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

दिनांक: **8** सितंबर, 2025

सेवा में/To,

उ.क्षे.वि.स. एवं टीसीसी के सभी सदस्य एवं विशेष आमंत्रित (संलग्न सूचीनुसार)
Members of NRPC & TCC & Special Invitees (As per List)

विषय: ऑनलाइन माध्यम में दिनांक 03.09.2025 को आयोजित एनआरपीसी की विशेष बैठक के कार्यवृत्त

Subject: MoM of Special Meeting of NRPC held on 03.09.2025 through online mode -reg.

महोदय/महोदया,

एनआरपीसी की विशेष बैठक दिनांक **03.09.2025 (12:30 PM)** को वीडियो कॉन्फ्रेंसिंग के माध्यम से आयोजित की गयी थी। बैठक के कार्यवृत संलग्न है। यह उ.क्षे.वि.स. की वेबसाइट (http://164.100.60.165/) पर भी उपलब्ध है।

Special Meeting of NRPC was held on **03.09.2025 (12:30 PM)** via Video Conferencing. MoM of the meeting is attached herewith. The same is also available on NRPC Sectt. Website (http://164.100.60.165/).

भवदीय
Yours faithfully

8/9/2025

(ऋषिका शरण)
(Rishika Sharan)
सदस्य सचिव
Member Secretary

Copy to:

1. Sh. H Rajesh Prasad, IAS, Chairperson, NRPC and Principal Secretary to Government Power Development Department, J&K (**jkpdd9@gmail.com**)
2. Er. Raheela Wani, Chairperson, TCC and Managing Director, JKPTCL (**mdjkptcl1@gmail.com**)

सत्यमेव जयते

उत्तर क्षेत्रीय विद्युत समिति

NORTHERN REGIONAL POWER COMMITTEE

Minutes of

Special meeting of

Northern Regional Power Committee

Date: 3rd September 2025

Time: 12:30 PM

Via: Online Mode

एनआरपीसी की विशेष बैठक के कार्यवृत

Minutes of Special meeting of Northern Regional Power Committee (NRPC)

Minutes of Special Meeting held on 03.09.2025 through online mode

INTRODUCTION

Special Meeting of NRPC was held on 03.09.2025 through VC (online mode) to discuss the ISTS proposals furnished by the CTUIL.

NRPC opening remarks

Chairperson, NRPC welcomed all the participants. He informed that the meeting was convened to discuss *Transmission system for evacuation of 5GW RE power from Renewable Energy Parks in Leh* proposed by CTUIL. The involvement of all States utilities is very much vital in this regard. He requested Member secretary (MS), NRPC to take up the agenda items. Member Secretary, NRPC also welcomed all the participants and directed to NRPC Secretariat for present the agenda items.

Agenda:

A.1 Transmission System for Evacuation of 5GW RE power from Renewable Energy Parks in Leh (agenda by CTUIL)

A.4.1 CTUIL vide letter dated 28.08.2025 has submitted the ISTS network expansion scheme. Since the costing of scheme is more than Rs. 500 Cr., the deliberation and recommendation of NRPC forum is required.

A.4.2 CTU mentioned that based on the recommendations of the 7th NCT meeting, MOP vide letter dated 13.01.22 approved transmission system for evacuation of RE power from Renewable Energy Parks in Leh (Pang) [5 GW RE Leh-Kaithal

Transmission corridor] for implementation under RTM by POWERGRID with commissioning time frame of 5 years from approval.

A.4.3 The initial scheme comprised of ±350kV HVDC system (VSC) between Pang & Kaithal PS, AC system strengthening in Ladakh to provide RE power to Ladakh and J&K through 220kV Pang – Leh (Phyang) S/c line and EHVAC system for dispersal of power to load centres towards Modipuram at 765kV level and Bahadurgarh at 400kV level.

A.4.4 Further, Delinking of EHVAC system beyond Kaithal from Transmission system for evacuation of RE power was approved in 17th NCT meeting held on 29.04.24 with Implementation Timeframe of Mar'30 for HVDC System and 24 months from SPV transfer for EHVAC System (AC system would be required in the matching timeframe of the HVDC system i.e. 31.03.2030).

A.4.5 Earlier, VSC based HVDC scheme was considered over EHVAC system due to limited transmission corridor availability, low SCR at pang bus, point to point controlled power transfer from Pang to Kaithal, independent reactive power control, etc.

A.4.6 Subsequently, due to various design, contractual and technical issues (as informed by OEM to POWERGRID), bidding of the VSC HVDC scheme (Pang-Kaithal) scheme could not yet be concluded.

A.4.7 To deliberate on above issues with POWERGRID and OEMs and to explore feasibility of EHVAC scheme, various meetings were held on 08.08.25, 14.08.25 & 27.08.25 under the Chairmanship of Chairperson (CEA) amongst CEA, CTU, Grid-India and POWERGRID /OEMs.

A.4.8 As per deliberation in above meetings, it was concluded that implementation of VSC based HVDC has the following challenges:

- Complex Geography of Pang PS (at 4700m altitude and low temperature [-35 degree]) - No VSC HVDC solutions were available at such high altitude
- Design and performance challenges of equipment to be adopted for such altitude – exemption from performance requirements
- High level of UV and cosmic radiation- higher failure rate of power electronic devices
- Weak network strength, presence of multiple inverter based resources (Solar, BESS, HVDC, SynCon/STATCOM),

- Transportation and logistics concerns
- Additional time requirement as well as scope exclusion requirements
- Other technical challenges i.e. working at derated voltage (leads to requirement of more no. of semiconductor devices to maintain voltage)

A.4.9 Considering above facts, Joint Studies were carried out amongst CEA, CTU, Grid-India & POWERGRID on 07.08.25 and 13.08.25 to explore feasibility of EHVAC options for evacuation of power from Pang to various load centres of Northern region and the outcome of studies were further discussed in various meetings convened by CEA wherein the EHVAC scheme was finalized.

A.4.10 As part of EHVAC proposal, a 400/220kV pooling station at Pang is proposed with its 400kV interconnections to RE developer pooling stations i.e. 400kV PS1, PS2 & PS3 for integration of RE power. For evacuation of power from Pang PS, 400kV Sundernagar PS in Himachal Pradesh along with, its 400kV interconnection to Pang PS through 2xD/c line with 45% FSC at Sundernagar end is being proposed.

A.4.11 For further dispersal of power from Sundernagar to NR load centres various options were explored. As part of the scheme, 400kV Sundernagar is proposed to be interconnected to 400kV Kaithal S/s through 2x D/c line with 45% FSC at Kaithal end. Further, 765/400kV Kaithal PS to be interconnected to Bahadurgarh & Modipuram S/s through 400kV D/c lines.

A.4.12 Further to provide RE power to Ladakh and J&K, 220kV Pang – Leh (Phyang) S/c line is also proposed as part of the EHVAC system.

