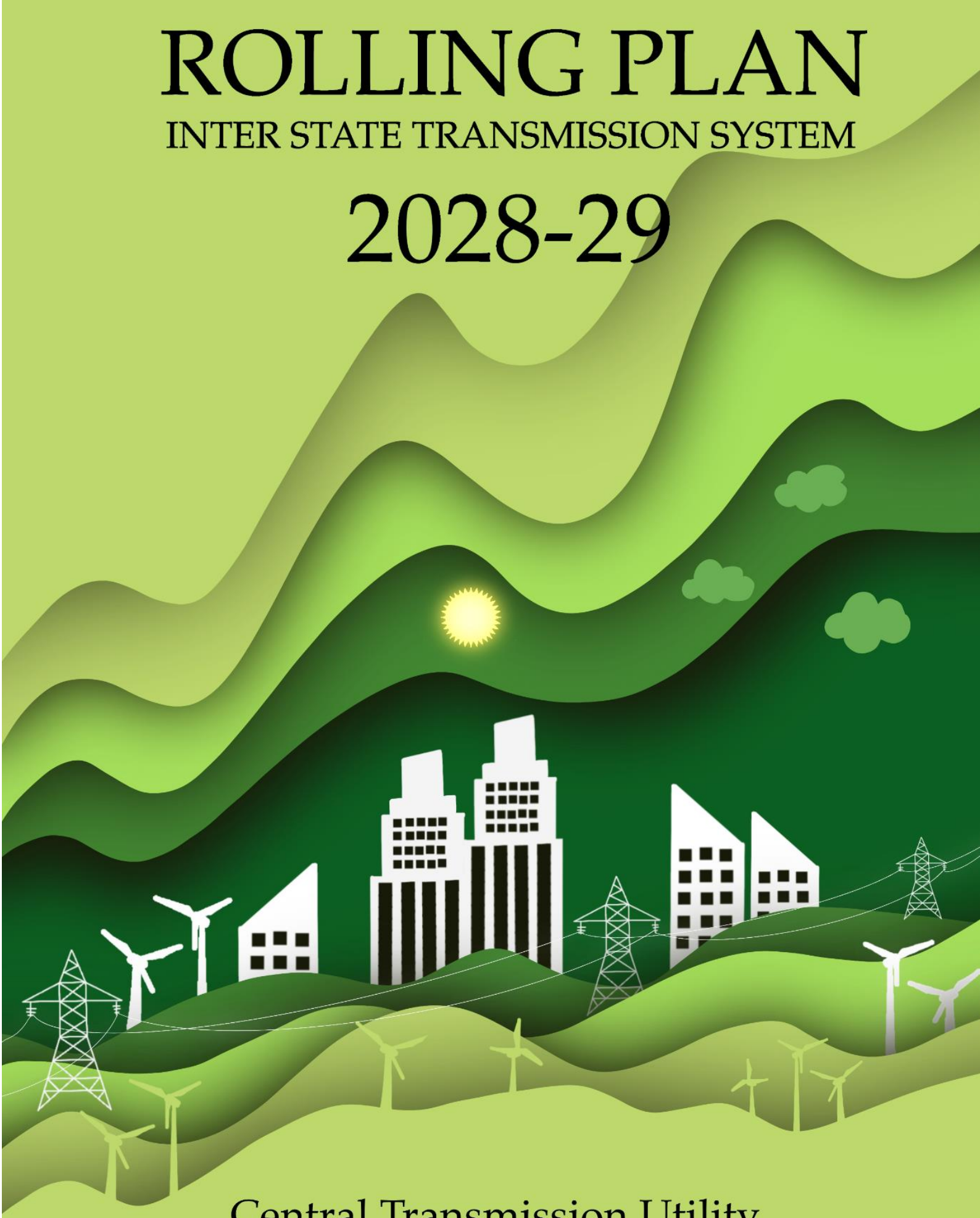
ROLLING PLAN

INTER STATE TRANSMISSION SYSTEM

2028-29



Central Transmission Utility

March 2024

ROLLING PLAN 2028-29

INTER-STATE TRANSMISSION SYSTEM (ISTS)

(REPORT)

March 2024

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Executive Summary

Today, India is on the path of high economic growth and is aiming to be a 5 trillion USD economy by 2030. Electricity sector is playing a very vital role in this economic development by acting as a secure and reliable source of energy. One of the emerging utilisations of electricity today is in the transportation sector with Central and State Governments promoting faster adoption of Electric Vehicles (EVs), to reduce emission of greenhouse gases. To meet the growing energy demand in sustainable and eco-friendly manner, India is going through a phase of energy transition at rapid pace with greater focus on development of new Renewable Energy (RE) resources. In this direction, at the COP26 climate conference in Glasgow, India has committed to achieve non-fossil energy capacity of 500GW by 2030 and to meet 50 per cent of its energy requirement through RE by 2030. Further, India has also set target of being a net zero emitter by 2070.

There is a continuous strong growth in demand for electricity in the country. The emerging utilisations of electricity today is observed in the transportation sector to reduce emission of greenhouse gases. Govt. of India came up with Green Hydrogen Policy in Feb 2022 and National Green Hydrogen Mission in January 2023, and it is expected that there is going to be power requirement in the National Grid to the tune of 125 GW from industries producing Green Hydrogen and Green Ammonia using power from Renewable Energy (RE) resources. ISTS planning has been initiated in this direction to provide requisite power to such industries from large RE complexes.

To achieve the energy transition goals and facilitate large scale integration of RE, Central Electricity Authority (CEA) published a Report titled “Transmission System for Integration of over 500GW RE Capacity by 2030” in Dec 2022 inter alia including details of the transmission requirement for RE integration till 2030, energy storage requirement in the grid, new HVDCs requirement etc. Also keeping pace with latest international best practices in transmission planning, CEA has updated and came up with “Manual on Transmission Planning Criteria, 2023”

The huge quantum of RE generations being integrated in the National Grid to meet the energy transition goals, needs to be transferred reliably and securely to all the major load centres of the country. This necessitates continuous development of a robust National Grid comprising of high capacity AC and HVDC systems along with state-of-the-art FACTS devices for controlling power system parameters. Electrical Energy storage (BESS/PHS) would play a significant role towards meeting energy transition goals. India’s path and ways of RE integration to its National Grid can act as blue print for other countries for development of new age electricity grid. There is also a thrust on development and integration of Energy Storage devices in form of batteries, pumped hydro etc. in the National Grid, for providing balancing power during low or no RE period and also increasing utilisation of transmission system associated with RE projects.

Transmission system plays a very crucial role of facilitating integration of generation resources and demand centres to the National Grid, and therefore should be planned and developed

adequately so as to enable seamless integration of generation projects and also facilitate availability of reliable, secure, and affordable power to all the consumers.

In this direction, and as per Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules, 2021, notified by Ministry of Power, Govt. of India, CTU has been publishing the ISTS Rolling Plan Reports on half-yearly basis (Interim Report in Sept and Final Report in March of every financial year) with last one being published on 30th Sept 2023. This ISTS Rolling Plan Report has been prepared to assess transmission system adequacy in ISTS for 2028-29 time-frame taking due consideration of "Transmission System for Integration of over 500MW RE Capacity by 2030" report.

Chapter-1 gives Background and Objectives of the ISTS Rolling Plan Report.

In **Chapter-2**, installed capacity & peak demand as on Jan'23 and projected installed capacity & demand by FY 2028-29 have been presented. All India installed capacity & peak demand are expected to increase from 430GW (including about 135.1GW RE + 47GW Hydro) & 240GW respectively as on Jan'24 to about 729 GW (including about 350GW RE + 62GW Hydro+36GW ESS) & 313GW respectively by FY 2028-29.

In order to integrate the envisaged generation capacity, predominantly RE, and to meet the projected demand, comprehensive studies have been performed on the National Grid on All India and Regional basis for planning and development of Inter-State Transmission System (ISTS). To perform the studies, Load Generation Balance (LGB) has been prepared considering the diurnal and seasonal load and generation variations across the country. Accordingly, nine number of load-generation scenarios have been identified corresponding to Monsoon, Summer, and Winter seasons along with three points on daily load curve for each season viz. Solar max, Peak demand, and Off-peak demand.

Detailed overview of the load generation balance preparation and challenges observed while balancing the same and study results have been brought out in **Chapter-3**. While preparing LGB for nine scenarios, merit order economic dispatch of thermal generations and RPO obligations of states have been taken into consideration. Maximum and minimum demand of 321GW and 195GW respectively have been considered in 2028-29 timeframe while working out the LGBs. ESS Charging has been considered as load in Solar Max scenarios and during discharging as Generation in other scenarios

Detailed system studies have been carried out for nine scenarios using PSS®E software after considering all the planned and under construction system, in line with provisions under CEA's Manual on Transmission Planning Criteria. Due to intermittent and variable nature of RE and with high penetration of RE in the Indian Grid, loading pattern on some of the lines is expected to change diurnally as well as seasonally. Further, transmission lines associated with thermal and hydro generations would be lightly loaded during high RE scenario. In the **Chapter-3**, study results have been presented for All India grid (above 400kV) including critically loaded lines & transformers under normal & N-1 condition, voltage violations, short circuit violations etc. Network expansion schemes have been planned and being planned to take care of the

observed system violations. Accordingly, year on year progressive addition of transmission system in ISTS network in terms of new transmission lines (ckm) and substations (MVA) upto 2028-29, and its corresponding broad estimated cost has also been brought out in the report. Cumulatively by 2028-29, transmission schemes comprising of 48,619 ckm of transmission lines and transformation capacity of 4,56,035 MVA at estimated cost of Rs 2,94,642 Cr. is expected to be added in the grid.

The Inter-Regional (IR) transmission capacity is expected to grow from present level of 1,16,540MW to about 1,34,540MW by 2028-29. Due to diurnal and seasonal variation in RE generation, power flow on all IR corridors except ER→SR, is observed in both directions. Maximum change is observed in WR→NR corridor, where power of the order of 16GW is flowing from WR to NR in Summer evening peak scenario and power of the order of 14GW is flowing from NR to WR in Winter solar max scenario. New high-capacity links in WR-SR, WR-NR, and WR-ER corridors are under various stages of planning or approval to cater to increased inter-regional power transfer.

Chapter-4 to **Chapter-8** is dedicated to detailed study results pertaining to each of the five regions, i.e., one Chapter for each Region. State wise LGBs have been prepared for all the regional grids for nine load-generation scenarios and outcomes of study results have been brought out. Critically loaded lines & transformers under normal & N-1 condition, voltage violations, short circuit violations etc. have been reported in both ISTS and STU network and possible reasons/cause for the same are also brought out in respective regional chapters. Further, detailed scope of works and implementation timeframe along with schematic of new ISTS schemes including schemes for RE evacuation for mitigating some of these violations have been brought out in these Chapters. For remaining violations, additional expansion schemes in ISTS are being planned after detailed studies, and accordingly the details of the same would be brought out in the subsequent Rolling Plan reports.

India being centrally placed in South Asia is playing a vital role in establishment of interconnections among countries to establish a large South Asian electricity grid. In **Chapter-9**, details on existing, under-construction and under discussion cross-border interconnections between India and neighbouring countries have been brought out.

The summary of the studies carried out, new expansion schemes planned, way forward etc. have been mentioned in **Chapter-10**.

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Chapter 1: Background and Objective

Indian power sector plays a pivotal role in the overall country's development and growth. Over the past decade, India's power sector has undergone a remarkable transformation, aimed at providing reliable, affordable and sustainable energy to its citizens with major economic reforms and liberalisation. Significant growth is seen in the installed capacity of Renewable Energy resources with the major policy support from GoI.

India's journey towards a clean and green energy has gained global recognition. India stands 4th globally in Renewable Energy Installed Capacity, with 44% of its total installed electricity capacity out of 430 GW coming from non-fossil energy sources as on Jan'24. Renewable Energy dominance is expected with continuous growth and evolving policies, integration of digital incentives, adoption of smart grid technologies, Internet of Things (IoT) and Artificial Intelligence (AI) for smarter energy management. Continued policy measures are must to attract investments and ensure the financial viability of the sector. India envisaged to enhance the non-Fossil fuel based installed generation capacity to 500 GW and about 50% non-Fossil share of installed electricity generation capacity by 2030. During the current study timeframe which is 5 years from now i.e., by 2028-29, it is proposed to additionally integrate about 237 GW non- fossil fuel energy resources out of total 262 GW of installed capacity addition. Further, 36.5 GW of Energy Storage is also envisaged as a balancing reserve resource.

Integration of large scale RE Generation capacity into the Grid poses many challenges like low-capacity utilization factor (CUF), intermittency, round the clock availability etc. To address these challenges, mitigating measures such as deployment of Energy Storage System including Pumped Storage Plants, adequate reactive compensation (including Dynamic Compensation), advanced planning of Transmission system for evacuation of RE Generation is to be taken up in consultation with all the stakeholders.

Considering the diurnal and seasonal variation of Generation and Demand across the country preparation of Load Generation Balance (LGB) with fair assumptions is the key to plan an optimised ISTS Transmission Network. Accordingly, considering the optimal dispatch scenarios capturing the availability of the various energy resources and to meet peak power requirements, an optimised ISTS network plan is evolved in consultation with various stakeholders.

In line with the Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules, 2021 notified by Ministry of Power, CTU is drawing up plan for Inter-State Transmission System (ISTS) for up to next five years on Rolling basis every year, involving two cycles i.e., from April to September and October to March identifying specific transmission projects which are required to be taken up along with their implementation timelines. In this direction, reports on Network Plan 2024-25, Rolling Plan 2026-2027 & 2027-28 has already been brought out on 31st Dec 2021, 31st March 2022 & 31st March 2023 respectively and the same is available on CTU website. This ISTS Rolling Plan report is being brought out wherein transmission system adequacy in ISTS has been ascertained

for 2028-29 timeframe. For preparation of this rolling plan, data received from various stakeholders and nodal officers are attached at **Annex-1.1**.

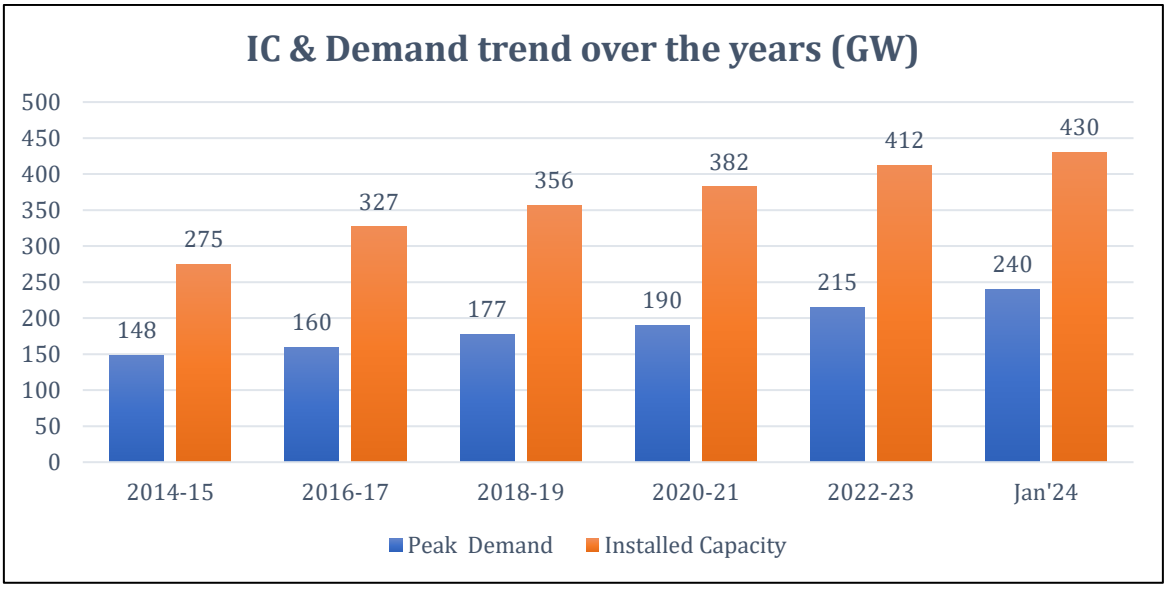
This report covers year wise ISTS planned and under implementation across the country to integrate the RE generation and to cater the growing demand. Detailed studies were carried out on the planned Transmission system including load flow, contingency analysis, voltage profile (reactive power management), short circuit studies etc on all India basis for 2028-29 timeframe for nine perspective load-generation scenarios covering three seasons and three different load condition (Solar max, Evening peak and Night off peak) of each season.

Chapter 2: Power Supply Scenario

India's peak demand met is about 240 GW and as per 20th EPS it is projected to be about 313 GW by 2028-29. Furthermore, bulk consumers such as Green Hydrogen/Ammonia plants of about 47 GW is planned to be integrated to the grid by 2028-29 which will further enhance the projected peak demand.

Non-fossil fuel based Installed generation capacity is around 189.5 GW (44% of total installed capacity) and is planned to increase to around 426 GW (62% of total installed capacity excluding ESS) by 2028-29 at a CAGR of 17.6%. Further, 36.5 GW of Energy Storage is also planned to integrate in the grid by 2028-29. Installed capacity vis a vis peak demand trend from FY 2014-15 to Jan'24 is depicted in Figure 2-1.

Figure 2-1: Installed Capacity & Demand trend in GW



2.1 Power Supply Scenario as of Jan'24

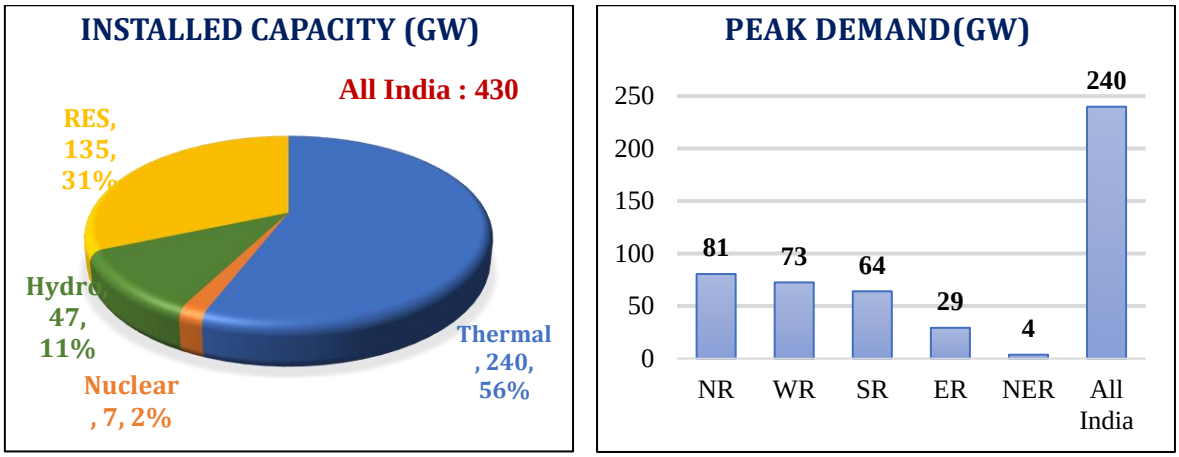
Total installed capacity as on Jan'24 is about 430 GW and the All-India peak demand met is of about 240 GW which is the highest ever peak demand met till date. Region-wise breakup of source wise installed capacity and peak demand met as of Jan'24 is given in the Table 2-1. Fossil and non-fossil fuel-based generation installed capacity accounts for 56% and 44% of total installed generation capacity respectively, which is portrayed in Figure 2-2.

Table 2-1:Installed Capacity and Peak Demand in GW as of Jan'24

Region	Fossil			Non-Fossil				Grand Total	Peak Demand
	Thermal	Gas/ Diesel	Total	Nuclear	Hydro	RES	Total		
NR	57.2	6.0	**63.2**	1.6	20.8	35.5	**58.0**	121.2	80.55
WR	76.1	10.8	**86.9**	2.5	7.6	43.7	**53.8**	140.7	72.56
SR	53.2	6.5	**59.7**	3.3	11.8	53.3	**68.5**	128.1	64.10
ER	27.9	0.1	**27.9**	0.0	4.8	1.9	**6.7**	34.6	29.30
NER	1.0	1.7	**2.6**	0.0	1.9	0.6	**2.5**	5.2	3.68
All India	215.3	25.0	**240.3**	7.5	46.9	135.1	**189.5**	429.8	239.93*

*with diversity

Figure 2-2: Installed Capacity and Peak Demand as of Jan'24



2.2 Envisaged Power Supply Scenario by 2028-29

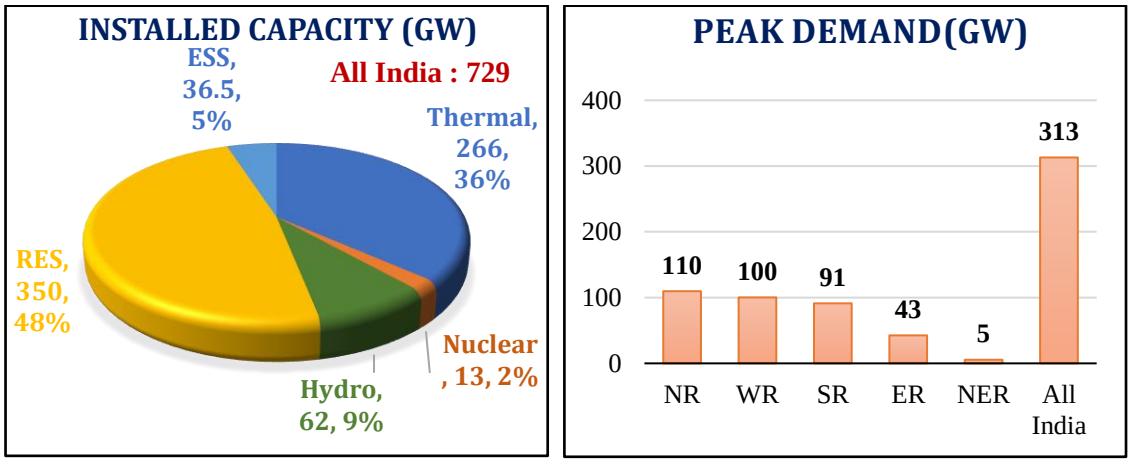
All India peak demand for 2028-29 is envisaged to be about 313 GW as per 20th Electric Power Survey (EPS) report of CEA. To meet the enhanced demand of about 73GW from present peak demand met of 240 GW, net generation capacity addition of about 299 GW including ESS is planned to be integrated in the grid after accounting the retirement of thermal generation by 2028-29 as anticipated in draft National Electricity Plan (NEP) of CEA.

Total installed generation capacity for 2028-29 shall be about 729 GW including the pumped and energy storage capacity as per report "Transmission System for Integration of 500 GW RE Capacity by 2030". The anticipated region-wise breakup of the installed capacity and projected peak demand for 2028-29 are summarised in Table 2-2. Renewable Energy resources generation installed capacity is expected to be about 48% of total installed generation capacity, which is shown in Figure 2-2.

Table 2-2:Projected Installed Capacity & Peak Demand by FY 2028-29

Region	Fossil			Non-Fossil				ESS	Grand Total	Peak Demand
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
NR	53.7	3.6	**57.3**	4.4	25.3	112.1	**141.8**	13.0	212.1	109.7
WR	93.2	10.1	**103.3**	3.2	6.1	97.2	**106.5**	3.6	213.4	100.2
SR	52.9	1.5	**54.4**	5.8	12.4	137.6	**155.8**	19.0	229.2	91.3
ER	48.4	0.0	**48.4**	0.0	14.0	2.5	**16.5**	0.9	65.9	42.5
NER	0.8	1.9	**2.6**	0.0	4.4	1.1	**5.5**	0.0	8.1	5.5
All India	249.0	17.1	**266.0**	13.5	62.1	350.5	**426.1**	36.5	728.6	313.1

Figure 2-3:Projected Installed Capacity & Peak Demand by FY 2028-29



The region wise growth in demand and fuel type wise increase in installed generation capacity for 2028-29 from Jan'24 is tabulated below in Table 2-3.

Peak Demand (GW)				
	As on Jan'24	*2028-29*	*Growth*	*CAGR*
NR	80.55	109.71	29.17	6.4%
WR	72.56	100.25	27.69	6.7%
SR	64.10	91.29	27.18	7.3%
ER	29.30	42.55	13.25	7.7%
NER	3.68	5.48	1.80	8.3%
All India	**239.9**	**313**	**73.1**	**5.5%**

Generation IC (GW)				
	As on Jan'24	*2028-29*	*Diff*	*CAGR*
Thermal	215.28	248.96	33.68	2.9%
Gas	25.04	17.09	-7.95	-7.4%
Nuclear	7.48	13.48	6.00	12.5%
Hydro	46.93	62.13	15.20	5.8%
Solar	74.31	232.93	158.62	25.7%
Other RE+ESS	60.77	154.05	93.28	20.4%
Total	**429.80**	**728.63**	**298.83**	**11.1%**

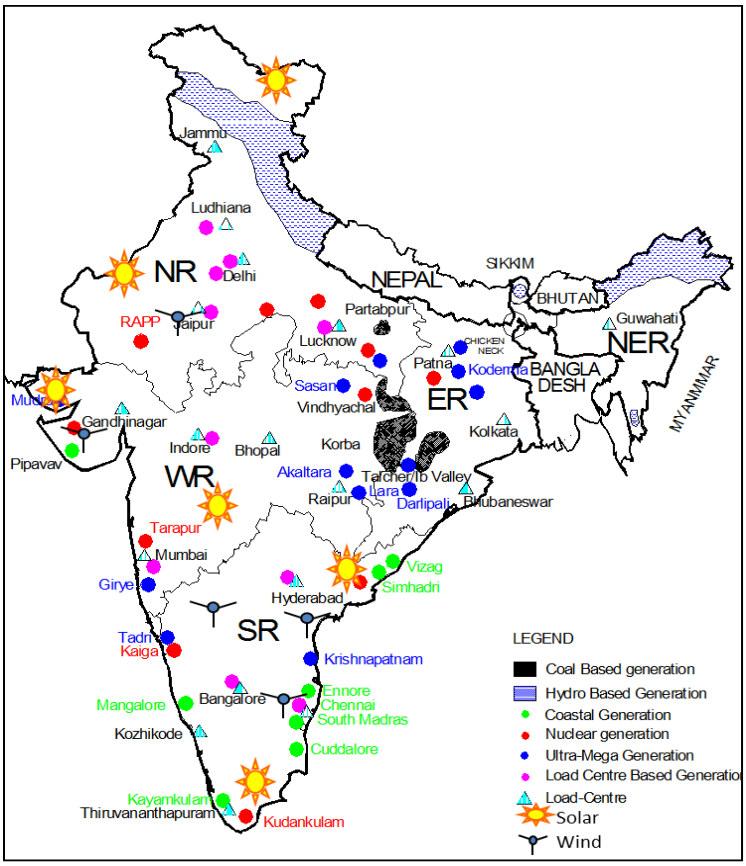
Table 2-3:Peak demand & Generation IC in 2023-24 and 2028-29

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Chapter 3: All India

Renewable-based generation installed capacity in total installed capacity mix is expected to change from 31% at present to about 48% by the year 2028-29. Further, it is going to continuously change with integration of increasing renewable energy plants in the Indian power sector. To plan transmission network for meeting electricity requirement of the country, first it is important to understand the locations of generation pockets and load centre in wide Indian demography. Most of the conventional thermal generation are in eastern part of the India due to availability of coal-reserves and hydro-potential is concentrated in Himalayan/ Sub-Himalayan Ranges whereas, new generation addition in the form of renewable energy is emerging in northern, western and southern part of India as depicted in Figure 3-1 which makes Indian power sector one of the most challenging and diversified. To meet energy demand of the country from conventional generation, strong backbone transmission system is already planned and implemented in past decades. With the advent of renewable-based generation addition, new transmission system is being planned and implemented which is resulting in changed power flow pattern on existing transmission system. It becomes important to understand diurnal and seasonal regional power exchanges taking place depending upon the generation and demand of a region. Therefore, any additional transmission system needs to be planned to cater the new load-generation scenario.

Figure 3-1: India's map showing various generations in different parts of the country



The present study has been carried out to identify power exchanges across the regions and adequacy of existing, approved and planned transmission systems to meet the power transfer

requirement for the timeframe of 2028-29 with an All India perspective. Periodic assessment of transmission requirement under ISTS is also made part of this report. Here it is to mention that substantial solar generation capacity addition has been envisaged in future which shall only generate in daytime. A region having a high solar installed capacity shall become an exporter of power during the afternoon and importer of the power during evening.

To study such phenomenon and analyses power flow patterns in transmission network, various scenarios were identified. Accordingly, nine load generation balance scenarios were prepared corresponding to Monsoon, Summer, and Winter season along with three points on daily load curve for each season. Details about the same will be discussed in next section.

3.1 Load Generation Balance

To replicate and simulate seasonal power requirement variations on annual basis, three load-generation scenarios within a day in three different seasons were chosen. Three points on load curves were identified for each day i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night). Further, the same was carried out for three seasons viz. Monsoon (August), Summer (June) and Winter (February). Accordingly, load generation has been prepared for following nine scenarios:

- Aug'27: Solar max (Scenario-1), Evening Peak (Scenario-2) and Night off-peak (Scenario-3)
- Jun'27: Solar max (Scenario-4), Evening Peak (Scenario-5) and Night off-peak (Scenario-6)
- Feb'28: Solar max (Scenario-7), Evening Peak (Scenario-8) and Night off-peak (Scenario-9)

During afternoon hours, solar generation is at its peak and thermal generation requirement is minimal. While in evening, solar generation is zero and the thermal generation requirement is maximum. Load Generation Balance (LGB) for above mentioned nine scenarios considered for the study was prepared. To prepare load generation balance, details about the selection of points on load curve and generation despatching philosophies are discussed subsequently.

All India peak demand considered for current study timeframe 2028-29 is about 313 GW as per 20th EPS. Further an additional demand of Green Hydrogen/Ammonia of about 13 GW has been considered as direct drawl from ISTS. To find out variation of this demand for nine scenarios, demand pattern of calendar year 2023 for the three representative months of three seasons were collected from Grid Controller of India Ltd. for monsoon (Aug-23), summer (Jun-23) and for winter (Feb-23). The data comprises of demand profile of all the days of the month with resolution of 5 mins time interval. Three load conditions each corresponding to solar max, evening peak and night off peak were selected from the representative demand curve of three seasons as depicted in Figure 3-2, Figure 3-3 & Figure 3-4 below. For evening peak scenario and night off peak scenario, maximum demand (between 3:55 pm to 11:55 pm) and minimum demand (between midnight to 06:00 am) were considered respectively. However, for solar max scenario, maximum demand corresponding to noon (12:00 pm) was considered.

To obtain the demand factors for study time-frame of 2028-29, demand corresponding to these load condition were divided by maximum All India/regional demand of the corresponding year i.e. 2023. All India/regional demand factors for different scenarios of 2028-29 are shown in Figure 3-5.

Figure 3-2:Summer (June'23) Load Curve

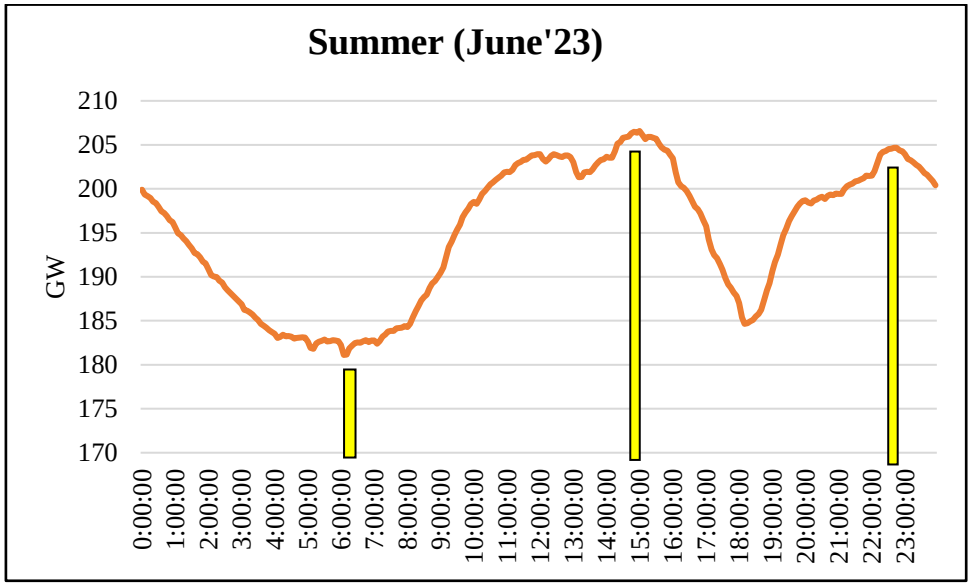


Figure 3-3: Monsoon (Aug'23) Load Curve

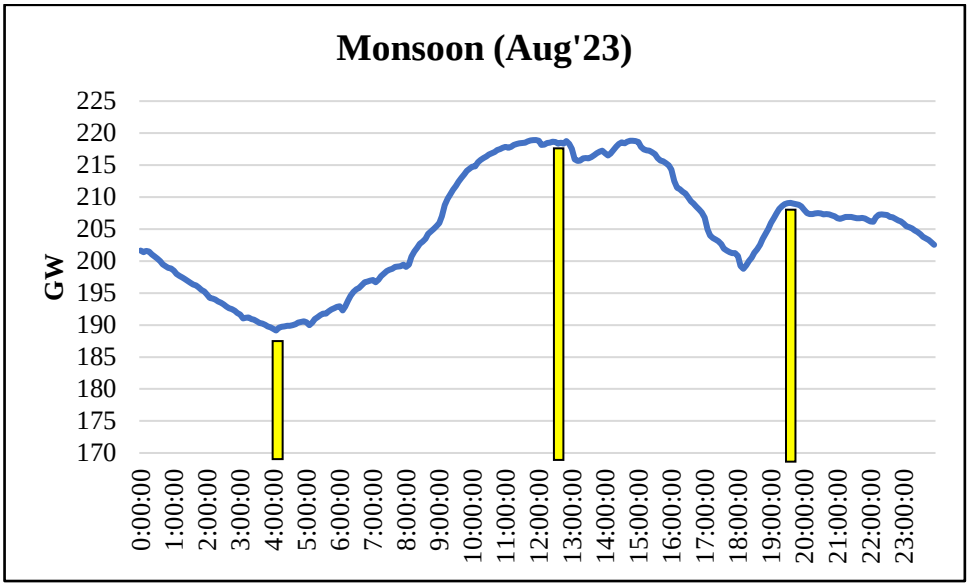


Figure 3-4:Winter (Feb'23) Load Curve

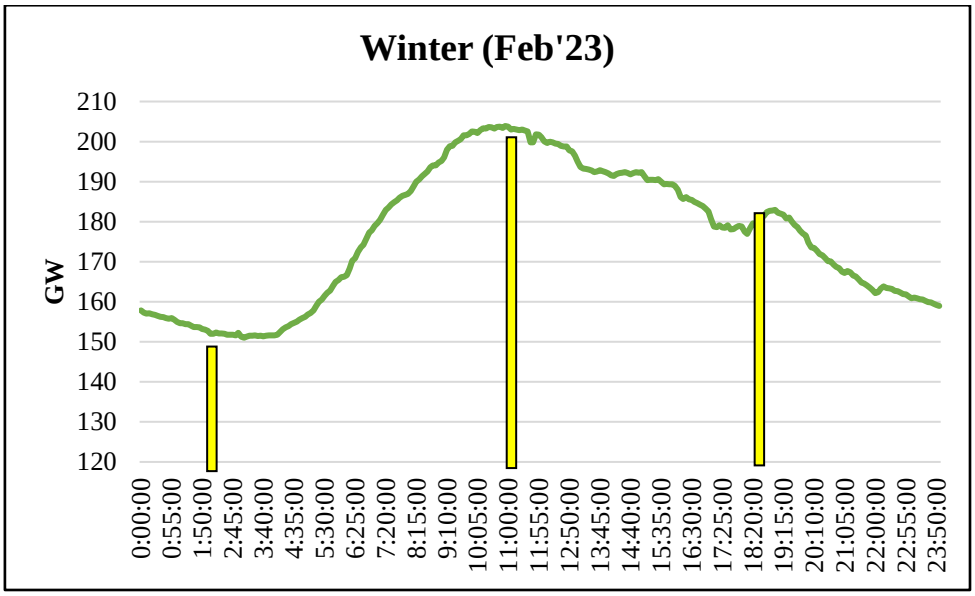
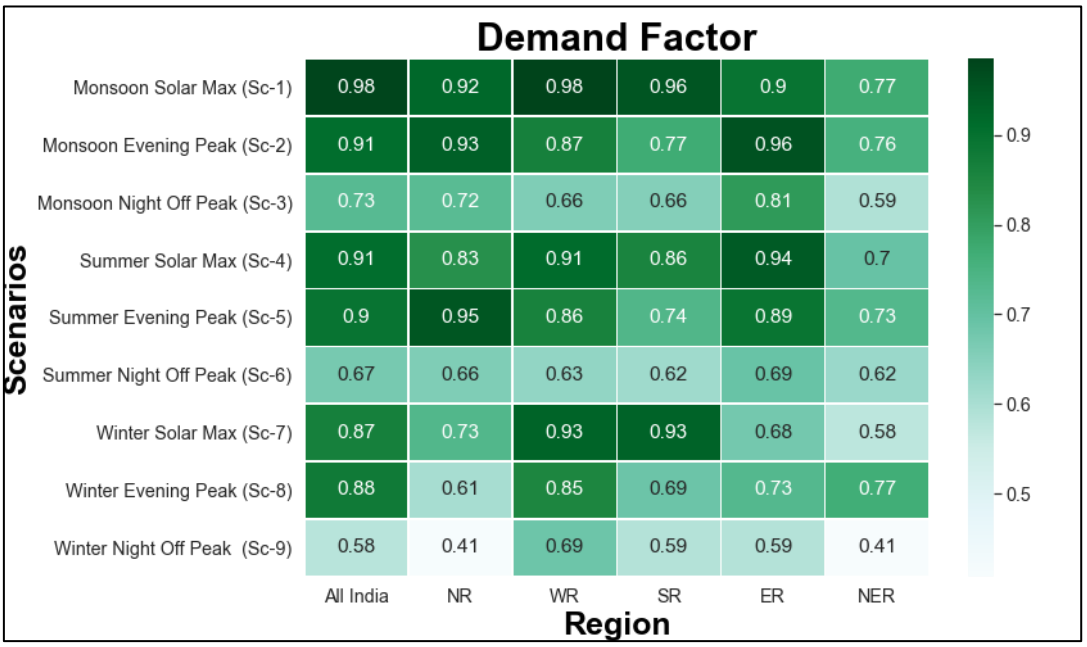


Figure 3-5:Demand factors considered for 2028-29-time frame



To meet the anticipated demand in different scenarios, various sources of generations viz. Thermal, Nuclear, Hydro, Gas, Solar & Wind are available. However, despatch of some of these generators shall be as per their diurnal and seasonal variation. Each generation except thermal generation in a region was despatched as per the despatch factors considered in regional chapters.

RE has been considered as must-run, at first the demand was balanced by RE generation. Since all utilities have RE RPO obligation, total RE generation has been apportioned as per RE RPO to all regions based on their projected EPS demand. Further, for accounting the availability of solar roof-top generation, equivalent demand was reduced from respective regions. After

determining the demand met by renewable energy, nuclear and hydro generation, remaining demand was met by Thermal.

Evening peak scenario of each month was setup first as the number of thermal units required on bar shall be maximum. Total thermal generation requirement for the evening peak scenario was apportioned between State and Central sector thermal generations as per their installed capacity in each region. Further, state thermal generation requirement was divided among the states as per their maximum demand in respective month of 2023. After obtaining state thermal generation requirement, thermal units were dispatched at technical maximum (85%) in merit order for each state.

ISGS, CGS & IPP thermal plants with lower variable cost were dispatched at technical maximum (85%) region wise progressively. To meet the demand of any deficit region thermal generation dispatches from other regions considering all India merit order for evening peak scenario was considered. For night off-peak scenario, on bar thermal units were scaled down proportionately.

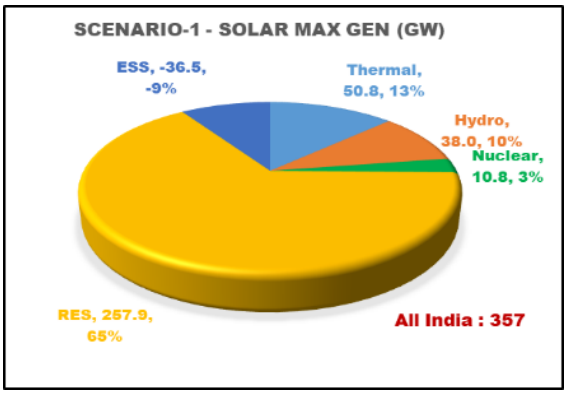
While preparing the present LGB for Solar max scenario, some plants were switched off to balance the load generation while running all the on-bar thermal plants at technical minimum of 40% as per recent CEA (Flexible operation of coal based thermal power generating units) regulation 2022. Accordingly, thermal plants with higher cost (on merit order basis) were switched off region wise progressively till the LGB is balanced.

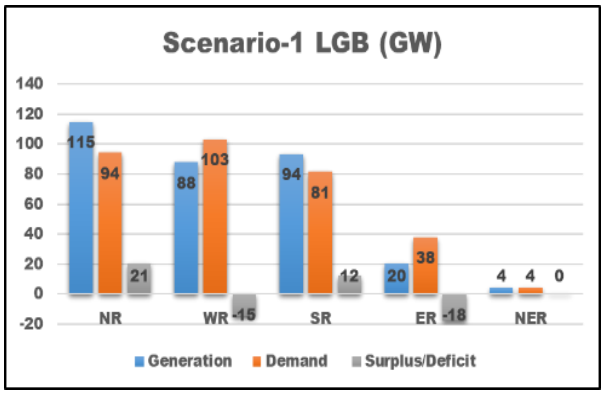
It is observed that in the Solar max scenario there is surplus power available in the grid. It is due to availability of peak solar generation and lesser demand in the noon. This surplus is on account of keeping the same number of thermal plants operating at technical minimum (40%) in Solar max scenario which are required to meet evening peak demand. Even after considering the flexibility exhibited by gas and hydro generation between the evening peak and Solar max scenario the surplus generation of about 38 GW dispatches is observed**.** To absorb the maximum RE generation during the daytime most of the thermal units are required to shut down necessitating the requirement of two-shift operation of thermal generation or more energy storage plants in the grid.

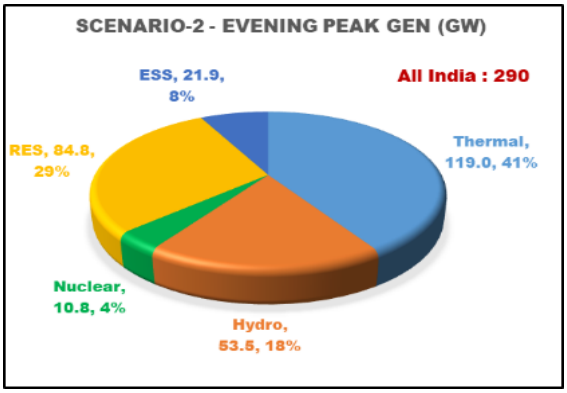
Based on above philosophy, LGB prepared for different scenarios are depicted in Figure 3-6, Figure 3-7, Figure 3-8 along with regional surplus/deficit scenario and details about the same are attached at **Annex-3.1.**

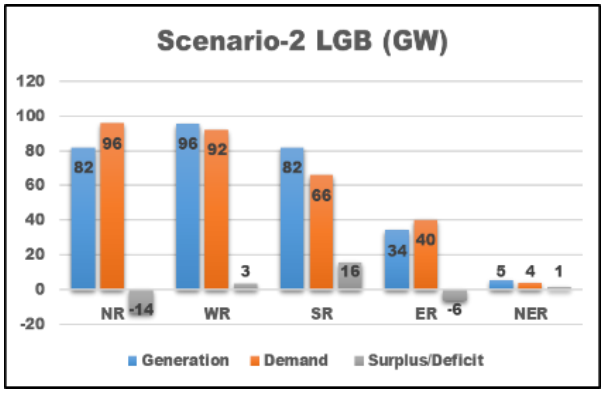
Monsoon Aug'2028

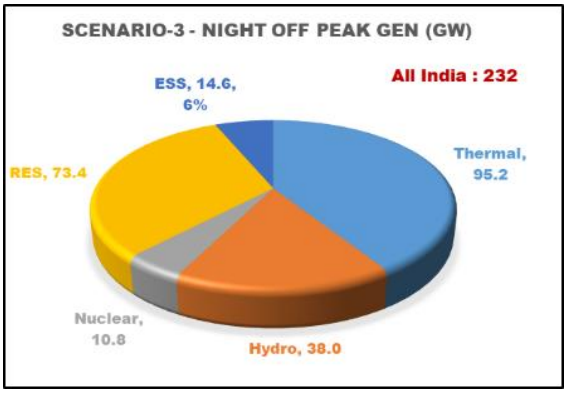
Figure 3-6:LGB for Monsoon (Aug'2028)

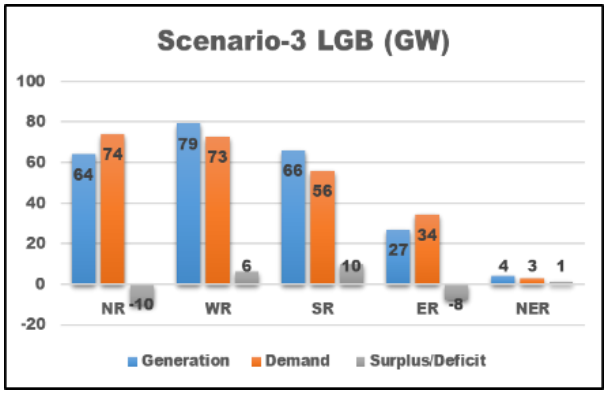






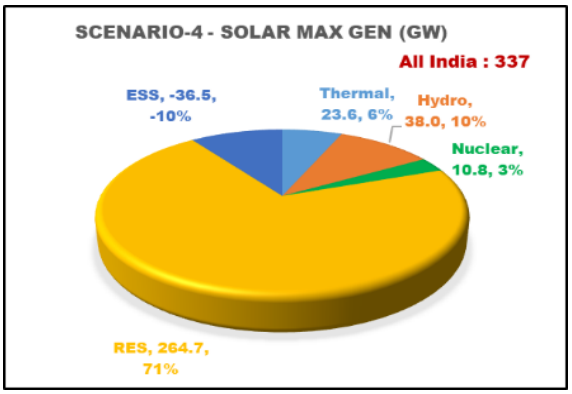


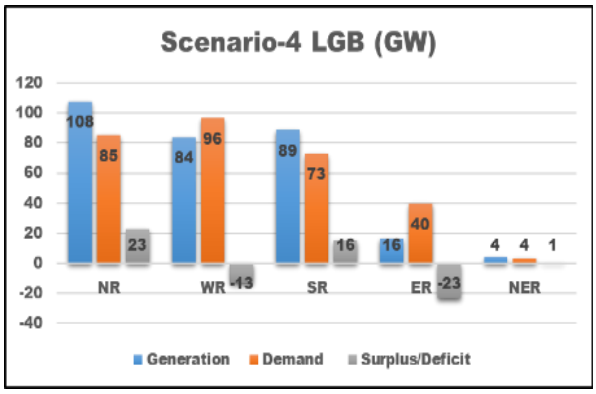


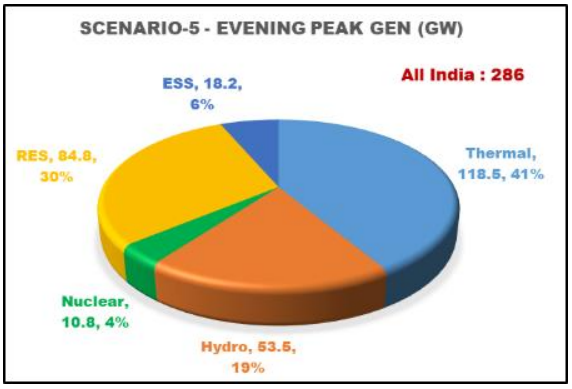


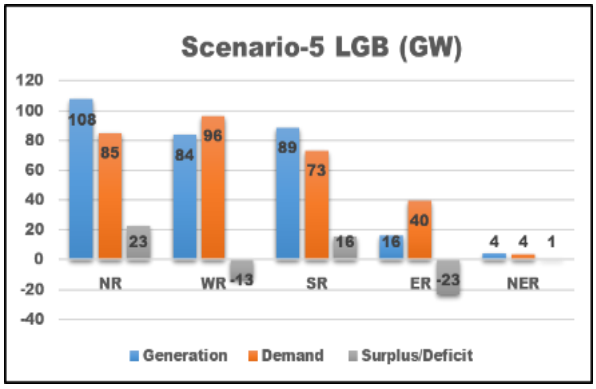
Summer June'2028

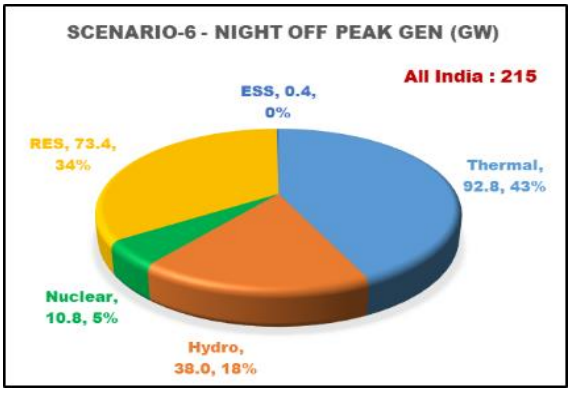
Figure 3-7: LGB for Summer (June'2028)

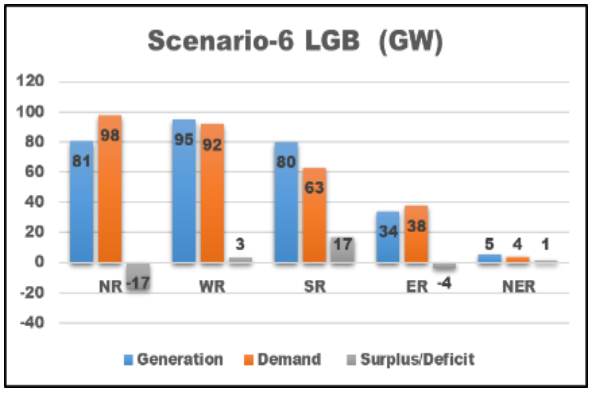






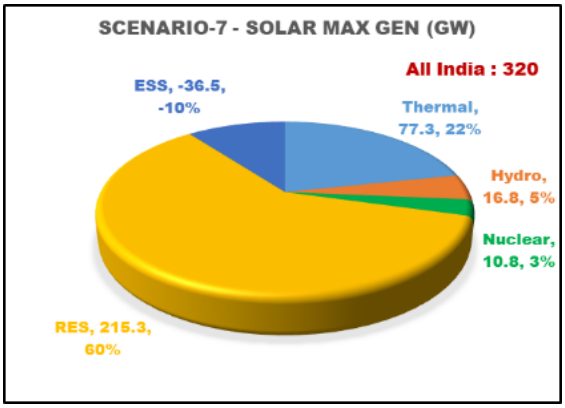


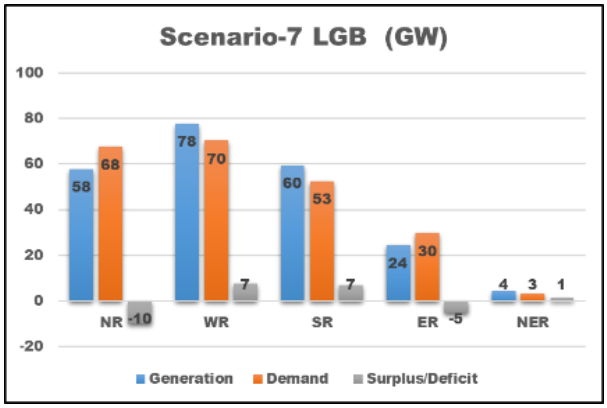


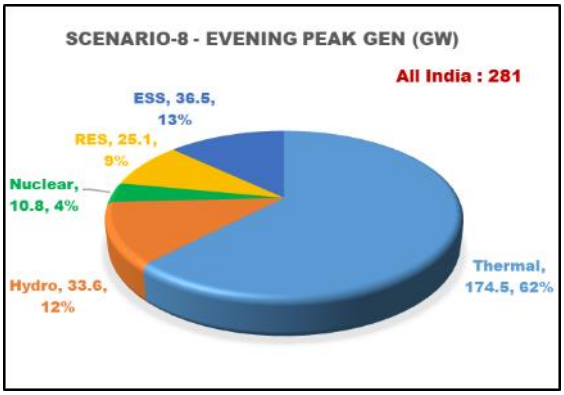


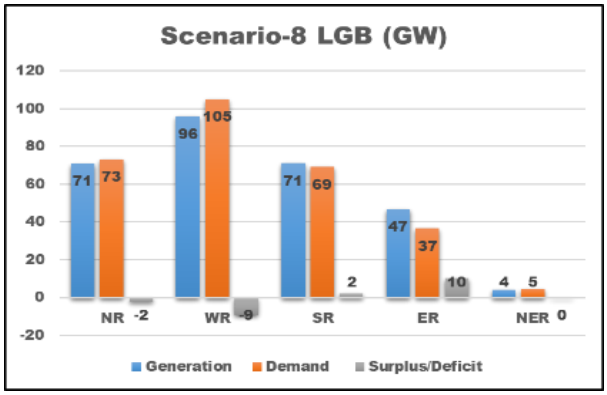
Winter Feb'2029

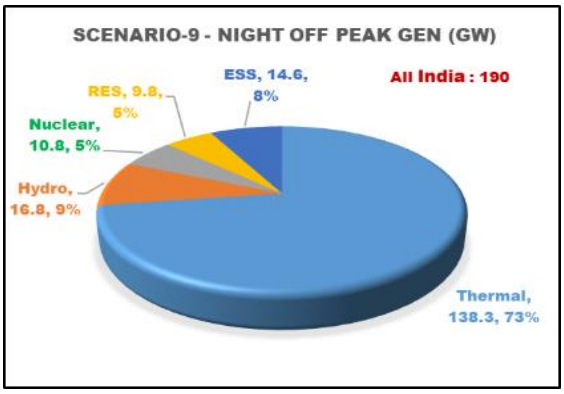
Figure 3-8:LGB for Winter (Feb'2029)

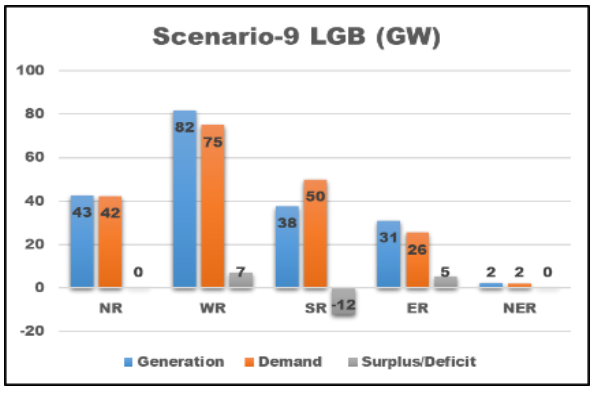












Out of these nine scenarios, Scenario-1(Aug'28 Solar max) and Scenario-9 (Feb'29 Night off peak) corresponds to two extreme cases with respect to demand i.e., highest demand (321 GW) and lowest demand (195 GW) scenarios respectively. In all other scenarios, all India demand is varying between these two demands as per demand factors. Further Scenario-4 corresponds to maximum RE generation share to meet the demand of that scenario. Based on LGB, region wise surplus/deficit in each scenario is summarised in Table 3-1 Furthermore, both maximum surplus and deficit of each region is highlighted too in Table 3-1.

Table 3-1:Regional Surplus/Deficit summary in MW

Surplus (+) / Deficit (-)	Monsoon (Aug'28)			Summer (Jun'28)			Winter (Feb'29)		
Scenario No. / Region	1	2	3	4	5	6	7	8	9
	Solar Max	Evening Peak Load	Off Peak	Solar Max	Evening Peak Load	Off Peak	Solar Max	Evening Peak Load	Off Peak
NR	20593	-13964	-10063	22531	-17195	-9947	22064	-2286	348
WR	-15101	3410	6387	-12798	3084	7443	-12681	-9205	6909
SR	12119	15875	10178	15523	16902	7067	-1746	1946	-12303
ER	-17683	-6189	-7521	-23206	-3768	-5350	-7993	10418	5387
NER	282	1292	1256	735	1402	1106	-342	-449	85

From the above table it may be inferred that:

- NR is importing power in evening peak scenario whereas, it is exporting power in solar max scenario due to high solar generation in NR. Maximum import of power is happening in Summer (June) evening peak load scenario & Maximum export of power is in Summer (June) solar max scenario.
- WR is exports the power with a maximum export of 7 GW in Summer (June) evening peak scenario except solar max scenarios. Maximum import of about 15 GW is happening in monsoon (Aug) solar max scenario.
- SR is mostly expected to export power except in winter season. Maximum export of power is 16 GW in Summer (Jun) evening peak scenario, whereas maximum import of the order of 12 GW is taking place in the Winter (February) night off peak scenario.
- ER is importing power in high renewable generation scenarios due to RE RPO requirements of ER. It shall not be able to meet its RPO requirement from its own regional RE and has to import RE power from neighbouring regions.
- NER mostly exports power in different scenarios except for Winter (February) season/ Low Hydro period where it is expected to import power.

