dispose of, deal with in any manner, turn to account or otherwise deal with any rights or property of the Company.

4 The liability of the member(s) is limited, and this liability is limited to the amount unpaid if any, on the shares held by them.

5 Every member of the company undertakes to contribute:

(i) to the assets of the company in the event of its being wound up while he is a member, or within one year after he ceases to be a member, for payment of the debts and liabilities of the company or of such debts and liabilities as may have been contracted before he ceases to be a member; and

(ii) to the costs, charges and expenses of winding up (and for the adjustment of the rights of the contributories among themselves), such amount as may be required, not exceeding * [ ] rupees.

(iii) The share capital of the company is [500000] rupees, divided into

50000	Equity Share	Shares of	10	Rupees each	

6

☑ We, the several persons, whose names and address are subscribed, are desirous of being formed into a company in pursuance of this memorandum of association, and we respectively agree to take the number of shares in the capital of the company set against our respective names:

☐ I, whose name and address is given below, am desirous of forming a company in pursuance of this memorandum of association and agree to take all the shares in the capital of the company:

☐ We, the several persons, whose names and addresses are subscribed, are desirous of being formed into a company in pursuance of this memorandum of association:

Subscriber Details					
S. No.	*Name, Address, Description and Occupation	DIN / PAN / Passport number	No. of shares taken	DSC	Dated
1	JASPAL SINGH KUSHWAHA S/O MITHAI LAL KUSHWAHA NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O C-64/ FIRST FLOOR, JVTS GARDEN CHATTARPUR EXTENSION South West Delhi 110074 OCCUPATION-SERVICE	1*3*2*3*	1 Equity,0 Preference		26/09/2025
2	VIJAY SHRIDHAR KULKARNI S/O SHRIDHAR GANESH KULKARNI NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O REGAL 501, MAPSKO ROYALE VILLE VATIKA INDIA NEXT, SECTOR-82, Narsinghpur GURGAON-122004 HARYANA OCCUPATION- SERVICE	1*3*7*8*	1 Equity,0 Preference		26/09/2025
3	REC POWER DEVELOPMENT AND CONSULTANCY LIMITED, CORE-4, SCOPE COMPLEX, 7, LODHI ROAD, NEW DELHI-110003, THROUGH ITS CEO THANGARAJAN SUBASH CHANDIRA BOSH S/O SITHAN THANGARAJAN R/O APARTMENT NO S-2, MIDDLE PORTION 2-B, JANGPURA, MATHURA ROAD, NEW DELHI-110014, OCCUPATION-SERVICE	0*7*2*1*	49994 Equity,0 Preferenc		26/09/2025
4	MUKUL AGARWAL S/O RAJESH KUMAR NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O HOUSE NO. 767, SECOND FLOOR, ANSAL C-2 BLOCK, NEAR WATER TANK ANSAL PLAZA SECTOR-3 PALAMVIHAR, GURGAON-122017, HARYANA OCCUPATION-SERVICE	1*3*2*8*	1 Equity,0 Preference		26/09/2025
5	ARVIND KUMAR S/O NAND KISHOR SINGH NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O T4-8A, SAI VATIKA APARTMENT, SECTOR-63, FARIDABAD - 121004, OCCUPATION-SERVICE	1*3*2*3*	1 Equity,0 Preference		26/09/2025
6	NAVITA DUBAL D/O PHOOL SINGH NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O FLAT NO. 307, GAUR GANGA-1 APARTMENT, SECTOR-4, BEHIND VAISHALI METRO STATION, VAISHALI GHAZIABAD UTTAR PRADESH- 201010 OCCUPATION-SERVICE	1*1*8*8*	1 Equity,0 Preference		26/09/2025

7	ANIL KUMAR PERALA S/O VENKATESHAM PERALA NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O A302 TARIKA APPARTMENT, SECTOR-43 GURGAON HARYANA-122001 OCCUPATION-SERVICE	B*V*P*1*2*	1 Equity,0 Preference	Perala Anil Kumar	26/09/2025
Total shares taken			50000 Equity,0 Preference		

Signed before me

Membership type of the witness *(ACA/FCA/ACS/FCS/ACMA/FCMA)*	***Name of the witness**	***Address, Description and Occupation**	**DIN / PAN / Passport number / Membership number**	**DSC**	**Dated**
FCA	VINAY KUMAR	A-805, NX BYTET-3, NX ONE, TECH ZONE - IV, GREATER NOIDA WEST -201318	4*2*9*	Vinay Kumar	26/09/2025

7 Shri / Smt _____ _____ Of _____ resident of _____ aged _____ years shall be the nominee in the event of death of the sole member.

Form No. INC-34

e-AOA (e-Articles of Association)

[Pursuant to Section 5 of the Companies Act, 2013 and rules made thereunder read with Schedule I]

सत्यमेव जयते

Form language

(•) English ( ) Hindi

Refer instruction kit for filing the form

*All fields marked in * are mandatory*

Table applicable to company as notified under schedule I of the Companies Act, 2013 *(F, G, H)*

F

Table F / G / H (basis on the selection of above-mentioned field) as notified under schedule I of the companies Act, 2013 is applicable to

(F – a company limited by shares
G– a company limited by guarantee and having a share capital
H – a company limited by guarantee and not having share capital)

F - A COMPANY LIMITED BY SHARES

The name of the company is

BARMER HVDC POWER TRANSMISSION LIMITED

Check if not applicable	Check if altered	Article No.	Description
			Interpretation
☐	☑	I	• (1) In these regulations-(a) the Act means the Companies Act 2013 (b) the sealmeans the common seal of the company. (2) Unless the context otherwiserequires words or expressions contained in these regulations shall bear thesame meaning as in the Act or any statutory modification thereof in force atthe date at which these regulations become binding on the company. (3)Public company means a company which- (a) is not a private company (b) has a minimum paid-up share capital as maybe prescribed Provided that a company which is a subsidiary of a company notbeing a private company shall be deemed to be public company for the purposesof this Act even where such subsidiary company continues to be a privatecompany in its articles.
			Share Capital and Variation of rights
☐	☐	II 1	• Subject to the provisions of the Act and these Articles the shares in the capital of the company shall be under the control of the Directors who may issue allot or otherwise dispose of the same or any of them to such persons in such proportion and on such terms and conditions and either at a premium or at par and at such time as they may from time to time think fit.
☐	☐	2	• Every person whose name is entered as a member in the register of members shall be entitled to receive within two months after incorporation in case of subscribers to the memorandum or after allotment or within one month after the application for the registration of transfer or transmission or within such other period as the conditions of issue shall be provided one certificate for all his shares without payment of any charges or several certificateseach for one or more of his sharesupon payment of twenty rupees for each certificate after the first. Every certificate shall be under the seal and shall specify the shares to which it relates and the amount paid - up thereon. In respect of any share or shares held

		jointly by several persons the company shall not be bound to issue more than one certificate and delivery of a certificate for a share to one of several joint holders shall be sufficient delivery to all such holders
☐ ☐	3	• If any share certificate be worn out defaced mutilated or torn or if there be no further space on the back for endorsement of transfer then upon production and surrender thereof to the company a new certificate may be issued in lieu thereof and if any certificate is lost or destroyed then upon proof thereof to the satisfaction of the company and on execution of such indemnity as the company deem adequate a new certificate in lieu thereof shall be given. Every certificate under this Article shall be issued on payment of twenty rupees for each certificate. The provisions of Articles(2) and(3) shall mutatis mutandis apply to debentures of the company.
☐ ☐	4	• Except as required by law no person shall be recognised by the company as holding any share upon any trust and the company shall not be bound by or be compelled in any way to recognise (even when having notice thereof) any equitable contingent future or partial interest in any share or any interest in any fractional part of a share or (except only as by these regulations or by law otherwise provided) any other rights in respect of any share except an absolute right to the entirety thereof in the registered holder.
☐ ☐	5	• The company may exercise the powers of paying commissions conferred by sub-section (6) of section 40 provided that the rate per cent or the amount of the commission paid or agreed to be paid shall be disclosed in the manner required by that section and rules made thereunder. The rate or amount of the commission shall not exceed the rate or amount prescribed in rules made under sub-section (6) of section 40. The commission may be satisfied by the payment of cash or the allotment of fully or partly paid shares or partly in the one way and partly in the other.
☐ ☐	6	• If at any time the share capital is divided into different classes of shares the rights attached to any class (unless otherwise provided by the terms of issue of the shares of that class) may subject to the provisions of section 48 and whether or not the company is being wound up be varied with the consent in writing of the holders of three-fourths of the issued shares of that class or with the sanction of a special resolution passed at a separate meeting of the holders of the shares of that class. To every such separate meeting the provisions of these regulations relating to general meetings shall mutatis mutandis apply but so that the necessary quorum shall be at least two persons holding at least one-third of the issued shares of the class in question.
☐ ☐	7	• The rights conferred upon the holders of the shares of any class issued with preferred or other rights shall not unless otherwise expressly provided by the terms of issue of the shares of that class be deemed to be varied by the creation or issue of further shares ranking pari passu therewith.
☐ ☐		• Subject to the provisions of section 55 any preference shares may with the sanction of an ordinary resolution

			be issued on the terms that they are to be redeemed on such terms and in such manner as the company before the issue of the shares may by special resolution determine.
			Lien
☐	☐	9	• The company shall have a first and paramount lienon every share (not being a fully paid share) for all monies (whether presently payable or not) called or payable at a fixed time in respect of that share and on all shares (not being fully paid shares) standing registered in the name of a single person for all monies presently payable by him or his estate to the companyProvided that the Board of directors may at any time declare any share to be wholly or in part exempt from the provisions of this clause. The companys lien if any on a share shall extend to all dividends payable and bonuses declared from time to time in respect of such shares.
☐	☐	10	• The company may sell in such manner as the Board thinks fit any shares on which the company has a lienProvided that no sale shall be madea unless a sum in respect of which the lien exists is presently payable or b until the expiration of fourteen days after a notice in writing stating and demanding payment of such part of the amount in respect of which the lien exists as is presently payable has been given to the registered holder for the time being of the share or the person entitled thereto by reason of his death or insolvency.
☐	☐	11	• To give effect to any such sale the Board may authorise some person to transfer the shares sold to the purchaser thereof The purchaser shall be registered as the holder of the shares comprised in any such transfer. The purchaser shall not be bound to see to the application of the purchase money nor shall his title to the shares be affected by any irregularity or invalidity in the proceedings in reference to the sale.
☐	☐	12	• The proceeds of the sale shall be received by the company and applied in payment of such part of the amount in respect of which the lien exists as is presently payable. The residue if any shall subject to a like lien for sums not presently payable as existed upon the shares before the sale be paid to the person entitled to the shares at the date of the sale.
			Calls on shares
☐	☐	13	• The Board may from time to time make calls upon the members in respect of any monies unpaid on their shares (whether on account of the nominal value of the shares or by way of premium) and not by the conditions of allotment thereof made payable at fixed timesProvided that no call shall exceed one-fourth of the nominal value of the share or be payable at less than one month from the date fixed for the payment of the last preceding call. Each member shall subject to receiving at least fourteen days notice specifying the time or times and place of payment pay to the company at the time or times and place so specified the amount called on his shares. A call may be revoked or postponed at the discretion of the Board.

☐ ☐	14	• A call shall be deemed to have been made at the time when the resolution of the Board authorizing the call was passed and may be required to be paid by instalments.
☐ ☐	15	• The joint holders of a share shall be jointly and severally liable to pay all calls in respect thereof.
☐ ☐	16	• If a sum called in respect of a share is not paid before or on the day appointed for payment thereof the person from whom the sum is due shall pay interest thereon from the day appointed for payment thereof to the time of actual payment at ten per cent per annum or at such lower rate if any as the Board may determine. The Board shall be at liberty to waive payment of any such interest wholly or in part.
☐ ☐	17	• Any sum which by the terms of issue of a share becomes payable on allotment or at any fixed date whether on account of the nominal value of the share or by way of premium shall for the purposes of these regulations be deemed to be a call duly made and payable on the date on which by the terms of issue such sum becomes payable. In case of non-payment of such sum all the relevant provisions of these regulations as to payment of interest and expenses forfeiture or otherwise shall apply as if such sum had become payable by virtue of a call duly made and notified.
☐ ☐	18	• The Board - a. may if it thinks fit receive from any member willing to advance the same all or any part of the monies uncalled and unpaid upon any shares held by him andb. upon all or any of the monies so advanced may (until the same would but for such advance become presently payable) pay interest at such rate not exceeding unless the company in general meeting shall otherwise direct twelve per cent per annum as may be agreed upon between the Board and the member paying the sum in advance.
		Transfer of shares
☐ ☐	19	• The instrument of transfer of any share in the company shall be executed by or on behalf of both the transferor and transferee. The transferor shall be deemed to remain a holder of the share until the name of the transferee is entered in the register of members in respect thereof.
☐ ☐	20	• The Board may subject to the right of appeal conferred by section 58 decline to register the transfer of a share not being a fully paid share to a person of whom they do not approve or any transfer of shares on which the company has a lien.
☐ ☐	21	• The Board may decline to recognise any instrument of transfer unlessa. the instrument of transfer is in the form as prescribed in rules made under sub-section (1) of section 56b. the instrument of transfer is accompanied by the certificate of the shares to which it relates and such other evidence as the Board may reasonably require to show the right of the transferor to make the transfer andc. the instrument of transfer is in respect of only one class of shares.
☐ ☐		• On giving not less than seven days previous notice in accordance with section 91 and rules made thereunder the registration of transfers may be suspended at such

			times and for such periods as the Board may from time to time determineProvided that such registration shall not be suspended for more than thirty days at any one time or for more than forty-five days in the aggregate in any year.
			Transmission of shares
☐	☐	23	• On the death of a member the survivor or survivors where the member was a joint holder and his nominee or nominees or legal representatives where he was a sole holder shall be the only persons recognised by the company as having any title to his interest in the shares Nothing in clause (i) shall release the estate of a deceased joint holder from any liability in respect of any share which had been jointly held by him with other persons.
☐	☐	24	• Any person becoming entitled to a share in consequence of the death or insolvency of a member may upon such evidence being produced as may from time to time properly be required by the Board and subject as hereinafter provided elect either to be registered himself as holder of the share or to make such transfer of the share as the deceased or insolvent member could have made. The Board shall in either case have the same right to decline or suspend registration as it would have had if the deceased or insolvent member had transferred the share before his death or insolvency.
☐	☐	25	• If the person so becoming entitled shall elect to be registered as holder of the share himself he shall deliver or send to the company a notice in writing signed by him stating that he so elects. If the person aforesaid shall elect to transfer the share he shall testify his election by executing a transfer of the share. All the limitations restrictions and provisions of these regulations relating to the right to transfer and the registration of transfers of shares shall be applicable to any such notice or transfer as aforesaid as if the death or insolvency of the member had not occurred and the notice or transfer were a transfer signed by that member.
☐	☐	26	• A person becoming entitled to a share by reason of the death or insolvency of the holder shall be entitled to the same dividends and other advantages to which he would be entitled if he were the registered holder of the share except that he shall not before being registered as a member in respect of the share be entitled in respect of it to exercise any right conferred by membership in relation to meetings of the company Provided that the Board may at any time give notice requiring any such person to elect either to be registered himself or to transfer the share and if the notice is not complied with within ninety days the Board may thereafter withhold payment of all dividends bonuses or other monies payable in respect of the share until the requirements of the notice have been complied with.
☑	☐		• In case of a One Person Company on the death of the sole member the person nominated by such member shall be the person recognised by the company as having title to all the shares of the member the nominee on becoming entitled to such shares in case of the members death shall be informed of such event by the

			Board of the company such nominee shall be entitled to the same dividends and other rights and liabilities to which such sole member of the company was entitled or liable on becoming member such nominee shall nominate any other person with the prior written consent of such person who shall in the event of the death of the member become the member of the company.
			Forfeiture of shares
☐	☐	28	• If a member fails to pay any call or instalment of a call on the day appointed for payment thereof the Board may at any time thereafter during such time as any part of the call or instalment remains unpaid serve a notice on him requiring payment of so much of the call or instalment as is unpaid together with any interest which may have accrued.
☐	☐	29	• The notice aforesaid shall name a further day (not being earlier than the expiry of fourteen days from the date of service of the notice) on or before which the payment required by the notice is to be made and state that in the event of non-payment on or before the day so named the shares in respect of which the call was made shall be liable to be forfeited.
☐	☐	30	• If the requirements of any such notice as aforesaid are not complied with any share in respect of which the notice has been given may at any time thereafter before the payment required by the notice has been made be forfeited by a resolution of the Board to that effect.
☐	☐	31	• A forfeited share may be sold or otherwise disposed of on such terms and in such manner as the Board thinks fit.At any time before a sale or disposal as aforesaid the Board may cancel the forfeiture on such terms as it thinks fit.
☐	☐	32	• A person whose shares have been forfeited shall cease to be a member in respect of the forfeited shares but shall notwithstanding the forfeiture remain liable to pay to the company all monies which at the date of forfeiture were presently payable by him to the company in respect of the shares. The liability of such person shall cease if and when the company shall have received payment in full of all such monies in respect of the shares.
☐	☐	33	• A duly verified declaration in writing that the declarant is a director the manager or the secretary of the company and that a share in the company has been duly forfeited on a date stated in the declaration shall be conclusive evidence of the facts therein stated as against all persons claiming to be entitled to the share The company may receive the consideration if any given for the share on any sale or disposal thereof and may execute a transfer of the share in favour of the person to whom the share is sold or disposed of The transferee shall thereupon be registered as the holder of the share and The transferee shall not be bound to see to the application of the purchase money if any nor shall his title to the share be affected by any irregularity or invalidity in the proceedings in reference to the forfeiture sale or disposal of the share.
☐	☐		• The provisions of these regulations as to forfeiture shall apply in the case of non-payment of any sum which by

			the terms of issue of a share becomes payable at a fixed time whether on account of the nominal value of the share or by way of premium as if the same had been payable by virtue of a call duly made and notified.
			Alteration of capital
☐	☐	35	• The company may from time to time by ordinary resolution increase the share capital by such sum to be divided into shares of such amount as may be specified in the resolution.
☐	☐	36	• Subject to the provisions of section 61 the company may by ordinary resolution consolidate and divide all or any of its share capital into shares of larger amount than its existing shares convert all or any of its fully paid-up shares into stock and reconvert that stock into fully paid-up shares of any denomination sub-divide its existing shares or any of them into shares of smaller amount than is fixed by the memorandum cancel any shares which at the date of the passing of the resolution have not been taken or agreed to be taken by any person.
☐	☐	37	• Where shares are converted into stock the holders of stock may transfer the same or any part thereof in the same manner as and subject to the same regulations under which the shares from which the stock arose might before the conversion have been transferred or as near thereto as circumstances admit Provided that the Board may from time to time fix the minimum amount of stock transferable so however that such minimum shall not exceed the nominal amount of the shares from which the stock arose. the holders of stock shall according to the amount of stock held by them have the same rights privileges and advantages as regards dividends voting at meetings of the companyand other matters as if they held the shares from which the stock arose but no such privilege or advantage (except participation in the dividends and profits of the company and in the assets on winding up) shall be conferred by an amount of stock which would not if existing in shares have conferred that privilege or advantage. such of the regulations of the company as are applicable to paid-up shares shall apply to stock and the words share and shareholder in those regulations shall include stock and stock-holder respectively.
☐	☐	38	• The company may by special resolution reduce in any manner and with and subject to any incident authorised and consent required by law it share capital any capital redemption reserve account or any share premium account.
			Capitalisation of profits
☐	☐		• The company in general meeting may upon the recommendation of the Board resolve that it is desirable to capitalise any part of the amount for the time being standing to the credit of any of the companys reserve accounts or to the credit of the profit and loss accountor otherwise available for distribution and that such sum be accordingly set free for distribution in the manner specified in clause (ii) amongst the members who would have been entitled thereto if distributed by way of dividend and in the same proportions. The sum aforesaid shall not be paid in cash but shall be applied subject to

			the provision contained in clause (iii) either in or towards paying up any amounts for the time being unpaid on any shares held by such members respectively paying up in full unissued shares of the company to be allotted and distributed credited as fully paid-up to and amongst such members in the proportions aforesaid partly in the way specified in sub-clause (A) and partly in that specified in sub-clause (B) A securities premium account and a capital redemption reserve account may for the purposes of this regulation be applied in the paying up of unissued shares to be issued to members of the company as fully paid bonus shares The Board shall give effect to the resolution passed by the company in pursuance of this regulation.
☐	☐	40	• Whenever such a resolution as aforesaid shall have been passed the Board shall make all appropriations and applications of the undivided profits resolved to be capitalised thereby and all allotments and issues of fully paid shares if any and generally do all acts and things required to give effect thereto. The Board shall have power to make such provisions by the issue of fractional certificates or by payment in cash or otherwise as it thinks fit for the case of shares becoming distributable in fractions and to authorise any person to enter on behalf of all the members entitled thereto into an agreement with the company providing for the allotment to them respectively credited as fully paid-up of any further shares to which they may be entitled upon such capitalisation or as the case may require for the payment by the company on their behalf by the application thereto of their respective proportions of profits resolved to be capitalised of the amount or any part of the amounts remaining unpaid on their existing shares Any agreement made under such authority shall be effective and binding on such members
			Buy-back of shares
☐	☐	41	• Notwithstanding anything contained in these articles but subject to the provisions of sections 68 to 70 and any other applicable provision of the Act or any other law for the time being in force the company may purchase its own shares or other specified securities.
			General meetings
☐	☐	42	• All general meetings other than annual general meeting shall be called extraordinary general meeting.
☐	☐	43	• The Board may whenever it thinks fit call an extraordinary general meeting. If at any time directors capable of acting who are sufficient in number to form a quorum are not within India any director or any two members of the company may call an extraordinary general meeting in the same manner as nearly as possible as that in which such a meeting may be called by the Board.
			Proceedings at general meetings
☐	☐	44	• No business shall be transacted at any general meeting unless a quorum of members is present at the time when the meeting proceeds to business. Save as otherwise provided herein the quorum for the general meetings shall be as provided in section 103.

☐	☐	45	• The chairperson if any of the Board shall preside as Chairperson at every general meeting of the company.
☐	☐	46	• If there is no such Chairperson or if he is not present within fifteen minutes after the time appointed for holding the meeting or is unwilling to act as chairperson of the meeting the directors present shall elect one of their members to be Chairperson of the meeting.
☐	☐	47	• If at any meeting no director is willing to act as Chairperson or if no director is present within fifteen minutes after the time appointed for holding the meeting the members present shall choose one of their members to be Chairperson of the meeting.
☑	☐	48	• In case of a One Person Company the resolution required to be passed at the general meetings of the company shall be deemed to have been passed if the resolution is agreed upon by the sole member and communicated to the company and entered in the minutes book maintained under section 118 such minutes book shall be signed and dated by the member the resolution shall become effective from the date of signing such minutes by the sole member.
			Adjournment of meeting
☐	☐	49	• The Chairperson may with the consent of any meeting at which a quorum is present and shall if so directed by the meeting adjourn the meeting from time to time and from place to place. No business shall be transacted at any adjourned meeting other than the business left unfinished at the meeting from which the adjournment took place. When a meeting is adjourned for thirty days or more notice of the adjourned meeting shall be given as in the case of an original meeting. Save as aforesaid and as provided in section 103 of the Act it shall not be necessary to give any notice of an adjournment or of the business to be transacted at an adjourned meeting.
			Voting rights
☐	☐	50	• Subject to any rights or restrictions for the time being attached to any class or classes of shares on a show of hands every member present in person shall have one vote and on a poll the voting rights of members shall be in proportion to his share in the paid-up equity share capital of the company.
☐	☐	51	• A member may exercise his vote at a meeting by electronic means in accordance with section 108 and shall vote only once.
☐	☐	52	• In the case of joint holders the vote of the senior who tenders a vote whether in person or by proxy shall be accepted to the exclusion of the votes of the other joint holders.For this purpose seniority shall be determined by the order in which the names stand in the register of members.
☐	☐	53	• A member of unsound mind or in respect of whom an order has been made by any court having jurisdiction in lunacy may vote whether on a show of hands or on a poll by his committee or other legal guardian and any such committee or guardian may on a poll vote by proxy.

☐	☐	54	• Any business other than that upon which a poll has been demanded maybe proceeded with pending the taking of the poll.
☐	☐	55	• No member shall be entitled to vote at any general meeting unless all calls or other sums presently payable by him in respect of shares in the company have been paid
☐	☐	56	• No objection shall be raised to the qualification of any voter except at the meeting or adjourned meeting at which the vote objected to is given or tendered and every vote not disallowed at such meeting shall be valid for all purposes. Any such objection made in due time shall be referred to the Chairperson of the meeting whose decision shall be final and conclusive.
			Proxy
☐	☐	57	• The instrument appointing a proxy and the power-of-attorney or other authority if any under which it is signed or a notarised copy of that power or authority shall be deposited at the registered office of the company not less than 48 hours before the time for holding the meeting or adjourned meeting at which the person named in the instrument proposes to vote or in the case of a poll not less than 24 hours before the time appointed for the taking of the poll and in default the instrument of proxy shall not be treated as valid.
☐	☐	58	• An instrument appointing a proxy shall be in the form as prescribed in the rules made under section 105
☐	☐	59	• A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death or insanity of the principal or the revocation of the proxy or of the authority under which the proxy was executed or the transfer of the shares in respect of which the proxy is givenProvided that no intimation in writing of such death insanity revocation or transfer shall have been received by the company at its office before the commencement of the meeting or adjourned meeting at which the proxy is used.
			Board of Directors
☐	☑		• The day to daymanagement of the business of the Company shall be vested with the Board ofDirectors of the Company or such person(s) as may be authorized by the Boardfrom time to time. The Board may exercise all such powers of the Company and doall such acts deeds and things as are not prohibited by the Act or any otherlaw for the time being in force or by the Memorandum of Association of theCompany and without prejudice to the foregoing shall be responsible for allpolicy matters and the supervision direction and control of the conduct of thebusiness affairs and operations of the Company. (i) The first Directors of the Companyshall be 1.RAJESH RAJ 2. VIJAY SHRIDHAR KULKARNI 3. JASPAL SINGH KUSHWAHA (ii) At everyannual general meeting one-third of such of the directors for the time beingas are liable to retire by rotation or if their number is neither three nor amultiple of three then the number nearest to one-third shall retire fromoffice. (iii) The directors to retire by rotation at every annual generalmeeting shall be those who have been

		60	longest in office since their lastappointment but as between persons who became directors on the same day thosewho are to retire shall in default of and subject to any agreement amongthemselves be determined by lot. (iv) At annual general meeting at which adirector retires as aforesaid the company may fill up the vacancy byappointing the retiring director or some other person thereto. The Board ofDirectors of the Company shall consist of not less than 3 but not more than 15Directors. The appointment of Directors including the Chairman ManagingDirector Whole time Director Part-time Director shall be done in the GeneralMeetings in accordance with the provisions of the Companies Act 2013 and Rulesmade thereunder and shall be eligible for reappointment. However till theCompany is a Government Company REC Power Development and Consultancy Limited(RECPDCL)- the holding company shall have the full powers to recommend nominate the name of any Directors to be appointed on the Board of the Company.Further RECPDCL shall also have the power to remove any director from officeat any time in its absolute discretion. RECPDCL shall also have the right tofill any vacancies in the office of director caused by removal resignationdeath or otherwise. Subject to provisions of the Act the Company may bypassing the resolution in General Meeting increasedecrease the maximum numberof Directors and may alter their qualification. Further the Company maysubject to the provisions of the Act remove any Director before the expirationof his period of office and appoint another person in place of him. The Boardmay appoint any person to act as alternate director for a Director during thelaters absence for a period of not less than three months from India and suchappointment shall have effect and such appointee whilst he holds office as analternate director shall be entitled to notice of meeting of the Board and toattend and vote there at accordingly but he shall not require anyqualification and shall ipso facto vacate office if and when the absentDirector returns to India. Casual vacancies among Directors may be filled bythe Board of Directors at their meeting and any person so appointed shall holdthe office as per the provision of section 161 of the Act. Subject to theprovisions of Section 161 and other applicable provisions (if any) of the Actthe Board shall have power at any time and from time to time to appoint aperson as an Additional Director but so that the total number of Directorsshall not at any time exceed the maximum number fixed by these Articles. TheAdditional Director so appointed shall retire from Office at next annual GeneralMeeting but shall be eligible for election by the company at that meeting as aDirector.
☐	☐	61	• The remuneration of the directors shall in so far as it consists of a monthly payment be deemed to accrue from day-to-day. In addition to the remuneration payable to them in pursuance of the Act the directors may be paid all travelling hotel and other expenses properly incurred by them in attending and returning from meetings of the Board of Directors or any committee thereof or general meetings of the company or in connection with the business of the company.
☐	☐	62	• The Board may pay all expenses incurred in getting up and registering the company.

☐	☐	63	• The company may exercise the powers conferred on it by section 88 with regard to the keeping of a foreign register and the Board may (subject to the provisions of that section) make and vary such regulations as it may think fit respecting the keeping of any such register.
☐	☐	64	• All cheques promissory notes drafts hundis bills of exchange and other negotiable instruments and all receipts for monies paid to the company shall be signed drawn accepted endorsed or otherwise executed as the case may be by such person and in such manner as the Board shall from time to time by resolution determine
☐	☐	65	• Every director present at any meeting of the Board or of a committee thereof shall sign his name in a book to be kept for that purpose.
☐	☐	66	• Subject to the provisions of section 149 the Board shall have power at any time and from time to time to appoint a person as an additional director provided the number of the directors and additional directors together shall not at any time exceed the maximum strength fixed for the Board by the articles. Such person shall hold office only up to the date of the next annual general meeting of the company but shall be eligible for appointment by the company as a director at that meeting subject to the provisions of the Act.
			Proceedings of the Board
☐	☐	67	• The Board of Directors may meet for the conduct of business adjourn and otherwise regulate its meetings as it thinks fit. A director may and the manager or secretary on the requisition of a director shall at any time summon a meeting of the Board.
☐	☐	68	• Save as otherwise expressly provided in the Act questions arising at any meeting of the Board shall be decided by a majority of votes. In case of an equality of votes the Chairperson of the Board if any shall have a second or casting vote.
☐	☐	69	• The continuing directors may act notwithstanding any vacancy in the Board but if and so long as their number is reduced below the quorum fixed by the Act for a meeting of the Board the continuing directors or director may act for the purpose of increasing the number of directors to that fixed for the quorum or of summoning a general meeting of the company but for no other purpose.
☐	☐	70	• The Board may elect a Chairperson of its meetings and determine the period for which he is to hold office. If no such Chairperson is elected or if at any meeting the Chairperson is not present within five minutes after the time appointed for holding the meeting the directors present may choose one of their number to be Chairperson of the meeting.
☐	☐	71	• The Board may subject to the provisions of the Act delegate any of its powers to committees consisting of such member or members of its body as it thinks fit. Any committee so formed shall in the exercise of the powers so delegated conform to any regulations that may be imposed on it by the Board.

☐	☐	72	• A committee may elect a Chairperson of its meetings. If no such Chairperson is elected or if at any meeting the Chairperson is not present within five minutes after the time appointed for holding the meeting the memberspresent may choose one of their members to be Chairperson of the meeting.
☐	☐	73	• A committee may meet and adjourn as it thinks fit. Questions arising at any meeting of a committee shall be determined by a majority of votes of the members present and in case of an equality of votes the Chairperson shall have a second or casting vote.
☐	☐	74	• All acts done in any meeting of the Board or of a committee thereof or by any person acting as a director shall notwithstanding that it may be afterwards discovered that there was some defect in the appointment of any one or more of such directors or of any person acting as aforesaid or that they or any of them were disqualified be as valid as if every such director or such person had been duly appointed and was qualified to be a director.
☐	☐	75	• Save as otherwise expressly provided in the Act a resolution in writing signed by all the members of the Board or of a committee thereof for the time being entitled to receive notice of a meeting of the Board or committee shall be valid and effective as if it had been passed at a meeting of the Board or committee duly convened and held.
☑	☐	76	• In case of a One Person Company where the company is having only one director all the businesses to be transacted at the meeting of the Board shall be entered into minutes book maintained under section 118 such minutes book shall be signed and dated by the director the resolution shall become effective from the date of signing such minutes by the director.
			Chief Executive Officer, Manager, Company Secretary or Chief Financial Officer
☐	☐	77	• Subject to the provisions of the Act A chief executive officer manager company secretary or chief financial officer may be appointed by the Board for such term at such remuneration and upon such conditions as it may think fit and any chief executive officer manager company secretary or chief financial officer so appointed may be removed by means of a resolution of the Board A director may be appointed as chief executive officer manager company secretary or chief financial officer
☐	☐	78	• A provision of the Act or these regulations requiring or authorising a thing to be done by or to a director and chief executive officer manager company secretary or chief financial officer shall not be satisfied by its being done by or to the same person acting both as director and as or in place of chief executive officer manager company secretary or chief financial officer.
			The Seal
☐	☐		• The Board shall provide for the safe custody of the seal. The seal of the company shall not be affixed to any instrument except by the authority of a resolution of the Board or of a committee of the Board authorised by it in

			that behalf and except in the presence of at least two directors and of the secretary or such other person as the Board may appoint for the purpose and those two directors and the secretary or other person aforesaid shall sign every instrument to which the seal of the company is so affixed in their presence.
			Dividends and Reserve
☐	☐	80	• The company in general meeting may declare dividends but no dividend shall exceed the amount recommended by the Board.
☐	☐	81	• Subject to the provisions of section 123 the Board may from time to time pay to the members such interim dividends as appear to it to be justified by the profits of the company.
☐	☐	82	• The Board may before recommending any dividend set aside out of the profits of the company such sums as it thinks fit as a reserve or reserves which shall at the discretion of the Board be applicable for any purpose to which the profits of the company may be properly applied including provision for meeting contingencies or for equalizing dividends and pending such application may at the like discretion either be employed in the business of the company or be invested in such investments (other than shares of the company) as the Board may from time to time thinks fit. The Board may also carry forward any profits which it may consider necessary not to divide without setting them aside as a reserve
☐	☐	83	• Subject to the rights of persons if any entitled to shares with special rights as to dividends all dividends shall be declared and paid according to the amounts paid or credited as paid on the shares in respect whereof the dividend is paid but if and so long as nothing is paid upon any of the shares in the company dividends may be declared and paid according to the amounts of the shares. No amount paid or credited as paid on a share in advance of calls shall be treated for the purposes of this regulation as paid on the share. All dividends shall be apportioned and paid proportionately to the amounts paid or credited as paid on the shares during any portion or portions of the period in respect of which the dividend is paid but if any share is issued on terms providing that it shall rank for dividend as from a particular date such share shall rank for dividend accordingly.
☐	☐	84	• The Board may deduct from any dividend payable to any member all sums of money if any presently payable by him to the company on account of calls or otherwise in relation to the shares of the company.
☐	☐	85	• Any dividend interest or other monies payable in cash in respect of shares may be paid by cheque or warrant sent through the post directed to the registered address of the holder or in the case of joint holders to the registered address of that one of the joint holders who is first named on the register of members or to such person and to such address as the holder or joint holders may in writing direct. Every such cheque or warrant shall be made payable to the order of the person to whom it is sent.

☐	☐	86	• Any one of two or more joint holders of a share may give effective receipts for any dividends bonuses or other monies payable in respect of such share.
☐	☐	87	• Notice of any dividend that may have been declared shall be given to the persons entitled to share therein in the manner mentioned in the Act.
☐	☐	88	• No dividend shall bear interest against the company.
			Accounts
☐	☐	89	• The Board shall from time to time determine whether and to what extent and at what times and places and under what conditions or regulations the accounts and books of the company or any of them shall be open to the inspection of members not being directors. No member (not being a director) shall have any right of inspecting any account or book or document of the company except as conferred by law or authorised by the Board or by the company in general meeting.
			Winding up
☐	☐	90	• Subject to the provisions of Chapter XX of the Act and rules made thereunder If the company shall be wound up the liquidator may with the sanction of a special resolution of the company and any other sanction required by the Act divide amongst the members in specie or kind the whole or any part of the assets of the company whether they shall consist of property of the same kind or not. For the purpose aforesaid the liquidator may set such value as he deems fair upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the members or different classes of members. The liquidator may with the like sanction vest the whole or any part of such assets in trustees upon such trusts for the benefit of the contributories if he considers necessary but so that no member shall be compelled to accept any shares or other securities whereon there is any liability.
			Indemnity
☐	☐	91	• Every officer of the company shall be indemnified out of the assets of the company against any liability incurred by him in defending any proceedings whether civil or criminal in which judgment is given in his favour or in which he is acquitted or in which relief is granted to him by the court or the Tribunal.
			Others
☐	☐	92	•

Subscriber Details

S. No.	Subscriber Details				
	***Name, Address, Description and Occupation**	**DIN / PAN / Passport number**	***Place**	**DSC**	**Dated**
1	REC POWER DEVELOPMENT AND CONSULTANCY LIMI	0*7*2*1*	NEW DELHI	Thangarajan Subash Chandra Bose	26/09/2025

	TED, CORE-4, SCOPE COMPLEX, 7, LODHI ROAD, NEW DELHI-110003, THROUGH ITS CEO THANGARAJAN SUBASH CHANDIRA BOSH S/O SITHAN THANGARAJAN R/O APARTMENT NO S-2, MIDDLE PORTION 2-B, JANGPURA, MATHURA ROAD, NEW DELHI-110014, OCCUPATION-SERVICE				
2	MUKUL AGARWAL S/O RAJESH KUMAR NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O HOUSE NO. 767, SECOND FLOOR, ANSAL C-2 BLOCK, NEAR WATER TANK ANSAL PLAZA SECTOR-3 PALAMVIHAR, GURGAON-122017, HARYANA OCCUPATION-SERVICE	1*3*2*8*	NEW DELHI		26/09/2025
3	ARVIND KUMAR S/O NAND KISHOR SINGH NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O T4-8A, SAI VATIKA APARTMENT, SECTOR-63, FARIDABAD - 121004, OCCUPATION-SERVICE	1*3*2*3*	NEW DELHI		26/09/2025
4	NAVITA DUBAL D/O PHOOL SINGH NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O FLAT NO. 307, GAUR GANGA-1 APARTMENT, SECTOR-4, BEHIND VAISHALI METRO STATION, VAISHALI GHAZIABAD UTTAR PRADESH-201010 OCCUPATION-SERVICE	1*1*8*8*	NEW DELHI		26/09/2025
5	ANIL KUMAR PERALA S/O VENKATESHAM PERALA NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O A302 TARIKA APPARTMENT, SECTOR-43 GURGAON HARYANA-122001 OCCUPATION-SERVICE	B*V*P*1*2*	NEW DELHI		26/09/2025
6	JASPAL SINGH KUSHWAHA S/O MITHAI LAL KUSHWAHA NOMINEE OF REC POWER DEVELOPMENT AND CONSULTANCY LIMITED R/O C-64/ FIRST FLOOR, JVTS GARDEN CHATTARPUR EXTENSION South West Delhi 110074 OCCUPATION-SERVICE	1*3*2*3*	NEW DELHI		26/09/2025
7	VIJAY SHRIDHAR KULKARNI S/O SHRIDHAR GANESH KULKARNI NOMINEE OF REC	1*3*7*8*	NEW DELHI		26/09/2025

	POWER DEVELOPMENT AN D CONSULTANCY LIMITED R/O REGAL 501, MAPSKO R OYALE VILLE VATIKA INDIA NEXT, SECTOR-82, Narsingh pur GURGAON-122004 HAR YANA OCCUPATION- SERVI CE				

Signed before me						
Name Prefix *(ACA/FCA/ACS/ FCS/ACMA/ FCMA)*	***Name of the witness**	***Address, Description and Occupation**	***DIN / PAN / Passport number / Membership**	***Place**	**DSC**	**Dated**
FCA	VINAY KUM AR	A-805, NX BYTE T-3, NX ONE, TE CH ZONE - IV, G REATER NOIDA WEST -201318	4*2*9*	NEW DELH I	Vinay Kumar	26/09/2025

REC Power Development and Consultancy Limited
(Formerly known as REC Power Distribution Company Limited,
A wholly owned subsidiary of REC Limited, a 'Maharatna CPSE'
under Ministry of Power, Govt. of India)

REC Power Development

संदर्भ संख्या: RECPDCL/TBCB/Barmer-II/25-26/5461 दिनांक: 02.03.2026

M/s Power Grid Corporation of India Limited,
'Saudamini', Plot no. 2, Sector – 29,
Gurgaon – 122001 (Haryana).

Kind Attention: Shri Pankaj Pandey, Executive Director

विषय: Selection of Bidder as Transmission service Provider to establish "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)"- **Issuance of Tentative Acquisition Price regarding**

महोदय,

This has reference to the RFP dated 28.01.2026 for selection of Transmission service Provider to establish "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through tariff based competitive bidding process.

As per the requirement of Clause 1.5 of RFP, we would like to intimate you that the Tentative Acquisition Price payable by the Selected Bidder to the BPC for the acquisition of one hundred percent (100%) of the equity shareholding of "BARMER HVDC POWER TRANSMISSION LIMITED" along with all its related assets and liabilities is **Rs. 1,870.40 Lakhs (Rupees Eighteen Crore Seventy Lakh Forty Thousand Only)**. This Acquisition Price shall be subject to adjustment based on the audited accounts of "BARMER HVDC POWER TRANSMISSION LIMITED" as on the date of execution of the Share Purchase Agreement.

It may please be noted that as on date, there are no contractual obligations undertaken by BPC on behalf of "BARMER HVDC POWER TRANSMISSION LIMITED" which are to be fulfilled by the TSP.

All other terms and conditions of the RFP remain the same.

धन्यवाद,

भवदीय,

2/3

(विजय कुलकर्णी)
वरिष्ठ महाप्रबंधक एवं विभागाध्यक्ष (टी & डी)

REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited, a 'Maharatna CPSE'
under Ministry of Power, Govt. of India)

Ref No.: REC PDCL/FIN/BHVDCPTL/2026-27/ 209

Dated: 22.09.2026

To,

M/s. Power Grid Corporation of India Limited
'Saudamini', Plot No.-2, Sector-29
Gurgaon-122001 (Haryana)

Kind Attention: Sh. Pankaj Pandey, Executive Director

Subject: Payment of Acquisition Price towards handing over of M/s. BARMER HVDC POWER TRANSMISSION LIMITED.

Sir,

This is to inform that the acquisition price of M/s. Barmer HVDC Power Transmission Limited is **Rs 18,97,52,835/- (Rupees Eighteen Crore Nineteen-Seven Lakh Fifty-Two Thousand Eight Hundred Thirty-Five Only)** as per the breakup given below:

S No	Particulars	Amount (INR)
1	Professional Fee of BPC #	17,70,00,000
2	Reimbursement of cost incurred by BPC #	1,22,52,835
3	Share Capital of Barmer HVDC Power Transmission Limited	5,00,000
Acquisition Value/ Net Amount Payable by Bidder		**18,97,52,835**

including GST

Kindly credit the above total amount i.e., **Rs. 18,97,52,835 /-** in the below mentioned Bank Account of REC Power Development and Consultancy Limited. TDS will be deposited by RECPDCL on behalf and under TAN of Barmer HVDC Power Transmission Limited.

D-Block, REC World Headquarter, Plot No. I-4, Sector-29, Gurugram, (Haryana) - 122001.
E-mail: co@recpdcl.in | Tel.: 0124-4441300 | www.recpdcl.in | CIN No. RECPDCL-U40101DL2007GOI165779 GST No. 06AADCR7399K1ZP

The acquisition price may be credited to our account through RTGS as per the following:

Bank Name, Address & Branch	**IDFC First Bank Limited** Gurgaon Golf Course Road Branch, Ground Floor Unit no. CG-01A and 01B, Gurgaon - 122003
Bank Account Name	**REC Power Development and Consultancy Ltd**
Bank Account No	**10171707713**
Bank IFSC Code No	**IDFB0021001**

Thanking You,

Yours faithfully

(Sumit Mehra)
DGM (F&A), RECPDCL

No. 25-17/91/2026-POWER GRID(MoP)
संख्या 25-17/91/2026-पावर ग्रिड(एमओपी)

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
***

Shram Shakti Bhawan, Rafi Marg
New Delhi, Dated 17th July, 2026

To,

Shri Jaspal Singh Kushwaha, Director,
M/s Barmer HVDC Power Transmission Limited,
Core 4, SCOPE Complex, 7 Lodhi Road
South Delhi, Delhi-110003

Subject: Prior approval of the Government of India under Section 68 (1) of the Electricity Act, 2003 to M/s Barmer HVDC Power Transmission Limited (a wholly owned subsidiary of REC Power Development and Consultancy Limited (RECPDCL)) for installation of the overhead transmission lines under the transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)"– regarding.

Sir,

I am directed to refer to the RECPDCL's online application ID SW4493741278-M029_D002_A003-1773666757403 dated 16.03.2026 on NSWS Portal, seeking prior approval of Government of India under Section 68 (1) of the Electricity Act, 2003 in favour of M/s Barmer HVDC Power Transmission Limited for installation of the following overhead transmission lines under the transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)":

(i) LILO of both circuits of 400 kV Fatehgarh-IV PS – Barmer-I PS D/c line at Barmer-II PS

(ii) Barmer-II PS – Barmer-I PS 400 kV D/c line (Quad)

(iii) ±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return)

2. Ministry of Power vide notification in Gazette no. CG-DL-E-30082025-265828 (No.3860) dated 29.08.2025 has appointed REC Power Development and Consultancy Limited (RECPDCL) as Bid Process Coordinator for the purpose of selection of Bidder as Transmission Service Provider (TSP) to establish the transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" to be implemented through Tariff Based Competitive Bidding (TBCB) route. RECPDCL, the Bid Process Coordinator, has incorporated the SPV, 'Barmer HVDC Power Transmission Limited', for implementation of the above-mentioned transmission scheme.

3. M/s Barmer HVDC Power Transmission Limited has submitted an Undertaking dated 12.06.2026 stating that the routes of above-mentioned overhead lines are outside the Revised GIB Priority Area of Rajasthan as referred in judgment of Hon'ble Supreme

Court of India dated 19.12.2025 in Writ Petition (Civil) No. 838 of 2019. Also, M/s Barmer HVDC Power Transmission Limited would comply with the directions of Hon'ble Supreme Court of India in its order dated 19.12.2025 in Writ Petition (Civil) No. 838 of 2019, including the optimization of route of the lines.

4. Ministry of Power, Government of India on the basis of the recommendation of Central Electricity Authority (CEA), conveys the prior approval under Section 68 (1) of the Electricity Act, 2003 to M/s Barmer HVDC Power Transmission Limited for installation of the following overhead transmission lines under the transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)":

(i) LILO of both circuits of Fatehgarh-IV PS - Barmer-I PS 400 kV D/c line at Barmer-II PS (LILO length is about 10 km)

(ii) Barmer-II PS - Barmer-I PS 400 kV D/c line (Line length is about 30 km)

(iii) Barmer-II (HVDC) - South Kalamb (HVDC) ± 800 kV HVDC Bipole line (with parallel Dedicated Metallic Return) (Line length is about 900 km)

5. The approval would be subject to compliance of:

(i) The relevant provisions of the Electricity Act, 2003, as amended from time to time and the rules and regulations made there under, and

(ii) CEA (Measures relating to Safety and Electric Supply) Regulations, 2023, and any subsequent amendments made thereto.

(iii) The directions of Hon'ble Supreme Court of India in its order dated 19.12.2025 in Writ Petition (Civil) No. 838 of 2019, including the optimization of route of the overhead lines and any other directions given by competent authorities in pursuance of the above order by the Hon'ble Supreme Court.

6. The approval would also be subject to the following conditions:

(i) The implementing agency will commence construction of the project within three years of grant of approval, unless this term is extended by Ministry of Power.

(ii) Ministry of Power may withdraw the approval before the expiry of the period of three years after giving a one-month notice.

(iii) The implementing agencies shall abide by the provisions of Works of Licensees Rules, 2006 notified by the Govt. of India, Ministry of Power in the Gazette of India, extra-ordinary Part-II, Section 3(i) dated 18-04-2006 (vide GSR 217 (E) dated 18-04-2006).

Yours faithfully,

M V N Vara Prasad

(M.V.N. Vara Prasad/ एम.वी.एन. वरा प्रसाद)
Under Secretary to the Government of India
Tele: 011-23730264

Copy to:

The Chairperson
Central Electricity Authority
Sewa Bhawan, R.K. Puram, New Delhi 110066.

***

Date: 25.08.2026

CERTIFICATE BY BID EVALUATION COMMITTEE

Subject: **Selection of Successful Bidder as Transmission Service Provider through Tariff Based Competitive Bidding Process to establish "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)"**

It is certified that:

a. The entire bid process has been carried out in accordance with the "Tariff based Competitive Bidding Guidelines for Transmission Service" and "Guidelines for encouraging competition in development of the Transmission Projects" issued by Ministry of Power, Govt. of India under Section 63 of the Electricity Act, 2003 as amended from time to time.

b. M/s Power Grid Corporation of India Limited, with the lowest annual transmission charges of Rs. 32,443.25 million, emerged as the successful bidder after the conclusion of electronic reverse auction.

c. The transmission charges of Rs. 32,443.25 million discovered after electronic reverse auction is acceptable.

(Amit Jog) General Manager, SBI, CCGRO-II, Chairman, BEC	(Bhanwar Singh Meena) Director (PSPA-I), CEA, Member, BEC	(Harvendra Kumar) SE (Procurement-I), RVPN, Member, BEC
(Kavita Jha) Director (PSETD), CEA Member, BEC	(Deepak N. Gawali) SE (Opn.), WRPC Secretariat Member, BEC	(Rajesh Raj) Chairman – (SPV) Convener – Member, BEC

Ref No.: RECPDCL/TBCB/Barmer II/2026-27/2630 Date: 02.09.2026

ORIGINAL

M/s Power Grid Corporation of India Limited
'Saudamini', Plot no. 2, Sector – 29,
Gurgaon – 122001 (Haryana)

Kind Attention: Sh. Pankaj Pandey, Executive Director

Subject: Establishment of "Transmission system for Evacuation of Power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through Tariff Based Competitive Bidding Process (TBCB) – **Letter of Intent**

Sir,

We refer to:

1. The Request for Proposal (RfP) dated 28.01.2026 comprising RfP, Draft Transmission Service Agreement, Share Purchase Agreement and Survey Report dated 06.02.2026 issued to M/s Power Grid Corporation of India Limited, as regards participation in the Global Invitation for Bids for establishment of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through Tariff Based Competitive Bidding process including all correspondence/ clarifications / amendments/ errata/corrigendum issued by REC Power Development and Consultancy Limited in regard thereto (hereinafter collectively referred to as the 'Final RFP') till the submission Bid Deadline and as listed below:

   (i) Amendment-I dated 11.02.2026,
   (ii) Amendment-II dated 01.04.2026,
   (iii) Amendment-III dated 17.04.2026,
   (iv) Amendment-IV & Clarification dated 23.04.2026,
   (v) Revision of MLC in HVDC letter issuing dated 06.05.2026,
   (vi) Amendment-V dated 15.05.2026,
   (vii) Amendment-VI & Additional Clarification dated 21.05.2026,
   (viii) Amendment-VII dated 01.06.2026,
   (ix) Amendment-VIII dated 05.06.2026,
   (x) Amendment-IX & Additional Clarification dated 08.06.2026,
   (xi) Amendment-X dated 15.06.2026,
   (xii) Amendment-XI dated 16.06.2026,
   (xiii) Amendment-XII dated 20.06.2026,
   (xiv) Amendment-XIII dated 24.06.2026,
   (xv) Amendment-XIV dated 25.06.2026,
   (xvi) Amendment-XV dated 25.06.2026,
   (xvii) Additional Clarification dated 26.06.2026,
   (xviii) Amendment-XVI dated 03.07.2026,

2. The offer of M/s Power Grid Corporation of India Limited by way of a Technical Bid pursuant to (1) above submitted on 20.07.2026 in response to the Final RFP.

3. The Initial Price Offer of M/s Power Grid Corporation of India Limited as submitted on 20.07.2026 in response to the Final RFP.

4. The final offer of M/s Power Grid Corporation of India Limited, discovered during e-Reverse Auction, commenced on 20.08.2026 in response to the Final RFP.

REC Power Development and Consultancy Limited Gurugram

5. The Technical Bid as in (2) above, the Initial Price Offer as in (3) above and the Final Offer as in (4) above hereinafter collectively referred to as the 'Bid'.

We are pleased to inform you that your proposal and offer received by way of the 'Bid' has been accepted and M/s Power Grid Corporation of India Limited is here by declared as Successful Bidder as per clause 3.6.1 of the Final RFP for the above project and consequently, this Letter of Intent (hereinafter referred to as the 'LoI') is being issued in 2 copies, One original plus One copy.

This LoI is based on the Final RFP and is further contingent upon you satisfying the following conditions:

(a) Acknowledging its issuance and unconditionally accepting its contents and recording 'Accepted unconditionally' under the signature and stamp of your authorized signatory on each page of the duplicate copy of this letter attached herewith and returning the same to REC Power Development and Consultancy Limited within 7 (Seven) days from the date of issuance of LoI.

(b) Completion of various activities as stipulated in the RFP including in particular Clause 2.15.2, Clause 2.15.3 and Clause 2.15.4 of the Final RFP within the timelines as prescribed therein.

(c) Provide the Contract Performance Guarantee of Rs. 716 Crore (Rupees Seven Hundred Sixteen Crore Only) within 10 (Ten) days from issue of this LoI, in favour of the Central Transmission Utility of India Limited, as per the provisions of Clause 2.12.

It may be noted that REC Power Development and Consultancy Limited has the rights available to them under the Final RFP, including rights under clause 2.15.5 and 3.6.3 thereof, upon your failure to comply with the aforementioned conditions.

As you are aware, the issuance and contents of this LoI are based on the Bid submitted by you as per the Final RFP including the Transmission Charges and other details regarding the Scheduled COD as contained therein. The Quoted Transmission Charges as submitted by you and the Scheduled COD of transmission elements as agreed by you in your Bid, as per Annexure 21 and Format-1 of Annexure-8 respectively of the Final RFP is enclosed herewith as Schedule-A and incorporated herein by way of reference.

Further, please note that relationship of M/s Power Grid Corporation of India Limited with the REC Power Development and Consultancy Limited & Central Transmission Utility of India Limited will be governed solely on the basis of the Final RFP.

You are requested to unconditionally accept the LoI, and record on one copy of the LoI, 'Accepted unconditionally', under the signature of the authorized signatory of your Company and return such copy to us within 7 (Seven) days of issue of LoI.

Yours faithfully,

REC Power Development and Consultancy Limited Gurugram

02.09.2026

(Ratnesh Kumar)
General Manager (Engg)

Enclosures:

1. Schedule A: Quoted Transmission Charges and the scheduled COD of transmission element submitted in your Bid, as per Annexure 21 and Format-1 of Annexure-8 respectively of the Final RfP.

Copy for kind information to:

1. **The Secretary,** Central Electricity Regulatory Commission, 6th Floor, Tower B, World Trade Centre, Nauroji Nagar, New Delhi-110029

2. **The Joint Secretary (Transmission),** Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi- 110 004

3. **The Director (Transmission),** Ministry of Power, Govt, of India, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001

4. **The Chairperson,** Central Electricity Authority, Sewa Bhawan, R K Puram, New Delhi-110086

5. **The Chief Operating Officer,** Central Transmission Utility of India Limited, 5th to 10th Floor, Ircon International Tower, Tower No.-1, Plot No. 16, Sector 32, Gurugram, Haryana – 122003

6. **The Chief Engineer (PSP & A - I),** Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi – 110066



ANNEXURE 21 - FORMAT FOR FINANCIAL BID

Quoted Annual Transmission Charges: Rs. 32,443.25 Million

Notes:

1. The Bidders are required to ensure compliance with the provisions of Clause 2.5.3 of this RFP.
2. Quotes to be in Rupees Millions and shall be up to two (2) decimal points.
3. The contents of this format shall be clearly typed.
4. The Financial Bid shall be digitally signed by the authorized signatory in whose name power of attorney as per Clause 2.5.2 is issued.
5. Ensure only one value for annual Transmission Charges is quoted. The same charge shall be payable every year to TSP for the term of TSA.



UNDERTAKING AND DETAILS OF EQUITY INVESTMENT

Format 1: Bidders' Undertakings

Date: 19/07/2026

To,

Chief Executive Officer,
REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited)
REC Corporate Head Quarter,
D Block, Plot No. I – 4,
Sec – 29 Gurugram – 122 001

Dear Sir,

Sub: Bidders' Undertakings in respect of Bid for selection of Bidder as TSP to establish Inter State transmission system for "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)"

We hereby undertake on our own behalf and on behalf of the TSP, that if selected as the Successful Bidder for the Project:

1. The Project shall comply with all the relevant electricity laws, codes, regulations, standards and Prudent Utility Practices, environment laws and relevant technical, operational and safety standards, and we shall execute any agreements that may be required to be executed as per law in this regard.

2. We confirm that the Project shall also comply with the standards and codes as per Clause 1.6.1.2 of the RFP and the TSP shall comply with the provisions contained in the Central Electricity Regulatory Commission Grant of Connectivity, Long-term Access and Medium-term Open Access in inter-state Transmission and related matters Open Access) Regulations, 2009.

3. We give our unconditional acceptance to the RFP dated **28.01.2026** issued by the BPC and the RFP Project Documents, as amended, and undertake to ensure that the TSP shall execute all the RFP Project Documents, as per the provisions of this RFP.

4. We have submitted the Bid on the terms and conditions contained in the RFP and the RFP Project Documents. Further, the Financial Bid submitted by us is strictly as per the format provided in Annexure 21 of the RFP, without mentioning any deviations, conditions, assumptions or notes in the said Annexure.

5. Our Bid is valid up to the period required under Clause 2.8 of the RFP.

REC Power Development and Consultancy Limited ★ Gurugram

POWER GRID CORPORATION OF INDIA LTD.

Vikas Kumar

विकास कुमार/ VIKAS KUMAR
मुख्य प्रबंधक (टी.बी.सी.बी.) / Chief Manager (TBCB)
पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम) / (A Government of India Enterprise)
Plot No.-2, Sector-29, Gurugram-122 001 (Haryana)

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6. Our Bid has been duly signed by authorized signatory and stamped in the manner and to the extent indicated in this RFP and the power of attorney / Board resolution in requisite format as per RFP has been enclosed with this undertaking.

7. [NOT APPLICABLE].

8. We confirm that our Bid meets the Scheduled COD of each transmission Element and the Project as specified below:

Sl. No	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
1.	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor	48 months from allocation of the project	2.09%	All the elements of the scheme except elements covered under Bipole-2 are required to be commissioned simultaneously as their utilization is dependent on each other. Further, elements under Bipole-2 shall have to be commissioned Simultaneously
2.	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS		0.63%	
3.	Barmer-II PS - Barmer-I PS 400 kV D/C line (Quad)		0.82%	
4.	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation	54 months from allocation of project (Bipole-1: 48 months, Bipole-2: 54 months)	33.66%	
5.	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb		32.77%	
6.	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	48 months from allocation of the project	22.35%	
7.	Augmentation of South Kalamb S/s by 4x1500 MVA, 765/400 kV ICTs (3 Nos. 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with	48 months from allocation of the project	2.81%	

REC Power Development and Consultancy Limited Gurugram

Vikasmumar

विकास कुमार / VIKAS KUMAR
मुख्य प्रबंधक (टी.बी.सी.बी.) / Chief Manager (TBCB)
पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड
Power Grid Corporation of India Ltd.
(भारत सरकार का उद्यम)/(A Govt of India Enterprise)
Plot No.-2, Sector-29, Gurgaon- 122 001 (Haryana)

POWER GRID CORPORATION OF INDIA LTD.

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	2x330 MVAR, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open)			
8.	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))	48 months from allocation of the project	4.87%	

Note: 50% of the percentage quoted transmission charges of respective terminal (i.e. Barmer-II or South Kalamb) is to be taken for each Bipole-1 and Bipole-2 for respective terminal

We agree that the payment of Transmission Charges for any Element irrespective of its successful commissioning on or before its Scheduled COD shall only be considered after the successful commissioning of Element(s) which are pre - required for declaring the commercial operation of such Element as mentioned in the above table.

Scheduled COD for the Project: 54 months from allocation of project (Bipole-1: 48 months, Bipole-2: 54 months)

9. We confirm that our Financial Bid conforms to all the conditions mentioned in this RFP, and in particular, we confirm that:

   a. Financial Bid in the prescribed format of Annexure 21 has been submitted duly signed by the authorized signatory.

   b. Financial Bid is unconditional.

   c. Only one Financial Bid has been submitted.

10. We have neither made any statement nor provided any information in this Bid, which to the best of our knowledge is materially inaccurate or misleading. Further, all the confirmations, declarations and representations made in our Bid are true and accurate. In case this is found to be incorrect after our acquisition of **Barmer HVDC Power Transmission Limited,** pursuant to our selection as Selected Bidder, we agree

Vikas Kumar

विकास कुमार/ VIKAS KUMAR
मुख्य प्रबंधक (टी.बी.सी.बी.) / Chief Manager (TBCB)
पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड
Power Grid Corporation of India Ltd.
(भारत सरकार का उद्यम)/(A Govt. of India Enterprise)
Plot No.-2, Sector-29, Gurgaon- 122 001 (Haryana)

that the same would be treated as a TSP's Event of Default under Transmission Service Agreement, and relevant provisions of Transmission Service Agreement shall apply.

11. We confirm that there are no litigations or other disputes against us which materially affect our ability to fulfill our obligations with regard to the Project as per the terms of RFP Project Documents.

12. Power of attorney/ Board resolution as per Clause 2.5.2 is enclosed.

Vikaskumar.....

विकास कुमार/ VIKAS KUMAR
मुख्य प्रबंधक (टी.बी.सी.बी.) / Chief Manager (TBCB)
पावर ग्रिड कॉर्पोरेशन ऑफ इंडिया लिमिटेड
Power Grid Corporation of India Ltd.
(भारत सरकार का उद्यम / A Government of India Enterprise)
Plot No. - Sector - 29, Gurgaon - 122001

(Signature)

Name: Vikas Kumar
Designation: Chief Manager

REC Power Development and Consultancy Limited ★ Gurugram

POWER GRID CORPORATION OF INDIA LTD. ★ POWERGRID

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फा.सं./F. No. 27-44/1/2024-REC DESK
भारत सरकार/Government of India
विद्युत मंत्रालय/Ministry of Power
***

Shram Shakti Bhawan, Rafi Marg,
New Delhi, dated 17th September, 2026

To

The CEO, RECPDCL
Plot No. I-4, Sector-29,
Gurugram (Haryana)-122001.

Subject: Approval of the Government for transfer of shares held by RECPDCL in various SPVs, incorporated for development of Inter/Intra State transmission systems to the Successful Bidder(s), selected through Tariff-Based Competitive Bidding process.

Sir,

I am directed to refer to RECPDCL's letters SEC No. 1/219/2026/2567 dated 31.08.2026, and SEC No. 1/219/2026/2651 dated 03.09.2026 on the subject mentioned above and to convey the approval of Competent Authority for divesting the shareholding of RECPDCL and its nominee in following Special Purpose Vehicles(SPVs), incorporated for carrying out bidding of various Inter/Intra-State transmission projects under Tariff Based Competitive Bidding(TBCB) mode, to the respective successful bidder(s), as indicated in below table, with a view to facilitate transfer of the SPV to the successful bidder, as required under Ministry of Heavy Industries, Department of Public Enterprises O.M. No. 22(I)12009-GM dated 04.02.2010:

Sl. No.	Name of the Project	Name of SPV	Successful Bidder
1	Establishment of 400/220/132 kV AIS Sakoli (Distt. Bhandara)	Sakoli Power Transmission Limited	M/s Ashoka Buildcon Limited
2	Establishment of 765/400/220 kV AIS Balsane (Distt. Dhule)	Balsane Power Transmission Limited	M/s Resonia Limited
3	Construction of 220/132/33 kV AIS substation, Ranipur (Mau) and 220/132/33 kV AIS substation, Chunar (Mirzapur) with their associated lines	Ranipur Chunar Power Transmission Limited	M/s H G Infra Engineering Limited
4	Transmission System for Evacuation of Power Rajasthan REZ Ph-IV (Part-5: 6 GW) Barmer Complex, Barmer-II: 6 GW (Solar) (LCC Configuration)	Barmer HVDC Power Transmission Limited	M/s Power Grid Corporation of India Limited

5	Common Transmission system for evacuation of power from Lakadia (Phase-II: 7.5 GW), Jam Khambhaliya (Phase-II: 5.5 GW) and Jamnagar (Phase-I: 1GW)-Part B	Jam Khambhaliya Jamnagar Power Transmission Ltd	M/s Ceigall India Limited
6	Transmission system for Integration of Power from RE Projects in Lakadia REZ in Gujarat-Phase II (750 MW)	Lakadia II Power Transmission Limited	M/s Power Grid Corporation of India Limited

Yours faithfully,

(Nidhi Juneja)
Under Secretary to the Govt. of India
email: juneja.n13@nic.in /
sopfcrec-mop@gov.in
Tel: 011-23711302

Copy for information and necessary action to:

i. CMD, REC Ltd.

ii. US (Trans), MoP. with the request that transmission wing should also write to concerned states informing about the project for extending all possible help in assessment of compensation to be paid to landowners and also expediting forest clearance, if involved in the project.

iii. Sr. PPS to Secretary (Power)/JS (Distt. &Reforms)/Dir (Distt.), Ministry of Power

REC Power Development and Consultancy Limited
(A wholly owned subsidiary of REC Limited, a 'Maharatna CPSE'
under Ministry of Power, Govt. of India)

संदर्भ संख्या: आरईसीपीडीसीएल/टीबीसीबी/Barmer II/2026-27/2979 **दिनांक**: 22.09.2026

M/s Power Grid Corporation of India Limited
'Saudamini', Plot no. 2, Sector – 29,
Gurugram – 122001 (Haryana)

Kind Attention: Sh. Pankaj Pandey, Executive Director

विषय: Establishment of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through tariff based competitive bidding process – Extension of LoI- regarding

संदर्भ: Letter of Intent (LOI) No. RECPDCL/Barmer II/2026-27/2630, dated 02.09.2026

महोदय,

This is in reference to above referred Letter of Intent dated 02nd September, 2026 issued to M/s Power Grid Corporation of India Limited for "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)".

In this regard, in accordance with clause 2.15.2 of RFP, the validity of LoI is extended till 23.09.2026.

Further, as per clause 2.15.4 of RFP, the TSP shall apply to the Commission for grant of Transmission License and make an application to the Commission for adoption of Transmission Charges, as required under Section – 63 of the Electricity Act 2003, within 5 working days from the date of acquisition of SPV.

धन्यवाद।

भवदीय,

23/09/26

अनिल कुमार पेराला
उप महाप्रबंधक (अभियांत्रिकी)

SHARE PURCHASE AGREEMENT

BETWEEN

REC POWER DEVELOPMENT AND CONSULTANCY LIMITED

AND

BARMER HVDC POWER TRANSMISSION LIMITED

AND

POWER GRID CORPORATION OF INDIA LIMITED

Dated: 23rd September, 2026

सत्यमेव जयते

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

e-Stamp

Certificate No.	:	IN-DL04015296130694Y
Certificate Issued Date	:	21-Sep-2026 10:03 AM
Account Reference	:	SELFPRINT (PU)/ dl-self/ NEHRU/ DL-DLH
Unique Doc. Reference	:	SUBIN-DLDL-SELF06005567881139Y
Purchased by	:	REC POWER DEVELOPMENT AND CONSULTANCY
Description of Document	:	Article 5 General Agreement
Property Description	:	CORE-4, SCOPE COMPLEX, 7, LODHI ROAD, NEW DELHI - 110003
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	BARMER HVDC POWER TRANSMISSION LIMITED
Second Party	:	POWER GRID CORPORATION OF INDIA LIMITED
Stamp Duty Paid By	:	BARMER HVDC POWER TRANSMISSION LIMITED
Stamp Duty Amount(Rs.)	:	500 (Five Hundred only)

SELF PRINTED CERTIFICATE TO BE VERIFIED BY THE RECIPIENT AT WWW.SHCILESTAMP.COM

IN-DL04015296130694Y

Please write or type below this line

SHARE PURCHASE AGREEMENT

This **SHARE PURCHASE AGREEMENT** ('**Agreement**') made on the 23rd day of September, 2026 at New Delhi by and between:

REC POWER DEVELOPMENT AND CONSULTANCY LIMITED, a company incorporated under the Companies Act, 1956, vide CIN-U40101DL2007GOI165779 having its registered office at Core 4, SCOPE Complex, 7, Lodhi Road, New Delhi 110 003, India (hereinafter referred to as "**REC PDCL**", which expression shall, unless it be repugnant to the context or meaning thereof, be deemed to mean and include its successors and permitted assigns) of the **FIRST PART**;

REC Power Development & Consultancy Limited Gurugram

Barmer Hvdc Power Transmission Limited New Delhi 11003

POWER GRID CORPORATION OF INDIA LTD.

RECPDCL Barmer HVDC PTL PGCIL

Statutory Alert:
1. The authenticity of this Stamp certificate should be verified at 'www.shcilestamp.com' or using e-Stamp Mobile App of Stock Holding. Any discrepancy in the details on this Certificate and as available on the website / Mobile App renders it invalid.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

सत्यमेव जयते

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

e-Stamp

Certificate No.	:	IN-DL04019693771668Y
Certificate Issued Date	:	21-Sep-2026 10:12 AM
Account Reference	:	SELFPRINT (PU)/ dl-self/ NEHRU/ DL-DLH
Unique Doc. Reference	:	SUBIN-DLDL-SELF06013134902856Y
Purchased by	:	REC POWER DEVELOPMENT AND CONSULTANCY
Description of Document	:	Article 5 General Agreement
Property Description	:	CORE-4, SCOPE COMPLEX, 7, LODHI ROAD, NEW DELHI - 110003
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	BARMER HVDC POWER TRANSMISSION LIMITED
Second Party	:	POWER GRID CORPORATION OF INDIA LIMITED
Stamp Duty Paid By	:	BARMER HVDC POWER TRANSMISSION LIMITED
Stamp Duty Amount(Rs.)	:	500 (Five Hundred only)

SELF PRINTED CERTIFICATE TO BE VERIFIED BY THE RECIPIENT AT WWW.SHCILESTAMP.COM

IN-DL04019693771668Y

Please write or type below this line

AND

BARMER HVDC POWER TRANSMISSION LIMITED a company incorporated under the Companies Act, 2013 vide CIN- U42202DL2026GOI456212, having its registered office at Core 4, SCOPE Complex, 7, Lodhi Road, New Delhi 110003, India (herein after referred to as "**Company**" which expression shall, unless repugnant to the context, mean and include its successors in interest) of the **SECOND PART**.

REC Power Development and Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited Core 4, Scope Complex, 7, Lodhi Road New Delhi 11003

POWER GRID CORPORATION OF INDIA LTD.

RECPDCL Barmer HVDC PTL PGCIL

Statutory Alert:

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2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

सत्यमेव जयते

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

₹200

e-Stamp

Certificate No.	:	IN-DL02064654837007Y
Certificate Issued Date	:	18-Sep-2026 04:14 PM
Account Reference	:	SELFPRINT (PU)/ dl-self/ NEHRU/ DL-DLH
Unique Doc. Reference	:	SUBIN-DLDL-SELF02819413047526Y
Purchased by	:	REC POWER DEVELOPMENT AND CONSULTANCY
Description of Document	:	Article 5 General Agreement
Property Description	:	CORE-4, SCOPE COMPLEX, 7, LODHI ROAD, NEW DELHI - 110003
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	BARMER HVDC POWER TRANSMISSION LIMITED
Second Party	:	POWER GRID CORPORATION OF INDIA LIMITED
Stamp Duty Paid By	:	BARMER HVDC POWER TRANSMISSION LIMITED
Stamp Duty Amount(Rs.)	:	200 (Two Hundred only)

SELF PRINTED CERTIFICATE TO BE VERIFIED BY THE RECIPIENT AT WWW.SHCILESTAMP.COM

IN-DL02064654837007Y

Please write or type below this line

AND

POWER GRID CORPORATION OF INDIA LIMITED, a company incorporated under the Companies Act, 1956 vide CIN-L40101DL1989GOI038121 and having its registered office at **B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016** (hereinafter referred to as "**Selected Bidder**" which expression shall, unless repugnant to the context or meaning thereof, be deemed to mean and include its successors and permitted assigns) of the **THIRD PART.**

REC Power Development & Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited New Delhi 11003

POWER GRID CORPORATION OF INDIA LTD.

RECPDCL **Barmer HVDC PTL** **PGCIL**

Statutory Alert:

1. The authenticity of this Stamp certificate should be verified at 'www.shcilestamp.com' or using e-Stamp Mobile App of Stock Holding. Any discrepancy in the details on this Certificate and as available on the website / Mobile App renders it invalid.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

WHEREAS:

A. Ministry of Power, Government of India vide its Gazette Notification No. CG-DL-E-30082025-265828 dated 29.08.2025 has appointed REC Power Development and Consultancy Limited to be the Bid Process Coordinator (BPC) for the purpose of selection of Bidder as Transmission Service Provider (TSP) to establish "**Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)**" through tariff based competitive bidding process (hereinafter referred to as the "Project").

B. In accordance with the Bidding Guidelines, the BPC had initiated a competitive bidding process through issue of RFP for selecting a Successful Bidder to build, own, operate and transfer the Project comprising of the Elements mentioned in **Schedule 2** of the TSA. BPC had initiated this process in accordance with and on the terms and conditions mentioned in the RFP Project Documents (as defined hereinafter).

C. BPC has incorporated the Company and has undertaken the preliminary studies, obtained certain approvals, etc. regarding the Project on behalf of the Company

D. REC PDCL along with the Nominees hold one hundred per cent (100%) of the total issued and paid up equity share capital of the Company.

E. Pursuant to the said Bid Process, Power Grid Corporation of India Limited has been identified as the Selected Bidder vide Letter of Intent dated 02nd September, 2026 issued by the BPC in favour of the Selected Bidder.

F. As envisaged in the RFP, the Shares Seller (as defined hereinafter) has agreed to sell the Sale Shares (as defined hereinafter) to the Selected Bidder and the Selected Bidder has agreed to purchase the Sale Shares from the Shares Seller, subject to and on the terms and conditions set forth in this Agreement.

NOW THEREFORE, IN CONSIDERATION OF THE MUTUAL COVENANTS AND AGREEMENTS SET FORTH IN THIS AGREEMENT AND FOR OTHER GOOD AND VALUABLE CONSIDERATION, THE PARTIES HEREBY AGREE AS FOLLOWS:

REC Power Development and Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited New Delhi 11003

POWER GRID CORPORATION OF INDIA LTD.

RECPDCL **Barmer HVDC PTL** **PGCIL**

1. DEFINITIONS

1.1 Capitalised terms in this Agreement, unless defined in this Agreement shall, in so far as the context admits, have the same meaning in this Agreement as has been ascribed to them in the TSA.

1.2 Additionally, the following terms shall have the meaning hereinafter respectively assigned to them herein below:

(i) **"Acquisition Price"** shall mean INR 18,97,52,835/- (Rupees Eighteen Crore Ninety-Seven Lakh Fifty-Two Thousand Eight Hundred Thirty-Five Only) which is the aggregate consideration payable by the Selected Bidder towards purchase of the Sale Shares at par and for taking over of all assets and liabilities of the Company as on the Closing Date subject to adjustment as per the audited accounts of the Company as on the Closing Date;

(ii) **"Agreement"** or **"the Agreement"** or **"this Agreement"** shall mean this Share Purchase Agreement and shall include the recitals and/or annexures attached hereto, and the contracts, certificates, disclosures and other documents to be executed and delivered pursuant hereto, if any, and any amendments made to this Agreement by the Parties in writing;

(iii) **"Bid Process"** shall mean the competitive bidding process initiated by the BPC, by issuance of RFP for selecting a Successful Bidder to build, own, operate and transfer the Project in accordance with and on the terms and conditions mentioned in the RFP Project Documents;

(iv) **"Board"** shall mean the board of directors of the Company;

(v) **"Closing Date"** shall mean a mutually agreed date between the Parties falling within the period as mentioned in clause 2.15.2 of RFP or on failure of such mutual agreement between the Parties shall be the date falling on the last date of such period;

(vi) "**Encumbrance**" shall mean any mortgage, pledge, lien, charge, security assignment, hypothecation, trust, encumbrance or any other agreement having the effect of creating security interest;

(vii) "**Letter of Intent**" shall have the meaning ascribed thereto under the Bid Documents;

(viii) "**Nominees"** shall mean the Persons, who are named in Annexure A of this Agreement, holding the Sale Shares as nominees of REC PDCL;

(ix) "**Party**" shall mean REC PDCL, Company and the Selected Bidder, referred to individually, and "Parties" shall mean REC PDCL, Company and the Selected Bidder collectively referred to, as relevant;

(x) "**Person**" shall include an individual, an association, a corporation, a partnership, a joint venture, a trust, an unincorporated organisation, a joint stock company or other entity or organisation, including a government or political subdivision, or an agency or instrumentality thereof, and/or any other legal entity;

(xi) "**RFP Project Documents**" shall mean the following documents, referred to collectively:

a. Transmission Service Agreement; and
b. this Agreement.

(xii) "**Representations and Warranties**" shall mean the representations and warranties mentioned in Clause 4 hereto;

(xiii) "**RoC**" shall mean the Registrar of Companies;

(xiv) "**Sale Shares**" shall mean 50,000 shares, representing one hundred percent (100%) of the total issued, subscribed and fully paid-up equity share capital of the Company held by the Shares Seller and Nominees as more particularly described in Annexure A attached hereto;

(xv) "**Shares**" shall mean the fully paid-up equity shares of Company, of face value Rs. 10 each;

(xvi) "**Shares Seller**" shall mean REC PDCL; and

(xvii) "**Transmission Service Agreement**" or "**TSA**" means the agreement titled 'Transmission Service Agreement' to be executed on 23rd September, 2026 between Central Transmission Utility of India Limited (CTUIL) and Barmer HVDC Power Transmission Limited, pursuant to which the TSP shall build, own, operate and transfer the Project and make available the assets of the Project on a commercial basis.