A.4.13 To mitigate high loading at 220kV Leh (Phyang) - Khalsti-Kargil- Drass- Alusteng section, following measures were suggested as a separate strengthening scheme in matching timeframe of the EHVAC scheme :

- Reconductoring of 220kV Leh (Phyang)- Khalsti-Kargil-Drass-Alusteng section with HTLS line or additional 220kV corridor from Leh to Alusteng
- Suitable sectionlization arrangement at Pang generation end or Alusteng/Drass end to control loading on 220kV section (from Pang to Alusteng)

A.4.14 To maintain angular and voltage stability in base case as well as in various contingency scenarios, 8 nos. Syncon units (125MVAr) are proposed at Pang PS.

A.4.15 Establishment of 400/220kV PS-1, PS-2 & PS-3 along with 18 Nos. SynCons of 125 MVAr per unit (viz. 6 units at each PS) at 220 kV level (i.e. total of ± 125 x 18 = 2250 MVAr with suitable inertia) is considered in RE Developers scope.

A.4.16 For ease of implementation and gain operational experience, transmission scheme is phased out in two phases. The Ph-I (1.67GW evacuation capacity) and Ph-II (2.33GW evacuation capacity) covers all the transmission elements of scheme, whereas for Ph-III generation of 1 GW, requirement of additional SynCons/400kV interconnection will be identified based on Operational Feedback from Grid-India.

A.4.17 Considering FEED-1 study results and inputs received, cost of EHVAC scheme was derived to about Rs 32,239 Cr.(tentative). (Scheme is attached as **Enclosure-1**)

NRPC Deliberations:

A.4.18 CTU briefed about the scheme and informed that the proposal was discussed in the Joint Study meeting held on 07.08.25 and 13.08.25 amongst CEA, CTU, Grid-India & POWERGRID.

A.4.19 CTU mentioned that Pang-Kaithal VSC HVDC scheme was one of its kind in the entire world due to the involvement of extreme high altitude. POWERGRID engaged with major HVDC suppliers and as per their recommendation, decided to carry out Front End Engineering Design (FEED) Study in two stages; (i) Network Level and (ii) Equipment Level. The FEED-1 studies (Front-end engineering and design study) were carried out by OEMs comprised network studies i.e reactive power support requirement, filter requirement, dynamic & transient studies etc. The FEED-2 (equipment design studies) was included as part of pre bid studies. Based on FEED-1 study recommendations and inputs received, the cost of VSC HVDC option was worked out i.e. about Rs 43,456 Cr.

A.4.20 CTU highlighted that based on the result of FEED-I Study, following were the primary challenges in implementation of VSC based HVDC:

- Excessive Altitude [4700m] and rarified air resulting in enhanced requitements of Insulation.
- Extreme Environmental Conditions - low temperatures [-35 deg] and low oxygen levels
- High level of UV and cosmic radiation- higher failure rate of power electronic devices

- Limited corridors for laying transmission lines
- Non-existent transportation infrastructure for moving heavy equipment
- Low Short Circuit level at the Leh area
- Weak network strength, presence of multiple inverter-based resources Requires matching fixed and dynamic reactive compensation

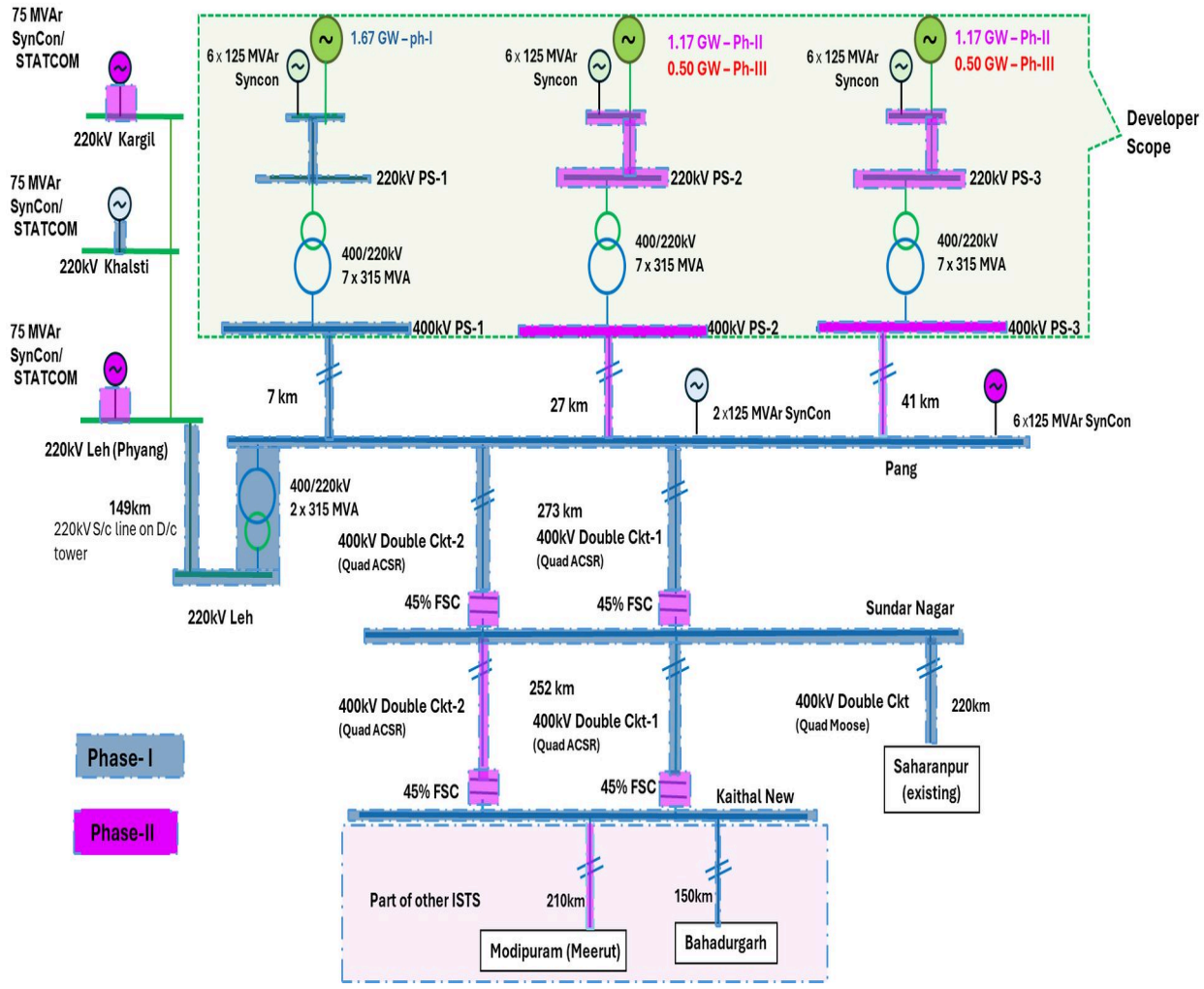
A.4.21 CTU mentioned that, based on the FEED-1 study's recommendations and the inputs received, most of OEMs were reluctant to undertake any contractual work. The Pang–Kaithal VSC HVDC scheme is the first of its kind globally, given the involvement of extremely high altitudes. OEMs were of view that it would be an experimental project, and the design and performance reliability of equipment at such altitudes are difficult to guarantee.