Considering the above LGB for nine scenarios, load flow cases were prepared for detailed studies to assess the adequacy of Inter State Transmission System including inter-regional corridors planned to cater the power transfer requirement across the region in study timeframe of FY 2028-29. Study results of the same have been discussed in subsequent sections.

3.2 Study Results and Analysis

Based on the load-generation scenarios for different regions, various simulation studies have been carried out in PSSE. Transmission system planned and under implementation for various loads/generations scheduled to be commissioned for current study timeframe of 2028-29 are considered for conducting these studies. Based on the studies performed, results of the study are analysed and deliberated below-

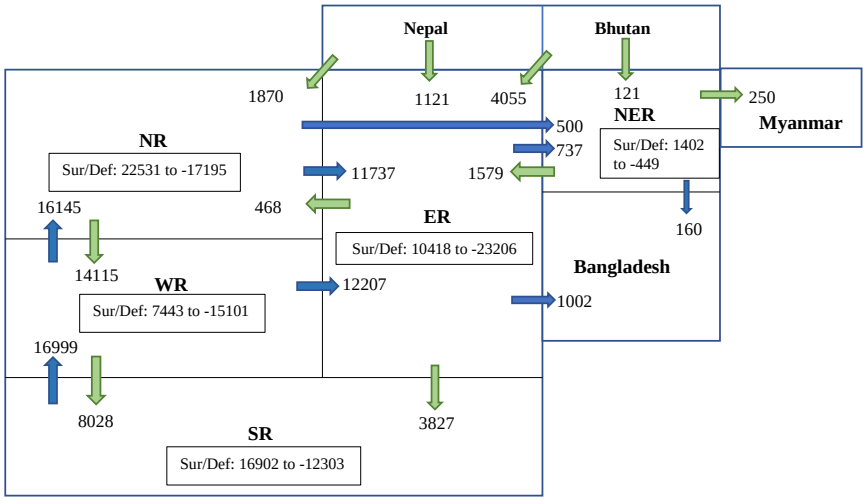
3.2.1 Power Flow Analysis

a) Inter-Regional Corridor

Inter-regional flows between various regions, based on simulation studies for current study timeframe of 2028-29 are summarised below in Table 3-2 for all the nine scenarios. Maximum and minimum flow between each inter-regional corridor are also highlighted in Table 3-2.

Table 3-2:IR flow summary in MW

IR Flows	Monsoon (Aug'28)			Summer (Jun'28)			Winter (Feb'29)		
Scenario No. / Corridor	1	2	3	4	5	6	7	8	9
	Solar Max	Peak Load	Off Peak	Solar Max	Peak Load	Off Peak	Solar Max	Peak Load	Off Peak
WR-NR	-12323	13298	12114	-10912	16145	10591	-14115	-12	664
ER-NR	-8994	-1607	-1952	-11737	468	-1551	-7202	-1	-1349
ER-WR	-9377	-5457	-6505	-12207	-4563	-4927	-7189	-1492	-1252
ER-SR	1116	6	335	96	226	1126	2167	2868	3827
WR-SR	-12283	-15918	-11729	-14683	-16999	-8318	-2468	-4448	8028
ER-NER	-893	-952	-1033	-866	-1354	-1579	-340	737	-184



From the above it can be seen that-

- Power on WR-NR corridor is flowing in both directions in different scenarios. Maximum power of the order of 16 GW is flowing from WR to NR in June evening peak scenario whereas, maximum power flow of the order of 14 GW is flowing from NR to WR in February solar max scenario.
- Power on ER-NR corridor is always flowing from NR to ER with maximum power of about 12 GW in summer solar max scenario.
- Power on ER-WR corridor is always flowing in the directions of WR to ER with maximum flow of 12 GW in Summer solar max scenario.

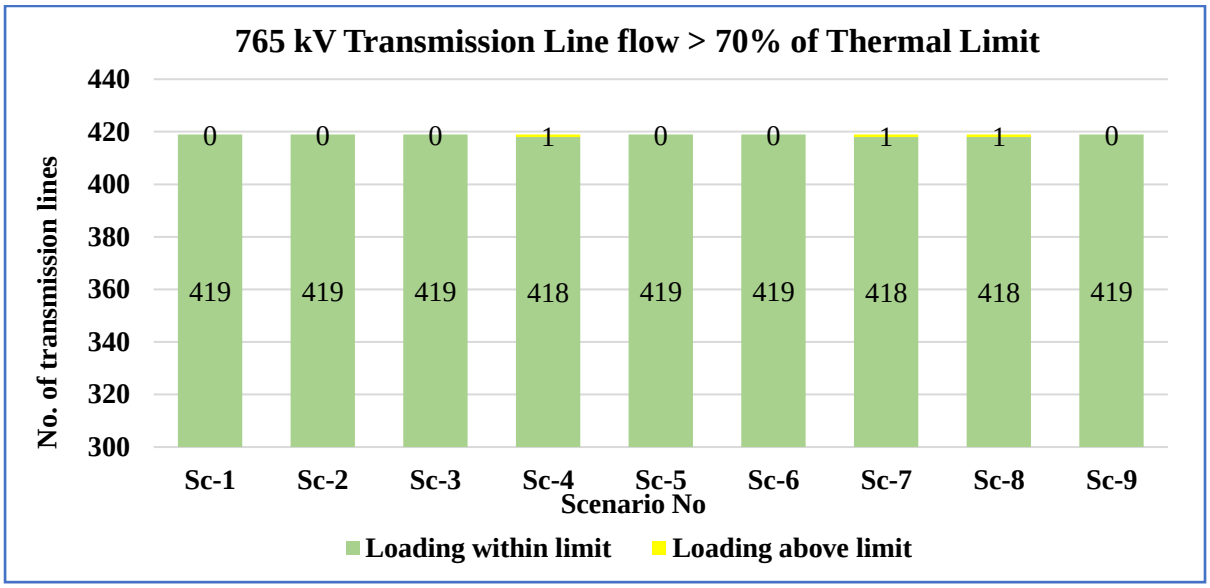
- Power on ER-SR corridor is flowing from ER to SR with maximum power of the tune of 4 GW.
- Power on WR-SR corridor is mostly flowing towards WR from SR with maximum flow of 17 GW except in winter night off peak scenario.

Each inter-regional corridor comprises of multiple 765 kV, 400 kV, 220 kV & HVDC transmission lines. Loading on these inter-regional tie lines for all nine scenarios along with their permissible thermal design limit are tabulated in **Annex-3.2** and power flow exceeding the 70% of thermal design limit are highlighted in yellow in the same annexure. While analysing the annexure, it is observed that all the inter-regional tie lines are loaded below 70% of their design limit.

b) Transmission Line

All the 765 kV and 400 kV lines of ISTS and Intra-state were monitored for any possible overloading in the base case prepared for nine scenarios. There are about 419 nos. of 765 kV lines and about 2431 nos. of 400 kV lines. Lines with their base case loading were compared with their thermal design limit and flows exceeding the 70% of thermal design limit in any of the scenario are tabulated at **Annex-3.3**. None of the 765 kV lines were observed to be loaded beyond 70% thermal limit except three lines and few 400 kV lines were loaded beyond the limit. If we see in terms of percentage, less than 1% of total no. of lines (400 kV) are loaded beyond 70% of thermal limit. Summary of the results is shown below in Figure 3-9 & Figure 3-10:

Figure 3-9:765kV Tr. line flow > 70% of thermal limit under base case



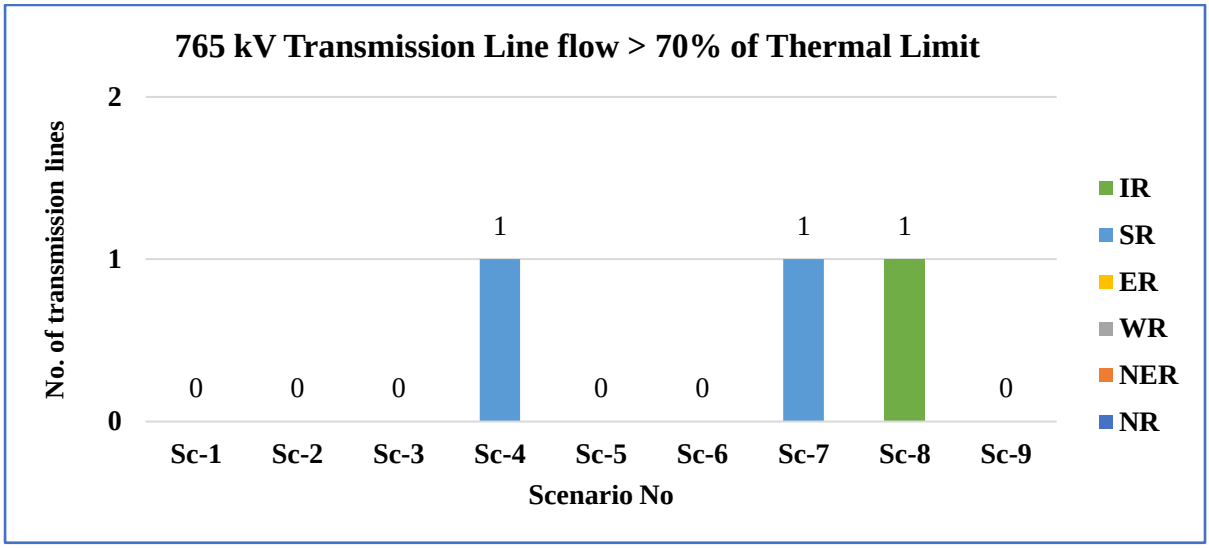
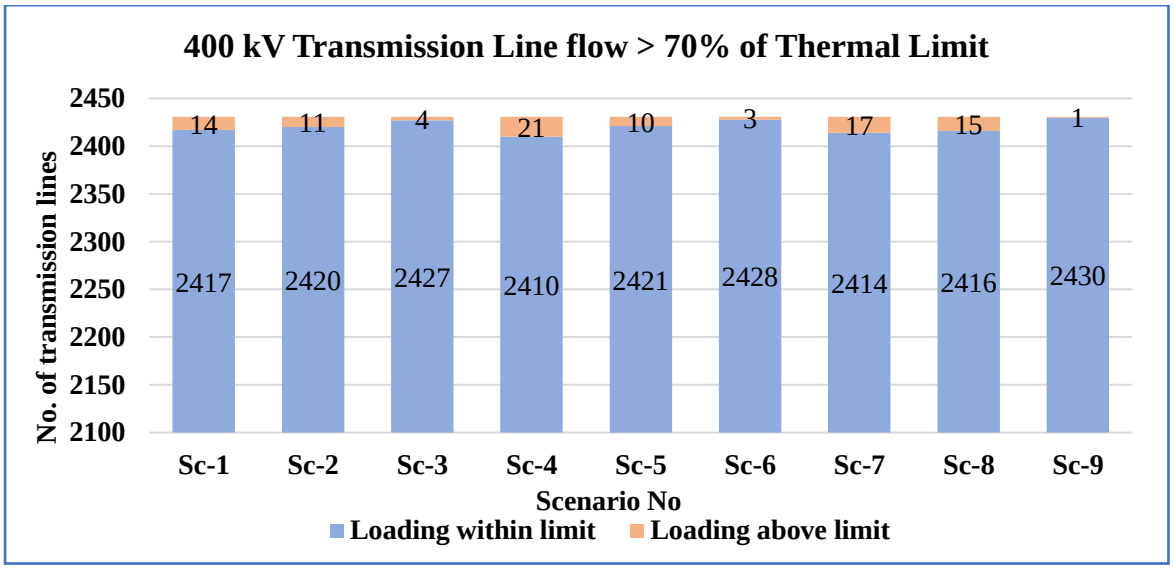
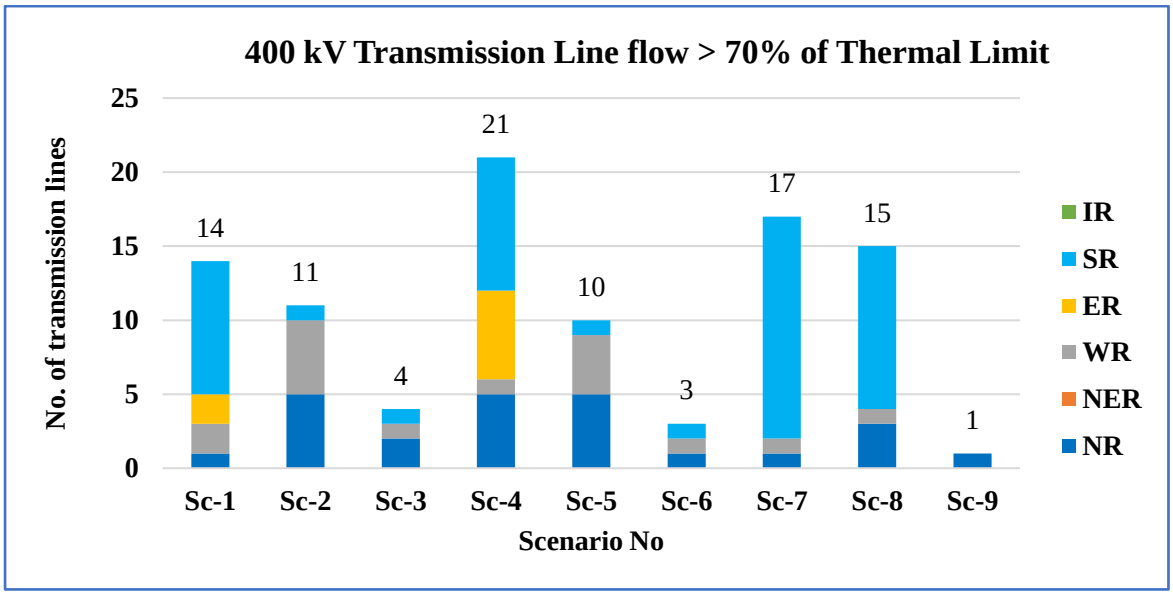


Figure 3-10:400kV Tr. line flow > 70% of thermal limit under base case



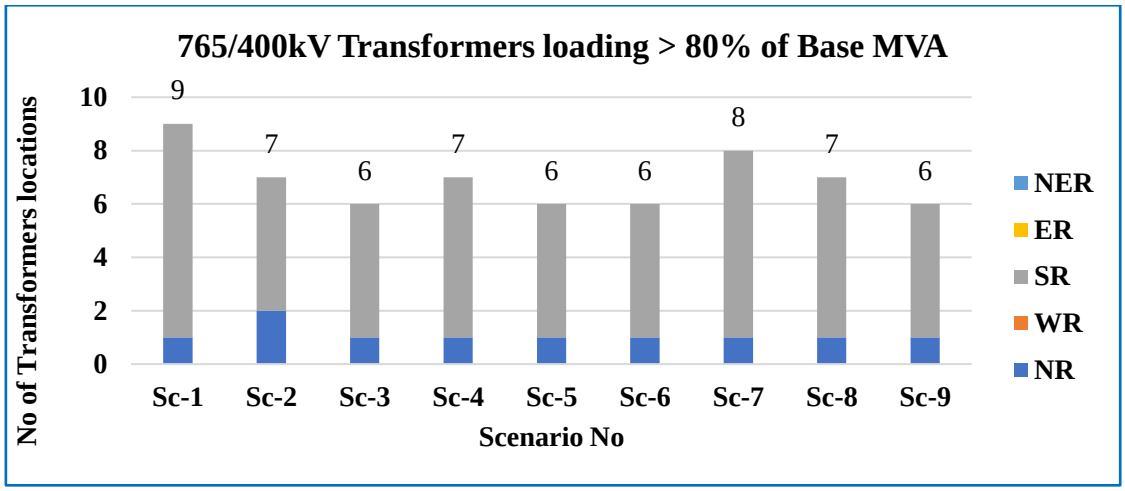


It was observed that only 3 nos. of 765 kV lines are loaded beyond 70% of the thermal limit in in Scenario-4, 7 and 8, however their loading are below 3000 MW. About 14, 21 and 17 nos. of 400 kV lines in Scenarios-1, 4, and 7 (Solar max scenarios) respectively are loaded above 70% of the thermal limit. However, to understand the criticality of this loading, detailed contingency studies have been carried out, which are discussed in subsequent sections.

c) Transformer

In the study time frame, there would be about 400 nos. of 765/400 kV transformer at 149 nos. of 765/400 kV substations. Loading patterns of these transformers obtained from simulation studies are tabulated in **Annex-3.4** and loading more than 80% of their rating in any scenarios are also highlighted. Number of substations, where loading is more than 80% of rating in all scenarios are depicted in Figure 3-11 & Figure 3-12. However, if we see in terms of percentage, less than 3% of total no. of transformers are loaded beyond 80% of their rating.

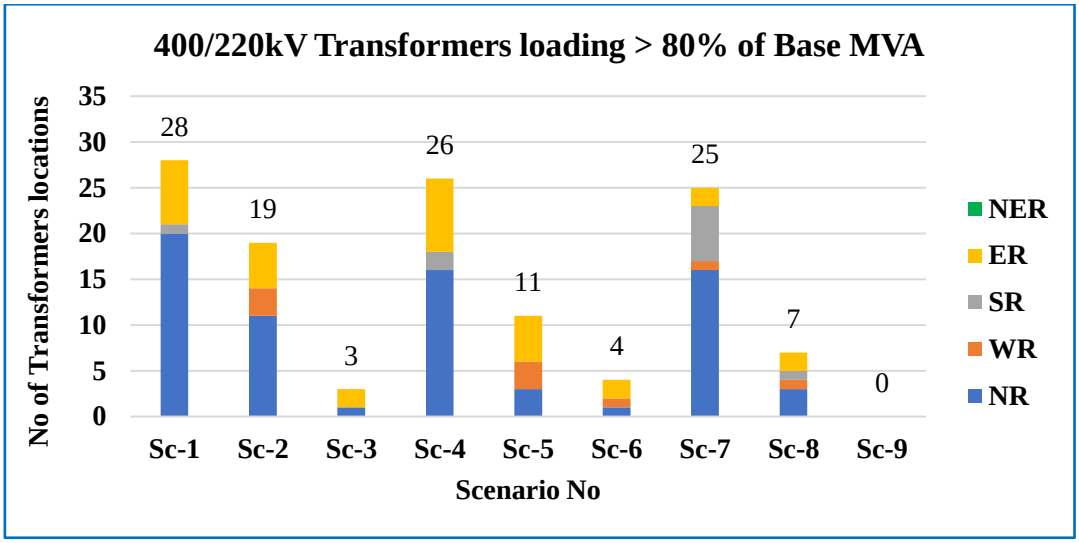
Figure 3-11:765/400kV ICT Loading under base case



Under solar max scenarios viz. Scenarios 1, 4 and 7 about 9, 7 and 8 substations located in different region, where ICTs are getting loaded above 80% of MVA rating. Maximum number of substation where loading is above 80% of MVA rating are corresponding to solar max scenarios. These substations are predominantly located in southern region.

Similar analysis was carried out for 400/220 kV transformers. There are 1445 nos. of transformers located at about 536 nos. of 400/220 kV stations.

Figure 3-12:400/220kV ICT loading under Base Case



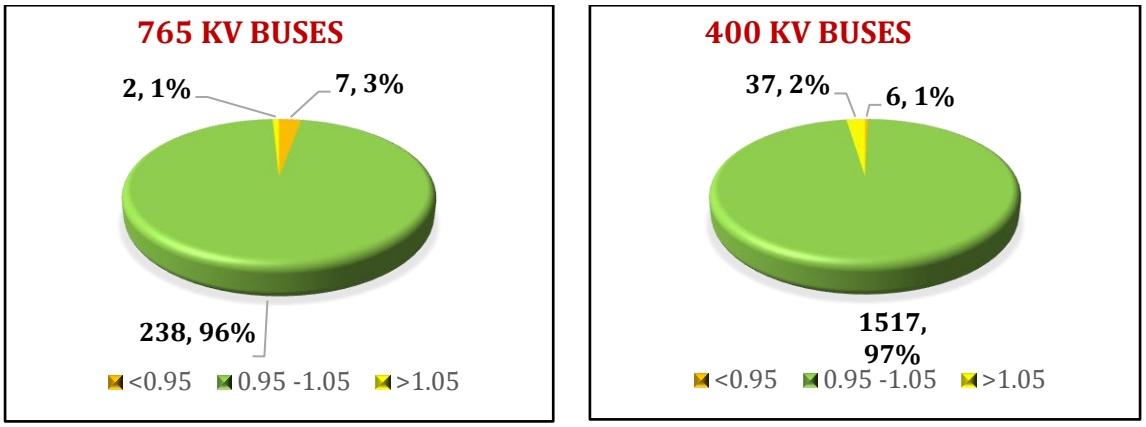
Under solar max scenarios viz. Scenarios 1, 4 and 7 about 28, 26 and 25 substations located in different region predominantly in northern region, where ICTs are getting loaded above 80% of MVA rating. However, if we see in terms of percentage, less than 2% of total no. of transformers are loaded beyond 80% of their rating. The need for augmentation would depend upon the number of transformers, parallel paths availability etc. Hence simulation with contingencies is discussed in subsequent sections.

d) Voltage Profile

With injection of high amount of RE into the Indian Grid, it is expected that in the same day power flow on a line would reverse. Transmission lines associated with thermal and hydro would be lightly loaded in solar max scenarios. Though adequate reactive compensation is planned in the form of switchable line reactors, bus reactors, STATCOMs, SVCs at the time of inception of transmission projects. Impact of various shunt devices on voltages of all buses in all the scenarios are observed and analysed during simulation studies.

Voltages of all 765 kV and 400 kV buses were observed in all the nine scenarios. Maximum and minimum voltage of each bus was identified from nine voltages available in nine scenarios. For voltage variation beyond ±0.05 pu from nominal voltage was considered as voltage violation. Maximum and minimum voltage of buses is considered to calculate the number of buses having voltage beyond 1 pu and voltage below 1 pu respectively. Results of the analysis is plotted below in Figure 3-13.

Figure 3-13: Pie-chart showing number of 765 KV & 400 KV buses



From the above voltage plots it can be observed that about 95% of the buses at 765 kV level and at 400 kV level voltage are found to be in the range of 0.95 to 1.05 pu in All India Base case scenarios. About 2 buses at 765kV & 37 buses at 400 kV voltage are having voltage beyond 1.05 pu in any of the scenarios. Whereas around 7 nodes at 765 kV and 6 nodes at 400 kV are facing low voltage in one of the scenarios.

Details of the buses exceeding the voltage 1.05 pu and buses having voltage below the 0.95 pu in any of the scenario are enclosed at **Annex-3.5.** For buses experiencing low voltages, measures like switching of switchable line reactors, increasing operating voltage of nearby generators may be taken into consideration.

3.2.2 Contingency Analysis

Contingency analysis has been carried out on all the 765 kV & 400kV transmission lines, and 765/400 kV & 400/220 kV transformers to ascertain the loading levels under outage of any other 765 kV or 400 kV or HVDC transmission element. Results of the analysis are discussed below:

a) Transmission Line

765kV line loadings beyond 3000 MW under N-1 was assessed first. Thereafter, to carry out a sensitivity analysis, number of lines loaded beyond 3200 MW and 3500 MW under N-1 contingencies were also identified. The list of such lines is at Annex-3.6 and the same has been summarised below in Figure 3-14, Figure 3-15 & Figure 3-16.

Figure 3-14: 765kV Tr. line loadings>3000MW under N-1 Contingency

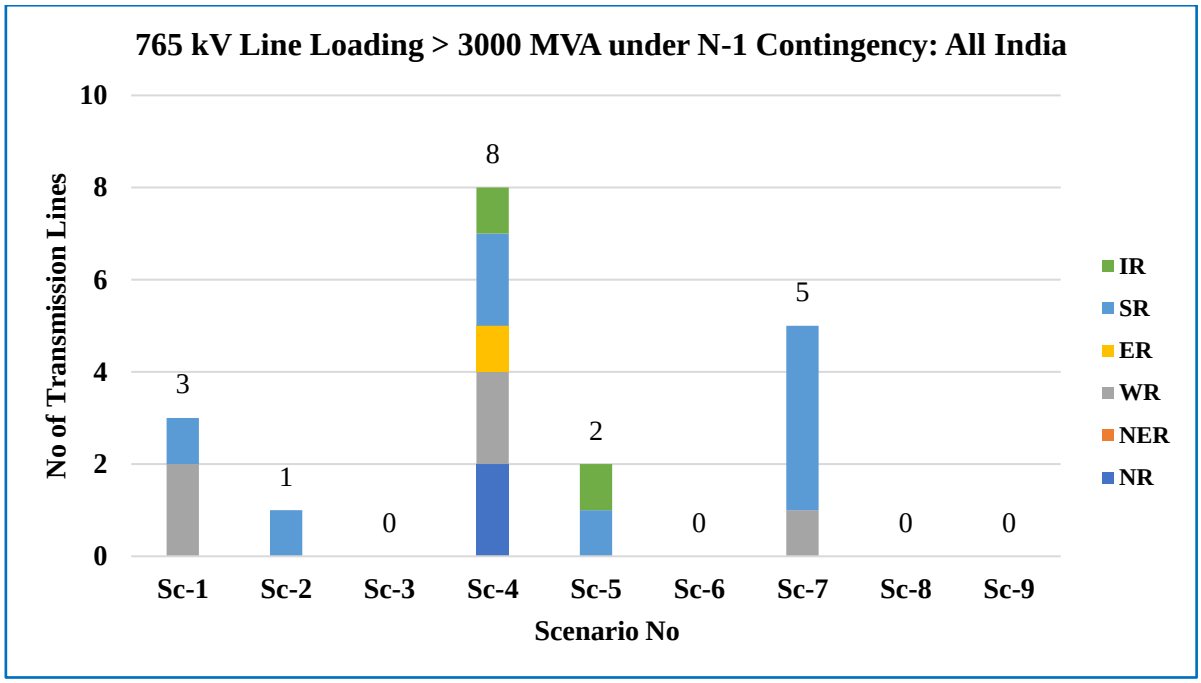


Figure 3-15:765kV line loading>3200 MW under N-1 Contingency

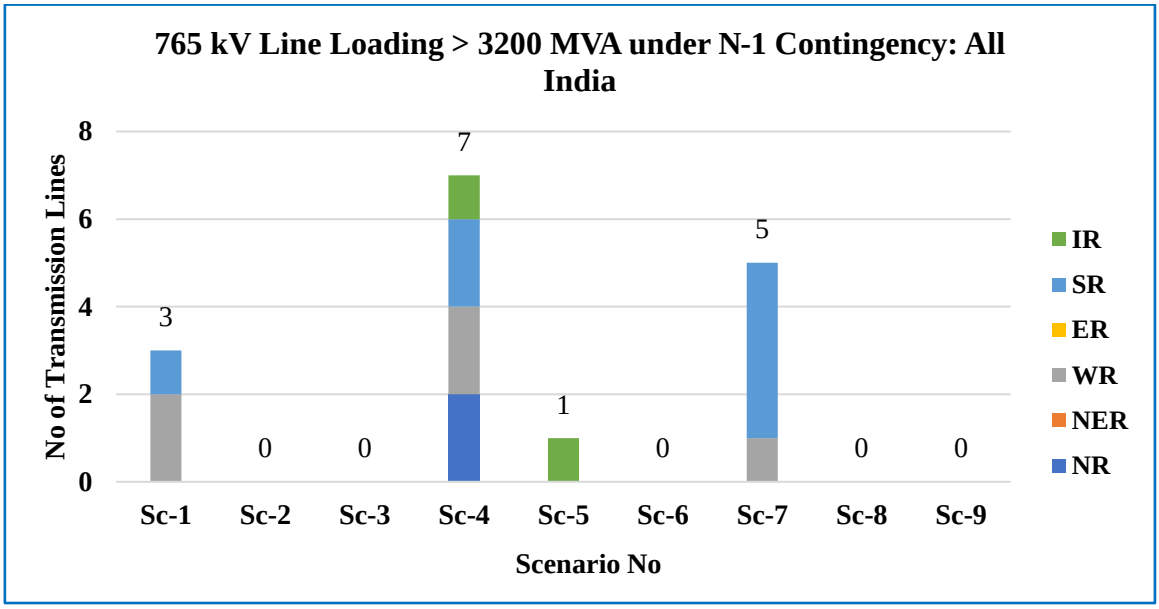
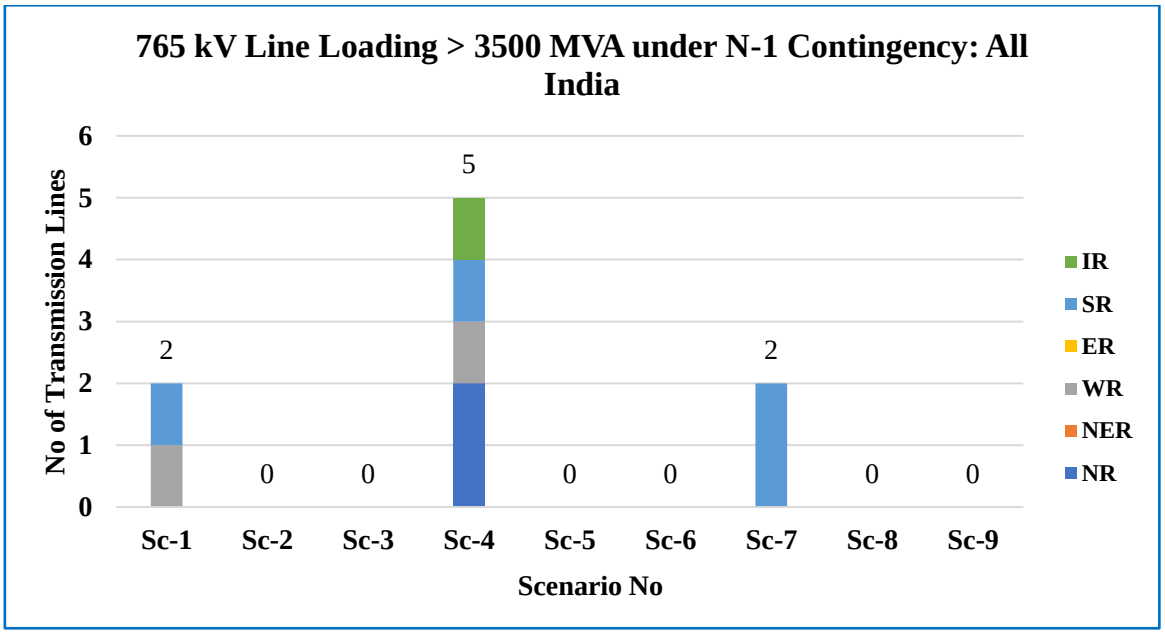


Figure 3-16:765kV line loading>3500 MW under N-1 Contingency



The most critical 765 kV lines are Nizamabad-Nizamabad2, Tiruvalam-Ariyalur, Cuduppa-Tiruvalam. Maximum loadings occur during solar max scenarios. Detailed studies regarding the reason for the overloading and probable mitigation measures are discussed in respective regional chapters.

Further, for 400kV transmission lines, loading greater than 90% and 100% of thermal limit under N-1 Contingency has been assessed and the results are tabulated at **Annex-3.6.** The results are summarised below in Figure 3-17 & Figure 3-18.

Figure 3-17:400kV line loading>90% of thermal limit under N-1 Contingency

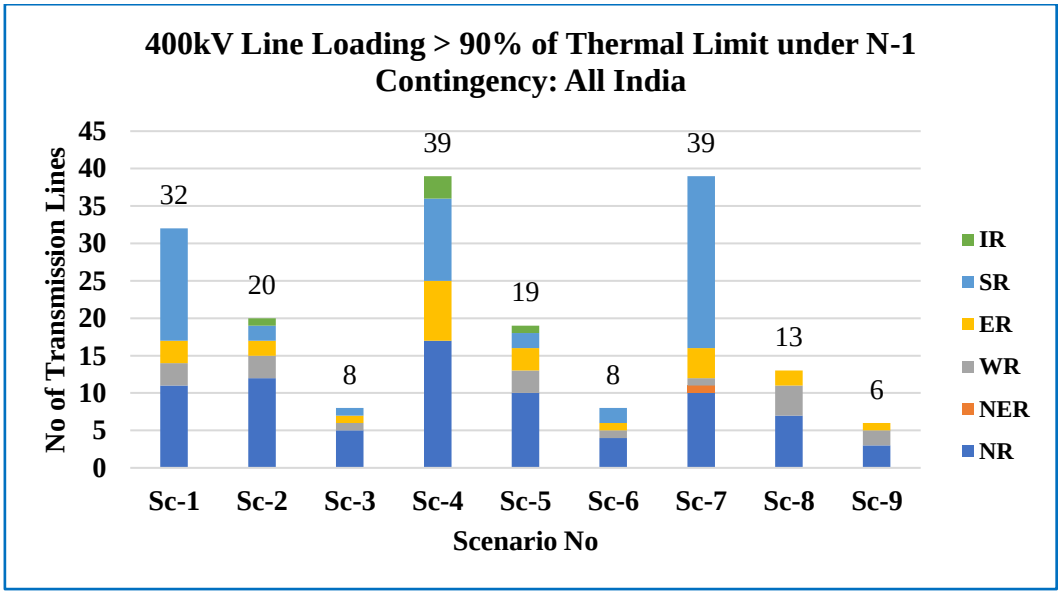
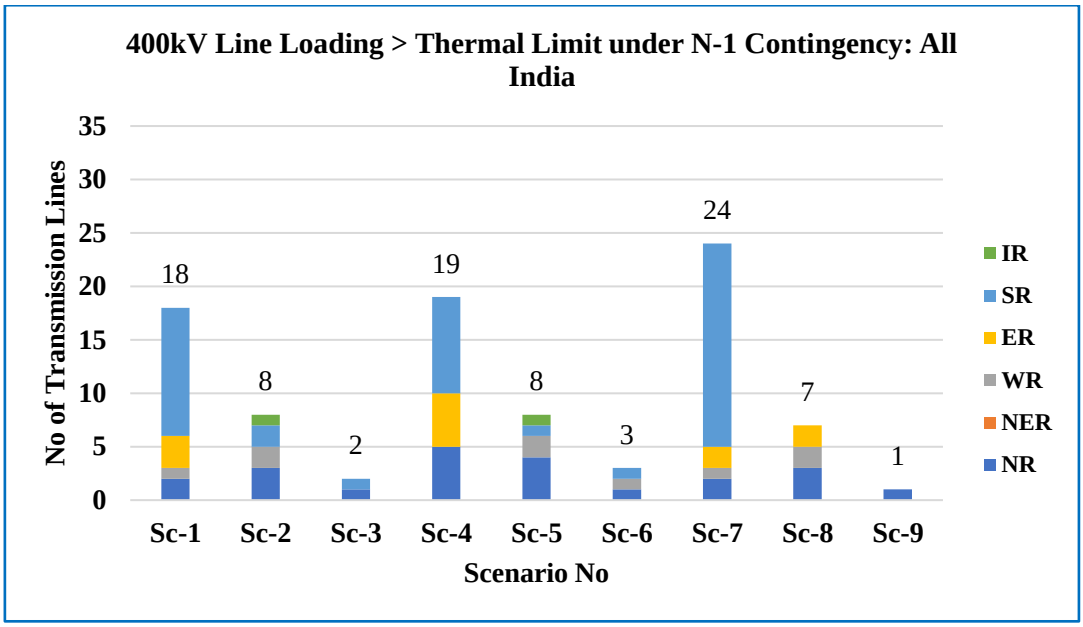


Figure 3-18:400kV line loading>thermal limit under N-1 Contingency



Max no. of 400kV lines on which loadings exceeds 90% and 100% of thermal limit are 39 and 24 in Solar max scenarios i.e. Scenario-7. Further, detailed analysis and studies are being carried to plan additional systems, if any, in respective regional chapter.

b) Transformers

Number of substations where ICTs shall get loaded above 90% and 100% of MVA rating under N-1 contingency are depicted below in Figure 3-19 & Figure 3-20 for 765/400 kV ICT and Figure 3-21 & Figure 3-22 for 400/220 kV ICT. Detailed results are attached at **Annex-3.7.**

Figure 3-19:765/400kV ICT loading≥90% of MVA rating under N-1 Contingency

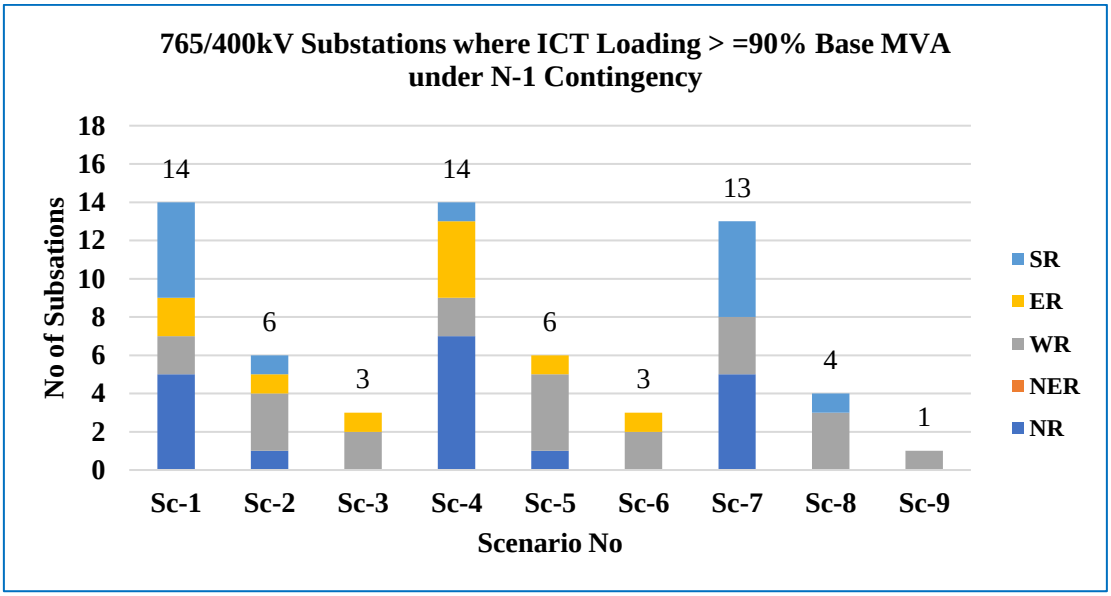
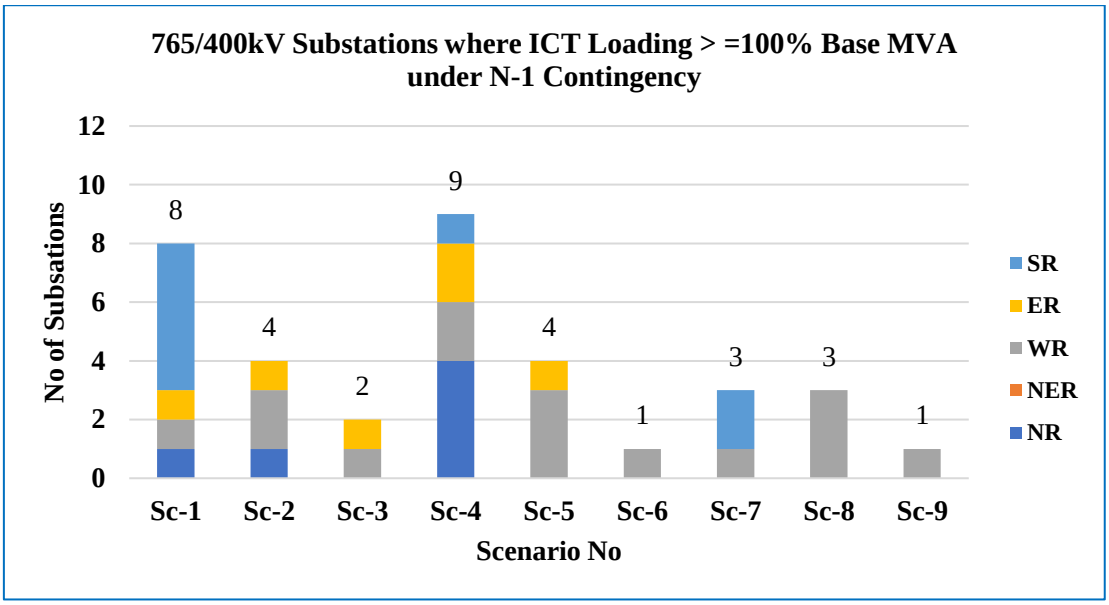


Figure 3-20:765/400kV ICT loading≥100% of MVA rating under N-1 Contingency



Maximum number of transformers exceeding the loading greater than MVA rating under N-1 contingency in each of the seasons are corresponding to Solar max scenarios viz. Scenarios-1, 4 and 7. These locations corresponding to Scenario-4 where ICT loading violations have been observed are Vemagiri, Warangal-New, C. Peta, South Olpad, Bhadla-3, Jeerat-New, Duburi, Ariyalur, Coimbatore etc. Thus, detailed analysis and studies are performed in respective regional chapter to plan for remedial measures.

Figure 3-21:400/220kV ICT loadings≥ 90% of MVA rating under N-1 Contingency

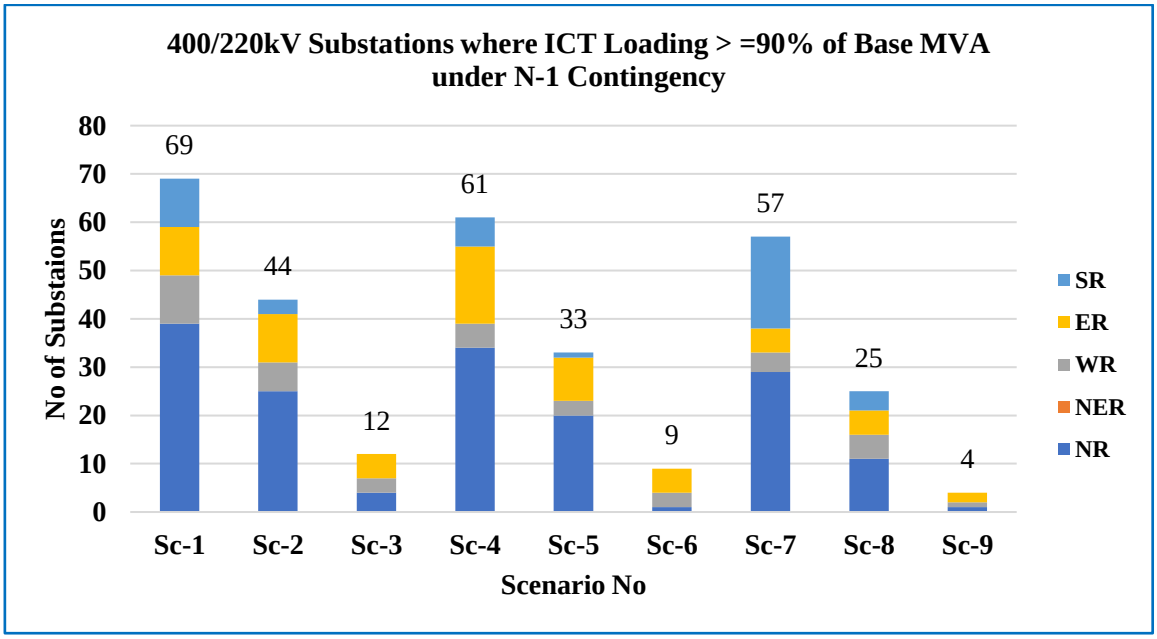
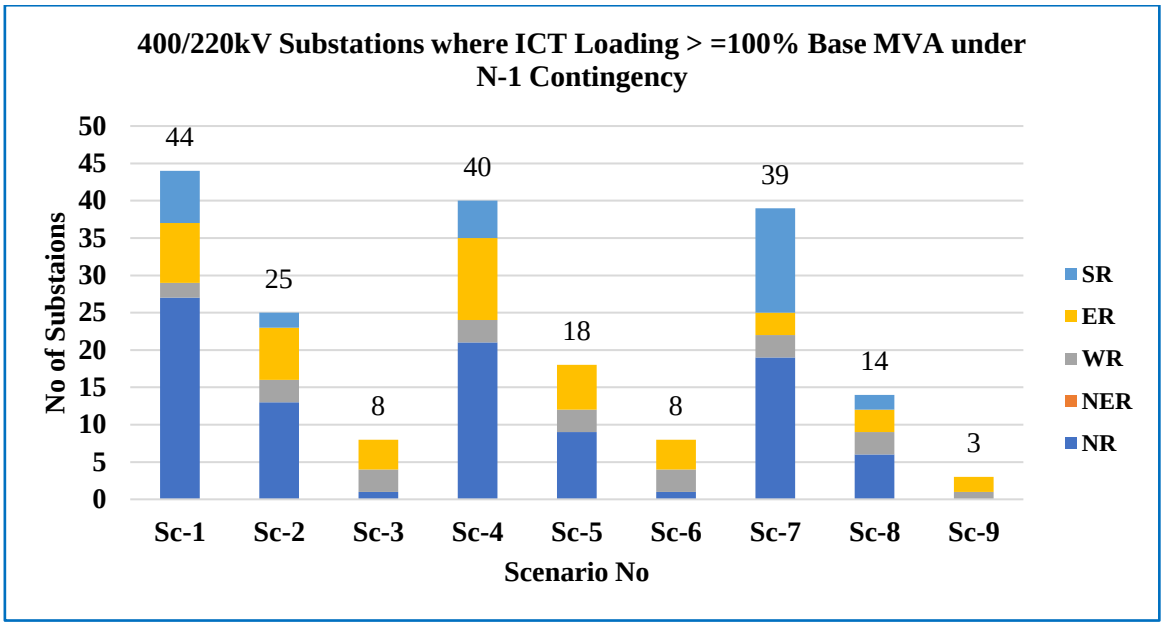


Figure 3-22:400/220kV ICT loadings≥ 100% of MVA rating under N-1 Contingency

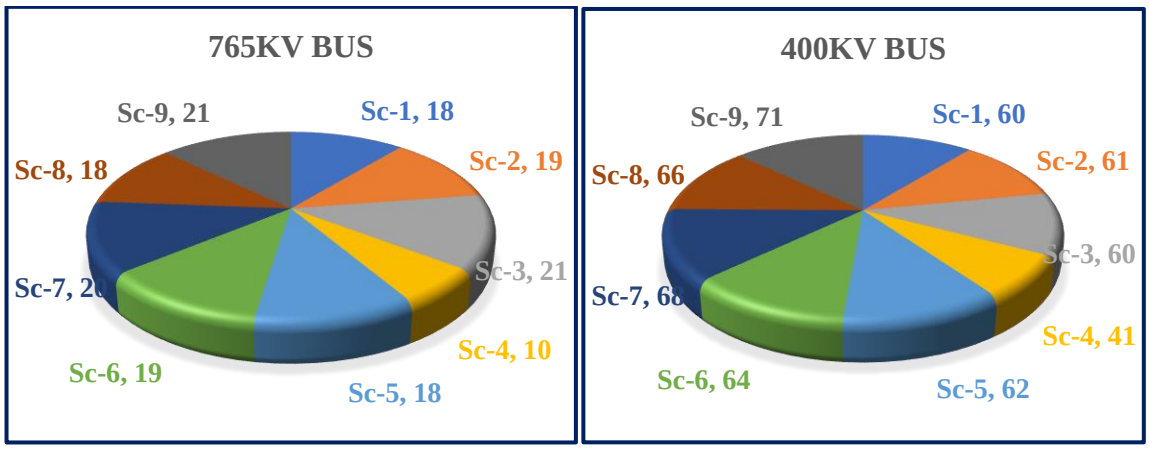


Maximum number of transformers exceeding the loading greater than MVA rating under N-1 contingency in each of the seasons are corresponding to Solar max scenarios viz. Scenarios-1, 4 and 7. Thus, substations requiring ICT augmentation are being studied in detail in respective regional chapters.

3.2.3 Short Circuit Analysis

Short circuit level was calculated for all 765 kV and 400 kV buses on pan India basis. After finding the fault level for all buses exceeding the design fault level under any scenario were identified. Figure 3-23 shows the number of 765 kV & 400 kV buses exceeding the design fault current under different scenarios. Details about the buses exceeding design fault current limit are attached at **Annex-3.8** under various scenarios.

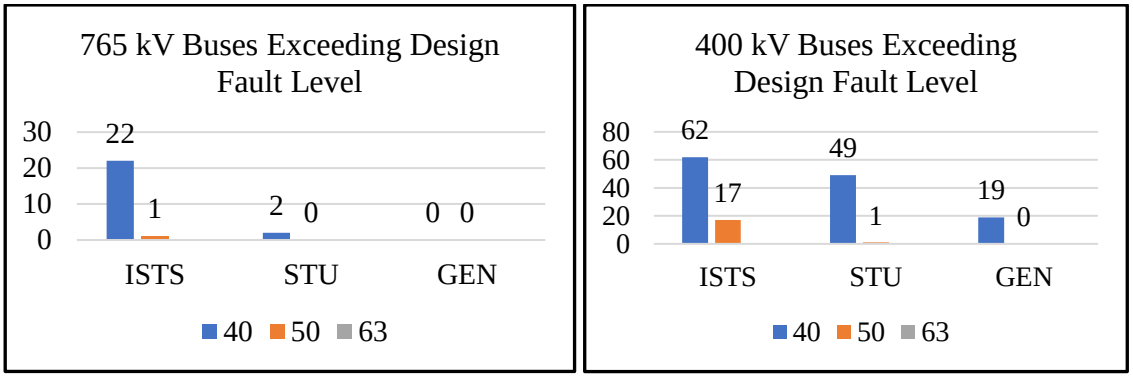
Figure 3-23: Pie-chart showing short circuit level at 765 kV & 400 kV buses on pan India basis



From the above charts it can be seen that number of fault level violations are highest in February scenario i.e. scenario-7, 8 and 9. While identifying the reason for the same it is noticed that number of thermal machines on bar are maximum in February scenario. Hence fault contribution from these machines shall be maximum under these scenarios. Accordingly,

scenario-8 of February is chosen to identify the number of violation taking place at ISTS/STU/Gen buses and same is represented below in Figure 3-24.

Figure 3-24: Violation of fault level in Sc-8 at ISTS/STU/Gen buses at 765 kV & 400 kV levels



Further to understand the criticality of the case, maximum fault violation at buses are tabulated below in Table 3-3.

Table 3-3: Maximum violation of fault level at ISTS/STU/GEN buses

➢ 765 kV ISTS ▪ Jabalpur Pool(50kA): 54kA ▪ Kurnool(40kA): 56kA	➢ 400 kV ISTS ▪ Kurnool-new (50kA): 68 kA ▪ Merrut(40kA): 66kA ▪ Bikaner-NW(40kA): 61kA
➢ 765 kV STU ▪ Jaipur(40kA): 47kA ▪ G. Noida (40kA): 45kA	➢ 400 kV STU ▪ Vednata(50kA): 53 kA ▪ Kurnool(40kA): 61 kA ▪ G. Noida (40kA): 60KA

3.3 ISTS Expansion upto 2028-29

3.3.1 Summary of ISTS network

Region wise and year wise ISTS network expansion across the country upto FY 2028-29 is enclosed in **Annex-3.9**. Summary of ckm addition, MVA addition and the broad estimated cost of ISTS network ***under construction*** are tabulated below in Table 3-4, Table 3-5 & Table 3-6 respectively.

Table 3-4: Under Construction Transmission Line (in ckm)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2023-24	980	320	354	-	371	**2,025**
2	2024-25	3,479	1,611	7,742	185	340	**13,357**
3	2025-26	1,642	940	178	3	150	**2,913**
4	2026-27	-	-	-	-	-	**-**
5	2027-28	-	-	-	-	-	**-**
6	2028-29	-	-	2,028	-	-	**2,028**
	Total	**6,101**	**2,871**	**10,302**	**188**	**861**	**20,322**

Table 3-5: Under Construction Transformation Capacity (in MVA)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2023-24	5,000	5,000	7,135	-	-	**17,135**
2	2024-25	41,500	18,000	49,185	1,250	320	**1,10,255**
3	2025-26	20,500	24,000	3,715	1,500	320	**50,035**
4	2026-27	1,000	-	-	-	-	**1,000**
5	2027-28	-	-	-	-	-	**-**
6	2028-29	-	-	6,630	-	-	**6,630**
	Total	**68,000**	**47,000**	**66,665**	**2,750**	**640**	**1,85,055**

Table 3-6:Broad estimated cost (in ₹ Cr.) (Under Construction)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2023-24	1,361	655	1,834	48	1,346	**5,244**
2	2024-25	12,356	6,149	23,867	742	493	**43,607**
3	2025-26	11,254	7,250	624	671	245	**20,044**
4	2026-27	135	-	-	-	-	**135**
5	2027-28	-	-	-	-	-	**-**
6	2028-29	-	-	26,967	-	-	**26,967**
	Total	**₹ 25,106**	**₹ 14,053**	**₹ 53,291**	**₹ 1,461**	**₹ 2,085**	**₹ 95,997**

Summary of ckm addition, MVA addition and the broad estimated cost of ISTS network ***under planning/bidding/approval*** are tabulated below in Table 3-7, Table 3-8 & Table 3-9 respectively.

Table 3-7: Under planning/bidding/approval Transmission Lines (in ckm)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	-	-	-	-	**-**
2	2025-26	1,670	320	6,652	850	120	**9,612**
3	2026-27	3,870	3,013	4,835	-	-	**11,718**
4	2027-28	-	1,960	-	50	75	**2,085**
5	2028-29	2,558	360	1,964	-	-	**4,882**
	Total	**8,098**	**5,653**	**13,451**	**900**	**195**	**28,297**

Table 3-8: Under planning/bidding/approval Transformation Capacity (in MVA)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	500	5,000	-	-	**5,500**
2	2025-26	26,100	12,500	46,390	6,000	1,400	**92,390**
3	2026-27	39,500	37,000	35,700	-	-	**1,12,200**
4	2027-28	-	28,000	-	-	-	**28,000**
5	2028-29	22,630	2,760	7,500	-	-	**32,890**
	Total	**88,230**	**80,760**	**94,590**	**6,000**	**1,400**	**2,70,980**

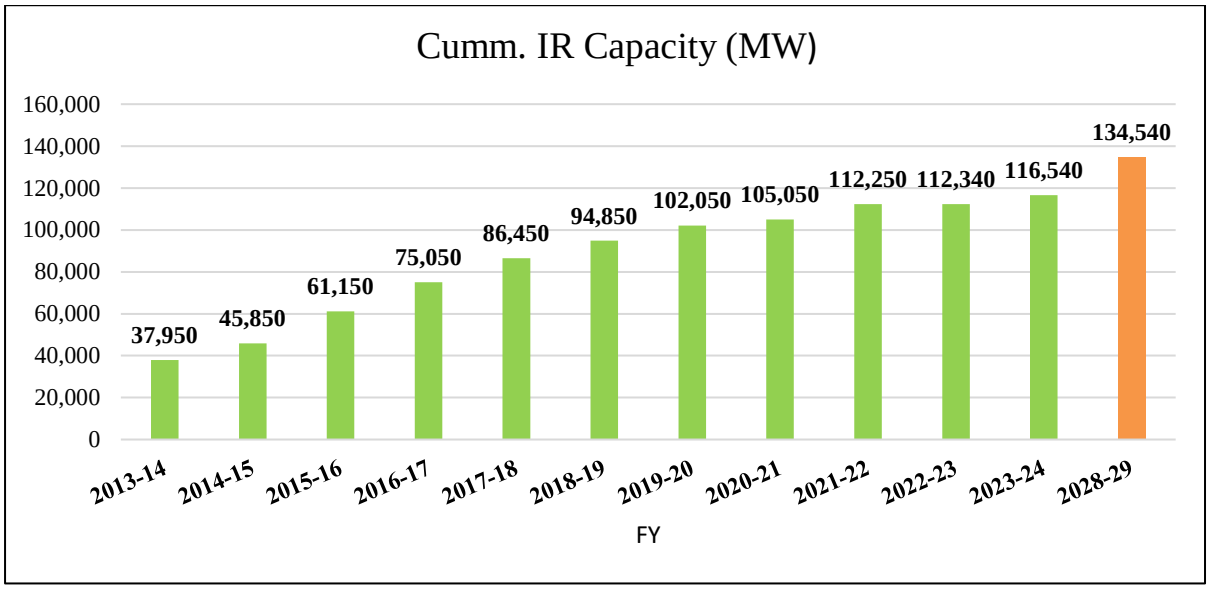
Table 3-9:Broad estimated cost (in ₹ Cr.) (under planning/bidding/approval)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	11	285	-	-	**296**
2	2025-26	9,932	1,087	32,343	5,439	613	**49,414**
3	2026-27	25,949	15,468	26,081	96	-	**67,594**
4	2027-28	-	10,051	-	413	633	**11,097**
5	2028-29	46,059	11,485	12,700	-	-	**70,244**
	Total	**₹ 81,940**	**₹ 38,102**	**₹ 71,409**	**₹ 5,948**	**₹ 1,246**	**₹ 1,98,645**

3.3.2 Inter-Regional (IR) Capacity

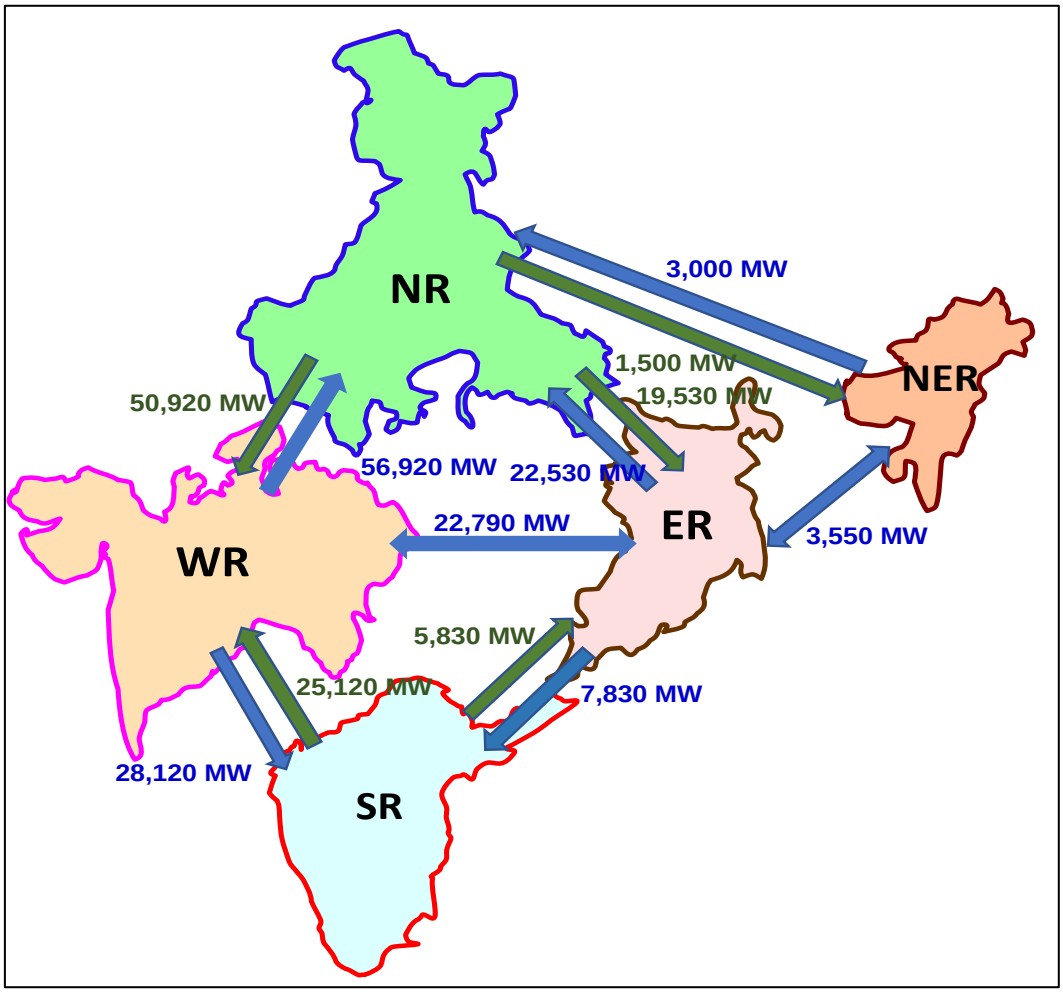
The progressive growth in Inter-Regional (IR) transmission capacity from 2013-14 till 2028-29 is given below in Figure 3-25. As on Feb'24, IR transmission capacity is about 116 GW which is expected to increase to about 135 GW by 2028-29.