1.3 Interpretation Clause

Unless the context otherwise requires, the provisions of the TSA relating to the interpretation of the TSA shall apply to this Agreement as if they were set out in full in this Agreement and to this end are incorporated herein by reference.

REC Power Development and Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited New Delhi 11003

POWER GRID CORPORATION OF INDIA LTD.

2. TRANSFER OF SHARES

2.1 Subject to the terms and conditions of this Agreement, the Shares Seller agrees to sell and transfer to the Selected Bidder and the Selected Bidder hereby agrees to purchase from the Shares Seller, the Sale Shares free from Encumbrances together with all assets and liabilities of the Company with rights and benefits attached thereto in consideration of the Acquisition Price and the covenants, undertakings and the agreements of the Selected Bidder contained in this Agreement.

2.2 The Shares Seller hereby undertakes to cause the Nominees to transfer part of the Sale Shares held by them as nominees of the Shares Seller to the Nominees of Selected Bidder and execute any documents required to deliver good title to the Sale Shares to the Selected Bidder.

3. CLOSING

3.1 Prior to the Closing Date, the Selected Bidder shall provide to the Shares Seller, valid share transfer forms duly stamped with requisite amount of stamp duty payable on the transfer of the Sale Shares ("**Share Transfer Forms**").

3.2 On the Closing Date, the Shares Seller shall hand over to the Selected Bidder or its authorised representative, the original share certificates representing the Sale Shares ("**Sale Share Certificates**") executed by the Shares Seller and the Nominees, simultaneously against the Selected Bidder handing over to the Shares Seller, demand drafts drawn in favour of the Shares Seller or by confirmation of RTGS transfer in favour of the Shares Seller, for the Acquisition Price payable to it.

Provided that prior to the handing over of the Sale Share Certificates to the Selected Bidder as mentioned above, the Selected Bidder shall provide satisfactory evidence to REC PDCL that on the Closing Date, the Selected Bidder has furnished the Contract Performance Guarantee to Central Transmission Utility of India Limited (CTUIL) and is in a position to comply with all other requirements of Clause 2.15.2 of the RFP.

3.3 The Selected Bidder shall immediately upon receiving the Sale Share Certificates and the Share Transfer Forms, duly execute the Share Transfer Forms and duly lodge the Share Transfer Forms and the Share Certificates with the Company along with the names of its nominees to be appointed on the Board of the Company. The new registered office address of the Company shall be within the jurisdiction of the RoC of New Delhi or within the jurisdiction of any other RoC, as required by selected bidder, by following the due process as may be required, which would be the new registered office of the Company. The Company shall, upon receipt of the said documents from the Selected Bidder, do the following:

(i) Immediately on the Closing Date convene a meeting of the Board, wherein the Board shall pass the following necessary resolutions:

(a) approving the transfer of the Shares constituting the Sale Shares from the Shares Seller and the Nominees to the name of the **Power Grid Corporation of India Limited** and its nominees and transfer of all assets and liabilities of the Company as on Closing Date;

(b) approving the **Power Grid Corporation of India Limited** and its nominees as the members of the Company and entering the name of the **Power Grid Corporation of India Limited** and its nominees in the register of members.

(c) changing the address of the registered office of the Company to the new address as provided by the Selected Bidder as per clause 3.3 above.

(d) appointing the Directors of the Selected Bidder on the Board of the Company.

Immediately pursuant to the resignation of the existing Directors, the newly constituted Board of Directors shall continue/hold the meeting and pass the following resolution:

(e) accepting the resignations of the other existing Directors on the Board and the Chair of the meeting which was taken by one of the existing Directors shall be vacated and appointment of a new Chairman who shall be one of the newly appointed Director.

(f) terminating all the authorizations granted regarding the business and/or operations of the Company or the operations of the bank accounts of the Company, with prospective effect; and

(g) acknowledging and accepting the terms and conditions as contained in the executed copies of the RFP Project Documents and to abide by the provisions contained therein.

(ii) Enter the name of the **Power Grid Corporation of India Limited** and its nominees as the legal and beneficial owner of the Sale Shares, free of all Encumbrances, in the register of members of the Company;

(iii) Make the necessary endorsements on the Sale Share Certificates, indicating the name of the **Power Grid Corporation of India Limited** and its nominees as the legal and beneficial owner of the Sale Shares evidenced there under;

(iv) Return the original Sale Share Certificates, duly endorsed in the name of the **Power Grid Corporation of India Limited** and its nominees, to the **Power Grid Corporation of India Limited** and its nominees, as the case may be or its authorized representative;

(v) Handover all the statutory registers and records, if any, of the Company to the Selected Bidder.

(vi) Handover certified true copies of the Board resolution passed by the Company as per (i) (c) to (i) (d) of Clause 3.3 (i) to the Selected Bidder.

3.4 The Parties to this Agreement agree to take all measures that may be required to ensure that all the events contemplated in the **Clauses 3.1 to 3.3** above on the Closing Date are completed on the same day.

Notwithstanding the provisions of **Clause 3.3** hereto, all proceedings to be taken and all documents to be executed and delivered by the Parties at the Closing Date shall be deemed to have been taken and executed simultaneously and no proceedings shall be deemed to have been taken nor documents executed or delivered until all have been taken, executed and delivered.

3.5 The Selected Bidder hereby acknowledges and agrees that after the date of acquisition of one hundred percent (100%) of the Shares of the Company by the Selected Bidder as per Clause 3.3, (a) the authority of the BPC in respect of the Bid Process shall forthwith cease and any actions to be taken thereafter regarding the Bid Process will be undertaken by the Central Transmission Utility of India Limited (CTUIL) themselves, (b) all rights and obligations of the BPC shall cease forthwith, (c) all other rights and obligations of the Company shall be of the TSP and (d) any decisions taken by the BPC on behalf of the Company prior to the date of acquisition, shall continue to be binding on the Company and/or Central Transmission Utility of India Limited (CTUIL)as the case may be.

3.6 This Agreement shall be effective from the date of its signing by the Parties and shall remain in force until all the obligations of the respective Parties under Clause 3.3 hereto are fulfilled.

4. REPRESENTATIONS AND WARRANTIES

4.1 The Selected Bidder hereby represents and warrants to the Shares Seller that:

4.1.1 The Selected Bidder has full legal right, power and authority to enter into, execute and deliver this Agreement and to perform the obligations, undertakings and transactions set forth herein, and this Agreement has been duly and validly executed and delivered by the Selected Bidder and constitutes its legal, valid and binding obligations, enforceable against it in accordance with its terms;

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4.1.2 The execution, delivery and performance of this Agreement by the Selected Bidder (i) will not violate or contravene any provision of the Memorandum of Association or Articles of the Selected Bidder, (ii) will not violate or contravene any law, statute, rule, regulation, licensing requirement, order, writ, injunction or decree of any court, governmental instrumentality or other regulatory, governmental or public body, agency or authority by which the Selected Bidder is bound or by which any of its and/or their properties or assets are bound, and (iii) except to the extent that the same have been duly and properly completed or obtained, will not require any filing with, or permit, consent or approval of or license from, or the giving of any notice to, any court, governmental instrumentality or other regulatory, governmental or public body, agency or authority, joint venture party, or any other entity or person whatsoever; and

4.1.3 The Selected Bidder is not restricted in any manner whatsoever, including without limitation, on account of any judicial or governmental order, action or proceeding, or any contractual obligation assumed by the Selected Bidder, from purchasing the Sale Shares from the Shares Seller in the manner provided for in this Agreement.

4.2 The Shares Seller hereby represents and warrants to the Selected Bidder that;

4.2.1 The Shares Seller and the Nominees are the legal and beneficial owners of the Sale Shares, free and clear of any Encumbrance and the delivery to the Selected Bidder of the Sale Shares pursuant to the provisions of this Agreement will transfer to the Selected Bidder a good title to the Sale Shares.

4.2.2 The Shares Seller has full legal right, power and authority to enter into, execute and deliver this Agreement and to perform the obligations, undertakings and transactions set forth herein. The execution, delivery and performance of this Agreement will not violate the Memorandum and Articles of Association of the Shares Seller or contravene any contract by which it is bound.

4.2.3 The Shares Seller has obtained requisite authorizations to sell and transfer the Sale Shares to the Selected Bidder. The Shares Seller also represent that it is not prevented from transferring and selling the Sale Shares. Also, to the best of its knowledge, the Sale Shares are not the subject matter of any claim or pending proceeding or threatened by any legal proceeding made by any third party.

4.3 Except as specified in Clause 4.2 above, the Shares Seller shall not be deemed to have, made any representation or warranty whatsoever, whether express or implied, in relation to the Sale Shares or Company, including but not limited to any implied warranty or representation as to the business or affairs of Company.

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4.4 The Representations and Warranties are given as at the date of this Agreement except that where a Representation and Warranty is expressed to be made as at another date, the Representation and Warranty is given with respect to that date only.

4.5 Each Representation and Warranty is to be construed independently of the others and is not limited by reference to any other Warranty. The Representations, Warranties and undertakings contained in this **Clause 4** hereto or in any document delivered pursuant to or in connection with this Agreement are continuing in nature and shall survive the Closing Date for a period of one (1) year.

4.6 The Parties represent to each other that all Representations and Warranties provided herein by the respective Party shall be true as of Closing Date.

5. OBLIGATIONS OF THE SELECTED BIDDER

The Selected Bidder agrees that the Shares Seller shall not be liable in any manner, nor shall it assume any responsibility or liability whatsoever, in respect of the business of the Company and its operations or activities, arising after the Closing Date, to any Person or any authority, central, state, local or municipal or otherwise and the same shall be the sole responsibility of the Selected Bidder.

6. MISCELLANEOUS

6.1 NOTICES

a) All notices to be given under this Agreement shall be in writing and in the English language.

b) All notices must be delivered personally or by registered or certified mail or by recognised courier to the addresses below:

Selected Bidder: **Power Grid Corporation of India Limited,**
B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016

REC PDCL: **REC Power Development and Consultancy Limited**
Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003

Company: **Barmer HVDC Power Transmission Limited**
Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003

REC Power Development and Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited New Delhi 11003 Core-4, SCOPE Complex, 7, Lodhi Road

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c) Any Party may by notice of at least fifteen (15) days to the other Parties change the address and / or addresses to which such notices and communications to it are to be delivered or mailed.

6.2 RESOLUTION OF DISPUTES

6.2.1 If any dispute arises between the Parties, in connection with the validity, interpretation, implementation or alleged breach of any provision of this Agreement ("Dispute"), the disputing Parties hereto shall endeavor to settle such Dispute amicably. The attempt to bring about an amicable settlement shall be considered to have failed if not resolved within sixty (60) days from the date of the Dispute.

6.2.2 If the Parties are unable to amicably settle the Dispute in accordance with Clause 6.2.1 within the period specified therein, any of the Parties shall be entitled to within thirty (30) days after expiry of the aforesaid period, refer the Dispute to the Chief Executive Officer/Director of REC PDCL and Chief Executive/ Managing Director of the Selected Bidder for resolution of the said Dispute. The attempt to bring about such resolution shall be considered to have failed if not resolved within thirty (30) days from the date of receipt of a written notification in this regard.

6.2.3 In the event the Dispute is not settled in accordance with Clause 6.2.2 above, any Party to the Dispute shall be entitled to serve a notice invoking this Clause and making a reference to a sole arbitrator. If the Parties to the Dispute cannot agree as to the appointment of the sole arbitrator within thirty (30) days of receipt of the notice of the Party making the reference, then the Shares Seller along with the Company shall appoint one arbitrator and the Selected Bidder shall appoint one arbitrator and the two arbitrators, so appointed shall appoint a third arbitrator. However, after the Closing Date, in such an event the Shares Seller shall appoint one arbitrator and the Selected Bidder along with the Company shall appoint one arbitrator and the two arbitrators, so appointed shall appoint the third arbitrator.

6.2.4 The place of the arbitration shall be New Delhi. The Arbitration proceedings shall be governed by the Arbitration and Conciliation Act, 1996.

6.2.5 The proceedings of arbitration shall be in English language.

6.2.6 The arbitrator's award shall be substantiated in writing. The arbitrators shall also decide on the costs of the arbitration proceedings. In case the arbitrators have not decided on the costs of the arbitration proceedings, each Party to the Dispute shall bear its own costs, in relation to the arbitration proceedings.

REC Power Development and Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited New Delhi 11003 Core 4, Scope Complex, 7, Lodhi Road

POWER GRID CORPORATION OF INDIA LTD. पावरग्रिड POWERGRID

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6.3 AUTHORISED PERSON

For the purposes of this Agreement, the Selected Bidder is represented by Sh. Arup Kumar Samanta, General Manager, Company Secretariat, POWERGRID, pursuant to an authorization granted to Sh. Arup Kumar Samanta, General Manager, Company Secretariat, POWERGRID through necessary Board resolutions. Further, Sh. Arup Kumar Samanta, General Manager, Company Secretariat, POWERGRID is also authorized by such resolutions to take any decision which may be required to be taken, do all acts and execute all documents which are or may be required by the Selected Bidder for the proper and effective fulfillment of the rights and obligations under this Agreement. Any action taken or document executed by Sh. Arup Kumar Samanta, General Manager, Company Secretariat, POWERGRID shall be deemed to be acts done or documents executed by the Selected Bidder and shall be binding on the Selected Bidder.

6.4 RESERVATION OF RIGHTS

No forbearance, indulgence or relaxation or inaction by any Party at any time to require performance of any of the provisions of this Agreement shall in any way affect, diminish or prejudice the right of such Party to require performance of that provision, and any waiver or acquiescence by any Party of any breach of any of the provisions of this Agreement shall not be construed as a waiver or acquiescence of any continuing or succeeding breach of such provisions, a waiver of any right under or arising out of this Agreement or acquiescence to or recognition of rights other than that expressly stipulated in this Agreement.

6.5 CUMULATIVE RIGHTS

All remedies of either Party under this Agreement whether provided herein or conferred by statute, civil law, common law, custom or trade usage, are cumulative and not alternative and may be enforced successively or concurrently.

6.6 PARTIAL INVALIDITY

If any provision of this Agreement or the application thereof to any person or circumstance shall be invalid or unenforceable to any extent, the remainder of this Agreement and the application of such provision to persons or circumstances other than those as to which it is held invalid or unenforceable shall not be affected thereby, and each provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law. Any invalid or unenforceable provision of this Agreement shall be replaced with a provision, which is valid and enforceable and most nearly reflects the original intent of the unenforceable provision.

6.7 TERMINATION

If (i) the Closing does not occur on the Closing Date for any reason whatsoever, or (ii) the Letter of Intent is withdrawn or terminated for any reason, or (iii) due to termination of the TSA by the Central Transmission Utility of India Limited (CTUIL) in accordance with Article 3.3.2 or Article 13 of the TSA thereof, REC PDCL shall have a right to terminate this Agreement forthwith by giving a written notice to the other Parties hereto.

6.8 AMENDMENTS

No modification or amendment of this Agreement and no waiver of any of the terms or conditions hereof shall be valid or binding unless made in writing and duly executed by all the Parties.

6.9 ASSIGNMENT

This Agreement and the rights and liabilities hereunder shall bind and inure to the benefit of the respective successors of the Parties hereto, but no Party hereto shall assign or transfer its rights and liabilities hereunder to any other Person without the prior written consent of the other Parties, which will not be unreasonably withheld.

6.10 ENTIRE AGREEMENT

This Agreement constitutes the entire Agreement between the Parties with respect to the subject matter herein and supersedes and cancels any prior oral or written agreement, representation, understanding, arrangement, communication or expression of intent relating to the subject matter of this Agreement.

6.11 COSTS

Each of the Parties hereto shall pay their own costs and expenses relating to the negotiation, preparation and execution of this Agreement and the transactions contemplated by this Agreement.

The Selected Bidder shall be liable to bear and pay the costs in respect of this Agreement and transfer of Sale Shares.

6.12 RELATIONSHIP

None of the provisions of this Agreement shall be deemed to constitute a partnership between the Parties hereto and no Party shall have any authority to bind the other Party otherwise than under this Agreement or shall be deemed to be the agent of the other in any way.

REC Power Development and Consultancy Limited Gurugram

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6.13 GOVERNING LAW AND JURISDICTION

This Agreement shall be governed by and construed in accordance with the laws of India and shall be subject to the exclusive jurisdiction of the courts of Delhi.

6.14 COUNTERPARTS

This Agreement may be executed in counterparts by the Parties and each fully executed counterpart shall be deemed to be original.

6.15 CONFIDENTIALITY

The Parties undertake to hold in confidence and not to disclose the terms and conditions of the transaction contemplated hereby to third parties, except:

(a) to their professional advisors;

(b) to their officers, employees, agents or representatives, who need to have access to such information for the proper performance of their activities;

(c) disclosures required under Law;

without the prior written consent of the other Parties.

Provided that the Central Transmission Utility of India Limited (CTUIL)and REC PDCL may at any time, disclose the terms and conditions of transactions contemplated hereby to any person, to the extent stipulated under the law or the Bidding Guidelines.

6.16 INDEMNIFICATION

The Parties hereby agree that transfer of Sale Shares to the Selected Bidder shall vest all the rights, privileges, licenses, responsibilities, liabilities and other obligations pertaining to the Company in the Selected Bidder.

- The Selected Bidder hereby agrees that the Selected Bidder shall not be entitled to any claims or initiate any legal proceedings by itself or through the Transmission Service Provider against the Shares Seller, its directors, officers, employees and the subscribers including the members of any committees appointed by them in respect of any actions or decisions taken by any of them up to the Closing Date in furtherance of the Project referred to in recital A of this Agreement.

REC Power Development and Consultancy Limited Gurugram

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- Further, the Selected Bidder hereby indemnifies and holds harmless at all times the Shares Seller against all past, present and future third party claims and liabilities arising out of actions or decisions taken by any of the persons or bodies referred to in Clause 6.3 up to the Closing Date in furtherance of the Project referred to above or otherwise concerning the Company. All such actions shall be defended by the Selected Bidder either itself or through the TSP at its own cost.

- The Parties hereby agree that the provisions of this clause shall survive the termination of this Agreement.

6.17 SURVIVAL

The provisions of Clause 1 (Definitions and Interpretation), Clause 4 (Representations and Warranties), Clause 6.2 (Resolution of Disputes), Clause 6.7 (Termination), Clause 6.15 (Confidentiality), Clause 6.16 (Indemnification) and other representations, warranties, covenants and provisions contained herein that by their nature are intended to survive, shall survive the termination of this Agreement

6.18 FORCE MAJEURE

No party shall be liable for its inability or delay in performing any of its obligations hereunder if such delay is caused by circumstances beyond the reasonable control of the party including delay caused through flood, riot, Act of God, lighting civil commotion, storm, tempest and earthquake.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE CAUSED THIS AGREEMENT TO BE DULY EXECUTED AND DELIVERED AS OF THE DAY AND YEAR FIRST ABOVE WRITTEN

SIGNED AND DELIVERED by the within named **REC POWER DEVELOPMENT AND CONSULTANCY LIMITED** by the hand of Sh. Rajkumar Sonkar, HoD (CS)

(Authorised pursuant to the resolution passed by its Board of Directors in its meeting held on 02nd September, 2026)

IN THE PRESENCE OF:

WITNESS:
(Name and address)

1. Anil Kumar Perala
DGM (Engg)
RECPDCL

(Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003)

2. RITAM BISWAS,
Dy. MANAGER (ENGG.),
RECPDCL

(Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003)

SIGNED AND DELIVERED by the within named **BARMER HVDC POWER TRANSMISSION LIMITED** by the hand of Sh. Jaspal Singh Kushwaha, Director

(Authorised pursuant to the resolution passed by its Board of Directors in its meeting held on 23rd September, 2026)

WITNESS:
(Name and address)

RITU MADAN ARORA
CM(CS)
RECPDCL

(Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003)

Nirbhay Goel, DM(CS)
REC Limited

(Core-4, SCOPE Complex, 7, Lodhi Road, New Delhi-110003)

SIGNED AND DELIVERED by the within named **POWER GRID CORPORATION OF INDIA LIMITED** by the hand of Sh. Arup Kumar Samanta, General Manager, Company Secretariat, POWERGRID

(Authorised pursuant to the resolution passed by its Board of Directors in its meeting held on 09th March, 2026)

WITNESS:
(Name and address)

1. d. Aditya Mahesh
Ch. Mgr. (TBCB)
Power Grid Corporation of India Ltd.
B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016

Rohit Jain
Ch. Mgr (TBCB)
POWERGRID
B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016

ANNEXURE A

DESCRIPTION OF THE SALE SHARES

S. NO.	NAME OF THE SHAREHOLDER(s)	NUMBER OF EQUITY SHARES HELD	PERCENTAGE OF THE TOTAL PAID UP EQUITY CAPITAL
1.	REC Power Development and Consultancy Limited	49,994	99.988
2.	Shri Jaspal Singh Kushwaha*	1	0.002
3.	Shri Mukul Agarwal*	1	0.002
4.	Shri Ratnesh Kumar*	1	0.002
5.	Smt. Navita Dubal*	1	0.002
6.	Shri Arvind Kumar*	1	0.002
7.	Shri Anil Kumar Perala*	1	0.002
	Total	50,000	100.000

*** Held as nominee of REC PDCL.**

REC Power Development and Consultancy Limited Gurugram

Barmer HVDC Power Transmission Limited New Delhi 11003

POWER GRID CORPORATION OF INDIA LTD. पावरग्रिड POWERGRID

TRANSMISSION SERVICE AGREEMENT

FOR

DEVELOPMENT AND OPERATION OF INTER-STATE TRANSMISSION SYSTEM

FOR TRANSMISSION OF ELECTRICITY THROUGH TARIFF BASED COMPETITIVE BIDDING FOR

TRANSMISSION SYSTEM FOR EVACUATION OF POWER FROM RAJASTHAN REZ PH-IV (PART-5: 6 GW) [BARMER COMPLEX] BARMER-II: 6 GW (SOLAR) (LCC CONFIGURATION)

BETWEEN THE

CENTRAL TRANSMISSION UTILITY OF INDIA LIMITED

(NODAL AGENCY)

AND

BARMER HVDC POWER TRANSMISSION LIMITED

25th Sept..., 2026

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CENTRAL TRANSMISSION UTILITY OF INDIA LTD.

New Delhi 11003

Bond

Indian-Non Judicial Stamp
Haryana Government
Transmission Service Agreement

Date :03/09/2026

Certificate No. G0C2026I1767

GRN No. 158212843

Stamp Duty Paid : ₹ 101
(Rs. One)

Penalty :₹ 0
(Rs. Zero Only)

Deponent

Name: Central Transmission utility of India ltd

H.No/Floor : 2 Sector/Ward : 29 Landmark : Na

City/Village : Gurugram District : Gurugram State : Haryana

Phone : 98******10

Purpose : ARTICLE 5 GENERAL AGREEMENT **to be submitted at Concerned office**

THIS TRANSMISISON SERVICE AGREEMENT (hereinafter referred to as "TSA" or "Agreement" or "the Agreement" or "this Agreement") is made on the ..23rd.... [Insert day] of ..September [Insert month] of Two Thousand and Twenty Six.

BETWEEN:

The **CENTRAL TRANSMISSION UTILITY OF INDIA LIMITED**, a company incorporated under the Companies Act, 2013, having its registered office at **Plot No.2, Sector 29, Gurugram, Haryana 122001, India** & Correspondence address at **Floor No. 5-10, Tower 1, Plot No. 16, IRCON International Tower, Institutional Area, Sector 32, Gurugram, Haryana – 122001, India,** acting as a Nodal Agency (referred to as the "Nodal Agency"), which expression shall unless repugnant to the context or meaning thereof include its successors, and permitted assigns) as Party of the one part;

AND

BARMER HVDC POWER TRANSMISSION LIMITED, incorporated under the Companies Act, 2013, having its registered office at Core-4, Scope Complex 7, Lodhi Road Delhi, South Delhi, Delhi 110003 (herein after referred to as "Transmission Service Provider" or "TSP" or "ISTS Licensee", which expression shall unless repugnant to the context or meaning thereof include its successors, and permitted assigns) as Party of the other part;

("Nodal Agency" and "TSP" are individually referred to as "Party" and collectively as the "Parties"

CENTRAL TRANSMISSION UTILITY OF INDIA LTD

New Delhi 110003

AND WHEREAS:

A) In accordance with the Bidding Guidelines, the Bid Process Coordinator (hereinafter referred to as BPC) had initiated a competitive e-reverse bidding process through issue of RFP for selecting a Successful Bidder to build, own, operate and transfer the Project comprising of the Elements mentioned in Schedule 1 (hereinafter referred to as the Project)

B) Pursuant to the said e-reverse bidding process, the BPC has identified the Successful Bidder, who will be responsible to set up the Project on build, own, operate and transfer basis to provide Transmission Service in accordance with the terms of this Agreement and the Transmission License.

C) The Selected Bidder has submitted the Contract Performance Guarantee and acquired one hundred percent (100%) of the equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities in terms of the provisions of the Share Purchase Agreement.

D) The TSP has agreed to make an application for a Transmission License to the Commission for setting up the Project on build, own, operate and transfer basis.

E) The TSP has further agreed to make an application to the Commission for the adoption of the Transmission Charges under Section 63 of the Electricity Act, 2003, along with a certification from the Bid Evaluation Committee in accordance with the Bidding Guidelines issued by Ministry of Power, Government of India.

F) The TSP has agreed to execute the agreement(s) required, if any, under Sharing Regulations within fifteen (15) days from the date of grant of Transmission License from the Commission.

G) The TSP agrees to the terms and conditions laid down under Sharing Regulations, for making available the ISTS and charge the Transmission Charges in accordance with the terms and conditions of Sharing Regulations.

H) The billing, collection and disbursement of the Transmission Charges by the CTU to the ISTS Licensee shall be governed as per Sharing Regulations.

I) The terms and conditions stipulated in the Transmission License issued by the Commission to the TSP shall be applicable to this Agreement and the TSP agrees to comply with these terms and conditions. In case of inconsistency between the Transmission License terms & conditions and the conditions of this Agreement, the conditions stipulated in the Transmission License granted by the Commission shall prevail.

NOW, THEREFORE, IN CONSIDERATION OF THE PREMISES AND MUTUAL AGREEMENTS, COVENANTS AND CONDITIONS SET FORTH HEREIN, IT IS HEREBY AGREED BY AND BETWEEN THE PARTIES HERETO AS FOLLOWS:

ARTICLE: 1

1 DEFINITIONS AND INTERPRETATIONS

1.1 Definitions:

1.1.1 The words / expressions used in this Agreement, unless as defined below or repugnant to the context, shall have the same meaning as assigned to them by the Electricity Act, 2003 and the rules or regulations framed there under including those issued / framed by the Commission (as defined hereunder), as amended or re-enacted from time to time or the General Clauses Act, failing which it shall bear its ordinary English meaning.

The words/expressions when used in this Agreement shall have the respective meanings as specified below:

"Acquisition Price" shall have the same meaning as defined in the Share Purchase Agreement;

"Act" or **"Electricity Act"** or **"Electricity Act 2003"** shall mean the Electricity Act, 2003 and any amendments made to the same or any succeeding enactment thereof;

"Affiliate" shall mean a company that either directly or indirectly

i. controls or

ii. is controlled by or

iii. is under common control with

a Bidding Company (in the case of a single company) or a Member (in the case of a Consortium) and "**control**" means ownership by one entity of at least twenty six percent (26%) of the voting rights of the other entity;

"Availability" in relation to the Project or in relation to any Element of the Project, for a given period shall mean the time in hours during that period the Project is capable to transmit electricity at its Rated Voltage and shall be expressed in percentage of total hours in the given period and shall be calculated as per the procedure contained in Appendix –IV to Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2024, attached herewith in Schedule 6;

"Bid" shall mean technical bid and financial bid submitted by the Bidder, in response to the RFP, in accordance with the terms and conditions of the RFP;

"Bid Deadline" shall mean the last date and time for submission of the Bid in response to RFP, as specified in the RFP;

"Bidding Company" shall refer to such single company that has made a Response to RFP for the Project;

"Bidding Consortium / Consortium" shall refer to a group of companies that has collectively made a Response to RFP for the Project;

"Bid Documents" or **"Bidding Documents"** shall mean the RFP, along with all attachments thereto or clarifications thereof;

"Bidding Guidelines" shall mean the "Tariff Based Competitive Bidding Guidelines for Transmission Service" and "Guidelines for Encouraging Competition in Development of Transmission Projects" issued by Government of India, Ministry of Power under Section – 63 of the Electricity Act as amended from time to time;

"Bid Process Coordinator" or **"BPC"** shall mean a person or its authorized representative as notified by the Government of India, responsible for carrying out the process for selection of Bidder who will acquire Transmission Service Provider;

"Bill" shall mean any bill raised by the CTU on the DICs to recover the Transmission Charges pursuant to the Sharing Regulations;

"Business Day" shall mean a day other than Sunday or a statutory holiday, on which the banks remain open for business in the State in which the Nodal Agency's registered office is located and the concerned TSP are located;

"CEA" shall mean the Central Electricity Authority constituted under Section -70 of the Electricity Act;

"Change in law" shall have the meaning ascribed thereto in Article 12;

"Commercial Operation Date" or **"COD"** shall mean the date as per Article 6.2;

"Commission" or **"CERC"** shall mean the Central Electricity Regulatory Commission referred to in sub-section (1) of Section 76 of the Electricity Act, 2003 or its successors and assigns;

"Competent Court of Law" shall mean the Supreme Court or any High Court, or any tribunal or any similar judicial or quasi-judicial body in India that has jurisdiction to adjudicate upon issues relating to the Project;

"Connection Agreement" shall mean the agreement between the CTU or STU or any other concerned parties and the TSP, setting out the terms relating to the connection of the Project to the Inter-connection Facilities and use of the Inter State Transmission System as per the provisions of the IEGC, as the case may be;

"Consultation Period" shall mean the period of sixty (60) days or such longer period as the Parties may agree, commencing from the date of issue of a TSP's Preliminary Notice or a Nodal Agency's Preliminary Termination Notice, as provided in Article 13 of this Agreement, for consultation between the Parties to mitigate the consequence of the relevant event having regard to all the circumstances;

"Consents, Clearances and Permits" shall mean all authorizations, licenses approvals, registrations, permits, waivers, privileges, acknowledgements, agreements, or concessions required to be obtained from or provided by any concerned authority for the development, execution and operation of Project including without any limitation for the construction, ownership, operation and maintenance of the Transmission Lines and/or sub-stations;

"Construction Period" shall mean the period from (and including) the Effective Date of the Transmission Service Agreement up to (but not including) the COD of the Element of the Project in relation to an Element and up to (but not including) the COD of the Project in relation to the Project.

"Contractors" shall mean the engineering, procurement, construction, operation & maintenance contractors, surveyors, advisors, consultants, designers, suppliers to the TSP and each of their respective sub-contractors (and each of their respective successors and permitted assigns) in their respective capacities as such;

"Contract Performance Guarantee" shall mean the irrevocable unconditional bank guarantee, or insurance surety bond or Payment on Order Instrument submitted and to be submitted by the TSP or by the Selected Bidder on behalf of the TSP to the Nodal Agency from a bank mentioned in Annexure 17 of the RFP, in the form attached here to as Schedule 8 (for bank guarantee) or Schedule 8A (for insurance surety bond issued by any of the insurance companies authorized by Insurance Regulatory and Development Authority of India), or Schedule-8B (for Payment on Order Instrument issued by PFC/REC/IREDA, in accordance with Article 3 of this Agreement and which shall include the additional bank guarantee or insurance surety bond or Payment on Order Instrument furnished by the TSP under this Agreement;

"Contract Year", for the purpose of payment of Transmission Charges, shall mean the period beginning on the COD, and ending on the immediately succeeding March 31 and thereafter each period of 12 months beginning on April 1 and ending on March 31 provided that the last Contract Year shall end on the last day of the term of the TSA;

"CTU" or **"Central Transmission Utility"** shall have same meaning as defined in the Electricity Act, 2003;

"Day" shall mean a day starting at 0000 hours and ending at 2400 hours;

"D/C" shall mean Double Circuit;

"Designated ISTS Customers" or **"DICs"** shall have the meaning as ascribed in the Sharing Regulations;

"Dispute" shall mean any dispute or difference of any kind between the Parties, in connection with or arising out of this Agreement including any issue on the interpretation and scope of the terms of this Agreement as provided in Article 16;

"Effective Date" for the purposes of this Agreement, shall have the same meaning as per Article 2.1 of this Agreement;

"Electrical Inspector" shall mean a person appointed as such by the Government under sub-section (1) of Section 162 of the Electricity Act 2003 and also includes Chief Electrical Inspector;

"Electricity Rules 2005" shall mean the rules framed pursuant to the Electricity Act 2003 and as amended from time to time;

"Element" shall mean each Transmission Line or each circuit of the Transmission Lines (where there are more than one circuit) or each bay of Sub-station or switching station or HVDC terminal or inverter station of the Project, including ICTs, Reactors, SVC, FSC, etc. forming part of the ISTS, which will be owned, operated and maintained by the concerned ISTS Licensee, and which has a separate Scheduled COD as per Schedule 2 of this Agreement and has a separate percentage for recovery of Transmission Charges on achieving COD as per Schedule 5 of this Agreement;

"Event of Default" shall mean the events as defined in Article 13 of this Agreement;

"Expiry Date" shall be the date which is thirty five (35) years from the COD of the Project;

"Financial Closure" shall mean the first Business Day on which funds are made available to the TSP pursuant to the Financing Agreements;

"Financially Evaluated Entity" shall mean the company which has been evaluated for the satisfaction of the financial requirement set forth in the RFP;

"Financing Agreements" shall mean the agreements pursuant to which the TSP is to finance the Project including the loan agreements, security documents, notes, indentures, security agreements, letters of credit and

other documents, as may be amended, modified, or replaced from time to time, but without in anyway increasing the liabilities of the Designated ISTS Customers / Nodal Agency;

"Financial Year" shall mean a period of twelve months at midnight Indian Standard Time (IST) between 1st April & 31st March;

"Force Majeure" and **"Force Majeure Event"** shall have the meaning assigned thereto in Article 11;

"GOI" shall mean Government of India;

"Grid Code" / "IEGC" shall mean the Grid Code specified by the Central Commission under Clause (h) of sub-section (1) of Section 79 of the Electricity Act;

"Independent Engineer" shall mean an agency/ company, appointed by Nodal Agency in accordance with the Guidelines for Encouraging Competition in Development of Transmission Projects.

"Indian Governmental Instrumentality" shall mean Government of India, Government of any State in India or any ministry, department, board, authority, agency, corporation, commission under the direct or indirect control of Government of India or any State Government or both, any political sub-division of any of them including any court or Commission or tribunal or judicial or quasi-judicial body in India but excluding the CTU, TSP and the Designated ISTS Customers;

"Insurances" shall mean the insurance cover to be obtained and maintained by the TSP in accordance with Article 9 of this Agreement;

"Interconnection Facilities" shall mean the facilities as may be set up for transmission of electricity through the use of the Project, on either one or both side of generating station's / CTU's / STU's / ISTS Licensee's / Designated ISTS Customer's substations (as the case may be) which shall include, without limitation, all other transmission lines, gantries, sub-stations and associated equipment not forming part of the Project;

"ISTS Licensee" shall be the TSP under this Agreement, consequent to having been awarded a Transmission License by the CERC and shall be referred to as the TSP or the ISTS Licensee, as the context may require in this Agreement;

"Law" or "Laws" in relation to this Agreement, shall mean all laws including electricity laws in force in India and any statute, ordinance, rule, regulation, notification, order or code, or any interpretation of any of them by an Indian Governmental Instrumentality having force of law and shall include all rules, regulations, decisions and orders of the Commission;

"Lead Member of the Bidding Consortium" or "Lead Member" shall mean a company who commits at least 26% equity stake in the Project, meets the technical requirement as specified in the RFP and so designated by other Member(s) in Bidding Consortium;

"Lenders" means the banks, financial institutions, multilateral funding agencies, non-banking financial companies registered with the Reserve Bank of India (RBI), insurance companies registered with the Insurance Regulatory & Development Authority (IRDA), pension funds regulated by the Pension Fund Regulatory & Development Authority (PFRDA),mutual funds registered with Securities & Exchange Board of India (SEBI), etc., including their successors and assigns, who have agreed on or before COD of the Project to provide the TSP with the debt financing described in the capital structure schedule, and any successor banks or financial institutions to whom their interests under the Financing Agreements may be transferred or assigned;

Provided that, such assignment or transfer shall not relieve the TSP of its obligations to the Nodal Agency under this Agreement in any manner and shall also does not lead to an increase in the liability of the Nodal Agency;

"Lenders Representative" shall mean the person notified by the Lender(s) in writing as being the representative of the Lender(s) or the Security Trustee and such person may from time to time be replaced by the Lender(s) pursuant to the Financing Agreements by written notice to the TSP;

"Letter of Intent" or **"LOI"** shall have the same meaning as in the RFP;

"Member in a Bidding Consortium / Member" shall mean each company in the Bidding Consortium;

"Month" shall mean a period of thirty (30) days from (and excluding) the date of the event;

"Monthly Transmission Charges" for any Element of the Project, after COD of the Element till COD of the Project, and for the Project after COD of the Project, shall mean the amount of Transmission Charges as specified in Schedule 5 of this Agreement multiplied by no. of days in the relevant month and divided by no. of days in the year;

"National Load Despatch Centre" shall mean the centre established as per sub-section (1) of Section 26 of the Electricity Act 2003;

"Nodal Agency" shall mean CTU, which shall execute and implement the Transmission Service Agreement (TSA);

Provided that while taking major decisions, CTU shall consult CEA on technical matters and any other matter it feels necessary.

"Notification" shall mean any notification, issued in the Gazette of India;

"Operating Period" for any Element of the Project shall mean the period from (and including) the COD of such Element of the Project, up to (and including) the Expiry Date and for the Project, shall mean the period from (and including) the COD of the Project, up to (and including) the Expiry Date;

"Parent Company" shall mean an entity that holds at least twenty six percent (26%) of the paid - up equity capital directly or indirectly in the Bidding Company or in the Member in a Bidding Consortium, as the case may be;

"Payment on Order Instrument" shall mean Letter of Undertaking from Indian Renewable Energy Development Agency Limited (IREDA) or Power Finance Corporation Limited (PFC) or REC Limited (REC) [the three non-banking financial institutions under Ministry of New & Renewable Energy (MNRE)/ Ministry of Power (MoP)], to pay in case situation of default of Transmission Service Provider (TSP) in terms of tender conditions/ Power Purchase Agreement (PPA) arises. Such Letter(s) will have same effect as that of a Bank Guarantee issued by any public sector bank. Such "Payment on Order instrument" would have terms and conditions similar to that of any Bank Guarantee given by any public sector bank and would promise to pay the Nodal Agency on demand within stipulated time. TSPs can seek such Letter(s) by offering due security to the above-mentioned three non-banking financial institutions mentioned above (IREDA, PFC & REC). Nodal Agency shall not accept the instrument of 'Letter of Undertaking' as described above or in any other form, from any other non-banking financial institutions or bank, except IREDA, PFC & REC;

"Preliminary Termination Notice" shall mean a Nodal Agency's Preliminary Termination Notice as defined in Article 13 of this Agreement;

"Project" shall mean **Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5: 6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)**, as detailed in Schedule 1 of this Agreement;

"Project Assets" shall mean all physical and other assets relating to and forming part of the Project including:

(a) rights over the Site for substations, ROW for transmission lines;

(b) tangible & intangible assets such as civil works and equipment including foundations, embankments, pavements, electrical systems, communication systems, relief centres, administrative offices, Sub-stations, software, tower and sub-stations designs etc;

(c) project facilities situated on the Site;

(d) all rights of the TSP under the project agreements;

(e) financial assets, such as receivables, security deposits etc;

(f) insurance proceeds; and

(g) Applicable Permits and authorisations relating to or in respect of the Transmission System;"

"Project Execution Plan" shall mean the plan referred to in Article 3.1.3(c) hereof;

"Prudent Utility Practices" shall mean the practices, methods and standards that are generally accepted internationally from time to time by electric transmission utilities for the purpose of ensuring the safe, efficient and economic design, construction, commissioning, operation, repair and maintenance of the Project and which practices, methods and standards shall be adjusted as necessary, to take account of:

(i) operation, repair and maintenance guidelines given by the manufacturers to be incorporated in the Project,

(ii) the requirements of Law, and

(iii) the physical conditions at the Site;

(iv) the safety of operating personnel and human beings;

"Rated Voltage" shall mean voltage at which the Transmission System is designed to operate or such lower voltage at which the line is charged, for the time being, in consultation with the Central Transmission Utility;

"Rebate" shall have the meaning as ascribed to in Article 10.3 of this Agreement;

"RFP" shall mean Request for Proposal dated 28.01.2026 along with all schedules, annexures and RFP Project Documents attached thereto, issued by the BPC for tariff based competitive bidding process for selection of Bidder as TSP to execute the Project, including any modifications, amendments or alterations thereto;

"RFP Project Documents" shall mean the following documents to be entered into in respect of the Project, by the Parties to the respective agreements:

a. Transmission Service Agreement,

b. Share Purchase Agreement,

c. Agreement(s) required under Sharing Regulations and

d. Any other agreement as may be required;

"RLDC" shall mean the relevant Regional Load Dispatch Centre as defined in the Electricity Act, 2003, in the region(s) in which the Project is located;

"RPC" shall mean the relevant Regional Power Committee established by the Government of India for the specific Region(s) in accordance with the Electricity Act, 2003 for facilitating integrated operation of the Power System in that Region;

"Scheduled COD" in relation to an Element(s) shall mean the date(s) as mentioned in Schedule 2 as against such Element(s) and in relation to the Project, shall mean the date as mentioned in Schedule 2 as against such Project, subject to the provisions of Article 4.4 of this Agreement, or such date as may be mutually agreed among the Parties;

"Scheduled Outage" shall mean the final outage plan as approved by the RPC as per the provisions of the Grid Code;

"Selected Bid" shall mean the technical Bid and the Final Offer of the Selected Bidder submitted during e-reverse bidding, which shall be downloaded and attached in Schedule 7 on or prior to the Effective Date;

"Share Purchase Agreement" shall mean the agreement amongst REC Power Development and Consultancy Limited,Barmer HVDC Power Transmission Limited and the Successful Bidder for the purchase of one hundred (100%) per cent of the shareholding of theBarmer HVDC Power Transmission Limited for the Acquisition Price, by the Successful Bidder on the terms and conditions as contained therein;

"Sharing Regulations" shall mean the Central Electricity Regulatory Commission (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020 and as amended from time to time;

"Site" in relation to a substation, switching station or HVDC terminal or inverter station, shall mean the land and other places upon which such station / terminal is to be established;

"SLDC" shall mean the State Load Despatch Centre established as per sub-section (1) of Section 31 of the Electricity Act 2003;

"STU" or **"State Transmission Utility"** shall be the Board or the Government company, specified as such by the State Government under sub-section (1) of Section 39 of the Electricity Act 2003;

"Successful Bidder" or **"Selected Bidder"** shall mean the Bidder selected pursuant to the RFP and who has to acquire one hundred percent (100%) equity shares ofBarmer HVDC Power Transmission Limited, along with all its related assets and liabilities, which will be responsible as the TSP to establish the Project on build, own, operate and transfer basis as per the terms of the TSA and other RFP Project Documents;

"TSP's Preliminary Notice" shall mean a notice issued by the TSP in pursuant to the provisions of Article 13.3 of this Agreement;

"Target Availability" shall have the meaning as ascribed hereto in Article 8.2 of this Agreement;

"Technically Evaluated Entity" shall mean the company which has been evaluated for the satisfaction of the technical requirement set forth in RFP;

"Termination Notice" shall mean a Nodal Agency's Termination Notice given by the Nodal Agency to the TSP pursuant to the provisions of Articles 3.3.2, 3.3.4, 4.4.2, 5.8, 13.2 and 13.3 of this Agreement for the termination of this Agreement;

"Term of Agreement" for the purposes of this Agreement shall have the meaning ascribed thereto in Article 2.2 of this Agreement;

"Transmission Charges" shall mean the Final Offer of the Selected Bidder during the e-reverse bidding and adopted by the Commission, payable to the TSP as per Sharing Regulations;

"Transmission License" shall mean the license granted by the Commission in terms of the relevant regulations for grant of such license issued under the Electricity Act;

"Transmission Service" shall mean making the Project available as per the terms and conditions of this Agreement and Sharing Regulations;

"Unscheduled Outage" shall mean an interruption resulting in reduction of the Availability of the Element(s) / Project (as the case may be) that is not a result of a Scheduled Outage or a Force Majeure Event.

"Ultimate Parent Company" shall mean an entity which owns at least twenty six percent (26%) equity in the Bidding Company or Member of a

Consortium, (as the case may be) and in the Technically Evaluated Entity and / or Financially Evaluated Entity (as the case may be) and such Bidding Company or Member of a Consortium, (as the case may be) and the Technically Evaluated Entity and / or Financially Evaluated Entity (as the case may be) shall be under the direct control or indirectly under the common control of such entity;

1.2 Interpretation:

Save where the contrary is indicated, any reference in this Agreement to:

"Agreement" shall be construed as including a reference to its Schedules, Appendices and Annexures;

"Rupee", **"Rupees"** and **"Rs."** shall denote lawful currency of India;

"crore" shall mean a reference to ten million (10,000,000) and a **"lakh"** shall mean a reference to one tenth of a million (1,00,000);

"encumbrance" shall be construed as a reference to a mortgage, charge, pledge, lien or other encumbrance securing any obligation of any person or any other type of preferential arrangement (including, without limitation, title transfer and retention arrangements) having a similar effect;

"holding company" of a company or corporation shall be construed as a reference to any company or corporation of which the other company or corporation is a subsidiary;

"indebtedness" shall be construed so as to include any obligation (whether incurred as principal or surety) for the payment or repayment of money, whether present or future, actual or contingent;

"person" shall have the meaning as defined in Section 2 (49) of the Act;

"subsidiary" of a company or corporation (the holding company) shall be construed as a reference to any company or corporation:

(i) which is controlled, directly or indirectly, by the holding company, or

(ii) more than half of the issued share capital of which is beneficially owned, directly or indirectly, by the holding company, or

(iii) which is a subsidiary of another subsidiary of the holding company,

for these purposes, a company or corporation shall be treated as being controlled by another if that other company or corporation is able to direct its affairs and/or to control the composition of its board of directors or equivalent body;

"winding-up", **"dissolution"**, **"insolvency"**, or **"reorganization"** in the context of a company or corporation shall have the same meaning as defined in the Companies Act, 1956/ Companies Act, 2013 (as the case may be).

1.2.1 Words importing the singular shall include the plural and vice versa.

1.2.2 This Agreement itself or any other agreement or document shall be construed as a reference to this or to such other agreement or document as it may have been, or may from time to time be, amended, varied, novated, replaced or supplemented.

1.2.3 A Law shall be construed as a reference to such Law including its amendments or re-enactments from time to time.

1.2.4 A time of day shall, save as otherwise provided in any agreement or document be construed as a reference to Indian Standard Time.

1.2.5 Different parts of this Agreement are to be taken as mutually explanatory and supplementary to each other and if there is any inconsistency between or among the parts of this Agreement, they shall be interpreted in a harmonious manner so as to give effect to each part.

1.2.6 The tables of contents and any headings or sub-headings in this Agreement have been inserted for ease of reference only and shall not affect the interpretation of this Agreement.

1.2.7 All interest payable under this Agreement shall accrue from day to day and be calculated on the basis of a year of three hundred and sixty five (365) days.

1.2.8 The words "hereof" or "herein", if and when used in this Agreement shall mean a reference to this Agreement.

1.2.9 The contents of Schedule 7 shall be referred to for ascertaining accuracy and correctness of the representations made by the Selected Bidder in Article 17.2.1 hereof.

ARTICLE: 2

2 EFFECTIVENESS AND TERM OF AGREEMENT

2.1 Effective Date:

This Agreement shall be effective from later of the dates of the following events:

a. The Selected Bidder, on behalf of the TSP, has provided the Contract Performance Guarantee, as per terms of Article 3.1 of this Agreement; and

b. The Selected Bidder has acquired for the Acquisition Price, one hundred percent (100%) of the equity shareholding of REC Power Development and Consultancy Limited inBarmer HVDC Power Transmission Limited along with all its related assets and liabilities as per the provisions of the Share Purchase Agreement. and

c. The Agreement is executed and delivered by the Parties;

2.2 Term and Termination:

2.2.1 Subject to Article 2.2.3 and Article 2.4, this Agreement shall continue to be effective in relation to the Project until the Expiry Date, when it shall automatically terminate.

2.2.2 Post the Expiry Date of this Agreement, the TSP shall ensure transfer of Project Assets to CTU or its successors or an agency as decided by the Central Government at zero cost and free from any encumbrance and liability. The transfer shall be completed within 90 days of expiry of this Agreement failing which CTU shall be entitled to take over the Project Assets Suo moto.

2.2.3 This Agreement shall terminate before the Expiry Date in accordance with Article 13 or Article 3.3.2 or Article 3.3.4.

2.3 Conditions prior to the expiry of the Transmission License

2.3.1 In order to continue the Project beyond the expiry of the Transmission License, the TSP shall be obligated to make an application to the Commission at least two (2) years before the date of expiry of the Transmission License, seeking the Commission's approval for the extension of the term of the Transmission License up to the Expiry Date.

2.3.2 The TSP shall timely comply with all the requirements that may be laid down by the Commission for extension of the term of the Transmission License beyond the initial term of twenty-five (25) years & upto the Expiry Date and the TSP shall keep the Nodal Agency fully informed about the progress on its application for extension of the term of the Transmission License.

2.4 Survival:

The expiry or termination of this Agreement shall not affect any accrued rights, obligations/ roles and liabilities of the Parties under this Agreement, including the right to receive liquidated damages as per the terms of this Agreement, nor shall it effect the survival of any continuing obligations/ roles for which this Agreement provides, either expressly or by necessary implication, which are to survive after the Expiry Date or termination including those under Articles 3.3.3, 3.3.5, Article 9.3 (Application of Insurance Proceeds), Article 11 (Force Majeure), Article 13 (Events of Default and Termination), Article 14 (Liability & Indemnification), Article 16 (Governing Law & Dispute Resolution), Article 19 (Miscellaneous).

2.5 Applicability of the provisions of this Agreement

2.5.1 For the purpose of Availability, Target Availability and the computation of Availability, Incentive, Penalty, the provisions provided in this Agreement shall apply and any future modifications in the relevant Rules and Regulations shall not be applicable for this Project.

2.5.2 For the purposes of this Agreement for ISTS systems developed under the tariff based competitive bidding framework, the provisions relating to the definitions (Availability and COD), Article 3 (Contract Performance Guarantee and Conditions Subsequent), Article 5 (Construction of the Project), Article 6 (Connection and Commissioning of the Project), Article 8 (Target Availability and calculation of Availability), Article 11 (Force Majeure), Article 12 (Change in Law), Article 13 (Event of Default), Article 14 (Indemnification), Article 15 (Assignment and Charges), Articles 16.1, 16.2 and 16.4 (Governing Laws and Dispute Resolution) and Article 17 (representation and warranties of the ISTS Licensee) of this agreement shall supersede the corresponding provisions under Sharing Regulations

ARTICLE: 3

3 CONDITIONS SUBSEQUENT

3.1 Satisfaction of conditions subsequent by the TSP

3.1.1 Within ten (10) days from the date of issue of Letter of Intent, the Selected Bidder, shall:

a. Provide the Contract Performance Guarantee, and

b. Acquire, for the Acquisition Price, one hundred percent (100%) equity shareholding of Barmer HVDC Power Transmission Limited from REC Power Development and Consultancy Limited, who shall sell to the Selected Bidder, the equity shareholding of Barmer HVDC Power Transmission Limited, along with all its related assets and liabilities.

c. Execute this Agreement.

The TSP shall, within five (5) working days from the date of acquisition of SPV by the Selected Bidder, undertake to apply to the Commission for the grant of Transmission License and for the adoption of tariff as required under section-63 of the Electricity Act.

The Selected Bidder, on behalf of the TSP, will provide to the Central Transmission Utility of India Limited (being the Nodal Agency) the Contract Performance Guarantee for an amount of Rs. 716 Crore (Rupees Seven Hundred and Sixteen Crore Only).

3.1.2 The Contract Performance Guarantee shall be initially valid for a period up to three (3) months after the Scheduled COD of the Project and shall be extended from time to time to be valid for a period up to three (3) months after the COD of the Project. In case the validity of the Contract Performance Guarantee is expiring before the validity specified in this Article, the TSP shall, at least thirty (30) days before the expiry of the Contract Performance Guarantee, replace the Contract Performance Guarantee with another Contract Performance Guarantee or extend the validity of the existing Contract Performance Guarantee until the validity period specified in this Article.

3.1.3 The TSP agrees and undertakes to duly perform and complete the following activities within six (6) months from the Effective Date (except for c) below), unless such completion is affected due to any Force Majeure Event, or if any of the activities is specifically waived in writing by the Nodal Agency:

a. To obtain the Transmission License for the Project from the

Commission;

b. To obtain the order for adoption of Transmission Charges by the Commission, as required under Section 63 of the Electricity Act 2003;

c. To submit to the Nodal Agency, CEA & Independent Engineer, the Project Execution Plan, immediately after award of contract(s) and maximum within one hundred and twenty (120) days from the Effective Date. Also, an approved copy each of Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) would be submitted to Independent Engineer & Nodal Agency in the same time period. The TSP's Project Execution Plan should be in conformity with the Scheduled COD as specified in Schedule 2 of this Agreement, and shall bring out clearly the organization structure, time plan and methodology for executing the Project, award of major contracts, designing, engineering, procurement, shipping, construction, testing and commissioning to commercial operation;

d. To submit to the Nodal Agency, CEA & Independent Engineer a detailed bar (GANTT) chart of the Project outlining each activity (taking longer than one Month), linkages as well as durations;

e. To submit to the Nodal Agency, CEA & Independent Engineer detailed specifications of conductor meeting the functional specifications specified in RFP;

f. To achieve Financial Closure;

g. To provide an irrevocable letter to the Lenders duly accepting and acknowledging the rights provided to the Lenders under the provisions of Article 15.3 of this Agreement and all other RFP Project Documents;

h. To award the Engineering, Procurement and Construction contract ("EPC contract") for the design and construction of the Project and shall have given to such Contractor an irrevocable notice to proceed; and

i. To sign the Agreement(s) required, if any, under Sharing Regulations.

3.2 Recognition of Lenders' Rights by the Nodal Agency

3.2.1 The Nodal Agency hereby accepts and acknowledges the rights provided to the Lenders as per Article 15.3 of this Agreement and all other RFP Project Documents.

3.3 Consequences of non-fulfilment of conditions subsequent

3.3.1 If any of the conditions specified in Article 3.1.3 is not duly fulfilled by the TSP even within three (3) Months after the time specified therein, then on

and from the expiry of such period and until the TSP has satisfied all the conditions specified in Article 3.1.3, the TSP shall, on a monthly basis, be liable to furnish to Central Transmission Utility of India Limited (being the Nodal Agency) additional Contract Performance Guarantee of Rupees Seventy One Crore Sixty Lakh Only (Rs. 71.60 Crore) within two (2) Business Days of expiry of every such Month. Such additional Contract Performance Guarantee shall be provided to Central Transmission Utility of India Limited (being the Nodal Agency) in the manner provided in Article 3.1.1 and shall become part of the Contract Performance Guarantee and all the provisions of this Agreement shall be construed accordingly. Central Transmission Utility of India Limited (being the Nodal Agency) shall be entitled to hold and / or invoke the Contract Performance Guarantee, including such additional Contract Performance Guarantee, in accordance with the provisions of this Agreement.

3.3.2 Subject to Article 3.3.4, if:

(i) the fulfilment of any of the conditions specified in Article 3.1.3 is delayed beyond nine (9) Months from the Effective Date and the TSP fails to furnish additional Contract Performance Guarantee to the Nodal Agency in accordance with Article 3.3.1 hereof; or

(ii) the TSP furnishes additional Performance Guarantee to the Nodal Agency in accordance with Article 3.3.1 hereof but fails to fulfil the conditions specified in Article 3.1.3 within a period of twelve (12) months from the Effective Date,

the Nodal Agency shall have the right to terminate this Agreement, by giving a Termination Notice to the TSP, in writing, of at least seven (7) days, with a copy to CEA and the Lenders' Representative in order to enable the Lenders to exercise right of substitution in accordance with Article 15.3 of this Agreement.

3.3.3 If the Nodal Agency elects to terminate this Agreement as per the provisions of Article 3.3.2, the TSP shall be liable to pay to the Nodal Agency an amount of Rs. 716 Crore (Rupees Seven Hundred and Sixteen Crore Only) as liquidated damages. The Nodal Agency shall be entitled to recover this amount of damages by invoking the Contract Performance Guarantee to the extent of liquidated damages, which shall be required by the Nodal Agency, and the balance shall be returned to TSP, if any.

It is clarified for removal of doubt that this Article shall survive the termination of this Agreement.

3.3.4 In case of inability of the TSP to fulfil the conditions specified in Article 3.1.3 due to any Force Majeure Event, the time period for fulfilment of the

condition subsequent as mentioned in Article 3.1.3, may be extended for a period of such Force Majeure Event. Alternatively, if deemed necessary, this Agreement may be terminated by the Nodal Agency by giving a Termination Notice to the TSP, in writing, of at least seven (7) days, with a copy to CEA and the Lenders' Representative in order to enable the Lenders to exercise right of substitution in accordance with Article 15.3 of this Agreement and the Contract Performance Guarantee shall be returned as per the provisions of Article 6.5.1.

Provided, that due to the provisions of this Article 3.3.4, any increase in the time period for completion of conditions subsequent mentioned under Article 3.1.3, shall lead to an equal increase in the time period for the Scheduled COD. If the Scheduled COD is extended beyond a period of one hundred eighty (180) days due to the provisions of this Article 3.3.4, the TSP will be allowed to recover the interest cost during construction corresponding to the period exceeding one hundred eighty (180) days by adjustment in the Transmission Charges in accordance with Schedule 9.

3.3.5 Upon termination of this Agreement as per Articles 3.3.2 and 3.3.4, the Nodal Agency may take steps to bid out the Project again.

3.3.6 The Nodal agency, on the failure of the TSP to fulfil its obligations, if it considers that there are sufficient grounds for so doing, apart from invoking the Contract Performance Guarantee under para 3.3.3 may also initiate proceedings for blacklisting the TSP as per provisions of Article 13.2 of TSA.

3.4 Progress Reports

The TSP shall notify the Nodal Agency and CEA in writing at least once a Month on the progress made in satisfying the conditions subsequent in Articles 3.1.3.

ARTICLE: 4

4 DEVELOPMENT OF THE PROJECT

4.1 TSP's obligations in development of the Project:

Subject to the terms and conditions of this Agreement, the TSP at its own cost and expense shall observe, comply with, perform, undertake and be responsible:

a. for procuring and maintaining in full force and effect all Consents, Clearances and Permits, required in accordance with Law for development of the Project;

b. for financing, constructing, owning and commissioning each of the Element of the Project for the scope of work set out in Schedule 1 of this Agreement in accordance with:

i. the Electricity Act and the Rules made thereof;

ii. the Grid Code;

iii. the CEA Regulations applicable, and as amended from time to time, for Transmission Lines and sub-stations:

- the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007;
- Central Electricity Authority (Technical Standards for construction of Electrical Plants and Electric Lines) Regulation, 2010;
- Central Electricity Authority (Grid Standard) Regulations, 2010;
- Central Electricity Authority (Safety requirements for construction, operation and maintenance of Electrical Plants and Electrical Lines) Regulation, 2011;
- Central Electricity Authority (Measures relating to Safety and Electricity Supply) Regulation, 2010;
- Central Electricity Authority (Technical Standards for Communication System in Power System Operation) Regulations, 2020.

iv. Safety/ security Guidelines laid down by the Government;

v. Prudent Utility Practices, relevant Indian Standards and the Law;

not later than the Scheduled COD as per Schedule 2 of this Agreement;

c. for entering into a Connection Agreement with the concerned parties in accordance with the Grid Code.

d. for owning the Project throughout the term of this Agreement free and clear of any encumbrances except those expressly permitted under Article 15 of this Agreement;

e. to co-ordinate and liaise with concerned agencies and provide on a timely basis relevant information with regard to the specifications of the Project that may be required for interconnecting the Project with the Interconnection Facilities;

f. for providing all assistance to the Arbitrators as they may require for the performance of their duties and responsibilities;

g. to provide to the Nodal Agency and CEA, on a monthly basis, progress reports with regard to the Project and its execution (in accordance with prescribed form) to enable the CEA to monitor and co-ordinate the development of the Project matching with the Interconnection Facilities;

h. to comply with Ministry of Power order no. 25-11/6/2018 – PG dated 02.07.2020 as well as other Guidelines issued by Govt. of India pertaining to this;

i. to procure the products associated with the Transmission System as per provisions of Public Procurement (Preference to Make in India) orders issued by Ministry of Power vide orders No. A-1/2021- FSC- Part(5) dated 16.11.2021 and No.: P45021/2/2017-PP (BE-II)-Part-4 Vol.II dated 19.07.2024 issued by Ministry of Power for transmission sector, as amended from time to time read with Department for Promotion of Industry and Internal Trade (DPIIT) orders in this regard (Procuring Entity as defined in above orders shall deemed to have included Selected Bidder and/ or TSP).

Also, to comply with Department of Expenditure, Ministry of Finance vide Order (Public Procurement No 1) bearing File No. 6/18/2019-PPD dated 23.07.2020, Order (Public Procurement No 2) bearing File No. 6/18/2019-PPD dated 23.07.2020 and Order (Public Procurement No. 3) bearing File No. 6/18/2019-PPD, dated 24.07.2020, Office Memorandum (OM) No.

F.18/37/2020-PPD dated 08.02.2021, OM No. F.12/1/2021-PPD(Pt.) dated 02.03.2021, OM No. F.7/10/2021-PPD dated 08.06.2021 and Order (Public Procurement No 4) bearing File No. F.7/10/2021- PPD dated 23.02.2023, as amended from time to time, regarding public procurement from a bidder of a country, which shares land border with India,

j. to submit to Nodal Agency information in the prescribed format [To be devised by Nodal Agency] for ensuring compliance to Article 4.1 i) above.

k. to comply with all its obligations undertaken in this Agreement.

4.2 Roles of the Nodal Agency in implementation of the Project:

4.2.1 Subject to the terms and conditions of this Agreement, the Nodal Agency shall be the holder and administrator of this Agreement and shall inter alia:

a. appoint an Independent Engineer within 90 days of the Effective Date

b. provide letters of recommendation to the concerned Indian Governmental Instrumentality, as may be requested by the TSP from time to time, for obtaining the Consents, Clearances and Permits required for the Project;

c. coordinate among TSP and upstream/downstream entities in respect of Interconnection Facilities; and

d. monitor the implementation of the Agreement and take appropriate action for breach thereof including revocation of guarantees, cancellation of Agreement, blacklisting etc

e. provide all assistance to the Arbitrators as required for the performance of their duties and responsibilities; and

f. perform any other responsibility (ies) as specified in this Agreement.

4.3 Time for Commencement and Completion:

a. The TSP shall take all necessary steps to commence work on the Project from the Effective Date of the Agreement and shall achieve Scheduled COD of the Project in accordance with the time schedule specified in Schedule 2 of this Agreement;

b. The COD of each Element of the Project shall occur no later than the Scheduled COD or within such extended time to which the TSP shall be entitled under Article 4.4 hereto.

4.4 Extension of time:

4.4.1 In the event that the TSP is unable to perform its obligations for the reasons solely attributable to the Nodal Agency, the Scheduled COD shall be extended, by a 'day to day' basis, subject to the provisions of Article 13.

4.4.2 In the event that an Element or the Project cannot be commissioned by its Scheduled COD on account of any Force Majeure Event as per Article 11, the Scheduled COD shall be extended, by a 'day to day' basis for a period of such Force Majeure Event. Alternatively, if deemed necessary, the Nodal Agency may terminate the Agreement as per the provisions of Article 13.4 by giving a Termination Notice to the TSP, in writing, of at least seven (7) days, with a copy to CEA and the Lenders' Representative in order to enable the Lenders to exercise right of substitution in accordance with Article 15.3 of this Agreement.

4.4.3 If the Parties have not agreed, within thirty (30) days after the affected Party's performance has ceased to be affected by the relevant circumstance, on how long the Scheduled COD should be deferred by, any Party may raise the Dispute to be resolved in accordance with Article 16.

4.5 Metering Arrangements:

4.5.1 The TSP shall comply with all the provisions of the IEGC and the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 as amended from time to time, with regard to the metering arrangements for the Project. The TSP shall fully cooperate with the CTU / STU / RLDC and extend all necessary assistance in taking meter readings.

4.6 Interconnection Facilities:

4.6.1 Subject to the terms and conditions of this Agreement, the TSP shall be responsible for connecting the Project with the interconnection point(s) specified in Schedule 1 of this Agreement. The Interconnection Facilities shall be developed as per the scope of work and responsibilities assigned in Schedule 1 of this Agreement. The Nodal Agency shall be responsible for coordinating to make available the Interconnection Facilities.

4.6.2 In order to remove any doubts, it is made clear that the obligation of the TSP within the scope of the project is to construct the Project as per Schedule-1 of this Agreement and in particular to connect it to the Interconnection Facilities as specified in this Agreement.

ARTICLE: 5

5 CONSTRUCTION OF THE PROJECT

5.1 TSP's Construction Responsibilities:

5.1.1 The TSP, at its own cost and expense, shall be responsible for designing, constructing, erecting, testing and commissioning each Element of the Project by the Scheduled COD in accordance with the Regulations and other applicable Laws specified in Article 4.1 of this Agreement.

5.1.2 The TSP acknowledges and agrees that it shall not be relieved from any of its obligations under this Agreement or be entitled to any extension of time or any compensation whatsoever by reason of the unsuitability of the Site or Transmission Line route(s).

5.1.3 The TSP shall be responsible for obtaining all Consents, Clearances and Permits related but not limited to road / rail / river / canal / power line / crossings, Power and Telecom Coordination Committee (PTCC), defence, civil aviation, right of way / way-leaves and environmental & forest clearances from relevant authorities required for developing, financing, constructing, maintaining/ renewing all such Consents, Clearances and Permits in order to carry out its obligations under this Agreement in general and shall furnish to the Nodal Agency such copy/ies of each Consents, Clearances and Permits, on demand. Nodal Agency shall provide letters of recommendation to the concerned Indian Governmental Instrumentality as may be requested by the TSP from time to time for obtaining the Consents, Clearances and Permits required for the Project.

5.1.4 The TSP shall be responsible for:

(a) acquisition of land for location specific substations, switching stations or HVDC terminal or inverter stations. Also, the actual location of Greenfield substations (Switching Stations or HVDC Terminal or Inverter Stations) for a generation pooling substation and for load serving substations in the scope of TSP;

- For a Generation Pooling Substation shall not be beyond 3 Km radius of the location proposed by the BPC in their Survey Report.
- For Load Serving Substation within the scope of TSP shall not be beyond 5 Km radius of the location proposed by the BPC in their Survey Report
- For an intermediate Substation shall not be beyond 10 Km radius of the location proposed by the BPC in their Survey Report.

(b) final selection of Site including its geo-technical investigation;

(c) survey and geo-technical investigation of line route in order to determine the final route of the Transmission Lines;

(d) seeking access to the Site and other places where the Project is being executed, at its own risk and costs, including payment of any crop, tree compensation or any other compensation as may be required.

5.1.5 In case the Project involves any resettlement and rehabilitation, the resettlement and rehabilitation package will be implemented by the State Government authorities, for which the costs is to be borne by the TSP and no changes would be allowed in the Transmission Charges on account of any variation in the resettlement and rehabilitation cost. The TSP shall provide assistance on best endeavour basis, in implementation of the resettlement and rehabilitation package, if execution of such package is in the interest of expeditious implementation of the Project and is beneficial to the Project affected persons.

5.2 Appointing Contractors:

5.2.1 The TSP shall conform to the requirements as provided in this Agreement while appointing Contractor(s) for procurement of goods & services.

5.2.2 The appointment of such Contractor(s) shall neither relieve the TSP of any of its obligations under this Agreement nor make the Nodal Agency liable for the performance of such Contractor(s).

5.3 Monthly Progress Reporting:

The TSP shall provide to the CEA, Nodal Agency & Independent Engineer, on a monthly basis, progress reports along with likely completion date of each Element with regard to the Project and its execution (in accordance with prescribed form). The Nodal Agency/ CEA shall monitor the development of the Project for its timely completion for improving and augmenting the electricity system as a part of its statutory responsibility.

5.4 Quality of Workmanship:

The TSP shall ensure that the Project is designed, built and completed in a good workmanship using sound engineering and construction practices, and using only materials and equipment that are new and manufactured as per the MQP and following approved FQP for erection, testing & commissioning and complying with Indian /International Standards such

that, the useful life of the Project will be at least thirty five (35) years from the COD of the Project.

The TSP shall ensure that all major substation equipment / component (e.g. transformers, reactors, Circuit Breakers, Instrument Transformers (IT), Surge Arresters (SA), Protection relays, clamps & connectors etc.), equipment in terminal stations of HVDC installations including Thyristor/ IGBT valves, Converter Transformers, smoothing reactors, Transformer bushings and wall bushings, GIS bus ducts, towers and gantry structures and transmission towers or poles and line materials (conductors, earthwire, OPGW, insulator, accessories for conductors, OPGW & earthwires, hardware fittings for insulators, aviation lights etc), facilities and system shall be designed, constructed and tested (Type test, Routine tests, Factory Acceptance Test (FAT)) in accordance with relevant CEA Regulations and Indian Standards. In case Indian Standards for any particular equipment/ system/ process is not available, IEC/ IEEE or equivalent International Standards and Codes shall be followed.

5.5 Progress Monitoring & Quality Assurance:

5.5.1 The Project Execution Plan submitted by the TSP in accordance with Article 3.1.3 c) shall comprise of detailed schedule of all the equipments/items /materials required for the Project, right from procurement of raw material till the dispatch from works and receipt at the site. Further, it should also include various stages of the construction schedule up to the commissioning of the Project.

5.5.2 Nodal Agency, CEA & Independent Engineer shall have access at all reasonable times to the Site and to the Manufacturer's works and to all such places where the Project is being executed.

5.5.3 Independent Engineer shall ensure conformity of the conductor specifications with the functional specifications specified in RFP.

5.5.4 The Independent Engineer shall monitor the following during construction of the Project:

a) Quality of equipments, material, foundation, structures and workmanship etc. as laid down in Article 5.4 and 6.1.4 of the TSA. Specifically, quality of Sub-station equipments, transmission line material and workmanship etc. would be checked in accordance with the Article 5.4.

b) Progress in the activities specified in Condition Subsequent.

c) Verification of readiness of the elements including the statutory clearances & completion of civil works, fixing of all components and finalisation of punch points (if any) prior to charging of the elements.

d) Progress of construction of substation and Transmission Lines.

5.5.5 The progress shall be reviewed by the Independent Engineer against the Project Execution Plan. The Independent Engineer shall prepare its report on monthly basis and submit the same to Nodal Agency highlighting the progress achieved till the end of respective month vis-à-vis milestone activities, areas of concern, if any, which may result in delay in the timely completion of the Project. Based on the progress, Nodal Agency and/ or CEA shall issue written instructions to the TSP to take corrective measures, as may be prudent for the timely completion of the Project. In case of any deficiency, the Nodal Agency would be at liberty to take action in accordance with the procedure of this Agreement.

5.5.6 For any delay in commissioning any critical Element(s), as identified in Schedule 1 & Schedule 2 of this Agreement, beyond a period of 45 days shall lead to a sequestration of 10% of the Contract Performance Guarantee.

5.6 Site regulations and Construction Documents

The TSP shall abide by the Safety Rules and Procedures as mentioned in Schedule 3 of this Agreement

The TSP shall retain at the Site and make available for inspection at all reasonable times, copies of the Consents, Clearances and Permits, construction drawings and other documents related to construction.

5.7 Supervision of work:

The TSP shall provide all necessary superintendence for execution of the Project and its supervisory personnel shall be available to provide full-time superintendence for execution of the Project. The TSP shall provide skilled personnel who are experienced in their respective fields.

5.8 Remedial Measures:

The TSP shall take all necessary actions for remedying the shortfall in achievement of timely progress in execution of the Project, if any, as intimated by the Independent Engineer and/ or CEA and/ or the Nodal Agency. However, such intimation by the Independent Engineer and/ or CEA and/ or the Nodal Agency and the subsequent effect of such remedial measures carried out by the TSP shall not relieve the TSP of its obligations in the Agreement. Independent Engineer and/ or CEA and/ or the Nodal Agency may carry out random inspections during the Project execution, as and when deemed necessary by it. If the shortfalls as intimated to the TSP are not remedied to the satisfaction of the CEA and/ or the Nodal Agency, this Agreement may be terminated by the Nodal Agency by giving a Termination Notice to the TSP, in writing, of at least seven (7) days, with a copy to CEA and the Lenders' Representative in order to enable the

Lenders to exercise right of substitution in accordance with Article 15.3 of this Agreement.

ARTICLE: 6

6 CONNECTION AND COMMISSIONING OF THE PROJECT

6.1 Connection with the Inter-Connection Facilities:

6.1.1 The TSP shall give the RLDC(s), CTU. / STU, as the case may be, and any other agencies as required, at least sixty (60) days advance written notice of the date on which it intends to connect an Element of the Project, which date shall not be earlier than its Scheduled COD or Schedule COD extended as per Article 4.4.1 & 4.4.2 of this Agreement, unless mutually agreed to by Parties. Further, any preponing of COD of any element prior to Scheduled COD must be approved by the Nodal Agency.

6.1.2 The RLDC / SLDC (as the case may be) or the CTU / STU (as the case may be), for reasonable cause, including non-availability of Interconnection Facilities as per Article 4.2, can defer the connection for up to fifteen (15) days from the date notified by the TSP pursuant to Article 6.1.1, if it notifies to the TSP in writing, before the date of connection, of the reason for the deferral and when the connection is to be rescheduled. However, no such deferment on one or more occasions would be for more than an aggregate period of thirty (30) days. Further, the Scheduled COD would be extended as required, for all such deferments on "day to day" basis.

6.1.3 Subject to Articles 6.1.1 and 6.1.2, any Element of Project may be connected with the Interconnection Facilities when:

a. it has been completed in accordance with this Agreement and the Connection Agreement;

b. it meets the Grid Code, Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 as amended from time to time and all other Indian legal requirements, and

c. The TSP has obtained the approval in writing of the Electrical Inspector certifying that the Element is ready from the point of view of safety of supply and can be connected with the Interconnection Facilities.

d. It has satisfactorily met all the testing requirements as per Articles 6.1.4

6.1.4 Site Acceptance Test (SAT)/ pre-commissioning tests of all major substation equipment, component, system, facilities shall be successfully carried out before commissioning. The Type tests, FAT and SAT reports

should be available at the substation / terminal station of HVDC installations for ready reference of operation and maintenance staff and has to be made available to the Independent Engineer appointed for quality monitoring or their authorised representatives, as and when they wish to examine the same.

6.2 Commercial Operation:

6.2.1 An Element of the Project shall be declared to have achieved COD twenty four (24) hours following the connection of the Element with the Interconnection Facilities pursuant to Article 6.1 or seven (7) days after the date on which it is declared by the TSP to be ready for charging but is not able to be charged for reasons not attributable to the TSP subject to Article 6.1.2.

Provided that an Element shall be declared to have achieved COD only after all the Element(s), if any, which are pre-required to have achieved COD as defined in Schedule 2 of this Agreement, have been declared to have achieved their respective COD.

6.2.2 Once any Element of the Project has been declared to have achieved deemed COD as per Article 6.2.1 above, such Element of the Project shall be deemed to have Availability equal to the Target Availability till the actual charging of the Element and to this extent, TSP shall be eligible for the Monthly Transmission Charges applicable for such Element.

6.3 Compensation for Direct Non Natural Force Majeure Event or Indirect Non Natural Force Majeure Event or Natural Force Majeure Event (affecting the Nodal Agency)

6.3.1 If the TSP is otherwise ready to connect the Element(s) of the Project and has given due notice, as per provisions of Article 6.1.1, to the concerned agencies of the date of intention to connect the Element(s) of the Project, where such date is not before the Scheduled COD, but is not able to connect the Element(s) of the Project by the said date specified in the notice, due to Direct Non Natural Force Majeure Event or Indirect Non Natural Force Majeure Event or Natural Force Majeure Event affecting the Nodal Agency, provided such Direct Non Natural Force Majeure Event or Indirect Non Natural Force Majeure Event or Natural Force Majeure Event affecting the Nodal Agency has continued for a period of more than three (3) continuous or non-continuous Months, the TSP shall, until the effects of the Direct Non Natural Force Majeure Event or of Indirect Non Natural Force Majeure Event or Natural Force Majeure Event affecting the Nodal Agency no longer prevent the TSP from connecting the Element(s) of the Project, be deemed to have achieved COD relevant to that date and to this extent, be deemed to have been providing Transmission Service with

effect from the date notified, and shall be treated as follows:

a. In case of delay due to Direct Non Natural Force Majeure Event, TSP is entitled for Transmission Charges calculated on Target Availability for the period of such events in excess of three (3) continuous or non continuous Months in the manner provided in (c) below.

b. In case of delay due to Indirect Non Natural Force Majeure Event or Natural Force Majeure Event affecting the Nodal Agency, TSP is entitled for payment for debt service which is due under the Financing Agreements, subject to a maximum of Transmission Charges calculated on Target Availability, for the period of such events in excess of three (3) continuous or non continuous Months in the manner provided in (c) below.

c. In case of delay due to Direct Non Natural Force Majeure Event or Indirect Non Natural Force Majeure Event or Natural Force Majeure Event affecting the Nodal Agency, the TSP is entitled for payments mentioned in (a) and (b) above, after commencement of Transmission Service, in the form of an increase in Transmission Charges. These amounts shall be paid from the date, being the later of a) the date of cessation of such Indirect Non Natural Force Majeure Event or Natural Force Majeure Event affecting the Nodal Agency and b) the completion of sixty (60) days from the receipt of the Financing Agreements by the Nodal Agency from the TSP.