A.4.22 CTU apprised that the FEED-1 study's results were discussed amongst CEA, CTU, Grid-India and POWERGRID/OEMs on 08.08.25, 14.08.25 & 27.08.25 under the Chairmanship of Chairperson (CEA), wherein it was decided to explore EHVAC option with new technologies like SynCons.

A.4.23 Considering above facts, Joint Studies were carried out amongst CEA, CTU, Grid-India & POWERGRID on 07.08.25 and 13.08.25, on the and based of these studies an EHVAC scheme was finalized.

A.4.24 **Broad Scheme Component Proposed under EHVAC scheme are as under:**

- Three Nos 400/220kV PS at Pang i.e. 400kV PS1, PS2 & PS3 (Under RE developers scope)
- New 400kV Pang and Sundernagar PS (HP)
- 8 nos. Syncon units (125MVAr) are proposed at Pang PS
- Pang PS - Sundernagar PS (HP) 2xD/c line with 45% FSC at Sundernagar end
- Sundernagar PS – Kaithal 2xD/c line with 45% FSC at Kaithal end
- 400kV Sundar Nagar to Saharanpur D/c line
- 400kV Kaithal S/s and its interconnection to Bahadurgarh & Modipuram S/s through 400kV D/c lines
- 220kV Pang – Leh (Phyang) S/c line



A.4.25 CTU briefed to forum that as part of EHVAC proposal, a 400/220kV pooling station at Pang is proposed with its 400kV interconnections to RE developer pooling stations i.e. 400kV PS1, PS2 & PS3 for integration of RE power. For evacuation of power from Pang PS, 400kV Sundernagar PS in Himachal Pradesh along with, its 400kV interconnection to Pang PS through 2xD/c line with 45% FSC at Sundernagar end is being proposed.

A.4.26 For further dispersal of power from Sundernagar to NR load centres various options were explored. As part of the scheme, 400kV Sundernagar is proposed to be interconnected to 400kV Kaithal S/s through 2x D/c line with 45% FSC at Kaithal end. Further, 765/400kV Kaithal PS to be interconnected to Bahadurgarh & Modipuram S/s through 400kV D/c lines.

A.4.27 Further to provide RE power to Ladakh and J&K, 220kV Pang – Leh (Phyang) S/c line is also proposed as part of the EHVAC system.

A.4.28 To mitigate high loading at 220kV Leh (Phyang) - KhalstiKargil- Drass- Alusteng section, following measures were suggested as a separate strengthening scheme in matching timeframe of the EHVAC scheme

- Reconductoring of 220kV Leh (Phyang)- Khalsti-KargilDrass-Alusteng section with HTLS line or additional 220kV corridor from Leh to Alusteng
- Suitable sectionlization arrangement at Pang generation end or Alusteng/Drass end to control loading on 220kV section (from Pang to Alusteng)

A.4.29 CTU informed that to ensure angular and voltage stability under both normal (base case) and various contingency conditions, 8 synchronous condenser (SynCon) units of 125 MVAr each are proposed at the Pang pooling station.

A.4.30 CTU stated that the establishment of 400/220kV Pooling Stations—PS-1, PS-2, and PS-3—along with 18 synchronous condensers (125 MVAr each), with 6 units at each pooling station at the 220kV level (i.e., a total of ±125 × 18 = 2250 MVAr with appropriate inertia), is included within the scope of RE developers.

A.4.31 CTU mentioned that for ease of implementation and to gain operational experience, transmission scheme is planned out in two phases.

Ph-I (1.67GW evacuation capacity)
Ph-II (2.33GW evacuation capacity)

For Ph-III generation of 1 GW, requirement of additional SynCons/400kV interconnection will be identified based on Operational Feedback from Grid-India.

A.4.32 CTU apprised that based on the inputs generated during FEED-1 study results and inputs received, Estimated Cost of EHVAC scheme is **Rs. 32,239 Cr (Tentative).** Phase-wise cost breakup is as follows:

- Ph-I: Rs. 23274 crores
- Ph-II: Rs. 8965 crores

A.4.33 CTU apprised that implementation Timeframe that has been worked out is as follows:

- Ph-I: Jul’29 (1.67 GW)
- Ph-II: Dec’30 (2.33 GW)

A.4.34 MS, NRPC requested all States to furnish the views/ comments for the proposal. Further, the proposal may be put up to the NCT along with the views of NRPC.

A.4.35 The UT of Ladakh highlighted that, at present, there is no alternate transmission line or generation source available in the event of failure of the single circuit transmission line maintained by Power Grid - *220 KV Leh (Phyang) - Khalsti-Kargil-Drass-Alestang section HTLS line or 220 KV corridor from Leh to Alestang,* particularly during the winter months from November to April.

A.4.36 The UT of Ladakh was of the view that, instead of reconductoring the 220kV Leh (Phyang)–Khalsti–Kargil–Drass–Alusteng section with an HTLS line, a separate 220kV or 400kV corridor between Srinagar and Ladakh may be planned, which POWERGRID may execute as ISTS.

A.4.37 MS, NRPC suggested that independent of the above scheme, CTU may conduct a separate study to assess the feasibility of an additional 220kV corridor from Leh to Alusteng from a grid operation perspective.

A.4.38 HPPTCL suggested that in areas of the corridor which are prone to avalanches, a detailed survey should be carried out to identify two possible parallel routes. The idea is that instead of constructing a double-circuit transmission line on a single set of towers, the circuits could be built as two separate single-circuit lines on different towers along the avalanche zone. This arrangement would ensure that even if one tower is damaged due to an avalanche, at least one circuit would remain in service, thereby maintaining power supply reliability.

A.4.39 POWERGRID submitted that, with respect to the route from Phyang to Sundernagar to Kaithal, a detailed survey has been conducted to assess how the mountain passes will be crossed. They have nearly finalized the tower spottings, and factors such as avalanche zones and snowfall have been duly considered in the planning process.

A.4.40 POWERGRID mentioned the following engineering challenges in execution of the proposed system:

- For the proposed AC system now, 02 nos. Double circuit AC transmission line (taller and heavier compared to earlier HVDC tower & dimensions

comparable to 765kV towers) is to be designed & constructed in the limited narrow corridor available along the mountainous route.

- Varying altitude, multiple wind zone, sub soil conditions, snow fall magnitude, avalanche zone requires approx. 35 types of transmission tower designs which will be unique to the proposed transmission system and an engineering challenge.
- High snowfall & avalanche prone stretches along transmission line route crossing high Himalayan passes like Baralacha, Lachung-La, Tangla-la, Rohtang etc. and narrow deep vallies.
- The absence of all-weather roads, poor conditions of existing roads and bridges, along with frequent soil erosion and landslides along the proposed route, necessitate limiting the size of equipment to be transported and require significant strengthening of roads and bridges.
- Limited working window of only 05 to 06 months in a year.
- Close proximity to international border (LAC with China) and sensitive military zone and requirement of close coordination with multiple government agencies like MoRTH, BRO, Defense Organizations, Aviation, Local Authorities etc.