Figure 3-25: Growth in IR Capacity (MW)



Details of approved Inter Regional corridor capacity are attached at **Annex-3.10** for 2028-29 and the schematic of the same is given below in Figure 3-26.

Figure 3-26: Inter-Regional Transmission Capacity by 2028-29



Chapter 4: Northern Region

Northern Region is connected to Western and Eastern Region through 765kV/400kV high capacity corridors along with Back to Back/ HVDCs. The thermal generating stations of Northern Regions are predominantly located in UP, Rajasthan and Haryana whereas hydro generation concentrated into J&K, HP and Uttarakhand. Further, Rajasthan is being a RE rich state comprise of lot of Solar & Wind capacity.

As of now Northern Region imports power from other regions during evening peak load period whereas it will export power to other regions during high RE scenarios in future.

4.1 Power Supply Scenario as on Jan'24

As on Jan'2024, total Installed Capacity of Northern Region is about 121.2 GW and the peak demand is about 81 GW. The state-wise breakup of installed capacity and peak demand is summarised at Table 4-1 below.

Table 4-1: NR Installed Capacity and Peak Demand as on Jan'24

(All Fig in GW)

State	Generation							Grand Total	Peak Demand
	Fossil			Non Fossil					
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total		
Delhi	3.6	2.1	5.8	0.1	0.7	0.3	1.1	6.9	7.4
Haryana	8.6	0.6	9.2	0.1	2.3	1.7	4.1	13.3	13.1
Himachal Pradesh	0.1	0.0	0.1	0.0	3.2	1.1	4.4	4.5	2.2
Jammu & Kashmir	0.9	0.3	1.2	0.1	2.3	0.3	2.7	3.8	3.2
Punjab	8.2	0.2	8.4	0.2	3.8	2.0	6.0	14.4	15.3
Rajasthan	13.4	0.8	14.2	0.6	1.9	24.1	26.6	40.9	18.1
UP	20.2	1.0	21.2	0.3	3.4	5.1	8.8	30.0	28.7
Uttrakhand	0.6	0.7	1.3	0.0	2.2	0.9	3.1	4.5	2.6
Chandigarh	0	0	0.1	0	0.1	0.1	0.2	0.2	0.2
Central unallocated	1.4	0.3	1.7	0.2	0.8	0	1.0	2.7	90.9
Total	**57.2**	**6**	**63.2**	**1.6**	**20.8**	**35.5**	**58.0**	**121.2**	**81**

Source: CEA monthly report

From above, it can be concluded that share of non-fossil fuel based generation capacity in total present installed capacity (IC) of 121.2 GW is about 58 GW i.e. 48% of total IC. This share would further increase in envisaged scenario of 2028-29 timeframe.

4.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Northern Region demand for 2028-29 timeframe is expected to increase to about 109.7 GW. As per the inputs received from various stakeholders, total

installed capacity of Northern Region for 2028-29 is expected to be about 217 GW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 4-2.**

Table 4-2: NR Installed Capacity and peak demand (2028-29)

(All Fig in GW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Delhi	0.5	1.5	2.0	-	-	-	-	-	2.0	10.5
Haryana	3.6	-	3.6	0.1	-	0.9	1.0	-	4.6	18.5
Himachal Pradesh	-	-	-	0.3	-	-	0.3	-	0.3	2.8
Jammu & Kashmir	-	0.2	0.2	1.2	-	-	1.2	-	1.4	4.0
Punjab	5.7	-	5.7	1.4	-	-	1.4	-	7.0	18.5
Rajasthan	10.0	0.2	10.2	0.5	-	20.7	21.3	-	31.5	23.6
UP	22.0	-	22.0	1.3	-	4.2	5.5	-	27.5	37.3
Uttrakhand	-	-	-	2.2	-	-	2.2	-	2.2	3.6
Chandigarh	-	-	-	-	-	-	-	-	0.0	0.5
Central	11.9	1.8	13.6	14.2	4.4	78.9	97.5	13.0	124.2	-
IPP	-	-	-	4.1	-	6.0	10.1	-	10.1	-
Rooftop / Other RE	-	-	-	-	-	5.9	5.9	-	5.9	-
NR	**53.7**	**3.6**	**57.3**	**25.3**	**4.4**	**116.6**	**146.3**	**13.0**	**216.6**	**109.7**

From above, it is observed that growth in installed capacity of Northern Region is majorly from non-fossil fuel-based generation resources. Share of non-fossil fuel based generation capacity in total present installed capacity (IC) is expected to be increased from 48% to 68%. There is a growth in peak demand of Northen Region from present time-frame (2023-24) to 2028-29 with a CAGR of 6.38%. The state wise peak demand growth is given at **Table 4-3.**

Table 4-3: Increase in Peak Demand of Various States of NR

(All Fig in MW)

	Peak Demand			
	2023-24	2028-29 (20th EPS)	Increase in demand	CAGR (%)
Chandigarh	411	519	108	4.78
Delhi	7,437	10,469	3032	7.08
Haryana	12,844	18,478	5634	7.55
Himachal Pradesh	2,181	2,829	648	5.34
Jammu & Kashmir & Ladakh	3,133	4,090	957	5.48
Punjab	15,293	18,478	3185	3.86
Rajasthan	18,128	23,590	5462	5.41
UP	28,284	37,270	8986	5.67

Peak Demand				
	2023-24	2028-29 (20th EPS)	Increase in demand	CAGR (%)
Uttarakhand	2,405	3,623	1218	8.54
NR	**80,548**	**1,09,714**	**29,166**	**6.38**

incl. Ladakh

From the above data it is observed that the CAGR growth of peak demand is maximum for Uttarakhand (8.54%) and minimum for Punjab (3.86%).

4.3 Load Generation Balance for 2028-29 Timeframe

In Chapter-3, All India Load Generation Balance (LGB) for identified nine scenarios - was prepared as per the methodology finalized in consultation with CTU, CEA and GRID INDIA. This section elaborates the Northern Region Load Generation Balance (LGB) for 2028-29 time-frame. For Northern Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned at Table 4-4 for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 4-4: Northern Region Generation Dispatch and Demand Factors

Scenario No & Name	Hydro	Nuclear	Solar	Wind	ESS	Gas	Regional DF
1-Aug Solar Max	70%	80%	90%	50%	-100%	0%	92%
2-Aug Peak Load	95%	80%	0%	70%	60%	50%	93%
3-Aug Night Off Peak	70%	80%	0%	60%	40%	50%	72%
4-Jun Solar Max	70%	80%	90%	50%	-100%	0%	83%
5-Jun Peak Load	95%	80%	0%	70%	50%	50%	95%
6-Jun Night Off Peak	70%	80%	0%	60%	1%	50%	66%
7-Feb Solar Max	30%	80%	90%	10%	-100%	0%	73%
8-Feb Peak Load	60%	80%	0%	35%	100%	50%	61%
9-Feb Night Off Peak	30%	80%	0%	10%	40%	30%	41%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import / export of NR and the inter regional flows through various

corridors is summarised in subsequent sections. Further, both maximum and minimum is also highlighted in table Table 4-5 below.

Table 4-5: IR Flows & Surplus/Deficit (Northern Region)

(All Fig in MW)

IR Flows	Aug'28 (Monsoon)			Jun'28 (Summer)			Feb'29 (Winter)		
Scenario No. / Corridor	1 Solar Max	2 Peak Load	3 Off Peak	4 Solar Max	5 Peak Load	6 Off Peak	7 Solar Max	8 Peak Load	9 Off Peak
WR-NR	-12323	13298	12114	-10912	16145	10591	-14115	-12	664
ER-NR	-8994	-1607	-1952	-11737	468	-1551	-7202	-1	-1349
NER-NR	-500	-	-	-500	-	-	-500	-	-
NEPAL-NR	1454	1870	1454	1454	1847	1454	623	1246	-
NR	-20362	13560	11616	-21695	18460	10494	-21193	1233	-685

Considering the above LGB for nine scenarios, load flow cases were prepared for 2028-29 timeframe. Detailed system studies have been carried out on the finalized load flow cases. The study results are discussed in subsequent sections.

4.4 ISTS Network Expansion Schemes Evolved from Mar'23 to Feb'24

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Northern Region (CMETS-NR) from March 2023 to February 2024. Brief of all such deliberated transmission schemes are tabulated below:

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in Cr.)
Rajasthan and Inter Regional (MP)			
1.	Implementation of Bus Sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)	2024-25	17.11
2.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 : 5.5GW) (Jaisalmer/Barmer Complex)	2025-26	20,080 (Incl. WR portion)
3.	Transmission system strengthening for interconnections of Bhadla-III & Bikaner-III complex	2026-27	1382
4.	Augmentation of transformation capacity at 400/220kV Bikaner-II PS by 400/220kV, 1x500 MVA ICT (3rd)	2024-25	55.82
5.	Requirement of one set of Bus Sectionalizer at 220kV level of 400/220kV Fatehgarh-IV PS (Section-1)	2024-25	11.74
6.	Augmentation of 5th ICT at Fatehgarh-III PS(Section-1)	2024-25	58.18
7.	Requirement of one set of Bus Sectionalizer at 400kV level of 400/220kV Bikaner-II PS	2024-25	28
8.	Augmentation of 400/220 kV, 1x500 MVA (4 th) ICT at 400/220kV Kankroli substation	2025-26	59.55

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in Cr.)
9.	Requirement of 1x80 MVAr (1-Ph) spare reactor unit at Beawar S/s under Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/ Barmer Complex): Part D scheme	2026-27	10.18
10.	Additional Transmission system for evacuation of power from Bhadla-III PS as part of Rajasthan REZ Phase-III scheme (20GW)	2025-26	368.83
11.	Transmission system for evacuation of power from Bikaner Complex as part of Rajasthan REZ Ph-IV (Part 3- 6 GW) [Bikaner complex]	2026-27	11326
12.	Transmission system for evacuation of power from Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part 4- 3.5 GW) [Fatehgarh/Barmer complex]	2026-27	12106
13.	Implementation of 1 no. of 220 kV line bay at 400/220 kV Fatehgarh-III PS(Sec-1) for interconnection of JSW Renew Energy Five Limited BESS Project (Stage-II Connectivity App No. 0212100040) (250 MW)	2025-26	5.94
Haryana			
1.	Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line	2025-26	30.72
Himachal Pradesh			
1.	Augmentation of 1x500 MVA (4th) ICT at 400/220 kV Nalagarh substation	2025-26	63.08
Jammu and Kashmir			
1.	Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315 MVA, 400/220kV ICT (3rd)	2025-26	82.04
2.	Transmission system scheme for Ratle HEP (850MW)	2026-27	1400
3.	Augmentation of 400/220 kV, 1x315 MVA (3rd) ICT at 400/220 kV New Wanpoh (PG) substation	2025-26	61
Uttar Pradesh			
1.	Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT	2024-25	61
2.	Replacement of existing 420kV 50MVAR Bus Reactors at Mandola & Muradnagar substation with 125MVAr bus reactor	2024-25	-
Delhi			
1.	Replacement of 1x315 MVA (ICT-3), 400/220 kV ICT to 500 MVA at 400/220 kV Bawana S/s	2025-26	40.6

Details of the schemes are reproduced below state-wise:

4.4.1 Rajasthan

a. Implementation of Bus Sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)

Transmission system for additional 20 GW REZ in NR (Phase-III) including Fatehgarh-III PS (new section) was agreed in the 3rd NRPC (TP) meeting held on 19.02.2021 and 49th

NRPC meeting held on 27.09.2021. Subsequently in the 5th NCT meeting held on 25.08.2021 & 02.09.2021, above scheme was agreed for implementation. As part of the above scheme, STATCOM along with MSC & MSR at Fatehgarh-III PS was also discussed and it was decided that its requirement would be reviewed at a later date. Subsequently in the 11th NCT meeting held on 28.12.22 and 17.01.23, It was agreed that 2x±300 MVAr STATCOM along with 4x125 MVAr MSC, 2x125 MVAr MSR along with 2 Nos. of 400 kV bays at Fatehgarh-III PS will be implemented as part of transmission schemes "Transmission system for evacuation of power from REZ in Rajasthan (20 GW) Phase-III Part F" which is currently in bidding stage.

In the 11th NCT meeting, it was also noted that +300 MVAr STATCOM should be placed in each 400kV section of Fatehgarh-III PS (Phase-III Part E1). Therefore, one set of sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2) is required to place +300 MVAr STATCOM units along with MSC & MSR in each 400kV section of Fatehgarh-III PS (Phase-III Part E1). The Scheme was approved in 16th Consultation meeting for Evolving Transmission Schemes in NR held on 28.02.23.

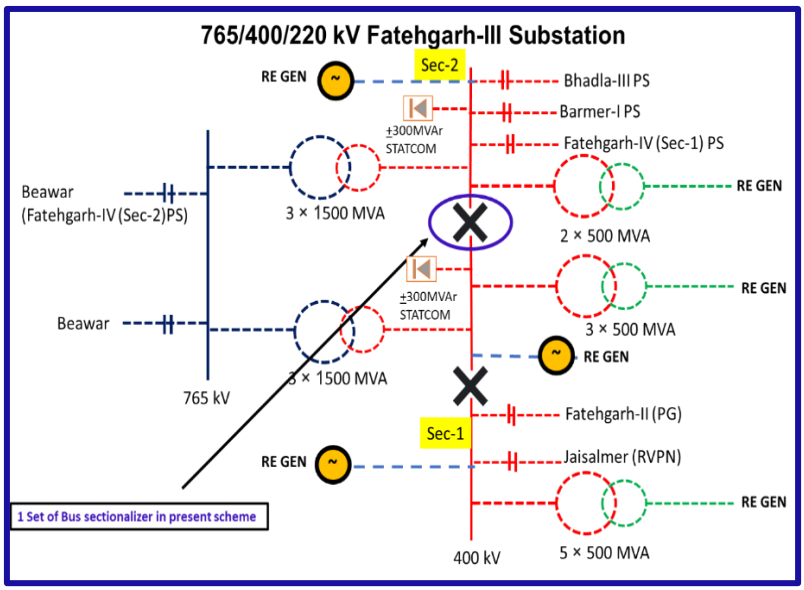


Figure 4-1 : Schematic of 765/400/220kV Fatehgarh-III PS

The scheme is under implementation as per details below:

Implementation of Bus Sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	1 Set of Bus sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)	400 kV Bus sectionalizer – 1 set	Matching with Ph-III Part-E1 package (refer note 1)

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
		Total Estimated Cost:	**₹ 17.11 Crore**

b. Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 : 5.5GW) (Jaisalmer/Barmer Complex)

The transmission scheme was earlier proposed for evacuation of about 7.5 GW power from Jaisalmer/Barmer Complex. The scheme was deliberated in the 12th NCT meeting held on 24.03.23. In the meeting, various issues like system strength (SCR), requirement of Barmer-I PS as well as high angular separation in the proposed 765 kV Jalore-Mandsaur D/c (length 320 kms) inter-regional transmission line were raised. Subsequently, various joint study meetings were held for review and phasing of transmission scheme among CEA, CTUIL and GRID-INDIA and revised studies were carried out.

Accordingly, revised studies were carried out incorporating the increased electricity demand of Rajasthan as suggested by Grid-India, and it was observed that the transmission system was adequate for evacuation of about 5.5 GW RE power (solar) in summer & winter scenario.

The modified transmission scheme was discussed and agreed in the 65th NRPC meeting held on 21.04.23. The scheme was further agreed in the 46th WRPC meeting held on 03.02.23. Further, transmission scheme for evacuation of power from Neemuch/Mandsaur 2 GW WEZ was proposed as transmission system in Western Region whereas creation of Mandsaur 765 kV S/s was envisaged as a part of Rajasthan REZ Ph-IV (Part-2) Scheme. As deliberated in the 12th NCT meeting, it was decided to combine the transmission scheme for Neemuch/Mandsaur with Rajasthan Ph-IV Part- C Scheme which involves the creation of 765 kV Mandsaur S/s.

Details of the scheme is as under

Part A : Rs 2206 Cr

Sl. No.	Description	Capacity/ckm
1	Establishment of 4x1500 MVA, 765/400 kV & 5x500 MVA, 400/220 kV Fatehgarh-IV (Section-2) Pooling Station along with 2x240 MVAr (765 kV) Bus Reactor & 2x125 MVAr (400 kV) Bus Reactor **[Future space provisions already approved at Fatehgarh-IV in 8th NCT meeting dated 25.03.22 would be utilized for the present scheme]**	• 765/400 kV, 1500 MVA ICT- 4 Nos. (13x500 MVA including one spare unit) • 765 kV ICT bays- 4 Nos. • 240 MVAR, 765 kV Bus Reactor- 2 Nos. (7x80 MVAR including one spare unit) • 765 kV Bus reactor bays-2 Nos. • 765 kV line bays - 4 Nos. [for LILO of Fatehgarh-III - Beawer 765 kV D/c (2nd) line at Fatehgarh-IV (Section-2) PS] • 400/220 kV, 500 MVA ICT -5 Nos. • 400 kV ICT bays- 9 Nos. • 400 kV line bays - 2 Nos. [For Fatehgarh-IV (Sec-2) - Bhinmal (PG) D/c line]

Sl. No.	Description	Capacity/ckm
		• 125 MVAR, 420 kV Bus Reactor-2 Nos. • 400 kV Bus reactor bays- 2 Nos. • 400 kV Sectionalisation bay: 1 set • 220 kV ICT bays- 5 Nos. • 220 kV line bays: 6 Nos. (for RE connectivity) • 220 kV BC (2 Nos.) and 220 kV TBC (2 Nos.) • 220 kV Sectionalisation bay: 1 set
2	Fatehgarh-IV (Section-2) PS – Bhinmal (PG) 400 kV D/c line (Twin HTLS) along with 50 MVAr switchable line reactor on each ckt at each end	Route Length: 200 km • 400 kV, 50 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 Nos. • 400 kV, 50 MVAr switchable line reactors at Bhinmal (PG) – 2 Nos. • Switching equipment for 400 kV 50 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 Nos. • Switching equipment for 400 kV 50 MVAr switchable line reactors at Bhinmal (PG) – 2 Nos.
3	LILO of both ckts of 765 kV Fatehgarh-III-Beawar D/c line (2nd) at Fatehgarh-IV (Section-2) PS along with 330 MVAr switchable line reactor at Fatehgarh-IV PS end of each ckt of 765 kV Fatehgarh-IV- Beawar D/c line (formed after LILO)	LILO length: 15 km • 330 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 nos. • Switching equipment for 330 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 nos. • 110 MVAr (765 kV) spare reactor single phase unit at Fatehgarh-IV (Section-2) PS end – 1 no.
4	2 nos. of 400 kV line bays at Bhinmal (PG)	400 kV line bays - 2 nos.

Part B : Rs 3279 Cr

Sl. No.	Description	Capacity/ckm
1	Establishment of 2x1500 MVA, 765/400 kV Substation at suitable location near Sirohi along with 2x240 MVAr (765 kV) & 2x125 MVAr (400 kV) Bus Reactor Future provisions: Space for • 765/400 kV ICT along with bays- 4 nos. • 765 kV line bays along with switchable line reactors – 10 nos. • 765 kV Bus Reactor along with bay: 1 nos. • 400 kV line bays along with switchable line reactor –4 nos. • 400 kV line bays –4 nos. • 400 kV Bus Reactor along with bay: 1 no. • 400 kV Sectionalization bay: 2 sets	• 765/400 kV 1500 MVA ICT- 2 nos. (7x500 MVA including one spare unit) • 765 kV ICT bays-2 no. • 240 MVAr Bus Reactor-2 nos. (7x80 MVAr including one spare unit) • 765 kV Bus reactor bays-2 nos. • 765 kV line bays- 2 nos. [for D/c line to Fatehgarh-IV (Section-2) PS] • 400 kV ICT bays- 2 no. • 400 kV line bays - 2 nos. [for D/c line to Chittorgarh (PG) S/s] • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 nos.

Sl. No.	Description	Capacity/ckm
	• 400/220 kV ICT along with bay - 6 nos. • 220 kV line bays -10 Nos. • 220 kV Sectionalization bay: 2 sets • 220 kV BC (3 nos.) & TBC (3 nos.) • STATCOM (2x±300 MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with two number 400 kV bays.	
2	Fatehgarh-IV (Section-2) PS – Sirohi PS 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end	Route Length – 240 km • 765 kV, 240 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 nos. • 765 kV, 240 MVAr switchable line reactors at Sirohi PS– 2 nos. • Switching equipment for 765 kV 240 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 nos. • Switching equipment for 765 kV 240 MVAr switchable line reactors at Sirohi PS – 2 nos.
3	Sirohi PS-Chittorgarh (PG) 400 kV D/c line along with 80 MVAr switchable line reactor for each circuit at Sirohi PS end (Quad)	Route Length ~160 km (Quad) • 400 kV, 80 MVAr switchable line reactors at Sirohi PS – 2 nos. • Switching equipment for 400 kV 80 MVAr switchable line reactors at Sirohi PS – 2 nos.
4	2 no. of 400 kV line bays at Chittorgarh (PG) S/s	400 kV line bays at Chittorgarh (PG) S/s - 2 nos.
5	2 no. of 765 kV line bays at Fatehgarh-IV (Section-2) PS	765 kV line bays at Fatehgarh-IV (Section-2) PS – 2 Nos.

Detailed scope of Part C of the scheme is given: Rs 2,708

Sl. No.	Description	Capacity / line length km
1.	Establishment of 3x1500MVA, 765/400/ kV & 5x500MVA 400/220kV Mandsaur Pooling Station along with 2x330 MVAr (765 kV) Bus Reactors (with 1x110 MVAr & 1x80 MVAr, 765 kV spare single phase reactor unit for line/bus reactor) **Future Provisions**: Space for: • 765/400 kV ICT along with bays- 3 no. • 765 kV line bays along with switchable line reactors – 12 nos. • 765 kV Bus Reactor along with bay: 2 no. • 765 kV Sectionaliser bay: 1 -set	765/400 kV, 1500 MVA ICT – 3 (10 single phase units of 500 MVA including one spare unit) 400/220 kV, 500 MVA ICT – 5 (3 nos. on 220 kV bus section-1 & 2 nos. on 220 kV bus section-2) 765 kV ICT bays – 3 400 kV ICT bays – 8 330 MVAR 765 kV bus reactor-2 (7x110 MVAR single phase units including one spare unit) 765 kV bus reactor bay- 2 765 kV line bay- 2 (for Indore line) 110 MVAR, 765 kV, 1-ph reactor (spare unit)-1 80 MVAR, 765 kV, 1-ph reactor (spare unit)-1 125 MVAR 420 kV bus reactor-2 400 kV reactor bay- 2 220 kV ICT bays - 5

Sl. No.	Description	Capacity / line length km
	• 400 kV line bays along with switchable line reactor – 12 nos. • 400/220 kV ICT along with bays -5 nos. • 400 kV Bus Reactor along with bay: 2 no. • 400 kV Sectionalization bay: 1- set • 220 kV line bays: 11 nos. • 220 kV Sectionalization bay: 1 set • 220 kV BC and TBC: 1 no. • STATCOM (± 300 MVAr) along with MSC (2x125 MVAr) & MSR (1x125 MVAr) along with one 400 kV bay.	220 kV line bays – 7 (4 nos. on bus section-1 and 3 nos. on bus section-2) 220 kV Bus Sectionaliser – 1 set 220 kV TBC bay – 2 no. 220 kV BC bay – 2 no.
2.	Mandsaur PS – Indore (PG) 765 kV D/c Line	Route Length – 200 km
3.	1x330 MVAr switchable line reactor (SLR) on each ckt at Mandsaur end of Mandsaur PS – Indore (PG) 765 kV D/c Line	• 330 MVAr, 765 kV switchable line reactor- 2. • Switching equipments for 765 kV line reactor- 2
4.	2 nos. of 765 kV line bays at Indore (PG) for termination of Mandsaur PS – Indore (PG) 765 kV D/c Line	• 765 kV line bays – 2 Nos. (for Indore (PG) end)

Part D : Rs 2,227 Cr

Sl. No.	Description	Capacity/ckm
1	Beawar- Mandsaur PS 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end	Route Length – 260 km • 765 kV, 240 MVAr switchable line reactors at Beawar – 2 nos. • 765 kV, 240 MVAr switchable line reactors at Mandsaur PS – 2 nos. • Switching equipment for 765 kV, 240 MVAr switchable line reactors at Beawar – 2 nos. • Switching equipment for 765 kV, 240 MVAr switchable line reactors at Mandsaur PS – 2 nos.
2	2 no. of 765 kV line bays each at Beawar S/s & Mandsaur S/s	765 kV line bays - 4 nos (2 nos. each at Beawer S/s & Mandsaur PS)

Part E : Rs 3251 Cr

Sl. No.	Description	Capacity/ckm
1	Establishment of, 765 kV Substation at suitable location near Rishabdeo (Distt. Udaipur) along with 2x240 MVAr (765 kV) Bus Reactor **Future Scope** **Space for** ➢ 765/400kV ICT along with bays- 5 no. along with spare unit ➢ 765 kV line bays along with switchable line reactors – 6 no. ➢ 765kV Bus Reactor along with bay: 1 no. ➢ 400 kV line bays along with switchable line reactor –4 no. ➢ 400 kV line bays –4 no. ➢ 400 kV Bus Reactor along with bay: 3 no. ➢ 400kV Sectionalization bay: 2 sets ➢ 400/220kV ICT along with bay - 6 no. ➢ 220kV line bays -10 no. ➢ 220 kV Sectionalization bay: 2 sets ➢ 220 kV BC (3 nos.) & TBC (3 nos.) ➢ STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with two number 400 kV bays.	• 240 MVAr Bus Reactor- 2 nos. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no • 765 kV line bays - 6 nos [for 765kV Sirohi PS- Rishabdeo – Mandsaur D/c & LILO of one circuit of 765 kV Chittorgarh-Banaskanta D/c line at Rishabdeo S/s]
2	Sirohi PS- Rishabdeo 765 kV D/c line along with 330 MVAr switchable line reactor for each circuit at Sirohi end	Route Length – 170 km • 765 kV, 330 MVAr switchable line reactors at Sirohi PS– 2 Nos. • Switching equipment for 765 kV, 330 MVAr switchable line reactors at Sirohi PS– 2 Nos. • 110 MVAr (765 kV) spare reactor single phase unit at Sirohi PS – 1 No.
3	Rishabdeo - Mandsaur PS 765 kV D/c line along with 330 MVAr switchable line reactor for each circuit at Rishabdeo/Salumbar end	Route Length – 160 km • 765 kV, 240 MVAr switchable line reactors at Rishabdeo – 2 nos. • Switching equipment for 765 kV, 240 MVAr switchable line reactors at Rishabdeo – 2 nos.
4	LILO of one circuit of 765 kV Chittorgarh-Banaskanta D/c line at Rishabdeo S/s (20 km)	LILO route length: 20 km
5	2 no. of 765 kV line bays each at Sirohi PS & Mandsaur S/s	• 765 kV line bays – 4 Nos. (2 Nos. each at Sirohi PS & Mandsaur PS)

Part F: Rs 2735 Cr

Sl. No.	Description	Capacity/ckm
1	Establishment of 3x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Barmer-I Pooling Station along with 2x240 MVAr (765 kV) Bus Reactor & 2x125 MVAr (400 kV) Bus Reactor Future provisions: Space for ➢ 765/400kV ICT along with bays- 3 no.	• 765/400 kV 1500 MVA ICT- 3 nos. (10x500 MVA including one spare unit) • 765 kV ICT bays-3 Nos. • 240 MVAr Bus Reactor-2 no. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no.

Sl. No.	Description	Capacity/ckm
	➢ 765 kV line bays along with switchable line reactors – 4 nos. ➢ 765kV Bus Reactor along with bay: 1 no. ➢ 400 kV line bays –4 ➢ 400 kV line bays along with switchable line reactor –4 nos. ➢ 400/220kV ICT along with bays -8 nos. ➢ 400 kV Bus Reactor along with bay: 1 no. ➢ 400kV Sectionalization bays: 2 sets ➢ 220 kV line bays for connectivity of RE Applications -10 nos. ➢ 220 kV Sectionalization bay: 3 sets ➢ 220 kV BC (3 nos.) & TBC (3 nos.) ➢ STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with two number 400 kV bays	• 765 kV line bays- 2 Nos. (for D/c line to Sirohi PS) • 400/220 kV 500 MVA ICT -2 Nos • 400 kV ICT bays- 5 Nos. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 nos. • 400 kV line bays - 2 nos. [for D/c line to Fatehgarh-III(Section-2) PS] • 220 kV ICT bays- 2 No. • 220 kV line bays: 4 Nos. (for RE connectivity) • 220 kV BC (1 No.) & TBC (1 No.)
2	Fatehgarh-III (Section-2) PS – Barmer-I PS 400 kV D/c line (Quad)	Route Length -50 km (Quad)
3	Barmer-I PS– Sirohi PS 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end	Route Length – 200 km • 765 kV, 240 MVAr switchable line reactors at Barmer-I PS – 2 nos. • 765 kV, 240 MVAr switchable line reactors at Sirohi PS – 2 nos. • Switching equipment for 765 kV 240 MVAr switchable line reactors at Barmer-I PS – 2 nos • Switching equipment for 765 kV 240 MVAr switchable line reactors at Sirohi PS – 2 nos.
4	2 no. of 400 kV line bays at Fatehgarh-III (Section-2) PS	400 kV line bays at Fatehgarh-III (Section-2) PS - 2 nos.
5	2 no. of 765 kV line bays at Sirohi PS	765 kV line bays at Sirohi PS – 2 nos

Detailed scope of Part H1 of the scheme is given: Rs 3674 Cr

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
1.	Establishment of 765/400 kV (2x1500 MVA), 400/22 kV (2x500 MVA) & 220/132 kV (3x200 MVA) Kurawar S/s (with 1x500 MVA spare single phase transformer unit) with 2x330 MVAr 765 kV bus reactor and 1x125 MVAr 420 kV bus reactor (with 1x110 MVAr & 1x80 MVAr, 765 kV spare single phase reactor unit for line/bus reactor) **Future Provisions**: Space for • 765/400 kV ICT along with bays- 4 no.	• 765/400 kV, 1500 MVA ICT – 2 (7 single units of 500 MVA including one spare unit) • 400/220 kV, 500 MVA ICT – 2 • 220/132 kV, 200 MVA ICT – 3 • 765 kV ICT bays- 2 • 400 kV ICT bays- 4 • 220 kV ICT bays – 5 • 132 kV ICT bays - 3 • 330 MVAR 765 kV bus reactor-2 • 125 MVAR 420 kV bus reactor-1 • 765 kV reactor bay- 2 • 765 kV line bays- 4 • 400 kV line bays- 4

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
	• 765 kV line bays along with switchable line reactors – 8 nos. • 765 kV Bus Reactor along with bay: 2 no. • 765 kV Sectionaliser bay: 1 -set • 400 kV line bays along with switchable line reactor – 10 nos. • 400/220 kV ICT along with bays -6 nos. • 420 kV Bus Reactor along with bay: 3no. • 400 kV Sectionalization bay: 1- set • 220 kV line bays: 12 nos. • 220 kV Sectionalization bay: 2 sets • 220 kV BC and TBC: 2 nos. • 220/132 kV ICT along with bays: 5 Nos. • 132 kV line bays: 16 nos. • 132 kV Sectionalization bay: 1 set • 132 kV TBC– 1 no. • STATCOM (±300 MVAr) along with MSR (2x125 MVAr) & MSC (1x125 MVAr) along with 400 kV bay.	• 400 kV reactor bay- 1 • 220 kV BC – 1 • 220 kV TBC – 1 • 132 kV TBC – 1 • 110 MVAR, 765 kV, 1-ph reactor (spare unit)-1 • 80 MVAR, 765 kV, 1-ph reactor (spare unit)-1
2.	Mandsaur – Kurawar 765 kV D/c line	Route length: 235 km
3.	240 MVAr switchable line reactors on each ckt at both ends of Mandsaur – Kurawar 765 kV D/c line	• 240 MVAr, 765 kV switchable line reactor- 4 (2 for Mandsaur end and 2 for Kurawar end) • Switching equipments for 765 kV line reactor- 4 (2 for Mandsaur end and 2 for Kurawar end)
4.	2 nos. of 765 kV line bays at Mandsaur S/s for termination of Mandsaur – Kurawar 765 kV D/c line	• 765 kV line bays – 2 Nos. (for Mandsaur end)
5.	LILO of Indore – Bhopal 765 kV S/c line at Kurawar	LILO route length: 15 km.
6.	Kurawar – Ashtha 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	Route length: 65 km
7.	2 nos. of 400 kV line bays at Ashtha (MP) S/s for termination of Kurawar – Ashtha 400 kV D/c line	400 kV line bays – 2 Nos. [for Ashtha (MP) end]
8.	LILO of one circuit of Indore – Itarsi 400 kV D/c line at Astha	LILO route length: 30 km
9.	2 nos. of 400 kV line bays at Ashtha (MP) S/s for LILO of one circuit of Indore – Itarsi 400 kV D/c line at Astha	400 kV line bays – 2 Nos. (for Ashtha (MP) end)
10.	Shujalpur – Kurawar 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	Route length: 40 km
11.	2 nos. of 400 kV line bays at Shujalpur(PG) S/s for termination of Shujalpur – Kurawar 400 kV D/c line	400 kV line bays – 2 Nos. [for Shujalpur(PG) end]

Part H2

Detailed scope of Part H2 of the scheme is given below:

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
1.	Provision of NGR bypass arrangement and inter tripping scheme on 240 MVAr Switchable Line Reactor at Bhopal end of Kurawar – Bhopal 765 kV S/c line (~Route length: 60 km)	NGR bypass arrangement and inter tripping scheme (Bhopal end)

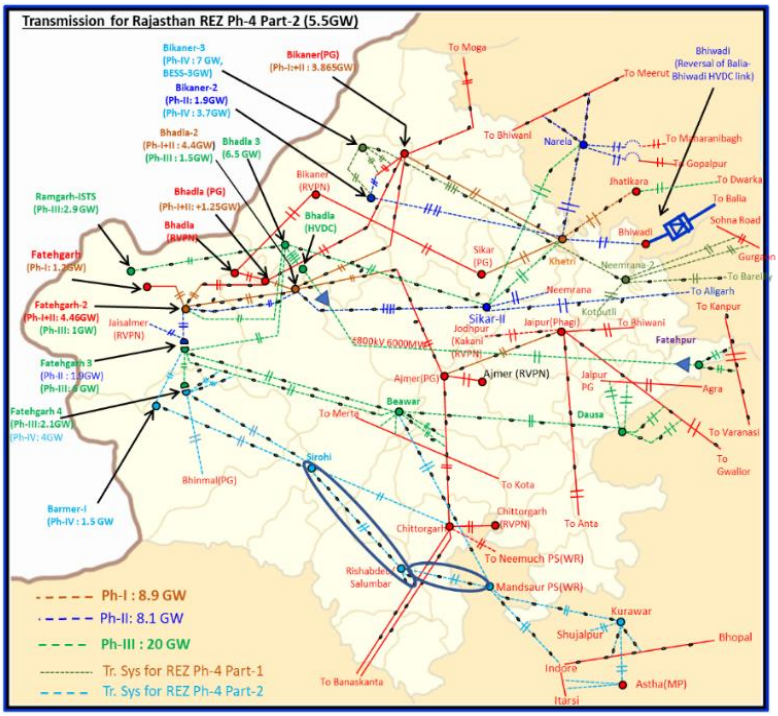


Figure 4-2: Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5GW) (Jaisalmer/Barmer Complex)

c. Transmission system strengthening for interconnections of Bhadla-III & Bikaner-III complex

Comprehensive Transmission scheme for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex) is under bidding for power transfer of 7.7GW incl. 4GW from Bikaner-III PS. The scheme comprises 765kV EHVAC corridor from Bikaner-III PS towards load centers of Delhi/UP. About 0.85 GW connectivity application granted/received at Bikaner-III PS (out of which few applications may be shifted at Bikaner-II PS to utilize vacated margin of about 0.675 GW at Bikaner-II PS in GNA). In view of that about 0.25GW RE applications will be available at Bikaner-III PS against 4GW RE evacuation capacity.

As part of Rajasthan REZ Ph-III (20GW) Transmission scheme, Bhadla-III & Ramgarh PS are being established for integration of 6.5GW & 2.9 GW RE potential respectively.

Ramgarh PS is also being inter-connected with Bhadla-III for evacuation of RE power. In order to facilitate evacuation of 9.4GW RE power from Ramgarh/Bhadla-III PS (6.5GW+2.9GW) from Bhadla-III onwards, 765kV Bhadla-III - Sikar-II D/c line [for about 2.9GW power transfer requirement] as well as 6GW HVDC corridor (±800kV Bhadla (HVDC) -Fatehpur(HVDC)) is being implemented as part of Ph-III scheme.

Accordingly, 765kV Bhadla-III - Bikaner-III D/c line is proposed to facilitate optimal utilization of EHVAC corridor beyond Bikaner-III PS for evacuation of RE generation including at Ramgarh/Bhadla-III PS. Further, as part of committee report "Transmission system for integration of over 500GW capacity by 2030" as well as MNRE/SECI inputs, a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan is evolved comprising 10 GW RE potential (Wind: 4 GW, Solar: 6 GW) along with 3GW BESS(net evacuation 5 GW) at Ramgarh in Jaisalmer complex by 2030. Out of 10 GW potential by 2030, in its Ph-I (by 2025) 3GW potential (Wind: 2GW, Solar: 1GW) was informed at Ramgarh. As part of above committee report, additional 3 GW RE injection at Ramgarh PS and 2GW RE injection at Bhadla-III/Bhadla-IV PS is envisaged beyond 2025 (Ph-II/III), which will utilize the planned HVDC corridor beyond Bhadla-3 as it will match implementation schedule of generation and transmission i.e. in 2026-27 timeframe.

GIB committee clearance is still pending for 400kV Fatehgarh-ll- Bhadla-lll D/c line under Ph-lll Part-B1 package as above line is emanating from Fatehgarh-ll PS, which is falling under GIB core area and adversely impacting progress of other linked packages. Accordingly, it was directed that process of delinking of 400kV Fatehgarh-ll- Bhadla-lll D/c line from Ph-lll Part-B1 may be carried out at the earliest and a separate package may be formed comprising this line. It is understood that RE developers are also facing challenges in getting DTL clearance from GIB committee at Fatehgarh-II PS. Deferment of 400kV Fatehgarh-ll- Bhadla-lll D/c line will also reduce the SCR at Bhadla-III PS/Bhadla HVDC which is already at boarder line. Therefore,765kV Bhadla-III PS - Bikaner-III PS D/c line shall also provide additional advantage to improve short circuit strength in Bhadla-III complex including for LCC HVDC terminal at Bhadla.

System studies were carried out under various scenarios considering 765 kV Bhadla-III – Bikaner-III D/c tie interconnection and study files were also circulated on 25.05.23. From the study results, it was observed that line loading with proposed strengthening is in order in normal as well as N-1 contingency condition. It is also observed that in Feb solar maximized scenario (revised case), loading of 400kV RAPS-Shujalpur D/c line is marginally higher (about 900MW) in N-1 contingency. Additionally loading of 765/400kV Bareilly ICT (2X1500MVA) is marginally higher in some scenarios (n-1:1550MW). The loading of the above line and ICT will be reviewed with progress of RE generation projects at Rajasthan and strengthening requirement will be identified later, if required. Further, short circuit level at Bikaner-III PS is also within limits (765kV-29.3kA ,400kV- 55kA, 220kV-24.3 kA) with proposed strengthening.

In view of the above considerations, 765 kV Bhadla-III – Bikaner-III D/c tie interconnection shall provide following advantages:

- Optimal utilization of EHVAC transmission system beyond Bikaner-III PS while providing flexibility of power transfer from Bhadla/Bikaner RE clusters
- Additional evacuation requirement from future RE generation of 181.5 GW (Ph-1/2) RE potential at Ramgarh/Bhadla-III (2 GW)
- Meeting evacuation requirement from Bhadla-III PS onwards for same RE generators coming up in 2025-26.
- Improves SCR in Bhadla-III complex including for LCC HVDC terminal at Bhadla
- Tie connection will also increase resiliency of transmission corridor in both the complexes i.e. Bhadla & Bikaner

The transmission scheme was discussed and agreed in the 67th NRPC meeting held on 30.06.23. The scheme was approved in 15th NCT meeting and is under bidding with tentative implementation timeframe of 24 months. Details of the scheme is as under

- 765 kV Bhadla-III – Bikaner-III D/c line along with 240 MVAr switchable line reactor for each circuit at Bhadla-III end (~150 km)

Estimated Cost : Rs 1382 Cr

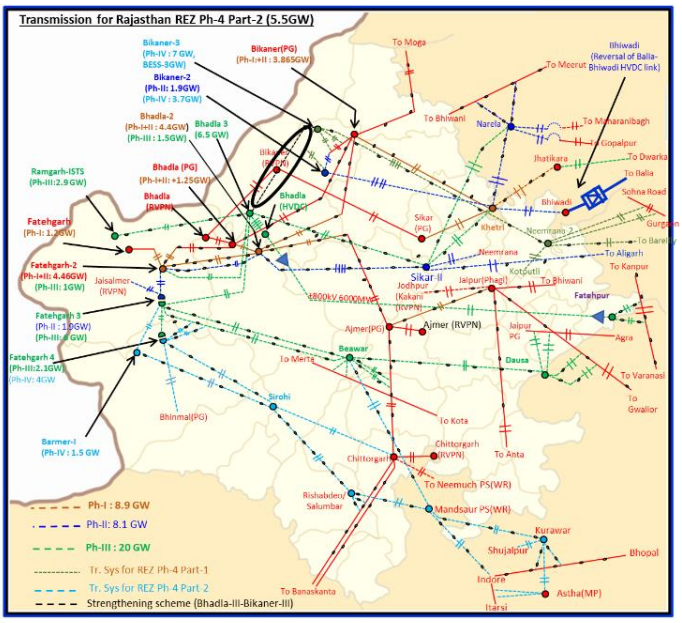


Figure 4-3: Transmission system strengthening for interconnection of Bhadla-III & Bikaner-III complex

d. Augmentation of transformation capacity at 400/220kV Bikaner-II PS by 400/220kV, 1x500 MVA ICT (3rd)

The scheme comprises augmentation of 400/220 kV, 1x500 MVA (3rd) ICT at 400/220 kV Bikaner-II PS. In the 1st Meeting of CTU Committee on Transmission Projects (CCTP) held on 15.11.2021, 2 no. of 400/220kV 500 MVA ICTs at Bikaner-II PS for evacuation of power from RE projects were approved.

It was informed that for 3785 MW connectivity granted at Bikaner-II PS (220kV), all applicants have opted for transition under GNA. Accordingly, there is a need to take up immediate evacuation system (ICTs) on an urgent basis. Further, as per the latest schedule

provided by applicants at Bikaner-II PS in GNA transition/JCC meeting, cumulative capacity of 3435MW is expected to be commissioned by Dec'24 and 150 MW scheduled for commission in Jan'25 thus makes the total quantum 3585MW by Jan'25. Balance 200 MW will commission afterwards (Mar'25 onwards). Accordingly, considering 2 nos. under implementation ICTs, 5 nos. additional ICT are required by Dec'24 and one no. by Jan'25. CCTP opined that though the process of transition of connectivity/LTA involves signing of agreements & submission of requisite bank guarantees (BGs) by the applicants in stipulated timelines, this may take 2 to 3 months to complete. It is to mention that ICT implementation takes a minimum of 18 months. Considering RE generation schedule informed by RE applicants, 6x500MVA, 400/220kV ICTs need to be taken up on an urgent basis without waiting for completion of process such as agreement signing, BG submission.

It was also informed that 5x500 MVA ICTs at Bikaner-II PS were already approved in the 9th NCT meeting held on 28.09.2022. The same was allocated to Powergrid Bikaner Transmission system Ltd. vide NCT letter dated 15.11.2022 with the condition that the implementation of ICTs is to be taken up for evacuation requirement beyond 2000 MW at 220 kV level of Bikaner-II PS, with implementation timeframe matching with schedule of RE generation or 18 months from date of allocation, whichever is later. Since at that time, LTA was much less than 2000MW, above condition didn't trigger, whereas in May'23, upon GNA transition, ICT requirement is arising. In view of the above deliberations, CCTP opined that implementation of 1 no. of 500 MVA (3rd), 400/220 kV ICT at Bikaner-II PS is to be taken up on urgent basis to facilitate evacuation of RE power from Bikaner-II PS.

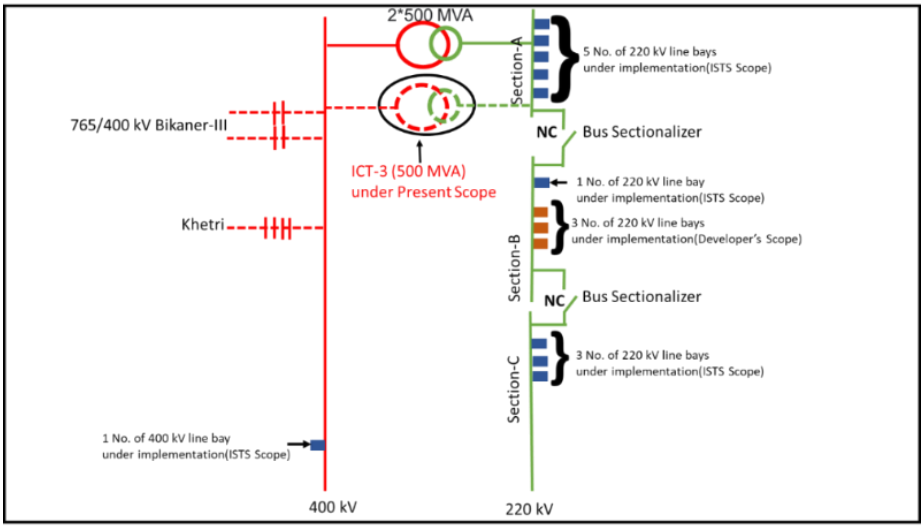


Figure 4-4: Schematic of 400/220 kV Bikaner-II PS

The scheme is under implementation with following details:

Augmentation of transformation capacity at 400/220 kV Bikaner-II PS by 400/220kV, 1x500 MVA ICT (3rd)

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	Augmentation of transformation capacity at 400/220kV Bikaner-II PS by 400/220 kV, 1x500 MVA (3rd) ICT along with associated transformer bays* *1 no. of 400kV (AIS) (including associated tie bay) and 1 no. of 220kV (AIS) transformer bay.	• 500 MVA, 400/220 kV ICT–1 no. • 400 kV ICT bay (including associated tie bay)– 1 no. • 220 kV ICT bay – 1 no.	18 months from the issue of OM by CTUIL.
		Total Estimated Cost:	**₹ 55.82 Crore**

e. Requirement of one set of Bus Sectionalizer at 220kV level of 400/220kV Fatehgarh-IV PS (Section-1)

Transmission system for evacuation of power from REZ in Rajasthan (20GW) under Phase-III was discussed in 3rd meeting of NRPC(TP) held on 19.02.2021. The scheme was recommended for implementation through TBCB in the 5th meeting of NCT held on 25.08.2021 and 02.09.2021. The modified Ph-III, Part A1 scheme comprised of 400/220kV 5x500MVA ICTs and 7 nos. of 220kV line bays for RE connectivity in the present scheme.

At present 2345 MW connectivity on 7 nos. of 220kV line bays were granted/agreed for grant at 220kV level of Fatehgarh-IV (Sec-1) (under implementation in Ph-III Part A1 scheme). In view of technical limitation on onward evacuation system through 400 kV Fatehgarh-IV- Fatehgarh-III (twin HLTS) D/c line(min. 2100 MVA/ckt), 2025 MW capacity (on 6 nos. of 220kV line bays) shall be evacuated through Phase-III scheme (Part A1 and other Ph-III elements) and balance 320MW capacity on 7th 220kV line bay shall be evacuated through Fatehgarh-IV (Sec-2) & associated transmission system as part of Ph-IV (Part-2 :5.5GW) scheme, which was recently approved in 14th NCT meeting. Considering above a bus sectionalizer is required at 220kV level of 400/220kV Fatehgarh-IV PS (Section-1) for reliable evacuation of RE power from Fatehgarh-IV PS (Sec-1).

CEA enquired about evacuation of power from generation project in case the generation granted connectivity at 7th bay comes up before Fatehgarh-IV PS (Sec-2) & its onward system. Regarding this, it was informed that for the generation project to be granted connectivity at 7th 220kV bay, the transmission system for Connectivity under GNA shall include Fatehgarh-IV (Sec-II) & associated Phase-IV (Part-2) transmission system. Therefore, the evacuation in case of early commissioning of generation project shall be as per 22.4 of GNA Regulations through deemed T-GNA from Section-I and associated Ph-III System subject to availability of margins.

In view of above deliberations, following ISTS scheme was agreed:

- One set of bus sectionalizer at 220kV level of 400/220kV Fatehgarh-IV PS (Section-1)

The scheme is under implementation with following details:

Scope of work along with tentative Cost and Implementation time-frame

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	One set of bus sectionalizer at 220kV level of 400/220kV Fatehgarh-IV PS (Section-1)	220 kV Bus sectionalizer – 1 no.	01/02/25
		Total Estimated Cost:	**INR 11.74 Crore**

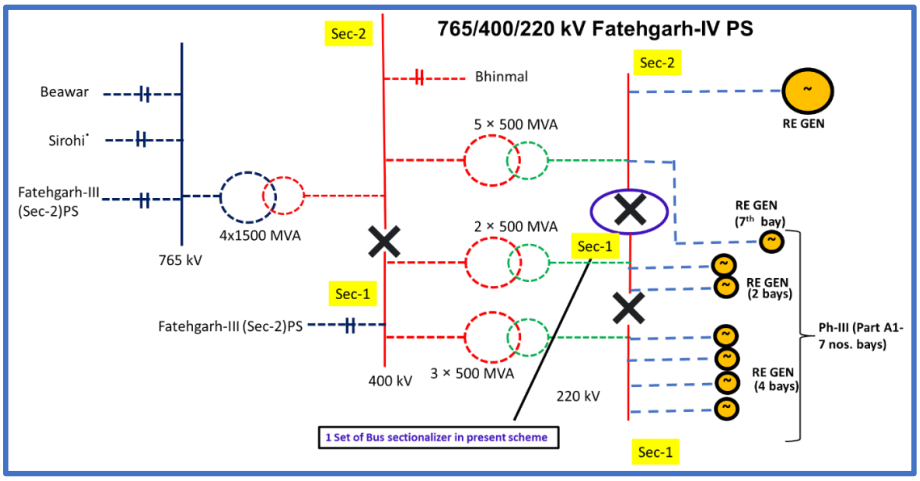


Figure 4-5: Schematic of 765/400/220kV Fatehgarh-IV S/s

f. Augmentation of 5th ICT at Fatehgarh-III PS (Section-1)

Transmission System Strengthening for potential solar energy zones Phase-II in Northern Region for 8.1 GW was discussed and agreed in the 5th Meeting of Northern Region Standing Committee on Transmission (NRSCT) held on 13.09.2019. Subsequently, the scheme was approved in the 6th meeting of National Committee on Transmission (NCT) held on 30.09.2019. As part the above scheme, Ph-II Part-A involved establishment of 4x500 MVA Ramgarh PS (now Fatehgarh-III PS (sec-1)) along with 400 kV D/c lines towards Fatehgarh-II PS & Jaisalmer-II (RVPN) S/s.

Subsequently, as part of Transmission system for evacuation of power from REZ in Rajasthan under Phase-III (20GW), augmentation of 5th ICT at Fatehgarh-III PS(Sec-1) was discussed and agreed in the 3rd NRPC(TP) held on 19.02.2021. Further, the 5th ICT at Fatehgarh-III PS(Sec-1) was taken up for discussion and approval in the 5th NCT meeting held on 25.08.2021 and 02.09.2021 as part of Ph-III Part-J scheme.

However, in the 5th NCT meeting, it was opined that one of the pilot project of Battery Storage System of 250 MW is being planned at perspective location near Fatehgarh-3, therefore there might be a possibility that the 5th ICT of 500 MVA at Fatehgarh-III PS(Sec1) may not be required and hence this item needs to be reviewed. Accordingly, the Augmentation of ICT(5th) at Fatehgarh-III PS (Sec1) was deferred in the 5th NCT meeting. Subsequently, in the manual on Transmission Planning Criteria 2023 by CEA published in March 2023, it is mentioned that 'N-1' reliability criteria may be considered for ICTs at the ISTS /STU pooling stations for renewable energy-based generation of more than 1000 MW after considering the capacity factor of renewable generating stations. Cumulative

connectivity quantum of 2280 MW was granted at Fatehgarh-III PS(Sec-1). Recently, 300 MW has been surrendered in GNA Transition process. The remaining connectivity granted at Fatehgarh-III PS is 1980 MW. Therefore, to satisfy N-1 reliability criteria at 400/220 kV Fatehgarh-III PS(Section-1), it is necessary to take up augmentation of 5th ICT at Fatehgarh-III PS(Sec-1) is required.

In meeting SECI queried that requirement of Augmentation of 5th ICT at Fatehgarh-III PS(Section-1) is due to BESS. CTU stated that this ICT augmentation is not for BESS, it is for requirement to meet the N-1 compliance as per CEA Transmission Planning Criteria 2023. SECI also queried regarding 220kV line bays for this ICT augmentation, it was stated that for this ICT augmentation requires separate transformer bays.

SECI enquired about revision of RE capacity of 1980MW from earlier granted 2280MW capacity at Fatehgarh-III PS(Section-1). CTU stated that earlier 2280MW connectivity allocated to RE applicants at Fatehgarh-III PS(Section-1) against potential of 1.98GW in Ph-II. However, in view of surrendered capacity (300MW) at Fatehgarh-III PS(Section-1) and new N-1 compliance requirement as per CEA Transmission Planning Criteria 2023, RE connectivity at Fatehgarh-III PS(Section-1) allocated to 1980MW.