Provided such increase in Transmission Charges shall be so as to put the TSP in the same economic position as the TSP would have been in case the TSP had been paid amounts mentioned in (a) and (b) above in a situation where the Force Majeure Event had not occurred.

For the avoidance of doubt, it is clarified that the charges payable under this Article 6.3.1 shall be recovered as per Sharing Regulations.

6.4 Liquidated Damages for Delay in achieving COD of Project:

6.4.1 If the TSP fails to achieve COD of any Element of the Project or the Project, by the Element's / Project's Scheduled COD or such Scheduled COD as extended under Articles 4.4.1 and 4.4.3, then the TSP shall pay to the Nodal Agency, a sum equivalent to 3.33% of Monthly Transmission Charges applicable for the Element of the Project [in case where no Elements have been defined, to be on the Project as a whole] / Project, for each day of delay up to sixty (60) days of delay and beyond that time limit, at the rate of five percent (5%) of the Monthly Transmission Charges applicable to such Element / Project, as liquidated damages for such delay

and not as penalty, without prejudice to any rights of the Nodal Agency under the Agreement.

6.4.2 The TSP's maximum liability under this Article 6.4 shall be limited to the amount of liquidated damages calculated in accordance with Article 6.4.1 for and up to six (6) months of delay for the Element or the Project.

Provided that, in case of failure of the TSP to achieve COD of the Element of the Project even after the expiry of six (6) months from its Scheduled COD, the provisions of Article 13 shall apply.

6.4.3 The TSP shall make payment to the Nodal Agency of the liquidated damages calculated pursuant to Article 6.4.1 within ten (10) days of the earlier of:

a. the date on which the applicable Element achieves COD; or

b. the date of termination of this Agreement.

The payment of such damages shall not relieve the TSP from its obligations to complete the Project or from any other obligation and liabilities under the Agreement.

6.4.4 If the TSP fails to pay the amount of liquidated damages to the Nodal Agency within the said period of ten (10) days, the Nodal Agency shall be entitled to recover the said amount of the liquidated damages by invoking the Contract Performance Guarantee. If the then existing Contract Performance Guarantee is for an amount which is less than the amount of the liquidated damages payable by the TSP to the Nodal Agency under this Article 6.3 and the TSP fails to make payment of the balance amount of the liquidated damages not covered by the Contract Performance Guarantee, then such balance amount shall be deducted from the Transmission Charges payable to the TSP. The right of the Nodal Agency to encash the Contract Performance Guarantee is without prejudice to the other rights of the Nodal Agency under this Agreement.

6.4.5 For avoidance of doubt, it is clarified that amount payable by TSP under this Article is over and above the penalty payable by TSP under Article 5.5.6 of this Agreement.

6.5 Return of Contract Performance Guarantee

6.5.1 The Contract Performance Guarantee as submitted by TSP in accordance with Article 3.1.1 shall be released by the Nodal Agency within three (3) months from the COD of the Project. In the event of delay in achieving Scheduled COD of any of the Elements by the TSP (otherwise than due to reasons as mentioned in Article 3.1.3 or Article 11) and consequent part

invocation of the Contract Performance Guarantee by the Nodal Agency, Nodal Agency shall release the Contract Performance Guarantee, if any remaining unadjusted, after the satisfactory completion by the TSP of all the requirements regarding achieving the Scheduled COD of the remaining Elements of the Project. It is clarified that the Nodal Agency shall also return / release the Contract Performance Guarantee in the event of (i) applicability of Article 3.3.2 to the extent the Contract Performance Guarantee is valid for an amount in excess of Rs. 716 Crore (Rupees Seven Hundred and Sixteen Crore Only), or (ii) termination of this Agreement by the Nodal Agency as mentioned under Article 3.3.4 of this Agreement.

6.5.2 The release of the Contract Performance Guarantee shall be without prejudice to other rights of the Nodal Agency under this Agreement.

ARTICLE: 7

7 OPERATION AND MAINTENANCE OF THE PROJECT

7.1 Operation and Maintenance of the Project:

The TSP shall be responsible for ensuring that the Project is operated and maintained in accordance with the regulations made by the Commission and CEA from time to time and provisions of the Act.

ARTICLE: 8

8 AVAILABILITY OF THE PROJECT

8.1 Calculation of Availability of the Project:

Calculation of Availability for the Elements and for the Project, as the case may be, shall be as per Appendix –IV to Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2024, as applicable on the Bid Deadline and as appended in Schedule 6 of this Agreement.

8.2 Target Availability:

The Target Availability of each Element and the Project shall be 95% for HVDC System, 98% for AC System, and 97% for Synchronous Condenser Station.

Payment of monthly Transmission charges based on actual availability will be calculated as per para 1.2 of Schedule 4 of this Agreement. In case of hybrid system, availability will be considered separately for AC System, HVDC System and Synchronous Condenser Station and monthly transmission charges based on actual availability shall be paid by categorizing the system into AC System, HVDC System or Synchronous Condenser Station (as applicable) and percentage of total transmission charges payable to the TSP for AC System, HVDC System, Synchronous Condenser Station as indicated in Schedule 5 of this Agreement.

If the availability of any Element or the Project is below the Target Availability, for six consecutive months in a Contract Year, the DIC(s) or the Nodal Agency may issue a show cause notice to the TSP, asking them to show cause as to why the Transmission Service Agreement be not terminated, and if no satisfactory cause is shown it may terminate the Agreement. If the Nodal Agency is of the opinion that the transmission system is of critical importance, it may carry out or cause to carry the operation and maintenance of transmission system at the risk and cost of TSP.

ARTICLE: 9

9 INSURANCES

9.1 Insurance:

9.1.1 The TSP shall effect and maintain or cause to be effected and maintained during the Construction Period and the Operating Period, adequate Insurances against such risks, with such deductibles including but not limited to any third party liability and endorsements and co-beneficiary/insured, as may be necessary under

a. any of the Financing Agreements,

b. the Laws, and

c. in accordance with Prudent Utility Practices.

The Insurances shall be taken effective from a date prior to the date of the Financial Closure till the Expiry Date.

9.2 Evidence of Insurance cover:

9.2.1 The TSP shall furnish to the Nodal Agency copies of certificates and policies of the Insurances, as and when the Nodal Agency may seek from the TSP as per the terms of Article 9.1

9.3 Application of Insurance Proceeds:

9.3.1 Save as expressly provided in this Agreement, the policies of Insurances and the Financing Agreements, the proceeds of any insurance claim made due to loss or damage to the Project or any part of the Project shall be first applied to reinstatement, replacement or renewal of such loss or damage

9.3.2 If a Natural Force Majeure Event renders the Project no longer economically and technically viable and the insurers under the Insurances make payment on a "total loss" or equivalent basis, the portion of the proceeds of such Insurance available to the TSP (after making admissible payments to the Lenders as per the Financing Agreements) shall be allocated only to the TSP Nodal Agency and / or concerned Designated ISTS Customers shall have no claim on such proceeds of the Insurance.

9.3.3 Subject to the requirements of the Lenders under the Financing Agreements, any dispute or difference between the Parties as to whether the Project is no longer economically and technically viable due to a Force Majeure Event or whether that event was adequately covered in accordance with this Agreement by the Insurances shall be determined in accordance with Article 16.

9.4 Effect on liability of the Nodal Agency / Designated ISTS Customers

9.4.1 The Nodal Agency and / or the Designated ISTS Customers shall have no financial obligations or liability whatsoever towards the TSP in respect of this Article 9.

ARTICLE: 10

10 BILLING AND PAYMENT OF TRANSMISSION CHARGES

10.1 Subject to provisions of this Article 10, the Monthly Transmission Charges shall be paid to the TSP, in Indian Rupees, on monthly basis as per the provisions of the Sharing Regulations, from the date on which an Element(s) has achieved COD until the Expiry Date of this Agreement, unless terminated earlier and in line with the provisions of Schedule 4 of this Agreement.

10.2 Calculation of Monthly Transmission Charges:

The Monthly Transmission Charges for each Contract Year including Incentive & Penalty payment shall be calculated in accordance with the provisions of Schedule 4 of this Agreement.

10.3 Rebate & Late Payment Surcharge:

The rebate and late payment surcharge shall be governed as per Sharing Regulations.

10.4 Disputed Bills, Default in payment by the Designated ISTS Customers & Annual Reconciliation:

Any Disputed Bill, Default in payment by the Designated ISTS Customers & Annual Reconciliation shall be governed as per Sharing Regulations.

ARTICLE: 11

11 FORCE MAJEURE

11.1 Definitions

11.1.1 The following terms shall have the meanings given hereunder.

11.2 Affected Party

11.2.1 An Affected Party means any Party whose performance has been affected by an event of Force Majeure.

11.2.2 Any event of Force Majeure shall be deemed to be an event of Force Majeure affecting the TSP only if the Force Majeure event affects and results in, late delivery of machinery and equipment for the Project or construction, completion, commissioning of the Project by Scheduled COD and/or operation thereafter;

11.3 Force Majeure

A 'Force Majeure' means any event or circumstance or combination of events and circumstances including those stated below that wholly or partly prevents or unavoidably delays an Affected Party in the performance of its obligations/ roles under this Agreement, but only if and to the extent that such events or circumstances are not within the reasonable control, directly or indirectly, of the Affected Party and could not have been avoided if the Affected Party had taken reasonable care or complied with Prudent Utility Practices:

(a) **Natural Force Majeure Events:**

i. act of God, including, but not limited to drought, fire and explosion (to the extent originating from a source external to the Site), earthquake, volcanic eruption, landslide, flood, cyclone, typhoon, tornado, or exceptionally adverse weather conditions, which are in excess of the statistical measures for the last hundred (100) years; and

ii. epidemic/ pandemic notified by Indian Governmental Instrumentality.

(b) **Non-Natural Force Majeure Events :**

I. Direct Non–Natural Force Majeure Events

- Nationalization or compulsory acquisition by any Indian Governmental Instrumentality of any material assets or rights of

the Affected Party; or

- the unlawful, unreasonable or discriminatory revocation of, or refusal to renew, any Consents, Clearances and Permits required by the Affected Party to perform their obligations/ roles under the RFP Project Documents or any unlawful, unreasonable or discriminatory refusal to grant any other Consents, Clearances and Permits required for the development/ operation of the Project, provided that a Competent Court of Law declares the revocation or refusal to be unlawful, unreasonable and discriminatory and strikes the same down; or

- any other unlawful, unreasonable or discriminatory action on the part of an Indian Governmental Instrumentality which is directed against the Project, provided that a Competent Court of Law declares the action to be unlawful, unreasonable and discriminatory and strikes the same down.

ii. Indirect Non - Natural Force Majeure Events

- act of war (whether declared or undeclared), invasion, armed conflict or act of foreign enemy, blockade, embargo, revolution, riot, insurrection, terrorist or military action; or

- radio active contamination or ionising radiation originating from a source in India or resulting from any other Indirect Non Natural Force Majeure Event mentioned above, excluding circumstances where the source or cause of contamination or radiation is brought or has been brought into or near the Site by the Affected Party or those employed or engaged by the Affected Party; or

- industry-wide strikes and labour disturbances, having a nationwide impact in India.

11.4 Force Majeure Exclusions

11.4.1 Force Majeure shall not include (i) any event or circumstance which is within the reasonable control of the Parties and (ii) the following conditions, except to the extent that they are consequences of an event of Force Majeure:

(a) Unavailability, late delivery, or changes in cost of the machinery, equipment, materials, spare parts etc. for the Project;

(b) Delay in the performance of any Contractors or their agents;

(c) Non-performance resulting from normal wear and tear typically experienced in transmission materials and equipment;

(d) Strikes or labour disturbance at the facilities of the Affected Party;

(e) Insufficiency of finances or funds or the Agreement becoming onerous to perform; and

(f) Non-performance caused by, or connected with, the Affected Party's:

i. negligent or intentional acts, errors or omissions;

ii. failure to comply with an Indian Law; or

iii. breach of, or default under this Agreement or any Project Documents.

(g) Any error or omission in the survey report provided by BPC during the bidding process.

11.5 Notification of Force Majeure Event

11.5.1 The Affected Party shall give notice to the other Party of any event of Force Majeure as soon as reasonably practicable, but not later than seven (7) days after the date on which such Party knew or should reasonably have known of the commencement of the event of Force Majeure. If an event of Force Majeure results in a breakdown of communications rendering it unreasonable to give notice within the applicable time limit specified herein, then the Party claiming Force Majeure shall give such notice as soon as reasonably practicable after reinstatement of communications, but not later than one (1) day after such reinstatement.

Provided that, such notice shall be a pre-condition to the Affected Party's entitlement to claim relief under this Agreement. Such notice shall include full particulars of the event of Force Majeure, its effects on the Party claiming relief and the remedial measures proposed. The Affected Party shall give the other Party regular reports on the progress of those remedial measures and such other information as the other Party may reasonably request about the Force Majeure.

11.5.2 The Affected Party shall give notice to the other Party of (i) the cessation of the relevant event of Force Majeure; and (ii) the cessation of the effects of such event of Force Majeure on the performance of its rights or obligations/ roles under this Agreement, as soon as practicable after becoming aware of each of these cessations.

11.6 Duty to perform and duty to mitigate

To the extent not prevented by a Force Majeure Event, the Affected Party shall continue to perform its obligations/ roles as provided in this Agreement. The Affected Party shall use its reasonable efforts to mitigate the effect of any event of Force Majeure as soon as practicable.

11.7 Available Relief for a Force Majeure Event

Subject to this Article 11,

(a) no Party shall be in breach of its obligations/ roles pursuant to this Agreement to the extent that the performance of its obligations/ roles was prevented, hindered or delayed due to a Force Majeure Event.

(b) each Party shall be entitled to claim relief for a Force Majeure Event affecting its performance in relation to its obligations/ roles under Articles 3.3.4, 4.4.2 and 6.3.1 of this Agreement.

(c) For the avoidance of doubt, it is clarified that the computation of Availability of the Element(s) under outage due to Force Majeure Event, as per Article 11.3 affecting the TSP shall be as per Appendix –IV to Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2024 as on Bid Deadline. For the event(s) for which the Element(s) is/are deemed to be available as per Appendix –IV to Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2024 then the Transmission Charges, as applicable to such Element(s), shall be payable as per Schedule 4, for the duration of such event(s).

(d) For so long as the TSP is claiming relief due to any Force Majeure Event under this Agreement, the Nodal Agency may, if it so desires, from time to time on one (1) day notice, inspect the Project and the TSP shall provide the Nodal Agency's personnel with access to the Project to carry out such inspections.

(e) For avoidance of doubt, the TSP acknowledges that for extension of Scheduled COD a period up to one hundred eighty (180) days due to Force Majeure event, no compensation on the grounds such as interest cost, incident expenditure, opportunity cost will be made to the TSP. However, if Scheduled COD is extended beyond a period of one hundred eighty (180) days due to Force Majeure event, the TSP will be allowed to recover the interest cost during construction corresponding to the period exceeding one hundred eighty (180) days by adjustment in the Transmission Charges in accordance with Schedule 9.

ARTICLE: 12

12 CHANGE IN LAW

12.1 Change in Law

12.1.1 Change in Law means the occurrence of any of the following after the Bid Deadline resulting into any additional recurring / non-recurring expenditure by the TSP or any savings of the TSP:

- the enactment, coming into effect, adoption, promulgation, amendment, modification or repeal (without re-enactment or consolidation) in India, of any Law, including rules and regulations framed pursuant to such Law, subject to the provisions under Article 12.1.2;
- a change in the interpretation or application of any Law by any Indian Governmental Instrumentality having the legal power to interpret or apply such Law, or any Competent Court of Law;
- the imposition of a requirement for obtaining any Consents, Clearances and Permits which was not required earlier;
- a change in the terms and conditions prescribed for obtaining any Consents, Clearances and Permits or the inclusion of any new terms or conditions for obtaining such Consents, Clearances and Permits;
- any change in the licensing regulations of the Commission, under which the Transmission License for the Project was granted if made applicable by such Commission to the TSP;
- change in wind zone; or
- any change in tax or introduction of any tax made applicable for providing Transmission Service by the TSP as per the terms of this Agreement.

12.1.2 Notwithstanding anything contained in this Agreement, Change in Law shall not cover any change:

a) Taxes on corporate income; and

b) Withholding tax on income or dividends distributed to the shareholders of the TSP.

12.2 Relief for Change in Law

12.2.1 During Construction Period, the impact of increase/decrease in the cost of the Project on the Transmission Charges shall be governed by the formula given in Schedule 9 of this Agreement.

12.2.2 During the Operation Period:

During the operation period, if as a result of Change in Law, the TSP suffers or is benefited from a change in costs or revenue, the aggregate financial effect of which exceeds 0.30% (zero point three percent) of the Annual Transmission Charges in aggregate for a Contract Year, the TSP may notify so to the Nodal Agency and propose amendments to this Agreement so as to place the TSP in the same financial position as it would have enjoyed had there been no such Change in Law resulting in change in costs or revenue as aforesaid.

12.2.3 For any claims made under Articles 12.2.1 and 12.2.2 above, the TSP shall provide to the Nodal Agency documentary proof of such increase / decrease in cost of the Project / revenue for establishing the impact of such Change in Law.

In cases where Change in Law results in decrease of cost and it comes to the notice of Nodal Agency that TSP has not informed Nodal Agency about such decrease in cost, Nodal Agency may initiate anpropriate claim.

12.3 Notification of Change in Law

12.3.1 If the TSP is affected by a Change in Law in accordance with Article 12.1 and wishes to claim relief for such Change in Law under this Article 12, it shall give notice to Nodal Agency of such Change in Law as soon as reasonably practicable after becoming aware of the same.

12.3.2 The TSP shall also be obliged to serve a notice to the Nodal Agency even when it is beneficially affected by a Change in Law.

12.3.3 Any notice served pursuant to Articles 12.3.1 and 12.3.2 shall provide, amongst other things, precise details of the Change in Law and its estimated impact on the TSP.

12.4 Payment on account of Change in Law

12.4.1 The payment for Change in Law shall be through a separate Bill. However, in case of any change in Monthly Transmission Charges by reason of Change in Law, as determined in accordance with this Agreement, the Bills to be raised by the Nodal Agency after such change in Transmission Charges shall appropriately reflect the changed Monthly Transmission Charges.

ARTICLE: 13

13 EVENTS OF DEFAULT AND TERMINATION

13.1 TSP's Event of Default

The occurrence and continuation of any of the following events shall constitute a TSP Event of Default, unless any such TSP Event of Default occurs as a result of any non-fulfilment of its obligations as prescribed under this Agreement by the Nodal Agency or a Force Majeure Event:

a. After having taken up the construction of the Project, the abandonment by the TSP or the TSP's Contractors of the construction of the Project for a continuous period of two (2) months and such default is not rectified within thirty (30) days from the receipt of notice from the Nodal Agency in this regard;

b. The failure to commission any Element of the Project by the date falling six (6) months after its Scheduled COD unless extended by Nodal Agency as per provisions of this Agreement;

c. If the TSP:

i. assigns, mortgages or charges or purports to assign, mortgage or charge any of its assets or rights related to the Project in contravention of the provisions of this Agreement; or

ii. transfers or novates any of its obligations pursuant to this Agreement, in a manner contrary to the provisions of this Agreement;

Except where such transfer is in pursuance of a Law and

- it does not affect the ability of the transferee to perform, and such transferee has the financial and technical capability to perform, its obligations under this Agreement;
- is to a transferee who assumes such obligations under the Project and this Agreement remains effective with respect to the transferee;

d. If:

i. The TSP becomes voluntarily or involuntarily the subject of any bankruptcy or insolvency or winding up proceedings and such proceedings remain uncontested for a period of thirty (30) days; or

ii. any winding up or bankruptcy or insolvency order is passed against the TSP; or

iii. the TSP goes into liquidation or dissolution or a receiver or any similar officer is appointed over all or substantially all of its assets or official liquidator is appointed to manage its affairs, pursuant to Law.

Provided that a dissolution or liquidation of the TSP will not be a TSP's Event of Default, where such dissolution or liquidation of the TSP is for the purpose of a merger, consolidation or reorganization with the prior approval of the Commission as per the provisions of Central Electricity Regulatory Commission (Procedure, terms and Conditions for grant of Transmission License and other related matters) Regulations, 2006 or as amended from time to time; or

e. Failure on the part of the TSP to comply with the provisions of Article 19.1 of this Agreement; or

f. the TSP repudiates this Agreement and does not rectify such breach even within a period of thirty (30) days from a notice from the Nodal Agency in this regard; or

g. after Commercial Operation Date of the Project, the TSP fails to achieve monthly Target Availability of 95% for HVDC System, 98% for AC System and 97% for Synchronous Condenser Station, for a period of six (6) consecutive months or within a non-consecutive period of six (6) months within any continuous aggregate period of eighteen(18) months except where the Availability is affected by Force Majeure Events as per Article 11; or

h. any of the representations and warranties made by the TSP in Article 17 of this Agreement being found to be untrue or inaccurate. Further, in addition to the above, any of the undertakings submitted by the Selected Bidder at the time of submission of the Bid being found to be breached or inaccurate, including but not limited to undertakings from its Parent Company / Affiliates related to the minimum equity obligation; or

i. the TSP fails to complete / fulfil all the activities / conditions within the specified period as per Article 3; or

j. except for the reasons solely attributable to Nodal Agency, the TSP is in material breach of any of its obligations under this Agreement and such material breach is not rectified by the TSP within thirty (30) days of receipt of notice in this regard from the Nodal Agency; or

k. TSP fails to take the possession of the land required for location specific substations, switching stations or HVDC terminal or inverter stations and / or fails to pay the requisite price to the parties and / or any

State Government authority from whom the land is acquired, within twelve (12) months from the Effective Date.

13.2 Termination Procedure for TSP Event of Default

a. Upon the occurrence and continuance of any TSP's Event of Default under Article 13.1 the Nodal Agency may serve notice on the TSP, with a copy to the CEA and the Lenders' Representative, of their intention to terminate this Agreement (a "Nodal Agency's Preliminary Termination Notice"), which shall specify in reasonable detail, the circumstances giving rise to such Nodal Agency's Preliminary Termination Notice.

b. Following the issue of a Nodal Agency's Preliminary Termination Notice, the Consultation Period shall apply and would be for the Parties to discuss as to what steps shall be taken with a view to mitigate the consequences of the relevant Event of Default having regard to all the circumstances.

c. During the Consultation Period, the Parties shall, save as otherwise provided in this Agreement, continue to perform their respective obligations/ roles under this Agreement, and the TSP shall not remove any material, equipment or any part of the Project, without prior consent of the Nodal Agency.

Following the expiry of the Consultation Period, unless the Parties shall have otherwise agreed to the contrary or the circumstances giving rise to Nodal Agency's Preliminary Termination Notice shall have ceased to exist or shall have been remedied, this Agreement may be terminated by the Nodal Agency by giving a Termination Notice to the TSP, in writing, of at least seven (7) days, with a copy to CEA and the Lenders' Representative in order to enable the Lenders to exercise right of substitution in accordance with Article 15.3 of this Agreement.

Further, the Nodal Agency may also initiate proceedings to blacklist the TSP & its Affiliates from participation in any RFP issued by BPCs for a period of 5 years.

13.3 Procedure for Nodal Agency's non-fulfilment of Role

a. Upon the Nodal Agency not being able to fulfil its role under Article 4.2, the TSP may serve notice on the Nodal Agency, with a copy to CEA and the Lenders' Representative (a "TSP's Preliminary Notice"), which notice shall specify in reasonable detail the circumstances giving rise to such non-fulfilment of role by the Nodal Agency.

b. Following the issue of a TSP's Preliminary Notice, the Consultation Period shall apply.

c. The Consultation Period would be for the Parties to discuss as to what steps shall be taken with a view to mitigate the consequences of the relevant non-fulfilment of role by the Nodal Agency including giving time extension to TSP, having regard to all the circumstances.

d. During the Consultation Period, both Parties shall, save as otherwise provided in this Agreement, continue to perform their respective obligations/ roles under this Agreement.

13.4 Termination due to Force Majeure

13.4.1 In case the Parties could not reach an agreement pursuant to Articles 3.3.4 and 4.4.2 of this Agreement and the Force Majeure Event or its effects continue to be present, the Nodal Agency shall have the right to cause termination of the Agreement. In case of such termination, the Contract Performance Guarantee shall be returned to the TSP as per the provisions of Article 6.5.1.

13.4.2 In case of termination of this Agreement, the TSP shall provide to the Nodal Agency the full names and addresses of its Contractors as well as complete designs, design drawings, manufacturing drawings, material specifications and technical information, as required by the Nodal Agency within thirty (30) days of Termination Notice.

13.5 Termination or amendment due to non-requirement of any Element or Project during construction

13.5.1 In case any Element or Project, which is under construction, is no longer required due to any reason whatsoever, the Nodal Agency may issue a notice to this effect to the TSP.

13.5.2 Nodal agency may also issue notice to the TSP seeking their response to the proposed termination/ amendment (as the case may be) of the Agreement. The Nodal Agency shall issue copy of such notice to Lenders. In the notice, Nodal Agency shall also include an assessment of the

physical progress made by TSP in the Element/ Project (as the case may be) that is no longer required.

13.5.3 The TSP shall neither carry out further investment nor carry out any work on the Element/ Project (as the case may be) that is no longer required after delivery of the notice.

13.5.4 After taking into account the comments of the TSP, the Nodal Agency may terminate the Agreement or amend it if both Parties agree to the amendment.

13.6 Revocation of the Transmission License

13.6.1 The Commission may, as per the provisions of the Electricity Act, 2003, revoke the Transmission License of the ISTS Licensee. Further, in such a case, the Agreement shall be deemed to have been terminated.

13.7 Termination Payment

13.7.1 If Agreement is terminated on account of Force Majeure Events, non-requirement of any Element or Project during Construction, Nodal Agency's non-fulfilment of Role & TSP's Event of Default, the TSP shall be entitled for Termination Payment equivalent to valuation of Project Assets. Upon payment, the Nodal Agency shall take over the Project Assets.

ARTICLE: 14

14 LIABILITY AND INDEMNIFICATION

14.1 Indemnity

14.1.1 The TSP shall indemnify, defend and hold the Nodal Agency harmless against:

(a) any and all third party claims, actions, suits or proceedings against the Nodal Agency for any loss of or damage to property of such third party, or death or injury to such third party, arising out of a breach by the TSP of any of its obligations under this Agreement, except to the extent that any such claim, action, suit or proceeding has arisen due to a negligent act or omission, breach of this Agreement or non-fulfilment of statutory duty on the part of Nodal Agency; and

(b) any and all losses, damages, costs and expenses including legal costs, fines, penalties and interest actually suffered or incurred by the Nodal Agency from third party claims arising by reason of

i. a breach by the TSP of any of its obligations under this Agreement, (provided that this Article 14 shall not apply to such breaches by the TSP, for which specific remedies have been provided for under this Agreement) except to the extent that any such losses, damages, costs and expenses including legal costs, fines, penalties and interest (together to constitute "Indemnifiable Losses") has arisen due to a negligent act or omission, breach of this Agreement or non-fulfilment of statutory duty on the part of the Nodal Agency, or

ii. any of the representations and warranties of the TSP under this Agreement being found to be inaccurate or untrue.

14.1.2 The Nodal Agency shall, in accordance with the Regulations framed by CERC in this regard, indemnify, defend and hold the TSP harmless against:

(a) any and all third party claims, actions, suits or proceedings against the TSP, for any loss of or damage to property of such third party, or death or injury to such third party, arising out of any material breach by the Nodal Agency of any of their roles under this Agreement, except to the extent that any such claim, action, suit or proceeding has arisen due to a negligent act or omission, breach of this Agreement or breach of statutory duty on the part of the TSP, its Contractors, servants or agents; and

(b) any and all losses, damages, costs and expenses including legal costs, fines, penalties and interest ('Indemnifiable Losses') actually suffered or incurred by the TSP from third party claims arising by reason of:

i. any material breach by the Nodal Agency of any of its roles under this Agreement (provided that, this Article 14 shall not apply to such breaches by the Nodal Agency, for which specific remedies have been provided for under this Agreement), except to the extent that any such Indemnifiable Losses have arisen due to a negligent act or omission, breach of this Agreement or breach of statutory duty on the part of the TSP, its Contractors, servants or agents or

ii. any of the representations and warranties of the Nodal Agency under this Agreement being found to be inaccurate or untrue.

14.2 Patent Indemnity:

14.2.1

(a) The TSP shall, subject to the Nodal Agency's compliance with Article 14.2.1 (b), indemnify and hold harmless the Nodal Agency and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Nodal Agency may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Agreement by reason of the setting up of the Project by the TSP.

Such indemnity shall not cover any use of the Project or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Agreement, any infringement resulting from the misuse of the Project or any part thereof, or any products produced in association or combination with any other equipment, plant or materials not supplied by the TSP, pursuant to the Agreement.

(b) If any proceedings are brought or any claim is made against the Nodal Agency arising out of the matters referred to in Article 14.2.1(a), the Nodal Agency shall promptly give the TSP a notice thereof, and the TSP shall at its own expense take necessary steps and attend such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. The TSP shall promptly notify the Nodal Agency of all actions taken in such proceedings or

claims.

(c) If the TSP fails to notify the Nodal Agency within twenty-eight (28) days after receipt of such notice from the Nodal Agency under Article 14.2.1(b) above, that it intends to attend any such proceedings or claim, then the Nodal Agency shall be free to attend the same on their own behalf at the cost of the TSP. Unless the TSP has so failed to notify the Nodal Agency within the twenty eight (28) days period, the Nodal Agency shall make no admission that may be prejudicial to the defence of any such proceedings or claims.

(d) The Nodal Agency shall, at the TSP's request, afford all available assistance to the TSP in attending to such proceedings or claim, and shall be reimbursed by the TSP for all reasonable expenses incurred in so doing.

14.2.2

(a) The Nodal Agency, in accordance with the Regulations framed by CERC in this regard, subject to the TSP's compliance with Article 14.2.2(b) shall indemnify and hold harmless the TSP and its employees, officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs and expenses of whatsoever nature, including attorney's fees and expenses, which the TSP may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Agreement by reason of the setting up of the Project by the TSP.

(b) If any proceedings are brought or any claim is made against the TSP arising out of the matters referred to in Article 14.2.2 (a) the TSP shall promptly give the Nodal Agency a notice thereof, and the Nodal Agency shall at its own expense take necessary steps and attend such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. The Nodal Agency shall promptly notify the TSP of all actions taken in such proceedings or claims.

(c) If the Nodal Agency fails to notify the TSP within twenty-eight (28) days after receipt of such notice from the TSP under Article 14.2.2(b) above, that it intends to attend any such proceedings or claim, then the TSP shall be free to attend the same on its own behalf at the cost of the Nodal Agency. Unless the Nodal Agency has so failed to notify the TSP within the twenty (28) days period, the TSP shall make no admission that may be prejudicial to the defence of any such proceedings or claim.

(d) The TSP shall, at the Nodal Agency request, afford all available assistance to the Nodal Agency in attending to such proceedings or claim, and shall be reimbursed by the Nodal Agency for all reasonable expenses incurred in so doing.

14.3 Monetary Limitation of liability

14.3.1 A Party ("Indemnifying Party") shall be liable to indemnify the other Party ("Indemnified Party") under this Article 14 for any indemnity claims made in a Contract Year only up to an amount of Rupees Forty-Seven Crore Seventy-Four Lakhs Only (Rs. 47.74 Crore).

14.4 Procedure for claiming indemnity

14.4.1 Where the Indemnified Party is entitled to indemnification from the Indemnifying Party pursuant to Articles 14.1 or 14.2 the Indemnified Party shall promptly notify the Indemnifying Party of such claim, proceeding, action or suit referred to in Articles 14.1 or 14.2 in respect of which it is entitled to be indemnified. Such notice shall be given as soon as reasonably practicable after the Indemnified Party becomes aware of such claim, proceeding, action or suit. The Indemnifying Party shall be liable to settle the indemnification claim within thirty (30) days of receipt of the above notice.

Provided however that, if:

i. the Parties choose to contest, defend or litigate such claim, action, suit or proceedings in accordance with Article 14.4.3 below; and

ii. the claim amount is not required to be paid/deposited to such third party pending the resolution of the Dispute,

the Indemnifying Party shall become liable to pay the claim amount to the Indemnified Party or to the third party, as the case may be, promptly following the resolution of the Dispute, if such Dispute is not settled in favour of the Indemnified Party.

14.4.2 The Indemnified Party may contest, defend and litigate a claim, action, suit or proceeding for which it is entitled to be indemnified under Articles 14.1 or 14.2 and the Indemnifying Party shall reimburse to the Indemnified Party all reasonable costs and expenses incurred by the Indemnified Party. However, such Indemnified Party shall not settle or compromise such claim, action, suit or proceedings without first getting the consent of the Indemnifying Party, which consent shall not be unreasonably withheld or delayed.

14.4.3 An Indemnifying Party may, at its own expense, assume control of the

defence of any proceedings brought against the Indemnified Party if it acknowledges its obligation to indemnify such Indemnified Party, gives such Indemnified Party prompt notice of its intention to assume control of the defence, and employs an independent legal counsel at its own cost that is reasonably satisfactory to the Indemnified Party.

14.5 Limitation on Liability

14.5.1 Except as expressly provided in this Agreement, neither the TSP nor the Nodal Agency nor their respective officers, directors, agents, employees or Affiliates (including, officers, directors, agents or employees of such Affiliates), shall be liable or responsible to the other Party or its Affiliates including its officers, directors, agents, employees, successors, insurers or permitted assigns for incidental, indirect or consequential, punitive or exemplary damages, connected with or resulting from performance or non-performance of this Agreement, or anything done in connection herewith, including claims in the nature of lost revenues, income or profits (other than payments expressly required and properly due under this Agreement), any increased expense of, reduction in or loss of transmission capacity or equipment used therefore, irrespective of whether such claims are based upon breach of warranty, tort (including negligence whether of the Nodal Agency, the TSP or others), strict liability, contract, breach of statutory duty, operation of law or otherwise.

14.5.2 The Nodal Agency shall have no recourse against any officer, director or shareholder of the TSP or any Affiliate of the TSP or any of its officers, directors or shareholders for such claims excluded under this Article. The TSP shall also have no recourse against any officer, director or shareholder of the Nodal Agency, or any Affiliate of the Nodal Agency or any of its officers, directors or shareholders for such claims excluded under this Article.

14.6 Duty to Mitigate

The party entitled to the benefit of an indemnity under this Article 14 shall take all reasonable measures to mitigate any loss or damage which has occurred. If the Party fails to take such measures, the other Party's liabilities shall be correspondingly reduced.

ARTICLE: 15

15 ASSIGNMENTS AND CHARGES

15.1 Assignments:

15.1.1 This Agreement shall be binding upon, and inure to the benefit of the Parties and their respective successors and permitted assigns. This Agreement shall not be assigned by any Party, except as provided in Article 15.3.

15.2 Permitted Charges:

15.2.1 Neither Party shall create or permit to subsist any encumbrance over all or any of its rights and benefits under this Agreement.

15.2.2 However, the TSP may create any encumbrance over all or part of the receivables, or the Project Assets of the Project in favour of the Lenders or the Lenders' Representative on their behalf, as security for amounts payable under the Financing Agreements and any other amounts agreed by the Parties.

Provided that:

i. the Lenders or the Lenders' Representative on their behalf shall have entered into the Financing Agreements and agreed in writing to the provisions of this Agreement; and

ii. any encumbrance granted by the TSP in accordance with this Article 15.2.2 shall contain provisions pursuant to which the Lenders or the Lender's Representative on their behalf agrees unconditionally with the TSP to release from such encumbrances upon payment by the TSP to the Lenders of all amounts due under the Financing Agreements.

15.2.3 Article 15.2.1 does not apply to:

a. liens arising by operation of law (or by an agreement evidencing the same) in the ordinary course of the TSP developing and operating the Project;

b. pledges of goods, the related documents of title and / or other related documents, arising or created in the ordinary course of the TSP developing and operating the Project; or

c. security arising out of retention of title provisions in relation to goods acquired in the ordinary course of the TSP developing and operating the Project.

15.3 Substitution Rights of the Lenders

15.3.1 The TSP would need to operate and maintain the Project under the provisions of this Agreement and cannot assign the Transmission License or transfer the Project or part thereof to any person by sale, lease, exchange or otherwise, without the prior approval of the Nodal Agency.

15.3.2 However, in the case of default by the TSP in debt repayments or in the case of default by the TSP as per Article 13 of this Agreement during the debt repayments, the Commission may, on an application from the Lenders, assign the Transmission License to the nominee of the Lenders subject to the fulfilment of the qualification requirements and provisions of the Central Electricity Regulatory Commission (Procedure, terms and Conditions for grant of Transmission License and other related matters) Regulations, 2006 and as amended from time to time.

ARTICLE: 16

16 GOVERNING LAW AND DISPUTE RESOLUTION

16.1 Governing Law:

This Agreement shall be governed by and construed in accordance with the Laws of India. Any legal proceedings in respect of any matters, claims or disputes under this Agreement shall be under the jurisdiction of appropriate courts in Delhi.

16.2 Amicable Settlement:

16.2.1 Either Party is entitled to raise any claim, dispute or difference of whatever nature arising under, out of or in connection with this Agreement, including its existence or validity or termination or whether during the execution of the Project or after its completion and whether prior to or after the abandonment of the Project or termination or breach of the Agreement by giving a written notice to the other Party, which shall contain:

(i) a description of the Dispute;

(ii) the grounds for such Dispute; and

(iii) all written material in support of its claim.

16.2.2 The other Party shall, within thirty (30) days of issue of notice issued under Article 16.2.1, furnish:

(i) counter-claim and defences, if any, regarding the Dispute; and

(ii) all written material in support of its defences and counter-claim.

16.2.3 Within thirty (30) days of issue of notice by the Party pursuant to Article 16.2.1, if the other Party does not furnish any counter claim or defense under Article 16.2.2, or thirty (30) days from the date of furnishing counter claims or defence by the other Party, both the Parties to the Dispute shall meet to settle such Dispute amicably. If the Parties fail to resolve the Dispute amicably within thirty (30) days from the later of the dates mentioned in this Article 16.2.3, the Dispute shall be referred for dispute resolution in accordance with Article 16.3.

16.3 Dispute Resolution:

All Disputes shall be adjudicated by the Commission.

16.4 Parties to Perform Obligations:

Notwithstanding the existence of any Dispute and difference referred to the Commission as provided in Article 16.3 and save as the Commission may otherwise direct by a final or interim order, the Parties hereto shall continue to perform their respective obligations/ roles (which are not in dispute) under this Agreement.

ARTICLE: 17

17 REPRESENTATION AND WARRANTIES

17.1 Representation and warranties of the Nodal Agency

17.1.1 The Nodal Agency hereby represents and warrants to and agrees with the TSP as follows and acknowledges and confirms that the TSP is relying on such representations and warranties in connection with the transactions described in this Agreement:

a. It has all requisite powers and authority to execute and consummate this Agreement;

b. This Agreement is enforceable against the Nodal Agency in accordance with its terms;

c. The consummation of the transactions contemplated by this Agreement on the part of Nodal Agency will not violate any provision of nor constitute a default under, nor give rise to a power to cancel any charter, mortgage, deed of trust or lien, lease, agreement, license, permit, evidence of indebtedness, restriction, or other contract to which the Nodal Agency is a Party or to which the Nodal Agency is bound, which violation, default or power has not been waived;

17.2 Representation and Warranties of the TSP:

17.2.1 The TSP hereby represents and warrants to and agrees with the Nodal Agency as follows and acknowledges and confirms that the Nodal Agency is relying on such representations and warranties in connection with the transactions described in this Agreement:

a. It has all requisite powers and has been duly authorized to execute and consummate this Agreement;

b. This Agreement is enforceable against it, in accordance with its terms;

c. The consummation of the transactions contemplated by this Agreement on the part of the TSP will not violate any provision of nor constitute a default under, nor give rise to a power to cancel any charter, mortgage, deed of trust or lien, lease, agreement, license, permit, evidence of indebtedness, restriction, or other contract to which the TSP is a Party or to which the TSP is bound which violation, default or power has not been waived;

d. The TSP is not insolvent and no insolvency proceedings have been instituted, nor threatened or pending by or against the TSP;

e. There are no actions, suits, claims, proceedings or investigations pending or, to the best of the TSP's knowledge, threatened in writing against the TSP at law, in equity, or otherwise, and whether civil or criminal in nature, before or by, any court, commission, arbitrator or governmental agency or authority, and there are no outstanding judgments, decrees or orders of any such courts, commission, arbitrator or governmental agencies or authorities, which materially adversely affect its ability to execute the Project or to comply with its obligations under this Agreement.

17.2.2 The TSP makes all the representations and warranties above to be valid as on the Effective Date of this Agreement.

ARTICLE: 18

18 INDEPENDENT ENGINEER

18.1 Appointment of Independent Engineer

The Nodal Agency shall appoint an agency/ company as Independent Engineer as per framework provided in the Guidelines for Encouraging Competition in Development of Transmission Projects for selection of Independent Engineer.

18.2 Roles and functions of Independent Engineer

The role and functions of the Independent Engineer shall include the following:

a. Progress Monitoring as required under this Agreement;

b. Ensuring Quality as required under this Agreement;

c. determining, as required under the Agreement, the costs of any works or services and/or their reasonableness during construction phase;

d. determining, as required under the Agreement, the period or any extension thereof, for performing any duty or obligation during construction phase;

e. determining, as required under the Agreement, the valuation of the Project Assets.

f. Assisting the Parties in resolution of Disputes and

g. Undertaking all other duties and functions in accordance with the Agreement.

18.3 Remuneration of Independent Engineer

The fee and charges of the Independent Engineer shall be paid by the Nodal Agency as per terms & conditions of appointment.

18.4 Termination of appointment

18.4.1 The Nodal Agency may, in its discretion, terminate the appointment of the Independent Engineer at any time, but only after appointment of another Independent Engineer.

18.4.2 If the TSP has reason to believe that the Independent Engineer is not discharging its duties and functions in a fair, efficient and diligent manner, it

may make a written representation to the Nodal Agency and seek termination of the appointment of the Independent Engineer. Upon receipt of such representation, the Nodal Agency shall hold a tripartite meeting with the TSP and Independent Engineer for an amicable resolution, and the decision of Nodal agency is final. In the event that the appointment of the Independent Engineer is terminated hereunder, the Nodal Agency shall appoint forthwith another Independent Engineer.

18.5 Authorised signatories

The Nodal Agency shall require the Independent Engineer to designate and notify to the Nodal Agency up to 2 (two) persons employed in its firm to sign for and on behalf of the Independent Engineer, and any communication or document required to be signed by the Independent Engineer shall be valid and effective only if signed by any of the designated persons; provided that the Independent Engineer may, by notice in writing, substitute any of the designated persons by any of its employees.

ARTICLE: 19

19 MISCELLANEOUS PROVISIONS

19.1 Equity Lock-in Commitment:

19.1.1 The aggregate equity share holding of the Selected Bidder in the issued and paid up equity share capital ofBarmer HVDC Power Transmission Limited shall not be less than Fifty one percent (51%) up to a period of one (1) year after COD of the Project.

Provided that, in case the Lead Member or Bidding Company is holding equity through Affiliate/s, Ultimate Parent Company or Parent Company, such restriction as specified above shall apply to such entities.

Provided further, that in case the Selected Bidder is a Bidding Consortium, the Lead Member shall continue to hold equity of at least twenty six percent (26%) upto a period of one (1) year after COD of the Project and any Member of such Bidding Consortium shall be allowed to divest its equity as long as the other remaining Members (which shall always include the Lead Member) hold the minimum equity specified above.

19.1.2 If equity is held by the Affiliates, Parent Company or Ultimate Parent Company of the Selected Bidder, then, subject to the second proviso to Article 19.1.1, such Affiliate, Parent Company or Ultimate Parent Company shall be eligible to transfer its shareholding inBarmer HVDC Power Transmission Limited to another Affiliate or to the Parent Company / Ultimate Parent Company of the Selected Bidder. If any such shareholding entity, qualifying as an Affiliate / Parent Company / Ultimate Parent Company, is likely to cease to meet the criteria to qualify as an Affiliate / Parent Company / Ultimate Parent Company, the shares held by such entity shall be transferred to another Affiliate / Parent Company / Ultimate Parent Company of the Selected Bidder.

19.1.3 Subject to Article 19.1.1, all transfer(s) of shareholding of Barmer HVDC Power Transmission Limited by any of the entities referred to in Article 19.1.1 and 19.1.2 above, shall be after prior written intimation to the Nodal Agency.

19.1.4 For computation of effective Equity holding, the Equity holding of the Selected Bidder or its Ultimate Parent Company in such Affiliate(s) or Parent Company and the equity holding of such Affiliate(s) or Ultimate Parent Company inBarmer HVDC Power Transmission Limited shall be computed in accordance with the example given below:

If the Parent Company or the Ultimate Parent Company of the Selected

Bidder A directly holds thirty percent (30%) of the equity inBarmer HVDC Power Transmission Limited then holding of Selected Bidder A inBarmer HVDC Power Transmission Limited shall be thirty percent (30%);

If Selected Bidder A holds thirty percent (30%) equity of the Affiliate and the Affiliate holds fifty percent (50%) equity inBarmer HVDC Power Transmission Limited, then, for the purposes of ascertaining the minimum equity/equity lock-in requirements specified above, the effective holding of Bidder A inBarmer HVDC Power Transmission Limited shall be fifteen percent (15%), (i.e., 30% x 50%)

19.1.5 The provisions as contained in this Article 19.1 shall override the terms of the consortium agreement submitted as part of the Bid.

19.1.6 The TSP shall be responsible to report to Nodal Agency, within thirty (30) days from the occurrence of any event that would result in any change in its equity holding structure from that which existed as on the date of signing of the Share Purchase Agreement. In such cases, the Nodal Agency would reserve the right to ascertain the equity holding structure and to call for all such required documents / information / clarifications as may be required.

19.2 Commitment of maintaining Qualification Requirement

19.2.1 The Selected Bidder will be required to continue to maintain compliance with the Qualification Requirements, as stipulated in RFP Document, till the COD of the Project. Where the Technically Evaluated Entity and/or the Financially Evaluated Entity is not the Bidding Company or a Member in a Bidding Consortium, as the case may be, the Bidding Company or Member shall continue to be an Affiliate of the Technically Evaluated Entity and/or Financially Evaluated Entity till the COD of the Project.

19.2.2 Failure to comply with the aforesaid provisions shall be dealt in the same manner as TSP's Event of Default as under Article 13 of this Agreement

19.3 Language:

19.3.1 All agreements, correspondence and communications between the Parties relating to this Agreement and all other documentation to be prepared and supplied under the Agreement shall be written in English, and the Agreement shall be construed and interpreted in accordance with English language.

19.3.2 If any of the agreements, correspondence, communications or documents are prepared in any language other than English, the English translation of such agreements, correspondence, communications or documents

shall prevail in matters of interpretation.

19.4 Affirmation

The TSP and the Nodal Agency, each affirm that:

1. neither it nor its respective directors, employees, or agents has paid or undertaken to pay or shall in the future pay any unlawful commission, bribe, pay-off or kick-back; and
2. it has not in any other manner paid any sums, whether in Indian currency or foreign currency and whether in India or abroad to the other Party to procure this Agreement, and the TSP and the Nodal Agency hereby undertake not to engage in any similar acts during the Term of Agreement.

19.5 Severability

The invalidity or enforceability, for any reason, of any part of this Agreement shall not prejudice or affect the validity or enforceability of the remainder of this Agreement, unless the part held invalid or unenforceable is fundamental to this Agreement.

19.6 Counterparts

This Agreement may be executed in one or more counterparts, each of which shall be deemed an original and all of which collectively shall be deemed one and the same Agreement.

19.7 Breach of Obligations/ Roles

The Parties acknowledge that a breach of any of the obligations/ roles contained herein would result in injuries. The Parties further acknowledge that the amount of the liquidated damages or the method of calculating the liquidated damages specified in this Agreement is a genuine and reasonable pre-estimate of the damages that may be suffered by the non-defaulting Party in each case specified under this Agreement.

19.8 Restriction of Shareholders / Owners Liability

19.8.1 Parties expressly agree and acknowledge that none of the shareholders of the Parties hereto shall be liable to the other Parties for any of the contractual obligations of the concerned Party under this Agreement.

19.8.2 Further, the financial liabilities of the shareholder(s) of each Party to this Agreement shall be restricted to the extent provided in the Indian Companies Act, 1956 / Companies Act, 2013 (as the case may be).

19.9 Taxes and Duties:

19.9.1 The TSP shall bear and promptly pay all statutory taxes, duties, levies and cess, assessed/levied on the TSP, its Contractors or their employees that are required to be paid by the TSP as per the Law in relation to the execution of the Project and for providing Transmission Service as per the terms of this Agreement.

19.9.2 The Nodal Agency shall be indemnified and held harmless by the TSP against any claims that may be made against the Nodal Agency in relation to the matters set out in Article 19.9.1.

19.9.3 The Nodal Agency shall not be liable for any payment of, taxes, duties, levies, cess whatsoever for discharging any obligation of the TSP by the Nodal Agency on behalf of TSP or its personnel, provided the TSP has consented in writing to the Nodal Agency for such work, for which consent shall not be unreasonably withheld.

19.10 No Consequential or Indirect Losses

The liability of the TSP shall be limited to that explicitly provided in this Agreement.

Provided that, notwithstanding anything contained in this Agreement, under no event shall the Nodal Agency or the TSP claim from one another any indirect or consequential losses or damages.

19.11 Discretion:

Except where this Agreement expressly requires a Party to act fairly or reasonably, a Party may exercise any discretion given to it under this Agreement in any way it deems fit.

19.12 Confidentiality

19.12.1 The Parties undertake to hold in confidence this Agreement and RFP Project Documents and not to disclose the terms and conditions of the transaction contemplated hereby to third parties, except:

(a) to their professional advisors;

(b) to their officers, contractors, employees, agents or representatives, financiers, who need to have access to such information for the proper performance of their activities; or

(c) disclosures required under Law,

without the prior written consent of the other Parties.

Provided that, the TSP agrees and acknowledges that the Nodal Agency,

may, at any time, disclose the terms and conditions of the Agreement and the RFP Project Documents to any person, to the extent stipulated under the Law and the Competitive Bidding Guidelines.

19.13 Order of priority in application:

Save as provided in Article 2.5, in case of inconsistencies between the terms and conditions stipulated in Transmission License issued by the Commission to the TSP, agreement(s) executed between the Parties, applicable Law including rules and regulations framed thereunder, the order of priority as between them shall be the order in which they are placed below:

- terms and conditions of Transmission License;
- applicable Law, rules and regulations framed thereunder;
- this Agreement;
- Agreement(s), if any, under Sharing Regulations.

19.14 Independent Entity:

19.14.1 The TSP shall be an independent entity performing its obligations pursuant to the Agreement.

19.14.2 Subject to the provisions of the Agreement, the TSP shall be solely responsible for the manner in which its obligations under this Agreement are to be performed. All employees and representatives of the TSP or Contractors engaged by the TSP in connection with the performance of the Agreement shall be under the complete control of the TSP and shall not be deemed to be employees, representatives, Contractors of the Nodal Agency and nothing contained in the Agreement or in any agreement or contract awarded by the TSP shall be construed to create any contractual relationship between any such employees, representatives or Contractors and the Nodal Agency.

19.15 Amendments:

19.15.1 This Agreement may only be amended or supplemented by a written agreement between the Parties.

19.16 Waiver:

19.16.1 No waiver by either Party of any default or breach by the other Party in the performance of any of the provisions of this Agreement shall be effective unless in writing duly executed by an authorised representative of such

Party.

19.16.2 Neither the failure by either Party to insist on any occasion upon the performance of the terms, conditions and provisions of this Agreement nor time or other indulgence granted by one Party to the other Parties shall act as a waiver of such breach or acceptance of any variation or the relinquishment of any such right or any other right under this Agreement, which shall remain in full force and effect.

19.17 Relationship of the Parties:

This Agreement shall not be interpreted or construed to create an association, joint venture, or partnership or agency or any such other relationship between the Parties or to impose any partnership obligation or liability upon either Party and neither Party shall have any right, power or authority to enter into any agreement or undertaking for, or act on behalf of, or to act as or be an agent or representative of, or to otherwise bind, the other Party.

19.18 Entirety:

19.18.1 This Agreement along with its sections, schedules and appendices is intended by the Parties as the final expression of their agreement and is intended also as a complete and exclusive statement of the terms of their agreement.

19.18.2 Except as provided in this Agreement, all prior written or oral understandings, offers or other communications of every kind pertaining to this Agreement or the provision of Transmission Service under this Agreement to the Nodal Agency by the TSP shall stand superseded and abrogated.

19.19 Notices:

19.19.1 All notices or other communications which are required to be given under this Agreement shall be in writing and in the English language.

19.19.2 If to the TSP, all notices or communications must be delivered personally or by registered post or facsimile or any other mode duly acknowledged to the addressee below:

(i) **M/s Powergrid Corporation of India Limited (Selected Bidder)**

Address :

Attention :

Email	:	tbcb@powergrid.in	akgupta@powergrid.in
Fax. No.	:	–	
Telephone No.	:	0124- 2822123	73030 90820

19.19.3 If to the Nodal Agency, all notices or communications must be delivered personally or by registered post or facsimile or any other mode duly acknowledged to the addresses below:

(i) **Central Transmission Utility of India Limited (Nodal Agency)**

Address	:	5th to 10th Floor, IRCON International Tower, Tower no-1, Plot no-16, Sector-32, Gurugram, Haryana: 122003
Attention	:	Ramachandra, Sr GM
Email	:	ramachand@powergrid.in
Fax. No.	:	
Telephone No.	:	9910378128

19.19.4 All notices or communications given by facsimile shall be confirmed by sending a copy of the same via post office in an envelope properly addressed to the appropriate Party for delivery by registered mail. All notices shall be deemed validly delivered upon receipt evidenced by an acknowledgement of the recipient, unless the Party delivering the notice can prove in case of delivery through the registered post that the recipient refused to acknowledge the receipt of the notice despite efforts of the postal authorities.

19.19.5 Any Party may by notice of at least fifteen (15) days to the other Party change the address and/or addresses to which such notices and communications to it are to be delivered or mailed.

19.20 Fraudulent and Corrupt Practices

19.20.1 The TSP and its respective officers, employees, agents and advisers shall observe the highest standard of ethics during the subsistence of this Agreement. Notwithstanding anything to the contrary contained in the Agreement, the Nodal Agency may terminate the Agreement without being liable in any manner whatsoever to the TSP, if it determines that the TSP has, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice in the Bid process. In such an event, the Nodal Agency shall forfeit the Contract Performance Guarantee of the TSP, without prejudice to any other right or remedy that may be available to the Nodal Agency hereunder or subsistence otherwise.

19.20.2 Without prejudice to the rights of the Nodal Agency under Clause 19.20.1 hereinabove and the rights and remedies which the Nodal Agency may have under this Agreement, if a TSP is found by the Nodal Agency to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice during the Bid process, or after the issue of Letter of Intent (hereinafter referred to as LoI) or after the execution of the agreement(s) required under Sharing Regulations, the Nodal Agency may terminate the Agreement without being liable in any manner whatsoever to the TSP. Further, the TSP & its Affiliates shall not be eligible to participate in any tender or RFP issued by any BPC for an indefinite period from the date such TSP is found by the Nodal Agency to have directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practices, as the case may be.

19.20.3 For the purposes of this Clause 19.20, the following terms shall have the meaning hereinafter respectively assigned to them:

(a) **"corrupt practice"** means (i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bid process (for avoidance of doubt, offering of employment to or employing or engaging in any manner whatsoever, directly or indirectly, any official of the BPC who is or has been associated or dealt in any manner, directly or indirectly with the Bid process or the LoI or has dealt with matters concerning the RFP Project Documents or arising there from, before or after the execution thereof, at any time prior to the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the BPC, shall be deemed to constitute influencing the actions of a person connected with the Bid Process); or (ii) engaging in any manner whatsoever, whether during the Bid Process or after the issue of the LoI or after the execution of the RFP Project Documents, as the case may be, any person in respect of any matter relating to the Project or the LoI or the RFP Project Documents, who at any time has been or is a legal, financial or technical adviser of the BPC in relation to any matter concerning the Project;

(b) "**fraudulent practice**" means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, in order to influence the Bid process;

(c) "**coercive practice**" means impairing or harming, or threatening to impair or harm, directly or indirectly, any person or property to influence any person's participation or action in the Bid process;

(d) "**undesirable practice**" means (i) establishing contact with any person connected with or employed or engaged by the BPC with the objective of canvassing, lobbying or in any manner influencing or attempting to influence the Bid process; or (ii) having a Conflict of Interest; and

(e) "**restrictive practice**" means forming a cartel or arriving at any understanding or arrangement among Bidders with the objective of restricting or manipulating a full and fair competition in the Bid process;

19.21 Compliance with Law:

Despite anything contained in this Agreement but without prejudice to Article 12, if any provision of this Agreement shall be in deviation or inconsistent with or repugnant to the provisions contained in the Electricity Act, 2003, or any rules and regulations made there under, such provision shall be deemed to be amended to the extent required to bring it into compliance with the aforesaid relevant provisions as amended from time to time.

IN WITNESS WHEREOF, THE PARTIES HAVE CAUSED THIS AGREEMENT TO BE EXECUTED BY THEIR DULY AUTHORISED REPRESENTATIVES AS OF THE DATE AND PLACE SET FORTH ABOVE.

1. For and on behalf of TSP

.....

[Signature, Name, Designation and Address]

2. For and on behalf of CTUIL.....[Insert name of the Nodal Agency]

KAMAL KUMAR JAIN

.....

[Signature, Name, Designation and Address]

WITNESSES:

1. For and on behalf of

: BPC

.....

[Signature] (PRABHA BARWAD)
DY. MANAGER (F&A)
RECPDCL, GURUGRAM

.....

[Insert, Name, Designation and Address of the Witness]

2. For and on behalf of

: Nodal Agency

.....

[Signature]
DEEPAK KRISHNAN
DM, CTUIL.

.....

[Insert Name, Designation and Address of the Witness]

SCHEDULES

Schedule: 1

Project Description and Scope of Project

Scope of the Project:

Sl. No.	Scope of the Transmission Scheme	Scheduled COD in months from Effective Date
1.	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor Barmer-II PS – AIS • 400/220 kV 500 MVA ICTs- 6 Nos. • 400 kV ICT bays- 6 Nos. • 220 kV ICT bays - 6 Nos. • 125 MVAr Bus Reactor-2 Nos. • 400 kV Bus reactor bays- 2 Nos. • 400 kV line bays– 4 Nos. (for RE interconnection) • 220 KV line bays – 7 Nos. (for RE connectivity) • 220 kV Sectionalization bay: 1 set • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 400 kV Sectionaliser bay- 1 Set Future provisions (excl. scope of present scheme): • 400 kV line bays along with switchable line reactor –6 • 400 kV line bays –4 Nos. • 400 kV Bus Reactor along with bays: 1 No. • 400/220 kV ICT along with bays-4 Nos. • 400 kV Sectionalization bays: 2 sets • 220 kV line bays for connectivity of RE Applications -5 Nos. • 220 kV Sectionalization bay: 2 sets • 220 kV BC (2 Nos.) & TBC (2 Nos.) • 2 Nos. of Syncon units* at 400 kV level along with 2 Nos. of 400 kV bays • STATCOM (2x±300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR) along with 400 kV bays (2 Nos.) *1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))	48 months (23.09.2030)

Sl. No.	Scope of the Transmission Scheme	Scheduled COD in months from Effective Date
2.	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS • 400 kV line bays- 4 Nos. (at Barmer-II PS end)	
3.	Barmer-II PS - Barmer-I PS 400 kV D/C line (Quad) • 400 kV line bays at Barmer-II PS – 2 Nos. • 400 kV line bays at Barmer-I PS– 2 Nos.	
4.	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation • HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos.)	54 months (23.03.2031) (Bipole-1:
5.	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb • HVDC terminal station (± 800 kV, 3000 MW (Bipole configuration)- 2 Nos.)	48 months (23.09.2030), Bipole-2: 54 months (23.03.2031))
6.	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	48 months (23.09.2030)
7.	Augmentation of South Kalamb S/s# by 4x1500 MVA, 765/400 kV ICTs (3 Nos. 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR as per details given below[5] (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400kV bus sectionalizer to be kept normally open) • 765/400 kV 1500 MVA ICTs- 4 Nos. • 765 kV ICT bays- 4 Nos. • 400 kV ICT bays- 4 Nos.	48 months (23.09.2030)

Sl. No.	Scope of the Transmission Scheme	Scheduled COD in months from Effective Date
	• 330 MVAr Bus Reactor-2 Nos. (at bus section-II) • 765 kV Bus reactor bays- 2 Nos. (at bus section-II) • 125 MVAr Bus Reactor-2 Nos. (at bus section-II) • 400 kV Bus reactor bays- 2 Nos. (at bus section-II)	
8.	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum)) • Syncon units – 2 Nos. • 400 kV line bays – 2 Nos.	48 months (23.09.2030)

#South Kalamb S/s establishment with 2x1500 MVA, 765/400 kV ICTs with 2x330 MVAr, 765 kV bus reactor and 2x125 MVAr, 420 kV bus reactor along with LILO of Pune-III – Boisar-II 765 kV D/C line (presently under construction by M/s WRNES TPTL, a subsidiary of Adani Energy Solutions Limited)

$ Network Expansion Scheme: Creation of New 765kV & 400kV Bus Sections-II & III through 765 kV Sectionalization bay: 2 sets & 400 kV Sectionalization bay: 2 sets alongwith 2x330 MVAr, 765 kV bus reactor & 2x125 MVAr, 420 kV bus reactor on Section-III is being proposed along with ICT augmentation (3x1500MVA, 765/400kV ICTs) at Bus Section -III at both 765kV & 400kV levels alongwith downstream 400kV lines at bus section-III from South Kalamb S/s with implementation timeframe of 24 months from effective date. [400kV Sectionaliser between Sections-I & II & between sections-II & III to be normally open. Further, 765kV sectionaliser between Sections-I & II & between II & III shall be kept normally closed. The 400kV sectionalisers can be closed under contingency conditions.].

Project Description

The transmission scheme comprises of the transmission system for evacuation of RE (Solar) power from Barmer area in the state of Rajasthan (Rajasthan REZ Ph-IV Part-5: 6 GW).

This scheme is a part of transmission system for evacuation of RE power from 75 GW of Renewable Energy Zones (REZs) identified by MNRE/SECI in Rajasthan. Out of 75 GW, evacuation of 13 GW has been planned from Fatehgarh (5 GW) and Barmer (8 GW) complex. Transmission schemes for 9 GW injection at Fatehgarh-IV PS and Barmer-I PS under Rajasthan REZ Ph-IV (Part-2: 5.5 GW) and Rajasthan REZ Ph-IV (Part-4: 3.5 GW) are under implementation. At present connectivity of about 6 GW capacity is already granted at Barmer-II PS and the present transmission scheme has been planned for evacuation of 6 GW RE (Solar) injection at Barmer-II Pooling station.

This comprehensive transmission scheme includes the establishment of 400 kV Barmer-II PS in Rajasthan along with 400 kV Barmer-II – Barmer-I D/c line and LILO of both circuits of 400 kV Fatehgarh-IV – Barmer-I D/c line at Barmer-II PS. The HVDC portion of the scheme includes establishment of ± 800 kV, 6000 MW Barmer-II(HVDC) [LCC] terminal station, ± 800 kV, 6000 MW, South Kalamb (HVDC) [LCC] terminal station along with Barmer-II – South Kalamb ±800 kV HVDC Bipole Line. For further dispersal of power, augmentation of South Kalamb S/s with 4 nos. of 765/400 kV, 1500MVA ICTs is to be implemented. Further, 2 Nos. of Syncon units at 400kV level of Barmer-II PS are also being proposed as part of comprehensive scheme.

Above transmission scheme has been discussed and agreed in the 36th CMETS-NR meeting held on 15.01.2025 and 35th CMETS-WR meeting held on 07.02.2025, 53rd TCC & 78th NRPC meeting held on 16-17th Mar'25, 53rd TCC/53rd WRPC meeting held on 13th Mar'25. Further, the transmission scheme was agreed in 30th NCT meeting held on 30.05.25. Subsequently, Ministry of Power, Government of India, vide its Gazette Notification CG-DL-E-30082025-265828 dated 29.08.2025 has notified the implementation of transmission scheme "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-5 :6 GW) [Barmer Complex] Barmer-II: 6 GW (Solar) (LCC Configuration)" through tariff based competitive bidding process route.

Specific Technical Requirement of 6000 MW (4x1500 MW), ±800 kV HVDC [Type: Line Commutated Converter (LCC)]

1. General

The proposed HVDC link shall be ±800 kV, 6000 MW HVDC line between Barmer-II and South Kalamb using Dedicated metallic return and consist of Bipole-1 (3000 MW) & Bipole-2 (3000 MW). Bipole-1 shall consist of Pole-1 (1500 MW) & Pole-2 (1500 MW) and Bipole-2 shall consist of Pole-3 (1500 MW) & Pole-4 (1500 MW). The HVDC terminals shall be implemented with 100% power reversal capability.

The system shall generally conform to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022, CEA (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations, as amended from time to time. Other CEA Regulations/Guidelines, Ministry of Power (MoP) Rules/Guidelines as amended up to date and, as applicable, shall also be followed. Further, any other Rule/Regulations/ Standard/Guidelines as mentioned in the Transmission Service Agreement shall also be followed.

2. Abbreviations

The following terminology shall apply at various places of this specification

DMR:	Dedicated Metallic Return
DMRTB:	Dedicated Metallic Return Transfer Breaker
DPS:	Dynamic Performance Studies
ESCR:	Effective Short Circuit Ratio
FAT:	Factory Acceptance Tests
HMI:	Human Machine Interface
HVAC:	High Voltage Alternating Current
HVDC:	High Voltage Direct Current
HVRT:	High Voltage Ride Through
IBR:	Inverter Based Resources
Id:	Direct current (any defined value)
LCC:	Line Commutated Converter
LI/SI:	Lightning Impulse/Switching Impulse
LVRT:	Low Voltage Ride Through
MTDC:	Multi-terminal HVDC transmission system
MVU:	Multiple Valve Unit
NBS:	Neutral Bus Switch
NGBS:	Neutral Ground Bus Switch
PCC:	Point of Common Coupling
PMR:	Pole Metallic Return
PMRTB:	Pole Metallic Return Transfer Breaker
RPC:	Reactive Power Control
SAS:	Substation Automation System
SCADA:	Supervisory Control and Data Acquisition
SCR:	Short Circuit Ratio

SSTI:	Sub-synchronous Torsional Interaction
TSP:	Transmission Service Provider
Ud:	Direct voltage (any defined value)
VDCOL:	Voltage Dependent Current Order Limit

3. Definitions

Bipole: A pair of 2 poles which are connected to opposite polarities (positive and negative). For power transmission in one Bipole, two such pairs (consisting of 4 converters) are required.
Forward Power flow direction: Active power transmission from Barmer-II HVDC to South Kalamb HVDC.
Inverter: HVDC terminal which is receiving the power.
MVU (Multiple Valve Unit): An assembly of a number of valves mounted into a single structure (these include components mounted on the valve structure, e.g., saturable reactor, surge arrester) which may be considered part of the valve.

PCC (Point of Common Coupling): The connection point between the HVDC and the power system at which performance requirements are defined.
Rectifier: HVDC terminal which is sending the power.
Reverse Power flow direction: Active power transmission from South Kalamb HVDC to Barmer-II HVDC.
Thyristor level: 'Thyristor level' comprises a single thyristor, control, protection, monitoring, auxiliary power and voltage grading components which make up a single voltage level within the valve.
Valve: Complete operative controllable or non-controllable valve device assembly, normally conducting in only one direction (the forward direction), which can function as a converter arm in a converter bridge
Valve Module: 'valve module' is the smallest assembly, comprising a number of thyristor levels, voltage grading and damping components, valve reactors, etc. from which the valve is built up and which exhibits the same electrical properties as the complete valve, but only a portion of the full voltage capability of the valve.

4. Design Consideration

The salient technical features for HVDC terminals shall be as follows (Table 1):

Table 1

Sl. No.	Item Description	Parameters
1.	Rectifier station location (Forward direction power)	Barmer-II HVDC (Rajasthan) [If the power direction is reversed, Barmer-II will become inverter]
2.	Inverter station location (Forward direction power)	South Kalamb HVDC (Maharashtra) [If the power direction is reversed, South Kalamb will become rectifier]
3.	Rated DC voltage (1.0 pu)	±800 kV DC at Rectifier HVDC Pole Bus
4.	Rated power (1.0 pu)	6000 MW at Rectifier DC Bus
5.	Minimum DC Power	150 MW (Single pole operation)
6.	AC system frequency	Nominal 50 Hz
7.	Fault Current level AC system	63 kA for 1 sec for Barmer-II 63 kA for 1 sec for South Kalamb
8.	Minimum Short circuit level (MVA) at 400 kV Barmer-II (both rectifier and inverter operation)	About 26000 MVA (with IBR contribution & Syncon Off) About 20250 MVA (without IBR contribution & Syncon Off) Note: • Above Short circuit levels have been considered with no SynCon and simultaneous outage of one ckt of each 400 kV D/c line connected with Barmer-II S/s. 400 kV Bus Sectionalizer at Barmer-II S/s is considered as normally close.
9.	Minimum Short circuit level (MVA) at 400 kV South Kalamb (both rectifier and inverter operation)	About 21700 MVA on 400 kV Section-1 and 19000 MVA on Section- 2 (considering Bus Sectionaliser in open condition) Note: • Above Short circuit levels are

Sl. No.	Item Description	Parameters
		calculated considering outage of 765/400 kV,1500 MVA ICT on each section. Bus Sectionaliser is kept in Open condition.
10.	Overload requirement	1.1 pu for 2 hours 1.2 pu for half hour 1.33 pu for 5 seconds
11.	Reverse power rating	100% of rated Forward direction power transfer rating[$] (with 1.33 pu overload for 5 second only)
12.	Reduced voltage	80% of rated DC voltage [Applicable for both power flow directions]
13.	Converter transformer	Single phase two winding design
14.	Thyristor valve	Water cooled
15.	Valve cooling system	Dry type design
16.	HVDC control system*	Main + hot standby
17.	HVDC protection system*	Duplicated Protection
18.	Auxiliary supply source	Supply sources tapped from 33 kV side of 2 Nos. of 400/220/33 kV transformer at Barmer-II and 33 kV tertiary of 2 Nos. 765/400/33 kV ICT at South Kalamb. Each auxiliary power shall be fetched from both separate sources of the 33 kV auxiliary supply in station. Additionally, one more 33 kV supply from independent source shall be arranged and connected to 33 kV Bus at both Barmer-II and South Kalamb Stations.
19.	DC Harmonic filter	Minimum One DC filter for each pole at each HVDC terminal station
20.	AC Network Impedance	Relevant CIGRE/IEC document shall be used for the Network harmonic

Sl. No.	Item Description	Parameters
		impedance together with information in PSSE network files provided by CTU.
21.	Negative sequence voltage (fundamental frequency)	1% for Design of equipment 1.5% for rating of equipment
22.	HVDC line online fault locator for pole lines	One No. per pole at each terminal station [when not integrated with Control & Protection System]
23.	HVDC paralleling and de-paralleling switch	As per Requirement
24.	Smoothing reactor on DC bus	As per requirement, but not less than 33% of total milli Henry (mH) required for each pole, shall be provided on DC pole bus
25.	Blocking filter	As per requirement
26.	Reliability and Availability Design Targets	As per Table 11
27.	Station Loss evaluation criteria	Methodology as per IEC 61803 and Target figures stated in Table 11
28.	System Grounding	Solidly grounded

*TSP can provide integrated Control and Protection system as well, meeting functional requirements.

$The power reversal in HVDC links shall be possible from the maximum active power transmission capacity from Barmer-II HVDC to South Kalamb HVDC to the maximum active power transmission capacity from South Kalamb HVDC to Barmer-II HVDC within 60 minutes. HVDC System shall be capable of at least three Power reversals in every 24 hours.

The criteria for the design and control of the network shall be as follows:

- 400 kV AC bus voltages shall normally be within ±5.0% of nominal voltage (400 kV). Bus voltages outside this range may occur from time to time and may exist for long periods due to abnormal loads and/or contingencies. Unless otherwise stated, all equipment shall be rated to operate safely for AC voltages between 360 kV- 440 kV at the converter stations.

- AC system frequency shall normally be within 48.5 Hz to 51 Hz and the HVDC system shall operate without any restrictions on power transfer.

However, equipment shall be rated for 47.5 Hz to 52.5 Hz band.

- For calculating reactive power exchange and filter performance, the 400 kV AC voltage variations to be taken shall be from 380 kV to 420 kV and the frequency shall be from 49.0 Hz to 50.5 Hz. However, frequency range for AC/DC filter rating shall be 48.5 Hz to 51 Hz.

5. Environmental Data

The following environmental data shall be considered (Table-2):

Table 2

Sr. No.	System data	Barmer-II	South Kalamb
1	Max/min Ambient temperature (dry bulb one-hour average) Max dry bulb 24 hr average	50 deg C max 0 (Zero)deg C min 40 deg C	50 deg C max 0 (Zero) deg C min 40 deg C
2	Relative Humidity (%, max)	100	100
3	Average annual rainfall	As per rainfall map of IMD	As per rainfall map of IMD
4	Iso-keraunic level	As applicable	As applicable
5	Wind Zone	As per National Building Code 2016	As per National Building Code 2016
6	Seismic Level	As per Seismic zone of the site	As per Seismic zone of the site
7	Altitude above sea level	<1000 m	<1000 m
8	Pollution level (IEC 60815)	Heavy	Heavy

6. System Performance

The HVDC system shall be designed to meet all performance requirements and shall be compatible to existing system. The HVDC system shall not cause instability to the AC existing Network. Also, it shall not cause adverse effects to other HVDC system in vicinity, RE based generation plants (near Barmer-II) as well as RE Generating Units at Barmer-II PS. This shall be verified by stability, multi-infeed and Sub Synchronous Resonance (SSR) studies and any other Study required, if applicable. Steady State, dynamic, HVRT, LVRT, Harmonic and flicker performance requirements as per applicable Rule/Regulations/Standards/Guidelines as per TSA shall be applicable.

The rated power transmission capacity shall be defined and guaranteed at

Rectifier DC Bus and rated transmission voltage shall be defined at the rectifier DC bus. In the calculation of the power transmission capability, the most unfavorable combination of control and measurement tolerances shall be considered without redundant cooling and thyristors. All components of the transmission system shall be rated to meet the requirements given in this section and other requirements specified elsewhere under these Specifications.

HVDC system performance and rating requirements for high voltage equipment and other critical equipment shall be determined taking into account the extreme values of environmental and AC and DC system parameters as applicable for performance/ rating requirements given under these Specifications and manufacturing and measuring tolerances.

7. Overload Requirements

Table 3

Rectifier DC bus Barmer-II for Bipole	Duration	Redundant cooling	Converter bus voltage
1.1 pu	2 hours	Available	380 kV - 420 kV
1.2 pu	0.5 hour	Available	380 kV - 420 kV
1.33 pu	5 seconds	Not available	380 kV - 420 kV

These overloads would be available for bipole mode of operation in forward power direction. However, Overloading requirement of 1.33 p.u. for 5 seconds shall be applicable in case of reverse Power flow also. For monopolar mode of operation or unbalanced mode of operation, equipment need not be uprated due to additional voltage drop in DMR path, instead TSP will indicate available power rating.

(a) Two Hour Over Load

The HVDC system shall be capable of operating for two hours at transmitted power levels at least 10% (ten percent) higher than the maximum continuous ratings for the specified nominal system conditions and environmental conditions.

If the AC bus voltage at Rectifier or Inverter is below 380 kV, the overload transmitted power capability may be progressively reduced to maintain the direct current at the maximum value obtained with the AC bus voltage at 380 kV.

It shall be permissible to apply the two-hour overload power at least once in every 12 hours period. The overload capability may be for an extended duration upto a maximum of twelve hours, in one or more intervals, in which case the product of power and time shall not exceed (i) 6600 MW-Hrs for each Bipole and (ii) 13200 MW-Hrs for both Bipoles in a 12-hour period and with

the maximum limit of power maintained at 1.1 pu in every converter.

(b) Half an Hour Overload

The HVDC system shall be capable of operating for half an hour at transmitted power levels of at least 20% (twenty percent) higher than the maximum continuous ratings and immediately following the five seconds overload conditions.

(c) Five Seconds Overload

The HVDC system shall be capable of operating at least for five seconds at transmitted power levels 33% greater than the maximum continuous ratings and at specified nominal system and environmental condition. It shall be assumed that the AC bus voltages do not change when this overload is applied.

The five second overload rating shall be achieved without tap changer operation, and the pole voltage may be reduced during the period of this overload.

It shall be permissible to apply the five second overload power once in any five-minute period. This five second overload shall also be permitted during operation at the two-hour overload rating with redundant coolers and heat exchangers available for service. Power greater than the two-hour overload shall form the start of five second overload period.

(d) It may be noted that 1.2 p.u. and 1.1 p.u. overload ratings are for power compensation following loss of a healthy converter as well as for transmission of excess power during peak generation with all converters in service, up to 1.1 p.u. (i.e. 6600 MW) and 1.2 p.u. (i.e. 7200 MW). However, the purpose of 33% overload is for system stability, power modulation and dynamic ride through of the system as a whole and can be initiated with the initial system conditions of 1.0 p.u. normal load operation or 1.1 p.u. or 1.2 p.u.overload Operation.

(e) For calculations, maximum line resistance shall be taken at a maximum conductor temperature of 85 °C with minimum wind velocity and maximum solar radiation while for minimum line resistance the conductor temperature shall be taken as 0 °C.

8. DC Voltage:

The nominal direct voltage at the Rectifier converter station DC line terminal shall be ± 800 kV relative to neutral. This voltage shall be maintained within ± 20 kV by tap changer and Firing angle control for all power flows (i.e. minimum to overload [1.1 p.u. power rating]) with balanced current between the poles/converters for all AC bus bar voltages between 380 kV and 420 kV and for all AC system frequencies between 49.0 Hz and 50.5 Hz.