A.4.41 POWERGRID highlighted in the meeting various actions already taken up by them for execution of this project:

- Land at Pang(300 Acre) and Kaithal(328 acre) is in possession (Kaithal-partial)
- Joint survey for augmentation of strengthening of road/bridges for transportation of heavy equipment completed with BRO and identified the locations / bridges to be strengthened
- Establishment of basic Infrastructure for initial site mobilisation, namely office establishment, accommodation, power supply generation (Solar/Battery), communication, water supply arrangements etc., are under progress.
- LiDAR survey for the transmission line route is in progress.

- Entered an agreement with DRDO and carried out weather acclimatisation training of employees for high altitudes.
- Collaborated with Jawahar Institute of mountaineering and carried out mountaineering training of employees for snow-walking
- Already about Rs.400 cr. expenditure incurred for carrying out above works to facilitate smooth execution.
- Implementation works of 220kV Pang- Phyang Line via Kharu is under progress and Packages are ready for awarded to facilitate construction power supply with reliability.
- Implementation of alternate green power supply arrangement through 2.1MW
- Solar PV coupled with 1200 kWh BESS is under progress at Pang
- Tied up with Defence for upgradation and utilisation of the existing helipad
- Tied up with IIT Roorkee for geotechnical studies at Pang

A.4.42 POWERGRID informed that project presents significant challenges due to the complexities of high altitudes, rugged terrain, extremely low temperatures, and unforeseen surprises/ risks/ complications during implementation and suggested that mode of implementation may be same as earlier scheme.

A.4.43 All constituents of the NRPC forum agreed with the proposal of CTU for the transmission system to evacuate 5 GW of renewable energy from the Renewable Energy Parks in Leh under the EHVAC scheme.

Decision of the Forum

Forum agreed the proposal of CTU for the Transmission system for evacuation of 5GW RE power from Renewable Energy Parks in Leh under EHVAC scheme.

Meeting ended with a vote of thanks to the chair

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NRPC Members for FY 2025-26

S. No.	NRPC Member	Category	Nominated/ Notified/Delegated Member	E-mail
1	Member (GO&D), CEA	Member (Grid Operation & Distribution), Central Electricity Authority (CEA)	Member (GO&D), CEA	member.god@cea.nic.in
2	NLDC	National Load Despatch Centre	Director (System Operation)	rk.porwal@grid-india.in
3	NRLDC	Northern Regional Load Despatch Centre	Executive Director	mkagarwal@grid-india.in
4	CTUIL	Central Transmission Utility	Chief Operating Officer	ashok@powergrid.in
5	PGCIL	Central Government owned Transmission Company	Director (Operations)	naveensrivastava@powergrid.in
6	NTPC	Central Generating Company	Director (Finance)	jaikumar@ntpc.co.in
7	BBMB		Chairman	cman@bbmb.nic.in
8	THDC		CGM (EM-Design)	rrsemwal@thdc.co.in
9	SJVN		CMD	sectt.cmd@sjvn.nic.in
10	NHPC		Director (Technical)	sadhikari@nhpc.nic.in
11	NPCIL		Director (Finance)	df@npcil.co.in
12	Delhi SLDC	State Load Despatch Centre	General Manager	gmsldc@delhisldc.org
13	Haryana SLDC		Chief Engineer (SO&C)	cesocomml@hvpn.org.in
14	Rajasthan SLDC		Chief Engineer (LD)	ce.ld@rvpn.co.in
15	Uttar Pradesh SLDC		Director	directorsldc@upsldc.org
16	Uttarakhand SLDC		Chief Engineer	anupam_singh@ptcul.org
17	Punjab SLDC		Chief Engineer	ce-sldc@punjabsldc.org
18	Himachal Pradesh SLDC		Managing Director	mdhpsldc@gmail.com
19	DTL	State Transmission Utility	CMD	cmd@dtl.gov.in
20	HVPNL		Managing Director	md@hvpn.org.in
21	RRVPNL		CMD	cmd.rvpn@rvpn.co.in
22	UPPTCL		Managing Director	md@upptcl.org
23	PTCUL		Managing Director	md@ptcul.org
24	PSTCL		CMD	cmd@pstcl.org
25	HPPTCL		Managing Director	md.tcl@hpmail.in
26	IPGCL	State Generating Company	Managing Director	md.ipgpp@nic.in
27	HPGCL		Managing Director	md@hpgcl.org.in
28	RRVUNL		CMD	cmd@rrvun.com
29	UPRVUNL		Director (Technical)	director.technical@uprvunl.org
30	UJVNL		Managing Director	mdujvnl@ujvnl.com
31	HPPCL		Managing Director	md@hppcl.in
32	PSPCL	State Generating Company & State owned Distribution Company	CMD	cmd-pspcl@pspcl.in
33	DHBVN	State owned Distribution Company (alphabetical rotational basis/nominated by state govt.)	Managing Director	md@dhbvn.org.in
34	Ajmer Vidyut Vitran Nigam Ltd.		Managing Director	MD.AVVNL@RAJASTHAN.GOV.IN
35	Purvanchal Vidyut Vitaran Nigam Ltd.		Managing Director	nomination awaited(md@puvvnl.in)
36	UPCL		Managing Director	md@upcl.org
37	HPSEB		Managing Director	md@hpseb.in
38	Prayagraj Power Generation Co. Ltd.	IPP having more than 1000 MW installed capacity	Head (Commercial & Regulatory)	sanjay.bhargava@tatapower.com
39	Aravali Power Company Pvt. Ltd		CEO	brahmajig@ntpc.co.in
40	Apraava Energy Private Limited		CEO	niraj.gupta@apraava.com
41	Talwandi Sabo Power Ltd.		Head Regulatory & Policy Advocacy	arun.kumar@vedanta.co.in
42	Nabha Power Limited		CEO	sk.narang@larsentoubro.com
43	MEIL Anpara Energy Ltd		COO & WTD, Executive Director	anandkumar.singh@meilanparapower.com arun.tholia@meilanparapower.com
44	Rosa Power Supply Company Ltd		Station Director	Hirday.tomar@relianceada.com
45	Lalitpur Power Generation Company Ltd		Managing Director	vksbankoti@bajajenergy.com
46	MEJA Urja Nigam Ltd.		CEO	hopmeja@ntpc.co.in
47	Adani Power Rajasthan Limited		Head, Thermal, O&M	Kanti.Biswas@adani.com
48	JSW Energy Ltd. (KWHEP)		Head Regulatory & Power Sales	jyotiprakash.panda@jsw.in
49	Transition Cleantech Services Private Limited	IPP having less than 1000 MW installed capacity (alphabetical rotational basis)		nomination awaited(pkanaujia@evrenenergy.com)
50	UT of J&K	From each of the Union Territories in the region, a representative nominated by the administration of the Union Territory concerned out of the entities engaged in generation/ transmission/ distribution of electricity in the Union Territory.	Chief Engineer, JKSPDCL/JKPDD	cejkpcl2@gmail.com/sojpdd@gmail.com
51	UT of Ladakh		Chief Engineer, LPDD	cepdladakh@gmail.com
52	UT of Chandigarh		Executive Engineer, EWEDC	seelo-chd@nic.in
53	NVVN	Nodal Agency appointed by the Government of India for coordinating cross-border power transactions	NVVN and PTC are two nodal agencies in Northern Region. Since PTC is already a member in this year for trader category, it is listed at serial no. 56.	ceonvvn@ntpc.co.in
54	TPDDL	Private Distribution Company in region (alphabetical rotational basis)	Head-Commercial	nomination awaited(ceo.office@tatapower-ddl.cpm)
55	Gurgaon Palwal Transmission Limited	Private transmission licensee (nominated by central govt.)	AVP-O&M	lokendra.ranawat@indigrid.com
56	PTC	Electricity Trader (nominated by central govt.)	CEO	cmd@ptcindia.com
57	ReNew Power Private Limited	RE Generating Company having more than 1000 MW installed capacity	CEO	sumant@renew.com
58	NTPC Green Energy Limited		CEO	rajivgupta@ntpc.co.in
59	Azure Power India Pvt. Limited		CEO	sunil.gupta@azurepower.com
60	Avaada Energy Private Limited		CEO	kishor.nair@avaada.com
61	Adani Green Energy Limited		COO	chaitanya.sahoo@adani.com