In view of above deliberations, following ISTS scheme was agreed:

- Augmentation of 400/220 kV ,1x500 MVA (5th) ICT at Fatehgarh-III PS(Section-1) along with transformer bays

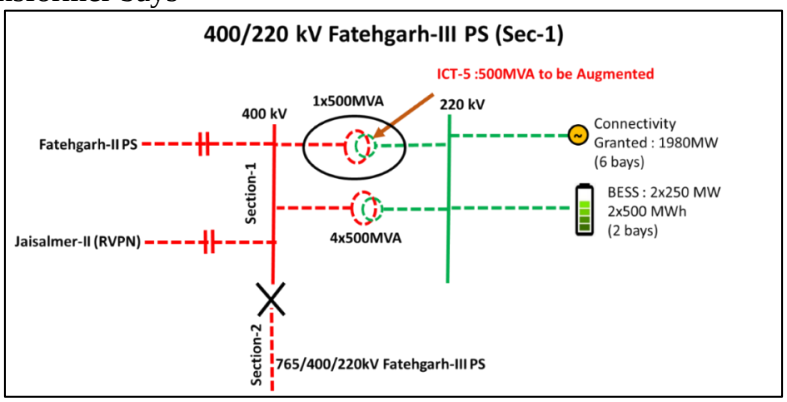


Figure 4-6: Schematic of 400/220kV Fatehgarh-III PS (Sec-I)

The scheme is under implementation with following details

Scope of work along with tentative Cost and Implementation time-frame

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	Augmentation with 400/220kV, 1x500MVA Transformer at Fatehgarh-III PS (5th ICT at Section-1) along with associated transformer bays* *1 no. of 400kV (AIS) (including associated tie bay) and 1 no. of 220kV (AIS) transformer bay	• 500 MVA 400/220 kV ICT– 1no. • 400 kV ICT bay (including associated tie bay) – 1 no.	18 months from the date of issue of OM by CTUIL

		• 220 kV ICT bay – 1 no	
		Total Estimated Cost:	**INR 58.18 Crore**

g. Requirement of one set of Bus Sectionalizer at 400kV level of 400/220kV Bikaner-II PS

Transmission system strengthening scheme for evacuation of power from solar energy zones in Rajasthan (8.1 GW) under Phase-II" was discussed in 4th meeting of NRSCT held on 25.07.19 and recommended for implementation through TBCB in the 6th meeting of erstwhile NCT held on 30.09.2019. As part of above, Ph-II, Part F scheme was modified in 4th NCT meeting held on 20.01.20 and 28.01.20 (deletion of 400/220 kV ICTs at Bikaner-II PS from approved scope).

2 nos. of 500MVA ICTs (1st & 2nd) and 1 no. of 500 MVA ICT (3rd) at Bikaner-II PS) is under implementation. Further, Augmentation by 400/220 kV, 5x500 MVA ICT (4th to 8th) at Bikaner-II PS was agreed for implementation as part of transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex)-Part E. As per NCT letter, above ICTs were to be taken up for evacuation requirement beyond 2000 MW at 220 kV level of Bikaner-II PS, with implementation timeframe matching with schedule of RE generation or 18 months from date of allocation, whichever is later. Subsequently, CTU vide mail 13.06.23 informed to POWERGRID for take up implementation of 5x500 MVA ICTs (4th to 8th) at Bikaner-II PS with implementation schedule of Dec'24 (4th to 7th) and Jan'25 (8th) after meeting the requirement specified in NCT letter dated 15.11.22.

POWERGRID vide letter dated 27.06.23 informed that 400kV bus sectionalizer (bays 428 &429) at Bikaner-II PS may be required after ICT-5 for taking up implementation of ICT-6th to 8th. It was also informed that in absence of 400kV bus sectionalizer bays, integration of existing 400kV section bus bar protection system & new bus bar protection system shall not be feasible. In view of the above, one set of sectionalizer at 400kV level of 400/220kV Bikaner-II PS is required.

Further, it was deliberated that tie one no. of 400kV tie bay (associated with 400/220kV ICT-4) shall also be required. In view of above deliberations, following ISTS scheme was agreed:

- One set of bus sectionalizer at 400kV level of 400/220kV Bikaner-II PS
- One no. of 400kV tie bay (associated with 400/220kV ICT-4 as per approved SLD)

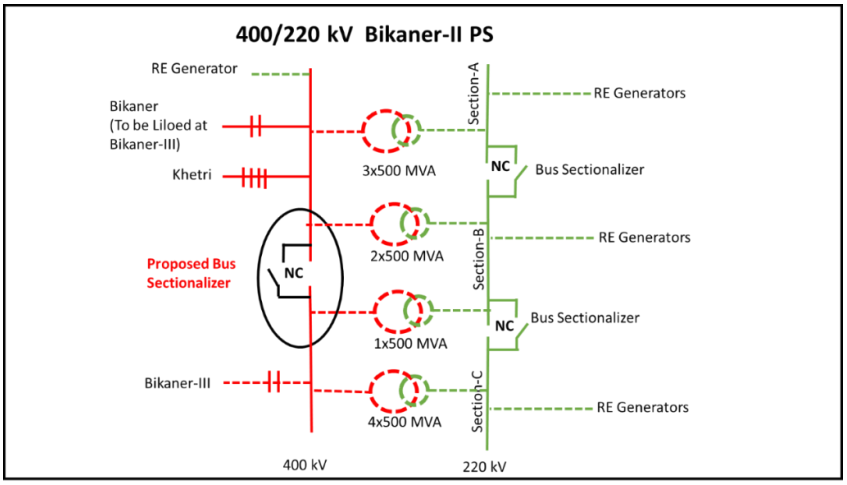


Figure 4-7: Schematic of 400/220kV Bikaner-II PS

The scheme is under implementation with following details:

Scope of work along with tentative Cost and Implementation time-frame

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	• One set of bus sectionalizer at 400kV level of 400/220kV Bikaner-II PS • One no. of 400kV tie bay (associated with 400/220kV ICT4)	• 400kV Bus sectionalizer– 1 no. • 400kV tie bay–1 no	Matching with implementation of 400/220kV ICTs (4th to 7th) i.e., Dec'24
		Total Estimated Cost:	**INR 28 Crore**

h. Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220kV Kankroli substation

At present, 400/220 kV Kankroli(PG) S/s is having transformation capacity of 3x315 MVA 400/220 kV ICTs and Connectivity was earlier granted to M/s Hindustan Zinc Limited as a Bulk Consumer during the 14th CMETS-NR meeting held on 23/12/2022.

Further during the 17th CMETS-NR meeting held on 31/03/2023, two nos. of LTA applications from M/s Serentica Renewables India 4 Private Limited, for 100 MW each, with injection point as Kallam substation (WR), for which M/s HZL was the drawee entity (as a Bulk Consumer) at Kankroli ISTS 400/220 kV substation were also discussed. In the meeting it was deliberated that based on the NRLDC inputs & CTUIL studies, considering the peak load of Kankroli complex, loading of Kankroli ICTs are observed to be N-1 non-compliant with drawl of above load (200 MW) and need of 1 No. of 500 MVA ICT (4th) ICT augmentation at Kankroli S/s for such drawl of power emerged.

In above meeting, following transmission system was agreed for drawl of power of 200 MW:

- 1x500 MVA.400/220kV ICT (4th) at Kankroli S/s along with associated 220kV bay
- Shifting of existing 50 MVAr Bus reactor [so as to accommodate ICT] and development of bay for reactor
- Extension of 220 kV side of ICT through 220kV Cable/GIB

Subsequently, in the 19th Consultation meeting for Evolving Transmission Schemes in NR held on 31.05.23, GNA for 200 MW (drawl of power from Kankroli (PG) S/s was agreed for grant to M/s HZL, upon completion of GNA Transition process as per the GNA Regulations. In the meeting it was deliberated that as per the present studies, 140 MW (out of 200MW load of M/s HZL) may be drawn with the existing transmission system and for the balance (60 MW) of quantum, 1x500 MVA.400/220kV ICT (4th) at Kankroli S/s shall be required. Accordingly, M/s HZL informed that they may seek effectiveness of GNA for Part quantum in future (as per GNA regulation), based on availability of margin at that time without availability of 4th 400/220 ICT at Kankroli. However, full GNA quantum shall be made effective only with the commissioning of required 1 No. of 400/220 kV ICT at Kankroli (ISTS) S/s (GNARE schedule of M/s HZL: Jul'24). Implementation of above ICT needs to be taken after completion of GNA transition process of M/s HZL.

RVPN vide letter 27.06.23 submitted the intra state proposal to CEA/CTU for creation of 220 kV GSS Nathdwara (Upgradation) substation along with associated transmission system incl. Nathdwara – Kankroli (PG) 220kV D/c line. Regarding this, CTU informed that, with agreed grant to M/s HZL, there will be no additional margin available in Kankroli (PG) ICTs for drawl of power and ICTs may become N-1 non-compliant in peak load condition (in Kankroli complex), therefore augmentation of ICT is also required for transfer of power to Nathdwara S/s through 220kV Nathdwara -Kankroli D/c line.

Further, CTU also requested RVPN to provide firm schedule of above intra state scheme so that approval of 400/220kV Kankroli ICT may be taken up. CEA in consultation with CTU & Grid-India agreed for the proposal and same was communicated vide CEA letter to RVPN on 31.08.23. In the letter it was also informed that RVPN shall furnish the firm schedule for implementation of above proposal so that 400/220 kV, 500MVA ICT augmentation (4th) at Kankroli (PGCIL) substation may be taken up accordingly.

RVPN vide letter dated 05.09.23 informed that tender for implementation of 220kV GSS Nathdwara (upgradation) along with its associated transmission system have been floated. The techno commercial bids shall be opened on 05.09.23 and the completion period is 18 months from the date of LOA. RVPN may update the status of award.

In 23rd CMETS-NR meeting held on 29.08.23, GNA application of M/s HZL was deliberated. In the meeting it was decided that as the ICT augmentation at Kankroli(PG) shall cater to load of HZL as well as future incremental drawl requirement of RVPN from existing as well as future(Nathdwara)system, the augmentation of ICT shall be considered as common augmentation and shall be under ISTS.

In view of above deliberations, following ICT augmentation scheme was proposed in ISTS:

- 1x500 MVA.400/220kV ICT (4th) at Kankroli S/s along with associated 220kV bay
- Shifting of existing 50 MVAr Bus reactor [so as to accommodate ICT] and development of bay for reactor
- Extension of 220 kV side of ICT through 220kV Cable/GIB

RVPN informed that for the Nathdwara transmission system tender (completion schedule is 18 months from award), Technical bids were opened on 5th Sep 2023 and the price bids are expected to be opened shortly and the. CTUIL informed that the implementation of ICT at Kankroli shall also take minimum 18 months from award. RVPN opined that since the award of Nathdwara system may take some time, it is recommended to consider Kankroli ICT for implementation after Nathdwara is awarded. RVPN informed that they will be in a position to confirm the same in the first week of October'23. CTUIL asked RVPN to inform the updated status at the earliest as ICT is required both for HZL as well as Nathdwara drawl.

Grid India stated that technically the proposal is in order. Accordingly, it was decided that implementation of ICT shall be taken up upon award of Nathdwara system by RVPN or submission of requisite Conn BGs by HZL for transition of 200 MW application as bulk consumer whichever is earlier. RVPN also asked about the financial implications of the ICT augmentation at Kankroli as it shall cater to load of HZL as well as RVPN. Regarding this, CTUIL informed that treatment shall be as per the sharing regulations.

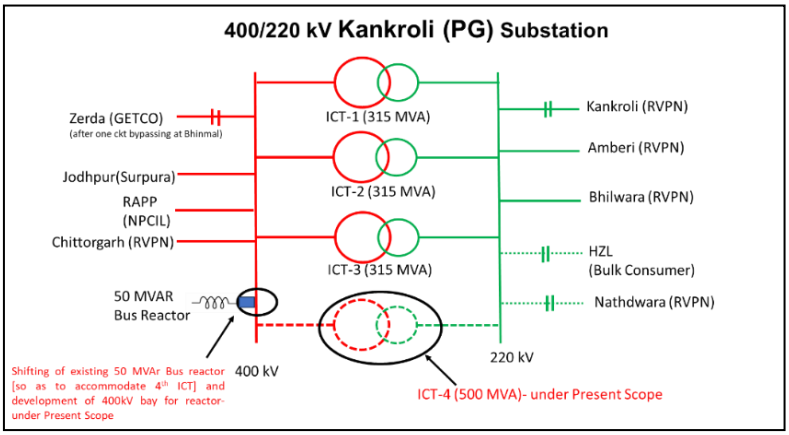


Figure 4-8: Schematic of 400/220kV Kankroli (PG) Substation

In view of above deliberations, following ICT augmentation scheme was agreed under ISTS:

Detailed scope of work for implementation:

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	Augmentation of 1x500 MVA 400/220 kV ICT(4th) at Kankroli (PG) S/s along with associated 220 kV transformer bay*	500 MVA, 400/220 kV ICT- 1 no. 220 kV ICT bay – 1 no	18 months from allocation

	*incl. extension of 220 kV side of ICT through 220 kV Cable/GIB		
2	Shifting of existing 50 MVAr Bus reactor [so as to accommodate 4th ICT] and development of 400kV bay for reactor	400kV bay for existing 50 MVAr Bus Reactor – 1 no	
		Total Estimated Cost:	**INR 59.55 Crore**

i. Requirement of 1x80 MVAr (1-Ph) spare reactor unit at Beawar S/s under Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/ Barmer Complex): Part D scheme

Transmission system for Renewable Energy Zones in Rajasthan Ph-IV(Part-2 :5.5GW) scheme was approved in the 14th NCT held on 09.06.2023. Part-D of this scheme involves implementation of Beawar- Mandsaur PS 765 kV D/c line along with 240 MVAR switchable line reactor for each circuit at each end. 765/400kV Beawar substation is being established under Phase-III Part-F scheme along associated with 330 MVAr line reactor(s) & bus reactors. As there is no 80MVAr spare Reactor (1-ph) available at Beawar substation in Ph-III Part-F scheme, it was proposed to consider 1x80 MVAr (1-ph) spare Reactor at Beawar end under Ph-IV Part-D scheme. Same was agreed in the 14th NCT meeting.

j. Transmission system strengthening to facilitate evacuation of power from Bhadla/Bikaner complex

Comprehensive Transmission scheme for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex) is under implementation for power transfer of 7.7GW incl. 4GW from Bikaner-III PS. The scheme comprises 765kV EHVAC corridor from Bikaner-III PS towards load centers of Delhi/UP. As part of the above scheme, 765 kV Bikaner-III -Neemrana 2xD/c and Neemrana-II – Bareilly (PG) D/c lines are being implemented.

Further, as part of Rajasthan REZ Ph-III (20GW) Transmission scheme, Bhadla-III & Ramgarh PS are being established for integration of 6.5GW & 2.9 GW RE potential respectively. Ramgarh PS is also being inter-connected with Bhadla-III for evacuation of RE power. In order to facilitate evacuation of 9.4GW RE power from Ramgarh/Bhadla-III PS (6.5GW+2.9GW) from Bhadla-III onwards, 765kV Bhadla-III - Sikar-II D/c line with implementation schedule of Mar'25 [for about 2.9GW power transfer requirement] as well as 6GW HVDC corridor (+800kV Bhadla (HVDC) -Fatehpur (HVDC)) with implementation schedule of Feb'28 (Pole-1) & Aug'28 (Pole-2) is being implemented as part of Ph-III scheme

Accordingly, in 19th CMETS-NR meeting, 765kV Bhadla-III - Bikaner-III D/c line was agreed to meet evacuation requirement from Bhadla-III PS onwards for some RE generators coming up in 2025-26 as well as Optimal utilization of EHVAC transmission system beyond Bikaner-III PS while providing flexibility of power transfer from Bhadla/Bikaner RE clusters. The scheme is under bidding.

To facilitate above evacuation of power as well as to meet N-1 criteria (beyond 765kV Bareilly S/s), additional 400 kV corridor i.e. 400kV Bareilly(765/400kV) – Bareilly(PG) D/c line (Quad) (2nd) along with augmentation with 1x1500 MVA, 765/400 kV ICT at Bareilly (765/400kV) S/s (3rd) is proposed. The above strengthening scheme is also included as part of connectivity system of various RE applications granted at Bikaner-III.

CEA agreed for the proposal, however they enquired about short circuit of 400kV Bareilly(765/400kV) & Bareilly(PG) S/s. CTU stated that short circuit level of 400kV Bareilly(765/400kV) is about 52kA (designed capacity:50 kA) & 400kV Bareilly(PG) S/s is about 51kA (designed capacity: 40 kA), however with above proposed scheme short circuit level increase marginally (1-2kA) on both the substations. CTU stated that to reduce short circuit level of various substation in NR, wherein short circuit level is already high (from designed capacity), measures will be taken as part of comprehensive scheme in a phased manner. Grid India stated that scheme is agreeable and they do not have any comment on above scheme.

POWERGRID vide mail 21.01.23 confirmed the space availability for 765/400kV ICT (3rd) at Bareilly (PG) (765/400kV) as well as 2 nos. of 400kV line bays each at Bareilly (PG) (765/400kV) and Bareilly (PG) (400kV). In view of that following transmission system strengthening was agreed to facilitate evacuation of power as well as to meet N-1 criteria (beyond 765kV Bareilly) in ISTS

- 400 kV Bareilly(765/400kV) – Bareilly(PG) D/c line (Quad) (2nd) (~4 km)
- Augmentation with 1x1500 MVA, 765/400 kV ICT(3rd) at Bareilly (765/400kV) S/s

Implementation Schedule: 18 months from allocation

The scheme is under approval with NCT.

k. Additional Transmission system for evacuation of power from Bhadla-III PS as part of Rajasthan REZ Phase-III scheme (20GW)

Transmission System requirement for additional 20 GW REZ in Northern Region (Phase-III) was approved in 5th NCT meeting held on 25.08.21 & 02.09.21. As part of the above scheme, establishment of 765/400/220kV Bhadla-III PS (765/400kV : 2x1500MVA, 400/220kV : 3x500MVA) was approved in Phase-III Part B1 package, which is under implementation. Further, 7x500MVA ICTs (incl. 10 nos. of 220kV line bays & 220kV sectionalizer was also approved) under RTM in Phase-III Part B1 package with following condition.

- The implementation of number of 220 kV bays and 400/220 kV transformers to be taken up based on receipt of stage-II connectivity and commensurate LTA respectively (beyond 1500 MW at Bhadla-III).
- 220 kV line bays and Transformer augmentations shall be reviewed based on stage-II connectivity at 220 kV voltage level and LTA applications respectively.

Further, connectivity application of about 7GW (against potential of 6.5GW) is already received at Bhadla-III PS, out of which 6.5GW is already granted/agreed for grant. Out of above RE application of about 3GW (400kV - 1GW, 220kV- 2GW) is granted through EHVAC system (Sch. Progressively from Mar'25) and balance 3.5GW is being granted on HVDC system (Expected Sch.: Feb'28) at Bhadla-III PS.

It was stated that with fulfilment of connectivity grant process (Intimation, BGs etc.), a total of 5 nos. of 400/220kV ICTs are required, out of which 3 nos. ICTs already under implementation (Ph-III Part B1). Therefore balance 2 nos. ICTs (4th & 5th) are required with 18 months schedule considering RE generation schedule. Further, a total of 4 nos. of 765/400kV ICTs are also required, out of which 2 nos. 765/400kV ICTs (Ph-III Part B1) are already under implementation. Additionally, 2 nos. of 765/400kV ICTs (3rd & 4th) are required (ICT-3:18 months (best effort Jun'25) & ICT-4: Dec'25) considering about 3-3.5GW power evacuation requirement from envisaged Bhadla-III PSas well as power flow through 400kV Fatehgarh-III- Bhadla-III PS D/c line. The above ICTs (765/400kV & 400/220kV) at Bhadla-III are also considered as part of connectivity transmission system for RE projects. Additionally, total 5 nos. of 220kV line bays are already under implementation in ISTS (Ph-III Part B1) which is sufficient at present.

CEA enquired about utilization of 765/400kV ICTs (3rd & 4th) after commissioning of Bhadla-Fatehpur HVDC System. CTU stated that due to time gap (about 3 years) in implementation time of EHVAC and HVDC system, ICTs would be required. Optimal utilization of 765/400kV ICTs may be planned with other future RE schemes from Bhadla-IV PS or other system strengthening schemes. CEA enquired that whether more power can be evacuated from Bhadla-III PS beyond 6.5GW identified potential. CTU stated that beyond 6.5GW, connectivity will be granted at Bhadla-IV PS on HVDC system for which system is under planning. It is not recommended to inject more generation at Bhadla-III PS, due to very less margin availability in Bhadla-III onwards EHVAC system. CEA & Grid-India agreed for proposal.

In view of deliberations held in the meeting, the following transmission system is agreed in ISTS.

- Augmentation of 2x500 MVA (4th & 5th) 400/220 kV ICTs at Bhadla-III PS
- 220 kV bus sectionalizer (1 set) along with 220kV BC (1 no.) bay and 220kV TBC (1 no.) bay at Bhadla-III PS
- Augmentation of 2x1500 MVA 765/400kV (3rd & 4th) ICTs at Bhadla-III PS

Implementation Schedule: 18 months from allocation (for S.No 1 & 2) For S.No. 3: ICT-3 : 18 months from allocation (Best effort: Jun'25), ICT-4 : Dec'25 (30.12.25)

The scheme is recently approved in NCT meeting and under bidding

l. Transmission system for evacuation of power from Bikaner & Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part-3 :6GW) and REZ Ph-IV (Part-4 :3.5GW) respectively

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 75 GW 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 was 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	Awarded
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 Bidding
3	Rajasthan REZ Ph-IV (Part-3:3.6GW) (Bikaner Complex)	3.6 GW (Solar)Bikaner-IV:3.6GW	Under approval with NCT
B	**Planned/Under Planning**		
1	Rajasthan REZ Ph-IV (Part-3a :2.4GW) (Bikaner Complex)	2.4 GW (Solar) Bikaner-IV : 2.4GW	**Scheme planned for 2026-27 time frame (EHVAC)-Present proposal**
2	Rajasthan REZ Ph-IV (Part-4 :3.5GW) (Jaisalmer/Barmer Complex)	3.5 GW (Solar) Fatehgarh-IV: 1 GW Barmer-I: 2.5 GW	
3	Rajasthan REZ Ph-IV (Part-5: 6GW) (Barmer Complex)	6 GW (Solar) Barmer-II : 6GW	**Scheme planned for 2029 time frame (HVDC)**
4	Rajasthan REZ Ph-IV (Part-6: 6GW) (Bhadla/Bikaner Complex)	6 GW (Solar) Bhadla-IV: 2 GW Bikaner-V: 4 GW*	

SECI to confirm total RE potential at Bikaner-V

Joint Study Meeting(s) were held in virtual mode on 28.12.23 and 09.01.24 with SECI, CEA, GRID-INDIA, RVPN, HVPN, PSTCL, UPPTCL and other STUs of Northern region to discuss the Transmission system for evacuation of power from Bikaner Complex as part of Rajasthan REZ Ph-IV (Part-3) scheme.

In 25th CMETS-NR meeting for about 3.6 GW (Solar) as part of Rajasthan REZ Ph-IV (Part-3 :3.6GW) (Bikaner Complex) for injection at Bikaner-IV in Rajasthan. The scheme was approved in 48th TCC/70th NRPC meeting held on 17th -18th Nov'23

Estimated Cost : Rs 8600Cr (Rs 2.4Cr/MW)

Based on subsequent discussions & studies, a comprehensive optimal scheme for 6 GW RE potential (Bikaner) is evolved with lesser cost (Rs 1.9 Cr/MW as compared to earlier Rs 2.4 Cr/MW).

Gist of discussion in Joint study meeting held on 28.12.23

In the meeting, it was stated that at present connectivity of about 6 GW is already agreed/received against its total potential (6GW). As part of EHVAC system, evacuation system is planned for 2.4GW capacity (thus makes total capacity of 6 GW at Bikaner-IV PS). For EHVAC system, studies were carried out in 2026-27 time frame in solar maximized scenario and Study files for solar maximized scenario was shared on 20.12.23 with all constituents. Following transmission scheme is proposed for evacuation of power from Rajasthan REZ Ph-IV (Part-3a :2.4GW) [Bikaner complex]

- Bikaner-IV PS – Churu 765 kV D/c line (2^{nd})
- LILO of other ckt of 765 kV Sikar-II (PG) -Khetri (PG) D/c line at Churu S/s
- Siwani – Sonipat (PG) 400 kV D/c line (Quad Moose)

In the meeting, CEA stated that with Phase-IV Part-3a (2.4GW) proposed scheme, there will be no requirement of 765/400kV Churu S/s & associated interconnections, which were earlier agreed in 25th CMETS-NR meeting as part of Phase-IV Part 3 (3.6GW) scheme.

CEA stated that in the earlier agreed Phase-IV Part 3 (3.6 GW) scheme, Churu S/s & associated transmission scheme (LILO of one ckt of 765 kV Sikar-II (PG) -Khetri (PG) D/c line at Churu S/s and Churu- Fatehabad (PG) 400 kV D/c line) was considered to address issue on synchronization of line after corridor outage (765kV Bikaner-IV-Siwani D/c line) in N-1-1/N-2 in peak solar hours as emphasized by Grid-India. CEA stated that in place of Bikaner-IV – Churu D/c line, a parallel corridor towards Siwani S/s i.e. 765kV Bikaner-IV- Siwani D/c line may be considered for additional 2.4GW evacuation of power as part of scheme. With the above parallel 765kV corridor i.e. 765kV Bikaner-IV – Siwani D/c line, angular stability issue under N-1-1 contingency will be resolved as 4 nos. of 765kV circuits are available towards Siwani S/s. Further in future, if there is requirement of establishment of Churu S/s, Bikaner-IV – Siwani D/c line may be LILOed at Churu S/s.

Further, it was deliberated that Transmission system for evacuation of power from Bikaner Complex as part of Rajasthan REZ Ph-IV (Part-3 :3.6GW) is being taken up for approval in next NCT. In view of that both the schemes viz Ph-IV: Part 3 (3.6GW) & Ph-IV: Part 3a (2.4GW)) may be considered comprehensively for 6GW evacuation.

CTU stated that they will review the proposal based on CEA observations and deliberations in meeting and evaluate various alternatives (with and wo Churu S/s) in a comprehensive manner. Accordingly, the scheme will be further deliberated and finalized in next Joint study meeting.

Gist of discussion in Joint study meeting held on 09.01.24

As per deliberation held in Joint study meeting held on 28.12.23, CTU examined both the proposals as below with two alternatives

- **Alternative-1 :** Bikaner-IV- Churu- Siwani 765kV D/c & Bikaner-IV- Siwani 765kV D/c & associated transmission interconnection at Churu S/s i.e. LILO of one ckt of 765 kV Sikar-II (PG) -Khetri (PG) D/c line at Churu S/s and Churu- Fatehabad (PG) 400 kV D/c line & onwards 400kV transmission system from Siwani S/s (Towards Jind, Patran, Sonipat)
- **Alternative-2:** Bikaner-IV- Siwani 765kV 2xD/c line & onwards 400kV transmission system from Siwani S/s (Towards Jind, Patran, Fatehabad, Sonipat)

It was stated that in place of LILO of one ckt of 765 kV Bikaner-III -Neemrana-II D/c line at Bikaner-IV PS, LILO of both ckts of 400kV Bikaner II- Bikaner-III D/c line (Quad) at Bikaner-IV is proposed which will relieve the ICT loadings at Bikaner(PG) & Bikaner-III PS and increase the operational margin on above ICTs. Additionally, STATCOM at Siwani (+300MVAr) is proposed in Alternate-2 to mitigate low voltage issue.

Further, Observations were received on 04.01.24 from Grid-India and CEA on both the alternatives for transmission system for evacuation of power from Bikaner complex as part of Rajasthan REZ Ph-IV (Part-3).

CTU analysed both the alternatives with above changes and observations are as under:

- **Estimated Cost of scheme is about 12% lower (about Rs 1200 Cr) in Alt-2 than Alt-1**
- In Alt-2, due to longer line length, under N-1 contingency of 765kV Bikaner-IV-Siwani , voltage dipping will be higher (about 10kV than Alt-1) and in the range of 730-740kV considering STATCOM at Bikaner-IV under various operating scenario. In above scenario STATCOM (±300MVAr) at Siwani may also be required (in case of operational difficulty of line reactors switching on EHVAC lines in RE pockets).
- With Alt-2, Churu Substation may be planned with future transmission proposals i.e. Bikaner-V, other strengthening schemes based on requirement. Therefore, RE evacuation from Churu S/s will only be possible at later stage (beyond 2027) in Alt-2.
- Comprehensive scheme for 6GW will be implemented with **tentative timeline of Sep'26 in Alt-2, however in Alt-1 tentative timeline for part scheme (3.6GW) was Jul'26**

Revised study files with proposed changes (LILO of both ckts of 400kV Bikaner II-Bikaner-III D/c line at Bikaner-IV PS in place of LILO of one ckt of 765 kV Bikaner-III -Neemrana-II D/c line at Bikaner-IV PS & Siwani STATCOM (in Alt-2)) was circulated on 06.05.24 along with study plots.

Off peak file were circulated on 13.01.24 to all stakeholders. Considering grant of connectivity to RE generators in Bikaner complex as well as for evacuation of power beyond above complex, transmission scheme was agreed in Joint study meetings (28.12.23 & 09.01.24) as well as in 27th CMETS-NR meeting held on 10.01.24 for evacuation of power from Bikaner Complex as part of Rajasthan REZ Ph-IV (Part-3 : 6 GW). The

transmission scheme was discussed and agreed in the 71st NRPC meeting held on 29.01.24. The scheme is recently approved in NCT meeting.

(a) Rajasthan REZ Ph-IV (Part-3 :6GW) (Bikaner Complex)

A. REZ Ph-IV (Part 3: 6GW) (Bikaner Complex) :Part A (Estimated Cost: Rs 5968.5 Cr)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	➢ Establishment of 6x1500 MVA, 765/400 kV & 6x500 MVA, 400/220 kV Bikaner-IV Pooling Station along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) Bus Reactors at a suitable location near Bikaner **Future provisions at Bikaner-IV PS: Space for** ▪ *765 kV line bays along with switchable line reactors – 8 nos.* ▪ *765kV Bus Reactor along with bay: 1 no.* ▪ *400 kV line bays along with switchable line reactor –4 nos.* ▪ *400 kV line bays–2 nos.* ▪ *400/220kV ICT along with bays -4 nos.* ▪ *400 kV Bus Reactor along with bay: 1 no.* ▪ *400kV Sectionalizer bay: 1 set* ▪ *220 kV line bays for connectivity of RE Applications -5 nos.* ▪ *220kV Sectionalizer bay: 2 sets* ▪ *220 kV BC (2 nos.) bays and 220 kV TBC (2 nos.) bays*	**Bikaner-IV PS -AIS** • 765/400 kV 1500 MVA ICTs- 6 nos. (19x500 MVA including one spare unit) • 400/220 kV 500 MVA ICTs -6 no. • 765 kV line bays – 2 nos. (for 765kV interconnection with Siwani S/s) • 400 kV line bays - 4 nos.(For LILO of both ckts of Bikaner II PS- Bikaner III PS) • 765 kV ICT bays-6 no. • 400 kV ICT bays- 12 no. • 220 kV ICT bays- 6 no. • 240 MVAr Bus Reactor-2 no. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 220 kV line bays: 6 nos. (for RE connectivity) • 400kV line bays (for RE connectivity)- 3 nos. • 400kV Sectionalizer bay: 1 set • 220 kV Sectionalizer bay: 1 set • 220 kV BC (2 nos.) bays and 220 kV TBC (2 nos.) bays • 400kV bays : 2 nos. (for STATCOM)
2	STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) at Bikaner-IV PS	• STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr)
3	LILO of both ckts of Bikaner II PS- Bikaner III PS (Quad) direct line at Bikaner-IV PS	Length -20 km (Quad) (LILO length)
4	Bikaner-IV PS – Siwani 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end	Line Length -260 km • 765 kV, 240 MVAr switchable line reactors at Bikaner-IV PS end– 2 nos. • 765 kV, 240 MVAr switchable line reactors at Siwani S/s end– 2 nos. • Switching equipment for 765kV, 240 MVAr switchable line reactors at Bikaner-IV PS end – 2 nos.

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
		• Switching equipment for 765kV, 240 MVAr switchable line reactors at Siwani S/s end – 2 nos.
5	Siwani– Fatehabad (PG) 400 kV D/c line (Quad)	Line Length ~80 km (Quad)
6	Siwani – Patran (Indi Grid) 400 kV D/c line (Quad) along with 80 MVAr switchable line reactor for each circuit at Siwani S/s end	Line Length -160 km (Quad) • 420 kV, 80 MVAr switchable line reactors at Siwani S/s end– 2 nos. • Switching equipment for 420kV, 80 MVAr switchable line reactors at Siwani S/s end – 2 nos. • 400kV GIS duct :700m at Patran S/s
7	2nos. 400 kV line bays each at Fatehabad (PG) & Patran (Indi Grid) S/s	• 400 kV line bays at Fatehabad (PG) S/s – 2 nos. • 400 kV line bays at Patran (Indi Grid) S/s – 2 nos.
8	2nos. 765 kV line bays at Siwani S/s	• 765 kV line bays at Siwani S/s – 2 nos.

B. REZ Ph-IV (Part 3: 6GW) (Bikaner Complex) :Part B (Estimated Cost: Rs 5357.36 Cr)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	➢ Establishment of 765/400kV, 6x1500 MVA S/s at suitable location near Siwani (Distt. Bhiwani) along with 2x240 MVAr (765kV) Bus Reactor & 2x125 MVAr (420kV) Bus Reactor **Future provisions at Siwani S/s:** **Space for** ▪ *765 kV line bays along with switchable line reactors – 8* ▪ *765kV Bus Reactor along with bay: 1 nos.* ▪ *400 kV line bays along with switchable line reactor –8 nos.* ▪ *400 kV Bus Reactor along with bays: 1 no.* ▪ *400kV Sectionalizer bay: 1 set*	**Siwani S/s- AIS** • 765/400 kV 1500 MVA ICTs- 6 nos. (19x500 MVA including one spare unit) • 765 kV ICT bays-6 no. • 400 kV ICT bays- 6 no. • 765 kV line bays – 2 nos. (for 765kV interconnection with Bikaner-IV PS) • 400 kV line bays – 4 nos. (for 400kV interconnections) • 240 MVAr Bus Reactor-2 no. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 nos. • 400kV Sectionalizer bay: 1 set • 400kV bays : 2 nos. (for STATCOM)
2	Bikaner-IV PS – Siwani 765 kV D/c (2^{nd}) line along with 240 MVAr switchable line reactor for each circuit at each end	Line Length -260 km • 765 kV, 240 MVAr switchable line reactors at Bikaner-IV PS end– 2 nos. • 765 kV, 240 MVAr switchable line reactors at Siwani S/s end– 2 nos. • Switching equipment for 765kV, 240 MVAr switchable line reactors at Bikaner-IV PS end – 2 nos.

		• Switching equipment for 765kV, 240 MVAr switchable line reactors at Siwani S/s end – 2 nos.
3	STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) at Siwani S/s	• STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr)
4	Siwani – Sonipat (PG) 400 kV D/c line (Quad) along with 63 MVAr switchable line reactor for each circuit at Siwani S/s end	Line Length -150 km (Quad) • 420 kV, 63 MVAr switchable line reactors at Siwani S/s end– 2 nos. • Switching equipment for 420kV, 63 MVAr switchable line reactors at Siwani S/s end – 2 nos.
5	Siwani – Jind (PG) 400 kV D/c line (Quad)	Line Length -110 km (Quad)
6	2 nos. 400 kV line bays each at Jind(PG) & Sonipat (PG) S/s	• 400 kV line bays at Jind (PG) S/s – 2 nos. • 400 kV line bays at Sonipat (PG) S/s – 2 nos.
7	2 nos. 765 kV line bays at Bikaner-IV PS	• 765 kV line bays at Bikaner-IV PS – 2 nos.

Further as part of 75GW REZ in Rajasthan (as part of 500GW report), 5 GW potential (3GW solar, 2 GW wind) along with net dispatch of 2GW considering 2GW BESS was considered at Bhadla complex (Bhadla-IV: 2GW). A comprehensive HVDC scheme is planned for 6GW evacuation from Bikaner-V (4GW) and Bhadla-IV (2GW) PS towards Baripada in Orissa (ER) through HVDC system, for which studies is undergoing for 2029 timeframe and will be taken up in Joint study meeting. However, grant of connectivity shall depend on application received at Bikaner-V & Bhadla-IV which may differ than Bikaner-V (4GW) & Bhadla-IV (2GW). Details of broad scheme is as under

Proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-6 :6 GW) [Bhadla/Bikaner Complex]

Bhadla-IV: 2 GW (Solar), Bikaner-V : 4GW (Solar)*

- Establishment of 6000 MW, ± 800 kV Merta (HVDC) [LCC] terminal station (4x1500 MW) in Merta-II substation

  - 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal.
  - 400kV bus sectionaliser -2 nos (1 Set) at Merta-II (HVDC) station

- Establishment of 765/400kV, 4x1500 MVA S/s & 400/220kV 4x500MVA pooling station at suitable location near Bikaner (Bikaner-V PS) along with 2x125 MVAr & 2x240 MVAr bus reactor

Future provisions

Space for

- 765/400kV ICTs along with bays- 2
- 765 kV line bays along with switchable line reactors – 10
- 765kV Bus Reactor along with bay: 1 nos.
- 400 kV line bays along with switchable line reactor –10
- 400kv line bays : 4 nos.
- 400 kV Bus Reactor along with bays: 1 no.
- 400kV Sectionalization bay: 2 sets
- 400/220kV ICT along with bays -6 nos.
- 220 kV line bays - 10 nos.
- 220kV Sectionalization bay: 3 sets

along with provision of 80-MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase)

- 220kV line bays (4 nos.) for RE connectivity at Bikaner-V PS
- Bikaner-V PS – Merta-2 765KV D/c line (~ 200kms) along with 240 MVAr switchable line reactor for each circuit at each end of Bikaner-V PS – Merta-2 765KV D/c line
- Establishment of 765/400kV, 3x1500 MVA S/s & 400/220kV 3x500MVA pooling station at suitable location near Bhadla (Bhadla-IV PS) along with 2x125 MVAr & 2x240 MVAr bus reactor

Future provisions

Space for

- 765/400kV ICTs along with bays- 3
- 765 kV line bays along with switchable line reactors – 10
- 765kV Bus Reactor along with bay: 1 nos.
- 400 kV line bays along with switchable line reactor –10
- 400kv line bays : 4 nos.
- 400 kV Bus Reactor along with bays: 1 no.
- 400kV Sectionalization bay: 2 sets
- 400/220kV ICT along with bays -7 nos.
- 220 kV line bays - 10 nos.
- 220kV Sectionalization bay: 3 sets

- Bhadla-IV PS – Merta-II 765KV D/c line (~ 250kms) along with 240 MVAr switchable line reactor for each circuit at each end of Bhadla-IV PS – Merta-2 765KV D/c line
- Augmentation of 765/400 kV, 3x1500 MVA ICTs at Merta-II S/s
- 6000 MW, ±800 kV Merta (HVDC) [LCC] terminal station (4x1500 MW)
- Establishment of 6000 MW, ±800 kV Baripada (HVDC) [LCC] terminal station (4x1500 MW) at suitable location near Baripada (Distt. Mayurbhanj)
- ±800 kV HVDC line (Hexa lapwing) between Merta-II (HVDC) & Baripada (HVDC) (with Dedicated Metallic Return) - 1600 km

EHVAC system beyond Baripada (HVDC) S/s is under planning.

**** Evacuation capacity among Bikaner-V and Bhadla-IV may vary depend on application received at Bikaner-V and Bhadla-IV***

(b) Rajasthan REZ Ph-IV (Part-4 :3.5GW) (Jaisalmer/Barmer Complex)

Joint Study Meeting(s) were held in virtual mode on 28.12.23 with SECI, CEA, GRID-INDIA, RVPN, UPPTCL and other STUs of Northern region to finalize the Transmission system for evacuation of power from Bikaner & Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part-3a :2.4GW) and REZ Ph-IV (Part-4 :3.5GW) respectively. Details of deliberations for Transmission system for evacuation of power from Bikaner & Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part-4 :3.5GW) is as under

Gist of discussion in 1st Joint study meeting held on 28.12.23

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 under bidding.

At present connectivity of about 9 GW capacity is already granted/received. 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 is planned. Studies were carried out in 2026-27 time frame in solar maximized scenario for EHVAC system and Study files for solar maximized scenario was shared on 20.12.23 with all constituents.

S.No	Transmission Scheme	RE Potential	Cumulative RE Potential
1	Rajasthan REZ Ph-IV (Part-2:5.5GW) (Jaisalmer/Barmer Complex) EHVAC system -Under Bidding	5.5GW (Solar) Fatehgarh-IV: 4 GW Barmer-I: 1.5 GW	5.5GW (Solar) Fatehgarh-IV: 4 GW Barmer-I: 1.5 GW
2	Rajasthan REZ Ph-IV (Part-4:3.5GW) (Jaisalmer/Barmer Complex) EHVAC system-Present proposal	3.5 GW (Solar) Fatehgarh-IV: 1 GW Barmer-I: 2.5 GW	9GW (Solar) Fatehgarh-IV: 5 GW Barmer-I: 4 GW
3	Rajasthan REZ Ph-IV	6 GW (Solar)	15 GW (Solar)

S.No	Transmission Scheme	RE Potential	Cumulative RE Potential
	(Part-5 : 6GW) (Barmer Complex) HVDC system towards WR/WR-SR	Barmer-II : 6 GW*	Fatehgarh-IV: 5 GW Barmer-I: 4 GW Barmer-II: 6 GW*

It was stated in meeting that the 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)) and 6GW HVDC system from Barmer-II PS (new pooling station is being established as part of HVDC scheme). The 6GW HVDC scheme comprises Barmer-II to Suitable locations in WR/SR through HVDC system.

In the joint study meeting, CTU stated that as per committee report Barmer-II PS was planned for 6GW RE potential (2GW BESS capacity) with 4GW evacuation capacity. In 25th CMETS-NR meeting, 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 3.5GW RE potential (solar) remains untapped due to non-materialisation of BESS capacity (Barmer-I : 1.5GW+Barmer-II: 2GW) in Barmer complex.

Details of RE potential considered in Fatehgarh/Barmer complex is under:

Subject to inputs from MNRE/SECI for enhancement of RE potential at Barmer-II PS

In the joint study meeting as well as in present CMETS meeting, CTU stated that as per committee report Barmer-II PS was planned for 6GW RE potential with 4GW evacuation capacity considering 2GW BESS capacity. SECI informed that total RE potential identified at Barmer complex is 13GW considering BESS of 3.5GW capacity. SECI reiterated that at present there is no clear visibility for RE projects with BESS in Rajasthan and therefore transmission system to be planned for 13 GW RE potential (solar) from Barmer complex due to non-materialization of BESS capacity. CTU stated that 4GW EHVAC system is already planned from Barmer-I PS and with 6GW RE potential considered at Barmer-II PS, transmission system for balance 3GW RE potential will be planned at later stage from new pooling station envisaged in Barmer complex

Accordingly, based on inputs from SECI it was decided in the meeting that total 6GW RE potential may be considered for planning of transmission scheme from Barmer-II PS.

In the Joint study meeting held on 28.12.2023, following transmission system for evacuation of power from Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part-4 :3.5GW) was proposed

Fatehgarh-IV: 1 GW (Solar), Barmer-I :2.5GW (Solar)

- Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Merta (Merta-II Substation) along with 2x125 MVAr & 2x240 MVAr bus reactor at Merta-II* S/s
- STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 2 nos. 400kV line bays at Barmer-I PS

- Augmentation with 765/400 kV, 2x1500 MVA Transformer (4th & 5th) at Barmer-I PS
- Augmentation of 3x500 MVA (3^{rd} to 5^{th}), 400/220 kV ICT at Barmer-I PS
- 220kV line bays (4 nos.) for RE connectivity at Barmer-I PS
- 220kV Sectionalization bay (1 set) along with BC (1 nos.) and 220 kV TBC (1 nos.) at Barmer-I PS
- Fatehgarh-IV PS – Barmer-I PS 400kV D/c line (Quad) (~40km)
- Barmer-I PS – Merta-II 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Barmer-I PS – Merta-II 765 kV D/c line (~320 km)
- Merta-II – Beawar 400 kV D/c line (Quad) (~55 km)
- Merta-II – Dausa 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Merta-II – Dausa 765 kV D/c line line (~250 km)
- Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Ghiror (Distt. Mainpuri) along with 2x125 MVAr & 2x240 MVAr bus reactor at Ghiror S/s (UP)
- Dausa - Ghiror 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Dausa - Ghiror 765 kV D/c line (~285 km)
- LILO of both ckt of 765 kV Aligarh (PG) -Orai (PG) D/c line (~40 km) at Ghiror S/s along with 240 MVAr switchable line reactor for each circuit at Ghiror S/s end of 765 kV Ghiror - Orai D/c line
- LILO of one ckt of 765kV Agra (PG) – Fatehpur(PG) 765kV D/c line at Ghiror along with 240 MVAr switchable line reactor at Ghiror S/s end of 765 kV Ghiror -Fatehpur line (~40 kms)

In above meeting, Grid-India enquired about installation of STATCOMs at new pooling stations in Bikaner and Fatehgarh/Barmer complex. CTU stated that at present 3 nos. STATCOMs are already operational at Fatehgarh-II, Bhadla-II & Bikaner-II and 2 nos. STATCOMs at Ramgarh and Fatehgarh-III are under implementation. Additionally, 3 nos. STATCOMs at Bikaner-IV, Siwani and Barmer-I is also planned in proposed schemes (Ph-IV: Part 3 & 4). Additionally, space provision to be kept STATCOM at Merta-II, & Ghiror S/s as part of future scope.

Grid-India stated that proposal is in order, however 400/220kV ICTs (2x315MVA) at Agra (PG) is critically loaded in N-1 contingency. CTU stated that with proposed scheme there is marginally increment (~5MW) in 400/220kV ICT loading in Agra. CTU stated that space is not available for installation of 3rd ICT at Agra(PG) S/s, therefore replacement of ICTs may be considered in future based on real time loadings.

CTU stated that in the present proposal they have optimally utilized the Aligarh-Orai and Fatehpur -Agra high capacity 765kV corridors as the loadings of lines are less in solar maximized scenario. 765/400kV Orai Substation is well connected with WR Grid and Power from 765/400kV Orai shall be dispersed to load centres of WR through various high capacity lines. CTU stated that they are planning to interconnect proposed Ghiror S/s to nearby UPPTCL substation i.e. 400/220kV Firozabad at 400kV level as part of present scheme. CTU requested UPPTCL to provide space availability for 2 nos. of 400kv line bays at Firozabad S/s. This will also relieve the loading of Agra ICTs and increase resiliency of system. UPPTCL agreed for the same.

UPPTCL requested that studies may be performed with Bhadla-Fatehpur HVDC system to check loadings with proposed system. CTU stated that Bhadla-Fatehpur system is under

bidding with scheduled implementation Feb'28 (Pole-1) and therefore not considered in studies, however they will carry out sensitivity case considering HVDC system and commensurate RE generation and will provide to UPPTCL. Same was provided to UPPTCL on 02.01.24.

CEA stated that proposal in order however, studies may be reviewed with UP intra state transmission system and associated RE generation in GEC-II. CTU agreed for the same. CTU enquired SECI and UPPTCL for envisaged RE potential in Bundelkhand region. UPPTCL stated that UPNEDA communicated 10GW RE potential in Bundelkhand region (UP), out of which UPPTCL has planned transmission scheme for evacuation of 4GW solar in intra state and transmission scheme is already approved in GEC-II. CTU stated that they have also received 1200MW solar application in Bundelkhand region for injection at Orai S/s which will be discussed in ensuing CMETS-NR meeting. It was stated that the above 4GW potential (out of 10GW potential) is part of 500GW report, however balance 6GW potential as indicated by UPNEDA is not part of 500GW report, therefore UPPTCL may provide communication to CEA/CTU in 2-3 days, so that same can be forwarded to SECI for evaluation of developable RE potential in this region. UPPTCL agreed for the same.

Further, UPPTCL informed in the meeting that space is available for 2 nos. of 400kV line bays at Firozabad S/s however, they will re-confirm the same after verification. Prima facie loading of 400kV Ghiror- Firozabad D/c line was observed to be in order. In view of that CTU included 400kV Ghiror- Firozabad as part of proposed Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4 :3.5 GW) [Fatehgarh/Barmer] Complex. This will also relieve the loading at Agra ICTs and increase resiliency of the system.

Revised study files with proposed changes (considering 400kV Ghiror- Firozabad D/c line & Barmer-I STATCOM as part of proposed scheme) and considering UP intra state solar generation and associated transmission scheme (GEC-II) was circulated on 01.05.24 along with study plots.

Gist of discussion in Joint study meeting held on 09.01.24

CTU stated that in Joint study meeting held on 28.12.23, Transmission system for evacuation of power from Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part-4 :3.5GW) was in-principally agreed. CTU stated that based on Grid-India observations, in revised studies, Guzuwaka HVDC is already reversed (1000MW) towards ER and Talchar-Kolar capacity is also kept minimum in forward direction (600-700MW). This will relieve loading of various WR-ER corridors incl. 765kV Ranchi – Dharamjaygarh D/c up to a certain extent.

CTU stated the loading of some of WR-ER corridors are in general high and with proposed scheme (Rajasthan Ph-IV (Part-4 :3.5 GW)), there is marginal increment on above Inter regional links in winter solar maximized scenario. In the next phase of studies (2028-29) with proposed HVDC corridors from NR to ER and NR to WR, loadings will be reviewed, and measures will be taken if required. Grid-India & CEA agreed for the same

UPPTCL informed that space is available at 400kV Firozabad S/s for interconnection of proposed 400kV Ghiror – Firozabad D/c line and power flow is in order on the above line. Revised study files with proposed changes in Ph-IV (Part-3: 6GW) and incorporating stakeholder comments on all India LGB, study files were circulated on 06.05.24 along with study plots.

As discussed earlier, off peak file were circulated on 12.01.24 to all stakeholders and based on voltages specially in Ghiror complex, reactive compensation was reviewed. Considering grant of connectivity to new RE generators in Fatehgarh/Barmer complex as well as for evacuation of power beyond Fatehgarh-IV PS/Barmer-I PS following transmission scheme is proposed as agreed in joint study meeting for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5GW) [Jaisalmer/Barmer Complex]

(c) Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4 :3.5 GW) [Fatehgarh/Barmer] Complex

Fatehgarh-IV: 1 GW (Solar), Barmer-I :2.5GW (Solar)

- Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Merta (Merta-II Substation) along with 2x125 MVAr & 2x240 MVAr bus reactor at Merta-II* S/s

Future provisions at Merta-II S/s(excl. scope for present scheme): Space for

  - 765/400kV ICTs along with bays- 4
  - 765 kV line bays along with switchable line reactors – 8
  - 765kV Bus Reactor along with bay: 1 nos.
  - 400 kV line bays along with switchable line reactor –8
  - 400 kV line bays – 2 nos.
  - 400 kV Bus Reactor along with bays: 1 no.
  - 400kV Sectionalizer bay: 2 sets
  - 400/220kV ICT along with bays -6 nos.
  - 220 kV line bays for RE injection -8 nos.
  - 220kV Sectionalizer bay: 2 set
  - 220 kV BC (3 nos.) bays and 220 kV TBC (3 nos.) bays
  - 6000 MW, ±800 kV Merta (HVDC) [LCC] terminal station (4x1500 MW) along with bays
  - STATCOM (2x±300MVAr, 4x125MVAr MSC, 2x125MVAr MSR) along with 400kV bays (2 nos.)

  along with provision of 80-MVAr & 110MVAr spare reactors (Single phase) & 500MVA spare transformer unit (Single phase)

- STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 2 nos. 400kV bays at Barmer-I PS
- Augmentation with 765/400 kV, 2x1500 MVA Transformer (4th & 5th) at Barmer-I PS
- Augmentation of 5x500 MVA (5th to 9th), 400/220 kV ICTs at Barmer-I PS
- 220kV line bays (6 nos.) for RE connectivity at Barmer-I PS
- 220kV Sectionalizer bay (1 set) along with 220 kV BC (1 nos.) bay and 220 kV TBC (1 nos.) bay at Barmer-I PS
- 400kV Sectionalizer bay (1 set) at Barmer-I S/s

- Fatehgarh-IV PS (Sec-2) – Barmer-I PS 400kV D/c line (Quad) (~25km)
- Barmer-I PS – Merta-II 765 kV D/c line along with 240 MVAr switchable line reactor at Barmer-I PS end and 330MVAr switchable line reactor at Merta-II PS end for each circuit of Barmer-I PS – Merta-II 765 kV D/c line (~320 km)
- Merta-II – Beawar 400 kV D/c line (Quad) (~55 km)
- Merta-II – Dausa 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Merta-II – Dausa 765 kV D/c line line (~250 km)
- Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Ghiror (Distt. Mainpuri) along with 2x125 MVAr & 2x240 MVAr bus reactor at Ghiror S/s (UP)

  Future provisions at Ghiror S/s (excl. scope for present scheme): Space for**

  - 765/400kV ICTs along with bays- 4
  - 765 kV line bays along with switchable line reactors – 6
  - 765kV Bus Reactor along with bay: 1 nos.
  - 400 kV line bays along with switchable line reactor –6
  - 400 kV Bus Reactor along with bays: 1 no.
  - 400kV Sectionalizer bay: 1 set
  - 400/220kV ICT along with bays -4 nos.
  - 220 kV line bays for drawl -6 nos.
  - 220kV Sectionalizer bay: 1 set
  - 220 kV BC (2 nos.) bay and 220 kV TBC (2 nos.) bay
  - STATCOM (2x±300MVAr, 4x125MVAr MSC, 2x125MVAr MSR) along with 400kV bays (2 nos.)

  along with provision of 80MVAr spare reactor (Single phase) & 500MVA spare transformer unit (Single phase

  ****Drawl requirement at Ghiror S/s to be confirmed by UPPTCL, accordingly future scope will be finalized***

- Dausa - Ghiror 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Dausa - Ghiror 765 kV D/c line (~285 km)
- LILO of both ckt of 765 kV Aligarh (PG) -Orai (PG) D/c line (~40 km) at Ghiror S/s along with 240 MVAr switchable line reactor for each circuit at Ghiror S/s end of 765 kV Ghiror -Orai D/c line
- LILO of one ckt of 765kV Agra (PG) – Fatehpur(PG) 765kV D/c line at Ghiror along with 240 MVAr switchable line reactor at Ghiror S/s end of 765 kV Ghiror -Fatehpur line (~40 kms)
- 400kV Ghiror-Firozabad (UPPTCL) D/c line (Quad) (~40 kms)

As deliberated earlier, HVDC system is to be planned for additional 6GW at Barmer complex with 2029 implementation schedule. Studies for HVDC scheme is undergoing and will be taken up in next Joint study meeting. Details of broad HVDC scheme is as under:

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

- Establishment of 400/220kV, 4x500MVA S/s at suitable location near Barmer (Barmer-II Substation) along with 2x125 MVAr bus reactor

  Future provisions at Barmer-II S/s:

Space for

- 400 kV line bays along with switchable line reactor –6
- 400 kV line bays –4
- 400 kV Bus Reactor along with bays: 1 no.
- 400/220 kV ICT along with bays -10 Nos.
- 400 kV Sectionalization bays: 2 sets
- 220 kV line bays for connectivity of RE Applications -15 Nos.
- 220kV Sectionalization bay: 3 sets
- 220 kV BC (4 Nos.) & TBC (4 Nos.)

- 220kV line bays (4 nos.) for RE connectivity at Barmer-II PS
- Barmer-I PS – Barmer-II PS 400kV D/c line (Quad)

- Establishment of 6000 MW, ± 800 kV Barmer-II (HVDC) [LCC] terminal station (4x1500 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 6000 MW, ±800 kV (HVDC) [LCC] terminal station (4x1500 MW) at suitable location in WR/SR or 2 nos. 3000MW, ±800 kV (HVDC) [LCC] terminal stations (Multi terminal) at suitable location(s) in WR/SR
- ±800 kV HVDC line (Hexa lapwing) between Barmer-II (HVDC) & WR /SR (HVDC) (with Dedicated Metallic Return)
- Associated EHVAC system strengthening in WR/SR

Exact HVDC terminal points in WR/WR-SR boundary are proposed to be identified based on detailed system studies involving stakeholders from NR, WR & SR.