In any monopolar operation, or three converter operation (unbalance operation of one Bipole in parallel with a monopole) the Pole Voltage to Ground may be decreased by equivalent Voltage drop in DMR line.

In the event that the AC system voltage is below 380 kV down to 360 kV, the DC line voltage may be correspondingly reduced.

If the AC system voltage at Rectifier or Inverter is above 420 kV but not exceeding 440 kV, the DC line voltage to ground may be increased but shall not exceed 820 kV at Rectifier. Higher than normal firing angles can be utilized

to restrict the DC line voltage under these conditions and the equipment should be adequately rated.

The above references to DC pole voltages shall be interpreted as extremes and shall not be exceeded due to measurement error, tap changer control dead band, tolerances in the manufacture or in the control system, or for any other reason.

9. **Reduced DC Line Voltage**

The HVDC system shall be capable of operating continuously at a nominal pole voltage of 640 kV relative to neutral at rectifier DC bus in bipolar as well as in monopole modes. Rectifier station shall be capable of transmitting not less than 4800 MW in bipolar link and 2400 MW in each Bipole. Redundant cooling may be in service. The pole voltage shall be within 20 kV of the above provided that the AC bus voltage is below 400 kV.

It shall also be possible to set DC voltage reference between 640 kV to 800 kV in either pole in the steps of 10 kV by the operator action.

Power levels in this voltage range shall be as permitted by the main circuit rating of the equipment. However, reduced voltage attempt by DC line protection shall directly first achieve 640 kV. The reduced voltage may be achieved by a combination of tap changer and firing angle control. Reduced voltage operation shall be possible to be ordered by operator from either station even with telecom out of service. The change from normal to reduced voltage operation and vice versa shall not require a valve group shutdown or reduction in power below that achievable with the reduced voltage. It shall be possible to start the transmission in reduced voltage mode.

10. Converters Operating modes

The HVDC equipment at both Converter Stations shall be designed and rated to operate with different DC power orders. Necessary facilities shall be provided to permit these modes of operation and to allow the individual Pole power and/or current orders and/or voltage to be set as per below.

Each Pole/Bipole shall be capable of transmitting power including overloads and for the system short circuit levels specified in this specification. The minimum operating modes are as follows:

(a) Balanced/ unbalanced bipolar operation
(b) Monopolar operation with Pole Metallic Return (PMR)
(c) Monopolar operation with Dedicated Metallic Return (DMR) [DMR1 or DMR2 or DMR1 parallel to DMR 2] mode or DMR [DMR1 or DMR2 or DMR1 parallel to DMR 2) in parallel with PMR
(d) Three converter operation at each HVDC terminal end. These 3 converters could be any 3 out of 4 converters at terminal station.
(e) Any converter of one polarity at one HVDC terminal can operate with any converter of same polarity at the other end (upto the overload capacity of converters)

All above operating modes shall also be available for reverse power and reduced voltage operation.

11. System Studies

The TSP shall be responsible for overall system engineering and detailed design of all elements, systems, facilities and equipment. The TSP shall have to carry out following studies for this purpose for both directions of power flow. The TSP may note that the following list is only indicative and if any other studies, calculations etc. are required the same shall have to be done by TSP.

(a) Main circuit parameters

(b) Transient Current Requirement and Short circuit studies

(c) Thermal Rating Study for Key Equipment

(d) Studies for Overvoltage Protection and Insulation co-ordination for AC and DC systems

(e) AC, DC Harmonics and Power Line Carrier (PLC)/Radio Interference (RI) filter design, rating and performance;

(f) Temporary overvoltage (Fundamental Frequency Temporary Over Voltage-FFTOV) and Ferro Resonance Overvoltage Studies;

(g) AC and DC Transient overvoltage Study, surge arrester stress;

(h) Runback and run up studies;

(i) AC breaker Transient Recovery Voltage (TRV) and rate of rise of recovery voltage (RRRV) studies;

(j) DC High Speed Switch Requirement Study

(k) Overload study;

(l) AC equivalent study;

The equivalents to be prepared for peak load, light load and extremely weak (minimum SCR) network scenarios. The dynamic network equivalent shall be prepared with full machine models having exciters, governor- turbine, generators, stabilizer models instead of voltage source models, upto a minimum of two buses away. These dynamic equivalent networks shall be used in PSCAD DPS, Real Time Digital Simulator (RTDS) DPS, with actual control & Protection panels.

(m) DC Commutation switch requirements;

(n) Load flow, stability, modulation and frequency controller design study;

(o) Electrical interference study (RI and PLC);

(p) Reliability and availability study;

(q) Audible noise study;

(r) Loss calculations/study

(s) Studies for deciding the operational logic & sequences considering Dedicated Metallic Return Conductor (DMR) operation and Metallic return with pole conductor, in case of monopolar Operation

(t) Impact of parallel AC lines

(u) Real Time Simulator-based studies for testing of actual HVDC Controls (Factory Acceptance Test or Factory System Test)

(v) AC/DC system interaction studies

(w) Interaction studies between this LCC HVDC and other HVDC stations, STATCOMs, SunCons which are electrically coupled nearby (including those planned in future) and other nearby Inverter Based Resources (IBR) & Inverter Based Load

(x) Studies to determine the requirements for communication between the converter stations and remote Load Despatch Centres (LDCs).

(y) Studies for designing the Equipment for Dedicated Metallic Return Conductor (DMR) operation and metallic return with pole conductor, in case of monopolar operation up to rated power (including overload).

(z) Sub synchronous Resonance & Self Excitation Studies

These studies are to demonstrate that the HVDC system does not excite the torsional modes of oscillations and self-excitation of the generators and Sub- synchronous Resonance in thermal/gas turbine generators near Converter Stations under all defined system operating conditions. The study shall demonstrate that the HVDC system has positive damping for all sub synchronous torsional modes of the generators.

(aa) Studies of DC Current flowing through Windings of Converter Transformers

(bb) AC line and other bays protection co-ordination studies.

(cc) DC over voltage studies

(dd) Station earthing

(ee) LVRT, HVRT, harmonic resonance and other dynamic studies

(ff) Studies for the Control Protection and Communication Systems

The study reports shall include the following study results:

(i) Dynamic Performance Study including the RE Resources near Converter Stations.

(ii) Hierarchical Structure of the Control and Protection

(iii) Redundancy of the Control and Protection Systems

(iv) DC Power and Current Control Modes and Features

(v) Switching Sequences and interlocking

(vi) AC & DC System Protections

For each protection, the report shall include the following:

a) Purpose of the protection

b) Principle of protection operation

c) Required accuracy of measuring signals

d) Fault detection and coordination between the DC controls and the protection and AC protection.

e) Consequences of protection operation, such as DC control and sequence control initiated at both converter stations

f) Redundancy of protection and operation of backup protection

g) Detailed calculations of the protection settings together with limiting fault cases and/or criteria that determines these settings.

h) Description of the applicable protection in case of loss of telecommunication.

(vii) Reactive Power Control

The study shall include at least the following:

a) Reactive power control principles for converter operation during steady state and transient conditions

b) Reference variable control criteria

c) Criteria for switching of reactive power sub banks

d) Operator operation, including control and monitoring features

e) Equipment description, emphasizing reliability/availability and maintenance features

f) Validity checking of signals

g) Switchover and control feature between AC voltage/reactive power controls

(viii) Telecommunication Interface Requirements

(ix) Station Control and SCADA System

(x) Control for Converter Transformer Tap changer

(xi) Additional Control Study

The report, as applicable shall include the studies of the following control modes with the AC network condition of Barmer-II and South Kalamb and actual performance of converter equipment and possible fault condition being taken into account,:

a) Power ramp down

b) Power ramp up

c) Damping of sub-synchronous oscillations

d) Abnormal AC voltage and frequency control

e) Supplementary modulation signals

(xii) Multi Infeed Interaction Study with nearby HVDC System

(xiii) Commutation failure performance study

Impact of the commutation failure & cascading commutation failure (if expected) on the inverter based resources (IBR) & associated AC network shall also be included in this study.

(gg) Any other studies as deemed necessary by TSP

The load flow and dynamic file shall be provided to the TSP in PSS/E 34 or newer version format. This will include maximum and minimum fault contribution from conventional generation and IBRs considering full power, reduced DC voltage power and other network scenarios which can lead to the highest possible dynamic overvoltage variations. Necessary Generic Models for IBRs or modelling assumptions shall also be provided for studies requiring the same. Conventional generator, lumped mass model and controller models in vicinity shall also be provided. For sharing User Defined Models (UDMs) TSP and Solution Providers will be required to abide with the statutory requirements of the UDM provider if required.

In case of absence of detailed models of nearby inverters, the harmonic distortions shall be considered as per the relevant CEA Regulations. The impedance of RE Park at the Pooling station PCC will be provided to the TSP. The rest of the network may be modelled by the harmonic impedance and the rating and performance studies shall be done accordingly. Harmonic impedance shall take into account all contingencies in base file, N-1, N-2 and other PSS/E scenarios for network for full power and reduced DC power.

PSS/E files are provided based on the data available at the time of issuance of RfP. TSP is required to validate the data before carrying out simulation. However, clarification, if any, may be sought before the bid submission. CEA/CTU shall endeavour to give clarification to the extent possible. In case of any discrepancy observed/non-availability of data for any of the machines and other control devices, typical values may be used in the studies with the intimation to CEA/CTU.

12. Digital Models

TSP shall provide to the CTU the following models of all supplied circuit components and control and protection of the HVDC Systems. The models shall be up to date with all the design features implemented in the Project.

(a) PSCAD
(b) PSS/E

TSP shall provide both UDM and Generic model for RMS based stability model (in PSS/E V36 or above) and EMT (PSCAD v5 and above). All appropriate control features shall be modelled in the above models and necessary documentation on the theory and use of model should be provided. Further, a generic model, benchmarked to the extent possible to the UDM PSS/E and PSCAD model, shall also be furnished. Generic models can be shared by the CEA, CTU and Grid-India with the concerned stakeholders/external party(ies) e.g. STUs etc. on need basis. For User Defined model, confidentiality shall be maintained by the CEA, CTU and Grid-India. For PSCAD, User Defined model shall be provided by the TSP for which confidentiality shall be maintained by the CEA, CTU and Grid-India. Both UDM (PSCAD and PSS/E) and Generic model (PSSE) shall be provided by

OEMs to CEA/CTU/GRID-INDIA without any NDA (Non-Disclosure Agreement)

Data sharing requirements as per Procedure for First Time Charging/Energization (FTC) and Integration of New or Modified Power System Element of Grid Controller of India Ltd. (GRID-INDIA) shall also be done by the TSP. All the requisite data/reports/models including User defined models/documents as required as per the CEA/CTU/Grid India Standards/ Guidelines shall be provided by the TSP.

Data sharing format will be subject to the agreement or other statutory requirements mandated by HVDC OEMs, if required.

13. **DC power circuit switching requirement:**

The TSP shall provide all DC switching devices as per the requirements of this Specification to enable the smooth and efficient operation of the HVDC system.

All disconnectors or isolators which are used to provide isolation for maintenance on any equipment shall have visible breaks. If a visible break is not inherent then an additional separate isolator having a visible break shall be provided.

The equipment arrangement shall be designed to ensure that no single contingency, fault or loss of any piece of equipment can cause or result in a bipolar shutdown or transient reduction in power transfer to less than the rating of one Pole.

High speed switches (paralleling & de-paralleling switches) for converters shall be provided with disconnectors on both sides.

The station layout shall provide safe access to all equipment for service and maintenance. The DC power circuit arrangement shall provide at least the following functions:

(a) Isolating and grounding Converter Station Pole for maintenance.

(b) Isolating and grounding either or both DC transmission line Poles for maintenance.

(c) Isolating and grounding the DMR conductor at the Converter Station for maintenance when operating in bipolar mode with balanced DC currents. All primary equipment, control, protection and measuring equipment necessary to achieve this function shall be provided. All the studies and design engineering necessary for the HVDC System to operate in such modes shall be performed.

(d) Clearing of a Pole for maintenance without affecting the power flow on the other Pole.

(e) Switching from DMR to "DMR in parallel with PMR" mode of operation during monopolar operation and back.

(f) Grounding of the neutral bus through a high-speed switch (NBGS) during bipolar operation balanced current mode.

(g) Clearing neutral bus fault on one Pole.

14. **Insulation co-ordination**

(a) HVDC System shall be suitably protected against Impulses and

disturbances external and internal to the system such as switching impulses, lighting impulses, steep front impulses, dynamic over voltages and load rejection (1.2 pu power). The insulation of all equipment shall be properly protected and coordinated with surge arresters and/or surge capacitors. Insulation coordination shall be done keeping in mind the minimum electrical clearances, safety clearances and maintenance clearances as per Switching Impulse Withstand Level (SIWL). Insulation coordination shall be done as per relevant IS/IEC Standards.

(b) The insulation of the equipment and protection levels of Surge Arresters connected to the converter AC bus bars of the converter stations at both rectifiers and inverter shall be coordinated with the insulation and surge arrester characteristics of the connected AC systems to which the converter stations are to be connected without exceeding the discharge duty of these arresters so as not to overload these existing arresters of the network. Only 336 kV surge arrester (rated voltage) shall be used on AC incoming 400 kV line side.

(c) The tripping action on Over Voltage for lines shall be as per the Regional Over Voltage Protection Philosophy specified by the RPC. In general or the default tripping action should initiate if the fundamental frequency over voltage exceeds 1.1 p.u. for 10 seconds and if 1.5 p.u. fundamental frequency voltage persists for more than 100 milliseconds. The HVDC over voltage strategy shall be coordinated with such setting.

(d) The minimum insulation levels for 800 kV DC to ground shall be as follows:

Table 4

HV Transformer LIWL/SIWL (kV)	Smoothing reactor LIWL/SIWL (kV)	Thyristor Valve Structure LIWL/SIWL (kV)	DC Busbar LIWL/SIWL (kV)
1800/1600	1800/1600	1800/1600	1900/1600

LIWL- Lightning Impulse Withstand Voltage

SIWL- Switching Impulse Withstand Voltage

(e) The ratio of **impulse withstand voltage** to impulse protective level shall be in line with Table 3 of IEC-60071-11.

(f) The TSP shall carryout insulation coordination studies for the Project. The TSP shall perform all necessary HVDC digital simulator studies and shall keep detailed report(s) on insulation coordination in its record. The

TSP shall carry out insulation coordination studies for rating of all arresters supplied for the project, establishing the required insulation level for supplied equipment and the clearances between energized parts and between energized parts and ground. The arrester arrangement and protective levels shall be selected such that, generally, the overvoltages on the AC side are protected by arresters on the AC side, and overvoltages on the DC side are adequately limited by an arrangement of arresters on the DC side. Critical components of the supplied converter equipment shall be directly protected by arresters connected closest to them. The arresters installed shall be rated such that these arresters are not overstressed for all operating modes and configurations. The studies must show that any existing 420 kV equipment including any existing surge arrestors will not be overstressed for all modes of operation and configurations of either Converter Station when HVDC station is extension of an existing AC station.

The report(s) shall detail the characteristics of the surge arresters, energy ratings and shall demonstrate that the selected insulation protective and withstand levels, discharge and coordinating currents, and arrester ratings and discharge capabilities are adequately coordinated and comply with the requirements of this Specification. It shall also detail all insulation and air clearances and leakage distances and shall justify the selected values based on the present Specifications. The report(s) shall include all assumptions made for the study parameters and describe the types of events modeled (i.e. AC and DC faults, valve hall faults, converter valve or control mis-operations, etc.) and identify the decisive cases that establish the insulation design.

(g) **Temporary Overvoltages**

The converter valves shall be capable of continuing to operate under the temporary overvoltage conditions specified below, which could occur with the valves deblocked and also that the valves are capable of deblocking under the highest temporary over voltage conditions within 5 (five) cycles of the initiation of a fault or disturbance. Equipment shall be designed for the applicable short circuit ratio and overvoltage arising thereby.

Temporary Overvoltage caused by Bipole link HVDC transmission shall be controlled to 1.54 pu or below. Events caused by other equipment in the AC network shall be controlled within the limits of the capability of the deblocked converter. In case the converter is tripped, and not possible to restart within seconds, filter tripping shall be allowed to limit overvoltages.

The actual temporary over voltage shall be determined by the TSP but equipment shall be designed for temporary over voltage not less than the values given above. In addition, so as to prevent operation and overstressing of the arresters, the TSP shall limit the temporary over voltages including harmonic, resonant, and ferro-resonant effects on the 400 kV AC bus bars so that:

- 705 kV crest phase to ground is not exceeded by more than 3 peaks;
- 565 kV crest phase to ground is not exceeded by more than 10 cycles;
- 510 kV crest phase to ground is not exceeded by more than 20 cycles.

In the calculation of temporary over voltages on the AC side the TSP shall allow for blocking of the complete Bipole(s) from up to the highest steady state transmission capability of the installation. On the DC side the TSP shall allow for the maximum load rejection which could occur and which leaves converter deblocked.

The converter Equipment shall be designed to withstand temporary over voltages corresponding to AC Side which are not less than 1.5 times 400 kV at converter stations with the converter blocked.

The TSP shall provide and commission all equipment necessary to limit the temporary 50 Hz overvoltage on the AC bus bars to the levels specified above. The actual temporary overvoltage shall be determined by the TSP but AC equipment shall be designed for temporary overvoltage not less than the values given above.

The connected AC harmonic filter shall be assumed to be that with the highest MVAr applicable to the mode of operation which does not exceed the maximum reactive power exchange with the AC system as specified in this specification.

The converter equipment shall be rated for continued operation under the maximum over voltage conditions to be defined by the TSP taking into consideration the dynamic over voltage profiles as determined by the design studies to be performed by the TSP. Irrespective of the over voltage profile derived by the TSP, the equipment shall be rated to withstand an over voltage according to above figures following deblocking.

DC withstand voltage design of equipment shall take due consideration of the temporary voltage stresses that the respective equipment may be exposed to based on studies of different disturbances as applicable.

Any switching equipment within the scope of supply of the TSP which may be called upon to operate at this voltage in either a main or backup role shall have the appropriate capability

HVRT Strategy:

The HVDC Station shall enter into HVRT mode (exit from continuous operating region) when the Voltage at AC bus i.e. 400 kV side (RMS) is above 1.1 p.u. due to faults/control actions/or any other cause.

The HVDC Station shall remain connected to the grid when voltage at the inter-connection point (AC bus), on any or all phases (symmetrical or asymmetrical overvoltage conditions) rises above the specified values given below for specified time:

Table 5

Over voltage (pu#)	Minimum time to remain connected at POI
V > 1.50	Instantaneous trip
1.50 ≥ V > 1.30	100 ms
1.30 ≥ V > 1.10	10 sec
V ≤ 1.10	Continuous

1 pu = 400 kV (3 phase RMS voltage at POI)

LVRT Strategy:

The HVDC Station shall enter into LVRT mode (exit from the continuous operating region) when the Voltage at AC bus i.e. 400 kV side (RMS) is below 0.9 p.u. due to faults/control actions/or any other cause.

The HVDC Station must remain connected to the grid when voltage at the interconnection point (AC bus), on any one, two or all phases (symmetrical or asymmetrical overvoltage conditions) dips up to the level depicted by the thick lines in the following curve:



1 p.u. = 400 kV (3 phase RMS voltage at POI)

During LVRT mode, HVDC Station shall withstand all above low voltage conditions. Restoration of voltage shall be said to be achieved when the voltage at PoI settles within +5% of pre fault voltage.

(h) **Transient overvoltages**

In the calculation of transient over voltages the TSP shall consider at least:

(i) Lightning surges propagating down the AC and DC overhead lines, including direct strike to line conductors and back flashover;

(ii) Lightning surges due to direct strike within the converter station in the event of shielding failure;

(iii) Steep fronted waves resulting from flashovers or faults, including those within the valve hall and to ground from the valve windings of the converter transformers;

(iv) over voltages due to switching of converter transformers, AC filters and shunt capacitors, shunt reactors, 765 kV and 400 kV transmission lines, 765 kV and 400 kV class transformers or other equipment;

(v) For re-closure of AC filters and capacitor banks, residual voltage on the capacitors shall be considered.

(vi) The saturation effects of converter transformer due to presence of remnant flux shall also be considered.

(vii) Application and clearing of single phase and three-phase to ground faults which may be cleared by AC circuit breakers. Possibilities of breaker re-strikes shall also be considered although the breaker should be designed as restrike free.

(viii) Faults within converter equipment, including control and telecommunication malfunctions;

(ix) Over-voltages due to blocking of 6 pulse or 12 pulse valve groups with and without bypass pair firing;

(x) Over-voltages due to DC and DMR line resonance.

(xi) Uneven distribution of over-voltages, particularly within the converter valves;

(xii) Commutation overshoot, particularly when operating at higher than normal firing or extinction angles coupled with dynamic over voltage conditions;

(xiii) Arrester location relative to protected equipment and arrester characteristics.

(xiv) For determination of maximum transient over voltages at converter bus with a sequence of clearance of three phase /single phase AC bus fault along with blocking of one pole running at overload with appropriate AC filters remaining connected and subsequent protection actions.

(xv) Continuous commutation failure at the inverter and rectifier valve misfire.

(xvi) Earth faults and short circuits within the valve halls and on DC filter bus.

(i) **Limitation of Overvoltage**

Blocking of the converter valves to protect them and other DC side equipment from sustained over voltages appearing on the AC system shall not be permitted. The use of converter valve group controls to limit temporary (dynamic) over voltages shall be permitted provided that the valves and other converter equipment are adequately rated.

(j) **Determination of Overvoltage**

The TSP shall determine the highest transient and temporary over voltages, which can occur with the equipment parameters selected and with the AC system and DC line as defined in this Specification.

(k) **Arrester Protective Levels**

The transient overvoltages imposed across insulation shall be limited by surge arresters. Dynamic over voltages may also be limited by surge arresters but only if the arresters are adequately rated for such duty.

The discharge current (coordinating current) shall be determined by the TSP appropriate to the arrester location and line & equipment parameters. For arresters connected to the 400 kV AC bus bars, the 8/20 microsecond wave coordinating discharge current shall be 10 kA, 15 kA or 20 kA as appropriate. Where multicolumn arresters are used or where arresters in separate housings are connected in parallel, unequal sharing of the discharge current shall be considered.

The TSP shall design the converter equipment to withstand a maximum continuous AC system voltage of 440 kV. The calculations for determination of arrester energy requirement shall be based on a maximum pre-fault voltage of 440 kV.

(l) **Lightning shield**

The TSP is responsible for the design of the lightning shield. The system shall also be designed to provide "effective shielding" to ensure that almost no insulation flashover can result from atmospheric discharges striking the overhead shielding.

Effective and adequate lightning protection shall be provided to protect all converter equipment including wall bushings and the Converter Station buildings from damage due to atmospheric discharges and shall ensure that any lightning strikes shall not cause flashover or mal-operation of any equipment which can affect the power transmission capability of the Converter Station.

15. Radio Interference (RI), Acoustic Noise (AN) and DC field

(a) All the necessary precautions shall be made during HVDC design to

ensure that there shall be no mal-operation, damage or danger to any equipment, system or personnel due to electromagnetic or electrostatic interference effects. The converter terminal(s) shall neither damage nor cause mal-operation of the DC control and protection system or the DC tele-control system.

(b) All the necessary precautions shall be taken in the form of noise suppression techniques, shielding and filtering devices to prevent harmful interference, which may be generated by the converter terminals, with the Power Line Carrier (PLC) systems, Radio communication systems, Television systems, VHF, UHF & microwave radio systems.

(c) The audible noise shall be limited to the following values for various areas of the converter station and buildings. It is to be demonstrated by calculation and site measurement that the specified sound pressure levels are not be exceeded.

Table 6

Valve hall (in places where long term access is required during normal operation) Mechanical equipment indoor areas requiring long term access (measured at 2 meter distance)	90 dBA
Equipment in outdoor areas (measured at 15 meter distance) except converter transformers	75 dBA
Office area*	45 dBA
Control rooms*	45 dBA
Diesel generator (Operating area)	75 dBA
Compressor areas (measured at 2 meter distance)	90 dBA
At the station boundary (Outside wall or fence)	70 dBA

* *"Background" noise from the ventilation system.*

(d) For area with permanent access, the total calculated electric field at ground level shall not exceed 20 kV/m excluding space charge in the DC outdoor yard. For area with permanent access in DC outdoor yard, calculated Ion current density shall be less than 20 nA/m^2 at ground level.

(e) Radio Interference (RI)

The TSP shall take the necessary precautions in the form of valve hall and building shielding to meet his own requirements plus the following:

(i) With the Bipole operating at any of the specified operating modes and power levels and within the design range of firing angles, the Radio Interference Level (RIL) from electromagnetic radiation generated by the converter shall not exceed 100 micro volt/m under fair weather conditions at any point outside station fence which are:

500 meters or more from the nearest bus connecting the valve to the converter transformers within the station.

And

at a lateral distance of 30 m for the conductors of any outgoing AC line, HVDC line and electrode line.

This RIL criterion shall be achieved at all frequencies within the range of 150 kHz to 300 MHz.

(ii) The valve hall design shall incorporate the screening requirements. The use of a mesh screen external to the building, covering all or part of the switchyard shall not be permitted.

(iii) The shielding shall be designed so that the specified radio interference levels shall not be exceeded assuming any earth resistivity between 10 and 1000 ohm-meter.

(iv) Maximum radio interference voltage for frequency between 0.5 MHz to 2 MHz at 1.1 times of maximum DC voltage for 800 kV DC system, 266 kV RMS for 400 kV system and 156 kV RMS for 220 kV system and 92 kV RMS for 132 kV system shall be 2500, 1000, 1000 and 500 micro-Volt respectively.

(f) Television Interference (TVI)

The Television Interference Level (TVIL) shall not exceed 10 micro volts/m at the locations/contour line specified above.

(g) Interference with Power-Line Carrier Systems

The TSP shall take the necessary precautions in the form of noise suppression techniques and filtering devices to prevent harmful interference from the converter stations to Power Line Carrier (PLC) systems operating on the HVAC transmission line networks connected to each station and also to other power line carrier systems located adjacent to the HVDC bipolar line such that PLC systems shall operate reliably in fair weather conditions. The frequency spectra to be protected for PLC system is 40 kHz to 500 kHz.

16. Dynamic Performance

(a) The purpose of dynamic performance design is to determine the control parameters for HVDC system and to ensure that the HVDC system

shall have smooth, stable and fast operation for both steady state and transient conditions without adversely affecting the connected AC grid.

The principal objectives of the design shall include:

(i) Optimal response of HVDC controls following step change in ordered parameters like DC current, DC voltage, power, etc.
(ii) Stable operation of the DC system following major disturbances.
(iii) Stabilization of the AC system following major disturbances.
(iv) Control of temporary over-voltages and avoidance of self-excitation of the generators.
(v) Control of frequency following quasi-static (slow) and fast changes in AC system load / generation at the rectifiers and/ or inverter ends.
(vi) Control of power levels depending on the system configuration. Such a control may require AC line load control (ACLLC) and Run Back control features.

(b) The HVDC system shall recover to 90% of the pre-fault DC power transfer level consistently within 120 ms from the instant of fault clearing, without subsequent commutation failure or sustained oscillation for all inverter AC system fault conditions. For all rectifiers AC system fault conditions, the recovery time, to 90% pre-fault power level, shall be within 100 ms from the instant of fault clearing. The TSP shall verify that such response time does not give rise for any risk of AC system instability in any system configuration. If it is in the interest of the overall improved recovery of the AC/ DC system, in such cases the recovery times other than those specified shall also be acceptable, subject to review.

(c) HVDC should continue operation at reduced power if conditions get outside the voltage, frequency and short circuit capacity ranges specified in system data as much as possible with its inherent capability.

(d) HVDC terminal Characteristic and Step responses: The control behavior at rectifier and inverter end for a typical HVDC Pole should broadly follow the following characteristics. It may be noted that minor justified variation from the below characteristics due to Parallel operation of Bipoles depending in the Control Strategy shall be acceptable.

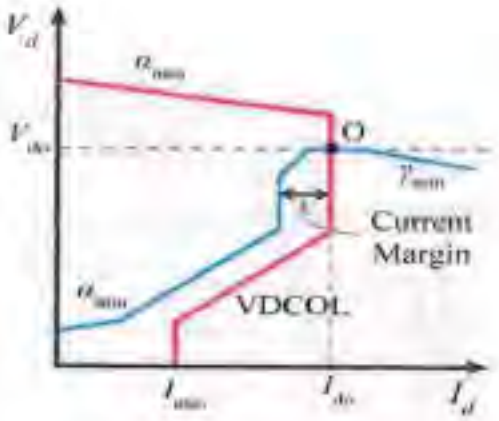
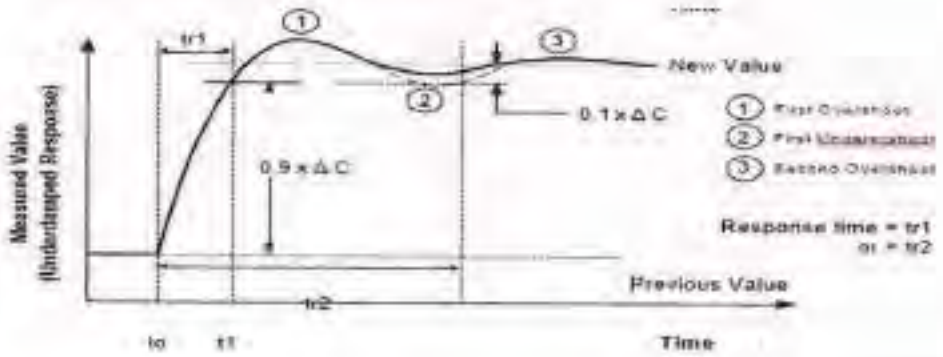


Fig-1- Current margin between rectifier and inverter

The response time (tr1) is defined as the time from the initiation of the order change to the time when 90% of the ordered change has been accomplished, subject to the condition that the measured value remains at the new order within a tolerance of +10% of the ordered change at rectifiers DC terminal after the first overshoot. If the measured value exceeds the tolerance of +10% of the ordered change after the first overshoot, then the response time (tr2) shall be defined to be the interval from the initiation of the order change to the time when the measured value returns to and thereafter remains at the new order within a tolerance of +10% of the ordered change. The first overshoot shall not exceed 30% of the ordered change and the measured value shall settle at the new order within a tolerance of +2% by the second overshoot. For an over damped system, the response times (tr3) is defined as the time from initiation of the order change to the time when 90% of the ordered change has been accomplished. The measured value shall settle at the new order within a tolerance of +2% by four times tr3. Step response to changes in power (current) order shall be executed in the following manner:
When the ordered change is *positive*:



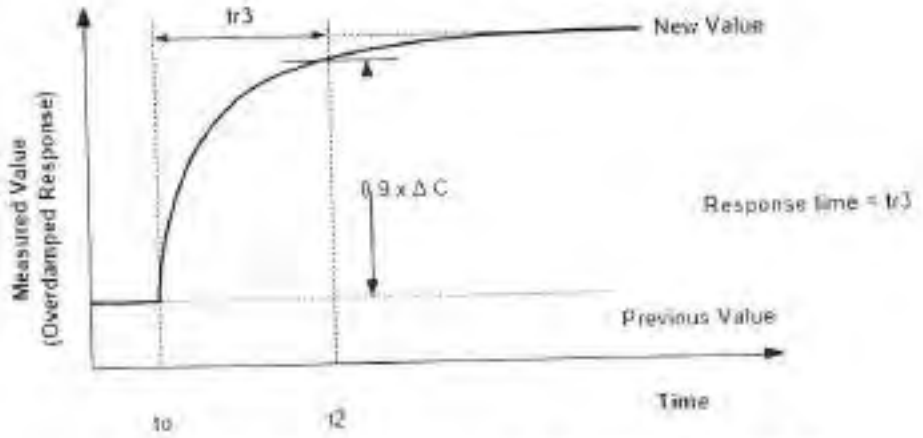
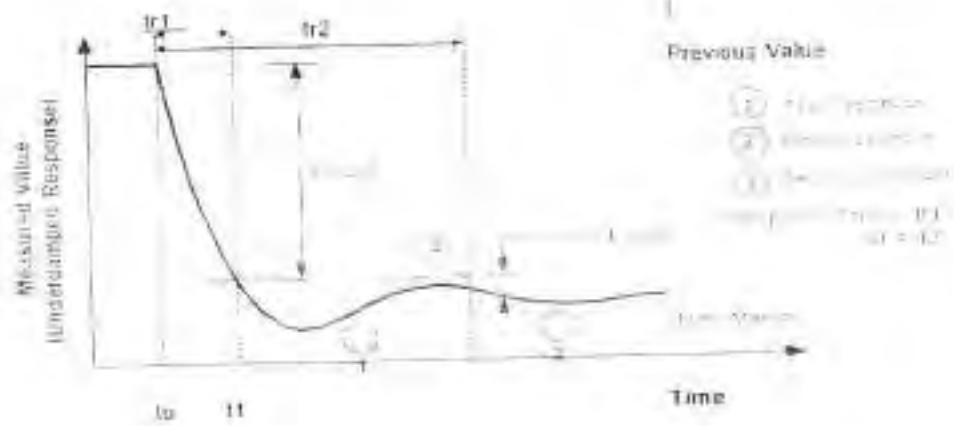


Fig 2- Definition of response to positive step change

When the ordered change is *negative*:



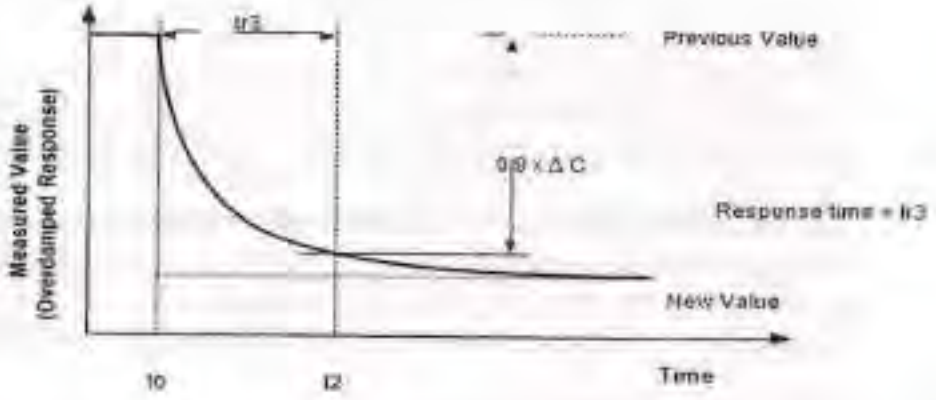


Fig 3- *Definition of response to negative step change*

(e) Power Order Step Response

The HVDC controls, when in power control mode or any other mode where the DC power transfer is controlled, shall respond to maintain the power transfer of the Poles at the ordered or desired level at any power level between minimum and the 30 minutes overload rating of the HVDC system.

When operating at any power order between the minimum and rated power transfer, the DC power controller shall respond to either a step increase or a step decrease in DC power order such that 90% of the ordered change is achieved within 150 milliseconds of the power order change at the rectifier. The TSP shall verify that such response time does not give rise for any risk of AC system instability in any system configuration. If it is in the interest of the overall improved recovery of the AC/ DC system, in such cases the recovery times other than those specified above shall also be acceptable.

(f) Response to AC Bus Voltage Change

The TSP shall demonstrate the response of the power controls to sudden changes in AC bus voltages of -5.0% to + 2.0% from its nominal value and ensure that it is stable.

(g) Power Voltage Instability

HVDC links operating in constant DC power control and weak AC system conditions can lead to power voltage instability under certain disturbances. To prevent such power voltage instability, the TSP shall provide control measures to prevent AC system collapse during AC system disturbance due to the action of the HVDC control. The TSP may adopt a power reduction or a dynamic gain supervision function in the control system to avoid such instability if the short circuit MVA changes during a particular power transmission level.

17. Main Circuit Design

The purpose of Main Circuit design is mainly to determine the operating characteristics and rating of thyristor valves and converter transformers (MVA, tap changer range etc.). It also forms the input for AC Filter and Reactive compensation design. The main circuit arrangement and circuit shall depend on type of HVDC system, Power Transmission requirements, DC Voltage Levels, connected AC voltage levels, Reactive Power requirements and AC & DC Harmonic requirements. The system shall meet various harmonic performance parameters, as specified elsewhere in this specification, on both AC Side and DC side. This requirement along with those given in Table-2, shall be met simultaneously by the AC/DC filters.

18. HVDC Station Equipment

The function blocks of converter station are Converter area (converter valves, converter transformer, smoothing reactor), DC yard (DC filters, DCCT, DC Voltage Divider, PLC filters of DC side, DC pole arresters, Disconnectors and ground switches), AC filter yard, AC yard and auxiliaries. A typical LCC based HVDC station shall consist of the following main equipment.

(a) Thyristor valves and its accessories e.g. damping and grading circuits converter cooling system, etc.,
(b) Converter transformers,
(c) Smoothing reactors,
(d) DC filters;
(e) AC filters (Harmonic filters and PLC filters) and shunt compensation;
(f) Control and protection of AC and DC side;
(g) Electrical and mechanical auxiliaries,
(h) Dedicated Metallic Return (DMR),
(i) AC switchyard equipment;
(j) DC switchyard equipment;
(k) AC & DC Surge arresters;
(l) AC & DC Measuring Instruments;
(m) Communication system between converter stations (OPGW)
(n) DC wall bushings
(o) AC wall bushings (if applicable)
(p) Auxiliary Power System
(q) Key interlocking system for valve hall, DC filters, AC filter
(r) Fundamental frequency blocking filter, if required

19. Converter Station AC Yard, Transformer yard and valve hall

(a) AC commutating bus equipment

The AC circuit breakers, disconnectors, instrument transformers and other switchyard equipment shall be similar to that of the equipment specified under Regulation 46 of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022. The bus rating shall be adopted according to the calculation considering single bus outage. The switching duties

of the AC circuit breakers will be decided based on transient over voltage study, insulation co-ordination, AC filters and protection studies.

(b) **Dynamic over voltage limiter devices**

Converters connected to relatively weak AC systems may cause dynamic over voltages (DOVs) during load rejection / disturbance. The DOV limiter shall consist of parallel arrester elements connected phase to phase or phase to ground and designed to absorb the desired amount of energy during a system disturbance to protect the HVDC system during the HVRT period. The DOV limiter shall be coordinated with recovery of DC system following a disturbance. The requirements of surge arresters shall be based on the insulation co-ordination study in line with relevant standards. The arresters used shall be metal oxide (ZnO) type conforming to relevant standards.

(c) **AC harmonic filters and shunt compensation**

(i) The HVDC converter generates harmonics during the Conversion process and AC harmonic filters shall be used to limit AC voltage distortion due to harmonics to acceptable levels and also to meet the reactive power exchange requirements based on the studies carried out.

TSP shall design the AC filter banks in such a way that it is possible to transmit full rated power even with 400 kV bus-sectionalisers open.

(ii) The AC harmonic filters shall be switched in and out by sub-bank circuit breakers in First-in First-out (FIFO) logic to increase lifetime of switchgear. Based on the studies, the reactive power requirement for the terminal and bank or sub-bank size shall be determined such that reactive power exchange with the AC bus shall remain within specified limits.

The permissible limit of voltage fluctuation for step changes which may occur repetitively is 1.5 percent; for occasional fluctuations other than step changes the maximum permissible limit is 3 percent.

(iii) The main filter equipment namely capacitors, reactors and resistors shall comply with the requirements of following IEC.

A. Capacitors-IEC 60871;
B. Reactors - IEC 60076-6;
C. Resistors - IEC 62001/As per owner's specification.
D. Only air-core reactors shall be used in AC and DC filters for harmonic filtration.

(iv) **Performance Requirement**

The AC filter performance shall be better or equal to as defined by following performance parameters:

A. The individual harmonic distortion, Dn, shall not exceed 1.5%
Individual Harmonic Distortion, Dn, = Vn/V1

B. The total effective distortion, Deff, shall not exceed 3.0%.
Total effective Distortion, Deff = $\sqrt{(\Sigma (Vn*100/V1)^2)}$.

C. The Telephone Influence Factor (TIF) shall not exceed 50.
Telephone Influence Factor, TIF = $\sqrt{(\Sigma (Vn*Fn/V1)^2)}$

Where Fn: Weighting factor for nth harmonic according to EEI publication - 60-68(1960) corrected to 50 Hz operation by graphical interpolation.

D. The Total Harmonic Distortion, V_{THD}, as defined below shall not exceed 2%:

$$V_{THD} = \sqrt{\sum_{n=2}^{n=40} \frac{V_n^2}{V_1^2}} X100$$

'1' refers to fundamental frequency (50 Hz)

'n' refers to the harmonic of n'th order (corresponding frequency is 50 x n Hz)

The performance of the AC harmonic filters shall be determined by calculation and shall be based on either as-tested parameters of components or the extreme values of manufacturing tolerances if as-tested values are not available. Performance requirements are to be met for all operating modes. In all Modes of operation, except the reduced DC line voltage modes, the performance requirement shall be met up to rated power with one larger size filter sub-bank and one characteristic harmonic sub-bank (largest) being out of service. All filter banks, sub-banks and branches shall be rated such that the remaining filter components are not overloaded due to detuning or resonance within the filters or between the filters, the generators, and the AC system for any combination of AC system voltage and/or frequency and configuration; or for any operating condition of the converters, or combination thereof, for which the converter valves are capable of continuous operation, or switching time between de-energized and energized states and there is no restriction on the operating power level for any operating conditions with one filter bank outage for power level up to 1.0 pu. Short-time and transient conditions as well as operation with discontinuous DC current must be fully taken into account. The system shall also meet the reactive power exchange limits on both the AC side.

(iv)(a) System Contribution

Bidder may suitably model nearby different RE generators as all these generators are required to meet harmonics requirement under "CEA Technical standards for Connectivity to the grid" regulations. Models provided by RE developers will be shared with selected TSP.

At Converter station ac bus, combined converter and static compensator (if used) harmonic currents as calculated for rating purposes shall be increased to allow for harmonic currents from the ac system in following manner:

(a) At 3rd and 5th Harmonics the increase in current to be allowed shall be calculated based on the assumption that the existing distortion shall be considered as 2% with respect to nominal voltage at converter Bus. This is to be considered for 3rd and 5th harmonic Filter component rating.

(b) At all even order harmonics and at all other non-characteristic or theoretically cancelled harmonics the increase in current to be allowed shall be not less than 50 (fifty) percent provided that the contribution of the harmonic in question to any rating parameter, in the absence of the above increase, is not greater then 10 (ten) percent of the total harmonic rating.

(c) At all characteristic harmonics or at any other harmonic which is effectively filtered (i.e. the harmonic contributes more than 10% of the total harmonic rating of a component in the absence of the increase) the increase in current to be allowed shall not be below 20 (twenty) percent.

(iv) (b) Power Monitoring Device and Power Quality Recorder

The TSP shall provide one number of Power Monitoring Device and Power Quality Recorder as per IEC 61000-4-30 class-A at suitable location (400 kV AC Bus) at each end of both end Substation for acquisition, visualization, evaluation and transmission of electrical measured variables such as alternating current, alternating voltage, frequency, power, harmonics etc. The acquisition and processing of measured variables and events shall be performed according to the power quality measurement standard IEC 61000-4-30 class-A compatible with IEC 61850 protocol.

(v) Shunt Reactor Banks

Shunt reactors, if required, of suitable size shall be provided to meet reactive power exchange requirements derived from the studies. The shunt reactor must be switched in or out by a circuit breaker. The shunt reactor shall conform to CEA's Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above Voltage class). The shunt reactor shall be covered under automatic switching under the reactive power control strategy.

(d) Power Line Carrier (PLC) filtering

PLC filters shall be installed close to converter transformers to

mitigate high frequency harmonic currents generated during thyristor switching.

(e) Converter transformers

(i) The converter transformer shall be designed in accordance with IEC- 60076-57-129. The converter transformers shall be single phase two winding units. The maximum flux density in any part of the core and yoke at the rated MVA, voltage and frequency shall be such that under 10% continuous over voltage condition it does not exceed 1.9 Tesla. The Converter transformer shall be capable of withstanding minimum DC current of 10 A per single phase transformer entering through the neutral.

(ii) The insulation level for the transformer AC (line side) windings and bushings shall be as given at Regulation 45 of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 and insulation levels of the valve side windings shall be determined in accordance with studies. The impedance of the transformer shall be determined as in accordance with studies and variations in impedance shall be as per the requirement of relevant standards.

(iii) Converter transformers shall be equipped with On Load Tap Changer (OLTC) and Metal Oxide Varistor (MOV) devices shall be provided between tap leads of the OLTC. The OLTC tap steps shall be determined in accordance with the operating strategy of both the converters. The OLTC shall be designed for a minimum 2,50,000 operations without repair or change of any part including oil. The OLTC shall be designed for a contact life of minimum 6,00,000 operations.

(iv) The requirements of soak pits and firewalls shall be in line with Regulation 46 of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 and Regulation 46 of Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023.

(v) The converter transformer bushing shall be designed in accordance with IEC-60137/ IEC-65700 as applicable.

20. Thyristor valves and valve cooling system

(a) The thyristor valve assembly shall be designed and tested as per relevant IEC/IS. The valve shall be designed and protected during operating conditions for various over voltage and over current stresses to which it may be subjected to due to faults occurring in various parts of the station.

(b) The thyristor valve modules, used for converting AC to DC or vice versa, shall be complete with associated electronic firing system; protection, monitoring & damping system, auxiliaries and cooling system. Twelve pulse scheme shall be used.

(c) In case of two series converter configuration, a bypass switch shall be provided to bypass any faulty converter and use the remaining series converter at lower DC voltage.

(d) The thyristor valves shall be water cooled, air insulated and indoor type. The valves shall be either suspended type or floor mounted type depending upon the operating DC voltage and seismic requirements. The Double or Quadruple valve design shall be used depending on voltage level.

(e) Necessary control and monitoring including tripping of the HVDC system in case of cooling system failure shall be provided.

(f) The valves shall be placed in the valve hall which shall have a positive pressure over atmospheric pressure and humidity control feature. The pressurization will be maintained by ventilation system.

(g) No oil immersed part is permitted to be used inside the valve as well as valve hall. The electronic components located within the valve shall be designed to eliminate overheat and arcing. Only components of low flammability, high reliability and adequate ratings in margins can be used. All thyristors including spare thyristors shall be identical and interchangeable between the converter stations.

(h) Requisite redundancy shall be kept through a provision of suitable number of spare thyristors in valve modules. The number of redundant thyristors shall not be less than 3.0% of the total number of thyristors in the valve. Status of each thyristor level on the valve while the equipment is in service shall be monitored.

(i) Description of Valve Cooling System:

(i) Fine Water Circuit

The fine water circuit shall consist of a main circuit and a water treatment circuit. The cooling medium in the fine water circuit shall be deionised water with low conductivity.

(ii) Main Water Circuit

The main cooling circuit shall consist of water within the thyristor valves, a de-aeration vessel /venting, pumps and filters.

The main circuit shall be provided with an expansion vessel with level transducers and pressurised with nitrogen, as per requirement of OEM design. The level transducers shall be used for control of the make-up water for the system, if applicable, and for detection of leakages.

There shall be two water pumps. One of the two water pumps shall circulate the 100% water through the main cooling circuit and the water treatment circuit. The other pump shall be included for redundancy purpose. The operation shall be automated and arranged into alternative weeks between these two pumps. Upon failure of the unit in service, the redundant shall be automatically activated.

(iii) Water Treatment Circuit

A part of the main flow shall be circulated in the water treatment

circuit. The water treatment circuit shall consist of oxygen removers (if required), ion exchangers and mechanical filter. Sensors shall be provided for measuring conductivity of the water, both in the main cooling circuit and in the treatment circuit at the exit side of the ion-exchanger. The water treatment circuit shall have provision to connect makeup pump and associated valves and strainers. The water pipe for fine water make up shall be connected to main fine water circuit through the water treatment circuit.

(iv) **Air Cooled Liquid Coolers**

The air-cooled liquid coolers shall cool the water from the thyristor valves. One redundant unit shall be provided by the TSP over and above the quantity required to achieve the operating temperatures for rated power.

All the stations shall have dry type coolers. Each cooler shall consist of cooling fans with separated air channels.

Suitable protection against corrosion, oxidation etc. shall be provided for all cooling equipment.

(v) **Mechanical Design**

The cooling system shall be pre-fabricated. There shall be three main parts:

- fine water pump unit;
- air cooled liquid coolers
- piping

The fine water pump unit shall be mounted on a frame and shall be placed in the valve cooling room. The air-cooled liquid coolers shall be placed outdoors, near to the valve cooling rooms. The piping shall be especially designed stainless steel and adapted to the station building.

(vi) **Control Equipment**

The valve cooling control equipment shall be specially designed for application to the cooling system for thyristor valves. There shall be two computer-based control systems such that either both are in ACTIVE mode, or when one system is in ACTIVE mode the other system shall be in ACTIVE STANDBY mode. Each computer-based system shall be self-checking and an automatic changeover to the other system shall take place in the case of failure of the active system.

(vii) **Design Criteria for the Cooling System**

Features to ensure high reliability, proper function and prolonged life time for the cooling system and thyristor valves shall be included. The following main components shall be supplied with redundancy in order to increase the availability:

- main circulation water pump
- air cooled liquid cooler (with one additional standby cooler)

- bypass valves
- transducers
- nitrogen bottles, if applicable

(viii) Design Cooling Requirements

Separate cooling system shall be designed to cool the heat generated in each 12-pulse group of thyristor valves for converter stations.

Cooling system shall be capable to operate and guarantee the design temperature specified steady state and overload conditions, up to max specified design dry bulb ambient temperature. Redundant Uninterrupted Power System/drive for valve cooling for each pole shall be rated for 2 minutes.

(ix) Ambient conditions

Ambient Conditions are specified in Table 2 of the specification.

(x) Materials

The materials in contact with the cooling water as well as for manufacturing of the air-cooled liquid cooler shall be selected in order to minimize the risk of corrosion.

(xi) Measure Against Water Leakage

The design of the valve cooling system shall be made to minimise leakages. The following precautions shall be taken to minimize the risk of water leakage from the system:

- choice of water pipe joint
- number of water pipe joints in the system shall be kept as low as possible, particularly in the thyristor valves;
- velocity of de-ionized water in the pipes and in the thyristor heat sinks shall be kept low
- water circulation within the pipes shall be free from trapped air bubbles

(xii) Valve Cooling Control and Monitoring

The valve cooling control systems shall be redundant and be equipped with an integrated data collecting unit that is connected to the station sequential event recorder system.

(xiii) Cooling Capacity Control

The water temperature to and from the thyristor valves are used as an input to the cooling capacity control.

In order to avoid condensation at the pipe lines within the thyristor valves the inlet fine water temperature shall be kept in an appropriate range.

(xiv) Protections

The following protections/monitoring shall be included:

- Temperature of the water from the valves

- Temperature of the water to the valves
- Water flow through the valves
- Water level in the expansion vessel
- Conductivity of the water from the water processing unit
- Conductivity of the water in the main circuit
- Pressure in the expansion vessel, if required
- Pressure in the nitrogen bottle, if required

(xv) **Leakage Detection**

There shall be three leakage detection methods used in parallel by the cooling control system. These methods can, depending on the nature of the leakage, generate trip of the converter and cooling system. However, one of the methods of leakage detection shall generate a leakage alarm if volume of leakage exceeds the reference volume, during the last 24 hours.

Besides these detection methods alarms for frequent make up and for long make up when automatic make-up of cooling water is used, generated by the cooling control programme shall be provided. The total schematic of valve cooling system with valve position, flow, temperature, make up details, conductivity, pump running etc shall be made available to the SCADA system of HVDC terminal.

21. Converter Station DC Outdoor Yard

(a) The DC yard shall comprise of equipment such as HVDC bushings, smoothing reactors, DC filters, DC current and voltage measuring instruments and switchgear, surge arrester, insulators, clamps and connectors.

(b) The specific creepage distance (corresponding to highest DC voltage) for DC yard and other areas shall at least be maintained as follows:

Table 7

Insulator type	Under light and medium pollution	Under heavy and very heavy pollution
Indoor porcelain or composite insulators for valve hall (other than valves) and indoor smoothing reactor area (if any)	20 mm/ kV	
Thyristor Valves	14 mm/ kV	
Outdoor porcelain insulators or bushings with RTV coating	50 mm/ kV	60 mm/ kV
Outdoor composite insulators or bushings	50 mm/ kV	

Note: Specific creepage distances less than 50 mm/ kV but not less than 45mm/ kV can be accepted for outdoor silicone rubber bushings due to manufacturing limitations and for HVDC equipment requiring necessary internal/ external insulation co-ordination. However, specific creepage distance less than 50 mm/ kV and flash distance less than 12 mm/ kV shall not be acceptable for outdoor jointed bushing.

The base voltage applicable for calculation of valve arrester creepage distance shall be:

$$U_{creepage} = \sqrt{\left(\frac{1}{3} + \frac{\sqrt{3}}{8\pi}\right)} * CCOV$$

Where, CCOV: Crest value of Continuous Operating Voltage

(c) **DC wall bushing**

DC wall bushing shall be designed as per IEC-65700. DC wall bushings, used for electrical connection between the equipment inside the valve hall and the outdoor DC yard shall be of polymer housing as per relevant standards. All bushings inside the valve hall including HVDC wall bushing shall be dry type/SF_6 gas filled or combination of both. There shall be no oil filled component inside valve hall.

(d) **Smoothing Reactor**

The smoothing reactor shall be designed as per IEC-60076-6. The smoothing reactor shall be of air core type. The reactors shall comply with relevant standards and shall have successfully passed DC tests as per their application. The smoothing reactor may be divided between pole and neutral for DC voltage above 500 kV. Each converter station shall be provided with one spare coil of smoothing reactor with all fitments, hardware & accessories. Minimum four nos. of insulators of each type for smoothing reactors shall be provided as spare.

For the design of smoothing reactor, the Si factor has to be within the limits (0.22 <Si< 1) where Si factor is defined as

$Si = U_{dn} / L_d * I_{dn}$

U_{dn} = Nominal HVDC Voltage level per pole

I_{dn} = Nominal HVDC Current

L_d = Total DC side inductance = $L_{dr} + 3.5 L_c$

L_{dr} = Smoothing Reactor inductance

L_c = Converter transformer inductance

The smoothing reactor shall be designed for Class H for inter turn insulation as per IEC 60085, however the maximum allowed hot-spot temperature rise shall be limited to one class lower i.e. Class F insulation.

(e) **DC Voltage and Current Measuring Devices**

The DC voltage and DC Current measuring equipment shall be installed at each pole. These equipment can be optical type or conventional type. The DC measuring equipment at pole and neutral bus shall be suitably located based on the control philosophy and different protection zones such that complete pole and neutral equipment are protected. The details of DC Measuring Equipment shall be as per '***Appendix-- C.1***'.

(f) **DC Filters**

Adequate numbers of DC harmonic filters shall be provided in DC yard to limit harmonic voltages present on the DC lines (pole lines and DMR line). However, minimum one No. DC filter per pole per station shall be provided. Common DC Filter for parallel poles are not acceptable.

The design shall be based on passive DC filters. The DC Filters shall consist of Low order filters, Harmonic Filters and High Frequency Filters as per the requirement of project specific studies. The main filter equipment like capacitors, reactors and resistors shall comply with the requirements of relevant IS/IEC standards/ CIGRE documents. A fundamental frequency series blocking filter shall be provided, as per

requirement. The required switches shall be provided. It shall be possible to connect and isolate a single DC filter arm without causing any reduction in transmitted power on the affected Pole.
The calculation of DC filter performance and rating shall be based on values of components, detuning, and harmonic voltages and currents. The TSP shall use "Three Pulse Model" or EMTDC model or equivalent for calculating performance and rating of DC filters.

There shall be no limitation on the energization of the DC filter arms by reason of either ambient temperature, frequency, initial mistuning or DC voltage within the ranges defined in this Specification. The DC filter components shall not become overloaded due to detuning or resonance within the DC filter or between the DC filter arms and the HVDC circuit, or the DMR, for any combination of conditions for which the converters are capable of continued operation.

TSP shall ensure that fundamental and 2nd harmonic resonance and adverse amplification does not occur on DC side. A parallel low order (2nd Harmonic) DC Filter shall be provided across each converter of each station. Earth resistivity along the DC line route will be considered as 250 ohm-m.

DC filter Performance:

The individual harmonic current (In) at any harmonic shall not exceed the value which could cause mal-operation of the HVDC system control and protection equipment supplied. The maximum equivalent disturbing current (Ieq), up to rated power in forward power direction, without any filter outage, for balanced bipolar and monopolar mode with metallic return or Dedicated Metallic Return (DMR) modes of operation shall be as follows:

Table 6

Operating Mode	Ieq
Balanced bipolar operation	1500 mA
Monopolar mode with metallic or DMR mode	2200 mA

The equivalent disturbing current includes not only the harmonics which flow in the DC Pole conductors and DMR lines but also the harmonics which are induced into the ground wires of the DC transmission line.

Mutual impedance calculation algorithms require that the ground wires be "eliminated" for this configuration; however, as specified herein, the current flow in the ground wires must be eventually taken into account in the calculation of equivalent disturbing current.

In Bipolar operation, the equivalent disturbing current shall be the psophometric weighted residual current of all harmonics of fundamental frequency from the 2nd to the 60th (i.e. 100-3000 Hz) according to the

following formula:

$$Ieq(x) = \sqrt{[IeC(x)^2 + IeS(x)^2]}$$

Where,

leq(x) is the equivalent disturbing current in milliamps (mA) psophometrically weighted at any point along the transmission corridors specified herein

$IeC\ (x)$ is the magnitude of the RSS equivalent disturbing current component due to harmonic voltage sources at Barmer-II (mA)

IeS(x) is the magnitude of the RSS equivalent disturbing current component due to harmonic voltage sources at South Kalamb Converter Station (mA)

x denotes the relative location along the transmission corridors.

The equivalent disturbing current at any point along the corridor due to harmonics from either Barmer-II or South Kalamb Converter Stations shall be calculated as follows:

$$Ie(x) = \sqrt{\sum_{n=1}^{n=60} [Ir(n, x) * P(n) * Hf]^2}$$

Where,

$Ir\ (n, x)$ is the magnitude of the equivalent residual rms current at each harmonic in milliamps

(n) is the psophometric weighting at harmonic "n" as per Consultative Committee for International Telephony and Telegraphy (CCITT)

n denotes the harmonic number.

Hf is the coupling factor which represents the normalized frequency dependent effects of typical coupling impedances to open wire circuits. The coupling factor Hf will be assumed as per table below:

Table 9

Frequency (Hz)	Coupling Factor (Hf)
40-500	0.70
600	0.80

Frequency (Hz)	Coupling Factor (Hf)
800	1.00
1200	1.30
1800	1.75
2400	2.15
3000	2.55
3600	2.80

As defined above, all harmonics up to the 60th shall be included in the calculation of equivalent disturbing current. The equivalent disturbing current shall be based on a "worst consistent set" of harmonic voltages at either end of the line.

The "worst consistent set" is defined as that set of harmonic driving voltages which could occur at any particular operating condition which results in the highest value of equivalent disturbing current that could occur for a period of longer than ten minutes.

A particular operating condition is defined in terms of:

a) The mode of operation, i.e. bipolar or monopolar in any specified mode of operation.

b) The DC voltage anywhere within the normal range for the mode of operation.

c) Reduced DC voltage operation on both Poles and reduced DC voltage on one Pole with the other Pole at nominal DC voltage.

d) The commutating reactance anywhere within the guaranteed range.

e) The firing angle anywhere within the range applicable to the mode of operation as defined above which shall include firing angles associated with reactive power control and AC filter and reactive power bank switching.

f) Worst case induced voltage from any parallel lines.

g) The converter AC bus voltages anywhere within the normal range specified.

h) The maximum 50 Hz negative phase sequence voltage of 1.5% for achievement of performance limits.

i) The DC current anywhere within the range applicable to the mode of operation.

j) Ambient temperature as defined in Table 2.

k) Differences in the smoothing reactor harmonic impedances of the Poles

DC filter rating

The rating of the DC filter components shall be based on the assumption that the per pole harmonic voltage is individually maximized at each harmonic for any particular operating mode, and the filter component currents due to the harmonic voltages at the terminals shall be assumed to add as RSS (Root Sum Squared) at each harmonic.

For the rating of the DC filter components, it shall be assumed that any one DC filter arm can be out of service in any converter Pole. The DC filters shall be rated for any loading up to the inherent continuous overload capability and short-time overload capability for all operating modes. The possible impact of reduced voltage operation and increased reactive absorption on the ratings of the DC filters shall also be considered.

Short time and transient conditions as well as operation with discontinuous DC current must be fully taken into account. Due allowances shall be made for possible current amplification resulting from resonances between the arms of the DC filters. In the calculation of the impedance of the DC transmission system when used for calculation of DC filter component rating, ±10% tolerance in the respective line length shall be included. AC system voltage and frequency variations as functions of duration specified in Table 2 shall be allowed in the calculation of harmonic voltages and DC filter detuning. In addition, capacitor unit or element failures appropriate to the duration for which the DC filter has to remain connected, shall be allowed for in the calculation of DC filter detuning.

(g) **Surge Arrester**

Surge arresters shall be gapless Metal Oxide arresters and shall be designed and tested as per relevant IS/IEC. The arresters shall be designed to absorb the desired amount of energy during a system disturbance and shall be coordinated with recovery of DC system following a disturbance as applicable.

Arresters at appropriate places may be provided as per requirement. However, the HVDC main arresters typically found in a HVDC System are as follows:

(i) Valve Arrester

(ii) Bridge Arrester

(iii) DC Line Arrester

(iv) DC Neutral and DC Filter Arrester

(v) Converter Transformer and AC Filter Bus Arrester

(vi) DMR line arresters

(vii) Smoothing Reactor Arrester (if applicable)

(viii) DC Neutral Switch Arresters

(ix) DC pole bus arrester

(x) Converter transformer primary neutral arrester

(h) **Fundamental frequency blocking filter:**

A fundamental frequency blocking filter may be installed to block the 50 Hz induced current in DC line in order to minimize the risk of converter transformer saturation due to possible induced fundamental frequency current from parallel AC lines

This induced current usually results from AC side second harmonic positive sequence voltage and from AC lines running parallel to DC line. The TSP shall consider any possible inductive and capacitive coupling between these lines.

For design purposes, 50 km of parallel un-transposed 765 kV AC Double Circuit line and 50 km of parallel un-transposed 400 kV AC Double circuit line within a radial distance of 70 m to be considered by the TSP to consider any possible inductive and capacitive coupling between the lines. The parallel section of AC lines shall be considered to be located at a point that results in maximum fundamental frequency current at each converter station.

Such a filter is formed of capacitor, reactor, resistor and arrester. Internal arrangement of these components is left to designer but the overall filter should offer significant impedance to 50 Hz current flowing in DC circuit. Blocking filter reactor shall be designed for Class H for inter turn insulation as per IEC 60085, however, the maximum allowed hot-spot temperature rise shall be limited to one class lower i.e. Class F insulation. The reactor may preferably have similar design as smoothing reactor to share common spare. The AC/DC/PLC/RI reactor shall be designed for Class F insulation as per IEC 60085, however, the maximum allowed hot-spot temperature rise shall be limited to one class lower i.e. Class B insulation.

(i) **DC commutation switches:**
These switches are required for commutating the DC current from one path to the other. They comprise of Dedicated Metallic Return Transfer Breaker (DMRTB), Pole Metallic Return Transfer Breaker (PMRTB), Neutral Bus Grounding Switch (NBGS). High Voltage High Speed (HVHS) switch and Neutral Bus Switch (NBS) shall also be provided suitably at both ends in all the poles.

22. Dedicated Metallic Return (DMR)

The neutral current return path for bipolar configuration or monopolar configuration shall be via a Dedicated Metallic Return (DMR) conductor connecting both converter terminals.

23. Control and Protection System

It shall be demonstrated that the HVDC control system is stable under all operating conditions and cannot excite oscillations, such as sub-synchronous oscillations, between the HVDC and AC system. The control system shall be tuned for optimal overall performance for all conditions and configurations of the AC system. The details of operator Control and Monitoring are mentioned in ***'Appendix C.2'***.

It shall also be demonstrated, by applying system faults and step responses in current order and power order during the factory acceptance testing (FAT), that the as-built control system does not excite low order harmonic resonance(s) in the AC system and/or between HVDC and AC systems for any system configuration

The performance of the integrated DC and AC systems shall also be demonstrated using an EMT-type program (such as PSCAD) in order to validate the system performance requirements. In the DPS program, all the HVDC protections shall be modelled. All feeders in the ac converter bus should have the required protections modelled for DPS studies with network equivalent.

Software based controls and protection shall be used to permit flexibility in effecting modifications. Protection and controls shall be duplicated for reliability. The control & protection shall provide fast controllability of the HVDC system

(a) Control System:

(i) The control system shall have redundancy with hot standby. Transfer of controls from Active Control system to Hot standby control system shall be seamless and there shall be no power interruption during this transition. Outage of one control system or part thereof, shall not result in any power reduction.

(ii) **The** control shall be designed to give fast, stable and proper response to normal control actions as well as during disturbances such as AC & DC faults.

(iii) DC converter terminals shall be either manned by operator or controlled by remote operation of SCADA system. The control system hierarchy shall be as follows:

1. Master Control
2. Station/Bipole Control
3. Pole/ Converter Control
4. Valve Control

(iv) The HVDC Station/Bipole shall have control features (as and when established by system design) including but not limited to the following:

1. Reactive power controller
2. Current and power controller
3. Frequency controller
4. Power modulator, pole power compensation. The modulator, if required, shall have feature which shall provide positive damping of AC network oscillations over the range of frequencies considered during system studies.
5. Sub Synchronous Resonance (SSR) Damping Controller (if required) based on studies.

   All necessary studies shall be carried out to ensure that the DC system shall not excite the mechanical, electromechanical or other natural frequencies of the nearby region generators and turbines under any operating mode. It shall be demonstrated by studies that the nearby generators shall not be adversely affected by the HVDC system, particularly with regard to Sub Synchronous Oscillation (SSO)/Sub Synchronous Resonance (SSR) and harmonic injection and self-excitation. Sub Synchronous Damping (SSD) Controller shall be provided for converter stations near Generating stations.
6. Run back/Run up controller (10 points) with provision to be linked to Special protection Scheme (SPS) of System Operator
7. AC system stability function, such as power swing damping function
8. RE Park Sub synchronous control interaction, Temporary and Transient over-voltages, harmonic interactions, stability, HVRT, LVRT etc. studies.
9. Interaction studies among various HVDC, SynCons and STATCOMs (planned/ execution) which are electrically coupled nearby.
10. The TSP shall study all interaction aspects between these converter stations, STATCOMs, SynCons and devise control strategies to ensure that no adverse interaction takes place among the above stations during steady state and fault recovery. Various fault cases for the purpose of this study shall be finalized by TSP during detailed engineering.
11. The HVDC system shall conform to the performance requirements specified herein. It shall be designed to optimally co-ordinate all aspects of its controls to ensure safe and reliable operation without adversely affecting the connected AC system and shall assist the latter following disturbances. The performance requirements shall be met under all

specified ambient conditions, modes of operation, AC system conditions and other parameters as given under these specifications. Any other Controller as deemed required for stable HVDC system operation with connected AC network.

(b) Protection System

The protection system shall be designed in Main-I and Main-II set up.

(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 busbars. These protections shall generally follow the same philosophy as in a typical AC substation i.e. detection of fault by relay and tripping of circuit breaker or may be dealt in similar way as described for DC side protection.

(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, and DMR line. 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. 'Main-I and Main-II' or 'Main and Standby' protection philosophy shall be adopted for HVDC equipment and system.

(ii) Following a DC Line fault, the HVDC System shall have the facility to restart. 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.

(iii) Protection system shall have two redundant systems with following protections (Some protection can be combined).

a) Converter differential protection, Converter protection
b) AC, DC over current/under current protection
c) AC, DC bus differential protection
d) AC conductor ground fault protection
e) Commutation failure protection
f) DC filter protection
g) Converter transformer valve winding protection
h) DC line differential protection
i) DC under voltage/ over voltage protection
j) DC line ground fault protection with restarts
k) Dedicated Metallic Return (DMR) protection
l) AC filter protections

m) Thyristor failure monitoring
n) AC overload protection
o) DMR line monitoring and protection
p) Sub Synchronous Torsional Interaction (SSTI) Protection (corresponding to synchronously run Power Plants)
q) Sub Synchronous Control Interaction Protection (corresponding to RE plants) etc.

24. DC Line fault locator

DC online fault locators shall be provided to monitor the entire DC line length and give location of the fault with good accuracy in the range of + 1000 meters for pole conductors. DC line Fault Locators shall utilize a method of measurement of time of arrival at each end of the HVDC line of the steep wave fronts, resulting from a fault on the HVDC, affected by the accuracy of the time measurements. Since the wave fronts shall propagate along the lines at $3x10^8$ m/sec (or 300 metres per microsecond), the time measurements must be in microseconds with an accuracy of ±3 microseconds in order to achieve a location accuracy of approximately ±1 km. Greater precision of fault location would be desirable. The DC online Fault Locator equipment at each station shall be time synchronized to the master clock system at the station in order to facilitate analysis of system disturbances recorded on the DC Line Fault Locators, the transient fault recorders and the alarm monitoring and recording system. Manually re-settable fault counter shall be provided as part of the equipment.

ELECTRIC CHARACTERISTICS

1) Control Panels

Identical control panels shall be provided for each DC Line Fault Locator within its own cubicle(s). The control panel shall include, but not be limited to the following facilities.

- Equipment on/ off control and indication;
- Equipment alarm or failure indications;
- Fault location readout display for the last detected line fault;
- Manual initiation of automatic self-test routines;
- Any other controls or indications

2) Printers

A printer shall be provided for each DC Line Fault Locator or it may be integrated with operator control and monitoring system. The printer shall print the day, hour, minute, second and millisecond of each fault or manual or automatic system test. The printer shall also print the location of each fault in kilometres from the respective station.

If fault locator is integrated with operator control and monitoring system that all these details shall be displayed on Video Display Unit (VDU) and stored in archives in the backup memory.

3) **Power Requirements**

The equipment shall be suitable for operation from the station battery supply. There shall be no loss of accuracy within specified variations of DC input voltage.

Note: Alternatively, TSP may also propose an integrated solution with the fault locator integrated into the HVDC Control and Protection system meeting the system requirements. If fault locator is integrated with operator control and monitoring system then all these details shall be displayed on Video Display Unit (VDU) and stored in archives in the backup memory.

25. Operations supervision and control

a) The TSP shall provide the control facilities from the operator control desk through a monitor and keyboard/mouse system. These facilities shall include all control operations, digital setting, indicating devices, Station single line diagram and symbols, any other special control devices and meters required for control and monitoring of the complete HVDC system.

b) The layout of the station single line diagram, together with control, indicating and metering devices on the control desk shall be logical, compact, of pleasing appearance, and shall facilitate efficient supervision and operation of the station(s) by the operator. Every detected change of position shall immediately be displayed in the single-line diagram on the station screen, recorded in the event list and printable.

c) Graphic representation of thyristor valves and valve cooling piping network shall be provided on station monitoring system. The graphical representation shall also display faulty thyristors in different colours indicating faulty thyristor position.

d) The 'Sequence of events' recorder, transient fault recorder, on-line DC Line fault locator, GPS/NavIC system, Station Master Clock, visual display system, operator control protection and monitoring system shall be a part of the HVDC system.

The details of operator control and monitoring system are provided at '***Appendix C.2*** - Operator Control and Monitoring System'. The Transient Fault Recorder provided for the HVDC system shall be as per '***Appendix C.3***'

26. Telecommunication

For smooth operation of the HVDC system, communication network with high reliability and availability shall be provided for transmission of control and protection signals between the two or more (in case of multi-terminal DC) HVDC terminals. The communication system design shall be as per '*Specific Technical Requirements for communication*'.

A limited remote data transfer of the HVDC system from the Load dispatch

centers shall be provided by TSP. All required remote control and remote monitoring facilities shall be provided at each converter station. Complete remote monitoring of each converter station shall be possible from opposite converter station.

The required numbers of Synchro phasor measurement using Phasor Measurement Units (PMUs) as per the "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" issued vide CEA letter No. CEA-PS-14-12/9/2024-PSETD Division dated 19.03.2025 shall be provided along with fibre optic connectivity, Global Positioning System Receiver and communication equipment.

27. Valve Hall

The valve hall shall mainly contain thyristor valves, its associated structure, cooling and arresters. No oil filled equipment shall be present inside the valve hall. In case the turret of converter transformers (having oil) is protruding inside the valve hall, suitable fire barrier matching with adjacent valve hall wall fire rating shall be provided. The valve halls shall be provided with interference screening, if required by OEM. In addition, the control cable and cable termination rooms shall be suitably screened to minimize radio interference. Necessary measures shall be taken to take care of high frequency noise emission from valves.

The valve halls shall have ample clearances such that the inspection of valves can be possible and allow access of mobile valve servicing equipment without any dismantling. The valve hall building shall be pressurized to prevent the ingress of unfiltered air. In addition, the building shall be properly sealed to minimize the flow of outside air into it and vice versa. Openings for equipment and services shall be weather proof. The Valve hall building shall consist of steel framed structure. The steel building shall be pre-engineered building fabricated in the factory and shall be assembled at site. Minimum two nos. scissor lift for erection and maintenance of valve modules shall be provided per station. Proper cable sealing shall be provided for cable entry into valve hall and control room to avoid entry of water and moisture.

28. Ventilation System for Valve Hall

Each valve hall shall have an independent ventilation system. Each ventilation system shall consist of two 100% capacity systems, one operating and one stand-by.

The ventilation of the valve hall shall be of a positive pressure type. Once through ventilation system will not be acceptable. The ventilation system shall be a closed cycle with fresh air intake limited to a maximum of 20% of the total air requirement. Fresh outdoor air shall be filtered and dehydrated before being blown into the valve hall by the air fans to avoid dust accumulation and condensation on components present in the valve hall. Suitable measures shall be taken to minimise stagnant air. Each valve hall shall be provided with remotely operated motorized exhaust dampers which shall be normally closed and will be opened under high pressure/emergency conditions only.

To ensure that the air being supplied to the valve hall is free from dust particles, a minimum three stage dust filtration process shall be supplied. This shall consist of at least the following:

1. Pre-Filters: To remove dust particles down to 10 microns in size with at least 95% efficiency.
2. Fine Filters: To remove dust particles down to 5 microns in size with at least 99% efficiency.
3. Absolute Filters: To remove dust particles down to 0.3 microns in size with at least 99.5% efficiency.

All the filters shall be panel type. Easy access should be available to the filters for replacement/cleaning.

It shall be possible to maintain specified conditions continuously inside the valve hall, both automatically and manually controllable from the station service panel (located in the control room) as well as from the local control panel.

In addition to the alarms for particular parameters like pressure, temperature & relative humidity etc., indicating instruments shall be provided for each valve hall. These parameters shall be integrated with station monitoring system also.

The valve hall shall be kept at a pressure above the atmospheric pressure under all conditions. The test shall be conducted at site to measure the pressure inside the valve hall for 48 hours.

Adequate numbers of de-humidifiers shall be provided for each valve hall as per design requirement

29. Air Conditioning System

Air conditioning shall be provided on a continuous basis in the control room, bay kiosks, valve module workshop & storage rooms, control & protection workshops, offices, first aid room, conference room, entrance halls, corridors etc. and all rooms containing electronic equipment.

The air conditioning system for the control room shall consist of two (2) systems each of 100% capacity; one operating and one stand-by. Both units shall be interconnected so that, in the event of breakdown of one unit, the stand-by unit can be placed into service. Stand-by and operating units shall be alternated monthly for regular operation. The operation of the units shall be automatically controlled including sequential start and stop with single command.

If valve base electronics and/or valve cooling control cubicles are located at places other than in the station control room, these areas can be cooled by using split Air Conditioning units

of appropriate capacity. At least two units shall be provided, one operating and one stand-by with the facility of automatic changeover after operator assigned time period.

A separate air conditioning system shall be provided for other areas of the service building. This shall also consist of two (2) Nos. each of 100% capacity; one operating and one stand-by.

30. Visual monitoring system (VMS) for watch and ward of station premises:

Visual monitoring system for effective watch and ward of substation premises shall cover all the transformers and reactors, outdoor DC yard, valve halls, indoor and outdoor isolators, earth switches, breakers, AC and DC capacitors, all other major AC Equipment (such as CB, isolators, CT, CVT, SA etc. as applicable), panel room, all entrance doors for the service building, other buildings, all the gates of switchyard and all entry and exit points of control room building and accordingly the location of cameras shall be decided. In addition to these locations, the cameras shall also be located around the boundaries at suitable locations .The camera shall be high definition color CCD camera with night vision feature. The VMS data partly/completely shall be recorded (minimum for 30 days) at least @25fps (or better) and stored on network video recorder and followed by transfer of the data to a juke box. The system shall use video signals from various cameras installed at different locations, process them for viewing on workstations/monitors in the control room and simultaneously record all the cameras. . The VMS data should go only to the intended personnel/facility and not to the remote server of the Camera (VMS supplier). The operation of cameras shall be integrated with the Network server placed in Control room of HVDC station. Sensors shall also be placed on boundary walls to prevent intrusion from outside and shall be connected to the CCTV system.

Mouse/keyboard controllers shall be used for pan, tilt, zoom and other functions of the desired camera. The Visual Monitoring System shall have provision of WAN connectivity for remote monitoring.

All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. The equipment should generally conform to Electromagnetic compatibility requirement for outdoor equipment in EHV substation.

Advisory on deployment of CCTV issued by Ministry of Electronics and Information Technology (MEITY) shall be followed.

At existing HVAC substations, the visual monitoring system if available shall be augmented as per existing or better specification as required.

31. Building Management System

A fully computerized and automatic Building Management System (BMS) shall control the operation of the mechanical systems serving the valve hall and service building and other systems as detailed below.