Enclosure-I

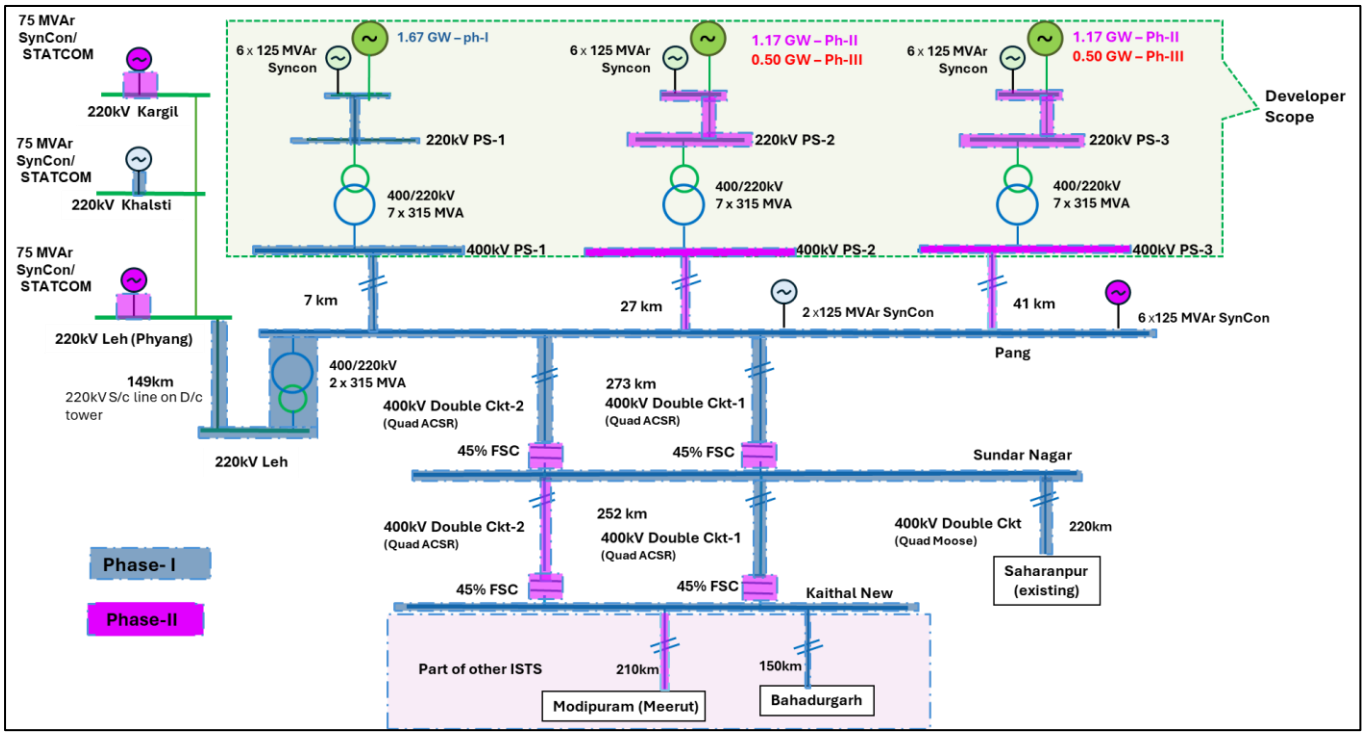
Transmission system for evacuation of 5GE RE power from Renewable Energy Parks in Leh

S. No.	Items	Details
1.	**Name of Scheme**	**Transmission system for evacuation of 5GW RE power from Renewable Energy Parks in Leh**
2.	**Scope of the scheme**	Details of Transmission scheme is enclosed in ***Annexure-I***
3.	**Depiction of the scheme on Transmission Grid Map**	Attached at **Exhibit-I**
4.	**Upstream/downstream system associated with the scheme**	220/66kV Leh(Phyang) S/s is existing substation which is interconnected to Khalsti S/s at 220kV level and to various load centres of Leh at 66kV level. 400/220kV Saharanpur S/s is an existing substation which is interconnected to Roorkee and Bagpat S/s at 400kV level.
5.	**Objective / Justification**	1. The present scheme comprises of Transmission system for evacuation of 5GW RE power from Renewable Energy Parks in Leh. 2. Based on the recommendations of the 7th NCT meeting, MOP vide letter dated 13.01.22 approved transmission system for evacuation of RE power from Renewable Energy Parks in Leh (Pang) [5 GW Leh-Kaithal Transmission corridor] for implementation under RTM by POWERGRID with implementation time frame of 5 years from approval i.e. approval of the Central Government for providing Central Grant for part funding of the project. 3. The scheme comprised of ±350kV HVDC system (VSC) between Pang & Kaithal PS, AC system strengthening in Ladakh to provide RE power to Ladakh and J&K through 220kV Pang – Leh (Phyang) S/c line and EHVAC system for dispersal of power to load centres towards Modipuram at 765kV level and Bahadurgarh at 400kV level. 4. Further, Delinking of EHVAC system beyond Kaithal from Transmission system for evacuation of RE power was approved in 17th NCT meeting held on 29.04.24 with Implementation Timeframe of Mar'30 for HVDC System and 24 months from SPV transfer for EHVAC System (AC system would be required in the matching timeframe of the HVDC system i.e. 31.03.2030). 5. Earlier, VSC based HVDC scheme was considered over EHVAC system due to limited transmission corridor availability, low SCR at pang bus, point to point controlled power transfer from Pang to Kaithal, independent reactive power control, etc. 6. Subsequently, due to various design, contractual and technical issues (as informed by OEM to POWERGRID),