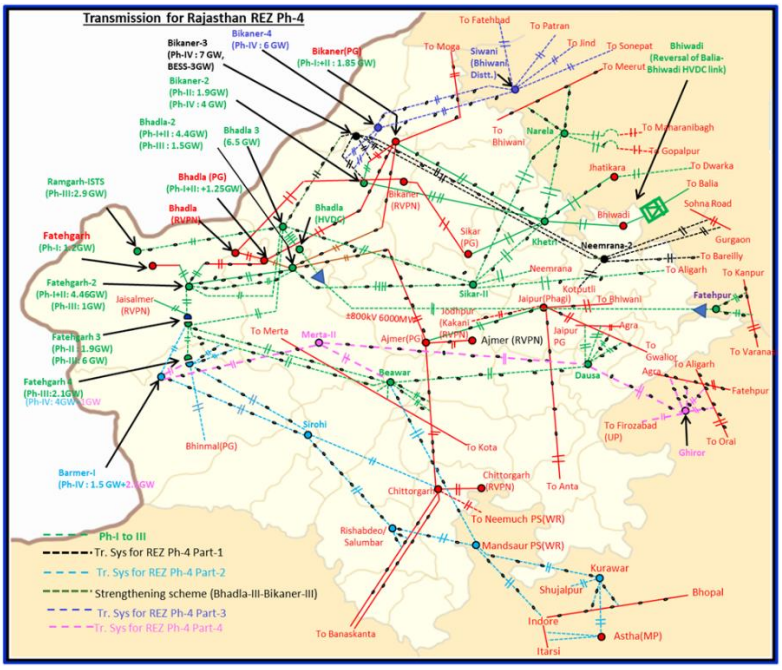


Figure 4-9:Transmission system for Rajasthan REZ Ph-IV (Part 3 & 4)

The scheme is also agreed in 71st NRPC meeting held on 29.01.24 and to be taken up in NCT meeting

m. Implementation of 1 no. of 220 kV line bay at 400/220 kV Fatehgarh-III PS(Sec-1) for interconnection of JSW Renew Energy Five Limited BESS Project (Stage-II Connectivity App No. 0212100040) (250 MW)

Stage-II Connectivity (App No. 0212100040) for 250 MW by M/s JSW Renew Energy Five Limited was agreed in the 17th CMETS-NR meeting held on 31/03/2023 with one 220 kV bay at Fatehgarh-III PS for interconnection under ISTS scope. M/s JSW Renew Energy Five Limited had earlier requested start date of connectivity under GNA from 15/12/2024 for 250 MW. M/s JSW Renew vide mail dated 05.09.2023 has requested start date of connectivity from 15.03.2025. Considering the same and expected commissioning date of transmission system, the start date of Connectivity under GNA was considered as 15/03/2025 in 23rd CMETS-NR meeting held on 29.08.2023. Subsequently, M/s JSW Renew vide mail 16.11.23 informed revised start date of connectivity as 30.06.25. Subsequently Conn BGs were submitted by M/s JSW Renew Energy on 08.12.23.

Considering above, implementation of 1 no. of 220 kV line bay at Fatehgarh-III PS is to be taken up for interconnection of M/s JSW Renew Energy Five Limited BESS Project-1 (250 MW)

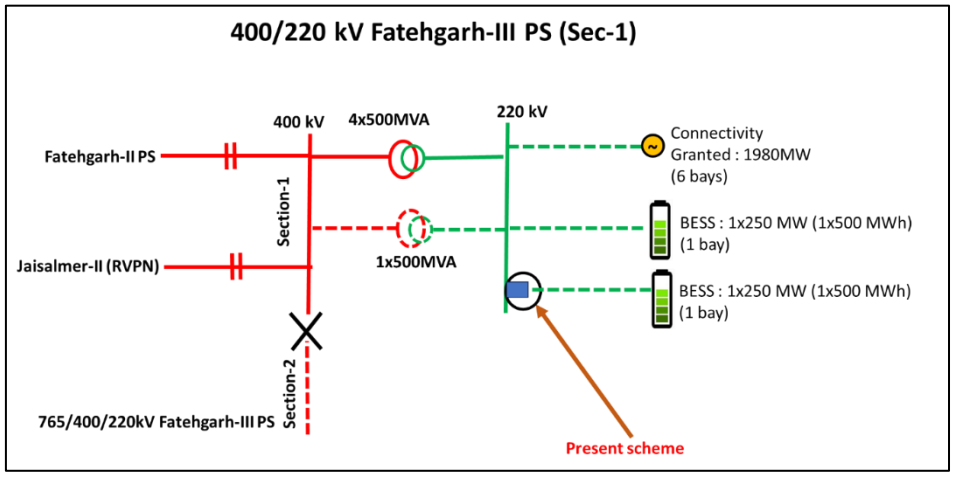


Figure 4-10: Schematic of 400/220kV Fatehgarh-III PS (Sec-1)

The scheme is under implementation with following details

Detailed scope of work for implementation:

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	1 no. of 220 kV line bay at 400/220 kV Fatehgarh-III PS (Sec-1) for interconnection of JSW Renew Energy Five Limited BESS Project (Stage-II	220 kV line bay – 1 no.	30.06.25

	Connectivity App No. 0212100040) (250 MW)		
		Total Estimated Cost:	**INR 5.94 Crore**

4.4.2 Haryana

(a) Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line

In 3rd NRPC-TP meeting held on 19.02.21, HVPNL's proposal of creation of 220 kV Chickenwas substation by LILO of both circuits of 220 kV Hisar (PG) to Fatehabad (HVPNL) D/c line was deliberated. In above agenda, Grid- India expressed concern on the high loading of 220 kV Hisar (PG) - Hisar (IA) D/c line and asked HVPNL to explore measures to relieve loadings of these lines. HVPNL agreed to the same.

Further, in the 54th NRPC meeting held on 31.05.22 it was desired that HVPN will take up the matter with CTU/CEA for reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line and Connector to be replaced at Hisar (IA) end.. Further, HVPN vide letter dated 21.09.22 has suggested that 220 kV Hisar (PG) Hisar (IA) D/c line may be augmented with high performance conductor and matter of augmentation may be taken up with POWERGRID being the custodian of above line.

It was informed that Grid-India vide mail 21.06.22 shared the loading data of past one year (Jun'21-Jun'22)

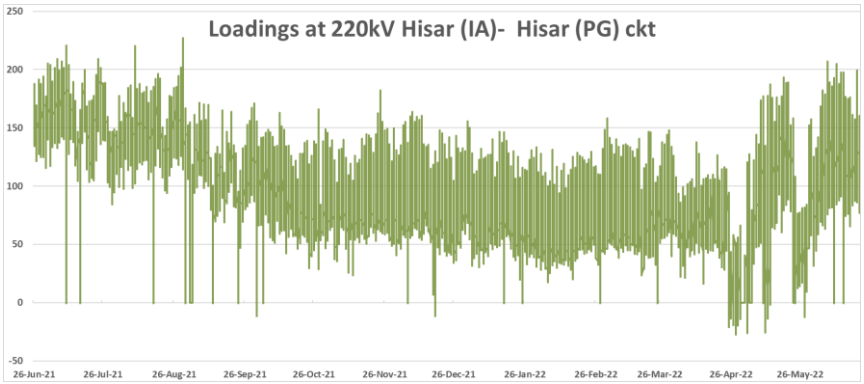


Figure 4-11: Loading of Hisar (PG)-Hisar(IA) D/c line of one year (Source: Grid-India)

CTU vide mail 03.02.23 to CEA & Grid-India informed that as per the loading pattern of 220kV Hisar(PG)-Hisar IA-Hisar (BBMB) D/c line also , it is seen that loading of Hisar (PG) - Hisar (IA) is high and may not fulfill N-1 Criteria. Further, in the 62th NRPC meeting held on 31.01.23, NRLDC agenda for high loading of Hisar (PG) - Hisar (IA) was also deliberated and it was decided to resolve the above issue. In view of that, CTU requested in above mail to convene a joint meeting with HVPN/POWERGRID/Grid-India to discuss and finalize on possible alternatives (Reconductoring/ load diversion/220kV new interconnection) to resolve above high loading issue.

Subsequently a joint meeting was held on 20.03.2023 to discuss transmission related issues in Haryana incl. high loading issue of 220 kV Hisar (PG) - Hisar (IA) D/c line. In the meeting, Reconductoring of 220 kV Hlisar (PG) - Hisar (IA) D/c line with HTLS conductor was agreed. In the meeting, it was decided that POWERGRID will intimate the type of HTLS conductor which can be implemented on existing towers of 220 kV Hisar (PG) - Hisar (IA) D/c line within two weeks. It was also decided that HVPNL will carry out the augmentation of line bay equipment at 220kV Hisar (IA) substation in the matching time frame of reconductoring of the 220 kV Hisar (PG) - Hisar (IA) D/c line.

Subsequently, POWERGRID vide mail 25.05.23 informed to CTU that they need the Conductor Ampacity requirement for the subject line for deciding the technical parameters for HTLS conductor which is suitable for existing towers. CTU in reply vide mail 02.06.23 informed that from the loading data of one year (Jun'21-Jun'22), it is observed that maximum loading on 220 kV Hisar (PG) – Hisar(IA) D/c Line is about 225MW/ckt (under n-1 contingency loading may increase to 365MW). Considering above historical loading data, minimum conductor ampacity required to be about 1000 Ampere/ckt (about 381MW/ckt) for reconductoring of above 220kV line.

Grid-India informed that reconductoring of above line with HTLS conductor of minimum 1000 ampere current requirement is adequate, however HVPN views may be taken for any future drawl requirement. HVPNL informed that at present, no future load is envisaged for drawl of power from Hisar (PG) substation.

POWERGRID informed that upto 1000 Ampere requirement, ACSS/GAP conductor were used in past for reconductoring of 220kV lines and same can be used for upto 1100 Ampere loading requirement. For requirement for more than 1100 Amperes, composite core type conductor is suitable due to sag limitation, however same is costlier (about 3 times) than ACSS/GAP conductor. CTU enquired about thermal capacity of ACSS/GAP type HTLS conductor available for more than 1000 Ampere (say 1050 A) with ACSS configuration

POWERGRID stated that in the past they had the latest design of 1092 Ampacity conductor so 1050 Ampere HTLS conductor can be designed for reconductoring of above line. CTU stated that with 1050 Ampere (about 400MW/ckt) HTLS conductor shall further provide additional margin on 220 kV Hisar (PG) - Hisar (IA) D/c line to meet the future demand. Grid-India agreed for the same.

CTU stated that HVPNL to carry out the necessary bay equipment upgradation works at 220kV Hisar (IA) end in the matching time frame of reconductoring of the 220 kV Hisar (PG) - Hisar (IA) D/c line. HVPNL stated that at present Bay equipment are designed with1250 ampere rating at Hisar (IA) end, but conductor need be changed for tie bay. Additionally, the CT ratio needs to be checked and changed accordingly from 800 ampere to 1200 ampere. HVPN stated that they will do detailed analysis in consultation with design team to upgrade the bays equipment's at Hisar (IA) end in coordination with implementing agency for reconductoring works.

Further in the earlier joint meeting, it was deliberated that HVPNL will examine the issue of high loading (of similar order as 220kV Hisar(PG) – Hisar(IA) D/c line) on Hisar (IA) - Hisar (BBMB) 220 kV D/ c line and plan adequate measures to relieve loading on the line.

In above Joint meeting HVPNL informed that Zebra conductor may be used for above line, however after the detailed analysis it emerged that 220 kV Hisar (IA) - Hisar (BBMB) D/ c line is already augmented in 2009 with INVAR conductor. Loading on above line is also significantly reduced with implementation of 400kV Bhiwani (PG) - Bhiwani line. CTU enquired about Ampacity of augmented conductor of Hisar (IA) - Hisar (BBMB) 220 kV D/ c line. HVPNL informed that INVAR conductor (TASCR) in above line is designed for150 degree with about 960 Ampere capacity.

Grid-India informed that in past during high demand season (Jun-Aug), in the event of shutdown of one ckt of Hisar (IA) - Hisar (BBMB) 220 kV D/c line, SLDC instructed to take other ckt out of service also due to very high loading. Grid-India stated that with INVAR conductor, other ckt can carry the load in the event of shutdown of one ckt. HVPNL concurred on the same.

CTU requested HVPNL to re-check bay equipment rating at Hisar (IA) & Hisar (BBMB) end for Hisar (IA) – Hisar (BBMB) 220 kV D/c line for optimal utilization of above line and take the necessary action in case of upgradation requirement & also send a confirmation to CEA & CTU in this regard

In view of above following ISTS transmission strengthening scheme was agreed in the meeting

- Reconductoring of 220 kV Hisar (PG) – Hisar (IA) D/c line (Single Zebra) with HTLS conductor (with minimum 1050Ampere/ckt requirement) along with bay equipment upgradation at 220kV Hisar (PG) end

The scheme is under implementation with following details

Scope of work along with tentative Cost and Implementation time-frame

Sl. No.	**Scope of the Transmission Scheme**	**Capacity/km**	**Implementation timeframe**
1	Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line (Single Zebra) with HTLS conductor (with minimum 1050 Ampere/ckt requirement)	14kM	18 months from the date of issuance of OM by CTUIL
2	Bay equipment upgradation at 220kV Hisar (PG) end		
Total Estimated Cost:			**INR 30.72 Crore**

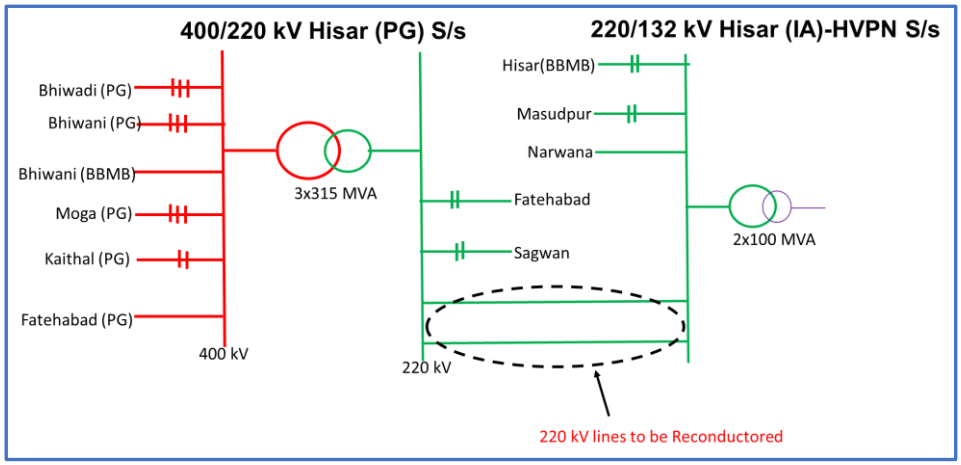


Figure 4-12: Schematic of 765/400/220kV Hisar (PG) S/s

4.4.3 Himachal Pradesh

(a) Augmentation of 1x500 MVA (4th) ICT at 400/220 kV Nallagarh substation

In the Quarterly operational feedback of October 2022, Grid-India highlighted the issue of 'N-1' non-compliance of loading of ICTs at Nallagarh (PG) S/s. Grid-India informed that currently with 3 no. of 315 MVA ICTs, loading of ICTs was more than 'N-1' compliance limit (>750 MW) during high drawl by HP and Punjab. Grid-India recommended that new ICT may be planned to relieve loading. Subsequently, the same was also discussed in the 62nd NRPC held on 31.01.2023.

The loading pattern of Nallagarh ICTs of past one year is as below:

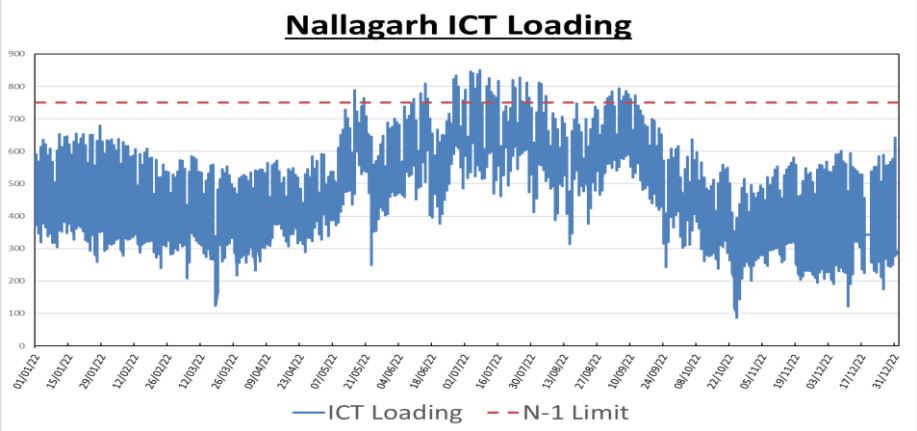


Figure 4-13: Loading of Nallagarh ICTs of Past one year (Source: Grid-India)

From the loading pattern of Nallagarh ICTs (3x315 MVA), it is observed that the loading is above N-1 limit for sufficient duration of time from May'22 to September-22 period. Loading of ICTs has reached maximum of about 850MW sometimes in July'22 and Aug'22.

Considering above as well as future load growth in Punjab, Chandigarh & HP as well as to satisfy the N-1 criteria of loading of ICTs, it was agreed to implement one no. of 400/220kV, 500 MVA ICT (4th) at Nallagarh S/s under ISTS with following scope. The scheme is under implementation with following details

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1	Augmentation of transformation capacity at 400/220kV Nalagarh S/s by 400/220 kV, 1x500 MVA (4th) ICT along with associated transformer bays* *1 no. of 400kV (AIS) (including associated tie bay) and 1 no. of 220kV (GIS) transformer bay along with GIS duct for interconnection of 220kV bay with ICT	• 500 MVA, 400/220 kV ICT–1 no. • 400 kV ICT bay (including associated tie bay) – 1 no. • 220 kV ICT bay – 1 no. (GIS)	24 months from the issue of OM by CTUIL *(refer note 1).*
		Total Estimated Cost:	**₹ 63.08 Crore**

Note: -

1. Best efforts shall be carried out to implement the transmission scheme within 18 months from the issue of OM by CTUIL

4.4.4 Jammu and Kashmir

(a) Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315 MVA, 400/220kV ICT (3rd)

400/220kV Amargarh S/s is the existing S/s of NRSS XXIX Transmission limited (NTL) (a subsidiary of India Grid Trust) with total transformation capacity of 630 MVA (2x315MVA). Augmentation of 400/220 kV ICT(3rd) at 400/220kV Amargarh (GIS) S/s was agreed in the 3rd NRPC(TP) held on 19.02.2021 with the time frame of March 2026. Same was taken up for discussion in 5th NCT was held on 25.08.2021 and 02.09.2021 wherein considering the timeframe of March, 2026, it was decided to defer the same and may be taken up later for approval.

Recently, JKPTCL vide letter dated 17.02.2022 to CEA informed that the 630 MVA 400/220 kV GIS at Amargarh is directly feeding the 450 MVA, 220/132 kV Zainakote GSS and the 320 MVA, 220/132 kV GSS Delina. The transmission plan (Kashmir region) for 2022-27 envisages addition of 2479 MVA at different voltage levels and stands approved in the CEA meeting held on 19-02-2021. The commissioning of the new Grid Stations necessitates provision of new sources or capacity augmentation at 400/220 kV level to enable the trickling down of the benefits of the new Grid stations to the consumers. In the JKPTCL letter, it was also stated that the existing sources of power shall not be able to cater to the increased demand of power and this necessitates immediate steps to augment the sources. It is proposed to augment the existing 220/132 kV GSS Zainakote from 450 MVA to 700 MVA and 220/132 kV GSS Delina from 320 MVA to 480 MVA by the end of 2023.The maximum drawl of power from 630 MVA Amargarh (GIS) during the present winter has been about 550 MW. In order to address the growing demand of power, it is imperative that Amargarh (GIS) S/s is augmented by atleast 50% i.e. 315 MVA.

Further, in the Quarterly operational feedback of January 2023, Grid-India has also highlighted the issue of 'N-1' non-compliance of loading of ICTs at Amargarh S/s. In the report it was informed that with 2 no. of 315 MVA ICTs, loading of ICTs was more than 'N-1' compliance limit (>425MW) most of the time in 2022-23 (Quarter 3: Oct'22-Dec'22) during high demand of J&K. Grid-India recommended that new ICT augmentation at Amargarh (GIS) may be expedited. In the 202nd OCC meeting held on 16.12.22, NRLDC stated that "loading of 400/220kV Amagarh ICTs was above N-1 contingency limits for last 30 days. Therefore, till capacity is augmented at 400/220kV Amargarh, any N-1 contingency is likely to lead to tripping of both ICTs as they are loaded beyond their N-1 contingency limit and there would be load loss in valley area". Subsequently in the recent 62nd NRPC meeting held on 31.01.22, agenda for N-1 violation related issues in Himalayan states of NR during winter 2022-23 was deliberated. In the meeting, CTU stated that new ICT at 400/220kV Amargarh has already been approved and implementation of these ICTs before their timeline of 2026 would be discussed with CEA.

In the 16th CMETS-NR meeting held on 28.02.23, it was deliberated that from the loading pattern of Amargarh ICTs (2x315 MVA), it is observed that the ICT loading is more than 425MW in the month of October to March and may become N-1 non-compliant.

The S/s owner i.e. M/s INDIGRID confirmed that the space is available for the installation of 400/220kV, 315MVA ICT (3rd) (Three single phase units) at Amargarh SS, however space is not available for 500MVA ICT. Further, transportation of 500 MVA (single phase units) ICT through enroute tunnels may also pose challenge. The details regarding the expansion of PEB Building, GIS BUS -1 & 2, GIS Duct for the connection with ICT, Land levelling need to be explored / identified and same would be provided shortly. Subsequently, M/s IndiGrid vide mail 15.03.22 informed that for installation of 400/220kV, 315MVA ICT (3rd) (Three single phase units) at Amargarh SS, required new Diameter at both sides along with GIB (420kV & 245kV 1-ph indoor and outdoor GIB). In the meeting, M/s INDIGRID stated that implementation timeframe of 21 months is a bit Compressed timeline due to issues in manufacturing as well as transportation of above ICT. INDIGRID requested to increase the time line for implementation of ICT. In reply, it was stated that timeline for implementation of ICT at GIS S/s has been kept as 21 months whereas in AIS S/s it is 18 months. Additionally, 3rd ICT is required on urgent basis due to critical loading in 'N-1' contingency and based on request of JKPTCL. In view of that it is expected that 3rd ICT would be available by Dec'24 (considering 21 months from expected approval in Mar'23), however efforts to be made for implementation of ICT in 18 months. JKPTCL also agreed for the same in meeting

GRID-INDIA stated that 315MVA ICT preferred over 500MVA ICT as spare (single phase unit of 105MVA) is already available at Amargarh S/s and will also be utilized with proposed 315MVA ICT also. CEA also concurred on installation of 400/220kV, 315MVA ICT (3rd) (Three single phase units) at Amargarh S/s. Considering the growing demand of power in J&K, as well as to meet the N-1 criteria of loading of ICTs, it was agreed to implement one no. of 400/220kV, 315MVA ICT (3rd) (Single phase units of 105MVA) at Amargarh (GIS) S/s under ISTS in 16th CMETS-NR meeting held on 28.02.23.

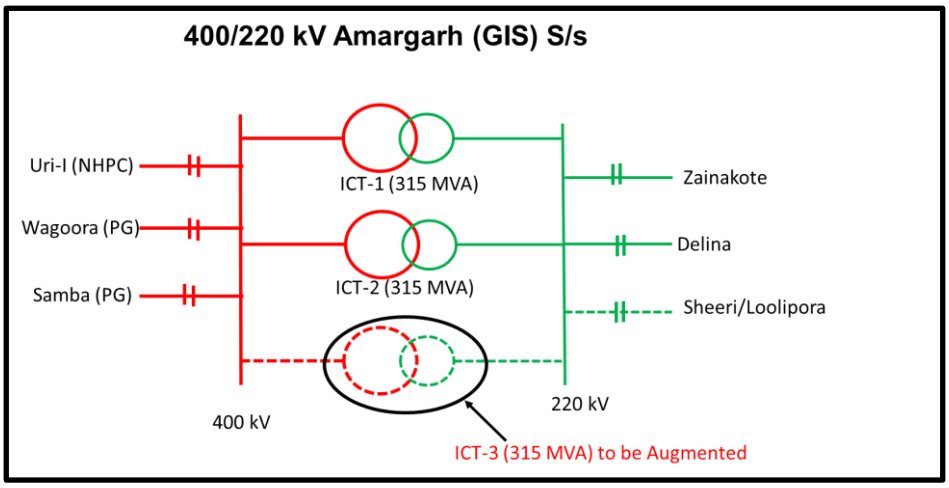


Figure 4-14: Schematic of 400/220 kV Amargarh (GIS) S/s

The scheme is under implementation with following details

Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315 MVA, 400/220kV ICT (3rd)

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation timeframe*
1	Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315MVA 400/220 kV ICT (3rd) (three single phase units of 105MVA) along with associated transformer bays* **along with GIB (420kV & 245kV 1-ph indoor and outdoor GIB)*	• 315 MVA, 400/220 kV ICT– 1 no. *(three nos. single phase units of 105MVA)* • 400 kV ICT bay (GIS) – 1no. + 1 no. additional bay for diameter completion *(refer note 2)* • 220 kV ICT bay (GIS) – 1 no.	21 months from the issue of OM by CTUIL *(refer note 1)*
		Total Estimated Cost:	₹ **82.04 Crore**

Note: -

1. Best efforts shall be carried out to implement the transmission scheme within 18 months from the issue of OM by CTUIL
2. One complete 400kV diameter (3 breakers) shall be implemented.

(b) Transmission system scheme for Ratle HEP (850MW)

In 3rd Consultation meeting for Evolving Transmission Schemes in NR held on 28/01/2022, connectivity system for Ratle HEP (850MW) was deliberated. In the meeting, It was informed that the transmission system for evacuation of Ratle HEP (850 MW) was discussed and agreed during the 4th NRPC(TP) meeting held on 05/10/2021 & 12/10/2021 wherein it was deliberated that Ratle HEP (850 MW) is a Run of River scheme located on river Chenab, in Kishtwar District of Jammu & Kashmir, with design overload of 10% and its completion schedule is Feb/March 2026. It was also agreed that Ratle HEP is approx. 20 km from Kishtwar PS, therefore, it can be directly connected with Kishtwar PS with 400 kV D/c line with high capacity conductor. During the above meeting, it was deliberated that RHPCL shall explore

the possibility of single-phase units of either 125 MVAR bus reactor or 80 MVAR reactor in case of transportation constraints.

In this meeting, RHPCL informed that they have already awarded 1x125 MVAr Bus Reactor at generation switchyard, wherein, supply of 1-phase or 3-phase units is left to the EPC contractor's scope. Accordingly in 3rd CMETS-NR meeting, it was decided to grant connectivity to RHPCL for Ratle HEP (850 MW) through following transmission system for Connectivity:

- Ratle HEP - Kishtwar (GIS) PS 400 kV D/c line (line suitable for carrying around 935 MW on each circuit at nominal voltage) along with 2 nos. of 400kV bays at Kishtwar S/s - To be implemented by the applicant (RHPCL)
- 125 MVAR, 420 kV bus reactor at Ratle HEP - To be implemented by applicant (RHPCL)
- Establishment of 400 kV Kishtwar (GIS) PS by LILO of one circuit of Kishenpur – Dulhasti 400kV D/c (Quad) line (Single Circuit Strung) and 125 MVAR Bus reactor at Kishtwar (GIS) PS– being implemented under ISTS

In 3rd NRPC-TP meeting it was also deliberated that outlet beyond Dulhasti is Dulhasti-Kishenpur 400kV line which is a single circuit line, the amount of power that can be exported/imported is limited. Hence, Dulhasti - Ratle section would be optimized to the extent possible. bay rating at Dulhasti is 2000A, which is further reduced to 700/800A due to reduced capacity of XLPE/OIL cable for connection of line to GIS bus at Dulhasti end.

In view of above a meeting was conveyed on 13.09.23 by CEA and CTU with NHPC to discuss upon feasibility for upgradation of switchgear equipment's incl. cable at 400kV Dulhasti switchyard as well as reconductoring of part system of 400kV Dulhasti-Kishtwar line. In the meeting, it was decided that NHPC shall explore the feasibility for upgradation of the switchgear and cables at Dulhasti substation to rating of 3150 A. NHPC may also explore the option of replacement of cables with GIB bus duct. The same would be intimated to CEA within one month.

NHPC vide mail dated 16.10.23 informed that GIS bay equipment installed at Dulhasti Power Station have a rating of 2000A. As suggested, complete replacement of GIS system would be required to accommodate requisite 3150 A. Accordingly, the existing rating of GIS busbar and associated switchgear like CB, CT, ES/ISO etc. needs to be uprated to 3150 A from 2000A. The compatibility issue of New GIS with old GIS will attract huge financial implication. It is envisaged that the space for the complete GIS compatible for 3150A may be required more than that of existing one and may not be feasible to comfortably accommodate within the existing underground space. Further, the existing items of pothead yard like wave traps, Isolators etc. also needs to be replaced which has an additional cost implication.

Further NHPC informed that there are two 400 kV cables (Line-1 is oil filled and Line-2 XLPE insulation) of 630 Sq.mm each are used for Power evacuation from Dulhasti GIS which can carry approx. 700-800A. As suggested, the replacement of cables with GIB bus duct may not be feasible at Dulhasti Power Station considering the constraints of cable tunnel space.

Considering the above facts, the uprating of all the above items will require significant Prolonged outages of generating units causing Generation and PAF Loss which will attract huge financial loss on account of loss of generation. Further, equipment replacement cost would also put an additional financial implication. In view of above factors, it is not possible to uprate the existing systems at Dulhasti Power station from 2000 A to 3150 A.

In view of above constraints, various other options were carried out and studies were reviewed. In the revised proposal, LILO of 400 kV Kishenpur- Dulhasti line (2nd ckt) at Kishtwar S/s (one ckt already LILOed as part of Pakaldul transmission system) along with Reconductoring of 400 kV Kishenpur-Kishtwar line (formed after LILO of Kishenpur- Dulhasti line at Kishtwar S/s) is proposed. In the revised scheme, there will be no requirement of space for installation of new GIS equipment and replacement of cables at Dulhasti switchyard for time being. Study files were also circulated on 24.11.23.

In the CMETS meeting it was stated that as part of transmission scheme, 400kV Kishenpur-Samba D/c line(Quad) line is proposed. Due to higher loading on 400/220kV ICTs as well as space constraint at Kishenpur S/s, bypassing of 400kV Kishtwar – Kishenpur line (Quad) at Kishenpur and connecting it with one of the circuit of Kishenpur-Samba 400kV D/c line (Quad) (thus forming 400kV Kishtwar-Samba (Quad) direct line (one ckt) & Kishenpur-Samba (Quad) (other ckt) line) is proposed. Further 4 nos. of bays shall be vacated at Samba S/s through bypassing both ckts of 400kV Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin) at Samba and connecting them together to form Kishenpur–Jalandhar D/c direct line (Twin). These bays will be utilized in present scheme through Kishenpur-Samba D/c line(Quad) line (one ckt bypassed at Kishenpur) & 400kV Samba-Jalandhar D/c line(Quad) line.

In view of space constraint for 400kV bays at Jalandhar S/s as well as higher loading on 400/220kV ICTs, bypassing 400kV Jalandhar – Nakodar line (Quad) at Jalandhar and connecting it with one of the circuit of Samba-Jalandhar 400kV D/c line (Quad) is proposed (forming Samba –Nakodar direct line). The vacated bay at Jalandhar S/s will be utilized for termination of another circuit of 400 kV Samba -Jalandhar D/c line (Quad).

It was deliberated that CTU vide mail 20.11.23 to POWERGRID requested information regarding maximum rating of the HTLS conductor suitable for Reconductoring of 400 kV Kishenpur-Kishtwar line (Twin Zebra), considering altitude and the bundle size of the line. It was also requested that POWERGRID may confirm the feasibility of the line bay upgradation requirements at Kishenpur Substation pertaining to the above line. In this regard POWERGRID vide mail 08.12.23 informed that 400 kV Kishenpur-Dulhasti line (Twin Zebra) line has bay equipment rating of 2000A (CB,CT, Isolator). In view of that bays upgradation is also required with Reconductoring of 400 kV Kishenpur-Kishtwar line (Zebra). Conductor configuration for reconductoring of 400 kV Kishenpur-Kishtwar line will be finalized based on POWERGRID inputs.

In the latest JCC meeting, M/s RHPCL informed commission schedule for their 850MW (4x205+1x30MW) HEP project. progressively from May’26. Further in the present meeting, M/s RHPCL confirmed the commissioning schedule of generation project progressively from

May'26. It was also requested that M/s RHPCL may also confirm generation schedule through mail/letter.

Grid-India in the meeting as well as in mail 04.12.23 queried about expected timelines of other HEP in the area such as Kiru, Kawar, Kirthai-I, Kirthai-II etc. as maximum of nearly 4000MW could be evacuated through 3 outgoing lines from Kishtwar i.e. 2 lines to Kishenpur and one line to Samba.

CTUIL informed that at present connectivity application received at Reoli Dugli, Purthi, Bardang and Dugar HEPs with schedule progressively from 2029, however no application is yet to received from Kiru, Kawar, Kirthai-I and Kirthai-II HEPs.

For evacuation of power from Reoli Dugli, Purthi and Bardang HEPs, separate high capacity transmission system will be planned and based on studies, connectivity of above high capacity corridor with Kishtwar S/s (via Dugar HEP) will be finalized.

Grid-India also stated that fault level at Kishtwar & Kishenpur also need to checked after the proposed interconnections. Based on the fault level assessments & transmission plan, switchgear rating may be selected. From the studies it is emerged that with Ratle HEP, fault level of Kishtwar S/s is about 23kA (designed capacity:50KA) and Kishenpur S/s is about 37kA (designed capacity: 40kA) which is within limits.

Further Grid-India stated that the requirement of line reactors for lines such as 400kV Kishtwar-Kishenpur (132km) and 400kV Kishtwar-Samba (160km) may be studied given the persistent issues of high voltage in hydro complex in winter months during off-peak hours. CTU informed that requirement of line reactor will be reviewed considering space availability. Accordingly, CTU analyzed the reactive compensation requirement, however feasibility for installation of line reactors along with space confirmation from POWERGRID & Sterlite is awaited. Same will be intimated in next CMETS-NR meeting.

Grid-India also mentioned in mail that the bay allocation of feeders at Kishtwar station is very important & incomer and outgoing feeders need to be kept in same diameter. PSTCL stated that they are planning to establish new substation at 400kV Wadala Granthian for which LILO of 400kV Jallandhar-Samba is under planning. CTU stated that at present with proposed scheme 400kV Samba-Jalandhar (Twin) (after bypassing above line will be Kishenpur-Samba (Twin)) and 400kV Samba-Jalandhar (Quad) line will be available for LILO in 2026-27 timeframe. In view of that PSTCL may carried out the studies for both the alternatives and share with CEA & CTU. PSTCL agreed for the same.

in view of above, following ISTS transmission scheme is agreed for evacuation of power for Ratle HEP (850MW):

Common Transmission system for Connectivity under GNA (under ISTS) :

Sl. No.	**Description of Transmission Element**	**Scope of work**

		(Type of Substation/Conductor capacity/km/no. of bays etc.)
1	400 kV Kishenpur-Samba D/c line (Quad) (2nd)	Length -35 km (Quad)
2	Bypassing of 400kV Kishtwar – Kishenpur line (Quad) (Under implementation as part of Pakaldul transmission scheme) at Kishenpur and connecting it with one of the circuit of Kishenpur-Samba 400kV D/c line(Quad), thus forming 400kV Kishtwar - Samba (Quad) direct line (one ckt)	
3	1x63 MVAr Switchable line reactor at Samba end of 400kV Kishtwar-Samba 400kV line(Quad) [formed after bypassing of 400kV Kishtwar – Kishenpur line (Quad) at Kishenpur and connecting it with one of the circuit of Kishenpur-Samba 400kV D/c line(Quad))	• 420 kV, 63 MVAr switchable line reactors at Samba S/s end– 1 nos. • Switching equipment for 420kV, 63 MVAr switchable line reactors at Samba S/s end – 1 no
4	Bypassing both ckts of 400kV Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin) at Samba and connecting them together to form Kishenpur– Jalandhar D/c direct line (Twin)	
5	Bays upgradation works (2000A to 3150A) at Samba end (bays vacated after bypassing of Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin))	Bay upgradation works- 4 nos. bays
6	1x80 MVAr Switchable line reactor at each ckt at Jallandhar end of Kishenpur– Jalandhar D/c direct line (Twin) (formed after bypassing both ckts of 400kV Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin) at Samba and connecting them together to form Kishenpur– Jalandhar D/c direct line (Twin))	• 420 kV, 80 MVAr switchable line reactors at Jallandhar S/s end– 2 nos. • Switching equipment for 420kV, 80 MVAr switchable line reactors at Jallandhar S/s end – 2 no
7	400kV Samba- Jalandhar D/c line(Quad) (2^{nd}) (only one circuit is to be terminated at Jalandhar while second circuit would be connected to bypassed circuit of Jalandhar –Nakodar 400kV D/c line)	Line Length -135 km
8	1x63 MVAr Switchable line reactor at Samba end of Samba –Nakodar direct line (Quad) (formed after bypassing of 400kV Jalandhar – Nakodar line (Quad) at Jalandhar and connecting it with one of the circuit of Samba-Jalandhar 400kV D/c	• 420 kV, 63 MVAr switchable line reactors at Samba S/s end– 1 nos.

	line(Quad Moose), thus forming Samba –Nakodar line (Quad))	Switching equipment for 420kV, 63 MVAr switchable line reactors at Samba S/s end – 1 no
9	Bypassing 400kV Jalandhar – Nakodar line (Quad) at Jalandhar and connecting it with one of the circuit of Samba-Jalandhar 400kV D/c line(Quad Moose), thus forming Samba –Nakodar line	
10	Reconductoring of 400 kV Kishenpur-Kishtwar line (Twin HTLS) (up to LILO point 400 kV Kishenpur- Dulhasti line) (minimum 2100 MVA capacity) (formed after LILO of Kishenpur-Dulhasti line at Kishtwar S/s) along with bay upgradation works (2000A to 3150A) at Kishenpur end for above line	Length – 132kms Bay upgradation works- 2 nos. bays
11	LILO of 400 kV Kishenpur- Dulhasti line (Twin HTLS) (minimum 2100 MVA capacity) at Kishtwar S/s (one ckt already LILOed as part of Pakaldul transmission system)	LILO Length- 10kms

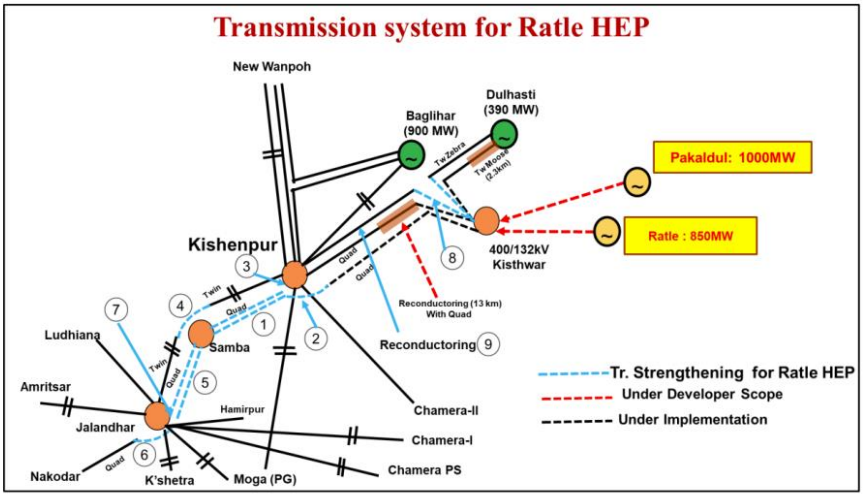


Figure 4-15: Transmission scheme for Ratle HEP

The scheme is being taken up for approval in NRPC meeting

(c) Augmentation of 400/220 kV, 1x315 MVA (3rd) ICT at 400/220 kV New Wanpoh (PG) substation

In 206th NR OCC meeting, POWERGRID highlighted that presently there is non- compliance of N-1 contingency in ICTs at some of its substations incl. New Wanpoh Substation. Accordingly, the proposal was deliberated in the 21st CMETS-NR meeting held on 31.07.23. In the meeting it was discussed that from the loading pattern of New Wanpoh ICTs (2x315 MVA), it is observed that Loading of ICTs have reached maximum of about 390 MW

(195MW/ICT) in past one year and loading is not breaching N-1 limit for peak Loading of ICTs (460 MW i.e. 230MW/ICT). Further, from rolling plan studies (2027-28) also, ICT is not breaching N-1 limits (after considering future interconnections). JKPTCL was requested to provide their inputs on 400/220kV ICT requirement at New Wanpoh S/s w.r.t upcoming interconnections from Mattan and Alusteng S/s along with details of load growth in above area. JKPTCL was also requested to update the commissioning schedule of above 220kV lines. JKPCTL stated that at present Alusteng substation is interconnected to Zainkote and Leh through 220kV lines and to provide redundant power supply, interconnection from New Wanpoh to Alusteng is under implementation (Dec'23) and may delay for 1-2 months.

JKPTCL stated that at present there is no need of this additional ICT, however, with the commissioning of their Mattan & Harven substations (to be commissioned in sep'23 with interconnection with Alusteng s/s), the loadings will increase at New Wanpoh S/s and therefore ICT augmentation may be considered in pipeline for implementation. CTU enquired about schedule of 220 kV New Wanpoh – Mattan D/c Line. JKPTCL informed that New Wanpoh - Mattan line has funding issues and implementation may take minimum 18 month's time from present. CTU stated that as per sharing regulation, charges for above ICT will be borne by JKPTCL under transformer component and therefore they need to confirm the ICT requirement at New Wanpoh along with schedule as ICT augmentation may take minimum 18 months.

POWERGRID suggested that implementation time of 18 months may not be sufficient for new ICT installation at New Wanpoh S/s due to transportation and limited working window in winter season. CTU noted the same and stated that special consideration for ICT implementation timeline will be decided at allocation stage. POWERGRID vide mail dated 28.06.23 confirmed the space availability for Augmentation of 400/220kV transformer (3rd 315 MVA Single phase units of 105MVA). Grid-India suggested that ICT augmentation can be taken up as ICTs may become n-1 non compliant in future and it is suggested that JKPTCL may agree to take up the ICT augmentation.

JKPTCL informed that they are expediting interconnection of New Wanpoh – Alusteng line and in view of growing demand and provide redundancy to Alusteng, JKPTCL require ICT augmentation at New Wanpoh substation. CTU stated that JKPTCL may also confirm the requirement to CTU through mail. Subsequently, JKPTCL vide letter dated 21.08.23 to CEA informed that the transmission plan (Kashmir region) for 2022-27 envisages addition of 2479 MVA at different voltage levels and stands approved in the CEA meeting held on 19-02-2021. This includes 1130 MVA at 220/33 kV Level, 480 MVA at 220/132 kV level and 869 MVA at 132/33 kV level. The commissioning of the new Grid Stations necessitates provision of new sources or capacity augmentation at 400/220 kV level to enable the trickling down of the benefits of the new Grid stations to the consumers. In the JKPTCL letter, it was also stated that the existing sources of power shall not be able to cater to the increased demand of power and this necessitates immediate steps to augment the sources. The 220/132kV GSS Delina has been augmented from 320 MVA to 480 MVA and it is proposed to augment the existing and 220/132 kV GSS Zainakote from 450 MVA to 700 MVA by the 2024. In the letter it was also informed that maximum drawl of power from 400/220kV, 2x315MVA (630MVA) New Wanpoh S/s during the previous winters has been more than 400MW and as such it is essential that New

Wanpoh substation is augmented by atleast 50% i.e. 315MVA to meet the growing demand of power in the valley.

Considering the request of JKPTCL to meet the growing demand of power in J&K, as well as to fulfill the N-1 criteria of ICTs in future, proposal to implement one no. of 400/220kV, 315 MVA ICT (3rd) at New Wanpoh (PG) S/s under ISTS was agreed in 21st CMETS-NR meeting. Further JKPTCL vide letter dated 07.10.23 informed that as per the present trend of power demand and the upcoming downstream projects, it is imperative that 400/220kV New Wanpoh substation is augmented by the end of 2025. In reply to CTU mail to provide firm schedule to implement 315 MVA ICT (3rd) at New Wanpoh (PG) S/s, JKPTCL vide mail dated 01.02.24 mentioned the firm schedule to be considered as 31.12.25 for above ICT augmentation.

The scheme is under implementation with following details

Project Name - Augmentation of 400/220 kV, 1x315 MVA (3rd) ICT at 400/220 kV New Wanpoh (PG) substation.

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	Augmentation of 400/220 kV,1x315 MVA (3rd) ICT (3x105 MVA single phase units) at New Wanpoh S/s along with associated transformer bays	315 MVA, 400/220 kV ICT (3x105 MVA single phase units)- 1 no. 400 kV ICT bay (AIS) – 1 no. (in existing dia) 220 kV ICT bay (AIS) – 1 no.	31.12.25
		Total Estimated Cost:	**INR 61.08 Crore**

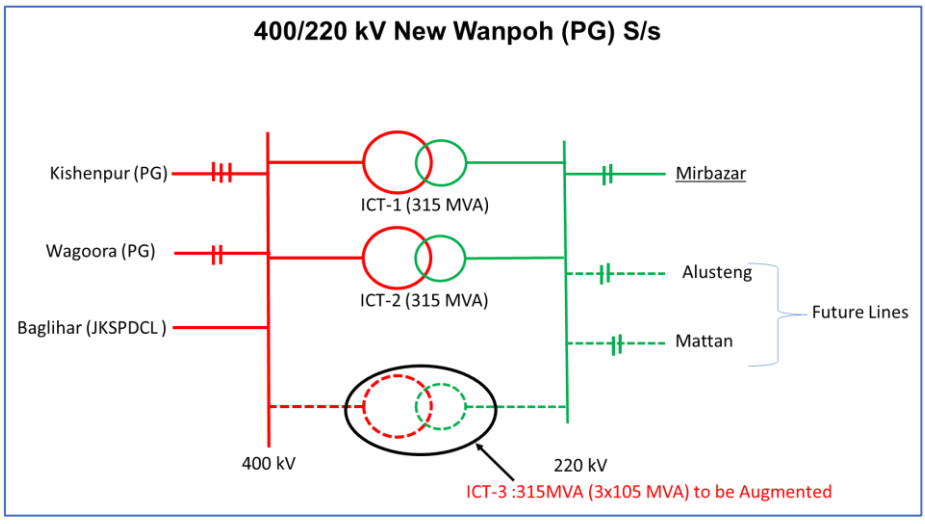


Figure 4-16: Schematic of 400/220 kV New Wanpoh (PG) S/s

4.4.5 Uttar Pradesh

a. Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT

In 207th OCC meeting held on 19.05.23, POWERGRID agenda for Non-Compliance of N-1 contingency in ICTs at Allahabad Substations was deliberated. In the meeting, POWERGRID highlighted that at present there are 3x315 MVA ICTs at Allahabad S/s and loading on these ICTs have increased substantially in past few years and requested forum to review the need for additional transformation capacity. It was decided in the meeting that CTU may be asked to do the system studies based on present and future forecasted load. Further, in the Quarterly operational feedback (Qtr 1 & 2) of FY-2022-23, Grid-India also highlighted the issue of 'N-1' non-compliance of loading of ICTs at Allahabad S/s.

The proposal was deliberated in the 20th CMETS-NR meeting held on 30.06.23. In the meeting it was stated that from the loading pattern of Allahabad ICTs (3x315 MVA), it is observed that it is above N-1 limit for sufficient duration of time in most of time in year (except Oct-Dec). Loading of ICTs have reached maximum of about 860 MW in summer season (July'22, April'23 & May'23). From studies, it emerged that on 3 no. of 315 MVA ICTs, loading of ICTs was more than 'N-1' compliance limit (>750 MW) in evening peak demand scenario of summer season.

POWERGRID vide mail dated 22.06.23 confirmed space availability for Augmentation of 1x500 MVA (4th), 400/220kV ICT at Allahabad Substation. However, 220kV side ICT bay will be AIS Type with ICT side termination through 220kV Cable/GIB. In the meeting, GRID-INDIA agreed for above proposal as the issue was already highlighted in operational feedback report. It was highlighted that Short Circuit level at 400 kV Allahabad S/s will increase to 52kA in next 5 years against the designed capacity of 40kA. With augmentation of one 500MVA ICT, short circuit level will further increase by 1 kA.

In the CMETS-NR meeting, Grid-India informed that short circuit level of most of old substations in Singrauli/ Rihand/ Anpara complex is high, however ICT augmentation is required with UP confirmation on above proposal as well as any intra state plan to relieve the loading of Allahabad ICTs.

UP informed that recently 400/220kV Jaunpur (1x315MVA +2x315MVA ICTs UC) S/s is commissioned which relieved Allahabad ICT loading marginally, however overloading is still there at Allahabad substation. In addition to that UPPTCL also do not have any future plan in nearby area to relieve the ICT loading at Allahabad. UP stated they have also carried out studies in Jun'24 timeframe in which 400/220kV Allahabad ICTs were observed to be overloaded and therefore ICT augmentation is required at 400/220kV Allahabad substation to meet the demand from 400/220kV Allahabad S/s reliably.

Considering the growing demand of power in UP, as well as to meet the N-1 criteria of ICTs, it was agreed to implement one no. of 400/220kV, 500 MVA ICT (4th) at Allahabad (PG) S/s under ISTS in the 20th CMETS-NR meeting.

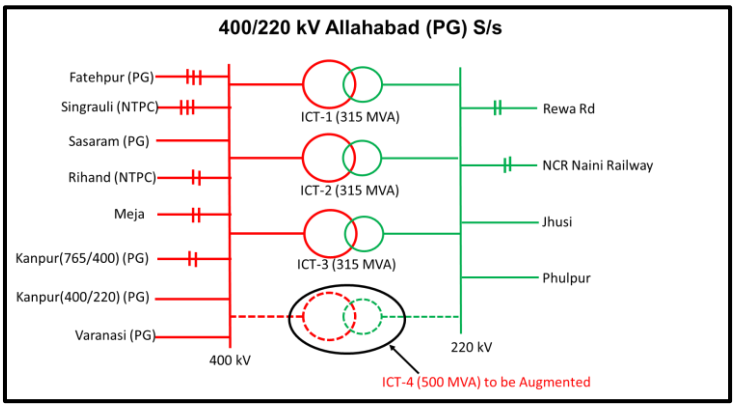


Figure 4-17: Schematic of 400/220 kV Allahabad (PG) S/s

The scheme is under implementation with following details

Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	Augmentation of Transformation Capacity at 400/220kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT along with associated transformer bays (AIS) and 220kV Cable for ICT bay termination.	• 500 MVA, 400/220 kV ICT- 1 no. • 400 kV ICT bay (AIS) – 1 no. • 220 kV ICT bay (AIS) – 1 no. • 220kV Cable for ICT bay termination – 1 Lot	18 months from the date of issue of OM by CTUIL.
		Total Estimated Cost:	**₹ 61 Crore**

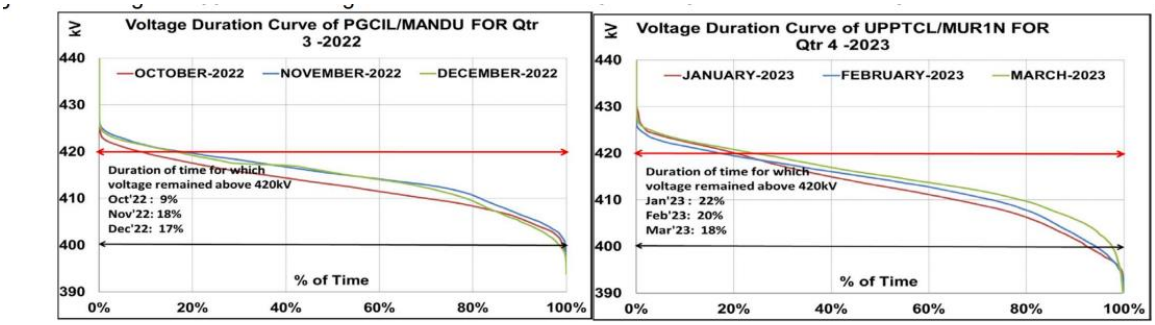
b. Replacement of existing 420kV 50MVAR Bus Reactors at Mandola & Muradnagar substation with 125MVAr bus reactor

POWERGRID vide letter dated 30.10.23 informed that 400/220kV Mandola substation in NR-I was commissioned in 1990 and 50MVAR Bus reactor (BHEL make, 3-phase) on this substation was commissioned in 1991. Due to the ageing of reactor, frequent leakages have been observed despite all preventive measures/overhauling of the reactor. The furan value of the reactor is also in increasing trend and present value is 2.4PPM. As reactor has already completed more than 32 years of service life and any major maintenance may not be enough to ensure further reliable & longer service period

In the above letter, it was also mentioned that apart from the above, 01 no. 420kV, 50MVAR Bus reactor (3x16.67 MVAR, CGL make 1 phase unit, DOCO - 1988) was commissioned at

Muradnagar substation of UPPTCL (owned by POWERGRID). Frequent oil leakages and deteriorated oil parameters along with high vibrations have been observed in these units. This reactor is also not reliable and is vulnerable to fail due to its ageing. Further any major maintenance may not be enough to ensure further reliable & longer service period. As the system fault level at both the substations have increased over a period of time (more than 30 years), therefore bus reactors of 50 MVAR may not be adequate at both stations (Mandola & Muradnagar). POWERGRID requested to review the augmentation of above said bus reactors for better voltage regulation.

In Grid India operational feedback report FY 2022-23(Q3) also, it was mentioned that voltage at 400kV Mandola remains more that 420kV for 9-18% of time and 415kV and above for about 40% of time. Similarly from operational feedback report FY 2022-23(Q4) it emerged that voltage at 400kV Muradnagar remains more than 420kV for 18-22% of time and 415kV and above for about 40% of time



Voltage duration curve of 400kV Mandola & Muradnagar for 2022-23 (Source: Grid-India)

Grid-India stated that voltage on 400kV Mandola and Muradnagar S/s remains high in various operational scenarios and already highlighted in Grid-India operational feedback report, so proposal is agreeable to them. CEA also agreed for the proposal.

POWERGRID suggested that proposal will be considered in ADD CAP in taken up in NRPC meeting. CTU stated that POWERGRID may send proposal to NRPC for its approval in ensuing NRPC meeting.

From Grid-India operational feedback as well as inputs received from POWERGRID, it was decided in the meeting that it is technically recommended to replace 50MVAr bus reactor each at Mandola (PG) & Muradnagar (UPPTCL) with 125MVAr (420kV) bus reactor.

4.4.6 Delhi

(a) Replacement of 1x315 MVA (ICT-3), 400/220 kV ICT to 500 MVA at 400/220 kV Bawana S/s

The Scheme comprises Replacement of 400/220 kV, 1x315 MVA (3rd) ICT (ICT-3) to 500 MVA at 400/220/66 kV Bawana (DTL) substation. The proposal was deliberated in the 26th CMETS-NR meeting held on 01.12.23, . In the meeting it was stated that CEA vide mail 30.08.23 informed that DTL vide its letter 28.08.23 to CEA, submitted the proposal for replacement of existing 400/220 kV, 315 MVA ICT (ICT-3, POWERGRID Asset) at Bawana substation with 500MVA ICT, to meet the peak load requirement of Delhi. In the letter, DTL

has informed that there are 6 nos. of 400/220 kV, 315 MVA ICTs installed at Bawana substation of DTL out of which ICT-3 belongs to POWERGRID and rest 5 nos. ICTs belong to DTL. Due to high fault level, bus split operation has been implemented at Bawana and 2x315 MVA ICT (ICT-2 &3) ICT, 4x315 MVA ICT (ICT-1,4,5 & 6) are kept on different bus sections.

As per loading conditions at Bawana substation, DTL has already planned replacement of ICT-2 and ICT-4 with 500 MVA ICTs. In addition, replacement of ICT-3, which belongs to POWERGRID is also required to make the system 'N-1' compliant. In view of that, CEA requested to CTU & Grid-India to furnish comments on the proposal. GRID INDIA vide mail dated 01.09.23 informed that due to split bus arrangement, the section having 2x315MVA ICTs is N-1 non-compliant at the time of high demand of Delhi state control area. The issue of N-1 non-compliance is being continuously raised by NRLDC in NR-OCC and NRPC meetings and also submitted in quarterly operational feedback to CTUIL/CEA. On highlight of the issue by NRLDC, DTL has implemented SPS at Bawana S/s section having 2x315 MVA ICTs. Considering above, Grid-India suggested to go ahead with ICT augmentation at 400/220kV Bawana with the future plan of drawl by Delhi from Bawana and nearby area to ensure N-1 compliance on 2 ICT section(s). CTU vide mail 06.09.23 informed that from the real time loading pattern shared by Grid-India, it emerged that total loading on 2x315 MVA ICTs (in one section) are in order of 400-450 MW during peak load scenario and ICTs may become N-1 non compliant in near future with growing demand.

Therefore, replacement of both the ICTs (ICT-2 &3) is required to ensure N-1 compliance. CTU also stated that establishment of 400/220kV Tikrikhurd Substation along with LILO of 400kV Bawana-Mandola D/c line were earlier approved in 2nd Meeting of NRPC-TP held on 1.09.2020, however the scheme is not yet awarded by DTL. It is requested that DTL may expedite the implementation of Tikrikhurd Substation as it will relieve the loading on Bawana ICTs in future.

CTU vide mail 11.09.23 requested POWERGRID to provide information regarding year of make for ICT-3 (315MVA) and, its remaining useful life (ICT & associated bays) as well as healthiness of above transformer (Residual Life Assessment Studies if any).POWERGRID vide email dated 18.09.2023 and letter dated 03.10.23 informed that 400/220/33 kV, 315 MVA ICT-3 along with associated bays (owned by POWERGRID) at Bawana substation was commissioned in June’1997. The equipment of associated bays of said ICT at Bawana have been replaced under ADD CAP (CB, CT & relays). Remaining bay equipment i.e. Isolators, CTs, Surge Arrestors are being replaced under ADD CAP 2019-2024.It is further to mention that ICT (BHEL make) which was commissioned in Jun’1997 was failed in Sep’18 and new ICT (Siemens make, YO - 2011) was commissioned in Nov’2018 in place of failed BHEL make ICT. The present ICT is in healthy condition and may be kept as regional spare. Grid-India stated that POWERGRID may inform OCC for above 315MVA ICT to be used as regional spare.