Scope of Work

The scope of work shall cover all necessary system provisions (including hardware and software) for synchronizing/integrating the BMS with the control and monitoring of

- Air Conditioning system,
- Valve hall ventilation system
- Fire Fighting Systems including Fire Spray and Hydrant systems, water level in Fire Water Tanks etc.
- Utility Services i.e. Water Storage and Supply,
- Access Control including Motorised Gate at the entrance to the station and for all entrance doors for the control room building including provision of electromagnetic door locks, card readers etc.
- Fire Detection and Alarm System.
- Illumination systems
- VMS

32. Water Supply and Distribution System

The water supply and distribution system shall include the supply, distribution and storage of water in the HVDC Station at least the following purposes.

a) storage of water for the firefighting system;

b) storage of water sufficient for 24 hours of continuous operation of HVDC converter in the event of interruption of water supply to the tanks;

c) water supply for the valve cooling system;

d) water supply for sanitary services.

Two Nos. 100% capacity water storage RCC tanks shall be provided. Each tank shall be constructed in such a way that there shall be segregation between requirement for fire water storage and water for other purposes. Both the tanks shall have interconnection piping with isolation valves for both tanks. Separate piping as per IS/IEC standard for firefighting, valve cooling and other purposes shall be provided from the tanks from independent headers.

33. Grounding & Safety:

a) The design of the grounding system shall be based on relevant IS/IEC/IEEE standards.

b) In order to prevent adverse effect (i.e. overheating due to induced circulating current) of magnetic field of air core reactors, special care shall be taken e.g. no closed loops are formed by the earthing conductors and in reinforcement bars of the foundation or other necessary mitigation measure to be provided. Air core reactor manufacturer's guidelines shall be followed.

c) The electrical safety clearances for the DC side shall not be less than the clearances applicable for an AC switchyard at the equivalent BIL level.

d) The total electric field at ground level shall be as prescribed in relevant standards.

e) Fencing and electrical interlocking & mechanical key arrangements shall be provided for all non-accessible areas, for valve halls, and for areas where for equipment mounted directly on ground without suitable height of steel structure, e.g. smoothing reactor area, AC and DC filter areas, as applicable.

f) Safety precautions in regards to gas/oil pipe lines in vicinity of HVDC/ AC lines shall be taken coordination with gas/ petroleum authorities.

34. Cables:

All cables shall be FRLSH type. The High Voltage (6.6 kV to 33 kV) power cables shall be XLPE insulated conforming to IS-7098 Part-2. The Low Voltage power cables shall be 1.1 kV XLPE insulated conforming to IS-7098 Part 1 or relevant IEC standards and/or PVC insulated conforming to IS-1554 Part 1. The control cables shall be 1.1 kV PVC insulated conforming to IS-1554 Part-1. The rating and size of cables shall be determined by TSP. All cables shall be armored except cables used for special purpose as per OEM recommendation. Fibre optic cables conforming to IEC– 60793 and 60794 shall be used to transmit the signals to and from various equipment and panels located in the AC/DC switchyards, Valve Halls, control rooms, valve cooling rooms etc.

35. Auxiliary Power Supply System:

The auxiliary power supply system shall have the following:

a) Highly reliable duplicated supply sources from two separate sources with automatic change-over facilities. Each of the sources of auxiliary power shall be from 33 kV side of 2 Nos. of 400/220/33 kV transformers at Barmer-II and 33 kV tertiary of 2 Nos. 765/400/33 kV ICT at South Kalamb. Additionally, one more 33 kV supply from independent source shall be arranged and connected to 33 kV Bus at both Barmer-II and South Kalamb Stations. This source shall be stepped down to 433 V by means of station service transformer of minimum 2000 kVA capacity and rated 33/0.433 kV.

b) Completely separated secondary distribution (415 V) systems for the auxiliaries of each converter.

c) Duplicated supply by two different 415 V power sources to essential loads.

d) Diesel Generator (DG) Set of minimum 1500 kVA capacity per pole shall be provided to meet essential loads. This generator set shall start

automatically and cater load immediately in case of loss of all the normal and standby supply sources. The DG sets shall be designed and rated so as to meet the load time characteristics of the essential loads of the entire station as determined by the TSP with a 10% margin on the load.

e) Parallel operation between station service transformers shall not be permitted at any voltage level in order to limit fault currents, prevent back feed into the AC bus and to ensure independence of supply sources. Also, parallel operation shall not be permitted between transformers and the DG set.

f) Suitable protection on all primary MV and LV supply connections shall be provided.

g) The 220 V DC supply system(s) per pole shall consist of at least two independent DC systems; each system consisting of one float-cum-boost charger, one battery bank and one distribution panel. A 48 V DC system consisting of two battery sets, two battery chargers and two distribution boards shall also be supplied for communication panels (wherever supplied). If desired, 48 V supply may be obtained from 220 V DC battery bank by use of adapters, without compromising backup time.

   (i) The station services DC system shall cater to the DC loads of HVAC and HVDC switchyards, auxiliary services control, valve and pole control, protection circuits, communication system loads etc.

   (ii) Minimum lighting load shall be connected to the station DC system.

   (iii) Sizing of 220 V battery and battery charger shall be done based on the number of bays specified (including future bays) as per CEA Regulations and relevant IS. 2 sets of 48 V battery banks for PLCC and communication equipment for present and future scope shall be provided at each new Substation with at least 10-hour battery backup and extended backup, if required.

h) All auxiliaries shall give rated output at voltage variation of ±10% and frequency variation of -5% to +3%. Sizing of LT Switchgear shall be suitable to cater the requirement for all present and future bays. AC & DC distribution boards shall have modules for all the feeders (including future as specified).

i) For substation extensions, existing facilities shall be augmented as required.

An indicative SLD for the Auxiliary Supply System is enclosed at ***'Appendix-C.5'***.

For the requirement of the Auxiliary Power as described above, Essential Load is defined as per below: -

Essential loads: *These are the loads whose failure shall affect the conversion capability of the HVDC system. These loads shall include, but not*

be limited to, the cooling and other auxiliaries of the converters, the cooling of transformers and reactors, valve hall cooling, etc. In addition, loads that must remain working in case of complete loss of the AC power supply shall also be included in essential loads. These loads shall include, but not be limited to, the station battery chargers, disconnecting switching and circuit breakers operating mechanism, the emergency lighting, fans to keep over pressure in valve halls, etc.

36. Fire Detection, Alarm and Protection system:

A comprehensive fire detection, alarm and protection system as per Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023 shall be provided. Valve Hall shall have Air aspiration system (fast and early smoke detection system). Suitable Infra-Red (IR)/Ultra Violet (UV) detector to detect the flashover inside the Valve Hall shall also be provided. The Valve hall wall towards converter transformers shall be suitable for minimum 3-hour fire rating.

Suitable fire detection system using smoke detectors and/or heat detectors shall be provided in HVDC Station for all room and areas. These smoke fire detection systems shall be connected to a separate Fire annunciation system clearly identifying the zone.

Hydrant System:

Suitable No. of hydrants shall be provided for protection of HVDC Station equipment in the yard and HVDC Station building.

HVWS System:

High Velocity Water Spray (HVWS) system shall be provided for converter transformer, ICTs and Shunt Reactors.

37. Testing and trial operation

All equipment/components including Thyristor valves, Converter Transformers, smoothing reactors, EHV DC Transformer bushings and wall bushings shall be subjected to Type tests, Routine tests, Factory Acceptance Test (FAT), Site Acceptance Test (SAT) as per relevant IS / IEC/ IEEE as applicable. The SAT shall consist of sub-system & system tests and shall be carried out after installation of equipment at site. The sub-system tests cover the major sub-system like valve cooling, AC & DC filters, HVDC converter, auxiliary systems, communication etc. After completion of sub-system tests, system tests covering power transmission tests, transient & dynamic control tests, measurement of electric field and RFI etc shall be conducted. After completion of all system tests, final trial operation of the HVDC System shall be carried out for continuous period of normal operation of not less than 10 days (for each Pole/Bipole separately, followed by entire HVDC link

consisting of two parallel Bipoles again for 10 days) during which the converter equipment shall be fully operational. The HVDC System shall be declared under Commercial Operation after the successful completion of its Trial Operation

38. Reactive power exchange

The reactive power exchange limits with the system for the Converter Stations are specified in this specification.

The following reactive power exchange limits shall be honored by the HVDC system:

(A) **Reactive power exchange limits**

Table 10

Minimum DC Power 150 MW	**Maximum DC Power 3000 MW per bipole**
In the entire range of HVDC power (minimum 1 pu)	
400 kV AC SYSTEM Barmer-II (Bus Sectionaliser Normally Close)	
Maximum Export at 420kV 50 MVAR	Import NIL at 380kV
400 kV AC SYSTEM South Kalamb (Bus Sectionaliser Normally Open)	
Minimum DC Power 150 MW	Maximum DC Power of 6000MW (3000MW per bipole)
Maximum Export at 420kV 50 MVAR	Import NIL at 380kV

However, the design should also consider the possibility of 400 kV Bus sectionaliser at either end to be kept open/closed based on system conditions.

The control of reactive power exchange shall be fully automatic and shall be continuously monitored. The control equipment, however, shall allow both automatic and operator-initiated switching. In the former case, adequate annunciation shall be provided to the operator. The reactive power control system shall not require any element switching for DC power flow changes of 150 MW in either direction since the last switching operation had taken place. Switching necessary to maintain the AC bus voltage within the ranges specified is permissible for power order changes of less than 150 MW.

Each breaker used for switching shunt reactive elements shall have point-on-wave switching control for energizing its branch, to minimize voltage disturbances while switching capacitors and filters, and minimize DC offset current while switching shunt reactors. Breakers used for switching shunt reactive and filter elements must be capable of de-energizing their branch at the maximum temporary overvoltage conditions specified in this specification, or as determined by the TSP's studies, including full load rejection studies, whichever is greater. The reactive compensation and overvoltage limiting equipment shall be designed such that at any power transfer level up to rated power in either direction, a complete or partial interruption of DC power transfer shall not result in a fundamental frequency over voltage beyond the values specified in this specification. The TSP shall provide controlled or point-on-wave switching for synchronous closing of converter transformer.

All the necessary studies of reactive compensation and voltage control shall be performed. The calculations of reactive power exchange and of voltage control shall be based on the most unfavorable combination of tolerances on equipment, connected system configuration and of changes in operating

conditions.

39. Pole Blocking

The HVDC System shall be designed such that the power transfer loss of a faulted Pole due to Pole blocking or during DC line fault clearing is transferred to the remaining Pole. The power transfer on the remaining Pole shall be increased up to its rated short-time power transfer capability to compensate for the power transfer loss on the faulted Pole and to minimize AC network disturbance.

When an increase in power transfer of the healthy Pole is required due to blocking of the other Pole, 90% of the increase in DC power transfer required shall be achieved within 100 milliseconds of the faulted Pole blocking.

For the case where a Pole blocks while communications are not in-service, 90% of the required DC power transfer to the other Pole shall be achieved within 100 milliseconds of the rectifier blocking.

The HVDC System shall recover to 90% of the pre-fault DC power transfer level consistently within 120 milliseconds from the instant of fault clearing, without subsequent commutation failure on the faulted or healthy Pole or sustained oscillation for all inverter system fault conditions. For all rectifier AC system fault conditions, the recovery time, to 90% pre-fault power level, shall be within 100 milliseconds from the instant of fault clearing. This recovery time shall be achieved for all short circuit levels as defined in this specification.

If it is in the interest of the overall improved recovery of the AC/ DC system, in such cases the recovery times other than those specified shall also be acceptable, subject to review.

40. Pole Deblocking and Converter Start-up

A coordinated sequence of starting an HVDC Pole shall be established and demonstrated during FAT. The sequence shall be in a such a manner that it will not impact the connected AC system. It shall be possible to start and deblock at minimum DC power specified in this specification earlier while maintaining all the AC and DC filter performance requirements.

41. AC bus fault

The TSP shall demonstrate the response of the power controller to DC voltage changes in the rectifiers and inverter for solid converter AC bus faults, both single phase-to-ground and three phase-to-ground.

The HVDC system shall recover to 90% of the pre-fault DC power transfer level consistently within 120 ms from the instant of fault clearing, without subsequent commutation failure or sustained oscillation for all inverter AC system fault conditions. For all rectifiers AC system fault conditions, the recovery time, to 90% pre-fault power level, shall be within 100 ms from the

instant of fault clearing. This recovery time shall be achieved for the fault levels above the minimum specified in Table-1. Recovery times greater than specified above shall be acceptable only if the higher recovery times results in the overall AC and DC system improvement.

The response time shall be determined in accordance with the general criteria defined in this specification. The specified response for the rectifiers ac system and inverter ac system faults shall be demonstrated [400 kV Barmer-II PS, 400 kV Barmer-I PS, 400 kV Fatehgarh-IV PS(Sec-2), 765 kV Beawar S/s, 765 kV Sirohi S/s, 765 kV Merta-II S/s, 765 kV & 400 kV Fatehgarh-III PS (Sec-2) PS, 400kV Bhinmal (PG)],[765 kV & 400 kV South Kalamb(Sec-1,Sec-2,Sec-3),765 kV Pune-III,765 kV Boisar-II] for the following conditions:

(i) Single phase-to-ground faults, for five cycle, ten cycle, and twenty cycle fault clearing and with fault levels resulting in voltage reduction to 90%, 70%, 50%, 30%, 20%, and 5% of nominal converter AC bus voltage.

(ii) Three Phase-to-ground faults, for five cycle fault clearing, with fault levels resulting in voltage reduction to 90%, 70%, 50%, 30%, 20% and 0% of nominal converter AC bus voltage.

(iii) Zero impedance three phase 400 kV AC busbar faults at Barmer-II and South Kalamb which are cleared after five cycles and which result in the loss of one DC pole.

(iv) Three phases to ground, five cycle, and Single line to ground, ten cycle faults. The outage of components would include 400 kV single circuits, 400 kV double circuits if these are on same tower, generator, filter bank etc.

(v) Three phase to ground, five cycle, and Single line to ground, ten cycle faults following conditions when system is already running under single contingency and which result in outage of further system components. The outage of components would include 400 kV single circuits, 400 kV double circuits if these are on same tower, generator, filter bank etc. Under such conditions it shall be shown that the system stability is maintained although the time required for recovery may exceed the values given above. For certain cases if there is a need for run back condition on HVDC the same shall be evolved by the TSP.

42. DC Line Faults

The DC line fault protection sequence shall detect the fault, de-energize the faulted line Pole by control action, allow a time period for fault deionization (settable between 50 ms to 1000 ms), and then automatically attempt restoration of the DC power transfer on the Pole.

There shall be 2 full voltage restarts followed by 1 reduced voltage (80% DC voltage) restart attempt. All equipment shall be dimensioned keeping these 3 restart attempts in mind.

For mono-polar Metallic return, minimum one restart attempts shall be considered at full voltage and current corresponding to 20% overload operation.

The minimum total time to restore the DC power to 90% of the pre-fault DC

power from the end of the deionization period shall not exceed 100 milliseconds (excluding the time allowed for deionization).

The system shall be designed and capable of the following:

a) During the DC line fault and deionization interval the power transfer on the non-faulted Pole shall be rapidly increased to the extent possible in order to minimize the impact on the DC power transfer.
b) On recovery of the faulted Pole the power transfer on both Poles shall resume the pre-fault values.
c) The transfer of power to the non-faulted Pole during the line fault clearing and recovery sequence shall occur even when the HVDC telecommunications are not in service.
d) The healthy Pole shall not fail commutation when a DC line faults occur on the other Pole or any time there after until the faulty Pole is back to normal operation.

The clearing and recovery of a DC line Pole fault shall be demonstrated in bipolar and monopolar mode at 1.0 pu power transfer prior to the fault for the particular mode. Faults shall be applied at the line ends and at the line midpoint in both power directions. The demonstration shall include the influence of the function provided to transfer power from the faulted Pole to the other Pole.

Suitable modeling of the DC line, which takes into account the electro-magnetic coupling between the Poles, shall be considered in the above studies.

DC reduced voltage restart shall be possible even when there is no telecommunication between rectifier and inverter stations.

43 Operation During Reduced AC Voltage Conditions

To assist in the recovery of the network, the Converter Stations shall be able to continue operation with reduced AC bus bar voltages.
In addition to the requirements of operation under over voltage conditions specified in this specification, the converter equipment shall be able to continue operating without blocking of converters with AC bus voltage reduced to voltage as depicted in the curve mentioned under LVRT Strategy at clause No.-14 "Insulation Co-ordination" during three phase faults, and to zero on one phase during single line to ground faults followed by voltage recovery to 80%. The gate control units shall be able to trigger the thyristor valve as soon as the voltage recovers after the AC bus voltage has dropped. The converters shall continue to transmit power to the extent possible under the above reduced voltage conditions. The valve firing system as well as all the cooling equipment shall be rated for these conditions. The cooling system shall not trip during AC system faults.

44. Controlled Shutdown

Each Pole shall be able to be shut down in a controlled manner by the automatic reduction in the power order accompanied by appropriate AC harmonic filter bank switching. The block and isolation of a converter Pole

shall be done without the block or shutdown of other Pole converters.

45. Power Runback

The controls shall be capable of achieving 90% of any step change requested by run-back modulation signals including within 200 milliseconds of receipt of the run-back signal.

46. Commutation Failure Performance

There shall be no commutation failures for the disturbances described below:

a) Disturbances resulting in AC voltage drops of 15% or less compared to the voltage prior to the disturbance. In this case, repetitive commutation failure shall not occur (though one or two commutation failure may occur).
b) Dynamic AC voltage swings of less than ±10% with an oscillation period of one second or longer.
c) Switching of any reactive element in the Converter Stations.
d) Energization of the converter transformer on the other Pole or any other AC transformer in the switchyard.
e) Sympathetic commutation failures shall not occur on the healthy Pole for faults on the other Pole.
f) The control system shall be designed to prevent multiple commutation failures after one commutation failure is detected.
g) The switching in and out or a tripping due to faults of a filter sub bank at the converter stations shall not result in a commutation failure, except for faults at 400 kV side of the filter sub bank.

47. Cyber security

The designed system shall be compliant with:

a) IEC-27001 Information security management
b) IEC-62443
c) CEA (Cyber Security in Power Sector) Guidelines, 2021

Cyber security shall be incorporated in the overall design of the HVDC controls, protection, communications, HMI and SCADA systems. The TSP shall propose a secure and robust design in the control and LAN systems, using next generation firewalls, dual firewall communication designs, routers, gateways, data diodes, etc. that have built in cyber secure measures.

48. Performance Guarantee for Converter Station (excluding HVDC line)

a) HVDC Station losses: The Guaranteed losses of HVDC converter stations shall include the no load loss and equivalent load loss. The equivalent load loss is the sum of load losses at specific loadings multiplied by weightage factors as per expected loading cycle. The Guaranteed losses shall be verified as per IEC 61803. The above losses shall be guaranteed at nominal

DC voltage (± 800 kV at rectifier end) and nominal AC system Voltage (400 kV, 50 Hz) at ambient temperature of 40 °C and relative humidity of 50%.

b) No load loss shall be guaranteed corresponding to converter transformer set at principal tap## with nominal AC system voltage and nominal frequency. Also refer maximum guaranteed loss figures in table below:

c) The system shall meet various harmonic performance parameters on both AC side and DC side as well as the reactive power exchange limits on AC side as per these specifications while calculating the guaranteed losses.

d) Design targets for HVDC station Reliability and Availability^^ and station guaranteed losses^

Table 11

1	Overall Energy availability of HVDC scheme per Bipole of 3000 MW (a) Overall Performance (b) Excluding transformer	 Not less than 97% Not less than 98%
2	Forced Energy Unavailability (FEU) per Bipole of 3000 MW	Not more than 0.6%
3	Schedule Energy Unavailability (SEU) per Bipole of 3000 MW	Not more than 1%
4	Single Pole outage per station per year	Not more than 8 (with average outage duration of 7.5 hours)
5	Bipole outage per station per year	Not more than 0.2 (with average outage duration of 8 hours)
6	No-load operation losses per Station (kW)	0.1 % of Bipole Rating
7	Equivalent load loss per Station (kW)*	0.35% of Bipole Rating

* **Equivalent load loss=** Load loss at 1000 MW in kW*0.4 + Load loss at 1500 MW in kW * 0.16 + Load loss at 2500 MW in kW * 0.16 + Load loss at 3000 MW in kW * 0.28).

^ - These loss figures shall be calculated on per station and per bipole basis as per details mentioned in (a), (b), (c) and (d) of this clause.
^^The details for calculating Availability are mentioned in ***'Appendix C.4'.***
Principal tap is the Tap Position of converter transformers when HVDC converters shall be delivering 1 p.u. power (6000 MW) at nominal DC voltage at rectifier (± 800 kV) keeping AC system voltage 400 kV, 50 Hz at 40 °C ambient temperature and humidity of 50%.

For the loss guarantee stated above, following equipment/systems shall be considered:

e) Determination of losses

The total losses of the HVDC converter station shall be calculated as the sum of the losses determined for each individual equipment. The major components to be included in the loss calculation and guarantees and the method of assessment for each component shall be as follows:

1. Converter Transformers as per IEC 60076-57-129
2. DC Smoothing Reactors
3. Thyristor Valves as per IEC 61803
4. Reactive Power Equipment, AC FILTER
5. Auxiliary Power Transformers
6. DC Filters and 50 Hz blocking filter as per IEC 61803
7. Miscellaneous Losses for the following equipment shall also be included:

a) Devices used for TOV suppression
b) Direct current voltage transformer
c) Surge capacitors
d) RI & PLC filters

Specific Exclusion:

Equipment specifically excluded from the loss calculations shall be the oil treatment plant and firefighting load, station auxiliary system energy consumption (such as illumination of indoor and outdoor services, Air conditioning & ventilation system for control room, service building, kiosk, battery & battery charger etc.) except auxiliary power consumption required by Converter transformer cooling and Valve cooling system.

f) Guaranteed Failure Rate of Thyristors

The maximum annual guaranteed thyristor level failure rate shall not exceed 0.2% per 12 pulse valve group. The failure rate shall not include failures directly attributable to operating and maintenance errors.

g) AC/DC HV Filter Capacitor Failure Rate Guarantee

The maximum guaranteed annual capacitor failure rate shall not exceed 0.15% except first unit failure. The capacitor shall be considered as failed if its Capacitance value varies more than ±5% of the (actual measured) name plate value or as indicated by manufacturer. Leakage of oil from the capacitor and deformation of the capacitor unit shall be considered as a failure even if the capacitance value is within the tolerance limits.

h) Flashover Guarantee

Flashover is defined as breakdown of insulation for self-restoring insulation media which leads to outage as defined elsewhere in this specification. TSP shall guarantee that there shall be not more than two pollution related flashovers per station per year for DC yards (base environmental conditions as given in this specification will be considered) for each Bipole separately. In case of a flashover, TSP shall make necessary investigations to establish the cause of the same, propose mitigation measures and implement the same. In case of flashover in common neutral area of both Bipoles, the flashover shall be counted in one of the Bipole with lesser number of flashover.

i) Guaranteed Failure Rate of Relay Module/ C&P Module/Component

The guaranteed failure rate of relay module/ C&P module/ component shall not be more than 0.5% (except 1st unit failure). This will include individual circuit boards but not computers. The failures directly attributable to operation & maintenance errors and other incidents unrelated to the DC system shall not be included in the calculation. The relay module/ C&P module/ component failure rate shall be monitored on per pole per station basis.

49. Commissioning and start of operation

The purpose of commissioning period is to demonstrate to the Nodal Agency satisfaction that the equipment is ready for its purpose and it functions satisfactorily under normal operating conditions. The testing and commissioning period will have the necessary duration to demonstrate the proper functioning of all the Project equipment and systems.

a) Site Testing

After the installation and preliminary adjustments of equipment, the Site tests shall be performed in the following stages.

- Erection checks
- Commissioning tests
- Sub-system tests
- Sub-system energization tests
- System tests

The site testing has been categorized in above stages for the sake of convenience only. There may be overlapping of two or more stages for particular tests. The TSP shall perform the site testing with complete responsibility.

The TSP shall provide all instruments, equipment and facilities required to perform these site tests. Calibration certificates for the test equipment shall be made available at site prior to the start of the testing.

All special and test equipment necessary to simulate devices or switching sequences and required for commissioning shall be provided by the TSP. Results of the site tests shall be well documented and shall form a part of plant documentation.

50. Mandatory Spares:

The mandatory spares for the HVDC Station shall be as per 'Annexure-B, 4, Mandatory spares for HVDC stations (substation/switchyard level)' of CEA's 'Guidelines for availability of spares and inventories for power transmission system, transmission lines & substation/switchyard) assets, 2020'.

The specific exclusion to the above list is Sl. No. 2.1, Converter Transformer and Sl. No. 3, Smoothing Reactor. Other Converter Transformer spares from Sl.No. 2.2 to Sl. No. 2.41 to be provided. The spare requirement for Smoothing Reactors shall be as per Clause 22 (d).

Minimum one No. (single phase two winding) spare Converter transformers of each type and rating per station, shall be provided. The spare Converter Transformers shall be inclusive of all fitments, hardware, bushings, as well coolers if mounted on the tank, accessories and oil complete in all respect.

51. HVDC building:

The Building shall comprise of but not limited to the following facilities:

1. Control & Relay Panel room
2. ACDB & DCDB room
3. Battery room
4. Service Room cum workshop
5. Valve hall
6. Cooling system room
7. AHU Room
8. Valve Hall Ventilation Room
9. Any Other room/facilities as per functional requirement

52. For Type Test requirement of equipment, CEA's 'Guidelines for the Type Tests for major equipment of Power Sector' is to be followed.

53. Applicable Standards:

All equipment and material shall be designed, manufactured, tested and commissioned in accordance with latest Indian Standards / IEC or IEEE standards, / CIGRE guidelines and the Acts, Rules, Laws and Regulations of India. Some of them are as follows

Table 12

Sr. No.	Description	Standard
1	Terminology for HVDC transmission	IEC 60633
2	Thyristor valves for HVDC transmission	IEC 60700(1-2)
3	Performance of HVDC with line commutated converters	IEC 60919(1-3)
4	Determination of power losses in High-Voltage Direct Current (HVDC) converter stations with line-commutated converters	IEC 61803
5	High-Voltage Direct Current (HVDC) installations - System tests	IEC 61975
6	High-Voltage Direct Current (HVDC) systems - Guidance to the specification and design evaluation of reactive power exchanges	IEC 62001 (1-4)
7	Bushings for DC Applications	IEC 65700
8	Insulation Coordination	IEC 60071 (1- 5)
9	Application guide for metal oxide arresters without gaps for HVDC converter stations	CIGRE report 33/14-05
10	Converter transformers	IEC 60076-57-129
11	Power transformers - Part 6: Reactors	IEC 600076-6
12	Shunt capacitors for AC power systems having a rated voltage above 1000 V	IEC 60871-(1-4)
13	Semiconductor devices - Part 6: Discrete devices –Thyristors	IEC 60747-6
14	Fire aspects of HVDC thyristor valves and valve halls.	CIGRE-TB 136 1999 SC 14 TF 14.01.04
15	Guidelines for the system design of HVDC project	IEC/TR 63127 Ed. 1.0
16	High voltage direct current (HVDC) power transmission - System requirements for DC-side equipment - Part 1: Line-Commutated Converters	IEC/TS 63014 Ed. 1.0
17	Guidelines for operation and maintenance of HVDC converter station	IEC/TR 63065 Ed. 1.0
18	Guidelines on Asset Management for HVDC Installations	IEC/TR 62978 Ed. 1.0
19	Transformer for HVDC applications	IEC:60076-57-129
20	Surge Arresters – Metal Oxide Surge Arresters without gaps for HVDC converter stations	IEC60099-9-Part -9
21	CT's and VT's	IEC 61869
22	Disconnectors and Earthing Switches	IEC 62271
23	Cyber Security	IEC 62443 IEC 27001
24	UPS, SMPS and Other Power supply units	IEC 62040 IEC 61558
25	Other items as per relevant and prevailing standards specified elsewhere in the specification for substation works.	

Appendix- C.1

DC Voltage Measuring Equipment

A proven type of voltage divider shall be provided for DC voltage measurement. The accuracy of the device shall not vary more than 0.5% with an ambient temperature change of 50° C. The overall voltage measuring system shall have an accuracy of at least 1.0% of full scale. The response time shall not be longer than 150 micro seconds, accepting an overshoot of up to 20% at that rise time. The measuring system shall achieve proper operation of the control and protection system to which it is connected.

The measurement range shall be sufficient to measure voltages up to 1.5 pu. Preference shall be given to devices which provide isolation between the HV primary connection and the output signal. If the output signal is not completely isolated from the HV connection, protection shall be provided to limit the possible output signal voltages to less than 2 kV in the event of a fault on the device.

All low-level signals shall be cabled separately from high level signals. The divider shall be so arranged that no leakage current on the surface of the insulator can pass to the measuring circuit. The insulator shall for this reason be continuous without any metallic intermediate flanges. Furthermore, the interior of the divider shall be so arranged that interior leakage currents do not influence the measurement.

For voltage measuring equipment to be erected in the outdoor switchyard, it shall be ensured that discharge activity on the housing shall not cause interference with the output signal.

For each voltage measuring device furnished, all necessary auxiliary power plus any equipment necessary for the transformation of the auxiliary power to an acceptable form shall be provided. Such transformation equipment shall be mounted in the control cubicles.

Direct Current Measuring Equipment

Direct Current Transducers supplied shall be mounted in bushings, if available. In locations where bushings are not available, free-standing transducers shall be provided. For each transducer furnished, the all-necessary auxiliary power plus any equipment necessary for the transformation of the auxiliary power to an acceptable form shall be provided.

The design of the measuring system shall be based on maximum interchangeability where any electronic module shall be compatible with any of the core and coil assemblies.

The transducer output signal shall be of sufficient magnitude to ensure that the content of the signal is usable at all levels of primary current from 1% to 300% of the rated current, with a measurement output possible up to 600% before saturation of the output signal occurs.

In the event of high current (up to 0.2s short circuit current), the DC CT shall remain unsaturated for 20 ms or longer. This time shall be measured from the instant the current attains 10 pu. The DC CT shall be provided with interlock circuits that indicate saturation of the DC CT, as well as DC CT faults.

It shall be ensured that any low-level signals generated are kept shielded from interference due to other higher voltage circuits. The low-level signals shall be cabled separately from high level signals.

It shall be ensured that all DC current measurement outputs are accurately calibrated with all the respective loads connected. If required, on-site adjustments to output calibration shall be possible. The sensitivity of the devices supplied for such calibration shall be appropriate for setting the required accuracy.

The electronic module shall be provided with interlock circuits to indicate that the measuring system is fully operable.
In case of Optical DC measuring system, the materials used in it shall be non-corrosive in nature.

Stationary Accuracy

The composite accuracy of all DC current measurement systems used for protective purposes shall be equal to or better than ±2% of rated DC current up to 120% of the maximum rated current and ±10% of rated DC current up to 1.2 times peak calculated fault DC current.

All DC current measuring system used for control purposes shall have a composite accuracy of ±0.75% of rated DC current from minimum rated current to 120% of the maximum rated current and ±10% of rated DC current from 120% up to 300% of the rated current.

All transducers used for corresponding functions, e.g. pole differential protection etc shall have matching accuracies equal to or better than ±2% of rated current up to 300% of the rated current.

Dynamic Accuracy

The response of the measuring systems shall be such that a linear current change within 150% of maximum rated current and with a rise time of 45 ms, is tracked by the transducer output with an error which does not exceed +0%, -2% of rated current on any point of the curve. The rise time is defined as the time required for the current to change from 10 to 90% of the full current change. The frequency response shall be within +3% at 1500 Hz.

Appendix C.2

Operator's Control, Monitoring and Support Systems

A. General Requirements

All hardware such as computers, computer peripherals/printers/ accessories, testing equipment etc and networking products shall conform to latest products based on industry standard. It shall be possible to fully monitor and control both stations as described below-

- Operation control of both converter station (from monitors) from South Kalamb
- Operation control of both converter stations (from monitors) from Barmer-II
- In separate operation control mode, all the terminals shall be able to control their own station individually.

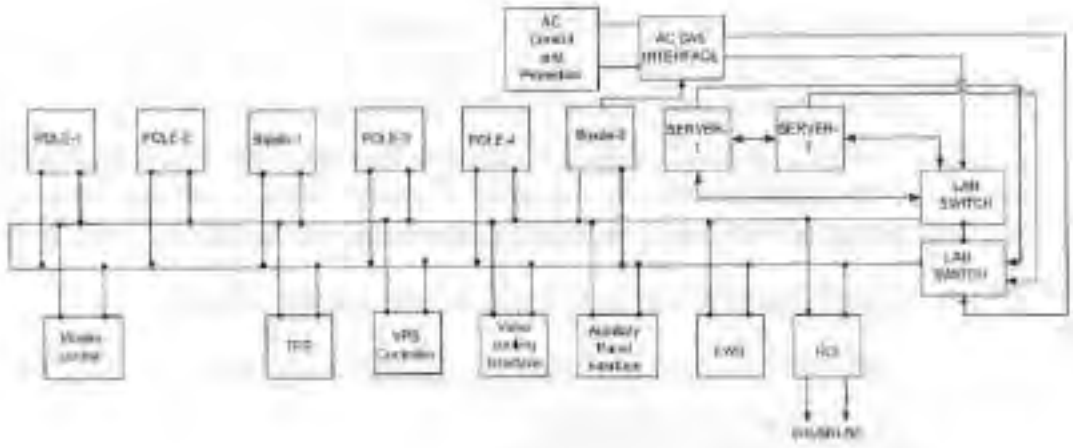
The above selection modes shall be separately provided for control of the DC system and the AC systems of either station.

A Station operator desk to be supplied at each converter station shall be able to control the stations. The control shall be possible from TFT Monitors and operator key board/ mouse. In the event of failure of the system, control and monitoring shall be by means of direct control at the Bipole control panels circuit breaker controls panels etc generally as shown in 'Figure-A'. This control could be made from PC connected to these control panels and necessary interface shall be provided to achieve this. The control functions to be provided from the equipment control panels shall include at least those listed under 'Table-A' and 'Table -B'. It shall also be possible for operator to know individual alarms by selecting the particular panel on the display monitor.

The TSP shall provide the equipment necessary for the purpose of control, status indication and metering of all equipment (keeping in view the intermediate Bay Kiosks to be provided in AC & DC yard,) at South Kalamb and Barmer-II.

The control room shall generally house the following equipment:

- Operator control, monitoring and support system
- DC line fault location equipment, if not integrated within C&P system
- Transient fault recorders, if not integrated within C&P system.
- Master controller equipment, if not integrated within C&P system.
- Station fire alarm, control & monitoring panel



Typical station control &/d monitoring system

'Figure – A'

(System shall be redundant with system A and system B. Only one system has been represented.)

i. HVDC Controls

The station control room at each converter station shall have facilities that include, but not be limited to, the functions shown on Table-A and B

A description of major HVDC control functions is outlined below:

1. Controlling Station (Master Station) Selector Switch

Control location selector switches shall be provided in each station control room. These selector switches shall enable the operator to control the HVDC system and/or the HVAC yard of any converter station from either South Kalamb and Barmer-II stations. HVDC and HVAC yard control & monitoring of other converter station shall be provided from TFT Monitors.

2. Bipole Controls

Bipole controls shall refer to the common control functions that affect both poles in a Bipole. These functions are typically Bipole power order, power direction, power limit and power ramp rate.

The power flow over the Bipole shall be maintained at the Bipole power order as set by the operator.

The power ramp rate shall control the timing sequence for loading Bipole at a pre-selected rate (within specified range) set by the operator.

The power limit control shall enable the operator to set different limits to Bipole loading. It shall also be possible to operate each pole separately from Bipole Controls.

3. Pole/Converter Current Order/Limit

The power setting divided by voltage shall determine the current order to either pole. However, this shall not preclude the ability to control each pole, by means of a directly entered manual current order signal.

The pole current limit set point shall enable the operator to raise/ lower current limits to optimize link capabilities under varying conditions such as ambient temperature, temporary reduction in capability etc.

4. **HVDC System Control Mode Selection (Per Pole)**

The following basic control modes shall be provided:

a) Power Control Mode
b) Current Control Mode

Disturbance free transfer of any pole from one control mode to another shall be possible.

5. **Miscellaneous Operator Controls**

a) DMR (Dedicated Metallic Return) Line Current Null Control

This control shall enable the operator to null the current flowing in the DMR (Dedicated Metallic Return) Line resulting from unequal sharing of load between poles during balanced operation.

b) Block/ Deblock

This control shall enable the operator to stop (block) or start (deblock) a converter. Automatic sequences shall be provided to fulfill preconditions for deblock. A normal stopping sequence initiated by "block" contact involves a sequence at each end that causes the voltage and current to drop to zero.

c) Pole Start/ Stop

This control shall enable start or stop of the complete pole, comprising converters at either of the rectifiers and the inverter and shall take care of all interlocks, start/stop preconditions and sequences automatically.

d) Direction of Power Transfer

Power flow shall be possible in both directions.

e) Pole Metallic Return/DMR (Dedicated Metallic Return)/DMR-PMR parallel Mode

This selector switch (or switches) shall enable an automatic sequence from Pole metallic return to DMR and vice versa. This mode change shall be possible even with power flowing in the DC system. It shall also be possible to operate DMR & PMR conductors in parallel.

f) DC Filter Connect/ Isolate

Motorized disconnects are specified for switching the filter arms to allow disconnection of a faulty filter bank or arm and for restoration to service as quickly as possible. An automatic switching sequence shall be provided which shall take care of all the interlocks.

g) DC Line Isolator

DC line isolators are specified for maintenance purposes and their electrical operation in local shall be possible. Operation shall be permitted only with pole blocked and station ground connected. Automatic operation shall also be possible if required by any sequences subject to satisfying all interlocks permitting the operation.

h) Grounding Switches in DC Yard

Grounding switches are specified for the DC switchyard area to allow each isolatable section of bus to be grounded. Only local electrical operation is required. However, if operation of any grounding switches is part of any automatic sequence(s), or is specified elsewhere, then those grounding switch(es) shall be operable locally as well as remotely.

i) Valve Hall Ground Switches

Remotely controlled motor operated grounding switches are specified for the valve halls to protect maintenance personnel. The operation of all the valve hall ground switches together as a group shall be possible by initiating a sequence from the control room. Provision shall however be made (key operated switch) for defeating the interlock to permit entry of authorised personnel into the restricted area of the valve hall.

j) Maintenance/Bypass Isolators for Metallic Return Transfer Switch / Bus (MRTS or MRTB)

Electrically local operated isolators shall be provided to establish a ground reference when MRTS is being maintained. These shall be interlocked with the MRTS.

k) Emergency Stop

An emergency stop button on pole basis shall be provided in the control room. Operation of this button shall automatically ramp down at a fast rate the direct power, lead to blocking of the converters and reach safe shut down with Operation of High speed parallel/ De-parallel switches.

l) HVAC Controls

HVAC controls shall consist of close-open operations for circuit breakers and motor operated disconnectors.

II. Station Control Facilities

The TSP shall provide the control facilities from the operator control desk through a TFT monitor and keyboard/ mouse system. These facilities shall include all control operations, digital setting, indicating devices, Station single line diagram and symbols, any other special control devices and meters required for control and monitoring of the complete HVDC system. The layout of the station single line diagram, together with control, indicating and metering devices on the control desk shall be logical, compact, and shall facilitate efficient supervision and operation of the station(s) by the operator.

iii. Station Level Status Supervision

The position of each switchgear e.g. Circuit breaker, isolator, earthing switch, transformer tap changer etc shallbe supervised continuously. Every detected change of position shall immediately be displayed in the single-line diagram on the station screen, recorded in the event list and an option to take hard copy printout of event list shall be available. Alarms shall be initiated in the case of spontaneous position changes.

The switchgear positions shall be indicated by two auxiliary switches, normally closed (NC) and normally open (NO), which shall give ambivalent signals. An alarm shall be initiated if these position indications are inconsistent or if the time required for operating mechanism to change position exceeds a predefined limit.

iv. System Indications and Power Measuring Facilities

The TSP shall provide DC and AC system / equipment indication facilities in the station control room at each converter station that shall include, but not be limited to, the functions shown on Table A and Table B. Alarms of slave stations shall be indicated and displayed both at Master Station and slave stations and vice-versa.

3-Dimensional graphic representation of thyristor valves and valve cooling piping network shall be provided on station monitoring system. The graphical representation shall also display faulty thyristors in different colours indicating faulty thyristor position.

Pressure, temperature and relative humidity of each valve hall shall also be displayed in the control room. Alarm(s) shall be raised in case any of the parameters exceed limits.

Table A' provides a list of minimum AC and DC metering facilities required, which shall be included on TFT monitors.

v. Energy Metering

Energy meters as per relevant CEA Guidelines and Specifications/Regulations for the 765 kV, 400 kV, 220 kV & 132 kV AC switchyards (as applicable) and 33 kV feeders at HVDC terminals shall be provided by the TSP.

B. System Requirements

General

The main control and monitoring systems shall be configured as dual redundant computer-based systems in a main and hot standby configuration generally as shown in 'Figure A'. The operator control, monitoring and support system could be integrated with station control system. Outage of any subsystem or complete loss of one system shall not affect the control and monitoring of the HVDC station. The system shall be based on open system

concept in hardware and software and industry standard communication protocols and graphical user interface.

The redundant, computer-based system shall accept control inputs from the Operator by means of TFT monitor/ mouse etc and send these commands to the HVDC and the HVAC control systems.

The system shall gather alarm, status and measurand data from the plant and display it to the Operator on the mimic diagram on TFT monitors, loggers etc as further defined below. The system shall be so designed that no alarm and status data or control data shall be lost.

Table -A Controls & Indications at South Kalamb and Barmer-II:-

Sl. No.	Signal Name	South Kalamb	Barmer-II
	CONTROLS SIGNALS		
1.	Bipole power order	√	√
2.	Bipole power order ramp	√	√
3.	Bipole power order limit	√	√
4.	Bipole power/current control	√	√
5.	Power direction P1,P3, P2,P4	√	√
6.	Power/Current control	√	√
7.	Current order setting	√	√
8.	Current ramp start/stop	√	√
9.	Current order ramp setting	√	√
10.	Current limit setting	√	√
11.	Master station transfer	√	√
12.	Metallic/DMR switching	√	√
13.	Reduced voltage on/off P1, P2, P3, P4	√	√
14.	Start/Stop & Block/deblock P1,	√	√
15.	Power Swing modulation on/off	√	√
16.	DC power /current control	√	√
17.	Emergency stop P1, P2, P3, P4	√	√
18.	Frequency control/on/off	√	√
19.	Frequency target/limits	√	√
20.	Connect/isolate P1, P2, P3, P4	√	√
21.	Joint/separate, Sync/Async	√	√
22.	DC Filter connect/isolate P1, P2,	√	√
23.	RPC auto/man off switching	√	√
24.	RPC Volt/Reactive Selection	√	√
25.	RPC MVAr/Voltage set points	√	√
26.	Open line test auto/man P1,P3,	√	√
27.	AC Filter (bank/ sub-bank)	√	√
28.	Conv. Trans Breaker	√	√
29.	AC Filter (bank/sub-bank)	√	√
30.	Con. Trans Disconn	√	√
31.	Tap changer auto/man P1, P2, P3, P4	√	√
32.	Valve hall Gr. Switch open/close	√	√
33.	South Kalamb Sw. yard Breaker	√	√

Sl. No.	Signal Name	South Kalamb	Barmer-II
34.	Barmer-II Sw. yard Breaker open	√	√
	INDICATIONS		
35.	DC OP Mode Pwr./current	√	√
36.	Gr/metallic return indication.	√	√
37.	Power direction P1.P3, P2.P4	√	√
38.	Pole Telecommunication healthy	√	√
39.	Pole blocked/deblock P1, P2,	√	√
40.	Master station South Kalamb-Barmer-II- LDC	√	√
41.	DC Station overload in use	√	√
42.	Power ramp in progress	√	√
43.	Stabilization control on/off	√	√
44.	Full/reduced DC voltage	√	√
45.	Tap changer Auto/Man	√	√
46.	Pole connect/isolate indication.	√	√
47.	Power direction normal/reverse	√	√
48.	Runback activated indication.	√	√
49.	Frequency control on/off	√	√
50.	Frequency control activated	√	√
51.	AC bay Circuit breakers	√	√
52.	AC bay disconnectors indication.	√	√
53.	AC Filter (Sub-bank) Circuit	√	√
54.	AC Filter (Sub-bank)	√	√
55.	DC filter con/isolated indication.	√	√

Table -B Indication Signals to RLDC

S.No	Signal Name	RLDC
1.	Bipole power order	√
2.	Power Swing modulation on/off	√
3.	DMR/metallic return indication. P1.P3, P2.P4	√
4.	Pole blocked/deblock P1, P2, P3, P4	√
5.	Runback activated indication.	√
6.	Frequency control on/off	√
7.	Frequency control activated	√
8.	Full/reduced DC voltage indication.	√
9.	AC bay Circuit breakers indication.	√
10.	AC bay disconnectors indication.	√
11.	DC Power Bipole	√
12.	DC Line current/ voltage P1.P3, P2.P4	√
13.	AC side A/MW/MVAR/ P1, P2, P3, P4	√
14.	AC Filter/Cap A. Mvar all banks	√
15.	AC Lines A/MW/MVAR/	√
16.	Station/AC system MW exchange	√
17	Station/AC System MVAR exch	√
18	AC Bus Voltage	√
19	AC Bus Frequency	√

The system shall also be designed to allow input of signals from the Dispatch centre for example, load frequency control (LFC) signals. The system shall be capable of meeting the control and monitoring requirements of each converter station and LDC while operating at maximum rating, with a reserve capacity of minimum twenty-five per cent. Equipment bins that are not fully equipped with cards shall be fully wired and be ready to accept additional cards. Power supply units shall be rated to meet the full capacity requirements

C. Functional Requirements

1. General

The redundant computer-based system shall be a highly reliable integrated system, which shall provide Operator's interface, alarm and monitoring system and operator guidance/ expert system.

The high-voltage apparatus within the station shall be operated from different places:

- Remote control centres
- Station operator control
- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time. The operation shall depend on the conditions of other functions, such as interlocking, synchro-check etc.

2. **Run Time Command Cancellation and Self-Supervision**

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled. Continuous self-supervision function with self-diagnostic feature shall be included.

3. **User Configuration**

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-in functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers). (Multi-activation of these additional functions should be possible).

The Functional requirement shall be divided into following levels:

a) Bay Level Functions.
b) System Level Functions.

D. Computer Information System Requirement:

A computer-based information system shall perform following functions:

- Initiation of commands to control HVDC system.
- Control and monitor the Valve cooling system.
- Monitoring of process data to give brief overview as well as a comprehensive view of each subsystem.

- Sequence of event recording and alarm system including determination of Event Categories (major, warning, alarm).
- Process data archiving and trending.

Soft copy of complete station documentation shall be available on Operator Work Stations.

All the system trends shall be available at least for one-year period and retrievable on demand from the main storage system. The process data logging shall have hourly/ daily logging of station data. Archiving and back up storing facility of the log sheets shall be possible and facilities taking backup on External hard discs/ Drives minimum 2 tera bytes shall be provided.

E. Remote Control, Monitoring and Tele Control systems

The TSP shall provide facilities for coordinated control and monitoring of the HVDC system. All required remote control and remote monitoring facilities shall be provided at each converter station. Complete remote monitoring of each converter station shall be possible from opposite converter station. The HVDC tele-control system equipment shall be used in the processing of signals to be transmitted over the fibre optic communication system between the converter stations of Bipolar scheme.

Appendix C.3

Transient Fault Recorders

1. General

The transient fault recorders (TFR) shall continuously monitor the power system. These could be integrated with operator control and monitoring system or supplied as standalone units.

Below requirements are specified for standalone units. Similar functional requirements will be applicable for integrated TFR.

One recorder per pole shall be provided at each converter station. The TFR may be provided in the form of central unit together with Data Acquisition Units (DAUs). Initiation by any one of the fault detecting sensors or external initiating contacts shall cause the fault recorder to record on all channels. The record shall comprise-fault information, time of fault information and post fault information. The TSP shall determine the number of analog and event inputs required for each recorder and supply these number plus minimum 25% spare channels. The TFR shall also have facility for harmonic analysis upto 50th harmonics of waveforms. Recorders shall be of solid-state modular construction microprocessor based and without moving parts. First in, first out (FIFO) printing logic shall be used. The necessary software for directly analyzing the records on the memory of the TFR shall also be supplied.

Facilities shall also be provided for data retrieval from TFR and analyse by means of a master station based on compatible PC having minimum configuration of 2.8 GHz clock speed, 1 TB hard disc & 16 GB RAM capacity, complete with 24-inch LED monitor, keyboard/ mouse etc and include laser colour printer with capability to print on A3 and A4 size paper. All necessary software package(s) along with facility to communicate between TFR & PC shall be provided by the TSP.

2. Input Signals

The input signals and starting sensors required for the HVDC system for commissioning and operation shall be determined by the TSP. The input signals to each fault recorder system for a pole shall include, but not be limited to, the following:

- Valve group firing pulse markers;
- Valve group ignition delay angle response
- Valve group voltage;
- Pole current order;
- DC line voltage (own pole);
- DC line voltage (other pole);
- DC neutral Bus voltage (Both poles)
- DC line current (own pole);
- DC line current (other pole);
- DC power (each pole and both converters)

- DC power (other pole and both converters)
- Current order
- AC bus voltage (3 phases);
- AC current to each valve group and transformer primary currents

The Triggering of TFR shall include, but not be limited to following inputs:

- Pole Block/ Deblock
- Pole Commutation Fail
- Pole Firing pulse loss
- Pole last Breaker opened
- Pole DC Protection Voltage level trigger
- Pole DC Protection dv/dt triggger
- Pole di/dt
- Pole 30 minutes, 2 hours and 5 seconds overload operated
- Pole MR/ GR sequence initiated
- AC Over voltage/ under voltage Protection operated.
- Full voltage/ RVO Changeover
- I_{dc} Limit by VDCOL
- DC O/V, U/V
- Telecommunication Fail

Each fault recorder shall be equipped with suitable input circuits and starting sensors for all of the input signals. The TSP shall ensure that the characteristics of the input circuits and starting sensors are well matched to the characteristics of the signal sources.

3. Electrical Characteristics

(i) Monitoring Systems

The recorder shall be a digital based type. Operation of the equipment shall be based on programs stored in non-volatile solid-state memory. Programs shall be stable and no inadvertent change of program(s) shall occur.

The recorder shall be equipped with a built-in post fault record- length timer, adjustable over a range of 0.5 to 10 seconds after the fault.

Normally open operation alarm contacts shall close while the fault recorder system is operating and be utilized as inputs to the alarm monitoring and reporting system. A three digit, manually resettable operations counter shall be provided that indicates the number of faults or disturbances recorded.

Facility for automatic storage of information to a PC or an independent storage device (e.g. a disc drive) shall be provided. The output shall be possible to be printed on plain paper in the A4/A3 format.
The recorded information shall include but not necessarily be limited to:

- Station Identification

- Identity of trigger source
- Record Identification for Analog, Event and Sensor traces
- Date/ Time: Year, Day, Hour, Minute, Second, Millisecond
- Analog traces
- Event traces
- Sensor traces
- Time marker trace which shall allow time interpolation of records to 2 ms.
- Start of record line.

(ii) Operations

The fault recorder shall continuously monitor the power system. Initiation by fault detecting sensors or by other input contacts or pre-selected events shall cause that particular recorder to record the fault information. The other pole recorder shall also record in a slave mode. Operation of any one of the initiating sensors shall start the recording mechanism or otherwise cause all channels to record until the fault clears or the record-length timer setting is exceeded.

The transient fault recorder shall have facility for suitable interface for transmission of recorded analog and digital information to a remote station. This shall be demonstrated by the TSP at site by using inter-station communication.

(iii) Input Circuitry

The input circuits for the recording channels shall be insulated for operation at potentials of 2000 Vrms between channels and between channel and ground. Each input recording channel shall be capable of operating from the output of 1A rms nominal secondaries of current transformers and capacitive voltage transformers with 63.5 V rated secondary. Each channel shall be supplied with a selection of current shunts and voltage multipliers to provide a range of high and low current or voltage ranges which can be selected by straps or similar method. The recorder shall also be capable of operating from the DCCT's and direct voltage devices supplied for the station. Any device required for processing of input signals in order to make them compatible to the equipment shall form an integral part of the supplied equipment. However, such processing of input signals shall in no way distort its waveform. The equipment shall be carefully screened, shielded, earthed and protected as may be required for its safe functioning. It shall be possible to position the reference point of any of the analog channels to any position on the record. The individual traces shall be identified on the record by numbering them in the order they are connected at the input.

The current values of scaling parameters related to the various channels shall be printed on each printout to enable quick interpretation of the records.

(iv) Starting Sensors

The initiating or detecting devices, which start the recording, shall be solid state and automatic self-resetting type.
Each sensor shall be equipped with an indicating lamp, viewable from the front of the cabinet, which operates when the sensor operates. The lamp shall remain 'on' until reset by the station operator. Failure to reset the lamp shall not affect subsequent operation of the sensor. Sensor settings shall be easily adjustable and easily accessible. One starting sensor for at least each of the following types of changes shall be provided.

- Level Changes Over Current Over Voltage Under voltage
- Swing Rate of change of nominal input
- Frequency
- Under frequency
- Over frequency

It shall be possible to adjust the response time of the sensors, in each case, to ensure the most rapid operation consistent with the characteristics of the analogue quantity being monitored.

It shall also be possible to initiate the fault recording, as required, by additional external relay contacts, either NO or NC.

(v) Pre-fault Periods

The recording system shall accurately record power system transient disturbances with a pre-fault period, which shall be settable between 50 to 250 ms.

(vi) Memories

Sufficient memory shall be provided to prevent any loss of records under all normal operating circumstances.

(vii) Time

A means shall be provided to record on the chart the time of occurrence of each fault or disturbance to a resolution of 2 milliseconds or better. The time clock shall be synchronized with the station master clock signal. Facility shall exist to display the time in hour, minutes and seconds on the front of the panel.

(viii) Calibrations

The recording system shall be so designed that each channel may be calibrated separately. Calibration shall be accomplished by applying the calibration level input in the test switches. Controls and switches shall be provided on the front panel to facilitate calibration.

(ix) Resolutions

a) Analog resolution

Analog to digital conversion shall be 12 bits (minimum). The amplitude of the recording shall be adjustable and magnification in fixed steps, of the recording, shall be provided.

b) Events Resolution

The event resolution at the lowest scan rate shall be two milliseconds or better.

c) Transient Response (analog channels)

The transient response delay of the analog input conditioning circuits to a step function input shall be less than 400 microseconds between 10% and 90% values of the step function with overshoot of the final value of the step function being not more than 2%.

(x) Recording Quality

Static trace width	1.5 mm maximum
Residual channel noise	0.1% of full-scale maximum at 50 Hz or any harmonic thereof
Recording resolution	0.1% of full scale
Phase error between channels	Less than 5 degrees at 50 Hz
Crosstalk	Lower than 50 dB (DC to 1500 Hz)

Scale alteration/ expansion facilities shall be provided.

(xi) Alarm Circuits and Indicators

Alarm circuits shall be provided to indicate inability for automatic operation due to power failure, out of paper condition, incorrect switch positioning or other failure(s), which shall be prominently visible on the recorder panel. Each alarm circuit shall include a normally open contact which shall be integrated into the station alarm monitoring and reporting system.

(xii) Power Requirements

The recording system shall be suitable for operation from the station battery supply. There shall be no loss of accuracy in the recording system for specified variations of DC input voltage.

Appendix C.4

DEFINITIONS

OUTAGE TERMS

1 Outage

The state in which equipment or a unit of equipment is unavailable for normal operation due to an event directly related to the same equipment or some unit of equipment.

2. Scheduled Outage

Scheduled outage is an outage which can be scheduled at least one week in advance. This includes planned maintenance, normally conducted on annual basis, and also unplanned maintenance or repair which can be deferred at least one week subsequent to discovery of the need for maintenance or repair. If the outage is extended due to additional work which would have otherwise caused a forced outage, the excess period is counted as a forced outage.

3. Forced Outage

The state in which equipment is unavailable for normal operation, but is not in the scheduled outage state, i.e. an outage which is not a scheduled outage.

4. Pole Outages

An outage which causes a reduction in the Bipole DC power system transfer capacity equal to or less than the power rating of one pole

5. Bipole Outages

An outage which causes a reduction in the bipolar DC system power transfer capacity greater than the power rating of one pole

CAPACITY TERMS

1. Maximum Continuous Capacity (Pm)

The maximum bipolar HVDC system capacity (MW) for which continuous operation under normal conditions is possible referred on to the rectifier DC bus, i.e. 3000 MW.

2. Outage Capacity (Po)

The capacity reduction in MW which the outage would have caused if the HVDC system were operating at its maximum continuous capacity (Pm) at the time of the outage.

3. Outage Derating Factor (ODF)

The ratio of outage capacity (Po) to maximum continuous capacity (Pm).
ODF = Po/Pm

OUTAGE DURATION TERMS

1. Actual Outage Duration (AOD)

The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/10th of an hour. Time less than 1/10 of an hour shall be counted as having duration of 1/10 of an hour.

2. Equivalent Outage Duration (EOD)

The actual outage duration (AOD) in hours, multiplied by the outage derating factor (ODF), so as to take account of partial loss of capacity.

EOD = AOD x ODF

Each equivalent outage duration may be classified according to the type of outage involved, i.e. equivalent forced outage duration (EFOD) and equivalent scheduled outage duration (ESOD).

TIME CATEGORIES

1. Period Hours (PH)

The number of hours in the reporting period.

In a full year the Period Hours are 8760 h (8784 h for a leap year). If the equipment is commissioned part way through a year the period hours shall be proportionately less than 8760 h. (This shall not be applicable for verification of guarantees).

2. Actual Outage Hours (AOH)

The sum of actual outage durations within the reporting period

AOH = $\sum$ AOD

The actual outage hours (AOH) may be classified according to the type of outage involved, i.e. AFOH and ASOH.

3. Equivalent Outage Hours (EOH)

The sum of all equivalent outage durations within the reporting period.

EOH = $\sum$ EOD

The equivalent outage hours may be classified according to the type of outage involved, i.e. equivalent forced outage hours (EFOH) and equivalent scheduled outage hours (ESOH).

If outage duration overlaps the beginning or end of a reporting period, only the EOD which lie within the reporting period shall be included in EOH.

AVAILABILITY AND RELIABILITY TERMS

1. Energy Unavailability (EU)

   Energy unavailability is a measure of the energy which could not have been transmitted due to (scheduled & forced) outages. The impact of overload capability of the individual poles shall not be considered for calculating the Energy unavailability.

   Energy Unavailability % (EU) = EOH/PH x 100

   Forced Energy Unavailability % (FEU) = EFOH/PH x 100

   Scheduled Energy Unavailability % (SEU) = ESOH/PH x 100

2. Energy Availability (EA)

   A measure of the energy which could have been transmitted except for limitations of capacity due to outages, arising from any cause, either forced or scheduled.

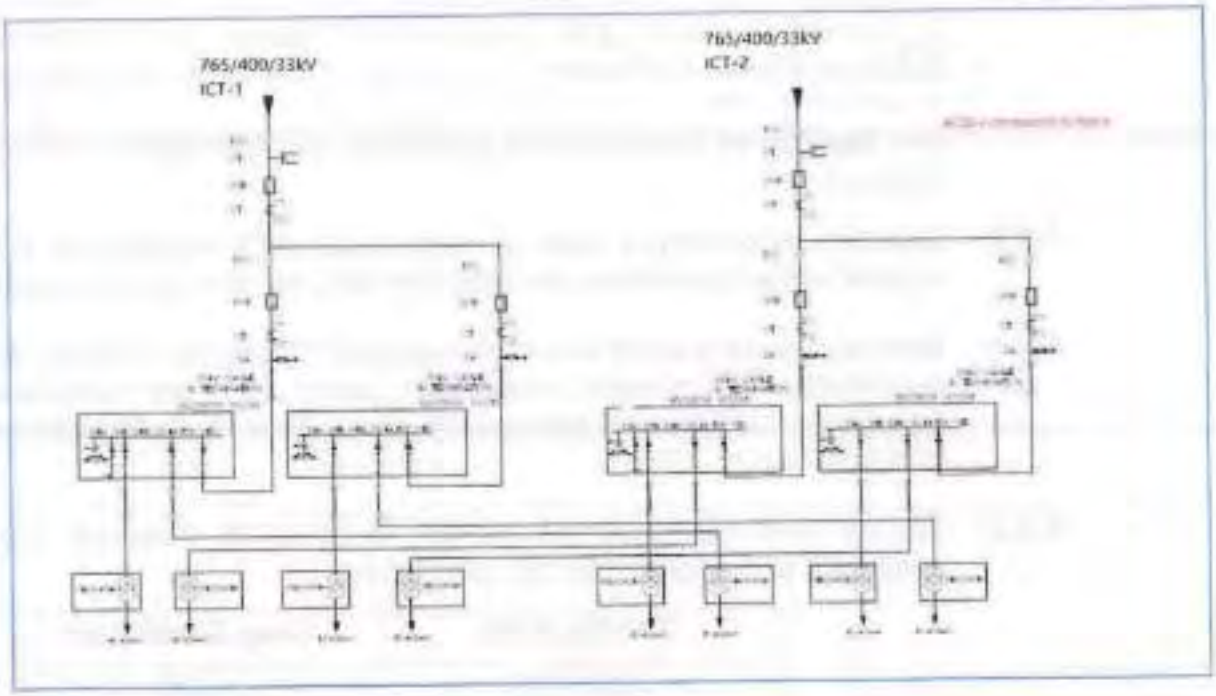
   Energy Availability % (EA) = (100 - EU)

3. Energy Utilisation (U)

   A factor giving a measure of energy actually transmitted over the system

   Energy Utilisation % (U) = [Total energy transmitted/ (Pm x PH)] x 100]

Appendix-C.5



SPECIFIC TECHNICAL REQUIREMENTS FOR HVDC TRANSMISSION LINE

A.1.0 The design, routing and construction of HVDC transmission lines shall be in accordance with CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022, as amended from time to time. Other CEA Regulations/ guidelines as amended up to date and Ministry of Power (MoP) guidelines, as applicable, shall also be followed.

A.2.0 Selection of tower type shall be made as per CEA Regulations, however in case lattice type towers are used, the following shall also be applicable:

A.2.1 Steel section of grade E 250 and/or grade E 350 as per IS 2062, only are permitted for use in towers, extensions, gantry structures and stub setting templates. For towers in snowbound areas, steel sections shall conform to Grade-C of IS-2062.

A.2.2 Towers shall be designed as per IS-802:2015, however the drag coefficient of the tower shall be as follows: -

Solidity Ratio	Drag Coefficient
Upto 0.05	3.6
0.1	3.4
0.2	2.9
0.3	2.5
0.4	2.2
0.5 and above	2.0

A.3.0 Transmission Service Provider (TSP) shall adopt any additional loading/design criteria for ensuring reliability of the line, if so desired and /or deemed necessary.

A.4.0 Transmission line shall be designed considering wind zones as specified in wind map given in National Building Code 2016, Vol.1. The developer shall also make his own assessment of local wind conditions and frequent occurrences of high intensity winds (HIW) due to thunderstorms, dust-storms, downburst etc. along the line route and wherever required, higher wind zone than that given in wind map shall be considered for tower design for ensuring reliability of line. Further, for transmission line sections passing within a distance of 50 km from the boundary of two wind zones, higher of the two wind zones shall be considered for design of towers located in such sections.

A.5.0 Selection of reliability level for design of tower shall be as per CEA Regulation (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022, as amended from time to time.

A.6.0 a) In case of construction of transmission line of Voltage level of 400 kV and above, under crossing of the existing transmission line shall not be

allowed. In the case where it is inevitable to under-cross the existing transmission line then TSP shall seek prior approval from Chief Electrical Inspector, CEA with detailed study ensuring that all statutory electrical clearances and Electric Field limit of 10 kV/m at 1 m and 1.8 m from ground level is not violated.

a) For power line crossing of 400 kV or above voltage level (if crossed over the existing line), large angle & dead-end towers (i.e. D/DD/QD) shall be used on either side of power line crossing.

b) For power line crossing of 132 kV and 220 kV (or 230 kV) voltage level, angle towers (B/C/D/DB/DC/DD/QB/QC/QD) shall be used on either side of power line crossing depending upon the merit of the prevailing site condition and line deviation requirement.

c) For power line crossing of 66 kV and below voltage level, suspension/tension towers shall be provided on either side of power line crossing depending upon the merit of the prevailing site condition and line deviation requirement.

d) For crossing of railways, national highways and state highways, the Rules/Regulations of appropriate authorities shall be followed.

A.7.0 The relevant conductor configuration shall be as follows: -

i. Type of conductor: ACSR / AAAC / AL59

Basic parameters for Transmission Line associated with HVDC Bipole link:

Transmission line	ACSR Conductor	AAAC conductor based on 53% conductivity of AL Alloy	Minimum size of AL59 conductor based on 59% conductivity of AL Alloy	Minimum size of AL59 conductor based on 59% conductivity of AL Alloy	Sub-conductor Spacing
±800 kV HVDC transmission lines *(hexa bundle configuration per pole)*	Lapwing: Stranding 45/4.78 mm-Al + 7/3.18 mm-Steel; 38.22 mm diameter; 807.5 mm^2, Aluminium area;	Stranding details: 61/4.38mm, 39.5 mm diameter; 921 mm^2 Aluminium alloy area; Maximum DC Resistance at 20°C	Stranding details: 61/4.36 mm, 39.2 mm diameter; 910 mm^2 Aluminium alloy area; Maximum DC	Stranding details: 61/4.17 mm, 37.53 mm diameter; 833 mm^2 Aluminiu m alloy area; Maximum DC Resistance at 20°C	457 mm

Transmission line	ACSR Conductor	AAAC conductor based on 53% conductivity of AL Alloy	Minimum size of AL59 conductor based on 59% conductivity of AL Alloy	Minimum size of AL59 conductor based on 59% conductivity of AL Alloy	Sub-conductor Spacing
	Maximum DC Resistance at 20°C (Ω/km): 0.0358; Minimum UTS: 188.69 kN	(Ω/km): 0.0361; Minimum UTS: 244.0 kN	Resistance at 20°C (Ω/km): 0.0326; Minimum UTS: 199.0 kN	(Ω/km): 0.0356; Minimum UTS: 181.96 kN	
Twin Lapwing transmission lines for DMR *(2 Nos Dedicated Metallic Return line with Twin bundle configuration)*	Lapwing: Stranding 45/4.78 mm-Al + 7/3.18 mm-Steel; 38.22 mm diameter; 807.5 mm² Aluminium area; Maximum DC Resistance at 20°C (Ω/km): 0.0358; Minimum UTS: 188.69 kN	Stranding details: 61/4.38mm, 39.5 mm diameter; 921 mm² Aluminium alloy area; Maximum DC Resistance at 20°C (Ω/km) 0.0361; Minimum UTS: 244.0 kN	Stranding details: 61/4.36mm, 39.2 mm diameter; 910 mm² Aluminium alloy area; Maximum DC Resistance at 20°C (Ω/km): 0.0326; Minimum UTS: 199.0 kN	Stranding details: 61/4.17 mm, 37.53 mm diameter; 833 mm² Aluminium alloy area; Maximum DC Resistance at 20°C (Ω/km): 0.0356; Minimum UTS: 181.96 kN	450 mm

Note: *The transmission lines have to be designed for a maximum operating conductor temperature of 85 °C.*

A.8.0 The required pole to pole spacing shall be governed by the tower design as well as minimum live metal clearances under different insulator swing angles. However, the spacing between Pole and DMR shall not be less than 9.7 m and pole to pole clearance shall not be less than 22.0 m. Also, the DMR line shall be placed above the pole.

A.9.0 All electrical clearances including minimum live metal clearance, ground

clearance and minimum mid span separation between earth wire and conductor shall be as per Central Electricity Authority (Measures Relating to Safety & Electric Supply) Regulations, 2023 as amended from time to time and relevant Indian Standards. For the clearances which are not included in CEA Regulation/ Indian Standard, following values shall be considered:

1) Minimum live metal clearances for ±800 kV line:

a.(i) Swings and Clearances:

Wind pressure Condition	Minimum electrical clearance
a) Swing angle (0°)	7.7 m
b) Swing angle (21°)	6.5 m
c) Swing angle (53°)	2.0 m

a.(ii) Swings and Clearances: For Jumper

Wind pressure Condition	Minimum electrical clearance
a) Swing angle (0°)	7.7 m
b) Swing angle (25°)	6.5 m
c) Swing angle (72°)	2.0 m

a.(iii) Swings and Clearances: For Jumper with pilot insulator

Wind pressure Condition	Minimum electrical clearance
a) Swing angle (0°)	7.7 m
b) Swing angle (25°)	6.5 m
c) Swing angle (66°)	2.0 m

b) (i) Minimum ground clearance for AL 59 conductor (61/4.17 mm, 37.53 mm diameter): 19 m

(ii) Minimum ground clearance for other conductors: 18 m

c) Minimum mid span separation between earthwire and Pole conductor: 12.0 m

2) Minimum live metal clearances for DMR line:

a) Swings and Clearances:

Wind pressure Condition	Minimum electrical clearance
a) Swing angle (0°)	1.53 m
b) Swing angle (15°)	1.53 m
b) Swing angle (30°)	1.37 m
d) Swing angle (45°)	1.22 m

e) Swing angle (60°)	1.07 m

b) Minimum mid span separation between earthwire and DMR conductor: 6.1 m

A.10.0 Shielding angle shall not exceed 10 deg for Pole and 30 deg for Dedicated Metallic Return

A.11.0 At least one out of two earth wires shall be OPGW and second earth wire, if not OPGW, shall be either of Galvanized Stranded Steel (GSS) or Aluminum Alloy Conductor Steel Reinforced (AACSR) or any other suitable conductor type depending upon span length and other technical consideration. However, minimum size of Galvanized Stranded Steel (GSS) shall be 7/4.5 mm & diameter 13.50 mm

A.12.0 Each tower shall be earthed such that tower footing impedance does not exceed 10 ohms. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. Additional earthing shall be provided on every 7 to 8 km distance for direct earthing of both shield wires. If site condition demands, multiple earthing or use of earthing enhancement compound shall be used.

A.13.0 Pile type foundation shall be used for towers located in river or creek bed or on bank of river having scourable strata or in areas where river flow or change in river course is anticipated, based on detailed soil investigation and previous years' maximum flood discharge of the river, maximum velocity of water, highest flood level, scour depth & anticipated change in course of river based on river morphology data of at least past 20 years to ensure availability and reliability of the transmission line.

A.14.0 Transmission line route shall be finalized, in consultation with appropriate authorities soas to avoid the habitant zones of endangered species and other protected species. Bird diverters, wherever required, shall be provided on the line. In order to optimize the route use of GATISHAKTI platform shall also be made.

A.15.0 The transmission lines shall be designed with porcelain/glass/ Composite Insulators as per site pollution severity level in the concerned area. However, minimum creepage distance and insulator length shall be as per follows:

Sl. No	Description	Type of Insulator	Insulator for ±800 kV HVDC Transmission Lines	Insulator for 132 kV Dedicated Metallic Return Conductor
1.	Minimum Creepage Distance for both Light and Medium as well as for	Composite Insulator	50400 mm	8000 mm

	Heavy and very heavy pollution level			
	Minimum Creepage Distance for Light and medium pollution level	Porcelain/Glass Insulator	37760 mm	5550 mm
2.	Minimum length of insulator	–	As per design requirement	2550 mm

A.16.0 Wherever, transmission lines are passing through cyclone prone areas (i.e. areas upto 60 km from coast)/ creek regions/ aggressive soil areas following shall also be applicable:

a) The fabricated tower parts and stubs shall have a minimum overall zinc coating of 900 gram/m^2 of surface area except for plates and sections below 5 mm thickness which shall have a minimum overall zinc coating of 610 gram/m^2 of surface area. The average zinc coating for all sections and plates of 5 mm and above thickness shall be maintained as 127 microns and that for plates and sections below 5 mm shall be maintained as 87 microns.

b) Ready mix concrete of M30 Grade shall be used to avoid use of locally available saline water. However, design mix concrete of M30 Grade conforming to IS 456 with potable water can be used at locations where transportation of ready-mix concrete is not feasible. Minimum cement content in any case shall not be less than 330 kg/m^3.

c) The surface of the reinforced steel shall be treated with epoxy-based coating to enhance corrosion performance of foundation. Use of epoxy coated reinforcement in foundation shall be as per IS 13620. In addition, two (2) coats of bituminous painting of minimum 1.6 kg/m^2 per coat shall be applied on all exposed faces of foundation (i.e. pedestal & base slab).

d) Double coat of 20 mm thick cement plaster shall be provided on all exposed concrete surface up to 300 mm below ground level to give protection to concrete surface from environmental and saline effect.

e) Before coping of chimney top portion, three coats of anti-corrosive paint of minimum 30-35 microns dry film thickness each shall be applied on the stub in the 50 mm coping portion as well as up to 350 mm above CL portion.

A.17.0 The raised chimney foundation is to be provided in areas prone to flooding/water stagnation like paddy field /agricultural field & undulated areas to avoid direct contact of water with steel part of tower. The top of the chimney of foundation should be at least above HFL (High Flood Level) or the historical water stagnation/ logging level (based on locally available

data) or above High Tide Level or 500 mm above Natural Ground level (whichever is higher).

A.18.0 Wherever, transmission lines are passing through cyclone prone areas i.e. areas up to 60 km from coast following shall also be applicable:

a) Terrain category-I, with terrain roughness factor (K2) of 1.08 shall be considered for tower design for exposed open terrain with few or no obstruction which also includes open sea coasts, open stretch of water, desert and flat treeless plains.

b) Importance factor for cyclonic region (K4) of 1.3 shall be considered for tower design.

c) The number of consecutive spans between the section points/ angle point shall not exceed 10 spans or 3 km instead of conventional practice of 15 spans or 5 km, in order to reduce the failure of such towers in coastal areas due to cascading effect. The section shall be terminated with tension tower/ angle tower and angle of deviation should be based on the site requirement.

A.19.0 The TSP shall abide by the Guidelines of CEA w.r.t. shifting of transmission lines for NHAI projects and other projects.

A.20.0 Safety precautions in regards to gas/oil pipe lines in vicinity of Transmission lines shall be taken in coordination with gas/ petroleum authorities.

A.21.0 The stringing of the transmission line in the forest area shall be carried out through drones.

A.22.0 RoW width and Span in different terrain shall be as per Schedule VII of CEA (Technical Standards for Construction of Electrical plants and Electric Lines) Regulations 2022 and RoW guidelines issued vide CEA-PS-14-86/2/2019-PSETD Division dated 24.09.2024.

SPECIFIC TECHNICAL REQUIREMENTS FOR HVAC TRANSMISSION LINE

A.1.0 The design, routing and construction of transmission lines shall be in accordance with Chapter V, Part-A of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022, as amended from time to time. Other CEA Regulations/ guidelines as amended up to date and Ministry of Power (MoP) guidelines, as applicable, shall also be followed.

A.2.0 Selection of tower type shall be made as per CEA Regulations, however in case lattice type towers are used, the following shall also be applicable:

A.2.1 Steel section of grade E 250 and/or grade E 350 as per IS 2062, only are permitted for use in towers, extensions, gantry structures and stub setting templates. For towers in snowbound areas, steel sections shall conform to Grade-C of IS-2062.

A.2.2 Towers shall be designed as per IS-802:2015, however the drag coefficient of the tower shall be as follows: -

Solidity Ratio	Drag Coefficient
Upto 0.05	3.6
0.1	3.4
0.2	2.9
0.3	2.5
0.4	2.2
0.5 and above	2.0

A.3.0 Transmission Service Provider (TSP) shall adopt any additional loading/design criteria for ensuring reliability of the line, if so desired and /or deemed necessary.

A.4.0 Transmission line shall be designed considering wind zones as specified in wind map given in National Building Code 2016, Vol.1. The developer shall also make his own assessment of local wind conditions and frequent occurrences of high intensity winds (HIW) due to thunderstorms, dust-storms, downburst etc along the line route and wherever required, higher wind zone than that given in wind map shall be considered for tower design for ensuring reliability of line. Further, for transmission line sections passing within a distance of 50 km from the boundary of two wind zones, higher of the two wind zones shall be considered for design of towers located in such sections.

A.5.0 Selection of reliability level for design of tower shall be as per CEA Regulation (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022, as amended from time to time.

A.6.0 a) In case of construction of transmission line of Voltage level of 400 kV and above, under crossing of the existing transmission line shall not be allowed. In the case where it is inevitable to under-cross the existing transmission line then TSP shall seek prior approval from Chief Electrical Inspector, CEA with detailed study ensuring that all statutory electrical

clearances and Electric Field limit of 10 kV/m at 1 m and 1.8 m from ground level is not violated.

b) For power line crossing of 400 kV or above voltage level, large angle and dead-end towers (i.e. D/DD/QD) shall be used on either side of power line crossing.

c) For power line crossing of 132 kV and 220 kV (or 230 kV) voltage level, angle towers (B/C/D/DB/DC/DD/QB/QC/QD) shall be used on either side of power line crossing depending upon the merit of the prevailing site condition and line deviation requirement.

d) For power line crossing of 66 kV and below voltage level, suspension/tension towers shall be provided on either side of power line crossing depending upon the merit of the prevailing site condition and line deviation requirement.

e) For crossing of railways, national highways and state highways, Regulations of appropriate authorities shall be followed.