S. No.	Items	Details
		bidding of the VSC HVDC scheme (Pang-Kaithal) scheme could not yet be concluded. 7. To deliberate on above issues with POWERGRID and OEMs and to explore feasibility of EHVAC scheme, various meetings were held on 08.08.25, 14.08.25 & 27.08.25 under the Chairmanship of Chairperson (CEA) amongst CEA, CTU, Grid-India and POWERGRID /OEMs. 8. Pang-Kaithal VSC HVDC scheme was one of its kind in the entire world due to the involvement of extreme high altitude. Accordingly the scheme was taken up in two stages viz FEED1 - FEED2. The FEED-1 studies (Front end engineering and design study) were carried out by OEMs comprised network studies i.e reactive power support requirement, filter requirement, dynamic & transient studies etc. The FEED-2 (equipment design studies) was included as part of pre bid studies. Based on FEED-1 study recommendations and inputs received, cost of VSC HVDC option was worked out to about Rs 43,456 Cr. 9. As per deliberation in above meetings, it was concluded that implementation of VSC based HVDC has the following challenges: • Complex Geography of Pang PS (at 4700m altitude and low temperature [-35 degree]) - No VSC HVDC solutions were available at such high altitude • Design and performance challenges of equipment to be adopted for such altitude – exemption from performance requirements • High level of UV and cosmic radiation- higher failure rate of power electronic devices • Weak network strength, presence of multiple inverter based resources (Solar, BESS, HVDC, SynCon/STATCOM), • Transportation and logistics concerns • Additional time requirement as well as scope exclusion requirements • Other technical challenges i.e. working at derated voltage (leads to requirement of more no. of semiconductor devices to maintain voltage) 10. Considering above facts, Joint Studies were carried out amongst CEA, CTU, Grid-India & POWERGRID on 07.08.25 and 13.08.25 to explore feasibility of EHVAC options for evacuation of power from Pang to various load centres of Northern region. The studies were carried out in solar maximized scenario in 2030 timeframe. The outcome of studies were further discussed in meetings convened by CEA held on 07.08.25, 13.08.25 & 26.08.25 wherein the EHVAC scheme was finalized. 11. As part of EHVAC proposal, a 400/220kV pooling station at Pang is proposed with its 400kV interconnections to RE developer pooling stations i.e. 400kV PS1, PS2 & PS3 for integration of RE power. For evacuation of power from Pang PS, 400kV Sundernagar PS in Himachal Pradesh along with

S. No.	Items	Details
		its 400kV interconnection to Pang PS through 2xD/c line with 45% FSC at Sundernagar end is being proposed. 12. For further dispersal of power from Sundernagar to NR load centres various options were explored. As part of the scheme, 400kV Sundernagar is proposed to be interconnected to 400kV Kaithal S/s through 2x D/c line with 45% FSC at Kaithal end. Further, 765/400kV Kaithal PS is proposed to be interconnected to Bahadurgarh & Modipuram S/s through 400kV D/c lines. 13. Further to provide RE power to Ladakh and J&K, 220kV Pang – Leh (Phyang) S/c line is also proposed as part of the EHVAC system. 14. To mitigate high loading at 220kV Leh (Phyang) - Khalsti-Kargil- Drass- Alusteng section, following measures were suggested as a separate strengthening scheme in matching timeframe of the EHVAC scheme : ➢ Reconductoring of 220kV Leh (Phyang)- Khalsti-Kargil-Drass-Alusteng section with HTLS line or additional 220kV corridor from Leh to Alusteng ➢ Suitable sectionlization arrangement at Pang generation end or Alusteng/Drass end to control loading on 220kV section (from Pang to Alusteng) 15. To maintain angular and voltage stability in base case as well as in various contingency scenarios, 8 nos. Syncon units (125MVAr) are proposed at Pang PS. 16. Establishment of 400/220kV PS-1,PS-2 & PS-3 along with 18 Nos. SynCons of 125 MVAr per unit (viz. 6 units at each PS) at 220 kV level (i.e. total of ± 125 x 18 = 2250 MVAr with suitable inertia) is considered in RE Developers scope. 17. For ease of implementation and to gain operational experience, transmission scheme is phased out in two phases. The Ph-I (1.67GW evacuation capacity) and Ph-II (2.33GW evacuation capacity) covers all the transmission elements of scheme, whereas for Ph-III generation of 1 GW, requirement of additional SynCons/400kV interconnection will be identified based on Operational Feedback from Grid-India. 18. Considering FEED-1 study results and inputs received, cost of EHVAC scheme was derived to about Rs 32,239 Cr.(tentative).
6.	**Estimated Cost**	**Rs 32,239 Cr (Tentative)** **Ph-I : Rs 23274 Cr** **Ph-II : Rs 8965 Cr**
7.	**Need of transmission phasing, if any**	**Ph-I : 1.67GW evacuation capacity** **Ph-II : 2.33GW evacuation capacity**
8.	**Implementation timeframe**	**Ph-I : Jul'29 (1.67GW)** **Ph-II : Dec'30 (2.33GW)**
9.	**System Study for evolution of the proposal**	Load flow results is attached at **Exhibit-II**

Exhibit-I


75 MVAr SynCon/ STATCOM
220kV Kargil
75 MVAr SynCon/ STATCOM
220kV Khalsti
75 MVAr SynCon/ STATCOM
220kV Leh (Phyang)
149km
220kV S/c line on D/c tower
220kV Leh
6 x 125 MVAr Syncon
1.67 GW – ph-I
220kV PS-1
400/220kV 7 x 315 MVA
400kV PS-1
6 x 125 MVAr Syncon
1.17 GW – Ph-II
0.50 GW – Ph-III
220kV PS-2
400/220kV 7 x 315 MVA
400kV PS-2
6 x 125 MVAr Syncon
1.17 GW – Ph-II
0.50 GW – Ph-III
220kV PS-3
400/220kV 7 x 315 MVA
400kV PS-3
Developer Scope
7 km
27 km
2 x125 MVAr SynCon
41 km
6 x125 MVAr SynCon
Pang
400/220kV 2 x 315 MVA
400kV Double Ckt-2 (Quad ACSR)
273 km
400kV Double Ckt-1 (Quad ACSR)
45% FSC
45% FSC
Sundar Nagar
400kV Double Ckt-2 (Quad ACSR)
252 km
400kV Double Ckt-1 (Quad ACSR)
400kV Double Ckt (Quad Moose)
220km
Saharanpur (existing)
45% FSC
45% FSC
Kaithal New
Part of other ISTS
210km
150km
Modipuram (Meerut)
Bahadurgarh
Phase- I
Phase-II

Transmission system for evacuation of 5GW RE power from Renewable Energy Parks in Leh