CEA vide letter dated 18.09.23 informed that replacement of both the 400/220 kV, 315 MVA ICTs (ICT-2 & 3) with 500 MVA ICTs is required to ensure 'N-1' compliance, out of which,

replacement of ICT-2 is already planned by DTL. In view of the above, proposal submitted by DTL for replacement of 400/220 kV, 315 MVA ICT (ICT-3), is generally in order. Grid-India & CEA in the 26th CMETS-NR meeting agreed for the proposal and emphasized on urgent requirement of replacement of both the ICTs (ICT-2 in Intra state and ICT-3 in Inter state) at Bawana S/s. DTL agreed for the requirement of ICT-3 (ISTS). CEA and CTU also stated that DTL may also expedite the replacement of ICT-2 (315 MVA with 500MVA), for N-1 compliance at Bawana S/s. DTL agreed for the same.

In view of above, Replacement of 400/220kV, 1x315 MVA (3rd) ICT (ICT-3) to 500 MVA at 400/220/66 kV Bawana (DTL) S/s to meet the N-1 criteria of ICTs was agreed in the 26th CMETS-NR meeting.

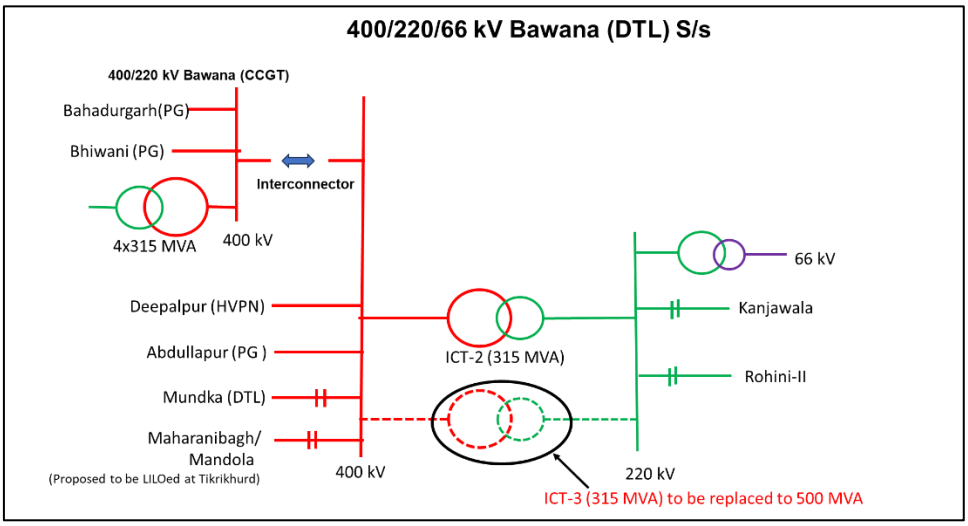


Figure 4-18: Schematic of 400/220/66 kV Bawana (DTL) S/s

The scheme is under implementation with following details

Project Name - Replacement of 1x315 MVA (ICT-3), 400/220 kV ICT to 500 MVA at 400/220/66 kV Bawana (DTL) substation

Sl. No.	Scope of the Transmission Scheme	Capacity/km	Implementation timeframe
1	Replacement of 400/220 kV, 1x315 MVA (3rd) ICT (ICT-3) to 500 MVA at 400/220/66 kV Bawana (DTL) substation	500 MVA, 400/220 kV ICT - 1 no.	18 months from the scheme allocation
		Total Estimated Cost:	**INR 40.6 Crore**

4.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in section 4.3, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are

expected to be commissioned in 2028-29 timeframe are considered for conducting these studies.

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 75 GW 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.

As part of committee report "Transmission system for integration of over 500GW capacity by 2030" as well as MNRE/SECI inputs, a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan is evolved. In the report, implementation of transmission system has been phased out in 3 parts; Phase-I by March 2025, Phase-II by December 2027 and Phase-III by December 2030. Therefore, priortized phase-I & phase-II potential and associated transmission system has also been considered in the PSSE files prepared for Rolling Plan of 2028-29 timeframe.

System studies have been conducted on these files prepared for 9 scenarios. Results of these studies were analysed and the same are deliberated in subsequent sections-

4.5.1 Short Circuit Analysis

Short circuit level was calculated for all 765kV and 400 kV buses of Northern Region and buses having fault level more than the design rating under any scenario were identified. From analysis it is emerged that there are 36 nos. of substations (765kV-1 nos., 400kV- 35 nos) in NR having fault level more than 10% of designed capacity

Out of above, 18 nos. of ISTS substations and 18 nos. of STU/Generator substations are there for which immediate action shall be required. Details of the substations under any scenario are tabulated below in Table 4-6 & Table 4-7:

ISTS Substations

Table 4-6: ISTS Buses Exceeding Designed Fault Level (1.1pu) in NR

Sl. No.	Substation Name	Scenario No.	Highest Fault level (kA)	Design Rating (kA)
1	765kV Meerut	All	46	40
2	400kV Meerut	All	66	40
3	400kV Neemrana	All	55	40
4	400kV Lucknow(765/400kV)	All	55	40
5	400kV Abdullapur	All	52	40
6	400kV Bassi	All	52	40
7	400kV Bhiwadi	All	51	40
8	400kV Ballabgarh	All	50	40
9	400kV Allahabad	All	52	40

10	400kV Patiala	All	48	40
11	400kV Panchkula	All	48	40
12	400kV Bhiwani	Most	55	40
13	400kV Balia	All	48	40
14	400kV Jallandhar	All	45	40
15	400kV Mohindergarh	All	45	40
16	400kV Mandola	All	45	40
17	400kV Sikar	All	44	40
18	400kV Bikaner	All	61	50

STU/Generation Substations

Table 4-7: STU Buses Exceeding Designed Fault Level (1.1pu) in NR

Sl. No.	Substation Name	Owner State	Scenario No.	Highest Fault level (kA)	Design Rating(kA)
1	400kV Greater Noida	UP	All	60	40
2	400kV Greater Noida	UP	All	59	40
3	400kV Dhanonda	Haryana	All	58	40
4	400kv Agra	UP	All	57	40
5	400kV Bawana	Delhi	Most	54	40
6	400kV Jaipur (Phagi)	Rajasthan	All	54	40
7	400kV Bawana Gas	Delhi	Most	54	40
8	400kV Daultabad	Haryana	Most	51	40
9	400kV Hapur	UP	Most	43	40
10	400kV Gaziabad	UP	Most	44	40
11	400kV Meja	UP	Most	50	40
12	400kV Dadri (NTPC)	UP	Most	55	40
13	400kV Anpara C	UP	All	52	40
14	400kV Anpara	UP	All	53	40
15	400kV Nakodar	UP	All	44	40
16	400kV Jhajjar	Haryana	All	48	40
17	400kV Kabulpur	Haryana	All	44	40

Sl. No.	Substation Name	Owner State	Scenario No.	Highest Fault level (kA)	Design Rating(kA)
18	Bhadla	Rajasthan	All	45	40

Studies to limit high short circuit on ISTS S/s will be carried out and taken up in next rolling plan. STUs/Generation developer are also required to take necessary actions such as bus splitting, bypassing of lines, fault limiting reactors etc to resolve the issue of high fault level at their substations.

4.5.2 Contingency Analysis

a) Transmission Lines

In the base case file prepared for 2028-29 timeframe, in NR, 4 nos. of 400 kV lines are observed to be having critical loading in base case or Contingency scenario. Details of such lines are as under Table 4-8 **:**

Table 4-8: Major transmission lines having critical loading in NR

Sl. No.	Name of the Line	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1	400kV Meja-Allahabad D/C Line	2,5,8	ISTS	665	1100	857	130
2	400kV Agra-Agra(UP) Line	1,2,4,5	ISTS	715	871	857	102
3	400kV Lucknow (PG) -Lucknow (765) D/C Line	1,4,7	ISTS	1131	2202	1714	129
4	ANPARA Singrauli 400 kV S/C Line	3,6,8,9	ISTS	839	1100	857	131

Additional system strengthening may be planned by respective STU's to feed the growing demand and increase in drawl from ISTS.

b) Transformers

In the base case file prepared for 2028-29 timeframe, following 400/220kV ICTs are having critical loading. Details of transformers is as under

Table 4-9 :

Table 4-9: Major transformers having critical loading in NR

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
1	400/220kV, 3x315 Kishenpur ICTs	1,4,5,7,8	ISTS	256	317	101	315
2	400/220kV, 3x500 Kurukshetra	2	ISTS	411	511	101	500
3	400/220kV, 3x500 Jind ICTs	1	ISTS	421	515	103	500
4	400/220kV, 2x315 Merta ICTs	2,8	STU	229	324	103	315
5	400/220kV, 1x315 +3x250 Hirapura ICTs	4,7	STU	295(315MVA) 234 (250MVA)	274	110	250
6	400/220kV, 2x315 Hindaun ICTs	4,5,7,8	STU	260	381	121	315
7	400/220kV, 2x315 Deedwana ICTs	`1,4,7	STU	237	352	112	315
8	400/220kV, 2x315 Ajmer ICTs	2,4,5,7	STU	270	378	120	315
9	400/220kV, 2x315 Kota ICTs	4,7,8	ISTS	320	400	127	315
10	400/220kV, 3x315 Chittorgarh ICTs	4,7	STU	282	365	117	315
11	400/220kV, 2x315+1x500 Bassi ICTs	1,4,7	ISTS	254 (315MVA)/ 403(500MVA)	341	109	315
12	400/220kV, 2x315+1x240 Orai ICTs	1,2,4,5	STU	2x268+1x204	263	110	240
13	400/220kV, 2x315 Kanpur ICTs	1,4	ISTS	293	375	120	315
14	400/220kV, 3x500 Patran ICTs	1	ISTS	412	535	107	500
15	400/220kV, 2x500 Aligarh ICTs	1,2,4,5	STU	371	527	106	500
16	400/220kV, 2x315 Suratgarh ICTs	2	STU	256	356	113	315
17	400/220kV, 4x500 Bhadla ICTs	4	STU	400	509	102	500

Respective STUs/Owners are required to take advance action to mitigate this issue. Additional system strengthening in these areas such as planning additional feeds from ISTS, shifting of loads, ICT augmentation, increase in self generation, etc. may be required to feed the growing demand.

4.5.3 Voltage Analysis

Voltages of all 765 kV and 400 kV buses were observed in all the nine scenarios. Maximum and minimum voltage of each bus were identified from the bus voltages in the nine number of scenarios. From the simulation results, no issue of undervoltage it was observed in Northern Region. However, 765kV & 400kV buses were observed to be having voltage more than 1.03 pu (≥1.03pu in minimum 2 scenarios is depicted in Table

Sl. No.	Bus Name	Voltage Level (kV)	Owner	Max(pu)	Scenario
1	Siwani	765	ISTS	1.03	8,9
2	Bikaner-IV	765	ISTS	1.03	2,6,9
3	Jaipur (Phagi)	765	STU	1.04	5,7
4	Ghiror	765	ISTS	1.04	1,2,6,7,9
5	Unnoa	765	STU	1.04	1,3,6,7,8,9
6	Fatehgarh	765	ISTS	1.03	1,7
7	Sahapuri	400	STU	1.03	6,7,9
8	Unchahaar	400	STU	1.03	1,7
9	Mainpuri	400	STU	1.03	1,7,9
10	Gonda	400	STU	1.04	1,7,8,9
11	Unnao	400	STU	1.04	1,6,7,8,9
12	Bareilly	400	STU	1.03	1,7,9
13	Bareilly	400	ISTS	1.03	1,7,9
14	Aligarh	400	ISTS	1.03	1,7
15	Lucknow	400	STU	1.03	1,7,9
16	Mainpuri	400	ISTS	1.04	1,7,9
17	Fatehgarh	400	ISTS	1.03	1,7
18	Panki	400	STU	1.03	1,7,9
19	Shahjahanpur	400	ISTS	1.03	1,7,9
20	Rosa	400	STU	1.03	1,7,9
21	Bareilly	400	ISTS	1.03	1,7,9
22	Sultanpur	400	STU	1.03	1,7,9
23	Khurja	400	Gen	1.03	1,7
24	Aligarh	400	STU	1.03	1,7,9
25	Panki	400	STU	1.03	1,7,9
26	Mohanlalganj	400	STU	1.03	1,7,9
27	Ghiror	400	ISTS	1.03	1,7
28	Maheba	400	STU	1.03	6,9
29	Farrukhabad	400	STU	1.04	6,7,9
30	Badaun	400	STU	1.04	1,6,7,9
31	Sambhal	400	STU	1.03	7,9
32	Jehta_Hardoi	400	STU	1.03	1,7,9
33	Raebareli	400	ISTS	1.03	1,7

From the voltage analysis, it is emerged that some of substations i.e. Siwani, Bikaner-IV, Fatehgarh, Bareilly, Aligarh, Ghiror etc. utilized for evacuation of Solar/RE power in

Rajasthan.. Due to no solar generation in evening/night time, there is minimal power flow on these 765kV long lines impacting high voltages. However adequate bus reactive compensation is also provided in this regard.

Some of substations i.e. Sambhal, Raebareli, Farukhabad, Maheba, Panki, Rosa, Mainpuri, Panki, Lucknow, Unnao etc. having high voltage in off peak scenarios and in winter season due to low demand in NR.

In the 4th NRPC meeting, issue of high voltage and requirement of reactive compensation at various substations was deliberated. In the meeting CTUIL informed that due to prevailing high voltage in NR grid. Based on the inputs from STUs, CTUIL would carry out the studies to assess the requirement of reactive compensation at various nodes in Northern Region to overcome the issue of high voltages.

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Chapter 5: Western Region

Due to geographical location, Western Region is connected to Northern, Southern and Eastern Regions through 765/400kV high-capacity corridors along with Back-to-Back HVDCs and Bi-Pole HVDC links. The thermal generating stations of Western Regions are predominantly concentrated in the coal rich states of Chhattisgarh, Eastern part of Maharashtra and Madhya Pradesh. Further, Gujarat, Maharashtra and Madhya Pradesh are RE rich states comprising of Solar & Wind capacity. Western part of Maharashtra, southern Gujarat and DD & DNH have high demand and less internal generation. Accordingly, power flows from Chhattisgarh/ Eastern Maharashtra through high-capacity corridors to Western part of Maharashtra, Southern Gujarat, DD & DNH. Based on the generation availability and demand, Western Region imports power from other regions during high RE scenarios whereas it exports power to other regions during evening peak and night off peak load.

5.1 Power Supply Scenario as on Jan'24

As on Jan'2024, total Installed Capacity (IC) of Western Region was about 141GW which constitute capacity from fossil sources (62% share) & balance (38% share) from non-fossil sources comprising of nuclear, renewable generation capacity including hydro and the peak demand met was about 73 GW. The share from non-fossil sources would further increase in future considering India's vision of generating 500 GW of non-fossil generation capacity by 2030. At present, there is no shortage of power supply in meeting these demands. State-wise breakup is summarised at **Table 5-1.**

Table 5-1:WR Installed Capacity and Demand met as on Jan'24

(All Fig in GW)

State	Generation								Peak Demand Met
	Fossil			Non-Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total		
Gujarat	18.6	6.6	25.1	0.8	0.8	22.0	23.5	48.7	24.5
MP	16.0	0.3	16.3	0.4	3.2	6.3	10.0	26.2	17.8
Maharashtra	25.4	3.5	28.9	0.9	3.3	13.9	18.1	47.0	28.0
Chhattisgarh	12.2	0.0	12.2	0.1	0.2	1.4	1.8	14.0	5.8
UT of DD & DNH	0.6	0.1	0.7	0.0	0.0	0.0	0.1	0.8	1.3
Goa	0.5	0.1	0.6	0.0	0.0	0.0	0.1	0.6	0.8
Central unallocated	2.8	0.2	3.0	0.3	0.0	0.0	0.3	3.4	0.0
WR	**76.1**	**10.8**	**86.9**	**2.5**	**7.6**	**43.7**	**53.8**	**140.7**	**72.6**

Source: CEA Monthly Report

5.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Western Region demand for 2028-29 timeframe is expected to increase to about 100 GW. The Installed capacity of Western Region is expected to be about 213GW. The state wise bifurcation of the same is given at Table 5-2**.**

Table 5-2: WR Installed Capacity and Peak Demand (2028-29)

(All Fig in GW)

State	Generation							ESS	Grand Total	Peak Demand
	Fossil			Non-Fossil						
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Gujarat	7.8	2.8	10.6	0.0	0.3	15.9	16.2	0.2	27.0	31.5
MP	6.9	0.0	6.9	0.0	3.1	4.8	7.9	0.0	14.8	24.1
Maharashtra	19.5	1.2	20.7	0.0	2.5	10.0	12.6	0.4	33.7	39.9
Chhattisgarh	1.6	0.0	1.6	0.0	0.1	0.2	0.4	0.0	1.9	8.2
DD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
DNH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Goa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Central	20.6	3.3	23.9	3.2	0.0	66.3	69.5	3.0	96.4	
IPP	36.8	2.8	39.6	0.0	0.0	0.0	0.0	0.0	39.6	
WR	**93.2**	**10.1**	**103.3**	**3.2**	**6.1**	**97.2**	**106.5**	**3.6**	**213.4**	**100.2**

There is growth of around 28GW in the peak demand of Western Region from present timeframe to 2028-29. The state wise growth in demand for 2028-29 from present time-frame is tabulated below at **Table 5-3:**

Table 5-3: Increase in Peak Demand of Various States of WR

(All Fig in MW)

Peak Demand				
State	**Present (MW)**	**20th EPS (MW)**	**Increase in demand (MW)**	***CAGR***
	2023-24	***2028-29***		
Gujarat	24544	31515	6971	5.1%
MP	17817	24091	6274	6.2%
Maharashtra	27996	39891	11895	7.3%
Chhattisgarh	5832	8152	2320	6.9%
UT of DD & DNH	1327	1970	643	8.2%
Goa	776	989	213	5.0%
WR	**72556**	**100246**	**27690**	**6.7%**

From the above data it is observed that the CAGR growth of peak demand is maximum for UT of DD & DNH (8.2%) and minimum for Goa (5%).

5.3 Load Generation Balance for 2028-29 timeframe

In Chapter-3, All India Load Generation Balance (LGB) for identified nine scenarios was prepared as per the methodology finalized in consultation with CTU, CEA and GRID INDIA. This section elaborates the Western Region Load Generation Balance (LGB) for 2028-29 time-frame. For Western Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned at **Table 5-4** for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 5-4: Western Region Generation Dispatch and Demand Factors

Scenario No & Name	Generation Dispatch Factors						Demand Factors
	Hydro	Nuclear	Solar	Wind	ESS	Gas	
1-Aug Solar Max	40%	80%	80%	55%	-100%	0%	98%
2-Aug Peak Load	70%	80%	0%	75%	60%	50%	87%
3-Aug Night Off Peak	40%	80%	0%	65%	40%	50%	66%
4-Jun Solar Max	40%	80%	85%	55%	-100%	0%	91%
5-Jun Peak Load	70%	80%	0%	75%	50%	50%	86%
6-Jun Night Off Peak	40%	80%	0%	65%	1%	50%	63%
7-Feb Solar Max	20%	80%	90%	10%	-100%	0%	93%
8-Feb Peak Load	40%	80%	0%	20%	100%	50%	85%
9-Feb Night Off Peak	20%	80%	0%	20%	40%	30%	69%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import/ export of WR and the inter-regional flows through various corridors is summarised in **Table 5-5.** Further, both maximum and minimum is also highlighted in table below.

Table 5-5: Drawl of various states from ISTS grid

All Fig in MW)

IR Flows	Import / Export of Western Region								
Scenario No / Corridors	Aug'28 Time Frame			Jun'28 Time Frame			Feb'29 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
WR-NR	-12323	13298	12114	-10912	16145	10591	-14115	-12	664
ER-WR	-9377	-5457	-6505	-12207	-4563	-4927	-7189	-1492	-1252
WR-SR	-12283	-15918	-11729	-14683	-16999	-8318	-2468	-4448	8028
Western Region	-15205	2860	6915	-13363	3733	7227	-9369	-2943	9969

Out of these nine scenarios, Scenario-1 and Scenario-9 corresponds to two extreme cases with import / export requirement of Western Region i.e. Maximum import (15.2 GW) and maximum export (9.9 GW) scenarios respectively. In all other scenarios, the import/ export of Western Region varies between these two extremes.

Considering the above LGB for nine scenarios, load flow cases were prepared for 2028-29 timeframe. Detailed system studies have been carried out on the finalized load flow cases. The study results are discussed in subsequent sections.

5.4 ISTS Network schemes evolved from Mar'23 to Feb'24

Various transmission systems have been planned for implementation in the Consultation Meetings for Evolving Transmission Schemes of WR (CMETS-WR) and joint study meetings held from Mar'2023 to Feb'2024. These schemes have either been approved or under various stages of approval. The details of the schemes have been summarized below at **Table 5-6:**

Table 5-6: Details of the schemes evolved in WR

Sl. No.	Name of Scheme	Time frame	Tentative cost (in Crores)
	Gujarat		
1.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part A	2026-27	4091
2.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part B	2026-27	4766
3.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part C	2026-27	5340
4.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part D	2026-27	3455
5.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E1	2025-26	216
6.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E2	2025-26	697
7.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E3	2025-26	216
8.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E4	2025-26	235
9.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part A	2028-29	24819

Sl. No.	Name of Scheme	Time frame	Tentative cost (in Crores)
10.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part A1	2025-26	21
11.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part B	2027-28	433
12.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part C	2028-29	12000
13.	Network Expansion scheme in Gujarat for drawl of about 3.6 GW load under Phase-I in Jamnagar area	2026-27	3815
14.	Augmentation of transformation capacity at 400/220kV Bhachau S/s in Gujarat	2025-26	49
15.	Augmentation of transformation capacity at Bhuj-I PS	2025-26	53.14
16.	Augmentation of transformation capacity at Bhuj-II PS	2025-26	413
17.	ICT Augmentation at Bhuj-II PS: Part B	2026-27	587
18.	Augmentation of transformation capacity at 765/400kV Lakadia S/s (WRSS XXI(A) Transco Ltd) in Gujarat – Part A	2025-26	142
19.	Augmentation of transformation capacity at 765/400kV Lakadia S/s (WRSS XXI(A) Transco Ltd) in Gujarat – Part B	2026-27	135
20.	Augmentation of transformation capacity at Lakadia PS: Part C	2026-27	501
21.	Augmentation of transformation capacity at Jam Khambhaliya PS (JKTL): Part A	2026-27	110
22.	Augmentation of Transformation capacity at Jam Khambhaliya PS (JKTL): Part B	2026-27	200
23.	Augmentation of transformation capacity at Banaskantha (Radhanesda) PS (GIS)	2025-26	88
24.	Transmission System for Offshore Wind Zone Phase-1 (500 MW VGF on coast of Gujarat for Subzone B3)	2028-29	6886
25.	Implementation of 400kV bay at Khavda-I PS (KPS1) for interconnection of RE project of Sarjan Realities Pvt. Ltd. (SRPL) (1150MW)	2025-26	31.8
26.	Interconnection of RE developer's DTL at Bay no. 412 of KPS-1 (400kV Bus Section-I)	2025-26	4.7
27.	Interconnection of RE developer's DTL at Bay no. 416 of KPS-2 (400kV Bus Section-I)	2025-26	12.26
Maharashtra			
1.	Western Region Network Expansion scheme in Kallam area of Maharashtra	2025-26	160
2.	Implementation of 1 no. 400kV bay at Kallam PS for interconnection of RE project of Torrent Solar Power Pvt. Ltd. (TSPPL)	2024-25	17.1
3.	Implementation of 1no. 220kV bay at Parli (PG) for interconnection of RE project of Renew Tej Shakti Pvt. Ltd. (RTSPL).	2025-26	5.84

Sl. No.	Name of Scheme	Time frame	Tentative cost (in Crores)
4.	Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune)	2028-29	1921
5.	Implementation of 400kV line bay at 765/400kV Parli (New) S/s for RE Interconnection	2025-26	18
6.	ICT Augmentation at Boisar (PG) S/s	2025-26	49.87
Madhya Pradesh			
1.	Augmentation of transformation capacity at 765/400kV Indore S/s in Madhya Pradesh	2025-26	126
2.	Replacement of 63 MVAr Bus reactor with 125 MVAr Bus reactor at 400kV level of Jabalpur S/s of POWERGRID	2025-26	17
3.	Transmission System for evacuation of power from Mahan Energen Limited Generating Station in Madhya Pradesh	2026-27	558
4.	400kV line bays & ICT Augmentation at 765/400/220kV Mandsaur S/s in MP	2026-27	143
5.	Augmentation of Transformation Capacity at 400/220kV Rajgarh (PG) S/s in MP by 400/220 kV, 1x500 MVA ICT (3rd)	2025-26	71
6.	Augmentation of Transformation Capacity at 400/220kV Rajgarh (PG) S/s in MP by 400/220 kV, 1x500 MVA ICT (4th)	2025-26	76
7.	Implementation of 400kV line bay at 765/400/220kV Indore (PG) S/s in MP for RE Interconnection	2025-26	9
UT of DD & DNH			
1.	Augmentation of transformation capacity at 400/220kV Magarwada GIS S/s in Dadra and Nagar Haveli and Daman and Diu	2025-26	64

Besides the above listed schemes, transmission system to cater to the power requirement of the upcoming Green Hydrogen and Green Ammonia manufacturing hubs in Western Region by 2028-29 (9.5GW at Navinal (Mundra) and 2.465GW at Kandla) has also been planned as a part of the Hydrogen Mission announced by Hon'ble Prime Minister of India on 15th August 2021. The above schemes are in addition to Transmission System for 1.5GW Green Hydrogen/Ammonia projects in Mundra area, which is presently under bidding process.

The schemes are detailed in the following sections.

5.4.1 Gujarat

a) Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW) and Phase-V (8GW)

The transmission system for evacuation of total 30GW power from Khavda RE Park was planned in 5 phases as per details below:

Phase	RE Capacity (GW)	Status of Transmission System
I	3	Under Implementation – • KPS1 S/s and KPS1 – Bhuj 765kV D/c line: Awarded to Adani with SCOD of Jan'24 • KPS2 S/s: Awarded to POWERGRID with SCOD of Dec'24 • KPS1 – KPS2 765kV D/c line: Awarded to Megha Engg with SCOD of Jan'25
II	5	Under Implementation • KPS3 S/s & KPS3 – KPS2 765kV D/c line: Awarded to POWERGRID with SCOD of Dec'24 • Khavda Ph-II Part A - Awarded to Adani with Expected SCOD of March'25 • Khavda Ph-II Parts B & C – Awarded to POWERGRID with Expected SCOD of March'25
III	7	Under Bidding- Agreed in 11th NCT – MoP Gazette issued in Apr'23
IV	7	Scheme discussed in 12th NCT meeting and to be deliberated again in ensuing NCT meeting (with modifications)
V	8 (HVDC)	Scheme discussed in 12th NCT meeting

Transmission Systems for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7GW) and Phase-V (8GW) along with Provision of Dynamic Reactive Compensation at KPS1, KPS3 & Navsari (New) Substations were approved in the 14th CMETS-WR meeting held on 30.12.2022 and in the 46th WRPC meeting held on 03.02.2023. Subsequently, the schemes were discussed in the 12th NCT meeting held on 24.03.2023 wherein Provision of Dynamic Reactive Compensation at KPS1 & KPS3 substations was agreed. However, regarding Khavda Phase-IV scheme, GRID-INDIA observed that large quantum of power is getting pooled at Navsari S/s (about 14,000 MW). Accordingly, it was decided to study the Khavda Phase-IV & Navsari STATCOM scheme again considering possibility of 2nd S/s near Navsari including measures to relieve high injection of power at Navsari. Regarding Khavda Phase-V scheme, GRID-INDIA had pointed out that VSC based HVDC(s) may also be explored in place of a single +/-800 kV LCC HVDC considering its inherent advantages such as reliable operation in low system strength areas, Reactive Power Support, Black-start capability etc. Accordingly, the Phase-V scheme was also agreed to be reviewed.

In order to review the above schemes, joint study meetings were held amongst CEA, CTUIL and GRID-INDIA on 20.04.2023 and 09.05.2023 and the Khavda Phase-IV and Phase-V schemes were agreed to be modified (after incorporating certain Intra-state schemes proposed by GETCO vide their letter dated 21.03.2023). The salient modifications agreed in the meetings are given below:

Phase-IV scheme:

- In order to enhance reliability and resiliency at KPS3, KPS3 – Lakadia 765 kV D/c line was planned instead of KPS3 – KPS2 765 kV 2nd D/c and KPS2 – Lakadia 765 kV 2nd D/c line.

- To enhance redundancy and reliability of power supply to Navsari(New) S/s and further upto Boisar-II S/s, it was agreed to establish South Olpad 765/400/220kV (GIS) S/s and change the termination of the earlier proposed Vadodara – Navsari(New) and Navsari(New) – Boisar-II 765kV D/c lines from Navsari(New) to South Olpad S/s so as to form Vadodara –South Olpad and South Olpad – Boisar-II 765kV D/c lines. To enhance infeeds into South Olpad S/s, Ahmedabad – South Olpad(GIS) (220km.) 765kV D/c line was also agreed. To provide anchoring at 400kV level, LILO of Gandhar – Hazira 400kV D/c line is also planned at South Olpad (GIS) S/s.

- 400kV bus of Boisar-II S/s has been planned to be split into two sections for fault level control at Boisar-II/Velgaon(MH) substations and ±200MVAr STATCOM with 2x125 MVAr MSC, 1x125 MVAr MSR has been proposed at each section. Further, ± 300 MVAr STATCOM with 3x125 MVAr MSC, 1x125 MVAr MSR planned earlier at Navsari (New) S/s has been made part of Phase-IV scheme.

- 765/400kV ICT Augmentation at KPS2 & KPS3 has been suitably modified to suit the requirements of RE injection at the Pooling Stations and 400kV line bays for RE interconnection have been proposed for implementation at KPS2 (Bus sections I & II) and KPS3 (Bus section-II) along with the ICT augmentation scope.

Phase-V scheme

- Instead of 8000MW, ±800 kV HVDC Bipole link (LCC) between KPS2 and Akola-III, following has been agreed:
    - 6000MW, ±800 kV HVDC Bipole link (LCC) between KPS2 and Nagpur

      [The shifting of LCC HVDC terminal from Akola-III to Nagpur would relieve the over loading of 765/400 kV ICTs at Aurangabad (PG)].
    - 2400 MW, ± 525 kV HVDC Bipole link (VSC) between KPS3(HVDC) and South Olpad

- Augmentation of transformation capacity at KPS3(GIS) by 1x1500MVA, 765/400 kV ICT on Bus section-II (8^{th}) (i.e. last 765/400kV ICT at KPS3) has been added to Phase-V scheme whose implementation is proposed to be taken up as per evacuation requirement at KPS3.

The final Transmission Systems for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7GW) and Phase-V (8GW) as agreed in above meetings was noted and agreed in 19^{th} CMETS-WR held on 30.05.2023 & 14^{th} NCT meeting held on 09.06.2023 (Schematic given at **Figure 5-1**). The schemes are detailed below.

Khavda Phase-IV (7GW)

Summary of the packages formulated for implementation of the scheme is given below:

Sl. No.	Name of the scheme	Implementation mode	Estimated Cost (₹ Crores)	Implementation Timeframe from effective date (in months)
1.	Part A	TBCB	4091	24
2.	Part B	TBCB	4,766	
3.	Part C	TBCB	5,340	
4.	Part D	TBCB	3,455	
5.	Part E1	RTM	216	
6.	Part E2	TBCB	697	21
7.	Part E3	RTM	216	24
8.	Part E4	RTM	235	24

The detailed scope of the agreed schemes is given below:

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part A

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Creation of 765 kV bus section-II at KPS3 (GIS) along with 765 kV Bus Sectionaliser & 1x330 MVAR, 765 kV Bus Reactors on Bus Section-II Bus section – II shall be created at 765 kV & 400 kV level both with 3x1500 MVA, 765/400 kV ICTs at Bus Section-II	Bus Section-II at KPS3 765 kV Bus Sectionaliser – 1 set 1500 MVA, 765/400 kV ICT – 3 Nos. 330 MVAR, 765 kV Bus Reactor – 1 No. 765 kV reactor bay – 1 No. 765 kV ICT bays – 3 Nos.
2.	Creation of 400 kV bus Section-II at KPS3 (GIS) along with 400 kV Bus Sectionaliser & 1x125 MVAR, 420 kV Bus Reactors on Bus Section-II and 3 Nos. 400 kV bays at Bus Section-II for RE interconnection	Bus Section-II at KPS3 400 kV Bus Sectionaliser – 1 set 125 MVAR, 420 kV Bus Reactors – 1 No. 400 kV reactor bay – 1 No. 400 kV ICT bays – 3 Nos. (for ICTs at Sl. 1 above) 400 kV line bays – 3 Nos. (for RE interconnection)
3.	KPS3 (GIS) – Lakadia (AIS) 765 kV D/C line	Route length: 185 km
4.	2 Nos. of 765 kV line bays each at KPS3 (GIS) & Lakadia (AIS) for KPS3 (GIS) – Lakadia (AIS) 765 kV D/C line	• 765 kV line bays (GIS) – 2 Nos. (at KPS3 end Bus section-II) • 765 kV line bays (AIS) – 2 Nos. (at Lakadia end)
5.	±300 MVAR STATCOM with 1x125 MVAR MSC, 2x125 MVAR MSR at KPS3 400 kV Bus section-II	• ±300 MVAR STATCOM (with 1x125 MVAR MSC, 2x125 MVAR MSR)

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
		• 400 kV bay – 1 No.
6.	KPS1 (GIS)– Bhuj PS 765 kV 2nd D/C line	Route length: 110 km
7.	2 Nos. of 765 kV line bays each at KPS1 (GIS) & Bhuj PS for KPS1 (GIS) – Bhuj PS 765 kV D/C line	• 765 kV line bays (GIS) – 2 Nos. (at KPS1 end Bus section-II) • 765 kV line bays (AIS) – 2 Nos. (at Bhuj end)
8.	330 MVAR switchable line reactors at KPS3 end of KPS3 (GIS) – Lakadia 765 kV D/C line (with NGR bypass arrangement)	• 330 MVAR, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 1x110 MVAR spare switchable reactor unit at KPS3 (GIS) end

Note:

i. Bay(s) required for completion of diameter (GIS) in one-and-half breaker scheme, shall also be executed by the TSP.

ii. TSP of KPS3 shall provide space for work envisaged at Sl. 1, 2, 4, 5 & 8.

iii. The TSP of the present scheme shall arrange for additional land for installation of STATCOM (with MSC/MSR) as specified at Sl. No. 5 at KPS3 and TSP of KPS3 shall provide space for 1 No. 400 kV bay for termination of STATCOM.

iv. TSP of KPS1 and Bhuj PS shall provide space for work envisaged at Sl. No. 7.

v. The TSP of the present scheme shall arrange for additional land adjoining Lakadia S/s for creation of 2 Nos. 765 kV diameter consisting of 1 main bay & 1 Tie bay (for each diameter) in one-and-half breaker AIS scheme, towards implementation of 2 Nos. 765 kV line bays at Lakadia S/s (at Sl. No. 4) associated with KPS3 – Lakadia 765 kV D/c line and the same shall be extendable in future for integration of 2nd main bay (future line with switchable line reactor) for diameter completion.

vi. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

vii. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part B

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Establishment of 2x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV GIS S/s at a suitable location South of Olpad (between Olpad and	765/400 kV, 1x1500 MVA ICT-2 Nos. (7x500 MVA single phase units including one spare unit)

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
	Ichhapore) with 2x330 MVAR, 765 kV & 1x125 MVAR, 420 kV bus reactors **Future Provisions**: Space for o 765/400 kV ICT along with bays- 4 Nos. o 765 kV line bays along with switchable line reactors – 8 Nos. o 765 kV Bus Reactor along with bay: 2 Nos. o 765 kV Sectionaliser bay: 1 - set o 400 kV line bays along with switchable line reactor – 8 Nos. o 400/220 kV ICT along with bays - 8 Nos. o 420 kV Bus Reactor along with bay: 3 Nos. o 400 kV Sectionalization bay: 1- set o 220 kV line bays: 18 Nos. o 220 kV Sectionalization bay: 1 set o 220 kV BC: 1 Nos. o Establishment of 2500 MW, ± 500 kV South Olpad (HVDC) [VSC] terminal station (2x1250 MW)	400/220 kV, 500 MVA ICT – 2 Nos. 765 kV ICT bays- 2 Nos. 400 kV ICT bays- 4 Nos. 220 kV ICT bays- 2 Nos. 220 kV BC bay – 1 No. 330 MVAR, 765 kV bus reactor- 2 Nos. 125 MVAR, 420 kV bus reactor- 1 No. 765 kV reactor bay- 2 Nos. 765 kV line bay- 4 Nos. 400 kV reactor bay- 1 No. 400 kV line bay- 4 Nos. 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 No.
2.	Vadodara (GIS) –South Olpad (GIS) 765 kV D/C line	Route length: 140 km
3.	240 MVAR switchable line reactors on each ckt at Vadodara (GIS) end of Vadodara (GIS) –South Olpad (GIS) 765 kV D/C line (with NGR bypass arrangement)	• 240 MVAR, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 1x80 MVAR spare bus reactor available at Vadodara (GIS) to be used as spare
4.	2 Nos. of 765 kV line bays at Vadodara (GIS) for Vadodara (GIS) – South Olpad (GIS) 765 kV D/C line	• 765 kV line bays (GIS) – 2 Nos. (at Vadodara end)
5.	LILO of Gandhar – Hazira 400 kV D/c line at South Olpad (GIS) using twin HTLS conductor with minimum capacity of 1700 MVA per ckt at nominal voltage	LILO route length ~ 10 km.
6.	Ahmedabad – South Olpad (GIS) 765 kV D/c line	Route length: 250 km
7.	240 MVAR switchable line reactors on each ckt at Ahmedabad & South Olpad (GIS) end of Ahmedabad – South Olpad (GIS) 765 kV D/c line (with NGR bypass arrangement)	• 240 MVAR, 765 kV switchable line reactor- 4 Nos. [2 for Ahmedabad end and 2 for South Olpad (GIS) end] • Switching equipment for 765 kV line reactor- 4 Nos. [2 for

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
		Ahmedabad end and 2 for South Olpad (GIS) end] • 1x80 MVAR, 765 kV 1-ph spare line reactor – 1 No. (for South Olpad end) • 1x80 MVAR, 765 kV 1-ph spare line reactor being implemented for Lakadia – Ahmedabad line (under Khavda Ph-II Part B scheme) at Ahmedabad S/s to be used as spare
8.	2 Nos. of 765 kV line bays at Ahmedabad S/s for Ahmedabad – South Olpad (GIS) 765 kV D/c line	• 765 kV line bays (AIS) – 2 Nos. (at Ahmedabad end)

Note:

i. TSP of Vadodara S/s shall provide space for work envisaged at Sl. No. 3 & 4 given above.

ii. TSP of Ahmedabad S/s shall provide space for work envisaged at Sl. No. 7 & 8 given above.

iii. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

iv. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part C

Sl. No.	Scope of the Transmission Scheme	Capacity / Route length
1.	Establishment of 4x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Boisar-II (GIS) S/s with 2x330 MVAR, 765 kV bus reactors and 2x125 MVAR, 420 kV bus reactors. (2x1500 MVA, 765/400 kV ICTs shall be on each 400 kV section and 2x500 MVA, 400/220 kV ICTs shall be on 400 kV Bus Section-II. 2x125 MVAR Bus reactors shall be such that one bus reactor is placed on each 400 kV bus section. 400 kV Bus Sectionaliser to be kept under normally OPEN condition) **Future Provisions:** Space for o 765/400 kV ICT along with bays- 2 No.	765/400 kV, 1500 MVA ICT- 4 Nos. (13x500 MVA single phase units including one spare unit) 400/220 kV, 500 MVA ICT – 2 Nos. 765 kV ICT bays- 4 Nos. 400 kV ICT bays- 6 Nos. (2 Nos. on Bus Section-I and 4 Nos. on Bus Section-II) 400 kV Bus Sectionaliser-1 set 220 kV ICT bays- 2 Nos.

Sl. No.	Scope of the Transmission Scheme	Capacity / Route length
	○ 765 kV line bays along with switchable line reactors – 8 Nos. ○ 765 kV Bus Reactor along with bay: 2 No. ○ 765 kV Sectionaliser bay: 1 - set ○ 400 kV line bays along with switchable line reactor – 8 Nos. ○ 400/220 kV ICT along with bays - 6 Nos. ○ 420 kV Bus Reactor along with bay: 2 No. ○ 220 kV line bays: 12 Nos. ○ 220 kV Sectionalization bay: 1 set ○ 220 kV BC: 1 No.	220 kV BC bay – 1 No. 330 MVAR, 765 kV bus reactor- 2 Nos. 125 MVAR, 420 kV bus reactor- 2 Nos. 765 kV reactor bays- 2 Nos. 765 kV line bays- 6 Nos. 400 kV reactor bays- 2 Nos. (one on each bus section) 400 kV line bay- 6 Nos. (4 Nos. on bus Section-I and 2 Nos. on bus Section-II) 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 No.
2.	South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line	Route length: 225 km
3.	2 Nos. of 765 kV line bays at South Olpad (GIS) for termination of South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line	765 kV line bays (GIS) – 2 Nos. (for South Olpad end)
4.	240 MVAR switchable line reactors on each ckt at South Olpad (GIS) & Boisar-II (GIS) end of South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line (with NGR bypass arrangement)	• 240 MVAR, 765 kV switchable line reactor- 4 [2 for Boisar-II (GIS) and 2 for South Olpad (GIS)] • Switching equipment for 765 kV line reactor- 4 (2 for Boisar-II (GIS) and 2 for South Olpad (GIS)) • 1x80 MVAR, 765 kV 1-ph spare line reactor – 1 No. (for Boisar-II end) • 1x80 MVAR, 765 kV 1-ph spare line reactor proposed for Ahmedabad – South Olpad (GIS) 765 kV line (under Khavda Ph-IV Part B scheme) at South Olpad (GIS) S/s to be used as spare
5.	LILO of Navsari (New) – Padghe (PG) 765 kV D/c line at Boisar-II	LILO route length: 25 km.

Sl. No.	Scope of the Transmission Scheme	Capacity / Route length
6.	Boisar-II (Sec-II) – Velgaon (MH) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	Route length: 10 km.
7.	2 Nos. of 400 kV line bays at Velgaon (MH) for termination of Boisar-II – Velgaon (MH) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	400 kV line bays (GIS) – 2 Nos. [for Velgaon (MH) end]
8.	LILO of Babhaleswar – Padghe (M) 400 kV D/c line at Boisar-II (Sec-I) using twin HTLS conductor with a minimum capacity of 1700 MVA per ckt at nominal voltage	LILO route length: 65 km.
9.	80 MVAR switchable line reactors at Boisar-II end of Boisar-II – Babhaleswar 400 kV D/c line (with NGR bypass arrangement) formed after above LILO	• 80 MVAR, 420 kV switchable line reactor including switching equipment- 2 Nos.
10.	±200 MVAR STATCOM with 2x125 MVAR MSC, 1x125 MVAR MSR at 400 kV bus section-I of Boisar-II and ±200 MVAR STATCOM with 2x125 MVAR MSC, 1x125 MVAR MSR at 400 kV bus section-II of Boisar-II	• ±200 MVAR STATCOM (with MSC/MSR) on 400 kV Section-I • 400 kV bay – 1 No. on Section-I • ±200 MVAR STATCOM (with MSC/MSR) on 400 kV section-II • 400 kV bay – 1 No. on Section-II
11.	± 300 MVAR STATCOM with 3x125 MVAR MSC, 1x125 MVAR MSR at 400 kV level of Navsari (New)(PG) S/s with 1 No. of 400 kV bay (GIS)	• ±300 MVAR STATCOM (with MSC/MSR) • 400 kV bay – 1 No.

Note:

i. Bay(s) required for completion of diameter (GIS) in one-and-half breaker scheme shall also be executed by the TSP.

ii. MSETCL shall carry out reconductoring of the balance portion of Padghe (M) – Boisar-II 400 kV D/c line (i.e. from LILO point upto Padghe(M)) and shall also carry out corresponding upgradation of 400 kV bays at Padghe (M) as may be required in matching time-frame of the LILO line. MSETCL has confirmed the maximum capacity of the line which can be achieved after reconductoring considering clearances in existing towers of Babhaleswar – Padghe (M) 400 kV D/c line as 1700 MVA per ckt.

iii. MSETCL shall implement the LILO of both circuits of Boisar-II – Velgaon 220 kV D/c line at Boisar-II (ISTS) S/s along with 4 Nos. 220 kV GIS bays at Boisar-II in matching time-frame of Boisar-II (ISTS) S/s.

iv. TSP of South Olpad (GIS) S/s shall provide space for work envisaged at Sl. No. 3 & 4.

v. MSETCL shall provide space for the work envisaged at Sl. No. 7 at Velgaon S/s.

vi. TSP of the subject scheme shall implement Inter-tripping scheme on South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line (for tripping of the switchable line reactor at either end along with the main line breaker).

vii. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

viii. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part D

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Establishment of 2x1500 MVA, 765/400 kV & 3x500 MVA, 400/220 kV Pune-III (GIS) S/s with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor. **Future Provisions**: Space for o 765/400 kV ICT along with bays- 4 No. o 765 kV line bays along with switchable line reactors – 8 Nos. o 765 kV Bus Reactor along with bay: 2 No. o 765 kV Sectionaliser bay: 1 -set o 400 kV line bays along with switchable line reactor – 12 Nos. o 400/220 kV ICT along with bays -5 Nos. o 400 kV Bus Reactor along with bay: 2 No. o 400 kV Sectionalization bay: 1 set o 220 kV line bays: 12 Nos. o 220 kV Sectionalization bay: 1 set o 220 kV BC: 1 No. o STATCOM (±300 MVAR) along with MSC (3x125 MVAR) & MSR (1x125 MVAR): alongwith 1 No. 400 kV bay: 1 No. o 80 MVAR, 765 kV, 1-ph reactor (spare unit for line reactor)-1 No.	765/400 kV, 1500 MVA ICT-2 Nos. (7x500 MVA including one spare unit) 400/220 kV, 500 MVA ICT – 3 Nos. 765 kV ICT bays- 2 Nos. 400 kV ICT bays- 5 Nos. 220 kV ICT bays- 3 Nos. 220 kV BC bay – 1 No. 330 MVAR, 765 kV bus reactor- 2 Nos. 125 MVAR, 420 kV bus reactor- 2 Nos. 765 kV reactor bay- 2 Nos. 765 kV line bay- 6 Nos. 400 kV reactor bay- 2 Nos. 400 kV line bay- 2 Nos. 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 No.

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
2.	Boisar-II – Pune-III 765 kV D/c line	Route length: 200 km
3.	330 MVAR switchable line reactors at Pune-III end of Boisar-II – Pune-III 765 kV D/c line (with NGR bypass arrangement).	• 330 MVAR, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 1x110 MVAR spare bus reactor available at Pune-III (GIS) to be used as spare
4.	2 Nos. of 765 kV line bays at Boisar-II for termination of Boisar-II – Pune-III 765 kV D/c line	• 765 kV line bays (GIS) – 2 Nos. (for Boisar-II end)
5.	LILO of Narendra (New) – Pune (GIS) 765 kV D/c line at Pune-III	LILO route length: 10 km.
6.	330 MVAR switchable line reactors at Pune-III end of Narendra (New) – Pune-III(GIS) 765 kV D/c line (with NGR bypass arrangement).	• 330 MVAR, 765 kV switchable line reactor- 2. • Switching equipment for 765 kV line reactor- 2 • 1x110 MVAR spare bus reactor (1-ph) available at Pune-III (GIS) to be used as spare
7.	LILO of Hinjewadi-Koyna 400 kV S/c line at Pune-III (GIS) S/s	LILO route length: 40 km.
8.	80 MVAR, 420 kV switchable Line Reactors on each ckt at Pune-III (GIS) end of Pune-III (GIS) – Koyna 400 kV line formed after above LILO (with NGR bypass arrangement).	• 80 MVAR, 420 kV switchable line reactor along with switching equipment- 2 Nos.

Note:

i. Bay(s) required for completion of diameter (GIS) in one-and-half breaker scheme, shall also be executed by the TSP.

ii. Logic for Inter-tripping scheme for tripping of the 330 MVAR switchable line reactor along with main line breaker at Pune (GIS) end of Pune (GIS) – Narendra (New) 765 kV D/c line shall be implemented by the owner of the line after LILO of Narendra (New) – Pune (GIS) 765 kV D/c line at Pune-III

iii. MSETCL shall implement the following 220 kV lines along with 5 Nos. 220 kV GIS bays at Pune-III (GIS) S/s in matching time-frame of Pune-III S/s:

iv. LILO of both circuits of Jejuri-Phursungi 220 kV D/c line at Pune-III S/s with HTLS conductor (twin zebra equivalent) along with reconductoring of balance line section viz. LILO point to Phursungi and LILO points to Jejuri with HTLS conductor (twin zebra equivalent)

v. Nanded City - Pune PG III 220 kV S/c line with HTLS conductor (twin zebra equivalent)

vi. TSP of Boisar-II S/s shall provide space for work envisaged at Sl. No. 4.

vii. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

viii. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E1

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Augmentation of transformation capacity at KPS1 (GIS) by 1x1500 MVA, 765/400 kV ICT (8^{th}) on bus section-I	1500 MVA, 765/400 kV ICT – 1 No. 765 kV bays – 2 Nos. on bus Section-I (including 1 No. bay for Dia completion) 400 kV bays – 2 Nos. on bus section-I (including 1 No. bay for Dia completion)

Note:

i. The TSP shall implement one complete diameter consisting of 2 main bays & 1 Tie bay at both 765 kV & 400 kV levels of KPS1 (GIS) for completion of diameter (GIS) in one-and-half breaker scheme.

ii. Further, TSP of KPS1 shall provide space to carry out the above augmentation work.

Khavda Ph-IV: Part-E1 scheme is currently under implementation by Khavda-Bhuj Transmission Ltd. (KBTL- subsidiary of Adani Transmission Ltd.) awarded through RTM mode vide MoP letter dated 07.07.2023.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E2

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Augmentation of transformation capacity at KPS2 (GIS) by 2x1500 MVA, 765/400 kV ICT on Bus section-I (5^{th} & 6^{th}) & 2x1500 MVA, 765/400 kV ICT on Bus section-II (7^{th} & 8^{th}) & 2 Nos. 400 kV bays at Bus Section-I for RE interconnection and 3 Nos. 400 kV	1500 MVA, 765/400 kV ICT – 4 Nos. 765 kV bays – 4 Nos. [2 Nos. complete Dia for 2 ICTs (one on each bus section) and balance 2 ICTs to be terminated in spare bays (one on each section)] 400 kV bays– 10 Nos. [4 Nos. ICT bays (2 on each section) & 5 Nos. line bays (2

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
	bays at Bus Section-II for RE interconnection	on bus section-I & 3 on bus section-II) along with 1 No. bay on Bus Section-II for Dia completion]

Note:

i. The TSP shall implement two complete diameters (1 on Bus Section-I & 1 on bus section-II) at 765 kV level of KPS2 (GIS) consisting of 2 Main Bays & 1 Tie Bay required for completion of diameter (GIS) in one-and-half breaker scheme.

ii. The TSP shall implement five complete diameters (2 on Bus Section-I & 3 on Bus Section-II) at 400 kV level of KPS2 (GIS) consisting of 2 Main Bays & 1 Tie bay required for completion of diameter (GIS) in one-and-half breaker scheme.

iii. Further, TSP of KPS2 shall provide space to carry out the above augmentation work.

iv. 2 Nos. 400 kV bays at Bus Section-I for RE interconnection and 1 No. 400 kV bays at Bus Section-II for RE interconnection are already under implementation at KPS2.

v. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E3

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Augmentation of transformation capacity at KPS3 (GIS) by 1x1500 MVA, 765/400 kV ICT (7^{th}) on Bus section-I	1500 MVA, 765/400 kV ICT – 1 No. 765 kV bays – 2 Nos. on Bus Section-I (including 1 No. bay for Dia completion) 400 kV bays – 2 Nos. on Bus section-I (including 1 No. bay for Dia completion)

Note:

i. The TSP shall implement one complete diameter consisting of 2 Main Bays & 1 Tie Bay at both 765 kV & 400 kV levels of KPS3 (GIS) required for completion of diameter (GIS) in one-and-half breaker scheme.

ii. Further, TSP of KPS3 shall provide space to carry out above augmentation work.

Khavda Ph-IV: Part-E3 scheme is currently under implementation by KPS3 Transmission Ltd. (K3TL- subsidiary of POWERGRID) awarded through RTM mode vide MoP letter dated 07.07.2023.

Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E4

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Augmentation of transformation capacity at Padghe (PG) (GIS) by 1x1500 MVA, 765/400 kV ICT (4^{th})	1500 MVA, 765/400 kV ICT – 1 No. 765 kV bays – 2 Nos. (including 1 No. bay for Dia completion) 400 kV bays – 2 Nos. (including 1 No. bay for Dia completion) 765 kV GIB Duct (single phase) – 510 m (approx.) for three phases 400 kV GIB Duct (single phase) – 500 m (approx.) for three phases

Note:

i. POWERGRID shall implement one complete diameter consisting of 2 main bays & 1 Tie Bay at both at 765 kV & 400 kV levels Padghe (PG)(GIS) required for completion of diameter (GIS) in one-and-half breaker scheme.

Khavda Ph-IV: Part-E4 scheme is currently under implementation by POWERGRID awarded through RTM mode vide MoP letter dated 07.07.2023.

Khavda Phase-V (8GW)

Summary of the packages formulated for implementation of the scheme is given below:

Sl. No.	Name of the scheme	Implementation mode	Estimated Cost (₹ Crores)	Implementation Timeframe from effective date
1.	Part A	TBCB	24,819	48 months for Bipole-1 (2x1500 MW) and 54 months for Bipole-2 (2x1500 MW)
2.	Part A1	RTM	21	Matching with implementation of Khavda Phase-V Part A scheme viz. Bipole-1 (2x1500 MW) ± 800 kV Nagpur (HVDC)

Sl. No.	Name of the scheme	Implementation mode	Estimated Cost (₹ Crores)	Implementation Timeframe from effective date
				[LCC] which is 48 months from SPV transfer.
3.	Part B	under review	433	-
4.	Part C	TBCB	12,000	48 months from SPV transfer

Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part A

Sl. No.	Scope	Capacity/ Route length
1.	Establishment of 6000 MW, ± 800 kV KPS2 (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard*.	6000 MW, ± 800 kV KPS2 (HVDC) [LCC] Terminal station
2.	Establishment of 6000 MW, ± 800 kV Nagpur (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard*	6000 MW, ± 800 kV Nagpur (HVDC) [LCC] terminal station
3.	±800 kV HVDC Bipole line (Hexa lapwing) between KPS2 (HVDC) and Nagpur (HVDC) (1200 km) (with Dedicated Metallic Return) (capable to evacuate 6000 MW with overload as specified)	Route length: 1200 km.
4.	Establishment of 6x1500 MVA, 765/400 kV ICTs at Nagpur–S/s along with 2x330 MVAR (765 kV) & 2x125 MVAR, 420 kV bus reactors along with associated interconnections with HVDC Switchyard*. The 400 kV bus shall be established in 2 sections through 1 set of 400 kV bus sectionaliser so that 3x1500 MVA ICTs are placed in each section. The bus sectionaliser shall be normally closed and may be opened based on Grid requirement. **Future Provisions at Nagpur:** Space for: ○ 765/400 kV, 1500 MVA ICT- 4 (1 on 400 kV bus section-II & 3 on future 400 kV bus section-III) ○ 765 kV line bays along with switchable line reactors – 10 Nos. ○ 765 kV Bus Reactor along with bay: 2 No. ○ 765 kV Sectionaliser bay: 1 -set ○ 400 kV line bays along with switchable line reactor – 12 Nos. ○ 400 kV Bus sectionaliser- 1 Set	• 765/400 kV, 1500 MVA ICT-6 (3 on each 400 kV section) (19 single phase units including one spare unit) • 765 kV ICT bays- 6 Nos. • 400 kV ICT bays- 6 Nos. (3 on each section) • 330 MVAR 765 kV bus reactor-2 Nos. • 125 MVAR 420 kV bus reactor-2 Nos. (one on each section) • 765 kV reactor bay- 2 Nos. • 765 kV line bay- 4 Nos. • 400 kV reactor bay- 2 Nos. (one on each section) • 400 kV Bus sectionaliser - 1 Set

Sl. No.	Scope	Capacity/ Route length
	○ 400/220 kV ICT along with bays -9 Nos. (3 Nos. on 400 kV bus sections II & 6 Nos. on future bus section-III) ○ 400 kV Bus Reactor along with bay: 4 No. (1 each on 400 kV bus sections I & II and 2 on future 400 kV bus section-III) ○ 220 kV line bays: 16 Nos. ○ 220 kV Sectionalization bay: 2 set ○ 220 kV BC & TBC: 3 Nos. ○ 80 MVAR, 765 kV, 1-ph reactor (spare unit for line reactor)-1	• 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor) - 1 No.
5.	LILO of Wardha – Raipur 765 kV one D/c line (out of 2xD/c lines) at Nagpur	LILO route length: 30 km.
6.	Installation of 240 MVAR switchable line reactor at Nagpur end on each ckt of Nagpur – Raipur 765 kV D/c line	• 240 MVAR, 765 kV switchable line reactors- 2 Nos. (at Nagpur end) • Switching equipment for 765 kV line reactor- 2 Nos. (at Nagpur end) • 80 MVAR, 765 kV, 1-ph reactor (spare unit for line reactor)-1 No.