A.7.0 The relevant conductor configuration shall be as follows: -

Type of conductor: ACSR / AAAC / AL59

Basic parameters:

Transmission line	**ACSR Conductor**	**Equivalent AAAC conductor based on 53% conductivity of Al Alloy**	**Equivalent AL59 conductor based on 59% conductivity of AL Alloy***	**Sub-conductor Spacing**
400 kV D/C (Quad Bundle) transmission lines	**Moose: Stranding** 54/3.53mm-Al + 7/3.53 mm-Steel; 31.77 mm diameter; 528.5 mm^2, Aluminium area; Maximum DC Resistance at 20°C (Ω/km): 0.0549; Minimum UTS: 159.60 kN	**Stranding details:** 61/3.55mm 31.95mm diameter; 604 mm^2, Aluminium alloy area; Maximum DC Resistance at 20°C (Ω/km): 0.05506; Minimum UTS: 159.80 kN	**Stranding details:** 61/3.31 mm 29.79 mm diameter; 525 mm^2, Aluminium alloy area; Maximum DC Resistance at 20°C (Ω/km): 0.0566; Minimum UTS: 124.70 kN	457 mm

Note:

1. *"To select any size above the minimum, the sizes mentioned in the Indian standard i.e IS-398(part-6) should be followed.*
2. *The transmission lines shall have to be designed for a maximum operatingconductor temperature of 85 °C.*

A.8.0 The required phase to phase spacing and horizontal spacing for 400 kV line shall be governed by the tower design as well as minimum live metal clearances for 400 kV voltage level under different insulator swing angles. However, the phase to phase spacing for 400 kV lines shall not be less than 8 m.

A.9.0 All electrical clearances including minimum live metal clearance, ground clearance and minimum mid span separation between earth wire and conductor as given below shall be considered:

Minimum live metal clearances for 400 kV line:

a) (i) Under stationary conditions:

From tower body: 3.05 m

(ii) Under Swing conditions

Wind Pressure Condition	Minimum Electrical Clearance
a) Swing angle (22°)	3.05 m
b) Swing angle (44°)	1.86 m

b) Minimum ground clearance: 8.84 m

c) Minimum mid span separation between earthwire and conductor for 400 kV line: 9.0 m

A.10.0 Shielding angle shall not exceed 20 deg for 400 kV transmission line.

A.11.0 The Fault current for design of line shall be 63 kA for 1 sec for 400 kV.

A.12.0 In case of 400 kV voltage class lines, at least one out of two earth wires shall be OPGW and second earth wire, if not OPGW, shall be either of Galvanized Standard Steel (GSS) or Aluminum Alloy Conductor Steel Reinforced (AACSR) conductor type or any other suitable conductor type depending upon span length and other technical consideration.

A.13.0 Each tower shall be earthed such that tower footing impedance does not exceed 10 ohms. Pipe type or Counterpoise type earthing shall be provided in accordance with relevant IS. Additional earthing shall be provided on every 7 to 8 km distance at tension tower for direct earthing of both shield wires. If site condition demands, multiple earthing or use of earthing enhancement compound shall be used.

A14.0 Pile type foundation shall be used for towers located in river or creek bed or on bank of river having scourable strata or in areas where river flow or change in river course is anticipated, based on detailed soil investigation and previous years' maximum flooddischarge of the river, maximum velocity

of water, highest flood level, scour depth and anticipated change in course of river based on river morphology data of at least past 20 years to ensure availability and reliability of the transmission line.

A.15.0 Transmission line route shall be finalized, in consultation with appropriate authorities so as to avoid the habitant zones of endangered species and other protected species. Bird diverters, wherever required, shall be provided on the transmission line. In order to optimize the route use of GATISHAKTI platform shall also be made. A.16.0 Wherever, transmission lines are passing through cyclone prone areas (i.e. areas up to 60 km from coast)/ creek regions/ aggressive soil areas following shall also be applicable:

a) The fabricated tower parts and stubs shall have a minimum overall zinc coating of 900 gram/m^2 of surface area except for plates and sections below 5 mm thickness which shall have a minimum overall zinc coating of 610 gram/m^2 of surface area. The average zinc coating for all sections and plates 5 mm and above thickness shall be maintained as 127 microns and that for plates and sections below 5 mm thickness shall be maintained as 87 microns.

b) Ready mix concrete of M30 Grade shall be used to avoid use of locally available saline water. However, design mix concrete of M30 Grade conforming to IS 456 with potable water can be used at locations where transportation of ready-mix concrete is not feasible. Minimum cement content in any case shall not be less than 330 kg/m^3.

c) The surface of the reinforced steel may be treated with epoxy-based coating to enhance corrosion performance of foundation. Use of epoxy coated reinforcement in foundation shall be as per IS 13620. In addition, two (2) coats of bituminous painting of minimum 1.6 kg/m^2 per coat shall be applied on all exposed faces of foundation (i.e. pedestal and base slab).

d) Double coat of 20 mm thick cement plaster shall be provided on all exposed concrete surface up to 300 mm below ground level to give protection to concrete surface from environmental and saline effect.

e) Before coping of chimney top portion, three coats of anti-corrosive paint of minimum 30-35 microns dry film thickness each shall be applied on the stub in the 50 mm coping portion as well as up to 350 mm above CI. portion.

A.17.0 The raised chimney foundation is to be provided in areas prone to flooding/water stagnation like paddy field /agricultural field and undulated areas to avoid direct contact of water with steel part of tower. The top of the chimney of foundation should be at least above HFL (High Flood Level) or the historical water stagnation/ logging level (based on locally available data) or above High Tide Level or 500 mm above Natural Ground level (whichever is higher).

A.18.0 (a) Routing of transmission line through protected areas of India shall be avoided to the extent possible. In case, it is not possible to avoid protected areas, the towers of the transmission line up to 765 kV level, which are installed in protected areas, shall be designed for Multi-circuit (4-circuits) configuration of same voltage level considering the Reliability Level and Design Span as per CEA (Technical standards for construction of Electrical

Plants and Electric Lines) Regulations, 2022, as amended from time to time. The top two circuits of these multi-circuit towers shall be used for stringing of the transmission line under present scope and the bottom two circuits shall be made available for stringing of any future transmission line of any transmission service providers/ State transmission utilities/Central transmission utilities passing through the same protected area. Further, the configuration and coordinates of such transmission towers shall be submitted to CEA, CTU and BPC by the TSP.

It shall be ensured that Minimum ground clearance is maintained such that statutory Electrical Clearances and Electric Field limit of 10 kV/m at 1 m and 1.8 m from ground level are not violated.

A.18.0 (b) Routing of transmission lines through all Metropolitan areas, Municipal Corporations, Municipalities, Nagar Panchayats, and all Urban Planning areas notified by State Governments and Forest areas notified by the Ministry of Environment, Forest and Climate Change (MoEFCC), shall be avoided to the extent possible. However, if it is not possible to avoid these areas, then, in order to optimize Right of Way (RoW) in all Metropolitan areas, Municipal Corporations, Municipalities, Nagar Panchayats, and all Urban Planning areas notified by State Governments, for up to 400 kV transmission lines, Double Circuit Pole Structures designed with a Reliability Level and Design Span as per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 as amended from time to time) (preferably with insulated cross arms) shall be implemented.

It shall also be ensured that Minimum ground clearance is maintained such that statutory Electrical Clearances and Electric Field limit of 10 kV/m at 1 m and 1.8 m from ground level are not violated.

In case of more than TWO parallel Circuits up to 400 kV, the same shall be accommodated using Pole Structures designed for so many Circuits.

A.19.0 The TSP shall abide by the Guidelines of CEA w.r.t. shifting of transmission lines for NHAI projects and other projects.

A.20.0 Safety precautions in regard to gas/oil pipelines in vicinity of Transmission lines shall be taken in coordination with gas/ petroleum authorities.

A.21.0 The stringing of the transmission line in the forest area shall be carried out through drones.

A.22.0 The tower shall be designed considering the porcelain Insulators with creepage factor of 31 mm/ kV irrespective of type of insulator used.

A.23.0 RoW width and Span in different terrain shall be as per Schedule VII of CEA (Technical Standards for Construction of Electrical plants and Electric Lines) Regulations 2022 and RoW guidelines issued vide CEA-PS-14-86/2/2019-PSETD Division dated 24.09.2024.

SPECIFIC TECHNICAL REQUIREMENTS FOR HVAC SUBSTATION

The **proposed HVDC and 400/220 kV HVAC Barmer-II S/s** shall be conventional Air Insulated Substation (AIS) type generally conforming to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022, as amended from time to time.

Extension of 765/400 kV South Kalamb S/s shall be conventional Air Insulated Substation (AIS) type generally conforming to the requirements of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 as amended from time to time.

Other CEA Regulations/guidelines as amended upto date and MoP guidelines as applicable, shall also be followed.

B.1.0 Salient features of Substation Equipment and Facilities

The design and specification of substation equipment are to be governed by the following factors:

B.1.1 Insulation Coordination

The system design parameters for substations/switchyards shall be as given below:

Sl. No.	Description of parameters	400/220 kV Barmer-II S/s		Extn. of 765/400 kV South Kalamb S/s	
		400 kV System	220 kV System	765 kV System	400 kV System
1.	System operating voltage	400 kV	220 kV	765 kV	400 kV
2.	Maximum voltage of the system (rms)	420 kV	245 kV	800 kV	420 kV
3.	Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz
4.	No. of phase	3	3	3	3
5.	Rated insulation levels				
i)	Lightning Impulse withstand voltage for (1.2/50 micro sec.) - for Equipment other than Transforme	1425 kV p 1550 kV p	1050 kVp 1050 kVp	2100 kV p 2100 kV p	1425 kV p 1550 kV p

Sl. No.	Description of parameters	400/220 kV Barmer-II S/s		Extn. of 765/400 kV South Kalamb S/s	
		400 kV System	220 kV System	765 kV System	400 kV System
	r and Reactors for Insulator String				
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1050 kV p	-	1550 kV p	1050 kV p
iii)	One-minute power frequency dry withstand voltage (rms)	630 kV	-	830 kV	630 kV
6.	Corona extinction voltage	320 kV	-	508 kV	320 kV
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	1000 micro-volts at 266 kV rms	1000 micro-volts at 156 kV rms	2500 micro-volts at 508 kV rms	1000 micro-volts at 266 kV rms
8.	Minimum creepage distance for insulator string/ longrod insulators/ outdoor bushings	13020 mm (31 mm/ kV)	7595 mm (31mm/ kV)	24800 mm (31 mm/ kV)	13020 mm (31 mm/ kV)
9.	Minimum creepage distance for switchyard equipment	10500 mm (25 mm/ kV)	6125 mm (25 mm/ kV)	20000 mm (25 mm/ kV)	10500 mm (25 mm/ kV)
10.	Max. fault current	63 kA	50 kA	50 kA	63 kA
11.	Duration of fault	1 Sec	1 Sec	1 Sec	1 Sec

B.1.2 Switching Scheme

The switching schemes, as mentioned below, shall be adopted at various voltage levels of substation/switchyard:

Substation	765 kV side	400 kV side	220 kV side
400/220 kV Barmer-II S/s	--	One & Half breaker	Double Main and Transfer
Extn. of 765/400 kV South Kalamb S/s	One & Half breaker	One & Half breaker	--

Notes: -

i) For one and half breaker switching scheme, any double circuit line consisting of two numbers of feeders and originating from the same transmission or generating switchyard shall not be terminated in one diameter.

ii) Two transformers of the same HV rating shall not be connected in the same diameter and similarly two bus reactors of same HV rating shall also not be connected in the same diameter.

iii) 400 kV Bus Sectionalisers shall be placed such that each section shall have even distribution of Poles, ICT, Feeders and filter bank(s)/sub-bank(s) so as to have maximum operational flexibility.

iv) HVDC Bipole -1 and Bipole-2 shall be on two different 400 kV bus sections.

v) A diameter in one and half breaker scheme is a set of 3 circuit breakers with associated isolators, earth switches, current transformers etc. for controlling 2 numbers of feeders.

vi) Connection arrangement of Switchable Line reactors shall be such that it can be used as Line reactor as well as Bus reactor with suitable NGR bypass arrangement. Further, Spare 1-phase Shunt Reactor unit shall be placed and connected in such a way that the spare unit can be utilized for all the bus and switchable line reactor banks (including future reactor banks) without its physical movement.

vii) Space for 765 kV and 400 kV future line bays shall be kept considering provision of switchable line reactors as per the scope of work.

viii) One (1) set of bus sectionalizer for 400 kV shall comprise 2 Nos. of bus sectionalizer bays with associated Circuit Breakers, Isolators and Current Transformers for both Main-I and Main-II buses.

ix) One (1) set of bus sectionalizer for 220 kV shall comprise 2 Nos. of bus sectionalizer bays with associated Circuit Breakers, Isolators and Current Transformers for both buses.

x) TSP shall plan the distribution of line and transformer feeders to bus bar in such a way that all power can be evacuated successfully without crossing thermal limit at any point of bus-bar.

xi) For AIS type substation, TSP shall keep space provisions for future elements such that interconnection arrangement to the corresponding future bays can be done with overhead AIS type connection without any cable/ GIS duct.

xii) ***Barmer- II S/s:***

400 kV Bus Sectionalization and space provision shall be with the following feeder distribution:

400 kV Bus Section-1	400 kV Bus Section-2	400 kV Bus Section-(Future)
a) 3 Nos. of present 400/220 kV ICT b) 1 No. of present Bus Reactor c) 4 Nos. of present 400 kV Line d) 2 Nos. of present 400 kV Line (RE interconnection) e) 1 No. present SynCon along with 400 kV bay (1 No.) f) 2 Nos. of future 400 kV Line along with switchable line reactor g) 1 No. future STATCOM along with 400 kV bay (1 Nos.) h) 2 Nos. for present interconnections for (2x1500 MW) for 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station.	a) 3 Nos. of present 400/220 kV ICT b) 1 No. of present Bus Reactor c) 2 Nos. of present 400 kV Line d) 2 Nos. of present 400 kV Line (RE interconnection) e) 1 No. present SynCon along with 400 kV bay (1 No.) f) 2 Nos. of future 400 kV Line along with switchable line reactor g) 1 No. future STATCOM along with 400 kV bays (1 No.) h) 1 No. future SynCon along with 400 kV bays (1 No.) i) 1 No. of future 400/220 kV ICT j) 2 Nos. for present interconnections for (2x1500 MW) for 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station.	a) 3 Nos. of future 400/220 kV ICT b) 1 No. of future Bus Reactor c) 6 Nos. of future 400 kV line bay (2 Nos. with switchable line reactor) d) 1 No. future SynCon along with 400 kV bay e) 1 set future sectionalizer

200 kV Bus Sectionalization and space provision shall be with the following feeder distribution

220 kV Bus Section-1	*220 kV Bus Section-2*	*220 kV Bus Section-3(Future Space Provision)*
a) 3 Nos. of 400/220 kV ICT b) 4 Nos. of 220 kV Line (for RE	a) 3 Nos. of 400/220 kV ICT b) 3 Nos. of 220 kV Line (for RE	a) 3 Nos. of future 400/220 kV ICT b) *4 Nos. of 220 kV future Line bays*

220 kV Bus Section-1	220 kV Bus Section-2	220 kV Bus Section-3(Future Space Provision)
connectivity) c) 1 No. Bus coupler & 1 No. Transfer Bus coupler	connectivity) c) 1 No. of 220 kV future Line bay d) 1 No. Bus coupler & 1 No. Transfer Bus coupler e) 1 No. of future 400/220 kV ICT	c) 1 No. Bus coupler & 1 No. Transfer bus coupler d) 01 No. sectionaliser bay

xiii) ***Extension of South kalamb S/s:***

765kV Bus Sectionalization and space provision shall be with the following feeder distribution

765 kV Bus Section-1	765 kV Bus Section-2	765 kV Bus Section-3 (Future)
a) 04 Nos. 765 kV line (existing) b) 02 Nos. 765/400 kV ICT (existing) c) 02 Nos. 765 kV Bus Reactor (existing) **d) 1 No. of present 765/400 kV ICT** *e) 1 No. of future 765/400 kV ICT*	**a) 3 Nos. of present 765/400kV ICT** **b) 2 Nos. of present 765 kV Bus Reactor** *c) 1 No. of future 765/400 kV ICT* *d) 4 Nos. of future 765kV line along with switchable line reactor*	*a) 4 Nos. of future 765/400kV ICT* *b) 2 Nos. of future 765 kV line along with switchable line reactor* *c) 2 Nos. of future 765 kV Bus Reactor*

400kV Bus Sectionalization and space provision shall be with the following feeder distribution

400kV Bus Section-1	**400kV Bus Section-2**	***400kV Bus Section-3 (Future)***
a) 2 No. of 765/400 kV ICT (existing) b) 2 Nos. of 400 kV Line (existing) c) 2 Nos. of 400 kV Bus Reactor (existing) **d) 1 No. of present 765/400 kV ICT** **e) 2 Nos. for present interconnections for (2x1500 MW) for 6000 MW, ± 800 kV South Kalamb (HVDC) [LCC] terminal station** *f) 1 No. of future 765/400 kV ICT* *g) 6 Nos. of future 400 kV Line*	**a) 3 Nos. of present 765/400kV ICT** **b) 2 Nos. of present 400 kV Bus Reactor** **c) 2 Nos. for present interconnections for (2x1500 MW) for 6000 MW, ± 800 kV South Kalamb (HVDC) [LCC] terminal station** *d) 1 No. of future 765/400 kV ICT* *e) 6 Nos. of future 400 kV Line*	*a) 4 Nos. of future 765/400 kV ICT* *b) 8 Nos. of future 400 kV Line* *c) 4 Nos. of future 400/220 kV ICT* *d) 2 Nos. of future 400 kV Bus Reactor*

xiv) **Extension of Barmer-I PS:**

For the Barmer-II PS - Barmer-I PS 400 KV D/C line, both circuits shall be terminated in new diameters at Barmer-I S/s. Accordingly, 2 (two) number half-diameter consisting of Main and associated Tie Bay shall be constructed under the present scope at Barmer-I PS. Further, all associated interconnection work shall also be in the present scope of TSP.

B.2.0 Substation Equipment and facilities (Voltage level as applicable):

The switchgear shall be designed and specified to withstand operating conditions and duty requirements. All equipment shall be designed considering the following minimum capacity.

Sl. No.	Description of bay	400/220 kV Barmer-II S/s		Extn. of 765/400 kV South Kalamb S/s	
		400 kV	220 kV	765 kV	400 kV
1.	Bus Bar	4000 A	3000 A	4000 A	4000 A
2.	Line bay	3150 A	1600 A	–	–
3.	Converter bay	3150 A	–	–	3150A
4.	ICT bay	3150 A	1600 A	3150 A	3150 A
5.	Bus Reactor bay	3150 A	–	3150 A	3150 A
6	Bus Sectionaliser bays	4000 A	3000 A	–	–
7	Bus Coupler bay	–	3000 A	–	–
8	Transfer Bus coupler bay	–	1600A	–	–

B.2.1 (765/√3)/ (400/√3)/33 kV, Single Phase Autotransformer

500 MVA, (765/√3)/ (400/√3)/33 kV, 1-phase autotransformer (including arrangement for 3-phase bank formation of 1500 MVA) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above Voltage Class)" as amended up to date, available on CEA website.

Connection arrangement for utilization of existing Spare Single Phase Transformer unit:

TSP shall make the arrangement of present ICT bank in such a way that the existing spare unit can be utilized for Transformer bank under present scope without its physical movement.

B.2.2 400/220 kV Autotransformer

500 MVA 400/220 kV, 3-phase Autotransformer shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above Voltage Class)" as amended up to date available on CEA website.

B.2.3 (765/√3) kV, Single Phase Shunt Reactor

110 MVAr, 765/√3 kV, 1-Phase Reactor (including arrangement for 3-phase bank formation of 330 MVAr) shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above Voltage class)" as amended up to date, available on CEA website.

Connection arrangement for utilization of existing Spare Single Phase Reactor unit:
TSP shall make the arrangement of present bank in such a way that the existing spare unit can be utilized for Reactor bank under present scope without its physical movement.

B.2.4 420 kV, 3-phase, Shunt Reactor

125 MVAr, 420 kV, 3-Phase Reactor shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above Voltage Class)" as amended up to date, available on CEA website.

B.2.5 765 kV, 400 kV and 220 kV AIS Substation equipment (as applicable)

B.2.5.1 Circuit Breakers (AIS)

The circuit breakers and accessories shall conform to IEC: 62271-100, IEC: 62271-1 and shall be of SF6 Type. The circuit breakers shall be of class C2-M2 (as per IEC) with regard to restrike probability during capacitive current breaking and mechanical endurance. The rated break time shall not exceed 40 ms for 765 kV and 400 kV circuit breakers and 60 ms for 220 kV circuit breakers. 765 kV, 400 kV and 220 kV Circuit breakers shall be provided with single phase and three phase auto reclosing. Each breaker would have two sets of trip circuits which would be connected to separate DC supplies for greater reliability. The Circuit breakers controlling 765 kV lines shall be provided either with pre-insertion closing resistor of about 450 ohms maximum with 9 ms insertion time or with Controlled Switching Device (CSD). The Circuit breakers controlling 400 kV lines shall be provided with pre insertion closing resistor of about 400 ohms with 8 ms insertion time or with Controlled Switching Device (CSD) for lines longer than 200 km. The short line fault capacity shall be same as the rated capacity and this is proposed to be achieved without use of opening resistors. The controlled switching device shall be provided in Circuit breakers of switchable line reactor and in Main and Tie circuit breakers of line with non-switchable line reactors, bus reactors and Transformers of voltage class 400 kV and above voltage class.

B.2.5.2 Isolators (AIS)

The isolators shall comply with IEC 62271-102 in general. 765 kV Isolator design shall be double break or vertical break or knee-type. 400 kV and 220kV Isolators shall be double break type. All Isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to

facilitate maintenance. Isolator rated for 400 kV and 220 kV shall be of extended mechanical endurance class - M2 as per IEC-62271-102. Isolator rated for 220 kV shall be suitable for bus transfer current switching duty as per IEC-62271-102. Main blades and earth blades shall be interlocked and interlock shall be fail safe type. 765 kV, 400 kV and 220 kV earth switch for line isolator shall be suitable for induced current switching duty as defined for Class-B.

B.2.5.3 Current Transformers (AIS)

Current Transformers shall comply with IEC 61869 in general. All ratios shall be obtained by secondary taps only. Generally, Current Transformers (CT) for 765 kV and 400 kV shall have six cores (four for protection and two for metering) and 220 kV Current Transformers shall have five cores (four for protection and one for metering). The burden and knee point voltage shall be in accordance with the requirements of the system including possible feeds for telemetry. The accuracy class for the protection core shall be PX and for the metering core it shall be 0.2S. The rated burden of cores shall be closer to the maximum burden requirement of metering and protection system (not more than 20 VA for metering core) for better sensitivity and accuracy. The instrument security factor shall be less than 5 for CTs upto 400 kV and less than 10 for CTs of 765 kV voltage class.

B.2.5.4 Capacitive Voltage Transformers (AIS)

Capacitive Voltage Transformers shall comply with IEC 61869 in general. These shall have three secondaries out of which two shall be used for protection and one for metering. The accuracy class for protection cores shall be 3P and for metering core shall be 0.2. The Capacitive Voltage Transformers on lines shall be suitable for Carrier Coupling. The Capacitance of CVT for 400 kV and 220 kV shall be of 4400/8800 pF depending on PLCC requirements whereas the Capacitance of CVT for 765 kV shall be 8800 pF. The rated burden of cores shall be closer to the maximum burden requirement of metering and protection system (not more than 50 VA for metering core) for better sensitivity and accuracy.

B.2.5.5 Surge Arresters (AIS)

624 kV336 kV Station High (SH) duty and 216 kV Station Medium (SM) duty gapless type Surge Arresters with thermal energy (Wth) of minimum 13 kJ/kV, 12 kJ/kV and 7 kJ/kV conforming to IEC 60099-4 in general shall be provided for 800 kV, 420 kV and 245 kV systems respectively. Other characteristics of Surge Arrester shall be chosen in accordance with system requirements. Surge Arresters shall be provided at line entrances, near Transformers and Reactor so as to achieve proper insulation coordination. Surge Arresters shall be provided with porcelain/ polymer housing fitted with pressure relief devices. A leakage current monitor with surge counter shall be provided with each surge arrester.

B.2.6 Protection Relaying and Control System

The protective relaying system proposed to be provided for transmission lines, auto-transformers, reactors and bus bars to minimize the damage to the equipment in the events of faults and abnormal conditions, is dealt in this section. All main protective relays shall be numerical type with IEC 61850 communication interface and should have interoperability during integration of numerical relays to communicate over IEC 61850 protocol with RTU/SAS/IEDs of different OEMs. All numerical relays shall have built in disturbance recording feature.

The protection circuits and relays of the transformer and reactor 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 groups failing, to obtain redundancy, and to take protection systems out for maintenance while the equipment remains in service.

a) Transmission Lines Protection

765 kV, 400 kV and 220 kV shall have Main-I numerical three zone distance protection scheme with carrier aided inter-tripping feature. 765 kV, 400 kV and 220 kV lines shall also have Main-II numerical distance protection scheme like Main-I but from different make that of Main-I. The Main-I and Main-II protection relays of same make may be provided only if they are of different hardware and manufacturing platform or different principle of operation.

However, Line Current Differential Relay (with back up distance protection feature) as Main–I and Main-II shall be considered at both ends for short lines (line length below 30 km) having Fiber Optic Communication Link. Differential relay at remote end shall be provided by the TSP. The associated power and control cabling and integration with SAS at remote end shall be provided by respective bay owner.

Further, all 765 kV, 400 kV and 220 kV lines shall be provided with single and three phase auto-reclosing facility to allow reclosing of circuit breakers in case of transient faults. These lines shall also be provided with distance to fault locators to identify the location of fault on transmission lines.

All 765 kV and 400 kV lines shall also be provided with two stages over voltage protection. The over voltage protection and distance to fault locator may be provided as in-built feature of Main-I and Main-II protection relays. Auto reclose as built-in function of Bay Control Unit (BCU) is also acceptable.

The Main-I and Main-II protection relays shall be fed from separate DC sources and shall be mounted in separate panels.

For 765 kV, 400 kV and 220 kV transmission lines, directional IDMT earth fault relay should be provided as standalone unit or in-built feature of Main-I and Main -II feature.

In case of 220 kV line bays where the line lengths are not indicated, Numerical Distance protection relay as Main–I and Line Current differential relay (with back up distance protection feature) as Main-II shall be provided. Further, in

such case, the matching line current differential relay for remote end shall be provided by the remote end bay owner.

In case of loop in loop out of transmission lines, the existing protection scheme shall be studied and suitable up-gradation (if required) shall be carried out.

b) Auto Transformer Protection

These shall have the following protections:

i) Numerical Differential Protection
ii) Numerical Restricted Earth Fault Protection
iii) Numerical Back-up Over-Current and Earth Fault Protection on High Voltage (HV) and Intermediate Voltage (IV) side
iv) Numerical Over Fluxing Protection on HV and IV side
v) Numerical Overload Alarm

Further, Numerical Back-up Over-current and earth fault protection on HV and IV side of autotransformer shall not be combined with other protective functions in the main relays and shall be independent relays. Besides these, power transformers shall also be provided with Buchholz relay, Magnetic Oil Gauge (MOG) with low oil level alarm protection against high oil and winding temperature and pressure relief device etc.

Suitable monitoring, control (operation of associated circuit breaker and isolator) and protection for LT auxiliary transformer connected to tertiary winding of auto-transformer for the purpose of auxiliary supply shall be provided. The over current and other necessary protection shall be provided for the auxiliary transformer. These protection and control may be provided as built in feature either in the bay controller to be provided for the auxiliary system or in the control and protection IEDs to be provided for autotransformer.

c) 765 kV and 400 kV Reactor Protection

Reactor shall be provided with the following protections:

i) Numerical Differential Protection.
ii) Numerical Restricted Earth Fault Protection
iii) Numerical Back-up impedance Protection.

Besides these, reactors shall also be provided with Buchholz relay, Magnetic Oil Gauge (MOG) with low oil level alarm, protection against oil and winding temperatures and pressure relief device, etc.

d) Bus Bar Protection

The high-speed low impedance type bus bar differential protection, which is essential to minimize the damage and maintain system stability at the time of bus bar faults, shall be provided for 765 kV, 400 kV and 220 kV buses. Duplicated bus bar protection is envisaged for 765 kV and 400 kV bus-bar protection. Bus bar protection scheme shall be such that it operates selectively

for each bus and incorporate necessary features required for ensuring security. The scheme shall have complete bus bar protection for present as well as future bays envisaged i.e. input/ output modules for future bays for the bus section under present scope shall also be provided.

Bus Bar protection system for new substation shall be de-centralized (distributed) type.

In case, the bus section is provided, then each side of bus section shall have separate set of bus bar protection schemes.

Peripheral Units (PUs) shall be provided by the respective bay owner.

For existing substations, the existing bus bar protection shall be augmented as per requirement.

e) Local Breaker Back up Protection

This shall be provided for each 765 kV, 400 kV and 220 kV circuit breakers and will be connected to de-energize the affected stuck breaker from both sides.

Notes:

1. *LBB and REF relays shall be provided separately from transformer differential relay.*
2. *LBB relay may also be provided as built-in protection function of distributed bus bar protection scheme; however, in such case separate LBB relay shall be provided for tie bays (in case of One and Half breaker scheme).*
3. *Over fluxing and overload protection can be provided as built-in feature of differential relay.*
4. *In 765 kV and 400 kV switchyard, if spare bay of half diameter is identified as future, Tie CB relay panel shall be with Auto-reclosure feature.*

B.2.7 Substation Automation System

a) For all the new substations, state of art Substation Automation System (SAS) conforming to IEC-61850 shall be provided. The distributed architecture shall be used for Substation Automation System, where the controls shall be provided through Bay Control Units. The Bay Control Unit is to be provided bay wise for voltage level 220 kV and above. All Bay Control Units as well as protection units are normally connected through an Optical fiber high speed network. The control and monitoring of circuit breaker, dis-connector, re-setting of relays etc. can be done from Human Machine Interface (HMI) from the control room.

The functions of control, annunciation, disturbance recording, event logging and measurement of electrical parameters shall be integrated in the Substation Automation System.

At the new substations, the Substation Automation System (SAS) shall be suitable for the operation and monitoring of the complete substation including proposed future bays/elements.

In existing substations with a Substation Automation System (SAS), augmentation of existing SAS shall be done for bays under the present scope.

In the existing Substations where Substation automation is not provided, control functions shall be done through control panels.

Necessary gateway and modems (as required) shall be provided to send data to RLDC/SLDC as per their requirement and shall be provisioned with 2+2 redundancy i.e. 2 channels for Main Control Centre and 2 channels for Backup Control Centre. In order to meet this requirement, suitable redundancy at port and card level need to be ensured by the TSP to avoid any single point of failure which may lead to interruption in real time grid operation. Accordingly, all the hardware for communication services of station as stated above shall support dual redundancy for data transmission of station to respective main and backup RLDCs. Any augmentation work at RLDC/SLDC is excluded from TSP's scope. However, all the configuration work at substation end required to send data to RLDC/SLDC shall be in the scope of TSP.

b) **Time Synchronization Equipment**

Time synchronization equipment complete in all respect including antenna, cable and processing equipment required to receive time signal through GPS/NavIC or from National Physical Laboratory (NPL) through INSAT shall be provided at new substations. This equipment shall be used to synchronize SAS and IEDs etc.

B.3.0 Substation Support facilities

Certain facilities required for operation & maintenance of substations as described below shall be provided at new substation. In existing substation, these facilities have already been provided and would be extended/ augmented as per requirement.

B.3.1 AC and DC power supplies

For catering the requirements of three phase and single phase AC supply and DC supply for various substation equipment (for present and future scope), the following arrangement is envisaged:

i) For LT Supply at each new Substation, two (2) Nos. of LT Transformers (minimum 800 kVA for substations with highest voltage rating as 765 kV) shall be provided which shall be fed from two independent sources as per the CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007.

Metering arrangement with Special Energy Meters (SEMs) shall be provided by TSP at 33 kV tertiary of Transformer for drawing auxiliary supply at new substation. Such SEMs shall be provided by CTU at the cost of the TSP. Accounting of such energy drawn by the TSP shall be done by RLDC/RPC as part of Regional Energy Accounting.

Additionally, Active Energy Meters may be provided at the same point in the 33 kV tertiary of Transformer by local SEB/DISCOM for energy accounting.

ii) 2 sets of 220 V battery banks for control and protection and 2 sets of 48 V battery banks for PLCC/ communication equipment shall be provided at each new Substation. Each battery bank shall have a float-cum-boost charger.

At new substation, sizing of 220 V battery and battery charger shall be done based on the number of bays specified (including future bays) as per CEA Regulations and relevant IS. 2 sets of 48 V battery banks for PLCC and communication equipment for present and future scope shall be provided at each new Substation with at least 10-hour battery backup and extended backup, if required. 48 V DC can be achieved from 220 V DC battery bank using adapter, if so desired by TSP, without compromising backup time.

iii) Suitable AC and DC distribution boards and associated LT Switchgear shall be provided at new substation.

For new substation, following switch boards shall be considered with duplicate supply with bus coupler/ sectionalizer and duplicate outgoing feeders except for Emergency lighting distribution board which shall have only one incoming feeder:

(a) 415 V Main Switchboard – 1 No.
(b) AC distribution board – 1 No.
(c) Main lighting distribution board – 1 No.
(d) Emergency lighting distribution board – 1 No.
(e) 220 Volt DC distribution board – 2 Nos.
(f) 48 Volt DC distribution board – 2 Nos.

Sizing of LT Switchgear shall be suitable to cater the requirement for all present andfuture bays. AC and DC distribution boards shall have modules for all the feeders (including future as specified).

iv) At new Substation, one No. of DG set (minimum 500 kVA for substations with highest voltage rating as 765 kV) shall be provided for emergency applications.

v) At new substation, sizing of battery and battery chargers shall be done based on the number of bays specified (including future bays).

vi) For substation extensions, existing facilities shall be augmented as required.

B.3.2 Fire Fighting System

Fire-fighting system for substation including Transformer and Reactor shall conform to CEA (Measures Relating to Safety & Electric Supply) Regulations, 2023 as amended from time to time.

Further, adequate water hydrants and portable fire extinguishers shall be provided in the substations. The main header of the firefighting system shall

be suitable for extension to bays covered under the future scope, necessary piping interface in this regard shall be provided.

At existing substations, the fire-fighting systems as available shall be extended to meet the additional requirements.

B.3.3 Oil evacuating, Filtering, Testing and Filling Apparatus

To monitor the quality of oil for satisfactory performance of Transformers, Shunt Reactors and for periodical maintenance necessary oil evacuating, filtering, testing and filling apparatus would be provided at new substations. Oil storage tanks of adequate capacities for storage of transformer oil would be provided.

Online Transformer Oil Drying Out System shall be provided in line with the provisions of Standard Specification and Technical Parameters for Transformers and Reactors (66 kV and above Voltage Class) as amended up to date available on CEA website.

B.3.4 Illumination

Normal and emergency AC and DC illumination shall be provided adequately in the control room and other buildings of the substation. The switchyard shall also be provided with adequate illumination.

The lighting of the entire control room building, fire-fighting pump house, other building (if any) and switchyard shall be done by LED based low power consumption luminaries.

B.3.5 Control Room

For the new substation, substation control room shall be provided to house substation work stations for station level control (SAS) along with its peripheral and recording equipment, AC and DC distribution boards, DC batteries and associated battery chargers, Fire Protection panels, Telecommunication panels and other panels as per requirements. Air conditioning shall be provided in the building as functional requirements. Main cable trenches from the control room shall have adequate space provision for laying of cables from the control room for all the future bays also.

At existing substations, the adequacy of size of control room shall be ascertained and the same shall be augmented as per requirement.

B.3.6 Control Concept

All the EHV circuit breakers in substation/switching stations shall be controlled and synchronized from the switchyard control room/remote control center. All the isolators shall have control from remote/local whereas the earth switches shall have local control only.

B.3.7 Visual monitoring system (VMS) for watch and ward of substation premises:

Visual Monitoring System for effective watch and ward of substation premises shall cover all the transformers and reactors, all other major AIS Equipment (such as CB, isolators, CT, CVT, SA etc. as applicable), panel room, all the gates of switchyard and all entry and exit points of control room building and accordingly the location of cameras shall be decided. In addition to the gates of the switchyard, the cameras shall also be located around the boundaries at suitable locations. The camera shall be high definition color CCD camera with night vision feature. The VMS data partly/completely shall be recorded (minimum for 15 days) at least @25fps (or better) and stored on network video recorder. The system shall use video signals from various cameras installed at different locations, process them for viewing on workstations/monitors in the control room and simultaneously record all the cameras. The VMS data should go only to the intended personnel/facility and not to the remote server of the Camera (VMS supplier).

Mouse/keyboard controllers shall be used for pan, tilt, zoom and other functions of the desired camera. The Visual Monitoring System shall have provision of WAN connectivity for remote monitoring.

All camera recordings shall have Camera ID and location/area of recording as well as date/time stamp. The equipment should generally conform to Electromagnetic compatibility requirement for outdoor equipment in EHV substation.

Advisory on deployment of CCTV issued by Ministry of Electronics and Information Technology (MEITY) shall be followed.

At existing substations, the visual monitoring system if available shall be augmented as per existing or better specification as required.

B.4.0 General Facilities

a) Line Gantry/Towers are envisaged for bays under the present scope only. However, for adjacent future line bay, gantry/ tower shall be designed for extension (considering Hexa conductor for 765 kV, Quad conductor 400 kV and Twin Conductor for 220 kV future lines) wherever applicable.

b) Bay extension works at existing substation shall be executed by TSP in accordance with the requirements/provisions mentioned above. However, interface points shall be considered keeping in view the existing design/arrangement at the substation.

c) TSP has to arrange for construction power and water on its own.

d) All outdoor steel structures including anchor/foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 610 gm/m^2 however, for coastal/ creek regions it shall be at least 900 gm/m^2 (if applicable).

e) In 400kV and 765 kV switchyard, if spare bay of half diameter is identified as future, all the equipment for Tie and Future Bay shall be designed considering the current rating of line bay i.e. 3150 A.

f) Boundary wall shall be brick masonry wall with RCC frame or Stone masonry wall or Precast RCC wall under present scope along the property line of complete substation area including future switchyard area to prevent encroachment and unauthorized access. Minimum height of the boundary wall shall be of 1.8 m from finished ground level (FGL).

g) All electrical equipment shall be installed above the Highest Flood Level (HFL) and where such equipment is not possible to be installed above the Highest Flood Level (HFL), it shall be ensured that there is no seepage , leakage or logging of water.

h) As per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022 and CEA Manual on Transmissions Planning criteria 2023, Line approaching substation shall normally be perpendicular to the substation boundary for a stretch of 2-3 kms. Accordingly, TSP shall ensure that line terminations at substations are arranged in a manner to avoid hindrance to future line terminations at the substations.

B.5 EXTENSION OF EXISTING SUBSTATION

Bidder is also advised to visit the substation sites and acquaint themselves with the topography, infrastructure such as the requirement of roads, cable trench, drainage and also the design philosophy.

SPECIFIC TECHNICAL REQUIREMENTS FOR SYNCHRONOUS CONDENSER

1. INTRODUCTION

This technical specification for Synchronous Condenser Stations consists of Synchronous Condenser (SynCon) units alternatively referred to as Synchronous Compensator where a SynCon unit consists of one synchronous condenser along with associated step-up transformer (s), cooling systems, flywheels (if applicable), auxiliary system and all associated switchgears.

Synchronous Condenser shall provide Inertia, Short Circuit support, continuous and dynamic supply of reactive power (capacitive and inductive) support for the regulation and stabilization of the voltage of 400 kV at Point of Common Coupling (PCC) under normal and transient conditions. The station shall operate in the leading and lagging MVAr region, as required to meet the specified inertia, short circuit requirements and reactive power capability curve and dynamic performance criteria.

The SynCon primarily shall be designed for continuous operation under varying grid conditions. The SynCon shall be equipped with a digital AVR (Automatic Voltage Regulator), Under/Over Excitation Limiters (UEL/OEL), V/Hz protection, and high inertia flywheels (if applicable) to enhance transient stability and damping.

The SynCon Station may consist of multiple identical synchronous condenser units, each operating in parallel and connected to the 400 kV HV bus (PCC), as per the design and space available. The design shall ensure compliance with grid code requirements, and the provision of inertia and fault current to support reliable and stable system operation.

1.1 Definitions

For the purpose of this specification, the following definitions / abbreviations are used:

PCC (Point of Common Coupling): Point of Common Coupling (herein also called as Point of Interconnection (POI) is the connection point between the Synchronous Condenser (SynCon) Station/plant (HV Side of step-up transformer) and ISTS at which performance requirements are defined.

Reference Voltage (Vref): The voltage set-point at the PCC where SynCon is expected to regulate voltage by injecting or absorbing reactive power while maintaining system stability.

MV (Medium Voltage): The voltage level at the low-voltage side of the step-up transformer, where SynCon and associated equipment are connected.

SynCon (Synchronous Condenser): SynCon is a DC-excited Synchronous machine that runs at no load and is used to control reactive power, which improves voltage stability and power factor in electrical grids

In the entire document the notion synchronous condenser refers to the synchronous machine installed in the **Synchronous Condenser unit**. The synchronous condenser shall be connected to the step-up transformer via the generator circuit breaker by an Isolated Phase Bus duct.

Following convention is used in this specification to define the reactive power output of the *Synchronous condenser unit*:

a) The notion **capacitive reactive power** (indicated as "+ MVAr") is used when the Synchronous condenser unit is injecting reactive power to the grid, i.e. when the synchronous condenser is operating in the overexcited capability range.

b) The notion **inductive reactive power** (indicated as "- MVAr") is used when the Synchronous condenser unit is absorbing reactive power from the grid, i.e. when the synchronous condenser is operating in the under excited capability range.

SynCon Unit (Synchronous Condenser Unit): In the entire document *Synchronous condenser unit* refers to the full scope of equipment working as one system at PCC. It includes but is not limited to:

(i) Synchronous Condenser and its auxiliaries.
(ii) Excitation System (Static/Brushless)
(iii) Flywheel and its auxiliaries, if option chosen
(iv) Step-up Transformers
(v) Generator Circuit Breaker (GCB)
(vi) Unit Transformer (Auxdiary Transformers)
(vii) Isolated Phase Bus Duct (IPBD) connecting Generator and Step-up Transformer
(viii) Lube Oil System
(ix) Auxiliary Power Supply (medium voltage/ low voltage)
(x) Equipment for control and protection of the equipment supplied under the specifications.
(xi) Reactive Power Oscillation Damper (RPOD)
(xii) Cooling System
(xiii) Other auxiliary systems required for power operation of the Synchronous Condenser.
(xiv) SynCon starting system (SFC/Pony motor)

AVR (Automatic Voltage Regulator): A digital control system associated with each SynCon Unit responsible for regulating the field excitation to maintain the terminal voltage or reactive power output, always fully redundant, this is channel A and B in terms of control and power circuits, with hot standby and automatic switch functionalities. AVR shall include functionalities like:

(a) UEL (Under Excitation Limiter): A protective function or control logic that prevents the SynCon from operating in unstable or under-excited regions of the capability curve, avoiding excessive reactive power absorption.

(b) OEL / OVEL (Over Excitation Limiter): A protection system that limits the field current to prevent thermal damage to the field winding during

overexcited operation (i.e., high reactive power generation).

Flywheel: A rotating mechanical mass connected to the SynCon shaft to increase its inertia and provide additional damping and system strength benefits.

Step-up Transformer: A Transformer connecting the SynCon (MV side) to the ISTS (400 kV side i.e. PCC), designed to match voltage levels and system impedance characteristics.

Capability Curve: The operational envelope of the SynCon showing the permissible limits of reactive power generation or absorption with respect to voltage at PCC and stator current.

Lagging Operation: Operation in which the SynCon absorbs capacitive reactive power (under-excited operation).

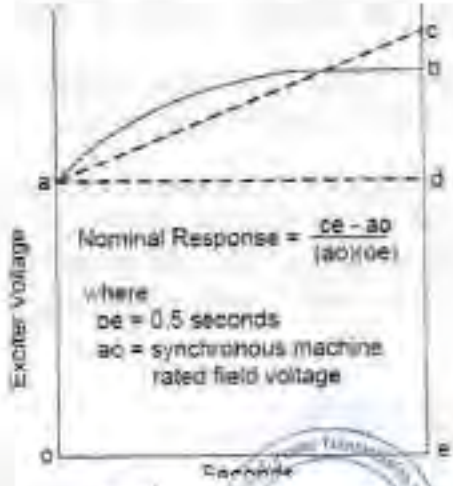
Leading Operation: Operation in which the SynCon generates capacitive reactive power (over-excited operation).

Response Time: The duration from a step change in control signal until the voltage changes by 90% of its final change, before any overshoot.

Settling Time: The duration from a step change in control signal input until the SynCon output settles to within ±5% of required control output.

Overshoot: The maximum system output minus the final settled value, divided by the actual change in system output (i.e., from its initial value to the final settled value), when the final settled value is within the defined settling band, expressed as a percentage.

Excitation response ratio: It is called the excitation system nominal response and defined as the rate of increase of the excitation system output voltage determined from the excitation system voltage response curve, divided by the rated field voltage. This rate, if maintained constant (curve ac), would develop the same voltage-time area as obtained from the response (curve ab) over the first half-second interval (unless a different time interval is specified). The RR is a measure of the speed of response for the excitation system, the higher the RR, the faster the response



Response ratio

Reactive power oscillation damper (RPOD): A reactive power oscillation damper (RPOD) implemented through control strategy designed to damp low-frequency electromechanical oscillations (typically 0.2–2 Hz) in power systems by modulating the SynCon reactive power output (Q) in response to system oscillations. When equipped with an excitation control system and a power oscillation damping (POD) controller, it can also actively damp oscillations in the grid by modulating its reactive power.

1.2 APPLICABLE STANDARDS

Unless otherwise specified herein, the plant shall be in accordance with the latest edition and amendments of Indian Electricity Grid Code (IEGC), CEA Technical Standards, appropriate International Electrotechnical Commission (IEC) and Institute of Electrical and Electronics Engineers (IEEE) standards operative at the Reference Date. In particular, the plant shall comply with the following Standards (as applicable):

CEA (Technical Standards for Connectivity to the Grid) and as amended time to time

IEC 60034 - Rotating Electrical Machines

IEC 60255-27 - Measuring relays and protection equipment (Product safety requirements)

IEEE C50.13 - Cylindrical-rotor 50 Hz and 60 Hz Synchronous Generators 10 MVA and Above

IEEE 115-Guides for Test Procedures for Synchronous Machines

IEEE 43 - Recommended Practice for Testing Insulation Resistance of Electrical Machinery

IEEE C37.013 - IEEE Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis

IEEE 421.5-2016 (IEEE Recommended Practice for Excitation System Models for Power System Stability Studies)

IEEE Std 1110-2019 - IEEE Guide for Synchronous Generator Modeling Practices and Parameter Verification

IEEE PES TR (2020) - Dynamic Performance and Application of Synchronous Condensers for Renewable Integration. (A technical report (not standard), but it explicitly describes the use of reactive power modulation for oscillation damping, with control block examples).

2. SCOPE OF WORK

The scope of works comprises the design, supply, factory testing, delivery, installation, commissioning and testing of the synchronous condenser unit (s), each of which comprises the key elements, but not limited to, the following:

(a) One XX MVA synchronous condenser (or as close as possible to this size) including rotor, stator, shaft, bearings, and base frame in case of cylindrical rotor or stator frame sole plates in case of salient pole solution, Excitation System & Voltage Regulating Equipment including Automatic Voltage Regulator (AVR), Power System Stabilizer (QSS) and Field Circuit Breakers for steady-state and dynamic voltage support

(b) Instrumentation, Monitoring and Control Systems including local and remote monitoring, diagnostic tools, and condition monitoring systems

(c) Slip Rings and Carbon Dust Extraction System (if static excitation system)

(d) One bank of three single phase transformer or three phase transformer XX MVA, xx / 400 kV step up transformer (size and secondary voltage to be finalised by the supplier, in accordance with the size of the offered synchronous condenser units) along with one spare (spare can be common for all the SynCon units), with secondary winding(s), complete with bushing CTs. Spare shall be of same rating as that of the main 1-ph or 3-ph transformer.

The synchronous condensers step-up transformers are to have continuous ratings that support sustained operation at all operating points on the reactive power capability curve

(e) 400 kV side bay equipment

(f) Bus duct (isolated) between the power transformer and the synchronous condenser

(g) Medium voltage generator circuit breaker complete with disconnectors, surge arresters, earth switches and instrument transformers (voltage to be confirmed by the supplier, in accordance with the size of the synchronous condenser units)

(h) Protection Systems including differential, overcurrent, under/overvoltage, out-of-step, loss-of-excitation, and backup protections.

(i) Static frequency converter (SFC) as per requirement

(j) Pony motor (s) for start–up (if required) and associated variable frequency drives

(k) Fly wheel (s) for increased inertia (as per requirement)

(l) One station transformer for auxiliary supplies in case one independent source of Auxiliary Power is a Station Transformer (this will be in common to all SynCon units)

(m) Unit Transformer (Auxiliary Transformers)

(n) LV auxiliary supply complete with back up supply

(o) LV surge arresters

(p) Control, SCADA and protection systems housed in a dedicated room inside the synchronous condenser building

(q) Fire walls and enclosures – as required by the fire and oil/water

containment, or noise mitigations

(r) Any other equipment for completion of the complete installation of the synchronous condenser

(s) SynCon Building (PEB - Pre-Engineered Building) – (Common machine hall for SynCons of all the SynCon Station is acceptable to reduce the requirement of the number of EOT Crane.)

Each equipment shall be type tested. Further, in respect of type test, CEA's 'Guidelines for the Type Tests for Major Equipment of Power Sector' shall be followed.

2.1 System Studies and Compliance

The TSP shall be responsible for conducting system studies including steady-state, transient stability, dynamic simulations, and electromagnetic transient studies to evaluate the impact of Synchronous Condenser operation on the grid.

The Grid data required for the studies shall be provided by CTU.

All study files and reports shall be documented and submitted to **CEA/CTU/GRID-INDIA** as per regulatory requirements.

SynCon unit shall be designed to operate at rated MVAr capacity upto an ambient temperature of 40° C. Beyond ambient temperature of 40° C, TSP shall provide the derating curve however, derating rate shall not be more than 1% of rated MVAr per degree Centigrade. There shall not be any impact on rated Short circuit current and Inertia due to increase in ambient temperature beyond 40° C. OEM/TSP shall submit temperature to MVAr derating curves (continuous & time limited). The SynCon shall be designed to support grid operation within a voltage range of ±10% and a frequency range of **47.5 Hz to 52.5 Hz at the PCC**.

2.1.1 System Studies

The TSP/supplier of Synchronous Condensers unit shall carry-out system studies in order to verify and demonstrate that the synchronous condensers units shall meet the specified performance requirements.

Load flow studies shall be performed in the initial stage to determine the optimal synchronous condensers units operating point for different system conditions.

The TSP/supplier of Synchronous Condensers unit shall perform studies to determine and confirm the design ratings and requirements of all plant and material to be supplied under this RfP.

The TSP/Supplier Synchronous Condensers may also refer IEEE Std 1110-2019 - IEEE Guide for Synchronous Generator Modelling Practices and Parameter Verification

System studies shall be performed as per the requirement. Studies are required to demonstrate that the synchronous condensers units shall meet all specified performance criteria.

When performing the designs, the following shall be considered:

1. All modes of operation specified in these specifications; and
2. The worst-case system conditions up to and including first contingency outage in the network.

The load flow and dynamic file shall be provided to the TSP in PSS/E 36 or newer version format.

PSS/E files are provided based on the data available at the time of issuance of RfP. TSP is required to validate the data before carrying out simulation. However, clarification, if any, may be sought before the bid submission. CEA/CTU shall endeavour to give clarification to the extent possible. In case of any discrepancy observed/non-availability of data for any of the machines and other control devices, typical values may be used in the studies with the intimation to CEA/CTU. The final tuning of generic parameters for various applicable scenarios shall be under the scope of TSP of the subject cited project. TSP after SPV transfer shall do the final tuning in consultation with CEA, CTU and Grid-India and share the converged dynamic files with CEA, CTUIL & Grid-India.

RMS & EMT Models shall be submitted in the format stipulated by CTUIL/ Grid-India.

2.1.2 Steady state operation study

The TSP/Supplier of Synchronous Condensers unit shall carry out such electrical studies and basic design studies as are required to design the synchronous condensers units. They shall perform design and verification studies to ensure adequate design and operation of the system.

This study comprises the verification of the design of the synchronous condenser units with respect to the steady-state performance. The steady-state operating points of the synchronous condenser units shall be simulated at the specified voltage range.

The main purpose of the steady state studies shall be:

1) Confirm short circuit capability including transformer
2) Confirm design of transformer OLTC and control settings

3) Demonstrate reactive capability including transformer under range of operating conditions

The operating points shall be represented as voltage/MVAR diagram. The load flow study points shall be also graphically included to determine the reactive power capability chart for the synchronous condenser units as built at the high voltage side of the step-up transformers. Additionally, steady-state voltages, currents and power through main components shall be demonstrated. The worst-case stresses of the individual components which occur on the operating points are input parameters for the component specification.

In addition to above, following test as per relevant International Standard shall also be carried out:

(a) No-Load Saturation Curve (Open-Circuit Characteristic, OCC)-Plot generated voltage vs. field current at rated speed — defines excitation requirements and saturation.

(b) Short-Circuit Characteristic (SCC)- Plot armature current vs. field current at rated speed with terminals shorted — used with OCC to compute synchronous reactance.

(c) Excitation System Performance Test (Steady-State)- Measure field current, voltage, and reactive power under rated voltage conditions.

(d) V-Curve (for Synchronous Condenser)-Plot stator current vs. field current at constant terminal voltage; determines stability margin and reactive power range.

(e) Reactive Capability Curve Test (for Condenser)-Determine leading and lagging VAR capability vs. field current and stator current limits.

TSP shall also submit Negative sequence impedance value.

2.1.3 Transient and stability study

Transient and stability studies shall be used to demonstrate the synchronous condenser unit control system performance, and, if applicable, to optimize the controller parameters of synchronous condenser unit during system disturbances, such as major faults or voltage changes at the PCC. Such studies shall be performed using the PSS/E and PSCAD software applying dynamic simulations, using a full PSS/E and PSCAD case. List of contingencies performed is attached in **Annexure D**.

The transient and stability studies shall be analysed in the following cases. These studies should demonstrate compliance with the relevant Performance requirements as per network configuration:

1. Analysis of the synchronous condensers unit's system response to step changes in the point of common coupling voltage or in the reference voltage, which can be performed in a single machine infinite bus case as relevant for the scenario.

2. Analysis of the synchronous condenser unit system response for faults for a range of system short-circuit power levels, to demonstrate compliance.
3. The following fault scenarios shall be analysed:
   a) A range of three-phase faults as specified (e.g. different duration, fault locations, retained voltage, network configuration).
   b) A range of unbalanced faults as specified (e.g. different duration, fault locations, retained voltage, network configuration).
   c) Control for the synchronous condenser units according to the requirement, i.e. Q-Control or U-Control
4. Analysis of the synchronous condenser unit system response for frequency disturbances.
5. V/Hz study and demonstration of stable operation of the V/Hz limiter

   The design shall ensure the adequacy of the synchronous condensers units in order to ensure stability during system transient, dynamic and fault conditions. This is inclusive of synchronous condenser units' response time (rise time and settling time) and of the synchronous condensers units' behaviour and contribution to the system's recovery from faults and network disturbances.

2.1.4 Small signal stability studies

1. **Voltage Step/impulse response**—

   +/- 5% step tests for Voltage control set points and then quantify rise time, overshoot, settling time for relevant control loops, and obtain frequency response (gain/phase margins) for critical control loops.

2. **Off-line frequency sweep (transfer function) tests for AVR and PSS:**

   Frequency response of the excitation system to be assessed over a frequency bandwidth of at least **0.01 – 10.0 Hz** by injecting sinusoidal signals with the specific bandwidth into the control blocks. The gain and phase variations with frequency of each measured transfer function are then compared with those obtained from the model

3. **Controller interaction studies** — evaluate interaction between synchronous condenser control loops (AVR, PSS/filter, reactive control, power/frequency control) and other nearby plant controllers (conventional generators, HVDC/FACTS, large converter plants). Include frequency-domain (Bode/Nyquist) and time-domain cross-validated tests as required.

4. **Oscillation Rejection Test:** This is a control and response sensitivity test. It is expected that SynCon model maintains a stable operation for all voltage modulated frequencies and for measured responses to be consistent with the

changes.

Grid voltage shall be modulated at following modulation frequencies through model playback or similar feature in SMIB model:

(a) 0.1 Hz
(b) 0.3 Hz
(c) 0.6 Hz
(d) 0.9 Hz
(e) 1 Hz
(f) 2 Hz
(g) 3 Hz
(h) 4 Hz
(i) 8 Hz
(j) 10 Hz
(k) Or any other frequency based on requirement

2.1.5 Software simulation models

The TSP shall provide the latest PSCAD (V 5.0 or above) and PSSE simulation model(s) (V36.0 or above) and parameters to CEA/CTU/GRID-INDIA along with detailed documentation for the purpose of future simulation to adequately represent and model the proposed SynCon system in the respective software.

For the simulation of SynCon unit in the PSS/E file (load flow and dynamic) and PSCAD (Transient), a model for SynCon unit is required for the study. TSP will share SynCon unit models with CEA, CTU and Grid-India along with detailed documentation for the above study purposes and simulations.

For PSS/E, both Generic and User-defined models shall be shared by the TSP with the CEA, CTU and Grid-India. Generic model (PSS/E) response shall be benchmarked with user-defined model (PSS/E and PSCAD) to the extent possible by the TSP. Generic models can be shared by the CEA, CTU and Grid-India with the concerned stakeholders/external party(ies) e. g. STUs etc. on need basis. For User Defined model (UDM), confidentiality shall be maintained by the CEA, CTU and Grid-India.

Both UDM (PSCAD and PSS/E) and Generic model (PSCAD and PSS/E) shall be provided by OEMs to CEA/CTU/GRID-INDIA without any NDA (Non-Disclosure Agreement). RMS & EMT Models shall be submitted in the format stipulated by CTUIL/GRID-INDIA.

Model documentation shall include the following details of the model:

a) The transfer function block diagram must include all functional controllers and physical plant that materially affect the performance of the model
b) Instructions on how the model should be set up and used
c) The models of the controllers and items of SynCon unit must be easily

identifiable.

d) Dynamic data must be provided as 'per unit' quantities on the machine megavolt amperes (MVA) base.
e) Shortest time constant (name, use and identifiable in the control block diagram) confirmed for both PSS/E models and also PSCAD models.

Model quality test of EMT & PDT model:

f) The submitted EMT & RMS (UDM) model shall be the representative of SynCon unit I with actual controls.
g) The EMT & RMS model should work appropriately within the PCC SCR range of 3 to 10 and X/R range of 3 to 14.
h) The applicable protections shall be appropriately modelled in the UDM Models.
i) EMT model should work appropriately on a range of simulation time step within 10-20us.
j) PDT (RMS) model work appropriately with a simulation time step of 1ms to 10 ms.
k) Submitted EMT model should have pre-compiled libraries and there should not be any need for loading dependent library/other files.
l) EMT model should initialize and complete the flat run in 5 sec. PSCAD & PSS/E models must allow stable initialisation and steady state run up to 5 minute.
m) Models must be initialised successfully for the entire intended plant operating range i.e reactive power set point from minimum to rated.
n) PSCAD models must have snapshot capability.
o) For User Define Model (UDM) EMT of SynCon unit, the complete model shall not be black-boxed and there shall be a full visibility/accessibility of passive components. TSP may black box the control/other parts wherein their Intellectual Property (IP) rights are involved.
p) For UDM models, TSP shall submit the schematics/block diagrams and its descriptions.
q) The RMS & EMT model used guide should contain the description of each parameter.
r) The range of parameters shall be mentioned in the PSS/E and PSCAD model user guide.
s) TSP shall specify the configurable and non-configurable parameters in the model user guide (PSS/E and PSCAD) for both Generic as well as UDM.
t) Model structure to be contained within its own module block including its plots.
u) PSCAD transformer model should include transformer specific saturation data where available (and not default model library provided settings)
v) EMT Models shall be compatible with

- Intel 15 Update 5 and newer (64-bit) and Visual Studio 2015 and newer
- Model should works across a range of time steps and does not require a specific time step

- These models must not be dependent on a specific Intel Visual FORTRAN version and should not have dependencies on additional external commercial software.

TSP shall fulfil and submit the technical connection data including models/data sheets etc. as per Grid India First Time Energization process & CTUIL Connection details process.

2.2 Functional Requirements

The Synchronous Condenser unit shall:

- Provide dynamic and steady-state reactive power support (both capacitive and inductive).
- Contribute to voltage stability, grid inertia, and short-circuit strength.
- Assist in damping of power oscillations and mitigation of sub-synchronous oscillations, if any.
- Assist in damping of reactive power oscillations and mitigation of oscillations, if any.
- Be capable of continuous operation during worst-case voltage and frequency conditions.

2.2.1 Design Considerations

- The Synchronous Condenser shall be designed with inertia specified to enhance system strength and frequency stability.
- Dedicated & coordinated control systems shall be provided in case of multiple SynCon units to ensure selective operation and avoid simultaneous tripping under common disturbances.

3. REQUIREMENT, RATINGS AND DESIGN INFORMATION

3.1 SynCon building

The SynCon station shall have independent building (PEB type) including a separate control room different from the main control room building of the main Substation. The building shall comprise of SynCons unit(s), EoT crane, control room, LT Switchgear room, Battery room, workshop space, Document/Library and general facilities etc. Adequate space shall be provided for smooth unloading and maintenance purposes of all the equipment in the SynCon building.

The SynCon Building shall comprise of following facilities:

1. Control & Relay Panel room
2. Excitation Room
3. ACDB & DCDB room

4. Battery room
5. Service Room cum workshop space
6. Conference room
7. SynCon unit(s)
8. Lobby
9. Corridor with minimum width of 1600 mm
10. Portico
11. Toilet facilities
12. Provision of shaft for electrical, sanitary, water supply facilities
13. Other facilities as per functional requirement of building
14. AHU Room

4. Ambient Condition

The following environmental data shall be considered (Table-1):

Table 1

Sr. No.	System Parameters	Values
1	Max/min Ambient temperature (dry bulb one-hour average) Max dry bulb 24 hr. average	50 deg C max 0 (Zero) deg C min 40 deg C
2	Relative Humidity (%, max)	100
3	Average annual rainfall	As per rainfall map of IMD
4	Iso-keraunic level	As applicable
5	Wind Zone	As per National Building Code 2016
6	Seismic Level	As per Seismic zone of the site
7	Altitude above sea level	<1000 m
8	Pollution level (IEC 60815)	Heavy

5. POWER SYSTEM REQUIREMENTS

The following AC Power System characteristics apply at the point of connection i.e. point of common coupling in this case (PCC). SynCon Station operation is required within the parameter value and duration given in following table:

Table 2

Sl. No	Power System Characteristic	Value	unit
1.	Nominal ac system voltage, line-to-line	400	kV
2.	Maximum continuous ac system voltage, line-to-line	440	kV
3.	Minimum continuous ac system voltage, line-to-line	360	kV
4.	Maximum short-term ac system voltage, line-to-line	As per HVRT Table	
5.	Maximum duration of item 4		
6.	Minimum short-term ac system voltage, line-to-line	As per LVRT Curve	
7.	Maximum duration of item 6		
8.	Nominal ac system frequency	50	Hz
9	Maximum continuous ac system frequency	52.5	Hz
10	Minimum continuous ac system frequency	47.5	Hz
11.	Lightning Impulse Withstand Voltage (LIWV)	1550	kV peak
12.	Switching Impulse Withstand Votlage (SIWV)	1175	kV peak
13.	Power Frequency Withstand Voltage	630	kV
14.	1) Maximum three-phase fault curren a) for performance requirements b) for rating of SynCon 2) X/R (Positive/Negative Seq) 3) X/R (Zero Seq) 4) Clearing time - normal	 1 a) 63 1 b) 63 2) 31 3) 10.6 4) 0.10	 kA kA for 1s s s

Sl. No	Power System Characteristic	Value	unit
	5) Clearing time – backup	5) 0.75	
15.	1) Maximum three-phase fault current (with IBR contribution & without Syncon)* 2) Maximum three-phase fault current (without IBR contribution & without Syncon)*	47.6 39.3	kA kA
16.	Minimum three-phase fault current (without IBR contribution & without Syncon)* with depleted system# -for performance requirements -for safe operation	 29.3 29.3	 kA kA
17.	1) Maximum single-phase fault current (with IBR contribution & without Syncon) * 2) Maximum single-phase fault current (without IBR contribution & without Syncon) *	34.8 26.4	kA kA
18.	Minimum single-phase fault current (without IBR contribution & without Syncon)* with depleted system#	19.8	kA
19.	Power System Phase Rotation	CCW	
20.	Rated voltage at SynCon terminals (to be selected by the Contractor)	xx	kV
21.	Capacitive capability on PCC at 1.0 p.u. voltage	+300	MVAr
22.	Inductive capability on PCC at 1.0 p.u. voltage	-200	MVAr
23.	Capacitive & Inductive capability on PCC at different Voltages (p.u.)	See below capability diagram	
24.	HV Side rated Voltage (at PCC)	400	kV
25.	Voltage variation at unit step-up transformer high-voltage side (for normal operation)	±10	%

Sl. No	Power System Characteristic	Value	unit
26.	Stored Energy - Inertia at Machine Terminal	>3000	MWs
27.	Short Circuit Contribution (SCC) on PCC at 1.0 p.u. voltage (calculation of SCC as per section 6)	>1200	MVA
28.	SynCon rated power factor	Zero	
29.	Rated frequency	50	Hz
30.	Maximum Overspeed shall not be more than % (of rated speed)	20	%
31.	Sub transient ratio xq''/xd''	< 1.1	
32.	Start-up and synchronization time (Contractor may offer lower times based on the SFC rating selected and overall Inertia of the SynCon & Flywheel)	30	Minutes
33.	Shut-down time to complete standstill	45	Minutes
34.	Stator winding connection	Wye	
35.	Neutral Grounding	High resistance grounding through Neutral Grounding Transformer with secondary loading Resistor	
36.	Sound pressure level (SPL) when measured at approximately 1 m distance from the Synchronous condenser surface during normal operation at rated ratings & ambient conditions.	≤90	dB (A)
37.	THD of L-L voltages	≤ 3%	

Sl. No	Power System Characteristic	Value	unit
38.	**Temperature rise over 40°C cold air**		
	Stator winding (installed RTDs)	85	K
	Rotor winding (resistance method)	90	K
39.	**Unbalanced load**		
	Maximum value for continuous operation (I_2/I_n)	10	%
	Maximum short term unbalanced load $(I_2/I_n)^2.t$	20	s

* values calculated as per studies

Depleted system-one ckt of 400kV Barmer-II-Barmer-I (formed by LILO), Barmer-II - Fatehgarh-IV and Barmer-II - Barmer-I (direct line) out simultaneously.

6. Technical Requirements

6.1 General Requirements

(b) Under design maximum ambient temperature conditions, all the SynCon units in a SynCon Station, combinedly, shall have a nominal reactive power capability of not less than +300 MVAr at 0.9 p.u. voltage and -200 MVAr at 1.1 p.u. voltage, as measured at PCC, including all tolerances for components for the equipment installed inside the building such as the synchronous condensers, the pony motor, the fly wheel and the generator circuit breaker and for the equipment installed outdoor such as the step-up power transformers, the TEWAC cooling system, the station transformers, the isolated phase bus duct etc. The expected availability of the synchronous condenser unit shall be not less than 97%.

(c) Indicative schematic diagram of a SynCon unit and typical capability curve of a SynCon Station (+300 MVAr/ - 200 MVAr) are given below

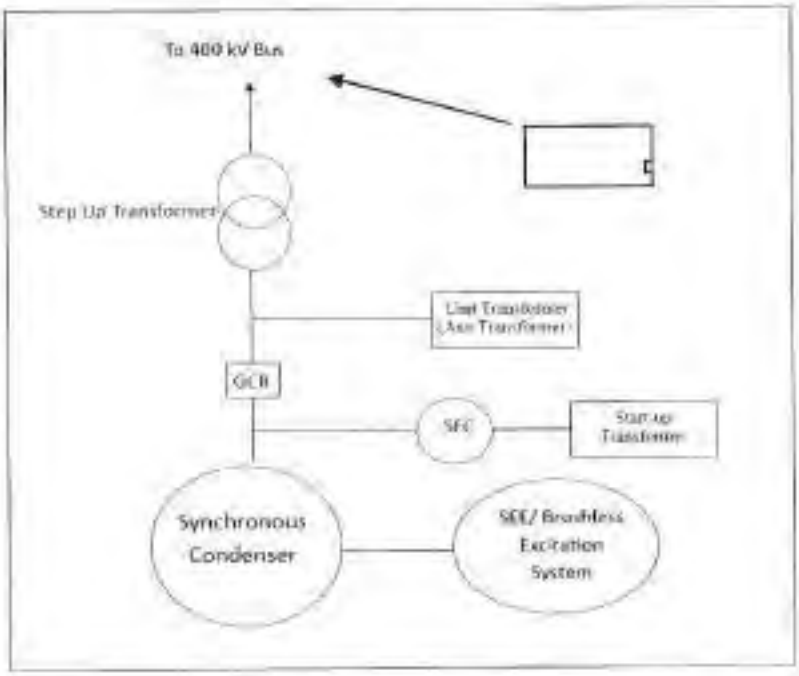
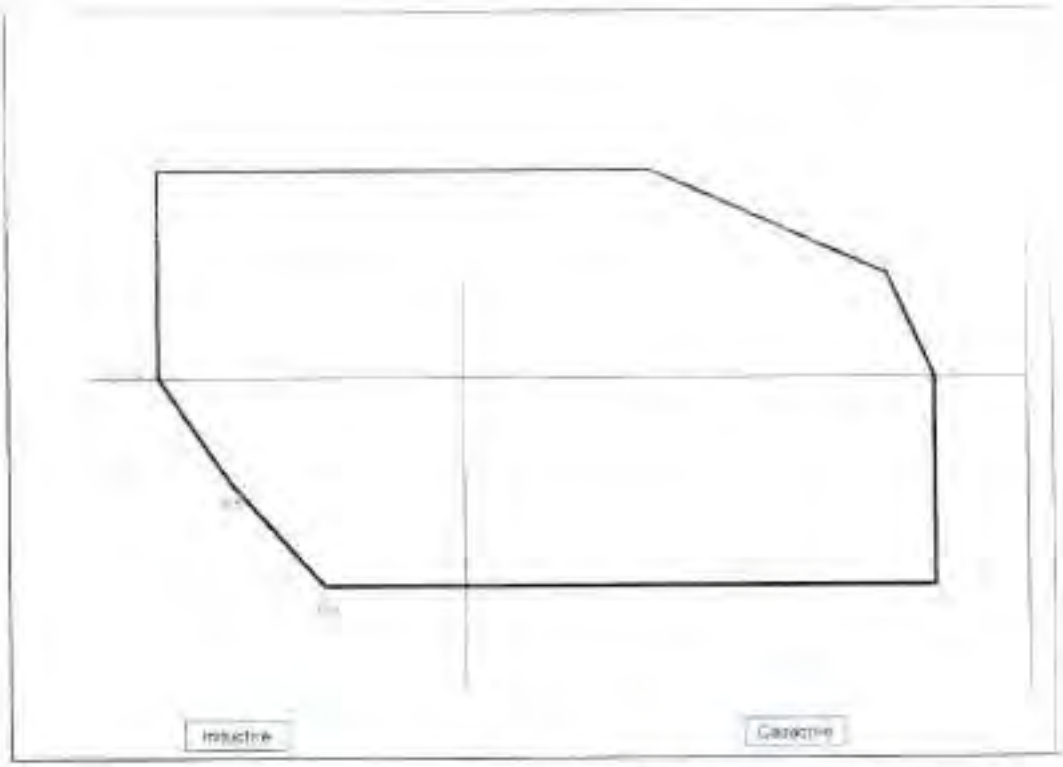


Figure-1: Conceptual Indicative Schematic diagram of SynCon Unit



Note: On x-axis, the base rating is taken as 300 MVAr

Figure-2: Capability Curve of SynCon Station

(d) The Terminal Voltage of SynCon shall be in the range of 10 kV to 28 kV.

(e) Insulation of SynCon shall be thermal class F for Stator and Rotor Winding as per relevant International Electrotechnical Commission with temperature rise limited corresponding to thermal class B insulation.

(f) The construction of the generator shall be such that the rotor poles and stator coils can be handled out or in without removal of the rotor and without disturbing the upper bearing bracket in case of vertically installed SynCon.

6.2 Voltage and Frequency

The synchronous condenser unit shall cope with voltage and frequency variation and stay in connection with the system for at least the minimum times as per Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 and amendments.

The following ranges of voltage and frequency are applicable:

1) Nominal voltage shall be 400 kV (1.0 p.u.) phase to phase
2) Minimum continuous voltage of 0.9 p.u.
3) Maximum continuous voltage of 1.1 p.u.
4) Max negative sequence voltage during normal operation of 1% measured at the HV side of the step-up transformer over a 10-minute averaging period
5) Nominal frequency of 50 Hz
6) Maximum continuous frequency of 52.5 Hz
7) Minimum continuous frequency of 47.5 Hz.

The synchronous condenser unit shall be capable of withstanding frequency variation and maintain continuous uninterrupted operation for frequency ranges of 47.5 Hz to 52.5 Hz within a voltage range of ±10%. Further, the Synchronous Condensers Unit shall be capable of **unrestricted** and uninterrupted continuous operation for the following frequency ranges.

Table: Frequency Variations Withstand Requirements for Unrestricted Operation

Sl. No.	Frequency Range (Hz)	Duration
1.	49.5 to 50.5	Continuous
2.	49.0 to 49.5	10 Minutes
3.	50.5 to 51	10 Minutes

4.	47.5 to 49	5 Minutes
5.	51 to 52.5	5 Minutes

The Synchronous Condenser Units shall be capable of continuous uninterrupted operation for Rate of Change of Frequency (ROCOF) up to 4Hz/second for 0.25 seconds and 3Hz/second for 1 second. Rate of change of frequency (ROCOF) is calculated as the average rate of change for multiple calculated system frequencies for a time period of greater than or equal to 0.1 second The measurement of the rate of change of frequency shall not react to the sudden changes in the waveform of voltage caused by disturbance in the system i.e. during fault occurrence or clearance.

Provided that Frequency should be calculated over a window of time. Instantaneous calculated frequency should not be used for protection; this calculation should occur over a time window. Typical window/filtering lengths are three to five cycles (60–100 ms).

The SynCon Station shall continue to absorb reactive power (rated reactive power up to 1.1 p.u., and inherent reactive power beyond 1.1 p.u.) during HVRT Conditions as per the following Table-3:

Table-3

Nominal Voltage (pu)	**Minimum time for remaining connected to the Grid and providing reactive power support (absorption)**
V > 1.50	Instantaneous trip
1.50 ≥ V > 1.30	100 milli seconds
1.30 ≥ V > 1.10	10 seconds
V ≤ 1.10	Continuous

1 pu = 400 kV (3 phase RMS voltage at POI)

SynCon Station may be tripped if the respective temporary over voltages as mentioned above persist for more than its respective mentioned duration.

The SynCon Station shall continue to inject reactive power (rated reactive power down up to 0.9 p.u., and inherent reactive power below 0.9 p.u.) during LVRT Conditions as per the following Curve (Figure-3) for the specified time:

V_T : Actual Voltage; V_n: Nominal Voltage

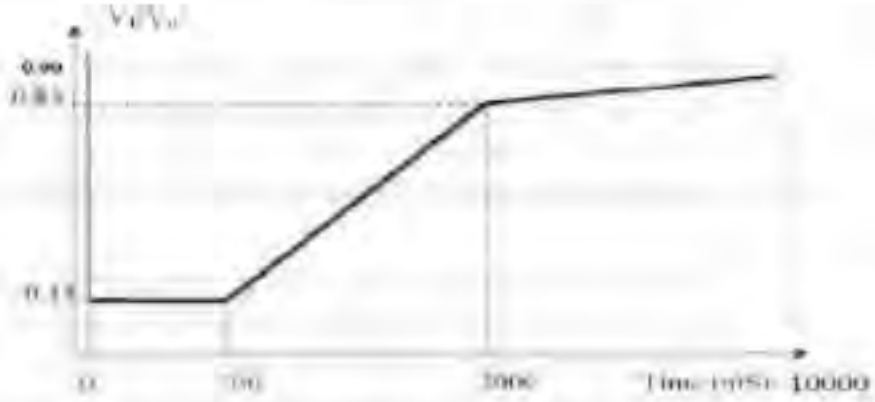


Figure-3: LVRT Curve

The synchronous condenser Station shall remain connected to the grid for a series of up to 10 voltage disturbance below 0.9 p.u within any 5-minute period as per the LVRT capability.

Provided that during such period synchronous condenser Station shall remain connected for at least 06 voltage disturbance below 0.5 p.u.

Provided further that during the multiple LVRT conditions, the SynCon Station shall meet the performance requirements specified in LVRT conditions.

TSP shall include the simulation tests to demonstrate the LVRT & HVRT compliance of SynCon and shall include the following simulations tests in the study reports on both Generic and UDM of PDT (RMS) and EMT models as per **Annexure D:**

Validation of AVR & PSS response:

In order to validate the AVR and PSS response, TSP shall carry out the testing of such controller(s) either through Hardware In Loop (HIL) test or in a laboratory as applicable. Based on the AVR controller response (open loop and closed loop) and PSS response received from HIL, the TSP shall benchmark such results with simulation-based results.

6.3 Continuous Ratings

1) The Synchronous Condensers Units shall be capable of operating continuously without tripping at the Voltage level from 0.9 p.u. to 1.1 p.u. at PCC in the specified ambient conditions.

   There are additional requirements for operation for periods of time beyond the 0.9 and 1.1 p.u. Voltage as described in Table 3. The Synchronous Condenser Units shall confirm that they are capable of operating in accordance with these requirements.

For the Voltage under 0.9 p.u. SynCon Units shall be capable to operate as per Figure-3.

2) The supplier of Synchronous Condensers shall select the nominal operating voltage for the low voltage side of the step-down transformers, to optimize the design of the Synchronous Condensers Unit(s)

3) The nominal continuous operating capability of SynCon Station shall be no less than 300 MVAr capacitive at 0.9 p.u. to no less than 200 MVAr inductive at 1.1 p.u. voltage as measured at PCC, including all tolerances for components upto designed temperature. Component tolerances shall be considered, when designing against the requirement for continuous rating and considering design ambient temperature conditions. Beyond design maximum ambient temperature, TSP shall provide the derating curve, however, derating rate shall not be more than 1% of rated MVAr per degree Centigrade. OEM/TSP shall submit temperature to MVAr derating curves (continuous & time limited). There shall not be any impact on rated short circuit current and Inertia due to increase in ambient temperature beyond design maximum ambient temperature.