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
	Phase-I : 1.67GW evacuation capacity	
1	400kV PS-1 - Pang Pooling Station D/c (Quad) line along with line bays at Pang Pooling Station Note: 400kV GIS line bays (2 nos) at PS-1 is under RE developer scope	Line Length ~7 km (Quad Moose)
2	Establishment of 400/220kV, 2x315MVA Pooling Station at Pang along with 1x125MVAr, 420kV bus reactor. **Future provisions :** ➢ 400 kV line bays –10 Nos. (4 nos. utilized for PS2 & PS3 interconnection in Ph-II scheme) ➢ 400/220 kV 315 MVA ICTs along with bays- 2 Nos. ➢ 400 kV Sectionalization bays: 2 set ➢ 220kV Sectionalization bay: 1 sets ➢ 220 kV BC (2 Nos.) & TBC (2 Nos.) ➢ 10 No. of Syncon units* at 400kV level along with 10 nos. of 400kV bays (6 nos. utilized in Ph-II scheme) ➢ 220kv line bays – 4 nos. *1 No. of SynCon unit comprises dynamic support of +125MVAr/-95MVAr (Minimum), Short circuit contribution at PCC of 750MVA (Minimum) (Value of inertia constant (sec) shall be considered 5)	Pang PS - GIS • 400/220 kV 315 MVA ICTs- 2 Nos. (7x105 MVA unit including one spare unit) • 400kV line bays – 6 nos. (for 400kV D/c interconnection PS1 and 2xD/c interconnection with Sundernagar S/s) • 400 kV ICT bays- 2 Nos. • 220 kV ICT bays - 2 Nos. • 125 MVAr Bus Reactor-1 Nos. • 400 kV Bus reactor bay- 1 Nos. • 220kV line bays – 1 nos. (for Leh (Phyang) interconnection • 400 kV bays for Syncons –2 Nos.
3	Establishment of 400kV Switching station near Sundar Nagar along with 2x125MVAr, 420kV bus reactor. **Future provisions (excl. scope of present scheme):** ➢ 400 kV line bays along with switchable line reactors –6 Nos. (2 nos. utilized for Kaithal interconnection in Ph-II scheme) ➢ 400 kV Sectionalization bays: 1 set ➢ 400/220 kV 315 MVA ICTs along with bays- 2 Nos ➢ 220kv line bays – 4 nos.	Sundar Nagar S/s - GIS • 400kV line bays – 6 nos. (for 400kV 2xD/c interconnection with Pang S/s & 400kV D/c interconnection with Kaithal S/s) • 125 MVAr Bus Reactor-2 Nos. • 400 kV Bus reactor bay- 2 Nos.

	➢ 220 kV BC (1 No.) & TBC (1 No.)	
4	Establishment of 400kV Kaithal substation along with 1x125MVAr, 420kV bus reactor **<u>Future provisions :</u>** ➢ 765/400 kV 1500 MVA ICTs- 4 Nos. ➢ 765 kV line bays along with switchable line reactor –6 nos. ➢ 400 kV line bays along with switchable line reactor –10 nos. (2 nos. utilized for Sundernagar interconnection in Ph-II scheme) ➢ 765 kV Bus Reactor along with bays: 1 No ➢ 400 kV Bus Reactor along with bays: 1 No. ➢ 400 kV Sectionalization bays: 1 set ➢ 400/220 kV ICT along with bays-2 Nos. ➢ 220 kV line bays -4 Nos. ➢ STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 400kv bays (2nos.)	Kaithal S/s - AIS • 400kV line bays – 2 nos. (for 400kV D/c interconnection with Sundernagar S/s) • 125 MVAr Bus Reactor-1 Nos. • 400 kV Bus reactor bay- 1 Nos.
5	2 No. of Syncon units* at 400kV level *1 No. of SynCon unit comprises dynamic support of +125MVAr/-95MVAr (Minimum), Short circuit contribution at PCC of 750MVA (Minimum) (Value of inertia constant (sec) shall be considered 5)	Syncon units – 2 nos.
6	220kV Pang – Leh (Phyang) (PG) S/c line (Deer conductor) on D/c towers along with line bays at both ends	Line Length ~149 km • 220 kV line bays at Leh (Phyang) S/s- 1 No.
7	400kV Pang - Sundar Nagar 2xD/c Quad ACSR line along with 63MVAr switchable line reactor on each ckt. at both ends.	Line Length-273km (Quad) • 420 kV, 63 MVAr switchable line reactors at Pang PS end– 4 Nos. • Switching equipment for 420kV, 63MVAr switchable line reactors at Pang PS end – 4 Nos. • 420 kV, 63 MVAr switchable line reactors at Sundar Nagar PS end– 4 Nos. • Switching equipment for 420kV, 63MVAr switchable line reactors at Sundar Nagar PS end – 4 Nos.

8	400kV Sundar Nagar – Kaithal D/c Quad ACSR line along with 50MVAr switchable line reactor on each ckt at both ends.	Line Length-252km (Quad) • 420 kV, 50 MVAr switchable line reactors at Sundar Nagar PS end– 2 Nos. • Switching equipment for 420kV, 50MVAr switchable line reactors at Sundar Nagar PS end – 2 Nos. • 420 kV, 50 MVAr switchable line reactors at Kaithal S/s end– 2 Nos. • Switching equipment for 420kV, 50MVAr switchable line reactors at Kaithal S/s end – 2 Nos.
9	400kV Sundar Nagar - Saharanpur D/c line (Quad) along with 50MVAr switchable line reactor on each ckt. at both ends.	Line Length-220km (Quad Moose) • 400kv line bays at Saharanpur S/s – 2 nos. • 420 kV, 50 MVAr switchable line reactors at Sundar Nagar PS end– 2 Nos. • Switching equipment for 420kV, 50MVAr switchable line reactors at Sundar Nagar PS end – 2 Nos. • 420 kV, 50 MVAr switchable line reactors at Saharanpur S/s end– 2 Nos. • Switching equipment for 420kV, 50MVAr switchable line reactors at Saharanpur S/s end – 2 Nos.
10	1 No. of Syncon units* at 220kV level of Khalsti S/s *1 No. of SynCon unit comprises dynamic support of ±75MVAr (Minimum), Short circuit contribution at PCC of 450MVA (Minimum) (Value of inertia constant (sec) shall be considered 5)	Syncon unit – 1 nos. • 220kv line bay at Khalsti – 1 no.
11	Kaithal - Bahadurgarh (PG) 400 kV D/C Line (Quad)	Line Length ~170 km (Quad) • 400kV line bays at Kaithal end • 400kV line bays at B'garh end – 2 nos.
	Phase-II: 2.33 GW evacuation capacity	
1	400kV PS-2- Pang Pooling Station D/c (Quad) line along with line bays at Pang Pooling Station Note: 400kV GIS line bays (2 nos) at PS-2 is under RE developer scope	Line Length ~27 km (Quad Moose) • 400kV line bays at Pang PS – 2 nos. (for 400kV D/c interconnection with PS2)