** The 400 kV interconnections (along with all associated equipment/ bus extension, etc.) between HVDC & HVAC switchyards shall be implemented by the TSP*

Note:

i. The 2x1500 MW poles shall emanate from 400 kV bus section 1 of KPS2 and terminate at bus section 1 of Nagpur. Similarly, the other 2x1500 MW poles shall emanate from 400 kV bus section 2 of KPS2 and terminate at bus section 2 of Nagpur.

ii. HVDC System will be designed considering 100% power reversal capability. The rated power transmission capacity as well as the rated transmission voltage shall be defined and guaranteed at the rectifier end of the AC yard.

iii. TSP of KPS2 shall provide space for the establishment of the HVDC system as per above scope.

iv. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

v. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part A1

Sl. No.	Scope	Capacity/ Route length
1.	Conversion of 330 MVAR Fixed LR at Wardha (on each ckt of Wardha – Raipur 765 kV D/c line being LILOed at Nagpur) into Bus Reactors at Wardha S/s	765 kV reactor bays- 2 Nos. & Conversion of 330 MVAR Fixed LR at Wardha (on each ckt of Wardha – Raipur 765 kV D/c line being LILOed at Nagpur) into Bus Reactors through creation of 2 new diameters and shifting of Reactors

Note:

i. POWERGRID shall implement two new diameters consisting of 1 main bay & 1 Tie bay at 765 kV level of Wardha S/s required in one-and-half breaker AIS scheme for termination of 2 Nos. of 330 MVAR Bus reactors & the same shall be extended in future for integration of 2nd main bay (future line with switchable line reactor) for diameter completion.

The subject scheme is currently under implementation by POWERGRID awarded through RTM mode vide MoP letter dated 07.07.2023.

Phase-V: Part B:

Augmentation of transformation capacity at KPS2 (GIS) by 1x1500 MVA, 765/400 kV ICT on Bus Section I (9th) and at KPS 3 (GIS) by 1x1500 MVA, 765/400 kV ICT on Bus Section-II (8th)

It was deliberated that the above ICTs would be required in the matching timeframe of VSC based HVDC (Part C) and hence are being reviewed and would be taken up subsequently.

Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part C

Sl. No.	Scope	Capacity/ Route length
1.	Establishment of 2500 MW, ± 500 kV KPS3 (HVDC) [VSC] terminal station (2x1250 MW) at a suitable location near KPS3 substation with associated interconnections with 400 kV HVAC Switchyard*	2500 MW, ± 500 kV KPS3 (HVDC) [VSC] Terminal station
2.	Establishment of 2500 MW, ± 500 kV South Olpad (HVDC) [VSC] terminal station (2x1250 MW) along with associated interconnections with 400 kV HVAC Switchyard of South Olpad S/s*	2500 MW, ± 500 kV South Olpad (HVDC) [VSC] terminal station
3.	Establishment of KPS3 (HVDC) S/s along with 2x125 MVAR, 420 kV bus reactors along with associated interconnections with HVDC Switchyard*. The 400	• 400/33 kV, 1x50 MVA ICT along with bays- 2 Nos.

Sl. No.	Scope	Capacity/ Route length
	kV bus shall be established in 2 sections through 1 set of 400 kV bus sectionaliser to be kept normally OPEN. 400/33 kV, 2x50 MVA transformers for exclusively supplying auxiliary power to HVDC terminal. MVAR **Future Provisions at KPS3 (HVDC) S/s** Space for: ○ 400 kV line bays – 6 Nos. (3 on each section) ○ 400 kV reactor bay- 2 Nos. (one on each section)	• 125 MVAR 420 kV bus reactor-2 Nos. (one on each section) • 400 kV reactor bay- 2 Nos. (one on each section) • 400 kV Bus sectionaliser- 1 Set
4.	KPS3 – KPS3 (HVDC) 400 kV 2xD/c (Quad ACSR/AAAC/AL59 moose equivalent) line along with the line bays at both substations	Route length- 2 km • 400 kV GIS line bays - 4 Nos. at KPS3 (2 Nos. on each bus section) • 400 kV GIS line bays - 4 Nos at KPS3 (HVDC) (2 Nos. on each bus section)
5.	±500 kV HVDC Bipole line between KPS3 (HVDC) and South Olpad (HVDC) (with Dedicated Metallic Return) (capable to evacuate 2500 MW)	Route length: 600 km

** The 400 kV interconnections (along with all associated equipment/ bus extension, etc.) between HVDC & HVAC switchyards shall be implemented by the TSP*

Note:

i. The 1250 MW pole-1 shall emanate from 400 kV bus section 1 of KPS3 (HVDC) and terminate at South Olpad S/s. Similarly, the 1250 MW pole-2 shall emanate from 400 kV bus section 2 of KPS3 (HVDC) and terminate at South Olpad S/s.

ii. HVDC System will be designed with 100% power reversal capability as well as black start, automatic grid restoration & dynamic reactive power support capability.

iii. The rated power transmission capacity as well as the rated transmission voltage shall be defined and guaranteed at the rectifier end of the AC yard.

iv. TSP of KPS3 shall provide space for scope at Sl. No. 4 as per the above scope

v. TSP of South Olpad S/s shall provide space for scope at Sl. No. 2 as per above scope

vi. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

vii. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

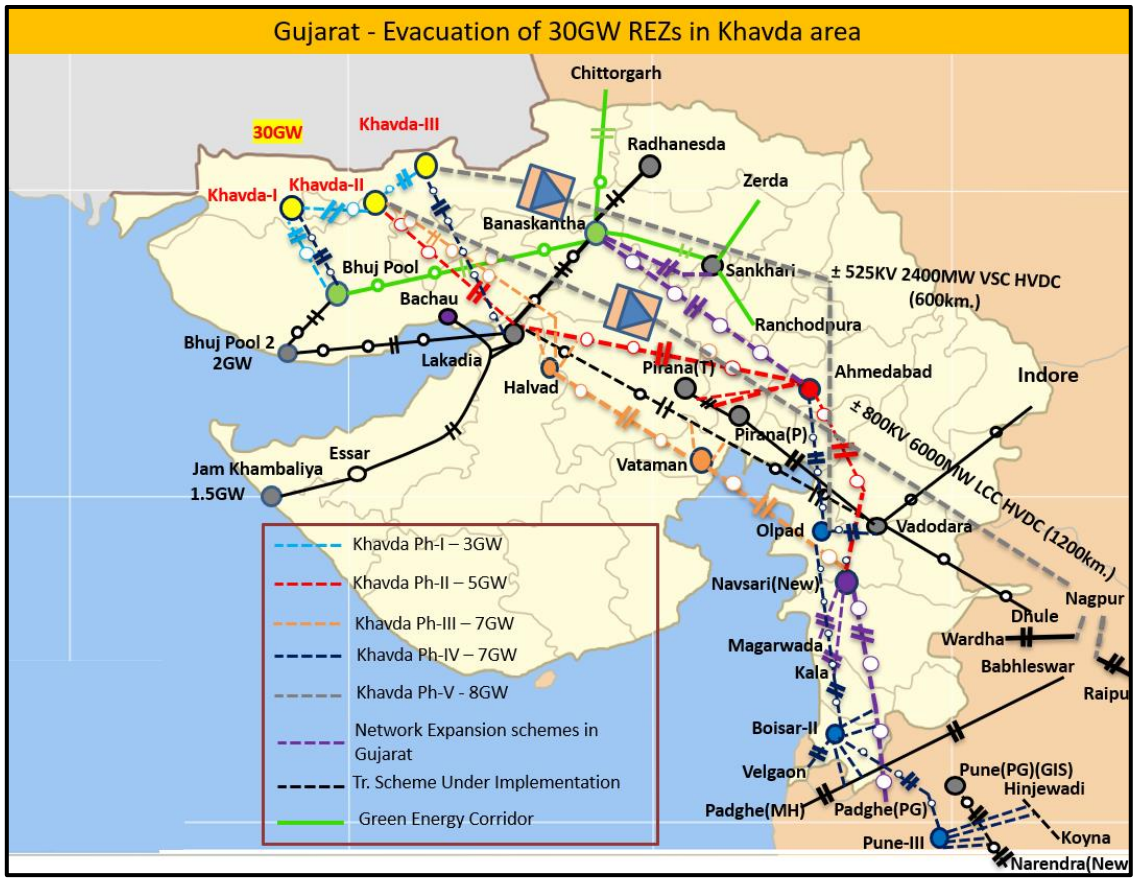


Figure 5-1 Schematic for Tr. Schemes for evacuation of power from 30GW REZ in Gujarat

b) Network Expansion scheme in Gujarat for drawl of about 3.6 GW load under Phase-I in Jamnagar area

RIL has requested for transition under GNA for 800MW (500MW from Oct'24 & 300MW from Mar'26) as bulk consumer at Jam Khambhaliya PS. Further, M/s EET Future has requested for transition under GNA for 1050MW (from Mar'26) as bulk consumer at Jam Khambhaliya PS and M/s RNSEL has requested for transition under GNA for 50MW (from Mar'28) as bulk consumer at Jam Khambhaliya PS. This shall result in total bulk consumer connectivity (under GNA) at Jam Khambhaliya to the tune of **1900MW**. Further, vide mails dated 12.01.2023 & 16.01.2023, M/s RIL/RNSEL has informed that cumulative capacity of 6000MW load is expected at Jamnagar by Dec'28. This translates in a total drawal requirement of 7GW (incl. 1.05GW of EET Future) in Jamnagar area.

A joint study meeting was held amongst CEA, CTU, GRID-INDIA and GETCO on 17.02.2023 to discuss the above matter, wherein after deliberations, the following transmission system was in-principally agreed to cater to Phase-I (Total 3.6GW) load in Jamnagar (~750MW)/ Jam Khambhaliya (~2850MW) area and to facilitate drawl/injection of power by GETCO from Jam Khambhaliya PS:

Network Expansion scheme in Gujarat for drawl of 3.6 GW load under phase-I in Jamnagar area:

- Establishment of 2x1500MVA, 765/400kV Jamnagar S/s (GIS)
- ±400MVAr STATCOM with 3x125 MVAr MSC & 2x125 MVAr MSR at Jamnagar 400kV Bus section
- Halvad – Jamnagar 765kV D/c line (170km.) with 330MVAr switchable line reactors on each ckt at Jamnagar end
- LILO of Jam Khambhaliya PS – Lakadia 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage] (LILO route length: 5 km]
- Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (50km.)
- LILO of CGPL – Jetpur 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage] (LILO route length: 65 km]
- LILO of one ckt of Kalavad – Bhogat 400kV D/c (Twin AL-59) line at Jam Khambhaliya PS OR LILO of both circuits of Kalavad – Bhogat 400kV D/c (Twin AL-59) line at Jam Khambhaliya PS depending on availability of space at Jam Khambhaliya PS (sought from M/s JKTL)

The above transmission system shall also be sufficient to cater to a cumulative demand of up to 5000MW i.e. an additional demand of 1400MW at Jamnagar (With 2150MW at Jamnagar and 2850MW at Jam Khambhaliya PS) with the following further augmentation:

Network Expansion scheme in Gujarat for drawl of 1.4 GW load under phase-II in Jamnagar area:

- Augmentation of transformation capacity at Jamnagar S/s with 1x1500MVA 765/400kV ICT (3rd)

Assumptions:

- Studies were carried out in 2027-28 Time-frame (Solar Max - Feb scenario).
- Khavda Phase-I to V system for 30GW REZ has been considered in study.

It was decided during the meeting that planning for an additional 2GW load in Jamnagar area shall be carried out at a later stage after identifying suitable 765kV in feeds to Jamnagar S/s and visibility of bulk consumer loads beyond 5GW. The proposed network expansion scheme would also help to increase short circuit level at Jam Khambhaliya PS and also reliability of evacuation of power from Jam Khambhaliya PS.

During the 16th CMETS-WR meeting, the above system was deliberated with various WR stakeholders. It was informed that space provision for additional 8 nos. of 400kV line bays is available at Jam Khambhaliya (GIS) PS. Considering the same, GETCO stated that LILO of both circuits of Kalavad – Bhogat 400kV D/c line at Jam Khambhaliya PS shall be carried out at Jam Khambhaliya (GIS). Schematic is given at **Figure 5-2**.

After deliberations members agreed with the following network expansion scheme in WR (with details of reactive compensation also mentioned therein):

Network Expansion scheme in Gujarat for drawl of about 3.6 GW load under phase-I in Jamnagar area:

Sl. No.	Scope of the Transmission Scheme	Capacity/line length km
1.	Establishment of 2X1500 MVA 765/400 kV Jamnagar(GIS) with 2X330 MVAR 765 kV bus reactor and 2X125 MVAR 420 kV bus reactor. **Future Scope**: Space for o 765/400kV ICT along with bays- 4 no. o 765 kV line bays along with switchable line reactors – 10 nos. o 765kV Bus Reactor along with bay: 2 no. o 765kV Sectionaliser bay: 1 -set o 400 kV line bays along with switchable line reactor – 8 nos. o 400/220kV ICT along with bays -6 nos. o 400 kV Bus Reactor along with bay: 2 no. o 400kV Sectionalization bay: 1- set o 220 kV line bays: 12 nos. o 220kV Sectionalization bay: 1 set o 220kV BC: 1 no. o Space for 80MVAR 1-ph spare reactor unit	765/400 kV, 1500 MVA ICT-2 765 kV ICT bays- 2 400 kV ICT bays- 2 330 MVAR 765 kV bus reactor- 2 125 MVAR 420 kV bus reactor- 2 765 kV reactor bay- 2 765 kV line bay- 2 400 kV reactor bay- 2 400 kV line bay- 10 500 MVA, 765/400 kV 1-Ph Spare ICT-1 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1
2.	Halvad – Jamnagar 765kV D/c line	170km
3.	2 nos. of 765kV line bays at Halvad for termination of Halvad – Jamnagar 765kV D/c line	765 kV line bays– 2 Nos. (for Halvad end)
4.	330MVAr switchable line reactors on each ckt at Jamnagar end of Halvad – Jamnagar 765kV D/c line (with NGR bypass arrangement)	• 330 MVAr, 765 kV switchable line reactor- 2. • Switching equipments for 765 kV line reactor- 2

Sl. No.	Scope of the Transmission Scheme	Capacity/line length km
5.	LILO of Jam Khambhaliya PS – Lakadia 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage]	LILO route length 5km.
6.	50MVAr, 420kV switchable line reactors on each ckt at Jamnagar end of Jamnagar – Lakadia 400kV D/c line (with NGR bypass arrangement)	• 50 MVAr, 420 kV switchable line reactor- 2. • Switching equipments for 400 kV line reactor- 2
7.	Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	50km.
8.	2 nos. of 400kV line bays at Jam Khambhaliya for termination of Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	• 400 kV line bays (GIS) – 2 Nos. (for Jam Khambhaliya end)
9.	LILO of CGPL – Jetpur 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage	LILO route length 65km.
10.	80MVAr, 420kV switchable line reactors on each ckt at Jamnagar end of Jamnagar – CGPL 400kV D/c line (with NGR bypass arrangement)	• 80 MVAr, 420 kV switchable line reactor- 2. • Switching equipments for 400 kV line reactor- 2
11.	LILO of both ckts of Kalavad – Bhogat 400kV D/c line (Twin AL-59) at Jam Khambhaliya PS with Twin AL59 Moose equivalent conductor	• LILO route length 10km.
12.	4 nos. of 400kV line bays at Jam Khambhaliya for LILO of both ckts of Kalavad – Bhogat 400kV D/c line	• 400 kV line bays (GIS) – 4 Nos. (for Jam Khambhaliya end)
13.	±400MVAr STATCOM with 3x125 MVAr MSC & 2x125 MVAr MSR at Jamnagar 400kV Bus section	• ±400MVAr STATCOM (with MSC/MSR) • 400kV bay – 1 no.

During the above meeting, it was also deliberated that the implementation timelines for the subject transmission shall be kept for 24 months. The proposed scheme was discussed and agreed for in the 47th WRPC meeting held on 15.06.2023 and the 15th NCT held on 25.08.2023.

Note:

i. *Implementation Timeframe: 31.03.2026 subject to minimum implementation time-frame of 24 months from date of allocation to the implementing agency*

ii. Bay*(s) as may be required for completion of diameter (GIS) in one-and-half breaker scheme, shall also be executed by the TSP.*

iii. *TSP (JKTL) shall enable Inter-tripping scheme on Jamnagar – Jam Khambhaliya 400 kV D/c line (for tripping of the 63MVAR switchable line reactor at Jam* Khambhaliya *PS end along with the main line breaker) after commissioning of the above system.*

Estimated Cost: Rs. 3815 Crores

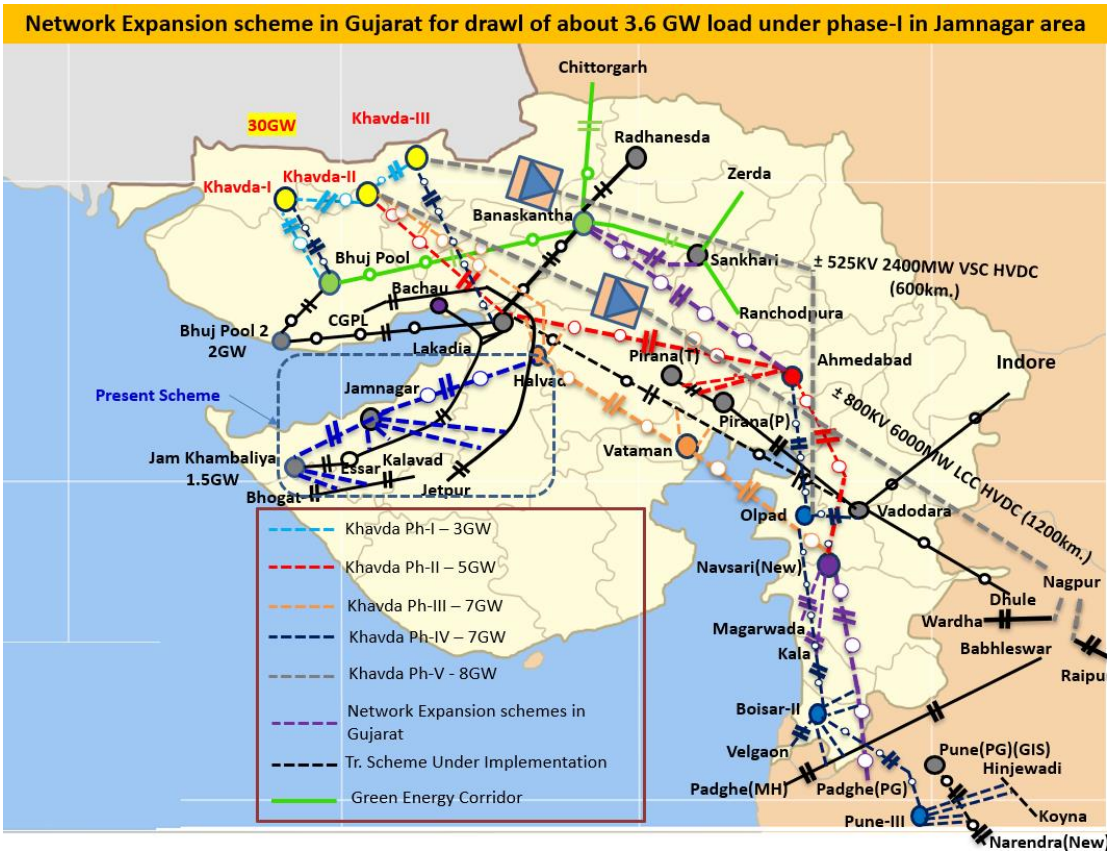


Figure 5-2 Schematic of Network Expansion Scheme to cater to 3.6GW load in Jamnagar

Vide MoP Gazette dated 07.11.2023, the transmission scheme was agreed to be implemented through TBCB route in matching time-frame of GNA applications viz. Mar'26 subject to minimum implementation time-frame of 24 months.

c) Augmentation of transformation capacity at 400/220kV Bhachau S/s in Gujarat

2x315MVA, 400/220kV ICTs at Bhachau was observed to be overloaded (322MVA) beyond MVA rating under N-1 contingency in 2027-28 time-frame (Scenario-7, Feb Solar Max). To meet the N-1 reliability criteria, 1x500 MVA, 400/220 kV ICT (3rd) is required. The scheme was deliberated & agreed in 20th Consultation Meeting for Evolving Transmission Schemes in WR held on 04.08.2023 with following scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of Transformation capacity at 400/220kV Bhachau S/s by 1x500MVA ICT (3rd)	400/220kV, 1x500MVA ICT – 1 No. 400kV bay – 1 No. 220kV bay – 1 No.

This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 26.10.2023 with an implementation time frame of 18 months i.e. anticipated by Apr'25.

Implementation time-frame: 18 months.

Estimated Cost: Rs. 49 Crores

d) Augmentation of transformation capacity at Bhuj-I PS

In view of receipt of applications for Connectivity for around 3,500MW, no margins were available for RE injection at Bhuj I PS. Hence, 1x500MVA, 400/220kV ICT (9th) was planned at Bhuj-I PS so as to enable of RE injection along with compliance to N-1 criteria. The scheme was awarded to POWERGRID through RTM for implementation vide CTU OM dated 02.01.2024 with implementation timeframe of 18 months. The scope is given below:

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Augmentation of transformation capacity at Bhuj-I PS by 1x500MVA, 400/220kV ICT (9th)	500MVA, 400/220kV ICTs: 1 Nos. 400kV ICT bays: 1 Nos. 220kV ICT bays: 1 Nos.

Implementation time-frame: 02.07.2025 (18 months from the date of award to implementing agency).

Estimated Cost: Rs. 53.14 Crores

e) Augmentation of transformation capacity at Bhuj-II PS

Augmentation of transformation capacity at Bhuj-II PS involves creation of New 220kV Bus Section at Bhuj-II PS, augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (3rd) and by 2x500MVA, 400/220kV ICT (5th & 6th) along with implementation of 220kV GIS line bay for ABREL (RJ) Projects Ltd. at New 220kV Bus Section. The transmission scheme would facilitate integration of 0.5GW power beyond 2GW at Bhuj-II PS (i.e., up to 2.5GW) and further, enable compliance of loading limits under 'N-1' contingency criteria considering connectivity under GNA applications received at Bhuj-II PS.

The scheme was agreed in the 22nd CMETS-WR meeting held on 23.10.2023 for ensuring 'N-1' compliance on existing Bhuj-II ICTs considering full dispatch from RE under GNA (2426.5MW connectivity received till Sept'23). The subject Transmission system was deliberated and approved in the 16th NCT meeting held on 30.11.2023 for implementation

through TBCB route with an implementation time frame of 21 months from SPV transfer. The scheme is currently under bidding. Schematic is given at **Figure 5-3**.

Augmentation of transformation capacity at Bhuj-II PS

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1	Creation of New 220kV Bus Section at Bhuj-II PS	• 220kV Bus sectionaliser bay - 1 Set *(to be kept normally CLOSED and may be opened based on system requirement)* • 220kV BC – 1 No.
2	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 2x500MVA, 400/220kV ICT (5th & 6th) (to be terminated at New 220kV Bus Section) and by 1x1500MVA, 765/400kV ICT (3rd)	• 500 MVA, 400/220 kV ICTs: 2 Nos. • 1500 MVA, 765/400 kV ICTs: 1 No. • 765 kV ICT bay: 2 No. [1 No. for ICT & 1 No. for Dia. completion (with provision of Switchable LR)] • 400 kV ICT bays: 4 Nos. [3 Nos. for ICT termination and 1 No. for Dia. Completion (with provision of Switchable LR)] • 220 kV ICT bays: 2 Nos. **GIB Duct length for 1x1500 MVA, 765/400 kV ICT:** • 1 Ph. 765 kV GIB Duct – 600 m (approx.) • 1 Ph. 400 kV GIB Duct – 625 m. (approx.) **GIB Duct length for 2x500 MVA, 400/220 kV ICTs:** • 1 Ph. 400 kV GIB – 300 m (approx.) • 1 Ph. 220 kV GIB – 750 m (approx.)
3	Implementation of 220 kV GIS line bay at Bhuj-II PS for ABREL (RJ) Projects Ltd. (to be terminated at New 220kV Bus Section)	• 220 kV line bay – 1 No. (GIS) **GIB Duct length:** • 1 Ph. 220 kV GIB – 150 m (approx.)

Note:

(1) Wherever required, TSP shall implement complete Dia consisting of 2 Main Bays & 1 Tie Bay required for completion of diameter (GIS) in one-and-half breaker scheme.

(2) GIB Bus Duct lengths are as communicated by TSP of Bhuj-II PS.

(3) TSP of Bhuj-II PS shall provide space for execution of above works.

Scheduled COD: 21 months from SPV transfer

Estimated Cost: Rs. 413 Crores

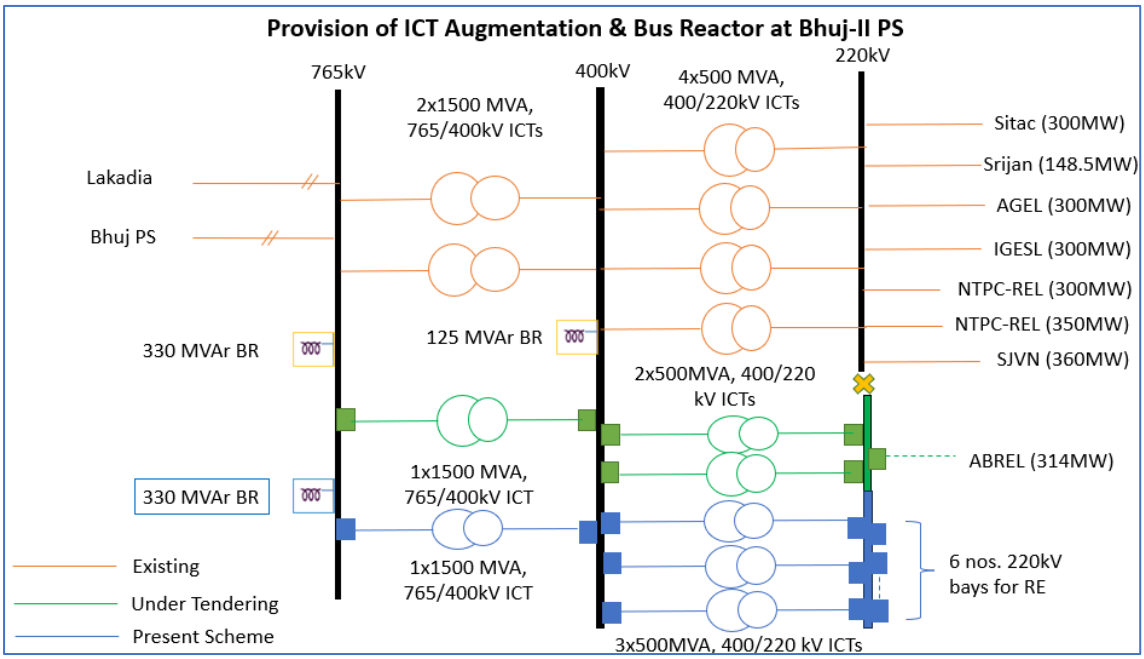


Figure 5-3: Schematic of Augmentation of transformation capacity at Bhuj-II PS

f) ICT Augmentation at Bhuj-II PS: Part B

- Para 4.4.5 of the Manual on Transmission Planning Criteria, 2023 published by CEA states as under:
  - "The 'N-1' criteria may not be applied to the immediate connectivity system of renewable generations with the ISTS/Intra-STS grid i.e. the line connecting the generation project switchyard to the grid and the step-up transformers at the grid station.
  - Provided that, 'N-1' criteria shall be applicable in case of renewable generation projects with storage, which are firm in nature and fully dispatchable.
  - Provided that, 'N-1' reliability criteria may be considered for ICTs at the ISTS / STU pooling stations for renewable energy-based generation of more than 1000 MW after considering the capacity factor of renewable generating stations."

- Bhuj-II PS is an existing substation with 4x500MVA, 400/220kV ICTs and 2x1500MVA, 765/400kV ICTs. To cater to applications received beyond 2000MW (upto 2500MW considering N-1) at Bhuj-II PS, creation of new 220kV Bus Section at Bhuj-II PS, installation of 2x500MVA, 400/220kV ICTs (5th & 6th) and 1x1500MVA, 765/400kV ICT (3rd) and implementation of 220kV GIS line bay at Bhuj-II PS for ABREL (RJ) Projects Limited (Terminated at New 220kV Bus Section) was agreed in the 16th NCT meeting held on 30.11.2023 through TBCB route. The scheme is presently under bidding.

- Further, Connectivity under GNA for 3324.5MW has been received at Bhuj-II PS till the month of Dec-23. Considering the rapid pace of applications being received at Bhuj-II PS, it was agreed in the 25th CMETS-WR meeting held on 29.01.2024 to install all remaining ICTs and 220kV bays at Bhuj-II PS in one go so as to minimize multiple implementation

time-lines/ co-ordination issues, etc. Further, installation of 1x330MVAr 765kV Bus Reactor (2nd) was also agreed at Bhuj-II PS with increasing RE penetration, in order to control voltages at the S/s. The BR has sensitivity of 2-3kV. Schematic is given at **Figure 5-4.**

ICT Augmentation at Bhuj-II PS

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 3x500MVA, 400/220kV ICT (7th, 8th & 9th)	500MVA, 400/220kV ICTs: 3 No. 400kV ICT bays: 3 No. 220kV ICT bays: 3 No..
2.	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (4th)	1500MVA, 765/400kV ICT: 1 No. 765kV ICT bay: 1 No. 400kV ICT bay: 1 No.
3.	Installation of 1x330MVAr 765kV Bus Reactor (2nd) along-with associated bay	330MVAr, 765kV Bus Reactor: 1 No. 765kV BR bay: 1 No.
4.	Implementation of 220kV GIS line bay at Bhuj-II PS for Aditya Birla Renewables Subsidiary Limited (ABRSL) [Appln No: 2200000321(362MW)]	220kV line bay – 1 No. (GIS) (Bus Sec-II)
5.	Implementation of 220kV GIS line bay at Bhuj-II PS for ACME Cleantech Solutions Private Limited (ACSPL) [Appln No: 2200000382(350MW)]	220kV line bay – 1 No. (GIS) (Bus Sec-II)
6.	Implementation of 220kV GIS line bay at Bhuj-II PS for ACME Cleantech Solutions Private Limited (ACSPL) [Appln No: 2200000431(50MW)]	220kV line bay – 1 No. (GIS) (Bus Sec-II)
7.	Implementation of 220kV GIS line bay at Bhuj-II PS for Avaada Energy Pvt Ltd. (AEPL) [Appl. No: 2200000444(100MW)]	220kV line bay – 1 No. (GIS) (Bus Sec-II)
8.	Implementation of 220kV GIS line bays at Bhuj-II PS for future applicants (commensurate with 400/220kV transformation capacity in Bus section-II)	220kV line bay – 2 Nos. (GIS) (Bus Sec-II)

Implementation time-frame: 21 months from SPV transfer

Estimated Cost: Rs. 587 Crores

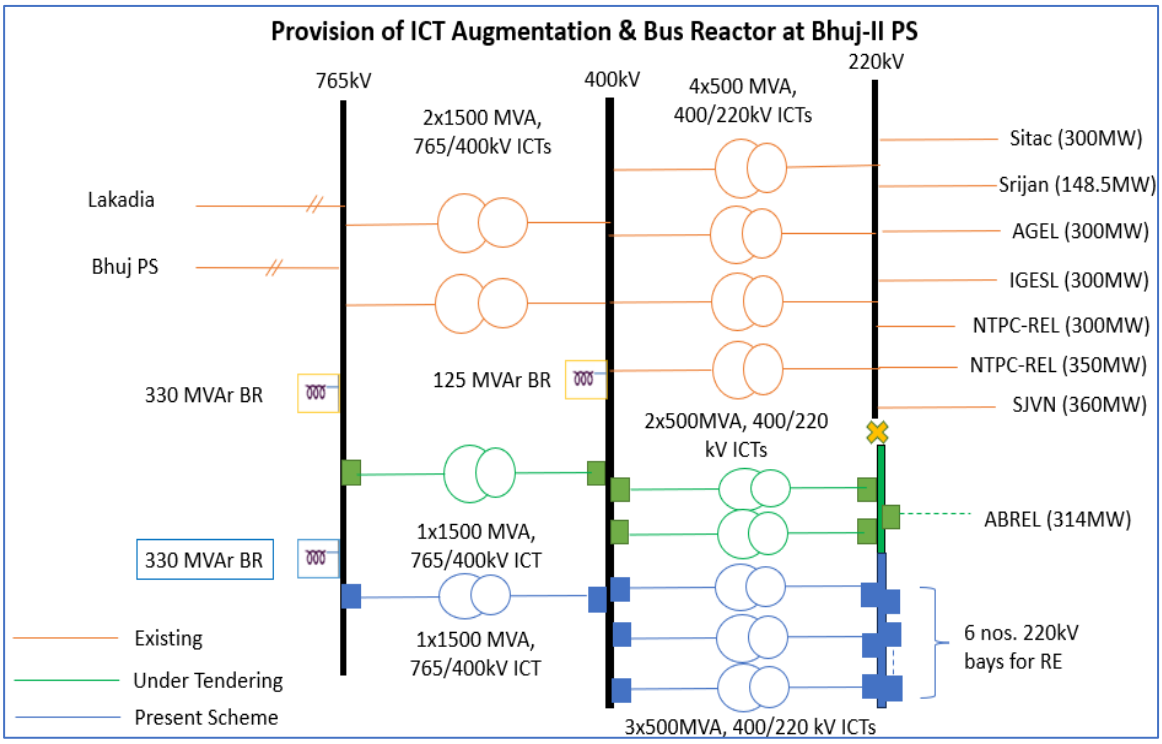


Figure 5-4: Schematic of ICT Augmentation at Bhuj-II PS: Part B

g) Augmentation of transformation capacity at 765/400kV Lakadia S/s (WRSS XXI(A) Transco Ltd) in Gujarat – Part A

The following proposed system shall enable evacuation of RE power from various generation projects in Lakadia area which have applied for Connectivity under GNA at Lakadia S/s at 220kV level. The 2x500MVA ICTs proposed at Lakadia S/s were part of ATS of RE generation projects. However, 2GW potential at Lakadia has been revived vide MNRE letter dated 14.02.2024 and MoP letter dated 16.02.2024 and thus the proposed ICTs now form part of Common Transmission System Augmentation/ Augmentation without ATS.

SI No.	***Scope of the Transmission Scheme***	***Capacity /km***
1.	Creation of 220kV switchyard at Lakadia 765/400kV S/s along with 220kV line bays for RE Interconnection	220 kV switchyard & 220kV line bays – 2 Nos. 220 kV Bus coupler – 1 No. 220 kV Transfer bus coupler – 1 No.
2.	Installation of 2x500 MVA, 400/220 kV ICTs (1st & 2nd) at Lakadia PS along with associated ICT bays	400/220kV, 1x500MVA ICT – 2 No. 400kV bay – 2 No. 220kV bay – 2 No. Associated 400 kV Bus Bar extension

2 nos. 220kV bays at Lakadia S/s allotted to:

- Avaada Inclean Pvt. Ltd. (AIPL) (50MW): Appl. No. 2200000011
- Avaada Energy Private Limited (AEPL) (300MW): Appl. No. 2200000131

Further, M/s Avaada Energy Private Limited (200MW): Appl. No. 2200000200 is sharing the 220kV bay of M/s AIPL (Appl. No. 2200000011).

The scheme was agreed in the 21st (2nd sitting) & 22nd (1st sitting) Consultation Meetings for Evolving Transmission Schemes in Western Region held on 28.08.2023 & 23.10.2023 respectively. The subject Transmission system was deliberated and approved in the 17th NCT meeting held on 31.01.2024. Schematic is given at **Figure 5-5.**

Implementation time-frame: 18 months from SPV transfer

Estimated Cost: Rs. 142 Crores

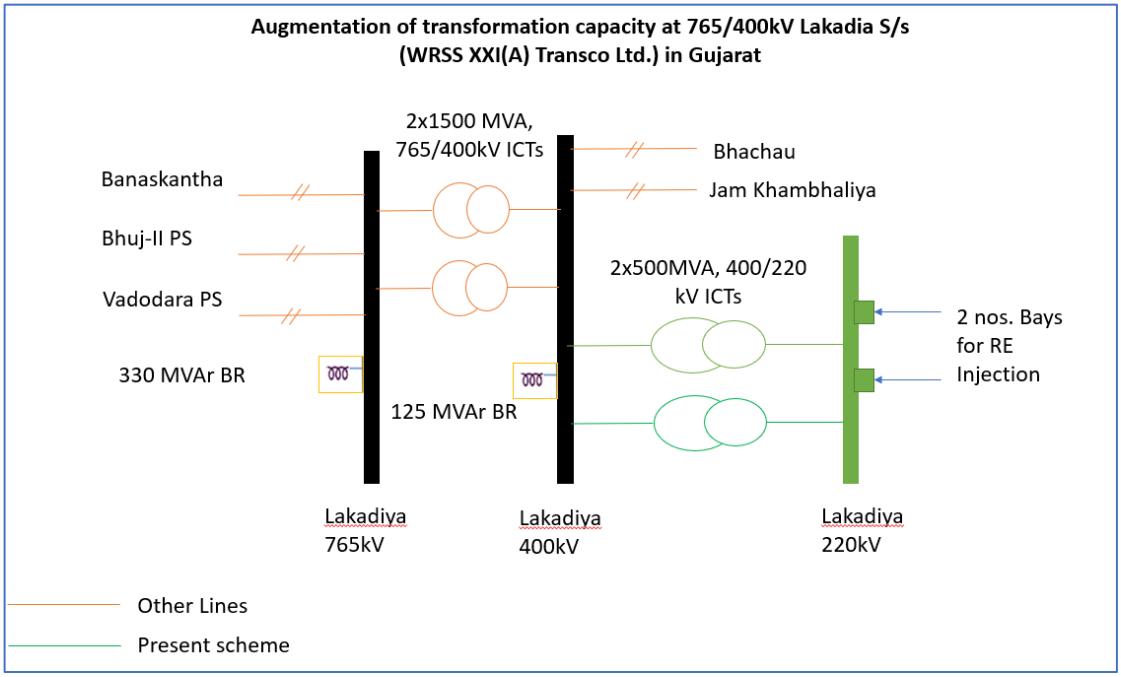


Figure 5-5: Schematic of ICT Augmentation at Lakadia S/s: Part A

h) Augmentation of transformation capacity at 765/400kV Lakadia S/s (WRSS XXI(A) Transco Ltd) in Gujarat – Part B

The proposed system shall enable evacuation of RE power from various generation projects in Lakadia area which have applied for Connectivity under GNA at Lakadia S/s at 220kV level. The 2x500MVA ICTs proposed at Lakadia were part of ATS of RE projects for 550MW (AMNSIL: 350MW & RS(S8)PL: 200MW). However, 2GW potential at Lakadia has been revived vide MNRE letter dated 14.02.2024 and MoP letter dated 16.02.2024 and thus the proposed ICTs now form part of Common Transmission System Augmentation/ Augmentation without ATS.

The scheme was agreed in the 23rd CMETS-WR held on 29.11.2023. The subject Transmission system was deliberated in the 17th NCT meeting held on 31.01.2024 at an estimated cost of Rs. 135 Cr. with tentative implementation timeframe of 18 months. It was decided that the same may be discussed again in subsequent meetings along with other 400/220kV ICTs at Lakadia so that the entire scope w.r.t. ICT augmentation at Lakadia S/s could be implemented in one go. Schematic is given at **Figure 5-6.**

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
1.	Installation of 2x500MVA, 400/220kV ICTs (3rd & 4th) at Lakadia PS along with associated ICT bays	400/220kV, 1x500MVA ICT – 2 No. 400kV ICT bay – 2 No. 220kV ICT bay – 2 No.
2.	Implementation of 220kV line bay at Lakadia PS for TEQ Green Power XVII Private Limited (TGPXVIIPL: 300MW)	220kV line bay – 1 no.
3.	Implementation of 220kV line bay at Lakadia PS for Arcelor Mittal Nippon Steel India Limited (AMNSIL: 350MW)	220kV line bay – 1 no.
4.	Implementation of 220kV line bay at Lakadia PS for Renew Solar (Shakti Eight) Private Limited (RS(S8)PL: 200MW)	220kV line bay – 1 no.

3 nos. 220kV bays at Lakadia S/s allotted to:

- TEQ Green Power XVII Private Limited (TGPXVIIPL: 300MW): Appl. No. 2200000311
- Arcelor Mittal Nippon Steel India Limited (AMNSIL: 350MW): Appl. No. 2200000324
- Renew Solar (Shakti Eight) Private Limited (RS(S8)PL: 200MW): Appl.No. 2200000341

Implementation time-frame: 18 months from SPV transfer

Estimated Cost: Rs. 135 Crores

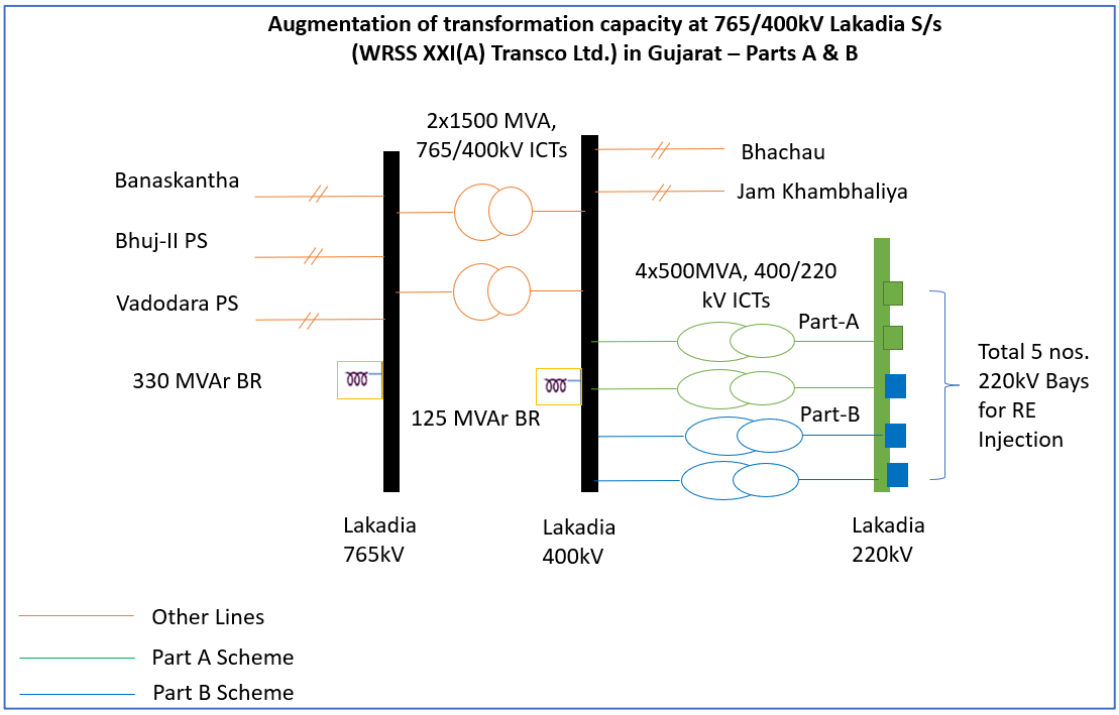


Figure 5-6: Schematic of ICT Augmentation at Lakadia S/s: Part B

i) Augmentation of transformation capacity at Lakadia PS: Part C

- Para 4.4.5 of the Manual on Transmission Planning Criteria, 2023 published by CEA states as under:
  - "The 'N-1' criteria may not be applied to the immediate connectivity system of renewable generations with the ISTS/Intra-STS grid i.e. the line connecting the generation project switchyard to the grid and the step-up transformers at the grid station.
  - Provided that, 'N-1' criteria shall be applicable in case of renewable generation projects with storage, which are firm in nature and fully dispatchable.
  - Provided that, 'N-1' reliability criteria may be considered for ICTs at the ISTS / STU pooling stations for renewable energy-based generation of more than 1000 MW after considering the capacity factor of renewable generating stations."

In the 24th CMETS-WR meeting held on 28.12.2023, in view of receipt of applications for connectivity under GNA for 1700MW at Lakadia PS in Gujarat (incl. application discussed and agreed in the meeting), 1x500MVA, 400/220kV ICT (5th) was agreed.

Subsequently, in the 25th CMETS-WR, additional applications for 542MW have been received taking the cumulative RE injection capacity to 2242MW for which additional 1x500MVA 400/220kV ICT (6th) shall also be required. Considering the rapid pace of applications being received at Lakadia PS, it was agreed to install all remaining ICTs and 220kV bays at Lakadia PS in one go so as to minimize multiple implementation time-lines / co-ordination issues, etc. In view of the same, the following scope was agreed at Lakadia PS:

Augmentation of transformation capacity at Lakadia PS

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Creation of New 220kV Bus Section at Lakadia PS along with 220kV Sectionaliser arrangement between existing & New 220kV bus	220kV Bus Sectionaliser - 1 set BC – 1 No. TBC – 1 No.
2.	Augmentation of transformation capacity at Lakadia PS by 4x500MVA, 400/220kV ICTs (5th 6th, 7th & 8th) terminated on new 220kV Bus Section	500MVA, 400/220kV ICTs: 4 No. 400kV ICT bays: 4 Nos. 220kV ICT bays: 4 No. (New Bus Section)
3.	Implementation of 220kV line bay at Lakadia PS for Juniper Green Energy Private Limited (JGEPL) (Appl. No. 2200000376: 300MW)	220kV line bay – 1 No. (New Bus Section)
4.	Implementation of 220kV line bay at Lakadia PS for TEQ Green Power XVI Pvt. Ltd. (TGPXVIPL) (Appl. No. 2200000398: 76MW)	220kV line bay – 1 No. (New Bus Section)
5.	Implementation of 220kV line bay at Lakadia PS for Ganeko Solar Pvt. Ltd. (GSPL) (Appl. No. 2200000458: 290MW)	220kV line bay – 1 No. (New Bus Section)
6.	Implementation of 220kV line bays at Lakadia PS for future RE applicants	220kV line bay – 4 Nos. (New Bus Section)
7.	Installation of 1x330MVAr 765kV Bus Reactor (2nd) along-with associated bay	330MVAr, 765kV Bus Reactor: 1 No. 765kV BR bay: 1 No.

Implementation time-frame: 15.02.2026 (subject to minimum schedule of 18 months) for Sl.1, 2, 4, 6 & 7, 30.06.2028 for Sl. 3 & 31.12.2026 for Sl.5

Estimated cost: Rs. 501 Crores

j) Augmentation of transformation capacity at Jam Khambhaliya PS (JKTL): Part A

The proposed augmentation of transformation capacity at Jam Khambhaliya PS (JKTL) shall enable evacuation of RE power from various generation projects in Jam Khambhaliya area which have applied for Connectivity under GNA at Jam Khambhaliya PS at 220kV level. Cumulative injection from developers at 220kV bus section-II shall be 750MW out of which 650MW (ACME & MRPL) is linked with 2x500 MVA, 400/220kV ICT (5th & 6th). The estimated cost of the scheme is about INR 110 Cr. M/s MRPL have informed that they shall implement their 220kV bay by themselves matching with availability of 220kV GIS Bus section-II and have requested that the Bus section-II be implemented at the earliest.

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Creation of New 220kV Bus Section at Jam Khambhaliya PS Space to be kept for 1 no. 220kV line bay in the same GIS hall for RE Interconnection being implemented by the RE developer (in addition to 2 nos. bays at Sl. 3).	220kV Bus sectionaliser bay - 1 Set *(to be kept normally CLOSED and may be opened based on system requirement)* 220kV BC – 1 No.
2.	Augmentation of transformation capacity at at Jam Khambhaliya PS (GIS) by 2x500MVA, 400/220kV ICTs (5^{th} & 6^{th}) terminated on New 220kV bus section	500MVA, 400/220kV ICTs: 2 Nos. 400kV ICT bays: NIL* 220kV ICT bays: 2 Nos.
3.	Implementation of 220kV GIS line bays at Jam Khambhaliya PS for RE Projects on New 220kV bus section	220kV line bay – 2 No. (GIS) (1 for ACME Sun Power Pvt. Ltd. and 1 for Juniper Green Energy Pvt. Ltd.)
**Note: Termination of the 2x500MVA ICTs under present scope is proposed in the '2' separate dias which are being developed by POWERGRID for M/s RIL for termination of 400kV Jam Khambhaliya - Jamnagar D/c line. In this respect, POWERGRID vide e-mail dated 08.12.2023 has informed the following:* • *2 complete 400kV diameters (Line-Tie-ICT) along with 400kV D/C line upto Jamnagar is being constructed and owned by POWERGRID for providing connectivity to Bulk Consumer i.e. RIL. Transmission charges for the said asset are not included in PoC pool and will be recovered based on bilateral agreement between POWERGRID and RIL.* • *400kV side GIS Duct length required for interconnection of ICT-5 & 6 at 400kV Jam Khambhaliya PS is approx. 350m. (Actual length shall be finalized based upon final layout).*		

The scheme was agreed in the 22nd CMETS-WR on 23.10.2023. The subject transmission system was deliberated and approved in the 17th NCT meeting held on 31.01.2024 with an estimated cost of Rs. 110 Cr. & tentative implementation timeframe of 21 months. Schematic is given at **Figure 5-7.**

After the deliberations in the 18th NCT held on 05.03.2024, it was decided to expedite the creation of new 220 kV Bus Section-II at Jam Khambhaliya PS with a time schedule of 18 months so as to facilitate interconnection of RE Project of M/s MRPL (250 MW), which is implementing the 220 kV bay by themselves at an early date and which requires the bus extension on urgent basis. It was also agreed for the 220kV GIS line bays (2 nos.) for RE interconnection to be implemented by 30.03.2026 & 30.06.2027 (subject to minimum schedule of 21 months from date of award of balance works).

Further, in the same meeting, it was agreed for implementation of the subject transmission scheme through TBCB route instead of RTM as agreed for in the 17th NCT meeting.

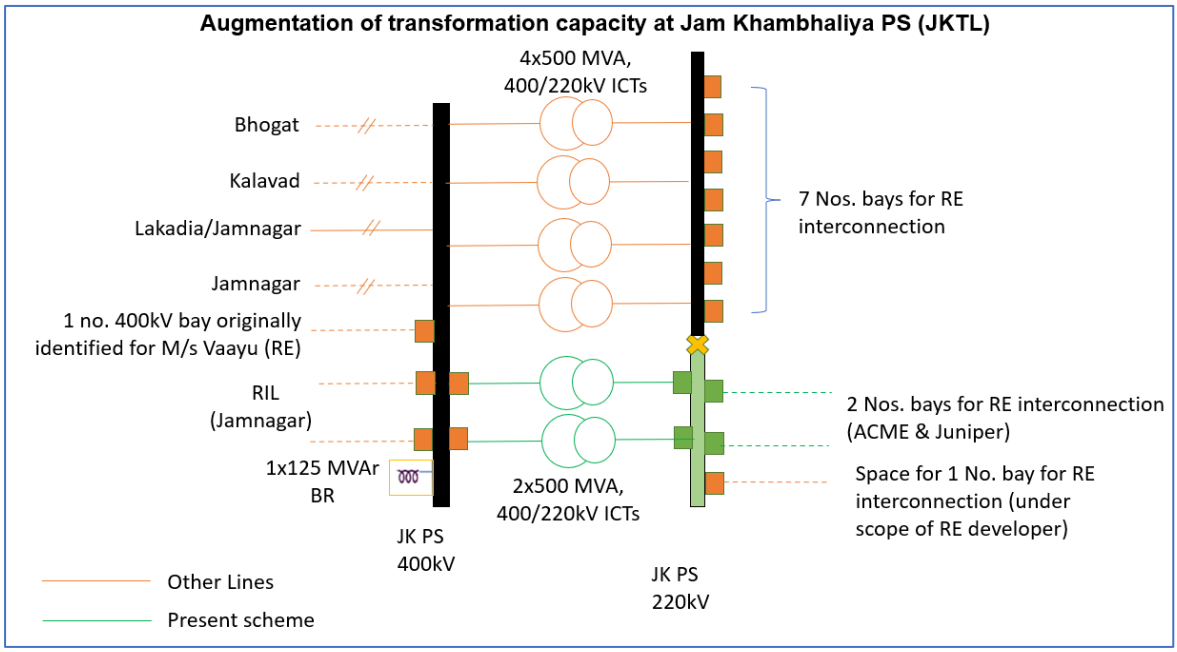


Figure 5-7: Schematic of ICT Augmentation at Jam Khambhaliya PS: Part A

k) Augmentation of Transformation capacity at Jam Khambhaliya PS (JKTL): Part B

Following proposals have been received from GETCO for drawal of power through the ISTS network in vicinity of Jam Khambhaliya PS:

- Installation of 2x500MVA, 400/220kV ICTs at Jam Khambhaliya (on segregated 220kV bus) (under ISTS) and 220 kV D/C Jam Khambhaliya (ISTS) – Kuvadiya line (In-STS): (10-12 km.)

  GETCO stated that the 220kV D/c line shall involve 18 months for implementation by STU. However, considering ISTS time-line of ~24 months from approval-to-COD, the line would be matched with 2x500MVA ICTs under ISTS

- LILO of both circuits of 400 kV D/C Jam Khambhaliya – Kalavad line at Babarzar 400 kV substation along with Establishment of 2x500MVA, 400/220kV ICTs at Babarzar. (In-STS):

  GETCO stated that the scheme is planned under In-STS GEC-II and may be expected by FY27 (under tenderization).

The above schemes were deliberated in 25th CMETS-WR held on 29.01.2024. With the above 2x500MVA ICTs for drawal of power by GETCO, the configuration at 220kV level of Jam Khambhaliya PS would be as below:

1) 220kV Section 1 (existing) with 4x500MVA ICTs and 7 nos. 220kV bays (existing)
2) **220kV Bus Sectionaliser between Section-1 (existing) and Section-2 (new)**
3) 220kV Section 2 (New) with proposed 2x500MVA ICTs (under proposed scope) + **1 No. 500MVA ICT (New)** and 3 nos. 220kV bays (2 nos. under proposed scope & 1 no. under applicant scope)
4) **220kV Bus Sectionaliser between Section-2 (new) and Section-3 (proposed above)**
5) 220kV Section 3 with New 2x500MVA ICTs and 4 nos. 220kV bays **(proposed above)**

Here, it is to be noted that 1 No. 500MVA ICT (7th) on Bus Section-II of Jam Khambhaliya PS has been proposed for RE injection. The last 220kV bus section-3 along with new 2x500MVA, 400/220kV ICTs and 4 nos. 220kV bays are required for GETCO drawal. Hence, it was agreed that the entire scope of work may be implemented under same scheme:

Augmentation of Transformation capacity at Jam Khambhaliya PS (JKTL)-Part B

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of transformation capacity at Jam Khambhaliya PS (GIS) by 1x500MVA, 400/220kV (7^{th}) ICT terminated on new 220kV bus section-2	500MVA, 400/220kV ICTs: 1 Nos. 400kV ICT bays: 1 No. (TSP to implement complete dia. with the other 400kV bay to be utilized by EETFEL (Bulk consumer)) 220kV ICT bays: 1 No.
2.	Creation of New 220kV Bus Section at Jam Khambhaliya PS (Section 3) (with space for 2 nos. 220kV line bays: future in same GIS hall)	220kV Bus sectionaliser bay - 1 Set *(to be kept normally OPEN and may be closed based on system requirement)* 220kV BC – 1 No.
3.	Augmentation of transformation capacity at Jam Khambhaliya PS (GIS) by 2x500MVA, 400/220kV ICT (8th & 9th) terminated on New 220kV bus section-3	500MVA, 400/220kV ICTs: 2 Nos. 400kV ICT bays: NIL (bays being implemented under Jamnagar scheme, which is currently under tendering, with schedule of Apr/May-26) 220kV ICT bays: 2 Nos.
4.	Implementation of 220kV GIS line bays at Jam Khambhaliya PS for Kuvadia 220kV D/c line	220kV line bay – 2 No. (GIS)

Implementation time-frame: 21 months from SPV transfer

In the 18^{th} NCT meeting held on 05.03.2024, it was decided to club the subject scheme with the previous scheme (Augmentation at Jam Khambhaliya: Part-A) as both are required in similar timeframe. Further it was also decided to implement the entire augmentation work at Jam Khambhaliya PS in one go under TBCB. Schematic is given at **Figure 5-8.**

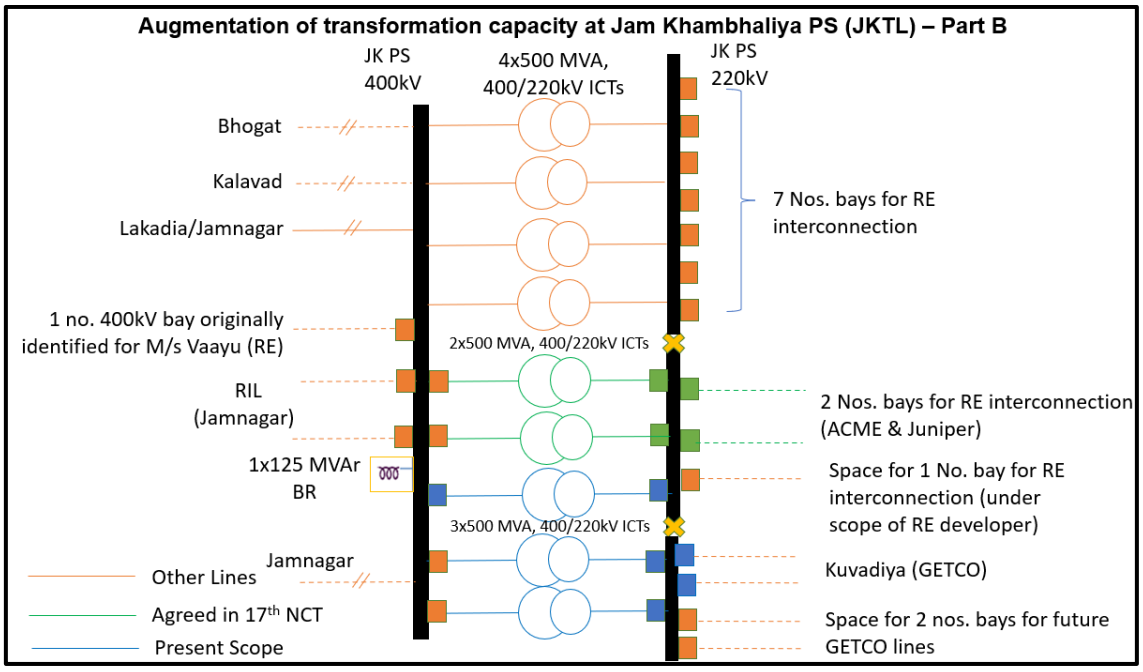


Figure 5-8: Schematic of ICT Augmentation at Jam Khambhaliya PS: Part B

l) Augmentation of transformation capacity at Banaskantha (Radhanesda) PS (GIS)

With the existing 2x500MVA, 400/220kV ICTs, no margin was available for RE injection beyond 1000MW. However, in view of receipt of applications for Connectivity for additional 250MW, 1x500MVA, 400/220kV ICT (3rd) at Banaskantha S/s was planned so as to enable RE injection along with complying to 'N-1' criteria. The scheme was discussed and agreed for in the 25th CMETS-WR held on 29.01.2024**.**

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
1.	Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS) by 1x500MVA 400/220kV ICT (3rd)	500MVA, 400/220kV ICT: 1 No. 400kV ICT bay: 1 Nos. 220kV ICT bay: 1 No.