4) The Synchronous Condensers Units shall be capable of continuous uninterrupted operation for system frequencies in the ranges of 47.5 Hz to 52.5 Hz.

5) The voltage reference for the voltage control at the point of connection should be continuously (or using steps of negligible size) controllable in the interval 0.9 p.u. to 1.1 p.u.

6) The Supplier of Synchronous Condensers shall confirm that the synchronous condensers will be rated and capable to operate for all the frequency ranges listed.

6.4 Voltage and reactive power control

Voltage and reactive power control capabilities shall be as per requirement specified. The Synchronous Condenser unit shall be able to control the reactive power and voltage at the PCC by the excitation system and by use of unit step up transformer on-load tap changer (OLTC) regulation range as appropriate.

7. SHORT CIRCUIT CONTRIBUTION

The Synchronous condenser unit for project /substation shall be able to supply a short circuit power (Short-circuit power must be calculated according to IEC

60909-0:2016, using saturated sub-transient reactance and transformer impedance).

Calculation of short circuit contribution (SCC) shall be done according to following formula:

$$SCC = \frac{S_{SC}}{(X_d'' + \frac{S_{SC}}{S_T} u_k)}$$

S_{SC} = rated S [MVA] of SynCon

S_T = rated S [MVA] of transformer

X_d'' = subtransient direct – axis reactance (saturated) in p.u.

u_k = *unit step – up transformer* impedance in p.u.

8. SYNCHRONOUS CONDENSER DESIGN AND CONSTRUCTION FEATURES

The Synchronous condenser unit installed shall be based on either salient pole (or) non-salient pole with air-cooling or water cooling. Hydrogen-cooled SynCon will not be accepted.

8.1 General Design Requirements

The synchronous condenser shall be totally enclosed water-air cooled (TEWAC) with air-water heat exchangers connected to a closed water-cooling system shall also be provided (as per system requirements).

The pipework shall be marked with colours and arrows to show which fluid is circulating which way in the respective pipe.

All necessary auxiliaries (lube oil system, cooling system), foundation plates and bolts, covers, air and oil coolers with adjacent piping shall be included (if applicable).

Suitable arrangement shall be mounted inside the synchronous condenser enclosure to prevent condensation during shut-down periods.

Sensors, detectors, and instrumentation necessary for supervision and control shall be installed.

Detectors to provide signals for the speed measurement shall be installed. These detectors are also used for overspeed protection.

A vibration monitoring/protection system shall be provided.

Relative shaft vibration - monitoring; absolute bearing casing vibration – protection shall also be provided.

The synchronous condenser shall be designed for continuous operation and 10,000 starts/stops in its lifetime (35 years).

8.2 Inertia Requirement

If the specified inertia requirements as mentioned in the Table-2 cannot be achieved with the rotor only, the TSP shall consider the installation of an additional flywheel.

8.3 Stator

8.3.1 Stator Frame and Core

The stator frame shall be of welded construction and equipped with suitably arranged braces to ensure structural rigidity. The interior of the stator casing/stator frame partly forms the cooling ducts and therefore the braces in the stator frame shall be arranged in such a manner that an optimum air flow will be obtained.

For easier transportation (if required) the stator casing/stator frame can be split up into two sections. The sections of the iron core and of the stator casing shall be clamped together by means of liberally dimensioned bolts. Care will be taken to avoid vibrations at the insulated joints.

The stack of laminations shall form the active part of the Synchronous condenser and shall be made of silicon alloy steel sheets. The segments shall be coated with an insulating varnish of good thermal and mechanical properties on both sides and stacked interleaved.

The core shall be clamped between non-magnetic pressure plates. A certain number of through bolts to be provided for an adequate and permanent compression of the active core. The compression fingers integrated in the pressure plates, distributing the pressure over the whole surface of the core uniformly.

The pressure fingers, plates and the core beams shall be designed to give stable and equal distributed pressure on the lamination.

The enclosure shall have openings to inspect the core and the windings.

All steelworks shall be thoroughly protected against corrosion.

Welded steel constructions shall follow relevant ISO standards.

8.3.2 Stator Core Tests

Before the stator winding is installed, the stator core shall be subjected to stator core loop test with high flux density (minimum 1T).

8.3.3 Stator Winding

The stator winding shall be three-phase with 6 terminals brought out from the synchronous condenser enclosure. Neutral of SynCon star point shall be

earthed in NGT panel through dry type distribution transformer with secondary loaded with a resistor.

All material inside the slot and the winding insulation shall be of thermal class F. No kind of magnetic material, such as for slot wedges, is permitted within the slots.

The winding must be capable of being easily substituted by removing a few adjacent coils or bars (as applicable). The end windings must be suitably braced and supported by rings of non-magnetic materials to withstand any forces caused by short circuit at the terminals of the machine in grounded or ungrounded operation.

The stator winding insulation shall be made of thermosetting epoxy resin impregnated mica tape system and shall be equipped with corona protection systems suitable for the selected rated voltage.

8.4 Rotor

The shaft shall be forged of steel and sufficiently rigid. It shall have an ample margin of strength and be provided with a forged coupling to Flywheel or other (if applicable) and specified in the technical specification.

For cylindrical rotor design, the shaft shall be machined from a single alloy steel forging to give the required mechanical, metallurgical and magnetic characteristics. Rotor shall have an adequate margin between critical speed and the operating range of speed to ensure smooth running.

The rotor shaft and rotor itself shall be designed to withstand all the operating conditions as well as overspeed.

For salient pole construction, poles shall have claws to fit in matching claw slots accurately machined on the rim/ Rotor body. The pole along with field coil shall be properly secured in the slots and wedged there properly.

The rotor assembly shall be of such design that the assembling and dismantling can easily be done at site.

8.5 Damper Winding

A low resistance damper winding made of full-length copper rods or copper rotor wedges shall be provided on all the poles to dampen rotor oscillations. They shall be short circuited at the ends by a completely electrically connected ring on either side. The damper windings shall be strong enough to withstand all the electrical and mechanical stresses occurring during operation.

All contacts shall either be brazed or safely pressed by means of bolts and elastic elements. Contact surfaces of pressed contacts shall be protected against oxidization and corrosion, i.e. by appropriate galvanization.

8.6 Collector rings and brushes (if applicable)

The collector rings shall be insulated from the shaft system by epoxy glass laminations and spaced sufficiently apart and the brushes arranged to eliminate the possibility of accidental short circuit while changing or adjusting the brushes. The brush gear for the collector shall be mounted on insulated studs from the top of the exciter brush gear housing. The slip ring housing shall have sufficient space for maintenance purposes. There shall be provision for the replacement of brushes while the machine is in operation, without interrupting the excitation or normal operation of the machine.

Carbon dust collection system shall be provided to remove carbon dust generated from carbon brushes. The filters used shall be metallic and washable type having high efficiency. The piping should be routed in a way to optimize spaces.

8.7 Rotor Winding/ Poles

The rotor winding shall have an insulation that fully conforms to thermal class 155 or higher.

For salient pole type construction, the field poles shall be of laminated construction and the material used shall be of high strength. On both ends, end plates of high-grade steel shall bebe fitted. The pole core and the pole end plates shall be clamped together by screwed bolts. The insulation materials used shall provide sufficient mechanical strength.

8.8 Instrumentation

All temperature sensors shall be Resistance Temperature Detectors (RTDs) of preferably duplex type (alternatively suitable nos. of single element RTDs with spares in place of duplex RTDs are also acceptable) and be wired to a terminal box with shielded cables.

8.8.1 Stator winding/Core

Detection / measurements shall be provided by means of RTDs; i.e. at least 3 (three) active RTDs and 1 (one) spare RTD per phase and per circuit distributed between phases and circuits around the stator bore, located between the upper and lower bar in the same slot; at least 3 (three) RTDs in the core located at each end and in the middle.

8.8.2 Rotor winding

Rotor winding temperature shall be measured using the resistance method or through RTDs as per IEC 60034-1.

In case of RTDs, Sufficient number (at least 12) of preferably duplex type RTDs (alternatively suitable nos. of single element RTDs with spares in place of duplex RTDs are also acceptable) shall be provided, distributed as per OEM design to monitor the temperature.

8.9 Terminal Boxes

Terminal boxes shall be of weatherproof construction to eliminate entry of dust, vermin and water with a degree of protection IP54. The terminal boxes on the SynCon shall be suitable to connect cable size required.

The phase terminal of the windings shall be brought out of stator frame by appropriate means and interfaced to insulated phase bus of adequate size & capacity. The leads on the neutral side shall be brought out of the stator frame and shorted through a suitable size bus bar. Provision shall be made on the main (Phase) side & neutral side of the SynCon for mounting of required no of CTs for AVR, control, protection & metering.

The phase terminals or a fitted cubicle shall be suitable for IPB termination. Insulated protective cage cover connection between stator and bus duct for line terminals shall be provided for safety of O&M and personnel.

A suitable neutral grounding cubicle shall be fitted to the neutral terminals. The cubicle shall allow for installation of all required CTs, neutral earthing via neutral earthing transformer and resistor.

Terminal boxes shall be provided for termination of the following signals/ terminals:

- Instrumentations
- Space heaters
- Temperature detectors

8.10 Bearings

The bearings shall be designed for the weight of the rotor of the synchronous condenser as well as for additional loads owing to abnormal service conditions.

The bearing pedestals may be a cast or welded structure, in any case providing the required strength and stiffness. To avoid the formation of shaft currents one pedestal is insulated from the foundation frame, pipe connections, etc. Suitable protection shall be provided to avoid the escape of oil and oil vapor via the shaft.

If the grid connection is tripped the synchronous condenser bearings shall be fed by the emergency DC pump from oil supply system until the synchronous condenser is on standstill (0 rpm).

The bearings shall withstand a defined overspeed of 10% during start-up.

A central oil mist extractor shall be present in the oil system to evacuate oil mist from the bearing housing.

The TSP shall ensure complete protection, control, and measurement for the bearing's safety and diagnosis, consisting of RTDs, at least one triple element (or two dual element) per bearing, to monitor bearing metal temperature.

8.11 Lube oil system

The flood lubricating system of the bearings shall be separately mounted. The oil plant shall comprise the bearing/oil container, the oil/water cooler for frictional heat dissipation, the flood-lubrication pump, as well as all necessary fittings, pipes, filters and supervisory instruments.

8.12 Lube oil pumps

A high-pressure oil system shall be provided for the bearing to avoid mixed friction at a low speed. A high-pressure pump with non-return valve shall take the oil from the sump and presses it between the lower part of the bearing and the shaft. The arrangement in the shell of the oil-jacked bearing ensures that no pressurized oil can infiltrate between the bearing lining and the shell.

The lube oil system shall have redundant (2 x 100%) oil pumps to supply lube oil to the bearings. They shall be fed by AC power supply. An automatic change-over from main to back-up AC pump shall occur in case of loss of lube oil pressure.

An emergency DC pump of sufficient capacity shall pump the oil until the synchronous condenser has come to a complete standstill in case of the grid connection is tripped. The DC pump shall be fed from the station battery.

8.13 Cooling system

To reduce the complexity of the synchronous condenser unit, the synchronous condenser shall be air-cooled. H2-cooling is not permissible.

Extraction of losses shall be via water-to-air heat exchangers (TEWAC cooling scheme). The secondary cooling system i.e water to air heat exchanger, shall be a redundant type such that it shall be possible to take out 10% (minimum one number) of the cooler module (fan unit) of secondary cooling system without affecting the rated performance of SynCon unit.

In case of Water cooled Stator Winding, Stator water cooling System shall be closed loop type with 2x100% AC motor driven circulating water pumps, 2x100% de-mineralised water heat exchangers, 2x100% filters, one mixed bed de-mineraliser and one alkalizer unit (as applicable).

The scope of this system shall include but is not limited to:

a) a Pump skid with all relevant components and measurement devices
b) a Set of outdoor coolers (chillers).
c) an Expansion tank (installed on the pump skid)
d) a Refill unit (installed on the pump skid)
e) Connecting pipe system including pipe supports and interface flange connections
f) a Cooling system cabling, excluded cabling to the outdoor coolers and the outdoor temperature sensor
g) an outdoor temperature sensor
h) all necessary foundation bolts for the cooling system and piping
i) Junction boxes for termination of control cables

The water-cooling system shall be connected to:

- the heat exchangers of the synchronous condenser to evacuate the heat generated by the machine.
- (if applicable) the fly-wheel's heat extraction system

The use of the coolant shall be adapted on the environmental condition listed in this specification.

The coolant shall be a mixture of ethylene or propylene glycol and water (with corrosion inhibitors as additives). If ambient conditions allow (ambient air permanently above freezing point) water with corrosion inhibitors can be used.

8.14 Monitoring sub-systems

Following On-Line monitoring sub-systems shall be provided for Synchronous Condenser:

8.14.1 Vibration Monitoring System

A continuous on-line vibration monitoring system complete with sensors, input/output module, control/processor unit, relays, junction boxes, cabling and associated accessories for measuring, monitoring and data acquisition of shaft vibration/run-out shall be provided.

The systems should be fully integrated with control system (SCADA) to facilitate shutdown and alarming, trending the values in SCADA for diagnosis.

8.14.2 Shaft Current online Monitoring of Synchronous condenser

A suitable shaft current online monitoring of Synchronous Condenser shall be provided to detect transient current in the synchronous condenser shaft.

8.15 Flywheel system (if applicable)

The flywheel shall be coupled to the synchronous condenser rotor.

The design shall enable a safe emergency run-down in case of total power loss (grid black-out). The required bearing lubrication during emergency run down shall be ensured by battery-powered DC pump, defined, and sized depending on unit specific parameters.

The main components of the flywheel assembly are the forged flywheel body and shall be coupled to synchronous condenser either directly or by means of attached shafts. The whole flywheel shall be supported by pedestal bearings.

The safe operation of the flywheel shall be covered by the standard protection concept for rotating power generation equipment, including overspeed, bearing temperatures and vibration limits.

8.16 Bearing and Shaft Vibration Measurement / Protection System

Two Proximity sensors (90^0 apart) and necessary provisions for the monitoring of shaft vibration amplitudes shall be installed on each bearing. The vibration measurement system for the bearing shall be integrated with the vibration system provided for SynCon.

At least two accelerometers per bearing shall be installed to monitor bearing casing vibration.

9. EXCITATION SYSTEM

9.1 General

Microprocessor based excitation system with thyristor control shall be provided to suit the Synchronous condenser characteristics. The excitation system shall comply with the requirements of IEC 60034-3 unless otherwise specified.

The excitation system may be offered as either:

- **Static Excitation System (SEE)** using controlled power electronic converters, **or**
- **Brushless Excitation System (BES)** using a shaft-mounted AC exciter and rotating rectifier assembly.

In case of SEE, the AC power required for the excitation shall be tapped from the SynCon terminal, stepped down by means of excitation transformers and rectified by fully controlled thyristor bridges and then fed to the SynCon field thereby controlling the voltage output. In case of Brushless Excitation System, the excitation power shall be supplied by a shaft-mounted AC exciter after rectification through a rotating diode bridge. The offered excitation system

shall be capable of delivering desired synchronous condenser terminal voltage and reactive power within the specified limits during all the steady-state and transient operating conditions. Any change in the SynCon terminal voltage shall be sensed by the voltage regulator which shall automatically control the field excitation to restore the setpoint. The temperature of the field shall be determined by the resistance method.

9.2 Static Excitation System (SEE)

In case of SEE, it shall consist of following:

a) Excitation transformer.
b) A Set of Thyristor converters (fully redundant Thyristor bridges) of suitable numbers shall be provided. Power thyristor converter shall be fully controlled three phase, full wave bridge type with fast and high ceiling performance. The converter shall have 'N+1' redundancy where N is the number of bridges required to deliver rated excitation current and the ceiling voltage or current and '+1' provides redundancy such that the failure of one power section does not lead to any operational limitations.
c) Facilities to ensure excitation power supply during starting
d) Field breaker and field discharge and suppression equipment.

9.3 Brushless Excitation System:

In case of BEE, it shall consist of following:

(a) Shaft-mounted three-phase AC exciter with stationary field and rotating armature
(b) Rotating rectifier assembly using high-reliability diodes with surge protection and with either complete bridge as redundant or at least one redundant parallel branch in each of the six arms of the bridge.
(c) No slip rings or brushes for main field current supply.
(d) Field flashing equipment shall be provided for voltage build-up and recovery under low residual conditions.
(e) Monitoring of rotating rectifier health via indirect measurement of exciter current, voltage, and unbalance detection.
(f) High ceiling performance with minimum 160% ceiling field voltage.

9.4 Regulator and sequencer

TSP shall provide Digital Controller and AVR having automatic voltage regulator mode (AVR) and field current regulator mode (Manual Mode), as well as the required sequencing and communication to the plant control system. It shall be according to following.

- Number of independent regulators: 2 (full N+1 redundancy, completely doubled hardware)
- Voltage Controller of PID-type/ PI type.

- Manual (field current) regulator, common hardware with AVR
- Bump less switch between voltage regulator and field current regulator
- Digital sequencer as part of the software
- Digital setpoint interface
- Synchronous condenser voltage and current sensing: 1 or 3-phase measurement.
- Reactive load compensation: raising/falling characteristic selectable
- Field current limitation including:
  - + Maximum limiter undelayed
  - + Maximum limiter delayed
  - + Minimum limiter undelayed
- Stator current limitation
- Over fluxing (Volts/Hertz) limiter
- Reactive power regulator
- Automatic generator voltage
- Thyristor conduction supervision via AC thyristor current measurement or detection of field voltage shape
- Soft start-up (provides smooth SynCon voltage increase according to required ramp)
- Interface to control system via suitable protocol
- Power System Stabilizer
- Provision to connect to LAN and NTP time server
- All Alarms and messages with timestamp.
- Fault recorder which records and stores curves in case of alarms or trips

Auxiliary power supply to excitation control and protection shall include suitable redundancy such that failure of one auxiliary source shall not affect excitation system operation.

Operation and monitoring:

Following Local operation and monitoring shall be provided via touch panel integrated in the front door of the control cabinet. Local operation Touch panel shall be Password protected,

- excitation ON/OFF
- setpoint RAISE/LOWER
- AUTO, MANUAL selection
- Voltage-/reactive power regulator or power factor regulator selection
- Alarms acknowledgement
- Indication shall include:
  - Measurement Values (SynCon Voltage and Current, Field current,

SynCon active power, SynCon reactive power, SynCon power factor, etc.)

- Event and Alarm lists
- Other local functions

All alarms of the excitation system are stored and indicated on SOE list in correct time sequence. Furthermore, the two alarms "Excitation Alarm" and "Excitation Trip" are wired to the terminal strip for external use.

Further included components:

- 1 precision Shunt for field current sensing
- All MCBs with supervision contact
- Real measuring, analogue Meters in regulators cabinet front door, for field current, field voltage, stator current and stator voltage
- 4-20 mA signal for remote indication of excitation current
- 4-20 mA signal for remote indication of excitation voltage

9.5 Closed-Loop Control

The set points will be adjusted via the automatic follow-up function.

Each automatic channel shall have its own manual controller for field current control and its own voltage and current transformer for the processing of the SynCon terminal voltage and terminal current.

The excitation system shall provide three modes of operation:

- Manual mode: the excitation current is modified locally via the Human Machine Interface (HMI) installed in the excitation panel, the automatic voltage control functions and the limiters are deactivated (test mode or commissioning mode).
- Automatic Mode local: The automatic voltage control is active and the control setpoint for the terminal voltage control shall be modified via the HMI screen installed in the excitation panel.
- Automatic Mode remote: The automatic voltage control is active and the control setpoint for the terminal voltage control shall be modified via plant operation and control interface.

The excitation system shall be electrically and thermally capable of delivering continuously up to 110 % of the rated field current required at design ambient temperature.

The initial response ceiling voltage of the excitation system shall be adequate to meet the step response conditions as verified by Contractor/TSP - Synchronous Condensers design. The SEE shall be able to deliver a ceiling field voltage of minimum *160%* of the rated field voltage (field voltage

applicable at rated field current, rated SynCon terminal voltage and defined rated reactive power rating of the SynCon).

The limiting functions of the automatic channel ensure that the SynCon is operated within its capability limits during grid operation. The following limiting and control functions shall be included:

- Stator current limitation
- Maximum field current limitation (field forcing)
- Over excitation limitation (field current)
- Under excitation limitation
- V/f limitation

The excitation system shall be provided with strategic spare parts.

The Excitation System shall have following step response characteristics:

	Description	Time
Response time	The duration from a step change in control signal until the voltage changes by 90% of its final change, before any overshoot.	Minimum 1 sec
Settling time	With the Syncol Unit unsynchronised following a disturbance equivalent to a 5% step change in the sensed Syncol Unit terminal voltage	Maximum 1.5 sec
	With the Syncol Unit	Maximum 2.5 sec
	Following any disturbance which causes an excitation limiter to operate.	Maximum 5sec

9.6 Power System Stabilizers

Power System Stabilizers (PSS) are used to enhance damping of power system oscillations through excitation control(s). TSP shall implement PSS controls in line with IEEE Standards 421. The PSS controller shall have configurable range of frequency (to damp) to have a flexibility during the operation phase.

9.7 Power Supply

In case of SEE, the excitation transformer shall be connected to SynCon isolated phase bus duct between generator circuit breaker and unit step up transformer or shall be supplied from the MV-busbar system. The excitation transformer shall be a three-phase, two-winding converter transformer. In the case of a Brushless Excitation System, the SynCon shall be provided with a shaft-mounted Permanent Magnet Generator (PMG) to supply independent power to the Excitation System, while the main rotor field excitation power shall be derived from the shaft-mounted AC exciter through rotating rectifiers.

9.8 Operating Aspects

The communication interface between the Excitation System and the plant operating control system shall have redundant connection.

Signal exchange to the Excitation System shall comprise all commands for Excitation System and SFC operation and the set-point values for different Excitation System closed loop controls. The opposite direction from the Excitation System to the Synchronous Condenser unit control system shall include the feedback signals, actual values, and several alarm signals.

An operator control panel shall be installed on the front door of the control cabinet. Local or remote operation can be selected by using the key switch at the control cabinet door.

The operator control panel shall provide all required software tools to configure, maintain, and troubleshoot the excitation systems.

10. STARTING SYSTEM

The machine starting system shall be supplied as a complete system including all equipment, control and power part, hardware and software, to perform, control and supervise the actual start-up process.

The static frequency converter (SFC) shall be provided to accelerate the synchronous condenser from any speed to the nominal speed, so as to allow the synchronous condenser units connection to the network. Specifically, if any synchronous condenser is freewheeling (e.g. following a trip), the synchronous condenser shall be able to be accelerated by the SFC, without the need of having the synchronous condenser come to a complete rest. In addition to this the drive shall have the capability to decelerate the synchronous condenser following GCB opening.

The synchronous condenser, the excitation system, the start-up system, the start supply transformer etc. shall not be overloaded in any respect; thermally, over fluxed, high currents / voltages or torque etc.

The normal start sequence duration shall be approximatively 30 min. (estimated time, required starting time< 30min) from the first rotation to required overspeed for successful synchronization.

At standstill, at the initialization of a sequence, the excitation shall be activated and supplying an excitation current to the rotor winding of the machine.

The SFC equipment will increase the frequency of the compensator until a running speed required for successful synchronization is achieved.

At this running speed of the SFC equipment, excitation is disconnected, and the exciting system of the compensator shall be activated.

The compensator achieves rated voltage and is synchronized into the grid.

If the synchronizing is unsuccessful, 2 further attempts shall be allowed.

11. Noise Levels

The overall noise level of the Synchronous Condensers Units yard shall be no greater than 85 dB(A) when measured at a distance of one metre and at a height of 1.5 metre from any equipment except SynCon. In case of SynCon, the noise level when measured at approximately 1 m distance from the Synchronous condenser surface during normal operation at rated ratings & ambient conditions shall not be more than 90 dB(A).

12. Step-up Power Transformer

The TSP shall provide single phase step-up transformers to operate as 3-phase bank with one unit as a common spare for stepping up the voltage from a suitable medium voltage value to 400 kV system as required for replacing any one of the faulty phase units. Alternatively equivalent 3-ph transformer can also be provided, in which case spare transformer of same rating shall also be provided.

TSP can have a common spare as mentioned above for all such SynCon Units whose Step up Transformer rating is same.

Step up Transformer shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above voltage class)" as amended up to date available on CEA website.

The Transformer shall be designed with the aim to achieve operation according to the overall performance requirements of the SynCon Station. The transformer should be designed and rated to carry complete capacitive and inductive reactive loading as specified for SynCon Station as well as harmonic currents associated with the most onerous operating conditions of SynCon Station, without loss of life.

The transformer shall be designed in accordance with the most up-to-date experience in SynCon application and shall incorporate the latest improvements of design currently employed in the industry. The Comprehensive design review of the Transformer of SynCon Station shall be carried out by the TSP.

12.1 General Requirements

The coupling transformer shall be designed electrically and mechanically for operating conditions peculiar to SynCon Station operation, which shall include, but not be limited to the following:

a) The transformer and all its accessories like Bushings, CTs etc. shall be designed to withstand without damage, the thermal and mechanical effects of any external short circuit to earth and of a short circuit across the terminals of any winding for a period of 3 seconds. The short circuit level of the 400 kV system to which the transformer shall be connected, will be as per the maximum short circuit level of the main substation. Short Circuit level of the Transformer shall be as per the Short Circuit level of the respective Substation. Short circuit level for HV bushing shall be 63 kA for 1 Sec.

b) The transformer shall be capable of being loaded in accordance with IEC 60076 or the overload conditions as specified whichever is the worst. There shall be no limitation imposed by bushings during its terminal fault.

c) The transformer shall be capable of withstanding the mechanical stresses caused by symmetrical or asymmetrical faults on any winding.

d) All protection class Current Transformers in the transformer shall be of PX/PS type. Other details of these Current Transformers shall be as per protection/metering requirements and shall be decided during detailed engineering. However, the parameters of the Winding Temperature Indicator (WTI) of Current Transformer for each winding shall be as per the Transformer manufacturer.

e) Transformers shall be capable of operating under natural cooled conditions up to the specified load. The forced cooling equipment shall come into operation by pre-set contacts of winding temperature indicator and the transformer shall operate as a forced cooling unit initially as Oil Natural Air Forced (ONAF) up to a specified load and then as Oil Forced Air Forced (OFAF). Cooling shall be so designed that during total failure of power supply to cooling fans and oil pumps, the transformer shall be able to operate at full load for at least ten (10) minutes without the calculated winding hot spot temperature exceeding 140° (degree) Celsius. Transformers fitted with two coolers, each capable of dissipating 50 percent of the heat due to losses at the continuous maximum rating, shall be capable of operating for 20 minutes in the event of failure of the oil circulating pump or blowers associated with one cooler without the calculated winding hot spot temperature exceeding 140° degree Celsius at continuous maximum rating.

f) The transformer shall be free from any electrostatic charging tendency (ECT) under all operating conditions when all oil circulation systems are in operation. In general, the oil flow speed shall not exceed 1.0

m/sec within winding in the oil flow system of the transformers. The manufacturer shall ensure that there is no electrostatic charging tendency in the design.

The Technical Parameters of the Transformer shall be as below

Table 3

Sl. No.	Description	Unit	Technical Parameters
1.1	Rated Capacity		
	HV	MVA	To meet the performance requirement and ratings of SynCon. The transformer shall be suitable for 100% reactive loading
	MV	MVA	
1.2	Voltage ratio (Line to Line)		XX (*)/400 kV
1.3	Single / Three Phase Design		Single phase/Three phase
1.4	Applicable Standard		IEC 60076
1.5	Rated Frequency	Hz	50
1.6	Cooling and Percentage Rating at different cooling		ONAN/ONAF/OFAF or ODAF): 60% / 80%/100% OR ONAN/ONAF1/ONAF2: 60% /80%/100% OR OFAF (with 5 x 25% unit cooler if required)
1.7	Impedance at 75°C (in percentage)		
	HV–MV		To suit the design requirements
1.8	Tolerance on Impedance (HV-MV)	%	As per IEC
1.9	Service		Outdoor
1.10	Duty		Continuous Reactive loading
1.11	Overload Capacity		IEC-60076-7

Sl. No.	Description	Unit	Technical Parameters
1.12	Temperature rise over 50 °C ambient Temp		
i)	Top oil measured by thermometer	0C	50
ii)	Average winding measured by resistance Method	0C	55
1.13	Windings		
i)	System Fault level		
	HV	kA	63
	MV	kA	To suit the design requirements.
ii)	Lightning Impulse withstand Voltage		
	HV	kVp	1425
	MV	kVp	*
	Neutral	kVp	170
iii)	Switching Impulse withstand Voltage		
	HV	kVp	1175
iv)	One Minute Power Frequency withstand Voltage		
	HV	kVrms	630
	MV	kVrms	*
	Neutral	kVrms	70
v)	Neutral Grounding		Solidly grounded
vi)	Insulation		
	HV		Graded
	MV		Uniform
vii)	Tan delta of winding	%	< 0.5
1.14	Vector Group (3 – ph) (unless specified differently elsewhere)		YNd*
1.15	Tap Changer		*
1.16	Bushing		
i)	Rated voltage		
	HV	kV	420
	MV	kV	*
	Neutral	kV	36
ii)	Rated current (Min.)		
	HV	A	*
	MV	A	*

Sl. No.	Description	Unit	Technical Parameters
	Neutral	A	*
iii)	Lightning Impulse withstand Voltage		
	HV	kVp	1550
	MV	kVp	*
	Neutral	kVp	170
iv)	Switching Impulse withstand Voltage		
	HV	kVp	1175
v)	One Minute Power Frequency withstand		
	Voltage		
	HV	kVrms	750
	MV	kVrms	*
	Neutral	kVrms	77
vi)	Minimum total creepage distances		
	HV	mm/kV	31
	MV	mm/kV	31
	Neutral	mm/kV	31
vii)	Tan delta of bushings*		
	HV	%	≤ 0.5
	MV	%	
viii)	Max Partial discharge level at Um		
	HV	pC	10
	MV	pC	10
	Neutral		-
1.17	Max Partial discharge level at 1.58 * Ur /√3	pC	100
1.18	Max Noise level at rated voltage and at principal tap at no load and all cooling Active	dB	80
1.19	**Maximum Permissible Losses of**		
	Transformers		
i)	Max. No Load Loss at rated voltage and Frequency	kW	To suit the design requirements.
ii)	Max. Load Loss at maximum continuous current and at 75° C	kW	To suit the design requirements.

Sl. No.	Description	Unit	Technical Parameters
iii)	Max. Auxiliary Loss at rated voltage and Frequency	kW	To suit the design requirements.

Tan δ value of OIP/RIP/RIS condenser bushing shall be 0.005 (max.) in the temperature range of 10°C to 40°C. If tan delta is measured at a temperature beyond above mentioned limit, necessary correction factor as per IEEE shall be applicable. The measured Tan δ value at site should not exceed by 0.001 w.r.t. factory results (measured at approx. similar temperature conditions) during warrantee period

Notes:

1. *No external or internal Transformers / Reactors are to be used to achieve the specified HV/MV impedances.*
2. *The criteria for Transformer losses shall be "Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)".*

(*) marked parameters shall be decided based on SynCon manufacturer's requirement

13. Generator Circuit Breaker

The Circuit Breaker shall in general be of G2/M2 class and comply to IEC/IEEE 62271-37-013:2021. They shall satisfy the General Technical Requirements and shall be designed to operate in the environmental conditions specified in this specification.

14. Bus duct

(a) The generator bus duct shall comply with the requirements of the latest versions of relevant Indian Standards or International Electrotechnical Commission standards.

(b) The bus duct shall be designed to carry maximum continuous current under normal site conditions without exceeding temperature rise limits. Based on these requirements standard size of bus duct as per relevant Indian Standards or International Electrotechnical Commission standards shall be used.

(c) Generator bus duct shall be segregated or isolated phase type. Bus duct rated more than 3150 Amperes shall be isolated phase type. The isolated phase ducts shall be preferred over the segregated phase bus ducts. The bus duct rated more than 6000 Amp shall be continuous isolated phase type.

(d) A hot air blowing system or air pressurization system shall be provided to prevent moisture deposition in case of isolated phase busducts while space heaters may be provided in case of other bus ducts.

15. Selection of Insulation Levels

15.1 Surge Arrestors

Protective levels of arresters connected to the 400 kV AC Bus Bars of the SynCon Station shall be coordinated with the insulation and surge arrester Characteristics of the 400 kV AC systems to which the SynCon Station is to be connected. The specification and characteristics of the surge arresters installed in 400 kV AC system is given in Substation specification. The front of wave (FWWL), lightning impulse (LIWL) and switching impulse (SIWL) withstand levels shall be determined by the following margins:

a) A SIWL at least 1.15 times the switching impulse protection level.
b) A LIWL which is an IEC standard level corresponding to the SIWL and shall be at least 1.25 times the lightning impulse protection level.
c) A FWWL which is at least 1.25 times the front of wave protection level.

In addition to above minimum basic requirement the various insulations level of 400 kV equipment shall be as below. The SynCon Station equipment, coupling transformers etc. shall be co- ordinated accordingly.

	SIWL	LIWL
All equipment other than Transformer Bushing and winding	1175 kVp	1550 kVp

15.2 Air clearances

The air clearances shall be determined by the TSP based on the required withstand levels for all waveforms in order to limit the probability of flashover within the SynCon Station to a target value of one flashover in 15 years.

15.3 Switchyard

The air clearances for switchyard equipment shall be equal to or greater than minimum values as specified in IEC-60071. Altitude correction factor (if any) shall also be considered as per IEC.

15.4 Leakage distances

The Creepage/leakage distance across insulation shall be determined by the TSP and shall be adequate to ensure that under condition of heavy pollution, the probability of a flash over of an insulator does not exceed one in 15 years. However, the leakage distance for all AC insulators for outdoor installation shall not be less than 25 mm/kV of the maximum operating phase to earth rms voltage at the insulator. The leakage distance of equipment connected to 400 kV systems shall not be less than 10500 mm.

Specific creepage distance for outdoor bushings, insulator strings and long rod insulators shall be minimum 31mm/kV.

16. PROTECTION SYSTEM

The synchronous condenser unit shall have a protection system with necessary back-ups to protect the equipment from critical failures and faults. The protection systems shall be secure and reliable to minimize any damage due to faults in the system. Protection relays shall be numerical type.

The mechanical protection (overtemperature, vibration) should be implemented in SynCon control panel system.

16.1 General Protection Concept

The function of the protective equipment is the detection of faults and the minimization of further damages. The selected protective system must ensure that faults are detected fast, selectively acted upon, and announced to the owner of the station. The protection system must ensure correct behavior during normal operation of the synchronous condenser unit even in case of faults outside the protected zone. The protective systems shall be independent of other equipment according to the protection philosophy.

The protection equipment must be designed with a comprehensive monitoring function to provide a high level of reliability and to avoid unnecessary shutdowns due to protection equipment malfunction. The monitoring system must elicit an alarm and block protection in case of internal defects.

A redundancy concept of the protection system design shall apply to the SynCon and the machine transformer consistently throughout by duplicating all the essential components. All implemented protection functions shall be doubled in the main A and main B protection relays. The redundancy starts with separate instrument transformer cores and continues through the protection relays and trip signal, which must pass through separate DC voltage paths to switchgear with 2 circuit-breaker trip coils. All protection zones shall have overlapping zones by using different CT's or CT cores. The protection relays shall be mounted in separate panels for A and B protection.

The auxiliary transformers shall be protected with overcurrent protection function.

16.2 Protection zones

The protection system for the synchronous condenser unit must be divided into various protection zones:

- Protection for the high voltage side of machine transformers
- Protection for the machine transformer included the isolated phase bus
- Protection for the synchronous condenser
- Protection for the MV/Auxiliary transformer

For the main protection zones common tripping relays must be used for protection A and B.

All types of faults that shall be detected by the protection system.

- Heavy short circuit faults (2 / 3 phase- and double earth fault) based on differential (ANSI 87) and overcurrent measuring (ANSI 50/51) principle.
- Single earth faults at the SynCon side of the transformer and IPB system by displacement voltage detection without selection where the fault happened.

16.3 Protection Functions

A. Minimum Synchronous Condenser Protection Functions

Function	Main A	Main B
Biased SynCon Differential Protection (87	Y	Y
95% Stator Earth Fault Protection (64 G1)	Y	N
100% Stator Earth Fault Protection (64 G2)	N	Y
Loss of Field Protection (40G)	Y	Y
Backup Impedance Protection (21G)	Y	Y
Overvoltage Protection (59G)	Y	Y
Negative Phase Sequence Current	Y	Y
Under Frequency Protection (81G)	Y	Y
Overload Protection for SynCon (51G)	Y	Y
Rotor Earth Fault Protection (64R)	Y	Y
Under Excitation Protection	Y	Y
Bearing Current Protection (50SC)	Y	Y
SynCon Pole slipping protection (98G)	Y	Y
Excitation System Overcurrent Protection (50/51 EXE)	Y	Y
Dead machine (27/50G)	Y	Y

B. Step Up Transformer Protection Functions

Function	Main A	Main B
Steep-up transformer differential protection (87T)	Y	Y
Restricted earth fault protection	Y	Y
Overcurrent Protection	Y	Y

Function	Main A	Main B
Over fluxing Protection	Y	Y
Back-up earth fault protection on Step-up transformer HV neutral (51NGT)	Y	Y
Buchholz Protection	Y	N
Pressure relief valve (PRV) Protection	N	Y
LV Winding Temperature Protection	N	Y
HV Winding Temperature Protection	Y	N
Oil temperature Protection (49)	Y	Y

C. Unit Transformer Protection Functions (Auxiliary Transformers)

Function	Main A	Main B
Restricted earth fault protection (64)	Y	Y
Instantaneous over current protection (50)	Y	Y
IDMT over current protection (51)	Y	Y
Back up Earth Fault Protection	Y	Y
Buchholz Protection	Y	N
Pressure relief valve (PRV) Protection	N	Y
LV Winding Temperature Protection	Y	N
HV Winding Temperature Protection	N	Y
Oil temperature Protection (49)	Y	Y

D. Pony Motor Protection Functions (if applicable)

Function	Main A	Main B
Overcurrent	Y	N
Overload / Thermal Protection	Y	N
Undercurrent Protection	Y	N
No of Starts Limiter	Y	N

E. Generator Circuit Breaker

Function	Main A	Main B

Current Checked Circuit Breaker Failure	Y	N
Trip Circuit Supervision	Y	Y
Synchronizing	Y	N

F. Breaker Failure Protection

a) High voltage circuit breaker

Each trip to the high voltage circuit breaker must simultaneously initiate a breaker failure start in the high voltage feeder protection system. This signal must be integrated in the high voltage feeder protection relay, which executes the breaker failure protection.

b) Generator circuit breaker

In case the generator circuit breaker does not open after a trip command, the breaker failure function in the SynCon protection relay must send an inter-trip signal to the high voltage circuit breaker.

The start of the breaker failure protection shall be realized over a signal from the trip relays to a binary input to the protection relays. This ensures that all trip signals will start the breaker failure function. The breaker failure protection supervises the current and the auxiliary contacts of the circuit breaker.

Generator Circuit Breaker Control

The control of the generator circuit breaker and the related disconnectors/earthing switches shall be implemented in synchronizing device.

Interlocking

The electrical interlocking shall be implemented in the software logic of the control device. The interlocking shall be realized with hardwired release signals. The release signal of the earthing switch and disconnector to and from the HV switchgear will be send as electrical signal. The earthing switch on the SynCon side must be interlocked with a release signal from the SynCon control system (it is only possible to close the earthing switch if the SynCon is stopped).

Synchronizing the SynCon

For the Synchronous condenser synchronizing a synchronizing relay shall be used. This synchronizing relay must work as a synchronizer. The synchronization of the SynCon to the grid shall be part of the start sequence of the SynCon control. In the synchronization step, synchronizing device monitor the voltage, the frequency, and the phase angle on both sides of the generator circuit breaker. The synchronization

device will send increase or decrease commands to the excitation system until the Synchronous condenser voltage matches the grid voltage. If the voltage, frequency, and phase angle are within the set limits the close command to the generator circuit breaker will be issued by the synchronizing device.

16.4 Control and Protection SFC-MV Switchgear

The control of the medium voltage feeder for the SFC can be implemented in multifunctional control & protection relays.

16.5 Control of Auxiliary System

The control of the auxiliary system shall be implemented in the SynCon control panel.

16.6 Voltage Regulator for the Tap Changer

The control of the voltage regulator of the Main Transformer (On Load Tap-Changer) and monitor auxiliary transformer (Off Load Tap-Changer) shall be implemented in a SynCon control panel.

16.7 Communication and Time Synchronization

Communication to Control System

The protection and control devices shall be connected to the plant control system through an optical Ethernet communication network configured in a ring or other redundant topology. Communication shall be based on the IEC 61850 standard. All protection and control signals, including trip signals, shall be transmitted to and processed within the plant control system and shall be displayed and monitored through the HMI system.

Time synchronization must be realized over the same interface. Time synchronization to protection devices shall be over network time protocol. TSP shall follow CEA (Cyber Security in Power Sector) Guidelines, 2021.

16.8 Specific Requirement for Phasor Measurement Units (PMUs)

TSP shall supply, install and commission required No. of Phasor Measurement Units (PMUs) as per the "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" issued vide CEA letter No. CEA-PS-14-12/9/2024-PSETD Division dated 19.03.2025 for the SynCon. The PMUs shall be provided with LAN switch and shall connect with LAN switch of control room of respective substations/ generating stations with Fibre Optic cable. The PMUs shall be connected with the FOTE at Substation/ generating stations for onwards data transmission to the PDC (Phasor Data Concentrator) located at respective RLDC. Configuration work in existing PDC at RLDC for new PMU integration shall be done by respective RLDC, however all the necessary support in this regard shall be ensured by TSP. The maintenance of all the PMUs and associated equipment shall be the responsibility of TSP.

Note: Existing Station owner/s to provide necessary support to integrate different equipment and applications of new extended bays with the existing substation e.g. Communication (through FOTE), Voice etc. for smooth operation and monitoring of new added grid elements.

16.9 Fault Recorder

Devices

The integral fault recorder function of the protection relay shall be used for recording of the current, the voltage and the trip signals during a fault in the electrical system.

If a trip occurs anywhere within the system, all fault recorders of all protection relays shall be triggered by a hardwired binary signal. This ensures that all relevant binary and analogue signals of the whole system will be recorded in case of a fault.

For testing and monitoring purpose, a manual trigger of the fault recorders must be foreseen.

Data Storage

The transfer of the fault/ disturbance records should be performed over the communication interface and the IEC61850 protocol.

Fault Analyses

Evaluation and analyses of the fault records take place on the engineering workstation.

16.10 Generator Disturbance Recorder (DR)

a) One No. microprocessor-based Disturbance Recorder (DR) shall be provided for each synchronous condenser to record graphic form of instantaneous values of voltage and current in all three phases and neutral, open and closed positions of relay contacts and breaker during disturbances.

b) It shall have the facility for slow and fast scan to record transient and dynamic performance of the system.

c) Both slow and fast scan facility shall have atleast 8 analog and 16 digital inputs.

d) The slow scan facility shall be provided with the following minimum features

- The input shall be MW, MVAR, field voltage, frequency and generator terminal voltage etc. Any transducers, if required for interfacing, shall be provided.

- It shall be suitable to record the frequency excursions and response of generator field and governor control on system fluctuations.
- It shall have options to select the scan rate in the range having a min. of 10Hz suitable to facilitate capture of low frequency waveforms in the range of 0.5 - 3Hz.
- The non-volatile memory shall be suitable for recording for a minimum of 15 minute at scan rate corresponding to selected pre-fault zone of recording.

e) The fast scan facility shall be provided with the following minimum features

- The input shall be voltages and current etc. Any transducers, if required for interfacing, shall be provided.
- It shall have scan rate of 1000 Hz or better for sampling each of the analog channel having fundamental frequency of 50 Hz. The frequency response for these channels shall be DC on the lower side to 500 Hz or better on the upper side. Any interposing devices provided shall be suitable for this frequency response.
- The pre and post fault recording time shall be atleast 200 ms and 5s respectively.

f) All external and internal faults in the DR equipment such as power supply fail, printer faults, paper exhausting, processor failure, memory failure etc. are to be indicated by means of light emitting diodes on the front of the panel of restitution unit. The DR shall be provided with a MMI (man machine interface) through a PC with VDU, keyboard and printer.

g) The internal clock of the system shall be synchronized through the GPS. The output shall be in IEEE/ COMTRADE format. The format shall be compatible for dynamic protection Relay Test Kit Necessary interfacing and software for analysis shall also be provided.

h) The amplitude resolution of the analog channels shall not be less than 16 bit and event resolution for digital channels shall be 1ms or better.

16.11 Metering

Operational Metering

The unit operational metering is measured by multifunction meter and linked to synchronous condenser control system for operation and control purposes.

16.12 SynCon Station Auxiliary Power Supply

The auxiliary supply of SynCon Station shall conform with the system requirements relating to reliability, availability, and redundancy, performing continuously to help ensure that the complete SynCon Station operates as

per the requirements. SynCon Station Auxiliary supply including all necessary switchgear (viz. AC/DC, lighting boards etc.) shall be completely separate from the main 765/400/220 kV substation auxiliary supply, all loads of SynCon station shall be fed from this supply. The auxiliary supply provides power to the excitation system, starting system, controllers, cooling system, station supplies, and various other essential and non-essential loads. All essential loads are connected to the DC system of the SynCon Station which is also to be provided separately from the DC system of the main 765/400/220 kV substation.

The auxiliary supply system shall be able to provide a stable supply for the SynCon Station during system faults such as single-phase faults, phase-to-phase faults, and three-phase faults and LVRT (Low Voltage Ride Through) to allow continuous operation of the SynCon Station during these transient events.

Auxiliary Supply System of SynCon Station shall be fed from two independent sources as per CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007. In addition to this one emergency incomer from DG set shall also be there. DG set of SynCon Station shall be separate from DG set of Main Substation.

16.13 Power and control cables, and cabling

(i) For essential auxiliaries, the power and control cables shall be of fire survival type. All other Power and control cables shall be of flame retardant low smoke (FRLS) type.
(ii) Cables to be directly buried shall be essentially armoured type.
(iii) Flame retardant low smoke cables and fire survival cables shall meet test requirements as per relevant American Society of Testing and Materials, International Electrotechnical Commission, Institute of Electrical and Electronics Engineers and Swedish Standards.
(iv) Derating factors for site ambient and ground temperatures, grouping and soil resistivity shall be considered while determining the size of cables.
(v) Cable installation shall be carried out as per relevant IS and other applicable standards.
(vi) Power cables and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables with higher voltage grade cables in topmost tier and control cables in bottommost tier.
(vii) All cables associated with one unit shall preferably be segregated from cables of other units.

(iv) Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.

16.14 Fire Protection System for SynCon Station:

Necessary fire protection for SynCon units and Step-up Transformer shall be required. The main features of these protections are as under.

A) Fire Detection and Alarm System:

Suitable fire detection system using smoke detectors and/or heat detectors shall be provided in SynCon Station for all room and areas. These smoke fire detection systems shall be connected to a separate Fire annunciation system clearly identifying the zone.

B) Hydrant System:

The hydrant system shall be extended from fire-fighting system of the substation in the yard. Suitable number of hydrants shall be provided for protection of SynCon Station equipment in the yard namely Step-up Transformers etc. as applicable for the station. Further suitable number of hydrants shall also be provided for SynCon Station building

HVW System:

HVW (High Velocity Water) Spray system shall be provided for Step-up transformers. The tapping for HVW system shall be done from nearby transformer/Reactor or any other suitable point of the main substation fire-fighting line.

Fire protection system shall be provided in accordance with the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2023.

17. VISUAL MONITORING SYSTEM FOR WATCH AND WARD OF SynCon STATION

Visual monitoring system (VMS) for effective watch and ward of SynCon station premises covering the areas of entire switchyard, SynCon building, Coupling Transformer, Cooling Towers and Main gate, shall be provided. The TSP shall design, supply, erect, test and commission the complete system including cameras, Digital video recorder system, mounting arrangement for cameras, cables, LAN Switches, UPS and any other items/accessories required to complete the system.

System with Colour IP Cameras for VMS surveillance would be located at various locations including indoor areas and outdoor switchyard. The VMS data partly/completely shall be recorded (minimum for 15 days) and stored on network video recorder.

Features of VMS system shall be as those specified for main substation. The number of cameras and their locations shall be decided in such a way that any location covered in the area can be scanned. The cameras shall be located in such a way to monitor at least:

a) Step-up Transformers.

b) SynCon Cooling System, Electrical and Mechanical Auxiliary area.
c) Entrance to SynCon Station.
d) All other Major Equipments (such as CB, CT, VT, SA etc.)

The cameras can be mounted on structures, buildings or any other suitable mounting arrangement.

Advisory on deployment of CCTV issued by Ministry of Electronics and Information Technology (MEITY) shall be followed.

18. Spares, Special Tools and Tackles

Considering high technology proprietary equipment of the SynCon TSP shall ensure necessary spares are procured to maintain the necessary reliability and availability of SynCon Station. Further all necessary special tools and tackles required for erection, testing, commissioning and maintenance of equipment shall also be taken.

19. Losses

19.1 Calculation of losses

The TSP must guarantee total losses of less than 2% of highest reactive power output of SynCon Station at PCC for complete Synchronous Condenser Station, under the following conditions:

a) At 40°C ambient temperature for specified Short Circuit Contribution at Point of Common Coupling
b) Specified rated frequency & voltage at Point of Common Coupling

The TSP shall calculate the total losses of the Synchronous Condenser Unit at each operating point specified below which must meet the guaranteed total losses mentioned above. The calculation of guarantee total losses shall include losses of all the components up to the PCC including losses of the synchronous condenser, flywheel (if applicable), IPB, transformer and the relevant auxiliary systems like pumps, fans, excitation system, building HVAC etc., whether conducting currents or not, based on the above assumptions.

The operating points shall be as follows:

i) Maximum Capacitive Output.
ii) Maximum Inductive Output; and
iii) Zero MVAr Output.

The actual losses shall be measured during SAT.

19.2 Loss measurement

Procedure according to IEC 60034-2-2 using the retardation method

Losses will be determined by measurement of partial losses using retardation method according to the ITP and as specified in IEC 60034-2.1, chapter 7.1.1, method 2-1-2C: Summation of separate losses without a full load test. Short

circuit test for the determination of the additional load losses to be applied for one type of synchronous machine per plant.

20. Availability and Reliability

20.1 Availability

The percentage availability of Synchronous Condenser is defined as follows:

$$\%\ Availability = \frac{Total\ time\ SynCon\ is\ able\ to\ Perfrom\ specified\ Duty}{Total\ time\ Period} x\ 100$$

Synchronous Condenser shall be considered to be available for service only if it is able to perform the whole of the specified duty. Operation with limited control functions or within a limited range of outputs (any parameters i.e. Inertia, Short Circuit MVA and Capacitive and Inductive MVAr) due to a subsystem failure shall be treated as unscheduled servicing downtime. The period basis for availability calculation shall be 12 months (365 days).

The total time period during which the SynCon Station is not able to perform the specified duty shall include Planned Outage hours (POH), Maintenance Outage Hours (MOH) and Forced Outage Hours (FOH).

Planned Outage (POH = Planned Outage Hours) is the state where the Equipment is unavailable due to Planned Maintenance activities (Scheduled Routine Maintenance, Scheduled Annual and Biennial Maintenance, Small Revisions and Major Revisions) that require the shutdown of the Equipment. Such activities leading to a Planned Outage.

Unplanned Outage

Unplanned Outage is the state where the Equipment is unavailable but is not in the Planned Outage state.

The Unplanned Outage can be due to **Forced Outage Hours** (FOH = Forced Outage Hours) or due to **Maintenance Outage Hours** (MOH = Maintenance Outage Hours)

Forced Outage is considered as an outage that requires removal of the Equipment from the Available State **immediately** or **within 7 days maximum**.

Maintenance Outage is considered an outage that **does not require immediate removal** from the Available State but requires the Equipment to be removed from the Available State **before the next Planned Outage**. This is scheduled **at least 7 days in advance** (otherwise it's classified as FOH).

20.2 Reliability

In the assessment of reliability, the following events shall also be considered to constitute a SynCon Station outage:

i) A SynCon Station shut down.

ii) A reduction of SynCon Station capacity (any parameters i.e. Inertia, Short Circuit MVA and Capacitive and Inductive MVAr) due to an outage of any component of SynCon Station

The calculated reliability of the complete SynCon Station shall be equal to or exceed the following design target values

	Design target for SynCon Station	Max acceptable Guaranteed value for SynCon Station
Total Number of Forced Outages	3	5

Here definition of Forced Outage shall be considered as same as given in the "20.1 Availability".

The period basis for availability calculation shall be 12 months (365 days).

21. Training on Synchronous Condenser

As a part of project, it shall be under the scope of TSP to provide the training regarding design, manufacturing, construction, testing, control & protection aspects of Synchronous Condenser at Manufacturer's works and training on operation & maintenance at some commissioned Project of the manufacturer for atleast 10 man-months to officials from CEA/CTU/Grid India in addition to its own manpower for the project.

Annexure D

Contingency Cases for Barmer-II SYNCON

A) N-1 Contingency

Contingency at 765 kV level

1. Three Phase Fault close to 765 kV bus of Barmer-I PS followed by tripping of one circuit of Barmer-I PS–Merta-II 765 kV D/c line (fault persist for 100 ms)
2. Single Phase to Ground Fault close to 765 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS–Merta-II 765 kV D/c line
3. Three Phase Fault close to 765 kV bus of Merta-II S/s followed by tripping of one circuit of Barmer-I PS–Merta-II 765 kV D/c line (fault persist for 100 ms)

4. Single Phase to Ground Fault close to 765 kV bus of Merta-II S/s followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS–Merta-II 765 kV D/c line
5. Three Phase Fault close to 765 kV bus of Barmer-I PS followed by tripping of one circuit of Barmer-I PS–Sirohi PS 765 kV D/c line (fault persist for 100 ms)
6. Single Phase to Ground Fault close to 765 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS–Sirohi PS 765 kV D/c line
7. Three Phase Fault close to 765 kV bus of Sirohi PS followed by tripping of one circuit of Barmer-I PS–Sirohi PS 765 kV D/c line (fault persist for 100 ms)
8. Single Phase to Ground Fault close to 765 kV bus of Sirohi PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS–Sirohi PS 765 kV D/c line
9. Three Phase Fault close to 765 kV bus of Fatehgarh-IV PS (Sec-2) followed by tripping of one circuit of Fatehgarh-IV PS (Sec-2) - Beawar 765 kV D/c line (fault persist for 100 ms)
10. Single Phase to Ground Fault close to 765 kV bus of Fatehgarh-IV PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Fatehgarh-IV PS (Sec-2) - Beawar 765 kV D/c line
11. Three Phase Fault close to 765 kV bus of Beawar S/s followed by tripping of one circuit of Fatehgarh-IV PS (Sec-2) - Beawar 765 kV D/c line (fault persist for 100 ms)
12. Single Phase to Ground Fault close to 765 kV bus of Beawar S/s followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Fatehgarh-IV PS (Sec-2) - Beawar 765 kV D/c line
13. Three Phase Fault close to 765 kV bus of Sirohi PS followed by tripping of one circuit of Sirohi PS-Fatehgarh-IV PS (Sec-2) 765 kV D/c line (fault persist for 100 ms)

14. Single Phase to Ground Fault close to 765 kV bus of Sirohi PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Sirohi PS-Fatehgarh-IV PS (Sec-2) 765 kV D/c line

15. Three Phase Fault close to 765 kV bus of Fatehgarh-IV PS (Sec-2) followed by tripping of one circuit of Sirohi PS-Fatehgarh-IV PS (Sec-2) 765kV D/c line (fault persist for 100 ms)

16. Single Phase to Ground Fault close to 765 kV bus of Fatehgarh-IV PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Sirohi PS-Fatehgarh-IV PS (Sec-2) 765kV D/c line

Contingency at 400 kV level

17. Three Phase Fault close to 400 kV bus of Barmer-II PS followed by tripping of one circuit of Barmer-II PS –Fatehgarh-IV PS (Sec-2) 400kV D/c line (fault persist for 100 ms)

18. Single Phase to Ground Fault close to 400 kV bus of Barmer-II PS-IV PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-II PS – Fatehgarh-IV PS (Sec-2) 400kV D/c line

19. Three Phase Fault close to 400 kV bus of Fatehgarh-IV PS (Sec-2) followed by tripping of one circuit of Barmer-II PS –Fatehgarh-IV PS (Sec-2) 400kV D/c line (fault persist for 100 ms)

20. Single Phase to Ground Fault close to 400 kV bus of Fatehgarh-IV PS(Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-II PS – Fatehgarh-IV PS (Sec-2) 400kV D/c line

21. Three Phase Fault close to 400 kV bus of Barmer-II PS followed by tripping of one circuit of Barmer-I PS –Barmer-II PS 400 kV D/c line (fault persist for 100 ms)

22. Single Phase to Ground Fault close to 400 kV bus of Barmer-II PS-IV PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS –Barmer-II PS 400 kV D/c line

23. Three Phase Fault close to 400 kV bus of Barmer-I PS followed by tripping of one circuit of Barmer-I PS –Barmer-II PS 400 kV D/c line (fault persist for 100 ms)

24. Single Phase to Ground Fault close to 400 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS –Barmer-II PS 400 kV D/c line

25. Three Phase Fault close to 400 kV bus of Barmer-I PS followed by tripping of one circuit of Barmer-I PS –Fatehgarh-III PS (Sec-2) 400 kV D/c line (fault persist for 100 ms)

26. Single Phase to Ground Fault close to 400 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the

faulted line i.e. tripping of one circuit of Barmer-I PS –Fatehgarh-III PS (Sec-2) 400 kV D/c line

27. Three Phase Fault close to 400 kV bus of Fatehgarh-III PS (Sec-2) followed by tripping of one circuit of Barmer-I PS –Fatehgarh-III PS (Sec-2) 400 kV D/c line (fault persist for 100 ms)

28. Single Phase to Ground Fault close to 400 kV bus of Fatehgarh-III PS(Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Barmer-I PS – Fatehgarh-III PS (Sec-2) 400 kV D/c line

29. Three Phase Fault close to 400 kV bus of Fatehgarh-IV PS (Sec-2) followed by tripping of one circuit of Fatehgarh-IV PS (Sec-2) –Bhinmal S/s 400 kV D/c line (fault persist for 100 ms)

30. Single Phase to Ground Fault close to 400 kV bus of Fatehgarh-IV PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Fatehgarh-IV PS (Sec-2) –Bhinmal S/s 400 kV D/c line

31. Three Phase Fault close to 400 kV bus of Bhinmal S/s followed by tripping of one circuit of Fatehgarh-IV PS (Sec-2) –Bhinmal S/s 400 kV D/c line (fault persist for 100 ms)

32. Single Phase to Ground Fault close to 400 kV bus of Bhinmal S/s followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. tripping of one circuit of Fatehgarh-IV PS (Sec-2) –Bhinmal S/s 400 kV D/c line

B) N-1-1 Contingency

Contingency at 765 kV level

33. Case 1 + Single Phase Fault close to 765 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Barmer-I PS–Merta-II 765 kV D/c line

34. Case 3 + Single Phase Fault close to 765 kV bus of Merta-II S/s followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Barmer-I PS–Merta-II 765 kV D/c line

35. Case 5 + Single Phase Fault close to 765 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and successful re-

closure (dead time 1 second) of 2nd circuit of Barmer-I PS–Sirohi PS 765 kV D/c line

36. Case 7 + Single Phase Fault close to 765 kV bus of Sirohi PS followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Barmer-I PS–Sirohi PS 765 kV D/c line

37. Case 9 + Single Phase Fault close to 765 kV bus of Fatehgarh-IV PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Fatehgarh-IV PS (Sec-2) - Beawar 765 kV D/c line

38. Case 11 + Single Phase Fault close to 765 kV bus of Beawar S/s followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Fatehgarh-IV PS (Sec-2) - Beawar 765 kV D/c line

39. Case 13 + Single Phase Fault close to 765 kV bus of Sirohi PS followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Sirohi PS-Fatehgarh-IV PS (Sec-2) line

40. Case 15 + Single Phase Fault close to 765 kV bus of Fatehgarh-IV PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and successful re-closure (dead time 1 second) of 2nd circuit of Sirohi PS-Fatehgarh-IV PS (Sec-2) line

Contingency at 400 kV level

41. Case 17+ Single Phase Fault close to 400 kV bus of Barmer-II PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Barmer-II PS –Fatehgarh-IV PS (Sec-2) 400 kV D/c line

42. Case 19+ Single Phase Fault close to 400 kV bus of Fatehgarh-IV PS(Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Barmer-II PS –Fatehgarh-IV PS (Sec-2) 400 kV D/c line

43. Case 21+ Single Phase Fault close to 400 kV bus of Barmer-II PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Barmer-I PS –Barmer-II PS 400 kV D/c line

44. Case 23+ Single Phase Fault close to 400 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Barmer-I PS –Barmer-II PS 400 kV D/c line

45. Case 25+ Single Phase Fault close to 400 kV bus of Barmer-I PS followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Barmer-I PS –Fatehgarh-III PS (Sec-2) 400 kV D/c line

46. Case 27+ Single Phase Fault close to 400 kV bus of Fatehgarh-III PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Barmer-I PS –Fatehgarh-III PS (Sec-2) 400 kV D/c line

47. Case 29+ Single Phase Fault close to 400 kV bus of Fatehgarh-IV PS (Sec-2) followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Fatehgarh-IV PS (Sec-2) – Bhinmal S/s 400 kV D/c line

48. Case 31+ Single Phase Fault close to 400 kV bus of Bhinmal S/s followed by single pole opening (100 ms) of the faulted phase and unsuccessful re-closure (dead time 1 second) followed by 3-pole opening (100 ms) of the faulted line i.e. 2nd circuit of Fatehgarh-IV PS (Sec-2) –Bhinmal S/s 400 kV D/c line

Contingency at 220kV level

49. Three phase fault close to 220 kV Barmer-II PS bus with Tripping of 400 MW generation at 220KV Barmer-II PS bus

50. Three phase fault close to 400 kV Barmer-II PS bus, with Tripping of 1195 MW generation at 400 kV Barmer-II PS bus

Contingency at HVDC level

51. Outage of one pole of HVDC Bipole of ±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (under forward mode of operation)

52. Outage of one pole of HVDC Bipole of ±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (under 50 % & 100% reversal mode of operation)

Note:

1. In the 'N-1-1' as stated above, if there is a temporary fault, the system shall not lose the second element after clearing of fault but shall successfully survive the disturbance.
2. In case of permanent fault, the system shall lose the second element as a result of fault clearing and thereafter, shall asymptotically reach to a new steady state without losing synchronism. In this new state, the system parameters (i.e. voltages and line loadings) shall not exceed emergency limits, however, there may be requirement of load shedding / rescheduling of generation so as to bring system parameters within normal limits.
3. All contingency cases to be performed in all study files provided by BPC to respective TSP.

Simulation tests to demonstrate the LVRT & HVRT compliance of other requirements of Syncon

Test No.	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
1	1	No	1.0 (Under excited)	Flat run (60s	Yes	Yes
2	1	No	0.1 (Under excited)	Flat run (60s	Yes	Yes
3	1	No	1.0 (Over excited)	Flat run (60s	Yes	Yes
4	1	No	0.1 (Over excited)	Flat run (60s	Yes	Yes
LVRT						
5	0.85	3.0	1.0 (Under excited)	Balanced Three phase	Yes	Yes
6	0.5	1.65			Yes	Yes
7	0.15	0.3			Yes	Yes
8	0.85	3.0		Unbalanced (LL)	Yes	No
9	0.5	1.65			Yes	No
10	0.15	0.3			Yes	No
11	0.85	3.0		Unbalanced (LG)	Yes	No
12	0.5	1.65			Yes	No
13	0.15	0.3			Yes	No

Test No.	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
14	0.85	3.0	0.5 (Under excited)	Balanced Three phase	Yes	Yes
15	0.5	1.65			Yes	Yes
16	0.15	0.3			Yes	Yes
17	0.85	3.0		Unbalanced (LLG)	Yes	No
18	0.5	1.65			Yes	No
19	0.15	0.3			Yes	No
20	0.85	3.0		Unbalanced (LG)	Yes	No
21	0.5	1.65			Yes	No
22	0.15	0.3			Yes	No
23	0.85	3.0	0.25 (Under excited)	Balanced Three phase	Yes	Yes
24	0.5	1.65			Yes	Yes
25	0.15	0.3			Yes	Yes
26	0.85	3.0		Unbalanced (LLG)	Yes	No
27	0.5	1.65			Yes	No
28	0.15	0.3			Yes	No
29	0.85	3.0		Unbalanced (LG)	Yes	No
30	0.5	1.65			Yes	No
31	0.15	0.3			Yes	No
32	0.85	3.0			Yes	Yes

Test No.	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
33	0.5	1.65	1.0 (Over excited)	Balanced Three phase	Yes	Yes
34	0.15	0.3			Yes	Yes
35	0.85	3.0		Unbalanced (LL)	Yes	No
35	0.5	1.65			Yes	No
36	0.15	0.3			Yes	No
37	0.85	3.0		Unbalanced (LG)	Yes	No
38	0.5	1.65			Yes	No
39	0.15	0.3			Yes	No
40	0.85	3.0	0.5 (Over excited)	Balanced Three phase	Yes	Yes
41	0.5	1.65			Yes	Yes
42	0.15	0.3			Yes	Yes
43	0.85	3.0		Unbalanced (LL)	Yes	No
44	0.5	1.65			Yes	No
44	0.15	0.3			Yes	No
45	0.85	3.0		Unbalanced (LG)	Yes	No
46	0.5	1.65			Yes	No
47	0.15	0.3			Yes	No
48	0.85	3.0		Balanced	Yes	Yes
49	0.5	1.65			Yes	Yes

Test No.	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
50	0.15	0.3	0.25 (Over excited)	Three phase	Yes	Yes
51	0.85	3.0		Unbalanced (LLG)	Yes	No
52	0.5	1.65			Yes	No
53	0.15	0.3			Yes	No
54	0.85	3.0		Unbalanced (LG)	Yes	No
55	0.5	1.65			Yes	No
56	0.15	0.3			Yes	No

HVRT

Test No.	PCC Target Voltage (pu)	Duration of voltage swel (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
57	1.5	0.1	1.0 (Over excited)	Balanced Three phase	Yes	Yes
58	1.3	10			Yes	Yes
59	1.1	Continuous			Yes	Yes
60	1.5	0.1		Single phase	Yes	No
61	1.3	10			Yes	No
62	1.1	Continuous			Yes	No
63	1.5	0.1	0.5 (Over excited)	Balanced Three phase	Yes	Yes
64	1.3	10			Yes	Yes

Test No	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
65	1.1	Continuous	0.25 (Over excited)		Yes	Yes
66	1.5	0.1		Single phase	Yes	No
67	1.3	10			Yes	No
68	1.1	Continuous			Yes	No
69	1.5	0.1		Balanced Three phase	Yes	Yes
70	1.3	10			Yes	Yes
71	1.1	Continuous			Yes	Yes
72	1.5	0.1		Single phase	Yes	No
73	1.3	10			Yes	No
74	1.1	Continuous			Yes	No
75	1.5	0.1	1.0 (Under excited)	Balanced Three phase	Yes	Yes
76	1.3	10			Yes	Yes
77	1.1	Continuous			Yes	Yes
78	1.5	0.1		Single phase	Yes	No
79	1.3	10			Yes	No
80	1.1	Continuous			Yes	No
81	1.5	0.1	0.5 (Under excited)	Balanced Three phase	Yes	Yes
82	1.3	10			Yes	Yes
83	1.1	Continuous			Yes	Yes

Test No.	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
84	1.5	0.1		Single phase	Yes	No
85	1.3	10			Yes	No
86	1.1	Continuous			Yes	No
87	1.5	0.1	0.25 (Under excited)	Balanced Three phase	Yes	Yes
88	1.3	10			Yes	Yes
89	1.1	Continuous			Yes	Yes
90	1.5	0.1		Single phase	Yes	No
91	1.3	10			Yes	No
92	1.1	Continuous			Yes	No

Effectiveness of PSS					
Test No.	Pre - fault Reactive Power dispatch (pu)	Nature of fault	PSS (In service/Wo service)	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
93	1.0 (Under excited)	3-phase bolted	With PSS	Yes	Yes
94			W/o PSS	Yes	Yes
95	1.0 (Over excited)		With PSS	Yes	Yes
96			W/o PSS	Yes	Yes

Excitation System Limiter Testing

Test No.	PCC Target Voltage (pu)	Duration of voltage dip (sec)	Pre - fault Reactive Power dispatch (pu)	Nature of voltage dip	To be done in PSCAD (Generic & UDM)	To be done in PSS/E (Generic & UDM)
Test No.	**Target Voltage (pu)**	Pre - fault Reactive Power dispatch (pu)	Description			
97	-5% step of Vref	0.1 (Under excited) (Within the generator's capability curve)	OEL & UEL models to be considered			
98	+5% step of Vref	0.1 (Over excited) (Within the generator's capability curve)	OEL & UEL models to be considered			
99. Excitation System Step Response Testing (Open & close loop)						
100. RoCof Testing (ROCOF) up to 4 Hz/second for 0.25 seconds						
101. RoCof Testing (ROCOF) up to 3 Hz/second for 1 second						
102. Impedance/frequency scan for a frequency range of 0-2500Hz (on SMIB)						
103. Oscillation Rejection Test (on SMIB) for 0.1, 0.3, 0.6, 0.9, 1.0 & 2.0, 3.0, 4.0, 8.0, 10.0 Hz						

SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION

The communication requirement shall be in accordance to CEA (Technical Standards for Communication System in Power System Operations) Regulations, 2020, CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022, CERC (Communication System for inter-State transmission of electricity) Regulations, 2017, CEA (Cyber Security in Power Sector) Guidelines, 2021, CERC Guidelines on "Interface Requirements" 2024 and all above documents as amended from time to time.
The communication services viz. SCADA, AGC (wherever applicable), VoIP, AMR and PMU have been identified as critical services and therefore shall be provisioned with 2+2 redundancy i.e. 2 channels for Main Control Centre and 2 channels for Backup Control Centre. In order to meet this requirement, suitable redundancy at port and card level need to be ensured by the TSP to avoid any single point of failure which may lead to interruption in real-time grid operation.
PMU to PDC communication (wherever required) shall be through 2 channels to the PDC (main) as there is no backup PDC at present.

Accordingly, all the hardware for communication services of station as stated above shall support dual redundancy for data transmission of station to respective main and backup RLDCs.

The complete ISTS communication system commissioned by TSP under the RFP shall be the asset of ISTS and shall be available for usage of ISTS requirements as suggested by CTU from time to time.

In order to meet the requirements for grid management and operation of substations, Transmission Service Provider (TSP) shall provide the following:

For smooth operation of the HVDC system, communication network with high reliability and availability shall be provided for transmission of control and protection signals between the two or more (in case of multi-terminal DC) HVDC terminals. The communication system design shall be as follows:

- Main-I
- Main-II (as hot standby to Main-I)
- Back-up communication

The TSP shall supply, install and commission SDH equipment required for the converter stations at Barmer-II and South Kalamb and the necessary repeater stations. The repeater stations for fibre optic communication are also included in the scope of the TSP. The number and locations of repeaters shall be finalized after a survey by TSP.

COMMUNICATION SYSTEMS GENERAL

Duplicated (2X100%) main communication systems (Main-I and Main-II) at Barmer-II and South Kalamb terminal and its repeaters comprise first cubicle of Main Fibre Optic Terminal equipment (FOTE) and second cubicle of Standby FOTE to be provided to meet the requirements of the control, protection, data transfer and telephone systems. The system shall be based on the fiber optic communication between the converter stations through ± 800 kV DC lines. Each Main and Standby FOTE system shall be independent of each other. TSP to design the optical fiber Communication system between the converter stations in such a way that communication is available even when there is complete failure of one FOTE system. All repeater stations required for the communication system shall be provided by TSP. The TSP shall provide all required equipment, accessories, routers, modems and facilities etc. as required, for successful commissioning and use of the communication channels at Barmer-II and South Kalamb HVDC Bipole terminal.

The backup communication link shall also be provided through OPGW on parallel AC Lines. Necessary support shall be provided by the TSP to other TSP/s whose existing communication network is required to be configured for backup communication. Configuration work shall be done by the backup communication system owner/s for the Barmer-II – South Kalamb HVDC link in coordination with the TSP. TSP shall be responsible for all interface requirements with the Communication system of the other TSP(s) whose OPGW/Communication equipment are required for successful commissioning of the backup communication link including hardware/accessories etc.

C.1.0 ±800 kV HVDC Bipole line between Barmer-II (HVDC) & South Kalamb (HVDC)

On Barmer-II (HVDC) – South Kalamb (HVDC) ±800kV HVDC line, TSP shall supply, install & commission One (1) No. OPGW cable containing 48 Fibres (48F) on one E/W peak and conventional earth wire on other E/W peak. OPGW diameter shall be inline with earthwire parameters mentioned in *'Specific technical requirements for HVDC transmission line'*.

The TSP shall install this OPGW from the gantry of Barmer-II (HVDC) up to the gantry of South Kalamb (HVDC) S/s with all associated hardware including Vibration Dampers, mid-way and gantry Joint Boxes (**called OPGW Hardware hereafter**) and finally terminate in Joint Boxes at end Substations. The transmission line length is 900 kms (approx.) where repeaters are required to meet link budget requirement of Barmer-II (HVDC) – South Kalamb (HVDC).

TSP shall finalize the location and number of repeater stations depending upon the actual site conditions. Further TSP shall comply to the requirements mentioned as per **Appendix-F.1**.

C.2.0 LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS

On LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS at Barmer-II PS, TSP to supply, install and commission OPGW and earth wire as per Tower Configurations:

(i) Loop-In and Loop out Ckt on Single Towers: Two (2) No. OPGW cable containing 24 Fibres (24F) to be installed and commissioned by the TSP on both Earthwire peaks

(ii) Loop-In and Loop out Ckt on Two separate Towers: One (1) No. OPGW cable containing 24 Fibres (24F) on one earthwire peak and conventional earthwire on other E/W peak for both Loop In and Loop Out Lines.

Note: On the 400 kV Fatehgarh-IV PS - Barmer-I PS line, 24 Fiber OPGW is proposed therefore on LILO portion 24 Fiber OPGW is considered (TSP need to do the site survey before installing OPGW).
The TSP shall install OPGW cables from Gantry of Barmer-II PS up to the LILO tower with all associated hardware including Vibration Dampers, LILO Tower, mid-way and gantry Joint Boxes (called **OPGW Hardware** hereafter) and finally terminate in Joint Boxes at Barmer-II PS. The transmission line length of LILO portion is 10 kms (approx.). After LILO, if fiber length for links **Barmer-I to Barmer-II PS** and **Fatehgarh-IV PS to Barmer-II PS** is above 225 kms then repeater shall be envisaged, otherwise line can be managed as a repeater less link.

TSP shall finalize the location of repeater station depending upon the actual site conditions. Further TSP shall comply to the requirements mentioned as per **Appendix-F.1**.

Maintenance of OPGW Cable and **OPGW Hardware** shall be the responsibility of TSP.

Note: Necessary optical interfaces shall be provided by TSP in the FOTE of Fatehgarh-IV PS and Barmer-I PS as per link budget requirement after change of fiber link length due to LILO.

C.3.0 Barmer-II PS – Barmer-I PS D/C line

(i) On Barmer-II PS – Barmer-I PS D/C line, TSP shall supply, install and commission One (1) No. OPGW cable containing 48 Fibres (48F) on one E/W peak and conventional earth wire on other E/W peak.

(ii) The TSP shall install this OPGW from gantry of Barmer-II PS up to the gantry of Barmer-I PS with all associated hardware including Vibration Dampers, mid-way & gantry Joint Boxes (called OPGW Hardware

hereafter) and finally terminate in Joint Boxes at end Substations. The transmission line length is 30 kms (approx.), where repeater may not be required to meet the link budget requirement of Barmer-II PS – Barmer-I PS link.

(iii) Maintenance of OPGW Cable and OPGW Hardware shall be the responsibility of TSP.

C.4.0 FOTE requirement at Barmer-I S/s.

(i) TSP shall supply, install and commission FODP with minimum 144 Fiber capacity alongwith panel and required Approach Cable (48F) with all associated hardware fittings from gantry tower to Bay Kiosk and from the Bay Kiosk to Control room.

(ii) TSP shall supply, install & commission One STM-16 (FOTE) equipment alongwith panel/s supporting minimum Three (3) directions with MSP (Multiplex Section Protection – 1+1) with necessary interfaces to meet the voice and data communication requirement among Barmer-I S/s, Barmer -II S/s and local patching with Control Room FOTE. The suitable DC Power Supply and backup to be provided for communication equipment.

(iii) FOTE/FODP panel shall be installed in the new Bay Kiosk (Switchyard Panel Room (SPR)). The FOTE under present scope shall be integrated by TSP with the existing FOTE at control room of Barmer-I S/s which shall be communicating with respective control center. TSP to provide necessary FODP sub rack / Splice trays/ Patch cords etc. and optical interfaces/equipment in the existing FOTE/FODP panels in control room for integration with the existing FOTE for onwards data transmission.

In case spare optical direction is not available in the existing FOTE at the control room, the TSP shall coordinate with station owner to reconfigure the directions in existing FOTE at control room. Alternatively, The TSP may integrate the FOTE under the present scope with existing FOTE in the nearby Kiosk connected to the control room FOTE (if available with spare direction). For this purpose, TSP shall provide necessary FODP sub rack / Splice trays/ Patch cords etc. and suitable optical interfaces/ equipment in the existing FOTE/FODP panels in another Kiosk (SPR).

(iv) FOTE and FODP can be accommodated in same panel to optimize space.