2	400kV PS-3 - Pang Pooling Station D/c (Quad) line along with line bays at Pang Pooling Station Note: 400kV GIS line bays (2 nos) at PS-3 is under RE developer scope	Line Length ~41 km (Quad Moose) • 400kV line bays at Pang PS – 2 nos. (for 400kV D/c interconnection with PS3)
3	400kV Sundar Nagar – Kaithal 2nd D/c Quad ACSR line along with 50MVAr switchable line reactor on each ckt at both ends and line bays at both ends.	Line Length-252km (Quad) • 420 kV, 50 MVAr switchable line reactors at Sundar Nagar PS end– 2 Nos. • Switching equipment for 420kV, 50MVAr switchable line reactors at Sundar Nagar PS end – 2 Nos. • 420 kV, 50 MVAr switchable line reactors at Kaithal S/s end– 2 Nos. • Switching equipment for 420kV, 50MVAr switchable line reactors at Kaithal S/s end – 2 Nos.
4	FSC (45%) on all four ckts. of 400kV Pang PS – Sundar Nagar 2xD/c line at Sunder Nagar end.	FSC (45%) – 4 Nos. (at Sunder Nagar end)
5	FSC (45%) on all four ckts. of 400kV Sundar Nagar – Kaithal 2xD/c line at Kaithal end.	FSC (45%) – 4 Nos. (at Kaithal end)
6	6 No. of Syncon units* at 400kV level of Pang PS *1 No. of SynCon unit comprises dynamic support of +125MVAr/-95MVAr (Minimum), Short circuit contribution at PCC of 750MVA (Minimum) (Value of inertia constant (sec) shall be considered 5)	Syncon units – 6 nos. • 400kV line bay at Pang PS– 6 no.
7	1 No. of Syncon units* each at 220kV level of Leh (Phyang) and Kargil S/s *1 No. of SynCon unit comprises dynamic support of ±75MVAr (Minimum), Short circuit contribution at PCC of 450MVA (Minimum) (Value of inertia constant (sec) shall be considered 5)	Syncon unit – 2 nos. • 220kV line bay at Leh (Phyang) S/s– 1 no. • 220kV line bay at Kargil S/s– 1 no.
8	Kaithal - Modipuram (Meerut) (UPPTCL) 400kV D/C Line along with 1x80MVAr switchable line reactor on each ckt at Kaithal end	Line Length ~210 km (Quad) • 400kV line bays at Kaithal end • 400kV line bays at Modipuram end – 2 nos. (GIS) • 420 kV, 80 MVAr switchable line reactors at Kaithal S/s end– 2 Nos.

		• Switching equipment for 420kV, 80MVAr switchable line reactors at Kaithal S/s end – 2 Nos.

For Phase-III (1 GW evacuation capacity), Space is to be kept assessing transmission requirement of additional system based on Operational Feedback of Grid-India. Following space requirements is to be kept during Phase-I:

- Space for 4x125MVAr SynCon at 400kV Pang along with associated bays.
- Space for 4 Nos. of 400 kV line bays along with line reactor at Sundarnagar S/s for any future 400kV interconnection

EXHIBIT-II

PHASE - I

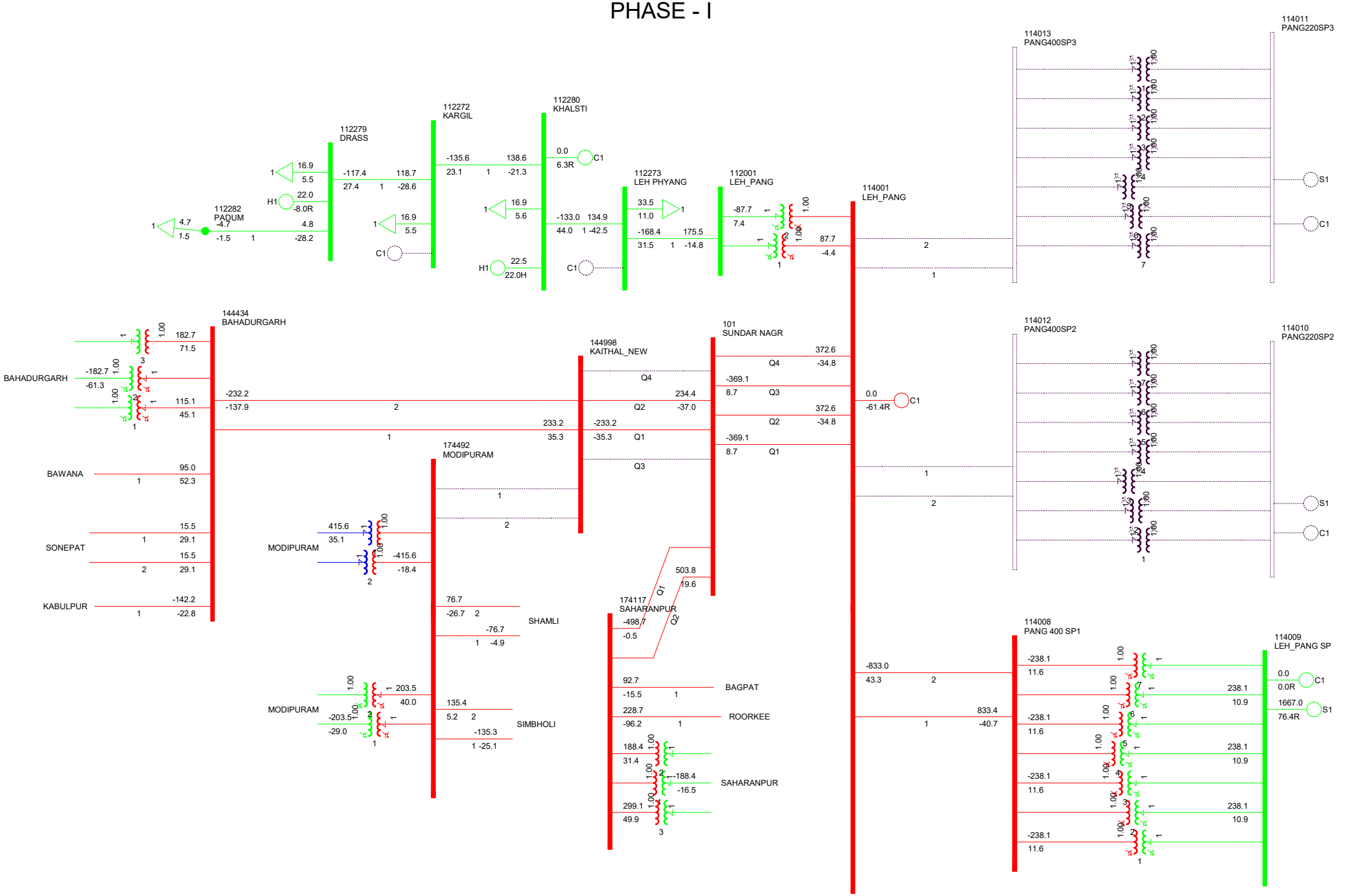


EXHIBIT - II

PHASE - I + II