(v) The maintenance of all the communication equipment including FOTE, FODP, approach cable, PMU, DCPS alongwith Battery Bank shall be the responsibility of TSP.

C.5.0 FOTE Requirement at ±800KV Barmer-II (HVDC) terminal station

(i) TSP shall supply install and commission one or more, FODP (with minimum 2x144F) alongwith panel and approach Cable (48F each) with all associated hardware fittings from gantry tower to Control Room for all the incoming lines envisaged under the present scope.

(ii) TSP shall supply, install and commission 2x STM-16 (FOTE) equipment (in redundant mode connected with separate fibre pairs of same OPGW) alongwith panel/s supporting minimum Five (5) directions with MSP (Multiplex Section Protection – 1+1) at Barmer-II (HVDC) S/s with necessary interfaces to meet the voice and data communication requirement among Barmer-II (AC), Barmer -II (HVDC), South Kalamb (HVDC)/ Repeater Stations. The suitable DC Power Supply and backup to be provided for each communication equipment operational in redundant mode.

(iii) FODP and FOTE equipment with panels shall be provided in the Control Room of Barmer-II (HVDC) S/s. FOTE & FODP Eq can be accommodated in the same panel to optimize space.

(iv) The new communication equipment under the present scope shall be compatible for integration with existing regional level centralized NMS. The local configuration of the new communication equipment shall be the responsibility of TSP. The configuration work in the existing centralized NMS for integration of new Communication equipment shall be done by Regional ULDC Team, however all the necessary support in this regard shall be ensured by TSP.

(v) TSP shall deploy Cyber Security System in compliance with CEA (Cyber Security in Power Sector) Guidelines, 2021 and CEA (Cyber Security in Power Sector) Regulation, from its date of publication/ notification and their amendments thereof.

(vi) The maintenance of all the communication equipment and software thereof including FOTE, FODP, approach cable, Repeater Station, DCPS alongwith Battery Bank & Cyber Security System shall be the responsibility of TSP.

C.6.0 FOTE Requirement at ±800KV South Kalamb (HVDC) terminal station

(i) TSP shall supply, install & commission one or more FODP (with minimum 2x144F) along with panel and approach Cable (48F each) with all associated hardware fittings from gantry tower to Control Room for all the incoming lines envisaged under the present scope.

(ii) TSP shall supply, install & commission 2x STM-16 (FOTE) equipment (in redundant mode connected with separate fibre pairs of same OPGW) along with panel/s supporting minimum Five (5) directions with MSP (Multiplex Section Protection – 1+1) at South Kalamb (HVDC) S/s with necessary interfaces to meet the voice and data communication requirement among South Kalamb (HVDC), Barmer-II (HVDC)/ Repeater Stations and South Kalamb (HVAC). The suitable DC Power Supply and backup to be provided for each communication equipment operational in redundant mode. The new communication equipment under present scope shall be integrated with the existing FOTE at South Kalamb S/s. Necessary accessories e.g. approach cable, FODP, optical interfaces etc. to be provided by bidder to complete the integration between FOTE at HVDC and HVAC of South Kalamb.

(iii) FODP and FOTE equipment with panels shall be provided in Control Room of South Kalamb (HVDC) S/s. FOTE & FODP Eq can be accommodated in the same panel to optimize space.

(iv) The new communication equipment under the present scope shall be compatible for integration with existing regional level centralized NMS. The local configuration of the new communication equipment shall be the responsibility of TSP. The configuration work in the existing centralized NMS for integration of new Communication equipment shall be done by Regional LILDC Team, however all the necessary support in this regard shall be ensured by TSP.

(v) TSP shall deploy Cyber Security System in compliance with CEA (Cyber Security in Power Sector) Guidelines, 2021 and CEA (Cyber Security in Power Sector) Regulation, from its date of publication/ notification and their amendments thereof.

(vi) The maintenance of all the communication equipment and software thereof including FOTE, FODP, approach cable, Repeater Station, DCPS along with Battery Bank & Cyber Security System shall be the responsibility of TSP.

C.7.0 FOTE requirement at Barmer -II S/s (400/220kV AC)

(4 No. of 400 kV line bays for REs, 7 No. of 220 kV line bays for REs, 4 No of 400 kV line bays for LILO and 2 No. of 400 kV line bays for Barmer-I to Barmer-II D/C line)

(i) TSP shall supply, install and commission one or more FODP to accommodate minimum 768 Fibers alongwith panel and required Approach Cable (48F/24F) with all associated hardware fittings from gantry tower to Bay Kiosk and from the Bay Kiosk to Control room.

(ii) TSP shall supply, install and commission One or more STM-16 (FOTE) equipment alongwith panel/s supporting minimum Seventeen (17) directions with MSP (Multiplex Section Protection – 1+1) with necessary interfaces to meet the voice and data communication requirement between Barmer-I PS, Fatehgarh-IV PS, 4 No. of 400 kV REs, 7 No. of 220 kV REs, Barmer-II (HVDC). These directions shall exclude the local patching among equipment (if any). The suitable DC Power Supply and backup to be provided for communication equipment.

(iii) FODP and FOTE equipment with panels shall be provided in Control Room of South Kalamb (HVDC) S/s. FOTE & FODP can be accommodated in same panel to optimize space.

(iv) The new communication equipment under the present scope shall be compatible for integration with existing regional level centralized NMS. The local configuration of the new communication equipment shall be the responsibility of TSP. The configuration work in the existing centralized NMS for integration of new Communication equipment shall be done by Regional ULDC Team, however all the necessary support in this regard shall be ensured by TSP.

(v) TSP shall deploy Cyber Security System in compliance with CEA (Cyber Security in Power Sector) Guidelines, 2021 and CEA (Cyber Security in Power Sector) Regulation, from its date of publication/ notification and their amendments thereof.

(vi) The maintenance of all the communication equipment and software thereof including FOTE, FODP, approach cable, DCPS along with Battery Bank shall be the responsibility of TSP.

C.8.0 Specific Requirement for Phasor Measurement Units (PMUs)

TSP shall supply, install and commission required No. of Phasor Measurement Units (PMUs) as per the "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" issued vide CEA letter No. CEA-PS-14-12/9/2024-PSETD Division dated 19.03.2025 for the scope of this RFP. The PMUs shall be provided with LAN switch and shall connect with LAN switch of control room of respective substations/ generating stations with Fibre Optic cable. The PMUs shall be connected with the FOTE at Substation/ generating stations for onwards data transmission to the PDC (Phasor Data Concentrator) located at respective RLDC. Configuration work in existing PDC at RLDC for new PMU integration shall be done by respective RLDC, however all the necessary support in this regard shall be ensured by TSP. The maintenance of all the PMUs and associated equipment shall be the responsibility of TSP.

Note: Existing Station owner/s to provide necessary support to integrate different equipment and applications of new extended bays with the existing substation e.g. Communication (through FOTE), Voice etc. for smooth operation and monitoring of new added grid elements.

C.9.0 Specific Requirement for UNMS Integration of FOTE

Communication system integration in UNMS/CSMS

TSP is to ensure integration of communication system into UNMS/CSMS as per following:

"The new communication equipment/ system under the present scope shall be compatible for integration with existing regional level NMS system/ Centralized Supervision & Monitoring System (CSMS) i.e. Regional UNMS. The local configuration of the new communication equipment/ system at the station end shall be the responsibility of TSP as per the following. The configuration work in the existing centralized NMS/ UNMS at Control center end, for integration of new Communication equipment/ system shall be done by Regional ULDC Team/ NMT, however all the necessary support in this regard shall be ensured by TSP.

Requirement for integration of Communication Equipment/ system with Regional UNMS:

1. TSP shall ensure that NMS/EMS/NE supplied by them is NBI compliant and all FCAPS functionality is supported in the NBI such as NE Inventory, Hardware Inventory– Shelf/Slot/Card/SFP/Port, Topology, Protections, Alarms, Performance-real time & periodic, Performance KPI parameters (E-1, STM, Ethernet), Remote Configuration, Cross Connects, Trails & Circuits, Services Provisioning (NE), E-1, STM, Ethernet, TX & RX Trace, loop back and details are published in the NBI guide for the configuration parameters.

2. TSP shall be obliged to provide/share all necessary documentations such as NBI Guide/MIB/IDL/WSDL/API files etc. for onward integration of their NMS/EMS/NE with regional UNMS.

3. The following support shall be provided by TSP for integration of their supplied equipment with regional UNMS:
   - Enabling & activating NBI license in their EMS/NMS and providing NBI login access along with User credentials
   - Assist in verifying NBI Connectivity with UNMS vendor for the successful communication and retrieval of data
   - Assist in troubleshooting (if required) for NBI connectivity along with UNMS vendor for the communication and retrieval of data.

4. For standalone NE which is not integrated with any EMS/NMS, TSP shall provide modality of complete FCAPS data acquisition as above through industry standard programmatic methods and provide the CLI command manual."

Appendix-F.1

Repeater Requirements

FOTE to be provided by TSP in repeater station/s shall be 2x STM-16 (FOTE) equipment (in redundant mode connected with separate fibre pairs of same OPGW/UGFO/Approach Cable)

- If the repeater location is finalized in the Control Room of a nearby substation, TSP shall provide OPGW to accommodate all the fibers in main transmission line on a single Earthwire peak with OPGW Hardware & mid-way Joint Boxes etc. of the line crossing the main line and required approach Cable to accommodate all the OPGW fibers with all associated hardware fittings, to establish connectivity between crossing point of main transmission line up to the repeater equipment in substation control room.

  TSP shall co-ordinate for Space and DC power supply sharing for repeater equipment.

  TSP shall provide FODP, FOTE (with STM-16 capacity) with suitable interfaces required for link budget of respective link.

OR

- If the repeater location is finalized in the nearby substation premises, the TSP shall identify the Space for repeater shelter in consultation with station owner. Further TSP shall provide OPGW to accommodate all the fibers in main transmission line on a single Earthwire peak with OPGW Hardware & mid-way Joint Boxes etc. of the line crossing the main line and required approach Cable/UGFO to accommodate all the OPGW fibers with all associated hardware fittings, to establish connectivity between crossing point of main transmission line up to the substation where the repeater shelter is to be housed.
  TSP shall provide repeater shelter along with FODP, FOTE (with STM-16 capacity) with suitable interfaces require for link budget of respective link, reliable power supply provisioning for AC and DC supply, battery bank, Air Conditioner and other associated systems.

OR

- If the repeater location is finalized on land near the transmission tower. TSP shall make the provisions for Land at nearby tower for repeater shelter. Further TSP shall provide required approach Cable to accommodate all the OPGW fibers with all associated hardware fittings to establish connectivity up to the location of repeater shelter.
  TSP shall provide repeater shelter along with FODP, FOTE (with STM-16 capacity) with suitable interfaces require for link budget of respective link, reliable power supply provisioning for AC and DC supply, battery bank, Air Conditioner and other associated systems

Maintenance of OPGW Cable and OPGW Hardware, repeater equipment & items associated with repeater shelter shall be responsibility of TSP.

Note: Existing Station owner/s to provide necessary support to integrate different equipment and applications of new extended bays with the existing substation e.g. Communication (through FOTE), Voice etc. for smooth operation and monitoring of new added grid elements.



Figure F.1

Note: In the proposed scheme Figure F.1, only one STM-16 (FOTE) is shown at Barmer-II (HVDC) and South Kalamb (HVDC). However, as per the requirement, the TSP shall supply, install and commission two (2) STM-16 (FOTE) equipment (in redundant mode, each connected with separate fibre pairs of the same OPGW) along with panels supporting a minimum of five (5) directions with MSP (1+1).

C.10.0 PLCC and PABX:

Power line carrier communication (PLCC) equipment complete for speech, tele-protection commands and data channels shall be provided on each transmission line. The protections for transmission line and the line compensating equipment shall have hundred percent back up communication channels i.e. two channels for tele-protection in addition to one channel for speech plus data for each direction. The PLCC equipment shall in brief include the following:

i. Coupling device, Coupling filters line traps, carrier terminals, protection couplers, HF cables, PABX (if applicable) and maintenance and testing instruments.

ii. At new substation, a telephone exchange (PABX) of 24 lines shall be provided at as means of effective communication among various buildings of the substation, remote end substations and with control centers (RLDC/SLDC) etc.

iii. Coupling devices shall be suitable for phase to phase coupling for 400 kV Transmission lines. The pass band of coupling devices shall have sufficient margin for adding communication channel in future if required. Necessary protection devices for safety of personnel and low voltage part against power frequency voltages and transient over voltage shall also be provided.

iv. The line traps shall be broad band tuned suitable for blocking the complete range of carrier frequencies. Line Trap shall have necessary protective devices such as lightning arresters for the protection of tuning device. Decoupling network consisting of line traps and coupling capacitors may also be required at certain substation in case of extreme frequency congestion.

v. The carrier terminals shall be of single side-band (SSB) amplitude modulation (AM) type and shall have 4 kHz band width. PLCC Carrier terminals and Protection couplers shall be considered for both ends of the line.

vi. PLCC equipment for all the transmission lines covered under the scheme shall be provided by TSP as per following configuration. PLCC to be provided for following lines under present scopeTSP shall provide new set of PLCC as per the following configuration:

Sl. No	Line name	PLCC configuration
1.	Fatehgarh-IV PS - Barmer-II PS [formed after LILO]	1 set Analog PLCC + 1 set Digital Protection Coupler for each circuit at both ends. Existing PLCC panel may also be

		utilized.
2	Barmer-I PS - Barmer-II PS [formed after LILO]	1 set Analog PLCC + 1 set Digital Protection Coupler for each circuit at both ends. Existing PLCC panel may also be utilized.
3	400 kV Barmer-II PS - Barmer-I PS D/C line	1 set Analog PLCC + 1 set Digital Protection Coupler for each circuit at both ends.
4.	800 kV HVDC Bipole line between Barmer-II (HVDC) and South Kalamb (HVDC)	Through SDH

Further, CVT and Wave trap for all line bays under present scope shall be provided by TSP.

vii. TSP shall provide/ undertake necessary addition/ modification/ shifting/ re-commissioning etc. of PLCC equipment due to LILO of transmission lines (wherever applicable).

viii. All other associated equipment like cabling, coupling device and HF cable shall also be provided by the TSP. 2 sets of 48V battery banks for PLCC and communication equipment shall be provided at each new Substation with at least 10 hours battery backup and extended backup, if required.

Frequently Asked Queries:

Transmission Line:

1.1 Please clarify that whether shutdowns for crossing of existing transmission lines of POWERGRID/STUs/ Power Evacuation Lines from Generation Plants/ Any other Transmission Licensee will be given to TSP on chargeable basis or free of cost.

Reply: Shutdowns for crossing of existing transmission lines of POWERGRID/ STUs/ Power Evacuation Lines from Generation Plants/ Any other Transmission Licensee will be given to TSP by the concerned owner of the lines as per their own terms and conditions. As far as shutdown of ISTS lines are concerned the same can be availed by approaching respective Regional Power Committee.

1.2 We understand that the suggested swing angle criteria are applicable for Suspension Insulator in Suspension Tower. Further, you are requested to provide similar swing angle and clearance criteria for Pilot Insulator with Jumper & Jumper.

Reply: It is clarified that the swing angle criteria (as mentioned in RFP) for transmission lines is applicable for Suspension Insulator in Suspension Tower. Further, as per Clause 3.0 of Specific Technical Requirements for transmission lines, Transmission service Provider (TSP) shall adopt any additional loading/design criteria for ensuring reliability of the line, if so desired and /or deemed necessary.

1.3 We request you to kindly allow that use of diamond configuration at Power line crossings and the existing owner of the lines may be directed to allow the same for the successful bidders.

Reply: Power line crossing including Diamond configuration is the responsibility of the TSP. TSP shall formally submit the profile of the crossing section to the owner of the existing line suggesting proposed crossing alternatives. The crossing will have to be carried out as per approval of owner of the existing line.

1.4 It is requested you to kindly provide present status of Forest Clearances if any transmission line corridor area falling in wildlife forest / reserve forest/ mangroves.

Reply: Based on the preliminary route survey, the process of initiation of forest clearance for the forest stretches, if any, enroute the proposed line alignment will be initiated by way of writing letters to the concerned authority (ies). However, it may be noted that it will be the responsibility of TSP for obtaining forest clearance for the forest stretches as provided in the survey report and also for any forest area encountered during detailed survey.

1.5 For transmission line, no special requirement is specified for type of Insulator and creepage in RFP document. Hence it is understood that bidder can decide the type of insulator along with creepage requirement based on general CEA regulations and relevant standards. Kindly confirm.

Reply: The minimum specific creepage distances shall be decided for the pollution condition in the area of installation keeping in mind further increase in pollution during

life of the line. It shall be as per CEA regulations and relevant standards. However, the tower shall be designed considering the porcelain insulators with creepage factor of 31 mm/kV irrespective of type of insulator used.

Substation:

2.1 We understand that space for storage of O&M spare shall be provided by the existing owner within the station boundary without any cost. Kindly confirm.

Reply: Space for storage of O&M spares shall be arranged by TSP on its own.

2.2 We presume that the O&M for the end Termination bays will be in the scope of the TSP and TSP shall not be liable for any payment towards O&M to the existing owner of the substation. Kindly confirm

Reply: Operation and maintenance of the bays is solely the responsibility of the TSP . TSP shall follow CEA's " Operation and Maintenance (O&M) guidelines and Standard Format for Memorandum of Understating between New TSP and Existing TSP" issued by CEA vide its letter No. I/28514/2023 dated 22.06.2023.

2.3 With reference to subject scheme of existing sub-station, we assumed following scope of work

(a) We assumed internal road is available and need not to be consider in the present scope of work

(b) Drainage is available and need not to consider in the present scope of work

(c) Cable trench extension adjacent to Main cable trench only under present scope of work.

(d) Levelled area being provided by developer for bay extension.

Reply: Regarding requirement of internal road, drainage, cable trench, leveling of the bay extension area, bidder is advised to visit site and acquaint themselves with the provisions/facilities available at substation.

2.4 Kindly provide the soil investigation report of soil parameters of existing substation.

Reply: Bidder is advised to visit the substation site and ascertain the requisite parameters.

2.5 Kindly confirm, energy accounting of aux. power consumption. Whether it will be on chargeable basis or part of transmission loss.

Reply: It will be on a chargeable basis.

2.6 We understand that VMS requirement is for unmanned stations only. For Manned stations VMS is not compulsory.
Reply: VMS shall be provided in line with requirements of RfP document.

2.7 It is understood that Construction water and power shall be provided free of cost to TSP by the respective substation owner for construction of new bays.

Reply: Arrangement of construction power & water is in the scope of TSP.

2.8 It is understood that the existing fire hydrant system shall be extended by the TSP for bay extension.

Reply: Existing fire hydrant system shall be extended from existing system (if required)

2.9 Please clarify the Status of land acquisition for Substations. Whether the lands have been acquired by BPC and will be transferred to TSP.

Reply: The acquisition of land for substation is in the scope of TSP.

2.10 We understood that no any dedicated metering CT & CVT is required for Line/feeders. Further, we understood that requisite Energy meters for various 765 kV, 400 kV & 220 kV Feeders shall be provided & installed by CTU free of cost to TSP.

Reply: Dedicated metering CT and CVT are not required for line/feeders. Metering core of existing CT/CVT can be used provided accuracy class matches with metering requirement. Requisite Special Energy Meters shall be provided and installed by CTU at the cost of TSP in C&P panel subject to space availability, else, in separate metering panel (to be provided by TSP at its cost).

2.11 A draft copy of the Connection Agreement may be furnished. A draft copy of the Connection Agreement may be furnished.

Reply: Web page link https://www.ctuil.in/formats_gna_transition

2.12 Please clarify whether the spare 765kV single phase Reactor unit for Bus reactor shall be provided with 1ph 765kV CB.

Reply: As per RfP, the spare 1-Ph reactor unit shall be utilized for all the bus and switchable line reactor banks (including for future reactor banks). Hence, 1ph 765 kV CB shall also be provided with spare 1-Ph reactor for utilizing with bus reactor as well as switchable line reactor.

2.13 It is understood that existing busbar protection has provision for future bays and also PUs are available for future bays. BPC to confirm availability of CU and PU for bays under present scope of work at existing substations. BPC may kindly confirm availability of communication ports for integrating new PUs with the existing CUs at existing substations.

Reply: Bus Bar Protection with Central Unit (CU) is required for the new bus section as specified in RfP. Peripheral Units (PUs) shall be provided by the respective bay owner. Further, augmentation/replacement of existing CU, if required, to meet the system requirement shall also be provided for proper functioning of bus bar protection.

2.14 For SCADA, it is understood that necessary process I/O shall be available for future bays and accordingly license for same. BPC to confirm.

Reply: Necessary process I/O along with license shall be in the scope of the successful bidder.

2.15 No separate FF system is envisaged under the present scope of work for existing substation. BPC to confirm.

Reply: Existing fire-fighting systems shall be extended to meet the additional requirements under present scope.

2.16 PLCC for 220 kV Lines are not under the scope of TSP. BPC to Confirm. It is requested to provide Type of Coupling for 220 kV Transmission Lines under present scope.

Reply: PLCC for 220 kV line is in the scope of developer of the line.
Inter circuit coupling for 220 kV D/C and phase to phase coupling for 220 kV S/C shall be applicable for PLCC.

2.17 BPC is requested to confirm the availability of space in the existing control rooms at existing substation for execution of extension work under present project.

Reply: Switchyard Panel Rooms are generally required for AIS type substation and relay room are required for GIS type substation. Further, if needed, the control room shall be augmented as per requirement.

Communication

3.1 What are the usage of OPGW, FOTE, PMU etc. under communication requirement of RFP?

Reply: User shall be responsible for providing compatible equipment along with appropriate interface for uninterrupted communication with the concerned control center and shall be responsible for successful integration with the communication system provided by CTU.
Communication systems e.g. OPGW, FOTE etc. & PMU are required for grid operation through RLDC/SLDC, speech communication, tele-protection and tele-metering.

3.2 Is space for installation of communication panels are provided to TSP in existing Substations incase new bays are in the scope of TSP?

Reply: The space related issues are deliberated in the RFP itself. TSP to install FOTE/FODP panels in the new Bay Kiosk (Switchyard Panel Room (SPR)) / Bay Kisok/ Relay Panel Room (in case of GIS S/s). Further, TSP to connect and integrate the proposed FOTE with the existing FOTE in the control room to complete the communication path upto RLDC.
In Case 132 kV Substation TSP shall accommodate the said panels either by extension of existing control room or other arrangements.

3.3 How is the OPGW laying done in case of LILO lines?

Reply: In case LILO lines are on same towers (e.g. both Line In and Line Out portion are on same towers, generally done LILO of S/C lines). Then 2x24F OPGW shall be required to install by TSP on both earthwire peak on 400 kV & 765 kV lines where two E/W peaks are available. On 220 & 132 kV lines where only one E/W peak is available TSP to install one No. 48F OPGW.
Incase LILO lines are on different towers (e.g. both Line In and Line Out portion are on different towers, generally done LILO of D/C lines). Then 1x24F OPGW shall be required to install by TSP on one earthwire peak and conventional earthwire on second earthwire peak, on both Line In and Line Out portion towers of 400 kV & 765 kV lines. On 220 kV &132 kV lines where only one E/W peak is available TSP to install one No. 24F OPGW in place of conventional earthwire.

3.4 How is the OPGW laying done in the case of Multi circuit Towers?

Reply: In case two different lines are using common multi circuit portion for some distance (originating from different stations, may be terminating on same or on different stations). Two No. 48F OPGW to be installed on both E/W peaks for common M/C portion of 765 kV & 400 kV lines.
Incase 220/132 kV lines using multi circuit portion where single E/W peak is available one No. 96F may be installed for common multi circuit portion.

3.5 How are PMUs integrated for new bays at existing Substations?

Reply: PMU data of new bays to be provided in the ethernet port of switch at control room and thereafter to be connected with existing FOTE of existing substation to send data to PDC of RLDC by TSP. These PMUs shall be provided with GPS/NavIC clock and LAN switch and shall connect with LAN switch of control room of respective substations with Fibre Optic cable. Further the "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" issued vide letter No. CEA-PS-14-12/9/2024-PSETD Division dated 19.03.2025 shall be followed.

3.6 Is Spare direction available in existing FOTE for integration with new bay kiosk FOTE.

Reply: The FOTE under present scope shall be integrated by TSP with the existing FOTE at control room of substation for onwards data transmission.
In case spare optical direction is not available in the existing FOTE at the control room, the TSP shall coordinate with station owner to reconfigure the directions in existing FOTE at control room.

3.7 What is the distance from LILO point to proposed substation for feasibility of repeater station?

Reply: Tentative Location of LILO point shall be as per survey report of BPC however exact location to be ascertained after detailed survey by TSP.

3.8 What is the make and model of existing OPGW in case LILO of main line at new substation?

Reply: All OPGW (alongwith optical fibers) meet Central Electricity Authority (Technical Standards for Communication System in Power System Operations) Regulations, 2020 and bidder shall install OPGW accordingly.

3.9 In case of LILO of existing line at new substation who shall provide PMUs at existing substation bays?

Reply: TSP to provide PMUs for all bays under their scope of RFP in compliance of the "Guidelines on Unified Philosophy for placement of PMUs in Indian Grid" issued vide letter No. CEA-PS-14-12/9/2024-PSETD Division dated 19.03.2025.

Planning:

4.1 Whether the Project/ Elements are eligible for early commissioning incentive as per MoP, GoI order dated 15.07.2015.?

Reply: Commissioning is to be done as per the timeline mentioned in RfP. However, early commissioning shall be treated as per applicable CERC Regulations/orders.

Schedule: 2

Scheduled COD

[Note: As referred to in the definition of "Element", "Scheduled COD", and in Articles 3.1.3 (c), 4.1 (b) and 4.3 (a) of this Agreement]

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
1.	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor	48 months (23.09.2030)	2.09%	All the elements of the scheme except elements covered under Bipole-2 are required to be commissioned simultaneously as their utilization is dependent on each other. Further, elements under Bipole-2 shall have to be commissioned simultaneously.
2.	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS		0.63%	
3.	400 kV Barmer-II PS - Barmer-I PS D/C line (Quad)		0.82%	
4.	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near Barmer-II substation	54 months (23.03.2031) (Bipole-1: 48 months (23.09.2030),	33.66%	
5.	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb	Bipole-2: 54 months (23.03.2031))	32.77%	

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
6.	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	48 months (23.09.2030)	22.35%	
7.	Augmentation of South Kalamb S/s by 4x1500 MVA, 765/400 kV ICTs (3 Nos 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on Section-II. The Section-II will be established under a different network expansion scheme in WR (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400 kV bus	48 months (23.09.2030)	2.81%	

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
	sectionalizer to be kept normally open)			
8.	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))	48 months (23.09.2030)	4.87%	

Note: 50% of the percentage quoted transmission charges of respective terminal (i.e. Barmer-II or South Kalamb) is to be taken for each Bipole-1 and Bipole-2 for respective terminal

The payment of Transmission Charges for any Element, irrespective of its successful commissioning on or before its Scheduled COD, shall only be considered after successful commissioning of the Element(s), which are pre-required for declaring the commercial operation of such Element as mentioned in the above table.

Scheduled COD for overall Project: 54 months (23.03.2031) (Bipole-1: 48 months (23.09.2030), Bipole-2: 54 months (23.03.2031))

[Note: List of Element(s) along with the critical Element(s) to be provided by CEA]

Schedule: 3

Safety Rules and Procedures

[Note: As referred to in Articles 5.6 of this Agreement]

1: **Site Regulations and Safety:**

The TSP shall establish Site regulations within sixty (60) days from fulfilment of conditions subsequent, as per Prudent Utility Practices setting out the rules to be observed till expiry of the Agreement at the Site and shall comply therewith.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the Project, gate control, sanitation, medical care, and fire prevention, public health, environment protection, security of public life, etc.

Copies of such Site regulations shall be provided to the Nodal Agency and the CEA for the purpose of monitoring of the Project.

2: **Emergency Work:**

In cases of any emergency, the TSP shall carry out all necessary remedial work as may be necessary.

If the work done or caused to be done by any entity other than the TSP, the TSP shall reimburse the actual costs incurred to the other Party carrying out such remedial works.

3: **Site Clearance:**

In the course of execution of the Agreement, the TSP shall keep the Site reasonably free from all unnecessary obstruction, storage, remove any surplus materials, clear away any wreckage, rubbish and temporary works from the Site, and remove any equipment no longer required for execution of the Agreement. After completion of all Elements of the Project, the TSP shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site clean and safe.

4: **Watching and Lighting:**

The TSP shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper construction, operation, maintenance / repair of any of the Elements of the Project, or for the safety of the owners and occupiers of adjacent property and for the safety of the public, during such maintenance / repair.

Schedule: 4

Computation of Transmission Charges

1.1 General

The Monthly Transmission Charges to be paid to the TSP for providing Transmission Service for any Contract Year during the term of the Agreement shall be computed in accordance with this Schedule and paid as per Sharing Regulations.

Illustration regarding payment of Transmission Charges under various scenarios (considering definitions of Contract Year, Expiry Date & Monthly Transmission Charges above) is as below: -

Illustration-1: In case the Project Elements achieve COD as per Schedule

Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	28	1-Feb-2018	1-Feb-2018	25%
Element 2	38	1-Dec-2018	1-Dec-2018	75%

Tariff Payable as follows:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	140 X 25% X ((28+31)/365)	5.65		--	0.00
1-Apr-18 to 30-Nov-18	140 X 25% X (244/365)	23.39		--	0.00
1-Dec-18 to 31-Mar-19	140 X 100% X (121/365)				46.41
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr to 30-Nov)	140 X 100% X (244/365)				93.59

Illustration-2: In case of extension of Scheduled COD as per Article 4.4.1 & 4.4.2 of this Agreement

Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	20	1-Feb-2018	1-Jul-2018	25%
Element 2	28	1-Oct-2018	1-Dec-2018	75%

Tariff Payable as follows:

	Transmission Charges for Element 1		Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	–	0.00		–	0.00
1-Apr-18 to 30-Jun-18	–	0.00		–	0.00
1-Jul-18 to 30-Nov-18	140 X 25% X (153/365)	14.67		–	0.00
1-Dec-18 to 31-Mar-19		140 X 100% X (121/365)			46.41
2		140 X 100% X 1			140
3		140 X 100% X 1			140
4		140 X 100% X 1			140
5		140 X 100% X 1			140
36 (1-Apr to 30-Nov)		140 X 100% X (244/365)			93.59

Illustration-3: In case of delay in achieving COD of Project & all individual Elements (COD of the Project achieved in Contract Year 1)

Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	20	1-Feb-2018	1-Dec-2018	25%
Element 2	28	1-Oct-2018	1-Dec-2018	75%

Tariff Payable as follows:

Transmission Charges for Element 1			**Transmission Charges for Element 2**		
1-Feb-18 to 31-Mar-18	--	0.00		--	0.00
1-Apr-18 to 30-Sept-18	--	0.00		--	0.00
1-Oct-18 to 30-Nov-18	--	0.00	1-Oct-18 to 30-Nov-18	--	0.00
1-Dec-18 to 31-Mar-19	140 X 100% X (121/365)				46.41
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr to 30-Nov)	140 X 100% X (244/365)				93.59

Illustration-4: In case of delay in achieving COD of Project & all individual Elements (COD of the Project achieved in Contract Year other than Contact Year 1)

Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	38	1-Oct-2019	1-May-2020	25%
Element 2	38	1-Oct-2019	1-May-2020	75%

Tariff Payment to be paid as:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Oct-19 to 31-Mar-20	--	0.00	1-Oct-19 to 31-Mar-20	--	0.00
1-Apr-20 to 30-Apr-20		0.00	1-Apr-20 to 30-Apr-20		0.00
1-May-20 to 31-Mar-21	140 X 100% X (335/365)				128.49
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				
.....					
.....					
36 (1-Apr to 30-Apr)	140 X 100% X (30/ 365)				11.51

Illustration5: In case of delay in achieving COD of Element but Project COD achieved on time

Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	20	1-Feb-2018	1-Jul-2018	25%
Element 2	30	1-Dec-2018	1-Dec-2018	75%

Tariff Payable as follows:

Transmission Charges for Element 1			Transmission Charges for Element 2		
1-Feb-18 to 31-Mar-18	--	0.00		--	0.00
1-Apr-18 to 30-Jun-18	--	0.00		--	0.00
1-Jul-18 to 30-Nov-18	140 X 25% X (153/365)	14.67		--	0.00
1-Dec-18 to 31-Mar-19	140 X 100% X (121/365)				46.41
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr to 30-Nov)	140 X 100% X (244/365)				93.59

Illustration-6: In case of early commissioning of Project

Quoted Transmission Charges: **Rs. 140 Million**

Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	38	1-Oct-2019	1-Jul-2019	25%
Element 2	38	1-Oct-2019	1-Jul-2019	75%

Tariff Payment to be paid as:

Transmission Charges for Element 1		Transmission Charges for Element 2
1-July-19 to 31-Mar-20	140 X 100% X (274/365)	105.09
2	140 X 100% X 1	140
3	140 X 100% X 1	140
4	140 X 100% X 1	140
5	140 X 100% X 1	140
36 (1-Apr to 30 Jun)	140 X 100% X (91/365)	34.91

Illustration-7: In case of early commissioning of an element

Quoted Transmission Charges: **Rs. 140 Million**
Completion Schedule:

Element No.	Completion Schedule in Months	Scheduled CoD of the Element	Actual CoD of the Element	% Charges recoverable on Scheduled CoD of the Element
Element 1	38	1-Oct-2019	1-Apr-2019	25%
Element 2	38	1-Jul-2019	1-Jul-2019	75%

Tariff Payment to be paid as:

Transmission Charges for Element 1			**Transmission Charges for Element 2**		
1-Apr-2019 to 30-Jun-19	140 X 25% X (91/365)	8.72	1-Apr-2019 to 30-Jun-19	--	0.00
1-July-19 to 31-Mar-20	140 X 100% X (274/ 365)				105.09
2	140 X 100% X 1				140
3	140 X 100% X 1				140
4	140 X 100% X 1				140
5	140 X 100% X 1				140
.....					
.....					
36 (1-Apr-30-Jun)	140 X 100% X (91/365)				34.91

The Transmission Charges shall be payable on monthly basis as computed above.

1.2 Computation of Monthly Transmission Charges

The Monthly Transmission Charges for any month m in a Contract Year n shall be calculated as below:

For AC System:

a. If Actual Transmission System Availability for the month m of contract year n is greater than or equal to 98% and less than or equal to 98.5%;

Monthly Transmission Charges MTC(m) = Tmn *1

a. If Actual Transmission System Availability for the month m of contract year n exceeds 98.5% and less than or equal to 99.75%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 98.5%)

c. If Actual Transmission System Availability for the month m of contract year n is greater than 99.75%;

Monthly Transmission Charges MTC(m) = Tmn * (99.75% / 98.5%)

d. If Actual Transmission System Availability for the month m of contract year n is less than 98%and greater than or equal to 95.00%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 98%)

e. If Actual Transmission System Availability for the month m of contract year falls below 95%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 98%) - 0.02 * (Tmn * (AA/ 95%)

For DC System:

a. If Actual Transmission System Availability for the month m of contract year n is greater than or equal to 95% and less than or equal to 96%;

Monthly Transmission Charges MTC(m) = Tmn *1

b. If Actual Transmission System Availability for the month m of contract year n exceeds 96% and less than or equal to 99.75%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 96%)

c. If Actual Transmission System Availability for the month m of contract year n is greater than 99.75%;

Monthly Transmission Charges MTC(m) = Tmn * (99.75% / 96%)

d. If Actual Transmission System Availability for the month m of contract year n is less than 95% and greater than or equal to 92.00%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 95%)

e. If Actual Transmission System Availability for the month m of contract year falls below 92%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 95%) - 0.02 * (Tmn * (AA/ 92%)

For Synchronous Condenser Station:

a. If Actual Transmission System Availability for the month m of contract year n is greater than or equal to 97% and less than or equal to 98.5;

Monthly Transmission Charges MTC(m) = Tmn *1

b. If Actual Transmission System Availability for the month m of contract year n exceeds 98.5% and less than or equal to 99.75%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 98.5%)

c. If Actual Transmission System Availability for the month m of contract year n is greater than 99.75%;

Monthly Transmission Charges MTC(m) = Tmn * (99.75% / 98.5%)

d. If Actual Transmission System Availability for the month m of contract year n is less than 97% and greater than or equal to 95%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 97%)

e. If Actual Transmission System Availability for the month m of contract year falls below 95%;

Monthly Transmission Charges MTC(m) = Tmn * (AA/ 97%) - 0.02 * (Tmn* (AA/ 95%))

where

- AA is the actual Availability, as certified by RPC, as per procedure provided in Schedule 6.
- m is the month in Contract Year 'n'
- Tmn= Transmission Charges for the month 'm' in Contract Year 'n' = (=Transmission Charge/ no. of days in the Year n)* no. of days in month m

Provided, no Transmission Charges shall be paid during the period for which the RLDC has not allowed the operation of the Element/Project due to the failure of the TSP to operate it as per the provisions of the Grid Code.

1.3 RLDC Fee & Charges

The payment of RLDC fee & charges, in accordance with relevant regulations of CERC, shall be the responsibility of the TSP.

Schedule: 5

Quoted Transmission Charges

[Quoted Transmission Charges from Annexure - 21 of the RFP of the Selected Bidder to be inserted here]

[To be incorporated from the Bid of the Selected Bidder submitted during the e-reverse auction after its selection]

Quoted Annual Transmission Charges: Rs. 32,443.25 Million

Proportionate Transmission Charges payable for each Element of the Project:

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
1.	Establishment of 400/220 kV, 6x500 MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor	48 months (23.09.2030)	2.09%	All the elements of the scheme except elements covered under Bipole-2 are required to be commissioned simultaneously as their utilization is dependent on each other. Further, elements under Bipole-2 shall have to be commissioned simultaneously.
2.	LILO of both circuits of 400 kV Fatehgarh-IV PS - Barmer-I PS D/C line at Barmer-II PS		0.63%	
3.	400 kV Barmer-II PS - Barmer-I PS D/C line (Quad)		0.82%	
4.	Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location	54 months (23.03.2031)	33.66%	

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
	near Barmer-II substation	(Bipole-1: 48 months (23.09.2030), Bipole-2: 54 months (23.03.2031))		
5.	Establishment of 6000 MW, ± 800 kV South Kalamb S/s (HVDC) [LCC] terminal station (4x1500 MW) at a suitable location near South of Kalamb		32.77%	
6.	±800 kV HVDC Bipole line (Hexa lapwing) between Barmer-II (HVDC) & South Kalamb (HVDC) (with parallel Dedicated Metallic Return) (capable to evacuate 6000 MW) [with 100% reverse power capability]	48 months (23.09.2030)	22.35%	
7.	Augmentation of South Kalamb S/s by 4x1500 MVA, 765/400 kV ICTs (3 Nos 400 kV & 765 kV Section-II & 1 No. on 400 kV & 765 kV Section-I) along with 2x330 MVAR, 765 kV bus reactor & 2x125 MVAR, 420 kV bus reactor on	48 months (23.09.2030)	2.81%	

Sl. No.	Name of the Transmission Element	Scheduled COD	Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project	Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element
	Section-II. The Section-II will be established under a different network expansion scheme in WR (2x1500 MW HVDC Bipole-I to be terminated on 400 kV Section-I & 2x1500 MW HVDC Bipole-II to be terminated on 400 kV Section-II of South Kalamb S/s & 765 kV bus sectionalizer to be kept normally closed & 400 kV bus sectionalizer to be kept normally open)			
8.	2 Nos. of Syncon units at 400 kV level of Barmer-II PS (1 No. of SynCon unit comprises dynamic support of +300 MVAr/-200 MVAr (Minimum) & Short circuit contribution at PCC of 1200 MVA (Minimum))	48 months (23.09.2030)	4.87%	

Note: 50% of the percentage quoted transmission charges of respective terminal (i.e. Barmer-II or South Kalamb) is to be taken for each Bipole-1 and Bipole-2 for respective terminal

Schedule: 6

Appendix IV of the Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations 2024

Procedure for Calculation of Transmission System Availability Factor for a Month

1. Transmission system availability factor for nth calendar month ("TAFPn") shall be calculated by the respective transmission licensee, verified by the concerned Regional Load Dispatch Centre (RLDC) and certified by the Member-Secretary, Regional Power Committee of the region concerned, separately for each AC and HVDC transmission system and grouped according to sharing of transmission charges. In the case of the AC system, transmission System Availability shall be calculated separately for each Regional Transmission System and inter-regional transmission system. In the case of the HVDC system, transmission System Availability shall be calculated on a consolidated basis for all inter-state HVDC systems.

2. Transmission system availability factor for nth calendar month ("TAFPn") shall be calculated by considering the following:

   i) **AC transmission lines**: Each circuit of AC transmission line shall be considered as one element;

   ii) **Inter-Connecting Transformers (ICTs):** Each ICT bank (three single-phase transformers together) shall form one element;

   iii) **Static VAR Compensator (SVC):** SVC, along with SVC transformer, shall form one element;

   iv) **Bus Reactors or Switchable line reactors:** Each Bus Reactors or Switchable line reactors shall be considered as one element;

   v) **HVDC Bi-pole links:** Each pole of the HVDC link, along with associated equipment at both ends, shall be considered as one element;

   vi) **HVDC back-to-back station**: Each block of the HVDC back-to-back station shall be considered as one element. If the associated AC line (necessary for the transfer of inter-regional power through the HVDC back-to-back station) is not available, the HVDC back-to-back station block shall also be considered unavailable;

   vii) **Static Synchronous Compensation ("STATCOM"):** Each STATCOM shall be considered as a separate element.

3. The Availability of the AC and HVDC portion of the Transmission system shall be calculated by considering each category of transmission elements as under:

i. AC Portion (%) for AC system

$$\frac{(\sum_{i=1}^{n} AVac_i \times Ac_i) + (\sum_{p=1}^{p} AVp_p \times Rx_p) + (\sum_{q=1}^{q} AVq_q \times ICT_q) + (\sum_{r=1}^{r} AVs_r \times SVC_r)}{(n \times Ac) + (p \times Rx) + (q \times ICT) + (r \times SVC)} \times 100$$

Where,

n	Total number of AC lines
AVac	Availability of i number of AC lines
p	Total number of bus reactors /switchable line reactors
AVp	Availability of p number of bus reactors/switchable line reactors
q	Total number of ICTs
AVq	Availability of q number of ICTs
r	Total number of SVCs
AVr	Availability of r number of SVCs
n	Total number of STATCOM
AVn	Availability of n number of STATCOM

ii. AC Portion (%) for HVDC System

$$\sum_{x=1}^{x} \left(\frac{\text{Capacity}_x \times AV_x}{\text{Capacity}_x} \right) \times \frac{x}{x}$$

$$\sum_{y=1}^{y} \left(\frac{\text{Capacity}_y \times AV_y}{\text{Capacity}_y} \right) \times \frac{y}{y}$$

Where,

Capacity$_x$	Total actual operated capacity of x^{th} HVDC pole
Capacity$_x$	Total rated capacity of x^{th} HVDC pole
AV$_x$	Availability of x^{th} HVDC pole
Capacity$_y$	Total actual operated capacity of y^{th} HVDC back to back station block
Capacity$_y$	Total rated capacity of y^{th} HVDC back to back station block
AV$_y$	Availability of y^{th} HVDC back to back station block
x	Total no of HVDC poles
y	Total no of HVDC Back to Back blocks

4. The availability for each category of transmission elements shall be calculated based on the weightage factor, total hours under consideration and non-available hours for each element of that category. The formulae for calculation of the Availability of each category of the transmission elements are as per **Appendix-V**. The weightage factor for each category of transmission elements shall be considered as under:

   (a) For each circuit of the AC line – The number of sub-conductors in the line multiplied by ckt-km;

   (b) For each HVDC pole- The rated MW capacity x ckt-km;

   (c) For each ICT bank – The rated MVA capacity;

   (d) For SVC- The rated MVAR capacity (inductive and capacitive);

   (e) For Bus Reactor/switchable line reactors – The rated MVAR capacity;

   (f) For HVDC back-to-back stations connecting two Regional grids- Rated MW capacity of each block; and

   (g) For STATCOM – Total rated MVAR Capacity.

5. The transmission elements under outage due to the following reasons shall be deemed to be available:

   i. Shut down availed for maintenance of another transmission scheme or construction of new element or renovation/upgradation/additional capitalization in an existing system approved by the Commission. If the other transmission scheme belongs to the transmission licensee, the Member Secretary, RPC may restrict the deemed availability period to that considered reasonable by him for the work involved. In case of a dispute regarding deemed availability, the matter may be referred to the Chairperson, CEA, within 30 days.

   ii. Switching off of a transmission line to restrict over-voltage and manual tripping of switched reactors as per the directions of the concerned RLDC.

   iii. Shut down of a transmission line due to the Project(s) of NHAI, Railways and Border Road Organization, including for shifting or modification of such transmission line or any other infrastructure project approved by Ministry of Power. Member Secretary, RPC may restrict the deemed availability period to that considered reasonable by him for the work involved; Provided that apart from the deemed availability, any other costs involved in the process of such shutdown of transmission line shall not be borne by the DICs.

   Provided that such deemed availability shall be considered only for the period for which DICs are not affected by the shutdown of such transmission line.

6. For the following contingencies, the outage period of transmission elements, as certified by the Member Secretary, RPC, shall be excluded from the total time of the element under the period of consideration for the following contingencies.

   i) Outage of elements due to force majeure events beyond the control of the transmission licensee. However, whether the same outage is due to force majeure (not design failure) will be verified by the Member Secretary, RPC. A reasonable restoration time for the element shall be considered by the Member Secretary, RPC, and any additional time taken by the transmission licensee for restoration of the element beyond the reasonable time shall be treated as outage time attributable to the transmission licensee. Member Secretary, RPC may consult the transmission licensee or any expert for estimation of reasonable restoration time. Circuits restored through ERS (Emergency Restoration System) shall be considered as available;

   ii) Outage caused by grid incident/disturbance 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, if the element is not restored on receipt of direction from RLDC while normalizing the system following grid incident/disturbance within reasonable time, the element will be considered not available for the period of outage after issuance of RLDC's direction for restoration;

   iii) The outage period which can be excluded for the purpose of sub-clause (i) and (ii) of this clause shall be declared as under

      a. Maximum up to one month by the Member Secretary, RPC;

      b. Beyond one month and up to three months after the decision at RPC;

      c. Beyond three months by the Commission for which the transmission license shall approach the Commission along with reasons and steps taken to mitigate the outage and restoration timeline.

7. Time frame for certification of transmission system availability: (1) The following schedule shall be followed for certification of availability by the Member Secretary of the concerned RPC:

   - Submission of outage data along with documentary proof (if any) and TAFPn calculation by Transmission Licensees to RLDC/ constituents

     – By the 5th of the following month;

   - Review of the outage data by RLDC / constituents and forward the same to respective RPC – by 20th of the month.

- Issue of availability certificate by respective RPC – by the 3rd of the next month.

Appendix-V

FORMULAE FOR CALCULATION OF AVAILABILITY OF EACH CATEGORY OF TRANSMISSION ELEMENTS

For AC transmission system

AVo(Availability of o no. of AC lines) = $\frac{\sum_{i=1}^{o} W_i(T_i - TNA_i)/T_i}{\sum_{i=1}^{o} W_i}$

AVq(Availability of q no. of ICTs) = $\frac{\sum_{k=1}^{q} W_k(T_k - TNA_k)/T_k}{\sum_{k=1}^{q} W_k}$

AVr(Availability of r no. of SVCs) = $\frac{\sum_{l=1}^{r} W_l(T_l - TNA_l)/T_l}{\sum_{l=1}^{r} W_l}$

AVp(Availability of p no. of Switched Bus reactors) = $\frac{\sum_{m=1}^{p} W_m(T_m - TNA_m)/T_m}{\sum_{m=1}^{p} W_m}$

AVu(Availability of u no. of STATCOMs) = $\frac{\sum_{n=1}^{u} W_n(T_n - TNA_n)/T_n}{\sum_{n=1}^{u} W_n}$

AV_{hbp}(Availability of an individual HVDC pole) = $\frac{(T_x - TN)}{T_x}$

AV_{hbb} (Availability of an individual HVDC Back-to-back Blocks) = $\frac{(T_y - TNA_y)}{T_y}$

For the HVDC transmission system

For the new HVDC commissioned but not completed twelve months

For first 12 months: [AV_{avg} or AV_{target}(85% & 85%)], subject to a ceiling of 95%

Where

o	=	Total number of AC lines
AVo	=	Availability of o number of AC lines
p	=	Total number of bus reactors (switchable line reactors)
AVp	=	Availability of p number of bus reactors (switchable line reactors)
q	=	Total number of ICTs
AVq	=	Availability of q number of ICTs
r	=	Total number of SVCs
AVr	=	Availability of r number of SVCs
t	=	Total number of STATCOM
AVt	=	Availability of t number of STATCOMs
Wo	=	Weighted factor for the AC line
Wq	=	Weighted factor for the ICT
Wr	=	Weighted factor for all the SVCs
Wt	=	Weighted factor for all the STATCOM
T_{o1}, T_{o2}, T_{on}		The total hours of o^{th} AC line, q^{th} ICT, r^{th} SVC, m^{th} Switched Bus Reactor
T_{t1}, T_{t2}, T_{tn}		At n^{th} STATCOM, x^{th} HVDC pole, y^{th} HVDC back-to-back block during the period under consideration (excluding time period for outages not attributed to transmission licensee for the reasons given in Para 5 of the procedure)
T_{oA}, T_{oA}		The non-availability hours (excluding the time period for outages not T_{oA1}, T_{oA2}, attributable to transmission licensee taken as deemed availability as T_{oA1}, T_{oA2}, T_{oAn}, T_{tA1} per Para 5 of the procedure) for o^{th} AC line, q^{th} ICT, r^{th} SVC, m^{th} Switched Bus Reactor, n^{th} STATCOM, x^{th} HVDC pole and y^{th} HVDC back-to-back block

Schedule: 7

Entire Bid (both financial bid and technical bid) of the Selected Bidder to be attached here

Bid dated 20.07.2026 and 20.08.2026 shall be an integral part of this Agreement.

Schedule: 8

Contract Performance Guarantee

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution. Foreign entities submitting Bids are required to follow the applicable law in their country.)

In consideration of the .....[Insert name of the SPV or Selected Bidder on behalf of the TSP, or Lead Member in case of the Consortium, with address] agreeing to undertake the obligations under the Transmission Service Agreement dated .....and the other RFP Project Documents and the Nodal Agency and the .....[Insert the name of the BPC], agreeing to execute the *RFP Project Documents* with the Selected Bidder, regarding setting up the Project, the .....[Insert name and address of the bank issuing the guarantee and address of the head office] (hereinafter referred to as "Guarantor Bank") hereby agrees unequivocally, irrevocably and unconditionally to pay to ..... (being the Nodal Agency) at .....[Insert the Place from the address of the Nodal Agency indicated in the TSA] forthwith on demand in writing from the Nodal Agency or any Officer authorized by it in this behalf, any amount up to and not exceeding Rupees ..... Crores (Rs .....) only [insert the amount of the bank guarantee] on behalf of M/s. .....[Insert name of the Selected Bidder or SPV]

This guarantee shall be valid and binding on the Guarantor Bank up to and including ..... and shall not be terminable by notice or any change in the constitution of the Bank or the term of the Transmission Service Agreement or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations or alternations made, given, or agreed with or without our knowledge or consent, by or between parties to the respective agreement.

Our liability under this Guarantee is restricted to Rs. ..... Crores (Rs. .....) only. Our Guarantee shall remain in force until .....[Insert the date of validity of the Guarantee as per Article 3.1.2 of this Agreement]. The Nodal Agency, shall be entitled to invoke this Guarantee up to three hundred sixty five (365) days of the last date of the validity of this Guarantee.

The Guarantor Bank hereby expressly agrees that it shall not require any proof in addition to the written demand from ..... (in its roles as the Nodal Agency), made in any format, raised at the above mentioned address of the Guarantor Bank, in order to make the said payment to Nodal Agency.

The Guarantor Bank shall make payment hereunder on first demand without restriction or conditions and notwithstanding any objection by ..... [Insert name of the Selected Bidder], ... [Insert name of the TSP] and / or any other person. The Guarantor Bank shall not require Nodal Agency to justify the invocation of this BANK GUARANTEE, nor shall the Guarantor Bank have any recourse against Nodal Agency in respect of any payment made hereunder.

THIS BANK GUARANTEE shall be interpreted in accordance with the laws of India.

The Guarantor Bank represents that this BANK GUARANTEE has been established in such form and with such content that it is fully enforceable in accordance with its terms as against the Guarantor Bank in the manner provided herein.

THIS BANK GUARANTEE shall not be affected in any manner by reason of merger, amalgamation, restructuring, liquidation, winding up, dissolution or any other change in the constitution of the Guarantor Bank.

THIS BANK GUARANTEE shall be a primary obligation of the Guarantor Bank and accordingly Nodal Agency shall not be obliged before enforcing this BANK GUARANTEE to take any action in any court or arbitral proceedings against ..... [Insert name of the SPV] or the Selected Bidder, as the case may be, to make any claim against or any demand on ..... [Insert name of the SPV] or the Selected Bidder, as the case may be, or to give any notice to ..... [Insert name of the SPV] or the Selected Bidder, as the case may be, or to enforce any security held by the Nodal Agency or to exercise, levy or enforce any distress, diligence or other process against ..... [Insert name of the SPV] or the Selected Bidder, as the case may be.

The Guarantor Bank acknowledges that this BANK GUARANTEE is not personal to Nodal Agency and may be assigned, in whole or in part, (whether absolutely or by way of security) by Nodal Agency to any entity to whom the Nodal Agency is entitled to assign its rights and obligations under the Transmission Service Agreement.

The Guarantor Bank hereby agrees and acknowledges that Nodal Agency shall have a right to invoke this Bank Guarantee either in part or in full, as it may deem fit.

Notwithstanding anything contained hereinabove, our liability under this Guarantee is restricted to Rs. ..... Crores (Rs. .....) only and it shall remain in force until .....[Date to be inserted on the basis of Article 3.1.2of the Transmission Service Agreement], with an additional claim period of three hundred sixty five (365) days thereafter. This BANK GUARANTEE shall be extended from time to time for such period, as may be desired by ..... [Insert name of the Selected Bidder or Lead Member in case of the Consortium or SPV]. We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only if Nodal Agency serves upon us a written claim or demand.

In witness where of:

Signature .....

Name .....

Power of attorney No.: .....

For:

.....[Insert Name of the Bank]

Banker's Seal and Full Address, including mailing address of the Head Office

Schedule: 8A

(ISB for CPG)

FORMAT FOR SURETY INSURANCE CONTRACT

(To be on non-judicial stamp paper of appropriate value as per Stamp Act relevant to place of execution.

Foreign entities submitting Bids are required to follow the applicable law of India)

In consideration of the ..... [Insert name of the SPV or Selected Bidder on behalf of SPV or Lead Member in case of the Consortium, with address] (hereinafter referred to as the **'Principal Debtor'** for the purposes of this Surety Insurance Contract as provided in Section 126 of the Indian Contract Act, 1872) having been selected to undertake the Transmission Project on the terms and conditions contained in the Transmission Service Agreement dated ...../ to be executed as per the Model Transmission Service Agreement provided along with the Request for Proposal **('RFP')** and other RFP Project Documents, subject to the condition of providing a Performance Bank Guarantee or a Surety Insurance Contract guaranteeing/insuring the due performance of the obligations under the Transmission Service Agreement, to the Central Transmission Utility of India Limited **('CTUIL')** [herein after referred to as the Nodal Agency], the [Insert name and address of the Insurance Company issuing the Surety Insurance Contract and address of the head office] (hereinafter referred to as **"Surety")** hereby agrees unequivocally, irrevocably, absolutely and unconditionally, without demur, to pay to the Nodal Agency at _____ [Insert Place and Address of the Nodal Agency indicated in Transmission Service Agreement, or to the designated Bank Account of the Nodal Agency, namely.....] forthwith on demand in writing from the Nodal Agency, or any Officer authorized by it in this behalf, intimated to the Surety at the address mentioned above, any amount as may be decided by the Nodal Agency not exceeding Rupees .....Crores (Rs.....) only [Insert the amount of the Surety Insurance Contract]

The Surety hereby acknowledges, accepts and confirms that the Surety has received from the Principal Debtor, by way of premium the entire consideration for the Surety to execute, in favour of the Nodal Agency, this Surety Insurance Contract, as extended by the Surety from time to time and assuming the obligation to pay to the Nodal Agency the amount in terms hereof, without any requirement for payment of any other consideration to the Surety by the Principal Debtor, or otherwise.

This Surety Insurance Contract shall be valid and binding on the Surety, as the principal obligation of the Surety to pay on demand by the Nodal Agency, and shall not be terminable by notice or any change in the constitution of the Surety or the term of the Transmission Service Agreement or by any other reasons whatsoever and the liability hereunder of the Surety shall not be impaired or discharged by any extension of time or variations or alternations made, given, or agreed (with or without the

knowledge or consent of the Surety) by or between the Principal Debtor and the Nodal Agency.

The liability of the Surety under this Surety Insurance Contract is restricted to Rupees ..... Crores (Rs) only. The Surety Insurance Contract shall remain in force until [Insert the date of validity of the Surety Insurance Contract]. The Nodal Agency shall be entitled to invoke this Surety Insurance Contract up to three hundred sixty five (365) days after the last date of the validity of this Surety Insurance Contract.

The Surety hereby expressly agrees that it shall not require any proof except for the written demand from the Nodal Agency, containing the statement that the contractor has failed to meet its contractual obligations raised at the above mentioned address of the Surety (address of Surety office should be a place in NCR only) and the Surety shall pay the amount without reference to the Principal Debtor.

Any such demand made by the Nodal Agency on the Surety shall be conclusive and binding not withstanding any difference between the Nodal Agency and the Principal Debtor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Surety undertakes not to revoke this guarantee during its currency without previous consent of the Nodal Agency and further agrees that the Surety Insurance Contract herein contained shall continue to be enforceable till the Nodal Agency discharges this contract or till the expiry of tenor (including Claim period) whichever is earlier.

The Surety shall make payment hereunder within two (02) working days on first demand without restriction or conditions and notwithstanding any objection by the Principal Debtor, namely, ... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person. The Surety shall not require the Nodal Agency to justify the invocation of this Surety Insurance Contract, nor shall the Surety have any recourse against the Nodal Agency in respect of any payment made hereunder.

This SURETY INSURANCE CONTRACT shall be interpreted in accordance with the laws of India.

This SURETY INSURANCE CONTRACT is being executed by the Surety in terms of the IRDAI (Surety Insurance Contract) Guidelines, 2022 and the Surety hereby acknowledges, accepts and confirms that this Surety Insurance Contract shall be a Contract of Guarantee as provided under Section 126 of the Indian Contract Act, 1872 and further shall be covered by Section 14(3)(b) of the Insolvency and Bankruptcy Code, 2016 (as amended) shall be enforceable as such.

The Surety represents that this Surety Insurance Contract has been established in such form and with such content that it is fully enforceable in accordance with its terms as against the Surety in the manner provided herein.

This SURETY INSURANCE CONTRACT shall not be affected in any manner by reason of merger, amalgamation, restructuring, liquidation, winding up, dissolution or any other change in the constitution of the Surety.

In order to give effect to this surety Bond, the Nodal Agency shall be entitled to act as if the surety insurer were the principal debtor and any change in the constitution of the contractor and/or the surety insurer, whether by their absorption with any other body or corporation or otherwise, shall not in any way or manner affect the liability or obligation of the surety insurer under this surety Bond.

This SURETY INSURANCE CONTRACT shall be a primary obligation of the Surety as a Principal to pay on demand by the Nodal Agency and the Nodal Agency shall not be obliged before enforcing this Surety Insurance Contract to take any action in any court or arbitral proceedings against the Principal Debtor, namely, ... [Insert name of SPV], or ... ...[Insert name of the Selected Bidder], or .....[Insert name of the TSP] and/or any other person, as the case may be, to make any claim against or any demand on the Principal Debtor, namely, ... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or..... [Insert name of the TSP] and/or any other person, as the case may be, or to give any notice to Principal Debtor, namely..... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person, as the case may be, or to enforce any security held by the Nodal Agency or to exercise, levy or enforce any distress, diligence or other process against the Principal Debtor, namely, ... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person, as the case may be.

The Surety acknowledges that this Surety Insurance Contract is not personal to the Nodal Agency and may be assigned, in whole or in part, (whether absolutely or by way of security) by Nodal Agency to any entity to whom the Nodal Agency is entitled to assign its rights and obligations under the Transmission Service Agreement Provided that any such assignment shall be in compliance with the relevant provisions of the Insurance Act 1938

The Surety hereby agrees and acknowledges that the Nodal Agency shall have a right to invoke this Surety Insurance Contract either in part or in full, as it may deem fit. In case of invocation of this Surety Insurance Contract in part, besides making payment for the part of Surety Insurance Contract invoked, surety at the request of nodal agency shall amend the value of Surety Insurance Contract to the extent of balance amount.

The Surety undertakes not to revoke this Surety Contract during its currency, except with the previous express consent of the Nodal Agency in writing and declares and warrants that it has the power to issue this Surety Contract and the undersigned has full powers to do so on behalf of the Surety

In witness where of:

Signature.....

Name: .....

Power of attorney No/ Employee No. as applicable: .....

For:

..... [Insert Name of the Surety-Insurance Company]

Banker's Seal and Full Address, including mailing address of the Head Office

Notes: 1. The Stamp Paper should be in the name of the Executing Insurance Company.





Schedule: 8B
(POI for CPG)

Format for Issuance of Payment on Order Instrument

Dear Sir,

1. Indian Renewable Energy Development Agency Limited ('IREDA")/PFC/REC has sanctioned a non-fund based limit loan of Rs. (Rupees ..... Only) to M/s. ..... [Insert name of SPV or selected Bidder] under the Loan Agreement executed on ..... to execute Transmission System Projects.

2. In consideration of the .....[Insert name of the SPV or Selected Bidder on behalf of SPV or Lead Member in case of the Consortium, with address] for the purposes of this Payment on Order Instrument ("POI") having been selected to undertake the Transmission Project on the terms and conditions contained in the Transmission Service Agreement dated ...../ to be executed as per the draft of the Model Transmission Service Agreement provided along with the Request for Proposal („RFP") and other RFP Project Documents, subject to the condition of providing a POI guaranteeing the due performance of the obligations under the Transmission Service Agreement to the Nodal Agency/Central Transmission Utility of India Limited („CTUIL"), the.....[Insert name and address of the non-banking financial institutions(IREDA/PFC/REC) issuing the POI and address of the head office] (hereinafter referred to as "**Guarantor**") hereby agrees unequivocally, irrevocably, absolutely and unconditionally, without demur, to pay to the Nodal Agency at ..... [Insert Place and Address of the Nodal Agency indicated in Transmission Service Agreement, or to the designated Bank Account of the Nodal Agency, namely .....] forthwith on demand in writing from the Nodal Agency, or any Officer authorized by it in this behalf, intimated to the Guarantor at the address mentioned above, any amount as may be decided by the Nodal Agency not exceeding Rupees ..... Crores (Rs) only [Insert the amount of Payment on Order Instrument]

3. At the request of .....and ....., [Insert name of on behalf of M/s. SPV or selected Bidder] this Payment on Order Instrument (POI) for an amount of Rs. ..... (Rupees .....) is being issued with IREDA/PFC/REC assuming the obligations to remit such amount to CTUIL from the sanctioned loan.

4. This Payment on Order Instrument comes into force immediately and IREDA/PFC/REC confirms that it has sufficient amount out of the sanctioned loan and shall maintain the required amount to pay under this Payment on Order Instrument, during the validity and claim period of this Payment on Order Instrument.

5. This POI has been issued by IREDA/PFC/REC utilizing the credit limit of M/s.....[Insert name of SPV or selected Bidder] IREDA/PFC/REC confirms that its liability to pay under this Payment on Order Instrument shall be primary and independent of whether at the time of invocation of

Payment on Order Instrument, the sanctioned funds are available or not and notwithstanding, the status of M/s ..... [Insert name of SPV or selected Bidder] at the relevant time and to whether IREDA/PFC/REC is able to recover the amount advanced by it to the said developer.

6. IREDA/PFC/REC and M/s. ..... .[Insert name of SPV or selected Bidder] hereby acknowledges, accepts and confirms that this Payment on Order Instrument shall be a Contract of Guarantee as provided under Section 126 of the Indian Contract Act, 1872 and further shall be covered by Section 14(3)(b) of the Insolvency and Bankruptcy Code, 2016 (as amended) shall be enforceable as such.

7. IREDA/PFC/REC liability under this POI is restricted to Rupees Crores (Rs.....) only. This POI shall remain in force until..... [Insert the date of validity of the POI]. The Nodal Agency shall be entitled to invoke this POI up to three hundred sixty-five (365) days after the last date of the validity of this POI. This POI shall be extended from time to time for such period, as may be desired by the TSP.

8. The Guarantor hereby expressly agrees that it shall not require any proof except for the written demand from the Nodal Agency, raised at the above- mentioned address of the Guarantor (address of Guarantor office should be in NCR only) and the Guarantor shall pay the amount to the Nodal Agency without reference to the TSP.

9. Any such demand made by the Nodal Agency on the Guarantor shall be conclusive and binding not withstanding any difference between the Nodal Agency and the TSP or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Guarantor undertakes not to revoke this guarantee during its currency without previous consent of the Nodal Agency and further agrees that the POI herein contained shall continue to be enforceable till the Nodal Agency discharges this contract or till the expiry of tenure or (including Claim period) whichever is earlier.

10. The Guarantor shall make payment hereunder within two (02) working days on first demand without restriction or conditions and notwithstanding any objection or disputes raised by the TSP, namely, ... [Insert name of SPV], or [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person. The Guarantor shall not require the Nodal Agency to justify the invocation of this POI, nor shall the Guarantor have any recourse against the Nodal Agency in respect of any payment made hereunder.

11. This POI shall be interpreted in accordance with the laws of India.

12. The Guarantor represents that this POI Contract has been established in such form and with such content that it is fully enforceable in accordance with its terms as against the Guarantor in the manner provided herein.

13. This POI shall not be affected in any manner by reason of merger, amalgamation, restructuring, liquidation, winding up, dissolution or any other change in the constitution of the Guarantor.

14. This POI Contract shall be a primary obligation of the Guarantor as a Principal to pay on demand by the Nodal Agency and the Nodal Agency shall not be obliged before enforcing this POI Contract to take any action in any court or arbitral proceedings against the TSP, namely, ... [Insert name of SPV], or..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person, as the case may be to make any claim against or any demand on the TSP, namely, ... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person, as the case may be, or to give any notice to TSP, namely..... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person, as the case may be, or to enforce any security held by the Nodal Agency or to exercise, levy or enforce any distress, diligence or other process against the TSP, namely, ... [Insert name of SPV], or ..... [Insert name of the Selected Bidder], or ..... [Insert name of the TSP] and/or any other person, as the case may be.

15. The Guarantor acknowledges that this POI Contract is not personal to the Nodal Agency and may be assigned, in whole or in part, (whether absolutely or by way of security) by Nodal Agency to any entity to whom the Nodal Agency is entitled to assign its rights and obligations under the Transmission Service Agreement.

16. The Guarantor hereby agrees and acknowledges that the Nodal Agency shall have a right to invoke this POI Contract either in part or in full, as it may deem fit. In case of invocation of this POI Contract in part, besides making payment for the part of POI Contract invoked, Guarantor at the request of Nodal Agency shall amend the value of POI Contract to the extent of balance amount.

IN WITNESS WHERE OF the non- banking financial institutions through its authorized officer, has set its hand and stamp on this..... day of.....at.....

Signature .....

Name:

Power of attorney No.: .....

For: .....[Insert Name of the non- banking financial institutions Company]

Seal and Full Address, including mailing address of the Head Office

Schedule: 9

Methodology for determining the Relief Under Force Majeure Event & Change in Law during Construction Period

The relief in the form of revision in tariff due to Force Majeure Event leading to extension of Scheduled COD for a period beyond one hundred eighty (180) days and/ or Change in Law during the construction period shall be as under:

$\Delta T = [(P \times d)] * [1-(1+ d)^(-n)]$

Where,

ΔT = Change in Transmission Charges for each year

P = Sum of cumulative increase or decrease in the cost of the Project due to Change in Law and interest cost during construction corresponding to the period exceeding one hundred eighty (180) due to Force Majeure Event leading to extension of Scheduled COD for a period beyond one hundred eighty (180) days

n = number of years over which the Transmission Charges has to be paid

d = Discount rate as notified by the CERC, applicable on the Bid Deadline

The increase in Transmission Charges as stated above shall be applicable only if the value of increase in Transmission Charges as calculated above exceeds 0.30% (zero point three percent) of the quoted Transmission Charges of the TSP.

सत्यमेव जयते

INDIA NON JUDICIAL

Government of National Capital Territory of Delhi

e-Stamp

Certificate No.	:	IN-DL00961454892778Y
Certificate Issued Date	:	17-Sep-2026 02:58 PM
Account Reference	:	IMPACC (IV)/ dl1074803/ DELHI/ DL-SWD
Unique Doc. Reference	:	SUBIN-DLDL10748030080548992113 1Y
Purchased by	:	BARMER HVDC POWER TRANSMISSION LIMITED
Description of Document	:	Article Others
Property Description	:	Not Applicable
Consideration Price (Rs.)	:	0 (Zero)
First Party	:	BARMER HVDC POWER TRANSMISSION LIMITED
Second Party	:	Not Applicable
Stamp Duty Paid By	:	BARMER HVDC POWER TRANSMISSION LIMITED
Stamp Duty Amount(Rs.)	:	100 (One Hundred only)

NOTARY
Dhan Singh Nagar
Advocate
R. No.-16726
New Delhi, INDIA
Expiry Date
31-1-2030
GOVT. OF INDIA

Please write or type below this line

General Power of Attorney

Know all men by these presents, we **Barmer HVDC Power Transmission Limited** (hereinafter referred to as BHPTL which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, and assigns) having its Registered Office at B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi – 110 016 do hereby constitute, appoint and authorize **Shri Rajesh Kumar Gupta**, Project Incharge of BHPTL residing at C-203, Nysa Skydale, Chhani- Dumad Road, Behind Satyam Exotica Bunglows, Chhani, Vadodara, Gujarat, Pin-391740 as our true and lawful attorney, to do in our name and our behalf, all of the acts or things hereinafter mentioned, that is to say:-

Statutory Alert:
1. The authenticity of this Stamp certificate should be verified at 'www.shcilestamp.com' or using e-Stamp Mobile App of Stock Holding. Any discrepancy in the details on this Certificate and as available on the website / Mobile App renders it invalid.
2. The onus of checking the legitimacy is on the users of the certificate.
3. In case of any discrepancy please inform the Competent Authority.

17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM 17-Sep-2026 02:58 PM
BARMER HVDC POWER TRANSMISSION LIMITED BARMER HVDC POWER TRANSMISSION LIMITED BARMER HVDC POWER TRANSMISSION LIMITED BARMER HVDC POWER TRANSMISSION LIMITED

1. To constitute, and defend legal cases, sign and verify plaints, written statements, petitions and objections, memorandum of appeal, claims, affidavits, applications, re-applications and pleadings of all kinds and to file them in Central Electricity Regulatory Commission (CERC), State Electricity Regulatory Commissions (SERCs), Appellate Tribunal for Electricity (ATE) , Civil, Criminal or Revenue courts, Arbitration, Labour Court, Industrial Tribunal, High Court and Supreme Court, whether having original or appellate jurisdiction and before Government or Local Authorities or Registration Authorities, Tax Authorities, Tribunals, etc.
2. To appear, before various Courts / Tribunals / CERC / SERCs / Appellate Tribunal for Electricity.
3. To appoint any Advocate, Vakil, Pleader, Solicitor or any other legal practitioner as Attorney to appear and conduct case proceedings on behalf of the company and to sign Vakalatnama.
4. To compromise, compound or withdraw cases from any Court / Tribunal / CERC / SERCs / Appellate Tribunal for Electricity.
5. To file petitions/applications or affidavits before the Supreme Court / High Court / CERC / SERCs / Appellate Tribunal for Electricity and to obtain the copies of documents, papers, records etc.
6. To file and receive back documents, to deposit and withdraw money from Courts, Tribunal, Registrar's Office and other Government or Local Authorities and to issue valid receipts thereof.
7. To apply for and obtain refund of stamp duty or court fee, etc.
8. To issue notices and accept service of any summons, notices or orders issued by any Court / Tribunal / CERC / SERCs / Appellate Tribunal for Electricity on behalf of the Company.
9. To execute deeds, agreements, bonds and other documents and returns in connection with the affairs of the company and file them or cause to be filed for Registration, whenever necessary.
10. To issue Project Authority Certificate(s) in respect of contracts for Load Despatch & Communication Systems, Transmission Systems etc. and to lodge claims with the Railways, Transporters, Shipping Agents and Clearing Agents and to settle/compromise such claims.
11. To lodge claims with the Insurance companies, to settle/compromise such claims and on satisfactory settlement thereof, to issue letters of subrogation/power of attorney in favour of Insurance companies.
12. To execute, sign and file applications, undertakings, agreements etc. to or with the Central / State Government(s) / Body(ies) to obtain 'right of way' or any of other Right(s) / Privilege(s) etc.
13. To execute, sign and file applications, undertakings, agreements, bills, documents etc. to or with the Central / State Government(s) / Body(ies) and other authorities / entities including Central Transmission Utility (CTU)/ Grid Controller Of India Limited (GRID INDIA) / Central Electricity Authority (CEA)/ CERC with respect to Commissioning of the Project,

NOTARY
Dhan Singh Nagar
Advocate
New Delhi, INDIA
Expiry Date
31-1-2030

realization of Transmission charges, to obtain 'right of way' or any of other Right(s) / Privilege(s) etc.

14. To execute Transmission Service Agreement (TSA) with Central Transmission Utility of India Limited (CTUIL)

15. To execute Consultancy, Funding and other Agreements.

16. To act as administrator for e-filing process with CERC and other Statutory authorities.

17. Generally to do all lawful acts, necessary for the above mentioned purposes.

The Company hereby agrees to ratify and confirm all and whatsoever the said Attorney shall lawfully do execute or perform or cause to be done, executed or performed in exercise of the power or authority conferred under and by virtue of this Power of Attorney.

★ .....

Signed by the within named
Barmer HVDC Power Transmission Limited
through the hand of
Duly authorized by the Board to issue such Power of Attorney

Dated this 25th **day of** September, **2026**

Accepted

.....

Signature of Attorney
Name: Shri Rajesh Kumar Gupta
Designation: Project Incharge, **Barmer HVDC Power Transmission Limited**
Address: C-203 Nysa Skydale, Chhani- Dumad Road, Behind Satyam Exotica Bunglows, Chhani, Vadodara, Gujarat, Pin-391740

Attested

★ .....

(Signature of the Executant)
Name: D Sudharshan
Designation: Director
Address: B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi - 110 016

NOTARY
Dhan Singh Nagar
Advocate
R. No.-16726
New Delhi, INDIA
Expiry Date
31-1-2030
GOVT. OF INDIA

25 SEP 2026

.....

Signature and Stamp of Notary of the place of execution

ATTESTED
NOTARY PUBLIC
DELHI

WITNESS

Form-I

This is as per CERC (Payment of Fees) Regulation, 2012.

	Particulars	
1	Name of the Petitioner/ Applicant	**Barmer HVDC Power Transmission Ltd.** (A 100% wholly owned subsidiary of Power Grid Corporation of India Limited)
2	Address of the Petitioner/Applicant	**Regd. Address:** B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi 110 016 **Address for correspondence:** ED (Commercial & RC), Power Grid Corporation of India Limited, Floor No. 02, Tower-01, IRCON International Tower, Plot No. 16, Institutional Area, Sector-32, Gurgaon-122003
3	Subject Matter	Petition under Section **14, 15, 79(1)(e)** of the Electricity Act, 2003 read with Central Electricity Regulatory Commission (Procedure, Terms and Conditions for Grant of Transmission License and other related matters) Regulations, 2024 with respect to Transmission License to **Barmer HVDC Power Transmission Ltd.** (a 100% wholly owned subsidiary of Power Grid Corporation of India Limited)
4	Petition No., if any	Not yet received Ref. No.
5	Details of generation assets (a) Generating station/units (b) Capacity in MW (c) Date of Commercial operation (d) Period for which fee paid (e) Amount of fee paid (f) Surcharge, if any transmission line/sub-station/	**Not Applicable**
6	**Details of Transmission Assets** (a) Transmission line and sub-stations (b) Date of commercial operation (c) Period for which fee paid (d) Amount of fee paid (e) Surcharge, if any	Assets under implementation by **Barmer HVDC Power Transmission Ltd.**
7	**Fee paid for Adoption of tariff for** (a) Generation asset (b) Transmission asset	 **No** **No**
8	**Application Fee for License** (a) Trading License	 No

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	(b) Transmission License (c) Period for which paid (d) Amount of fee paid	**Yes** **--** **Rs 1,00,000/-**
9	Fees paid for Miscellaneous Application	**Not Applicable**
10	Fees paid for Interlocutory Application	**Not Applicable**
11	Fee paid for Regulatory Compliance	**Not Applicable**
12	Fee paid for Review Application	**Not Applicable**
13	Licence fee for Inter-State Trading (a) Category (b) Period (c) Amount of fee paid (d) Surcharge, if any	**Not Applicable**
14	Licence fee for Inter-State Transmission (a) Expected/ Actual transmission Charge (b) Period (c) Amount of fee calculated as a percentage of transmission charge (d) Surcharge, if any	
15	Annual Registration Charge for Power Exchange (a) Period (b) Amount of turnover (c) Fee paid (d) Surcharge, if any	**Not Applicable**
16	Details of fee remitted (a) UTR No (b) Date of remittance (c) Amount remitted	**CMS/002017029021/2400280420** **25-09-2026** **Rs1,00,000/-**
Note: While S. No 1 to 3 are compulsory, the rest may be filled up as applicable		
Signature of the authorized Signatory with date **Sh. Rajesh Kumar Gupta** **Project I/c** **Date: 29-09-2026**		