Implementation time-frame: 21 months from allocation.

m)Transmission System for Offshore Wind Zone Phase-1 (500 MW VGF on coast of Gujarat for Subzone B3)

- Govt. of India has set a target of 500 GW capacity addition from non-fossil fuel-based generation capacity by 2030. MNRE has identified about 30 GW Offshore wind potential each in the coast of Gujarat and Tamil Nadu. Initially 5 GW Offshore wind potential each at Gujarat (CUF – 38%) and Tamil Nadu (CUF – 48%) has been prioritized for implementation.

- The Offshore wind potential may be integrated with the Onshore pooling station though Submarine cables and transmission system beyond Onshore wind has been planned as AC

transmission system. The transmission system for integration of 5 GW Offshore wind potential each at Gujarat and Tamil Nadu has already been identified.

- In the meeting held on 16.08.2023, between MNRE & CTUIL, following was decided:
  - Initial 02 GW transmission capacity (01 GW each off the coast of Gujarat and Tamil Nadu) shall be developed in the 1st Phase and further 04 GW each off the coast of Gujarat and Tamil Nadu shall be developed subsequently.
  - NIWE to demarcate the offshore sites of 01 GW capacity into 2 x 500 MW blocks each (500 MW for VGF Project and remaining 500 MW for Non-VGF Project) of the coast of Gujarat and Tamil Nadu and finalize the probable coordinates of the offshore pooling substations.
  - MNRE to share with CTUIL the site details with probable coordinates of the offshore substations and commissioning timelines for the above 1GW and the balance offshore wind energy projects.
- Transmission system for integration of 1GW Offshore wind in Gujarat (Subzone B3) was also deliberated in the 22nd CMETS-WR held on 23.10.2023, wherein, NIWE/MNRE were requested to provide the following inputs so that the scheme may be finalized.
  - Providing coordinates of B3-OSS-1 for VGF site (500MW)
  - Ampacity of 220kV export cables (1400sq. mm. or 1600 sq. mm.).
  - Details w.r.t. reactive power compensation (onshore / offshore)
- Subsequently, the matter was deliberated in MNRE in the meeting held on 22.12.2023 for finalization of the specifications of the transmission infrastructure in which following broad decisions were taken:
- The tentative timelines for the offshore wind energy projects are as follows:
  - 500 MW VGF project off-Gujarat coast to be commissioned by March 2028. Tender for the project to be published by March 2024
  - 4 GW non-VGF project off-Tamil Nadu coast to be commissioned by in FY 2029-30. Tender for the projects to be published on 01.02.2024
  - 500 MW VGF project off-Tamil Nadu coast to be commissioned by March 2029. Tender for the project to be published by March 2025.
  - Non-VGF project off-Gujarat coast will be tendered based on the response for the Tamil Nadu non-VGF project
- Offshore substation and subsea transmission line will be planned for the block-edge locations presented by NIWE in order to reduce conflicts with operations of offshore wind power developers and reduce the investment by PGCIL.

- The tentative specifications of the transmission infrastructure were agreed upon, and are as follows:
    - Operating voltage for the substation and the transmission line to be kept 220 kV.
    - Substation transformer configuration of 2 x 315 MVA to be used in order to allow for safety margins and evacuation of additional capacity if awarded capacity increases beyond 500 MW
    - 2 x 300 MVA capacity subsea cables to be used for power evacuation
- Based on the above inputs, the Transmission System for Offshore Wind Zone Phase-1 (500 MW VGF on coast of Gujarat for Subzone B3) was discussed and agreed in the 25th CMETS-WR meeting held on 29.01.2024. Schematic is given at **Figure 5-9.**

Transmission System for Offshore Wind Zone Phase-1 (500MW VGF on coast of Gujarat for Subzone B3):

A. Onwards Transmission System from Onshore Pooling Station

1. Installation of 2x1500MVA, 765/400 kV ICTs at Vataman along with 1x125 MVAr (420kV) Bus Reactor
2. Mahuva Onshore PS (GIS) – Vataman 400 kV D/c line (190 km) (Quad Moose) with 63MVAr & 50MVAr, 420kV switchable line reactors on each ckt at Mahuva & Vataman ends respectively.

Vataman switching S/s has been planned through LILO of Lakadia-Vadodara 765 kV D/c line at Vataman under Khavda Ph-III (7 GW) and is presently under implementation by POWERGRID (under TBCB) with implementation schedule of Dec'25.

B. Onshore Pooling Station

1. Establishment of 2x500 MVA, 400/220kV Mahuva Onshore Pooling Station (GIS) (Mahuva PS) alongwith 1x125 MVAR, 420kV bus reactor (with space provision for upgradation to 765 kV level to cater to future Offshore Wind Projects adjacent to B3, B4, B5 pockets in future)
2. 2 Nos. of 220kV line bays at Mahuva PS (GIS) for termination of B3-OSS-1 – Mahuva Onshore PS 220kV 2xS/c (3 core) cables
3. ± 300 MVAr STATCOM at 220kV level of Mahuva PS (GIS) with 1 No. of 220 kV bay
4. 220KV, 1x125MVAR Variable Bus Shunt Reactor (with control range between 25 – 125MVAr for each VSR) with 1 No. of 220 kV bay

Future provision (space for):

- 765/400 kV ICT along with bays- 6 Nos.
- 765 kV line bays along with switchable line reactors – 8 Nos.
- 765 kV Bus Reactor along with bay: 2 Nos.
- 765 kV Sectionaliser: 1 -set

- 400 kV line bays along with switchable line reactors– 8 Nos. (in addition to 2 nos. bays for Mahuva Onshore PS – Vataman 400 kV D/c line)
- 400/220 kV ICT along with bays -7 Nos.
- 400 kV Bus Reactor along with bays: 3 Nos.
- 400 kV Sectionalization bay: 1- set
- 220 kV line bays: 12 Nos.
- 220 kV Sectionalization bay: 1 set
- 220 kV BC and TBC: 1 No.
- STATCOM (±300 MVAR) alongwith associated bay at 220kV - 3 No.
- VSR (1x125MVAR with control range between 25 – 125MVAr for each VSR) alongwith associated bay at 220kV – 3No.

C. Offshore Pooling Station

1. Establishment of **2x315MVA**, 220/66kV Gujarat Offshore B3 Sub-Station Station-1 (B3-OSS-1) with 66kV line bays – **9** nos. for RE Interconnection
2. B3-OSS-1 – Mahuva Onshore PS (GIS) 220kV 2xS/c (3 core) cables (45 km*- undersea cable of about 35 km & underground cable of about 10 km) alongwith associated line bays at both ends (with capacity of 300MVA/ckt at nominal voltage) with 1x50MVAr switchable line reactors at B3-OSS-1 end on each cable

Note:

1. *The no. of 220 kV Submarine Cables has been considered assuming capacity of one three core cable as 300MVA.*
2. *Reactive compensation has been worked considering MVAr generation of about 3MVAr/km by 220 kV Submarine Cable.*
3. ** Distance indicated is beeline length, however, it may change based on actual survey.*

Expected Commissioning Schedule: Mar'28

Tentative Cost: Onshore Portion: Rs. 2186 Cr. & Offshore Portion: Rs. 4700 Cr.

Transmission System for Offshore Wind Zone Phase-2 (500 MW Non- VGF on coast of Gujarat for Subzone B3):

A. Onshore Pooling Station

1. Augmentation of Mahuva Onshore Pooling Station (GIS) by 1x500 MVA, 400/220kV ICT alongwith 1x125 MVAR, 420kV bus reactor
2. 2 Nos. of 220kV line bays at Mahuva PS(GIS) for termination of B3-OSS-1 – Mahuva Onshore PS 220kV 2xS/c (3 core) cables
3. 220KV, 1x125MVAR Variable Bus Shunt Reactor (with control range between 25 – 125MVAr for each VSR) with 1 Nos. of 220 kV bay

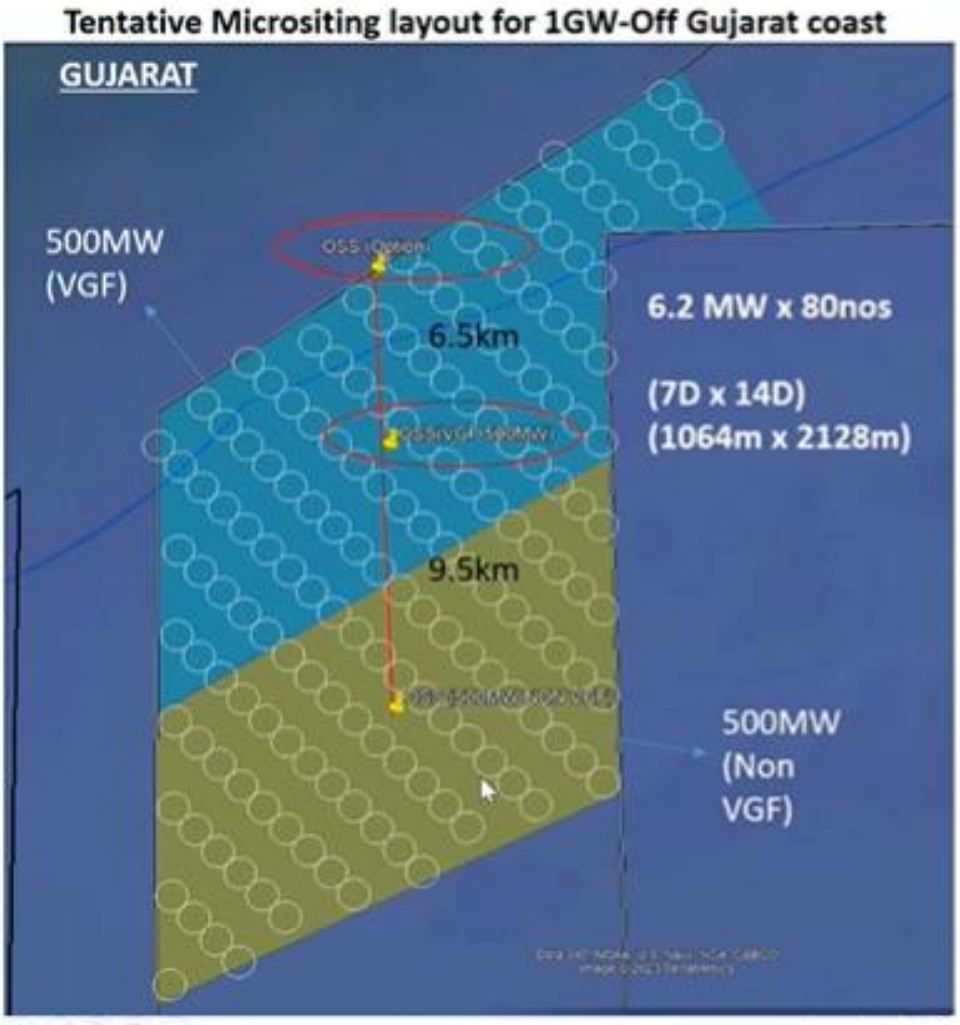
B. Offshore Pooling Station

1. Establishment of **2x315MVA**, 220/66kV Gujarat Offshore B3 Sub-Station Station-2 (B3-OSS-2) with 66kV line bays – **9** nos. for RE Interconnection
2. B3-OSS-2 – Mahuva Onshore PS (GIS) 220kV 2xS/c (3 core) cables (~60 km*) alongwith associated line bays at both ends (with capacity of 300MVA/ckt at nominal voltage) with 1x50MVAr switchable line reactors at B3-OSS-2 end on each cable

**The cable lengths are tentative and subject to change based on inputs from MNRE sought vide mail dated 06.10.2023.*

Note:

1. *The no. of 220 kV Submarine Cables has been considered assuming capacity of one three core cable as 300MVA.*
2. *Reactive compensation has been worked considering MVAr generation of about 3MVAr/km by 220 kV Submarine Cable.*



(Source: NIWE)

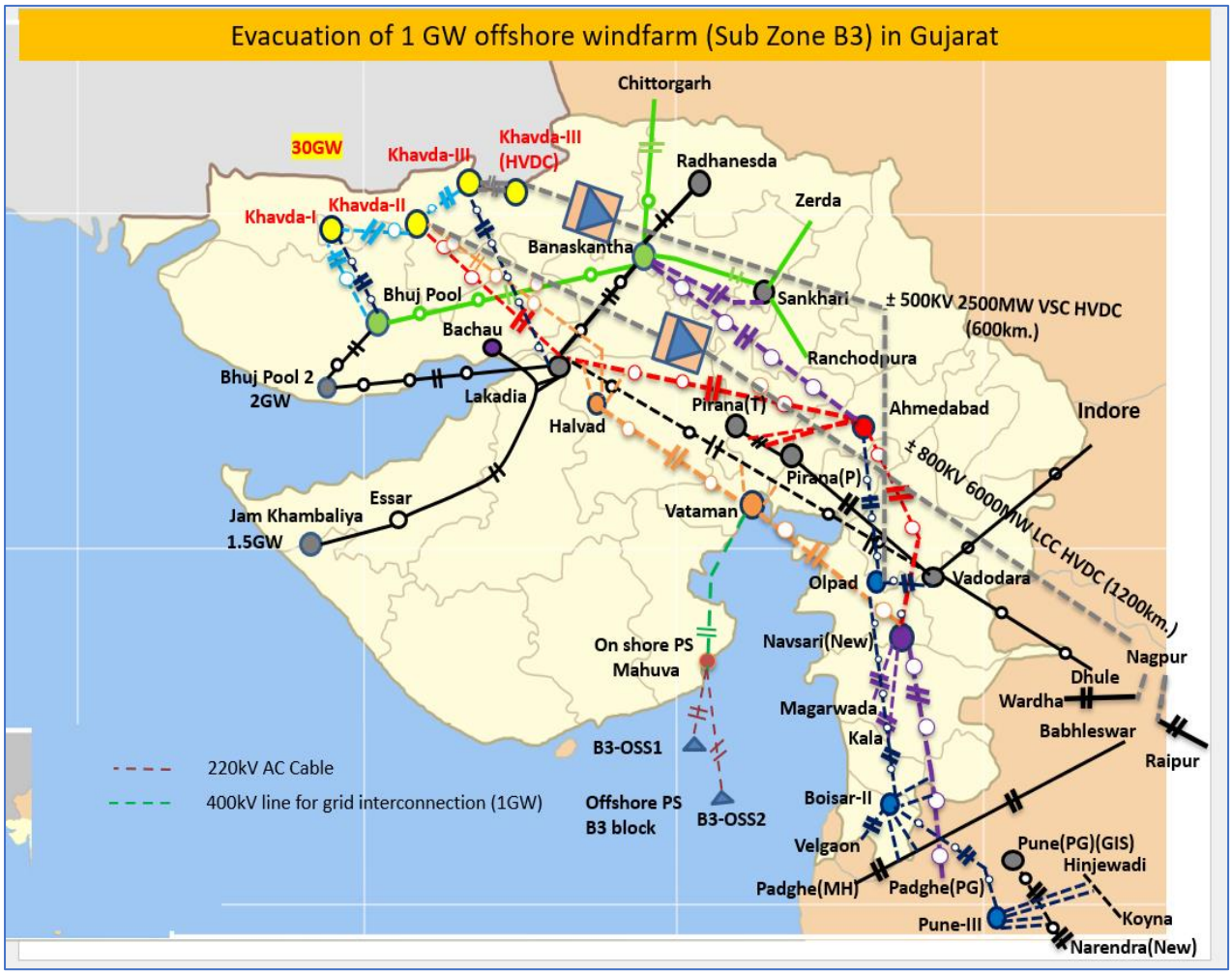


Figure 5-9 Schematic for Tr. System for evacuation of 500MW power from offshore wind zone

n) Implementation of 400kV bay at Khavda-I PS (KPS1) for interconnection of RE project of Sarjan Realities Pvt. Ltd. (SRPL) (1150MW)

KPS1 (Bus Section 1) was implemented by Khavda Bhuj Transmission Ltd. (KBTL) (a subsidiary of Adani Energy Solutions Ltd.) awarded through TBCB Route.

However, KPS1 Augmentation works (Bus Section 2) are under implementation by KPS1 Transmission Ltd. (a subsidiary of Megha Engineering & Infrastructures Ltd.) wherein, 3 nos. 400kV bays at KPS1 (Sec-2) are being implemented, which have been allocated to: AGEL (1000MW), AGEL (1050+250MW) & AGEL (1000MW).

Another 400kV GIS bay is required for enabling connectivity of Sarjan Realities Pvt. Ltd. (SRPL) (1150MW) at 2nd 400 kV bus section of KPS1.

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	400kV line bay at Khavda-I PS (KPS1) (GIS) for interconnection	• 400 kV GIS line bay – 1no. + 1 no. additional bay for diameter completion at	28.02.2026 *(refer note b)*

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
	of RE project of Sarjan Realities Pvt. Ltd. (1150MW)	2nd 400 kV bus section *(refer note a)*	

Note:

a. In view of GIS substation, one complete 400kV diameter with three Circuit Breakers (one and half switching scheme) shall be implemented at 400kV level for interconnection of RE project in one 400kV bay. Utilization of another 400kV bay of the diameter shall be identified in future.

b. *Implementing agency shall match the Implementation Timeframe of the subject transmission scheme with commissioning schedule of Khavda Phase-IV transmission system which is expected by 28.02.2026 (i.e., 24 months from the date of SPV transfer which is presently anticipated by Feb'24).*

Estimated Cost: Rs. 31.8 Crores

o) Interconnection of RE developer's DTL at Bay no. 412 of KPS-1 (400kV Bus Section-I)

KPS1 (Bus Section 1) was implemented by Khavda Bhuj Transmission Ltd. (KBTL) (a subsidiary of Adani Energy Solutions Ltd.) awarded through TBCB Route where in 3 nos. 400kV bays at KPS1 Sec-1, which have been allocated to: Adani Renewable Energy Holding Four Ltd. (AREH4L) for evacuation of 3.5GW of RE power [500MW (appl. no.- 1200002437) +2000MW (appl. no.- 1200002678) +1000MW (appl. no.- 1200002679)].

Another 400kV GIS bay is required for enabling Connectivity of Adani Green Energy Ltd. (AGEL) for 1050MW (appl. no. 1670426092248) at 400 kV bus section I of KPS1.

As per the original scope of transmission scheme under implementation by KBTL, in case of GIS Sub-station, GIS duct of the future bay shall be brought outside the GIS hall/ building with extension/ interface module suitably. In the instant case, future bay at KPS-1 (Section-1) is 412 which has been allocated to AGEL. Accordingly, this scheme has been proposed which includes installation of Line Trap, Surge Arrester, Line CVT, Control & Protection Panel, etc., to complete the balance work of bay no. 412, thereby enabling physical interconnection of AGEL's DTL with KPS-1 (Section-I). The scheme was awarded to KBTL through RTM for implementation vide CTU OM dated 16.02.2024.

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*
1.	Implementation of additional line bay equipment including other miscellaneous works required for physical interconnection of Dedicated Transmission Line of RE Developer at bay no. 412 of KPS-1 (400kV Bus Section-1)	As required for completion of scope of the scheme.

Note:

a. Implementing agency shall match the Implementation Timeframe of the subject transmission scheme with commissioning schedule of Khavda Phase-IV transmission system which is expected by 25.12.2025 (24 months from the date of SPV transfer which is 26.12.2023).

Estimated Cost: Rs. 4.7 Crores

p) Interconnection of RE developer's DTL at Bay no. 416 of KPS-2 (400kV Bus Section-I)

KPS2 is under implementation by KPS2 Transmission Ltd. (KPS2TL) (a subsidiary of Power Grid Corporation of India Ltd.) awarded through TBCB Route where in 2 nos. 400kV bays have been allocated to GIPCL for 1175MW [600MW (appl. no. 1200003371) + 575MW (appl. no. 2200000159)] & GSECL for 600MW (appl. no. 1200003331) at 400kV Bus Section-1 & and 1 no. 400kV line bay has been allocated to NTPC REL for 1555MW quantum [265MW (appl. no. 1200003585) + 100MW (appl. no. 1200003733) + 890MW (appl. no. 1200003953) + 300MW (appl. no. 330700007)] at 400kV Bus Section-2.

Another 400kV GIS bay is required for enabling Connectivity of GSECL for 1364MW [1000MW (appl. no. 230700005) +364MW (appl. no. 2200000048)] at 400 kV bus section-I of KPS2.

As per the original scope of transmission scheme under implementation by KPS2TL, in case of GIS Sub-station, GIS duct of the future bay shall be brought outside the GIS hall/building with extension/interface module suitably. In the instant case, future bay at KPS-2 (Section-1) is 416 which has been allocated to GSECL. Accordingly, this scheme has been proposed which includes installation of Line Trap, Surge Arrester, Line CVT, Control & Protection Panel, etc., to complete the balance work of bay no. 416, thereby enabling physical interconnection of GSECL's DTL with KPS2 (Section-I). The scheme was awarded to KPS2TL through RTM for implementation vide CTU OM dated 16.02.2024.

Sl. No.	***Scope of the Transmission Scheme***	***Item Description***
1.	Implementation of additional line bay equipment including other miscellaneous works required for physical interconnection of Dedicated Transmission Line of RE Developer at bay no. 416 of KPS-2 (400kV Bus Section-1)	As required for completion of scope of the scheme.

Note:

a. Implementing agency shall match the Implementation Timeframe of the subject transmission scheme with commissioning schedule of Khavda Phase-II transmission system which is expected by 28.03.2025.

Estimated Cost: Rs. 12.26 Crores

5.4.2 Maharashtra

a) Western Region Network Expansion scheme in Kallam area of Maharashtra

Govt. of India has set a target for establishing 500 GW capacity from non-fossil energy sources by 2030. In this direction, 2GW capacity has been identified at Kallam PS. Transmission System for evacuation of power from RE Projects in Osmanabad area (1 GW) in Maharashtra is presently under implementation by Kallam Transmission Ltd. which is expected by Mar'24. Further, augmentation of transformation capacity at Kallam PS by 2x500 MVA, 400/220 kV ICTs (3rd & 4th) along with 220kV bays for RE interconnection is also under implementation for enabling interconnection of additional 1GW at 220kV level of Kallam PS (expected by May'24).

Additional connectivity has also been granted to M/ s Torrent at 400kV level (1 no. bay) and hence there is cumulative requirement of evacuation of about 3.25GW (2GW at 220kV level and 1.25GW at 400kV level) from Kallam PS.

The subject transmission system shall enable evacuation of power beyond 1GW at Kallam PS (up to 3.25GW), by alleviating constraints in the area, using Renewable energy sources and is expected to play a significant role in fulfilling India's vision of generating 500 GW of non-fossil generation capacity by 2030.

The subject scheme includes LILO of both circuits of Parli(M) – Karjat(M)/Lonikand-II (M) 400 kV D/c line (twin moose) at Kallam PS along with 63 MVAR, 420 kV switchable line reactor (with NGR bypassing arrangement) on each ckt at Kallam PS end of Karjat – Kallam 400 kV D/c line. The scheme will facilitate integration of 2.25GW power beyond 1GW at Kallam PS (i.e. up to 3.25GW).

The scheme was discussed and agreed in joint study meeting amongst CEA, CTU, GRID-INDIA and MSETCL held on 23.05.2023 and in the 19th CMETS-WR held on 30.05.2023. The subject transmission system was subsequently approved in the 14th NCT meeting held on 09.06.2023 & recommended for implementation of the subject transmission scheme through TBCB route. Schematic is given at **Figure 5-10.**

Western Region Network Expansion scheme in Kallam area of Maharashtra

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	LILO of both circuits of Parli(M) – Karjat(M)/Lonikand-II (M) 400 kV D/c line (twin moose) at Kallam PS	LILO route length~ 15 km.
2.	4 Nos. 400 kV line bays at Kallam PS for LILO of both circuits of Parli(M) – Karjat(M)/Lonikand-II(M) 400 kV D/c line (twin moose) at Kallam PS	400 kV line bays (AIS) – 4 Nos. (for Kallam PS end)
3.	63 MVAR, 420 kV switchable line reactor (with NGR bypassing	63 MVAR, 420 kV switchable line reactor including

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
	arrangement) on each ckt at Kallam PS end of Karjat – Kallam 400 kV D/c line (~140km.)	Switching equipment - 2 Nos. (at Kallam end)

Note:

i. TSP of Kallam PS (Kallam Transmission Ltd.) shall provide requisite space at Kallam PS for above scope of work.

ii. The 50 MVAR fixed line reactors on each ckt at Parli (M) end of Kallam – Parli (M) 400 kV D/c line shall be converted into switchable line reactors (with NGR bypass arrangement & provision of inter-tripping scheme to trip the line reactors along with the main line breakers) by MSETCL in matching time-frame of the above scheme. MSETCL vide email dated 08.06.2023 has informed that conversion of fixed 50 MVAR line reactor at 400 kV Parli (M) (Girwali) end into switchable reactor is feasible.

iii. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.

Implementation timeframe: 18 months from SPV transfer

Estimated Cost: Rs. 160 Crores.

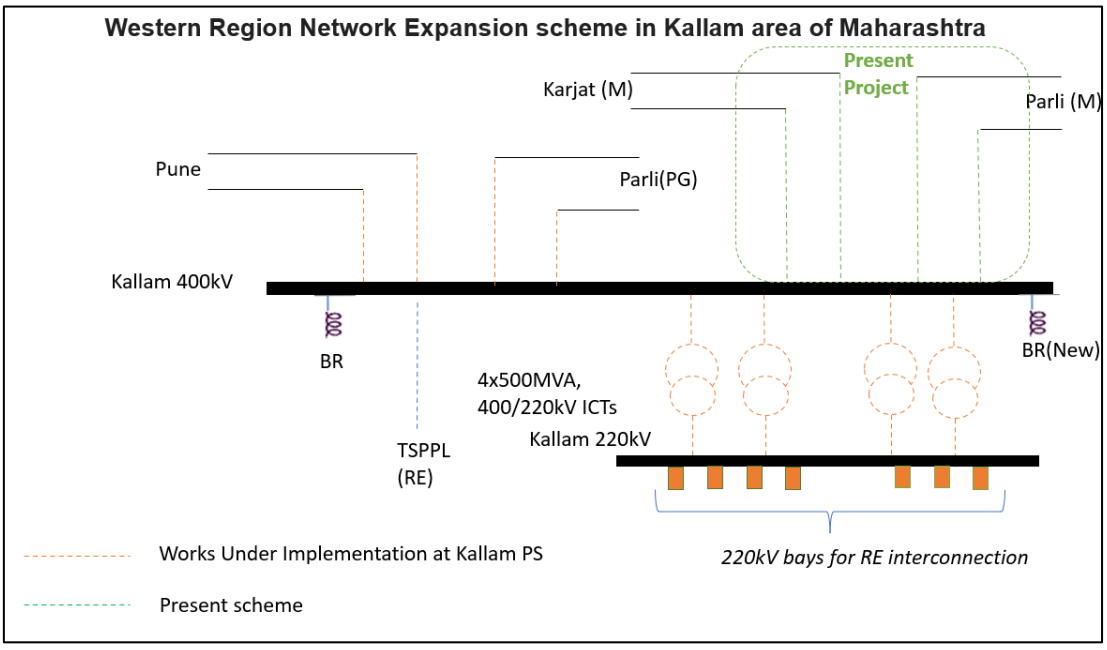


Figure 5-10: Schematic of Western Region Network Expansion scheme in Kallam area of Maharashtra

b) Implementation of 1 no. 400kV bay at Kallam PS for interconnection of RE project of Torrent Solar Power Pvt. Ltd. (TSPPL)

Kallam PS is under implementation by Kallam Transmission Ltd. (a subsidiary of India Grid Trust) as a part of "Transmission System for evacuation of power from RE projects in Osmanabad area (1GW) in Maharashtra" transmission scheme awarded through TBCB route with SCOD as 27.06.2023. As of now, the S/s has been charged and the commercial operation date is anticipated by 31.03.2024 as per the latest communication with the TSP.

The upstream generation project at 400kV level was pioneered by Torrent Solar Power Private Limited (TSPPL) following which Tata Power Renewable Energy Ltd. (TPREL) and Serentica Renewable India Pvt. Ltd. (SRIPL) have joined sharing the same bay with a cumulative injection quantum of more than 1.2GW (TSPPL:600MW; SRIPL: 300MW; TPREL: 302.8MW) till now.

The bay shall be utilized for enabling interconnection of 400kV S/c dedicated line of M/s Torrent Solar Power Pvt. Ltd. (TSPPL) with Kallam PS. The scheme was allotted to KTL vide CTU OM dated 08.06.2023 with implementation timeframe as given below with following scope of work:

Implementation of 1 no. 400kV bay at Kallam PS for interconnection of RE project of Torrent Solar Power Private Limited (TSPPL)

Sl. No.	Scope of the Transmission Scheme	Item Description
1.	400kV line bay at Kallam PS for interconnection of Torrent Solar Power Pvt. Ltd. (TSPPL)	• 400kV line bay (including associated tie bay) – 1no.

Implementation Timeframe: 31.03.2025 (matching with start date of connectivity of TPL).

Estimated Cost: Rs. 17.1 Crores

c) Implementation of 1no. 220kV bay at Parli (PG) for interconnection of RE project of Renew Tej Shakti Pvt. Ltd. (RTSPL)

Parli (PG) S/s was implemented by Power Grid Corporation of India Ltd. under the RTM route. Parli (PG) S/s is presently connected with existing 400kV Bhadrawati S/s (one ckt via Dhariwal TPS), 400/220kV Parli (M) S/s, 765/400kV Parli (New) S/s, planned 400/220kV Kallam PS, 765/400kV Solapur (PG) S/s, 765/400kV Warora PS through 400kV lines. The 1 no 220kV line bay is required for injection of 300MW cumulative RE power from M/s Renew Tej Shakti Pvt. Ltd. (RTSPL) at Parli (PG) PS and Stage-II Connectivity application was deliberated in 13th CMETS-WR held on 08.12.2022.

The scheme was allotted to POWERGRID vide CTU OM dated 21.04.2023 with implementation timeframe as given below with following scope of work:

Implementation of 1 no. 220kV bay at Parli (PG) for interconnection of RE project of M/s Renew Tej Shakti Pvt Ltd. (RTSPL)

Sl. No.	Scope of the Transmission Scheme	Item Descriptions
1.	220kV line bay at Parli(PG) S/s for interconnection of Renew Tej Shakti Pvt. Ltd. (RTSPL)	• 220 kV line bay – 1no.

Implementation Timeframe: 30.04.2025

Estimated Cost: Rs. 5.84 Crores

d) Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune)

- As identified by MOP, a potential of more than 10GW is available for Pumped Storage Plants in Maharashtra in the area between Boisar, Nashik & Pune.

- Applications have already been received from Tata power for Bhivpuri (1150MW) & Shirawata (1980MW) PSPs (3.13 GW). Hence, a new substation in vicinity of Kalamb (nearby Mumbai), which would be optimally distant from all the potential locations, has been planned to cater to the Pumped storage potential envisaged near Pune (more than 10GW). The substation shall have sufficient space for feeding local demand of Mumbai/Ambernath area.

- Out of various load generation scenarios, Sc-7 (PSP importing) & Sc-5 (PSP injecting) are observed to be extreme cases as far as power flow is concerned. New S/s considered at Kalamb through the LILO of Pune-III – Boisar-II 765kV D/c line is able to meet the following limits:

    - A drawal capacity of nearly 6000MW being N-1 compliant and without causing any over loadings, in the winter solar max scenario (Sc-7). Sc-7 has NR export scenario while all other regions are importing. In solar max (afternoon) scenario, PSPs are assumed to be importing power (pumping mode) so as to provide maximum benefits to ISTS Grid.
    - An injection capacity of nearly 4500MW being N-1 compliant and without causing any over loadings, in the summer evening peak scenario (Sc-5). Sc-5 has SR & WR export scenario while NR & ER are importing. In evening peak scenario, PSPs are assumed to be injecting power into the Grid to meet peak demand.

- The matter was discussed in a meeting held on 15.12.2023 amongst CEA, CTU, GRID-INDIA, MSETCL & TATA POWER as well as in the 24th CMETS-WR meeting held on 28.12.2023 wherein it was decided that the substation may be located at a suitable location in South of Kalamb so that it is located in vicinity of Neral (*where 400 kV Padghe – Nagthane D/c, 400 kV Talegaon – Kharghar line and 400 kV Talegaon – Kalwa line are crossing*), near TPC's PSPs as well as other upcoming PSPs north of Murbad (like Malshejghat PSP (1500MW) (AGEL) and Kengadi (1550MW), Jalond (2400MW) & Kalu (1150MW) PSPs of NHPC). Further, considering the huge PSP potential in the area, which are likely to tie up power for pumping mode from RE projects located far away,

space for establishment of 6000 MW, ± 800kV South Kalamb (HVDC) [LCC] terminal station (4x1500 MW) may also be kept in the substation so that an HVDC may also be planned at a future date. Schematic is given at **Figure 5-11.**

Network Expansion Scheme in Western Region to cater to Pumped Storage Potential near Talegaon (Pune)

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Establishment 4x1500 MVA, 765/400kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor **Future provision (space for)** ➢ 765/400 kV ICT along with bays- 7 Nos. (4 Nos. in Sec-II & 3 Nos. on Sec-III) ➢ 765 kV line bays along with switchable line reactors – 6 Nos. (4 Nos. on Sec-II & 2 Nos. on Sec-III) ➢ 765 kV Bus Reactor along with bay: 3 Nos. (2 Nos. on Sec-II & 1 No. on Sec-III) ➢ 765 kV Sectionaliser: 2 -sets ➢ 400 kV line bays along with switchable line reactors– 12 Nos. *(2 nos. on Sec-I, 6 nos. on Sec-II & 4 nos. on Sec-III)* ➢ 400/220 kV ICT along with bays -6 Nos. (on 400kV Sec-III, 3 nos. on 220kV Sec-I & 3 nos. on 220kV Sec-II) ➢ 400 kV Bus Reactor along with bays: 3 Nos. (2 Nos. on Sec-II & 1 No. on Sec-III) ➢ 400 kV Sectionalization bay: 2- set ➢ 220 kV line bays: 12 Nos. (6 nos. on Sec-I & 6 nos. on Sec-II) ➢ 220 kV Sectionalization bay: 1 set ➢ 220 kV BC and TBC: 2 Nos. ➢ Establishment of 6000 MW, ± 800kV South Kalamb (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400kV HVAC Switchyard (2x1500MW on 400kV Sec-I & 2x1500MW on 400kV Sec-II) & all associated equipment (incl. filters)/bus extension, etc.	• 765/400 kV, 1500 MVA ICT – 4 Nos. (13x500 MVA single phase units including one spare ICT Unit) • 765 kV ICT bays – 4 Nos. • 400 kV ICT bays – 4 Nos. • 765 kV Line bays – 4 Nos. • 1x330 MVAr, 765 kV bus reactor- 2 Nos. (7x110 MVAR single phase Reactors including one spare Unit for bus /line reactor) • 765 kV Bus reactor bay – 2 Nos. • 125 MVAr, 420 kV reactor- 2 Nos. • 400kV Reactor bay- 2 Nos. • 400kV line bays - 4 Nos. (for interconnection of TPC PSPs)
2.	LILO of Pune-III – Boisar-II 765kV D/c line at South Kalamb S/s with associated bays at South Kalamb S/s	• LILO Route length: 40 km (160 ckm.)
3.	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)	• 1x240 MVAr, 765 kV switchable line reactor – 2 nos. • Switching equipment for 765 kV line reactor – 2 nos.

Implementation Timeframe: 01.01.2028 as per start date of connectivity sought by TPC for Bhivpuri PSP. (Shirawta PSP is targeted by 1st November 2028)

Tentative Cost: Rs. 1921 Crores

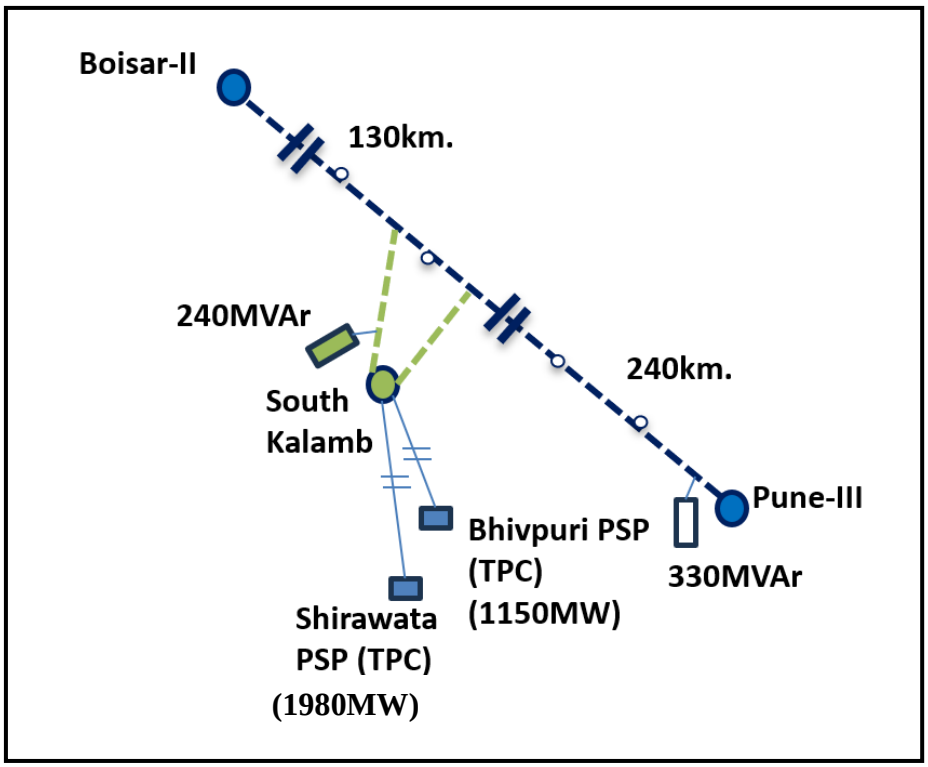


Figure 5-11 Schematic of the Network Expansion Scheme to cater to PSP near Talegaon (Pune)

e) Implementation of 400kV line bay at 765/400kV Parli (New) S/s for RE Interconnection.

765/400kV Parli (new) S/s is an existing substation implemented by POWERGRID Parli Transmission Ltd. (a subsidiary of Power Grid Corporation of India Ltd.) through TBCB Route. The subject 400kV line bay at Parli (New) S/s is allotted to Renew Pawan Shakti Pvt. Ltd. (RPSPL): appl. no. 231400018 (277MW) which is sharing the bay with Renew Pawan Shakti Pvt. Ltd. (RPSPL): appl. no. 331400012 (23MW). The 400kV line bay shall enable evacuation of RE power from various generation projects in Parli area which have applied/ shall apply for Connectivity under GNA at Parli (New) S/s at 400kV level. Schematic is given at **Figure 5-12.**

Implementation of 400kV line bay at 765/400kV Parli (New) S/s for RE Interconnection

Sl. No.	*Scope of the Transmission Scheme*	*Item Descriptions*
1.	400kV line bay at 765/400kV Parli (New) S/s for interconnection of RE Project.	• 400 kV line bay – 1no.

Implementation Timeframe: 31.12.2025

Estimated Cost: Rs. 18 Crores

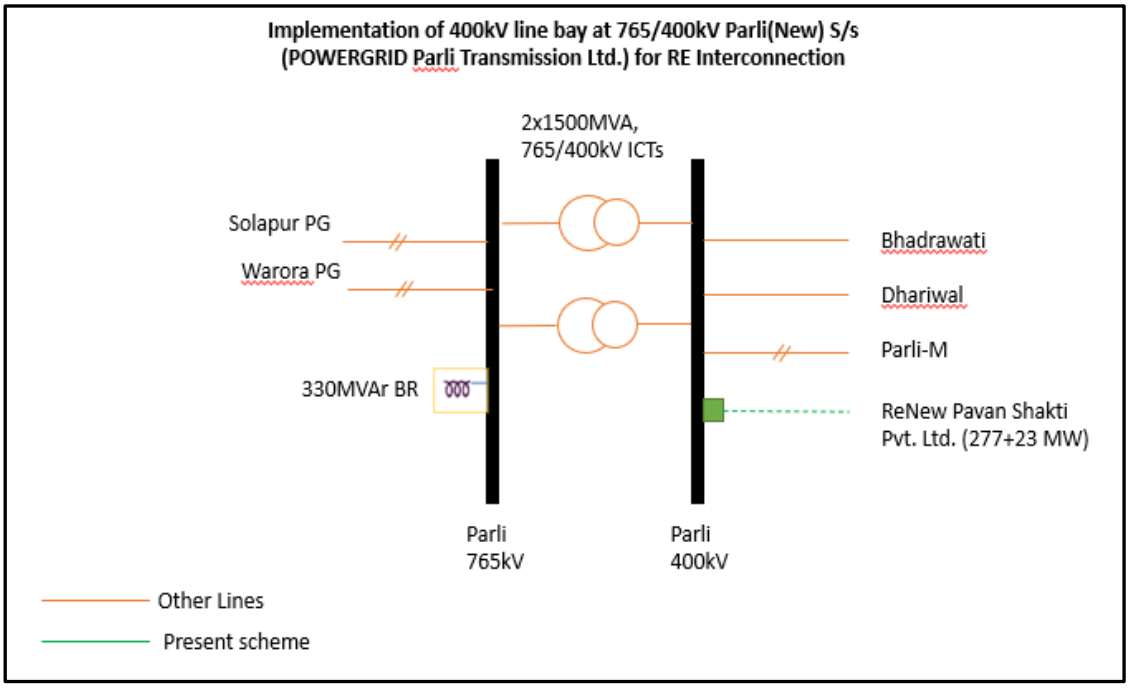


Figure 5-12: Schematic of 400kV line bay at 765/400kV Parli (New) S/s

f) ICT Augmentation at Boisar (PG) S/s

In view of the upcoming EHV consumers on Boisar (PG) – Nalsopara & Boisar (PG) – Vasai lines and delay in Velgaon S/s, MSETCL vide letter dated 08.11.2023 had requested to implement 1x500MVA, 400/220kV ICT (5th) at Boisar (PG) S/s. Further, the proposed Velgaon S/s is also getting delayed due to non-availability of land. Hence, the 5th ICT was required on urgent basis to retain reliability of power supply besides meeting the N-1 criteria.

Accordingly, the scheme was discussed in the 24th CMETS-WR held on 28.12.2023, wherein after the above deliberations, augmentation of Boisar (PG) S/s by 1x500MVA, 400/220kV ICT (5th) was agreed with the following scope of work.

ICT Augmentation at Boisar (PG) S/s

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Augmentation of transformation capacity at Boisar (PG) S/s by 1x500MVA, 400/220kV ICT (5th)	• 500MVA, 400/220kV ICTs: 1 No* • 400kV ICT bays: 1 No. (GIS)* • 220kV ICT bays: 1 No.*

**As per email dated 28.12.2023 from POWERGRID, Space is available at Boisar (PG) S/s for 400/220kV ICT-V. For accommodating the above, 1 no. 400kV GIS Bay (In existing Half Dia of One and Half CB Scheme) and 1 Nos. 220kV Bay (In DMT scheme) need to be constructed.*

Implementation time-frame: 21 months from allocation.

Estimated cost: Rs. 49.87 Crores

5.4.3 Madhya Pradesh

a) Augmentation of transformation capacity at 765/400kV Indore S/s in Madhya Pradesh

2x1500MVA, 765/400V ICTs at Indore were observed to be overloaded (1673 on ICT at Section-B under outage of 1500MVA ICT on Section-A) beyond MVA rating under N-1 contingency in 2027-28 time-frame (Scenario-7, Feb Solar Max). To meet the N-1 reliability criteria, 1x1500MVA, 765/400kV ICT (3rd) on Section-A (with Indore & Khandwa 400kV D/c lines) is required. The scheme was deliberated & agreed for in 20th CMETS-WR held on 04.08.2023. Further, the scheme was also deliberated and agreed for in the 16th NCT meeting held on 30.11.2023 with following scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of Transformation capacity at 765/400kV Indore S/s by 1x1500MVA ICT (3rd) [terminated on 400kV Bus section A with Indore & Khandwa 400kV D/c lines]	765/400kV, 1x1500MVA ICT – 1 No. 765kV bay – 1 No. 400kV bay – 1 No. (on bus section-A)

Implementation time-frame: 18 months

Estimated Cost: Rs. 126 Crores

The subject augmentation scheme was awarded to POWERGRID through RTM mode vide CTU forwarding letter dated 27.12.2023.

b) Replacement of 63 MVAr Bus reactor with 125 MVAr Bus reactor at 400kV level of Jabalpur S/s of POWERGRID

POWERGRID vide email dated 23rd May 2023 informed the WRPC that as per 41st meeting of WRPC, the replacement of 400kV 63 MVAR Bus reactor at 400/220kV Jabalpur S/s was approved under O&M. Additional capitalization in line with the recommendation of CPRI based on RLA after completion of its useful service life. However, recently, CTU has proposed replacement of 63 MVAR bus reactor with 125 MVAR bus reactor based on system conditions (Voltage sensitivity of 0.6kV for 63MVAr reactor and 1.2kV for 125MVAr reactor was observed at Jabalpur S/s) and accordingly POWERGRID proposed to replace the existing 400KV 63 MVAR Bus reactor with 125 MVAR bus reactor at Jabalpur under ADD-CAP.

Subsequently, in the 567th OCC committee meeting as well as in the recently concluded 47th WRPC meeting held on 15.06.2023, POWERGRID informed that the useful life of 400KV 63 MVAR Bus reactor at 400/220kV Jabalpur S/s has been completed and hence

the proposed replacement of 420kV, 63 MVAr Bus reactor with 420kV, 125MVAr bus reactor at Jabalpur (PG) S/s needs to be implemented as a new scheme. The above was noted in the WRPC meeting and it was decided that CTU shall take the scheme for further approvals in the ensuing CMETS-WR meeting. The matter was subsequently deliberated & agreed for in 20th CMETS-WR to be held on 04.08.2023. Further, vide CTU OM dated 26.10.2023, the subject scheme was awarded to POWERGRID through RTM route. The detailed scope of work along with estimated cost and implementation time frame is give below.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Replacement of 420kV, 63 MVAr Bus reactor with 420kV, 125MVAr bus reactor at Jabalpur (PG) S/s along with associated civil works	420kV, 125MVAr bus reactor – 1 No.

Implementation time-frame: 27 months

Estimated cost: Rs. 17 Crores

c) Transmission System for evacuation of power from Mahan Energen Limited Generating Station in Madhya Pradesh

As per CERC Regulation, 2004/2009, Connectivity has been granted to Mahan Energen Ltd. (Formerly Essar Power MP Ltd) (2x600MW) for 1100MW as per the following details:

- Mahan TPS – Bilaspur PS 400kV D/c (Quad ACSR Moose) line
- LILO of one ckt of 400kV Vindhyachal – Korba STPP at Mahan TPS
- 4 nos. 400kV line bays at Mahan TPS.

The LILO of one ckt. of 400kV Vindhyachal – Korba STPP at Mahan TPS was disconnected as per directions in CERC order dated 01.06.2022 in I.A. No. 4/IA/2022 in Petition No. 92/MP/2021. M/s MEL has opted for conversion to GNA for 1100MW under Regulation 37.6(1) of GNA Regulations, 2022. M/s MEL has also filed an application for grant of Connectivity for balance 100MW under Regulation 4 of GNA Regulations, 2022 for its existing plant.

Subsequently, a meeting was held amongst CEA, CTU, MPPTCL, CSPTCL, EPTCL & MEL on 01.09.2023, wherein, it was decided that M/s MEL was to apply for connectivity for the expansion of Bandhaura Thermal power Plant (2 x 800 MW) (Mahan Expansion project) being developed by Mahan Energen Limited (MEL). In this regard, it is to mention that MEL has filed an application to MP Power Transmission Co. Ltd (MP STU) for connectivity of 1320 MW (Gross) capacity of its Mahan Expansion project with Intra-State Transmission System & balance 280MW (Gross) capacity of the Mahan Expansion project to Inter State Transmission System under GNA.

The matter was discussed in a joint study meeting amongst CEA, CTU, MPPTCL, GRID-INDIA & MEL on 11.12.2023 & 11.01.2024 wherein a number of alternatives were studied and Alternative-V [MP STU proposed system + Mahan (existing bus) – Rewa PS (PG) 400kV D/c line (quad) (Under ISTS) & Mahan - Mahan (Ext) interconnector closed] was agreed as the best option from techno-economic point of view considering distinct advantages over other alternatives studied during the meeting. The matter was discussed and finalized in the 25th CMETS-WR meeting held on 29.01.2024. Schematic is given at **Figure 5-13.**

Transmission System for evacuation of power from Mahan Energen Limited Generating Station in Madhya Pradesh

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Mahan (existing bus) – Rewa PS (PG) 400kV D/c (quad) line	110km.
2.	2 nos. 400kV bays at Rewa PS (PG) for termination of Mahan (existing bus) – Rewa PS (PG) 400kV D/c line (quad) line	400kV bays: 2 Nos.

Note:

- 2 nos. 400kV line bays at MEL (existing) shall be under the scope of MEL
- POWERGRID to provide space at Rewa PS (PG) for scope at Sl. 2

Following transmission system proposed by MPPTCL was deliberated & agreed for evacuation of MP's share of about 1230MW power (1320 MW Gross capacity) from proposed 2x800 MW units of Mahan Expansion project to be developed by MPPTCL by Jan'27 as per PPA signed between MEL & MPPMCL:

Sl. No.	Transmission Infrastructure	Length/Capacity
1.	**Establishment of Rewa (Sagra) 400kV S/s with 2x500MVA,400/220kV and 2x200MVA, 220/132kV ICT**	**2x500MVA,400/220kV 2x200MVA, 220/132**
2.	PTEMPL Switchyard - Rewa(Sagra) 400kV DCDS line(Quad Moose)	150km
3.	LILO of both circuit of Rewa - Sirmour/Bansagar-I 220kV line at Rewa(Sagra) 400kV S/s	10km
4.	Rewa(Sagra) 400kV - Kotar 220kV DCDS line	45km
5.	Rewa(Sagra) 400kV - Rewa(Sagra) 132kV DCDS line (Interconnector) [In case on non-availbility of feeder bay at Existing EHV Substation then option for LILO of Existing Line will be explore]	10km

Sl. No.	Transmission Infrastructure	Length/Capacity
6.	Rewa(Sagra) 400kV - Rewa 132kV DCDS line [In case on non-availbility of feeder bay at Existing EHV Substation then option for LILO of Existing Line will be explore]	25km
7.	Rewa(Sagra) 400kV - Mangawan 132kV DCDS line [In case on non-availbility of feeder bay at Existing EHV Substation then option for LILO of Existing Line will be explore]	25km
8.	**Establishment of Amarpatan 400kV S/s with 2x500MVA,400/220kV and 2x200MVA, 220/132kV ICT**	**2x500MVA,400/220kV 2x200MVA, 220/132**
9.	Rewa(Sagra) - Amarpatan 400kV DCDS line(Quad / Twin Moose)	60km
10.	LILO of both circuit of Maihar - Satna (PGCIL) 220kV line at Amarpatan 400kV S/s	20Km
11.	Amarpatan 400kV - Amarpatan 132kV DCDS line (Interconnector) [In case on non-availbility of feeder bay at Existing EHV Substation then option for LILO of Existing Line will be explore]	10km
12.	Amarpatan 400kV - Satna -II 132kV DCDS line	35km
13.	Amarpatan 400kV - Rampur Baghelan 132kV DCDS line [In case on non-availbility of feeder bay at Existing EHV Substation then option for LILO of Existing Line will be explore]	25km
14.	Amarpatan 400kV - Unchehra 132kV DCDS line	25km

Note: *MPPTCL has stated that the above system may be slightly changed based on feasibility of physical implementation of downstream system and the same shall be intimated from time to time.*

Implementation time-frame*:* 24 months

Tentative Cost: Rs. 558 Crores

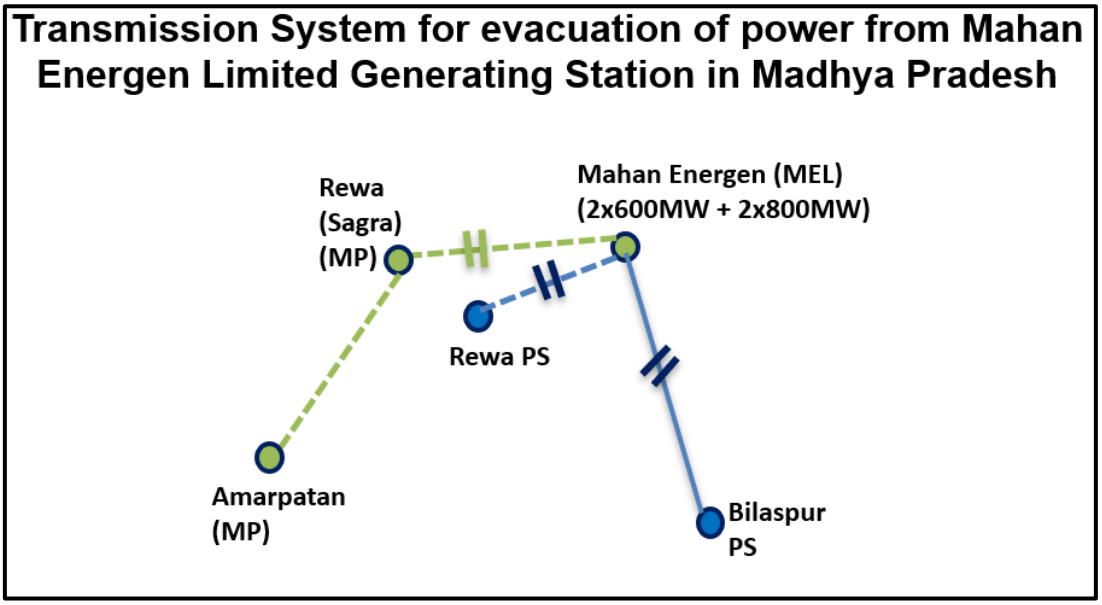


Figure 5-13 Schematic of Tr. System for evacuation of power from MEL TPS

d) 400kV line bays & ICT Augmentation at 765/400/220kV Mandsaur S/s in MP

The Mandsaur PS is being set-up with 3x1500MVA, 765/400kV ICTs to enable evacuation of power from 2GW Wind Potential (w/o BESS) identified under 181.5GW REZ potential. The S/s has been approved in the 14th NCT meeting held on 09.06.2023 & is currently under bidding with an implementation time-frame of 24 months from SPV Transfer. The present application shall result in cumulative injection of 3512MW (incl. 2000MW WEZ) at 400kV level of Mandsaur PS and hence, an additional 1x1500MVA, 765/400kV ICT (4th) is required.

The PSPs of M/s Greenko are tying up power from RE sources and the RE power stored during high RE periods shall be dispatched in conjunction with the 2GW WEZ at Mandsaur PS. Thus, the 4th ICT would be catering to WEZ potential and would also facilitate evacuation of RE power stored in PSP in a reliable manner. Hence, the 1x1500 MVA, 765/400 kV ICT (4th) at Mandsaur PS shall serve both RE projects as well as the subject PSPs (Energy storage).

The scheme was agreed in the 21st CMETS-WR (2nd sitting) meeting held on 29.08.2023. In 17th NCT meeting held on 31.01.2024, it was deliberated that PSPs should operate to store RE power in such a manner so as to ensure optimal loading on 765/400kV ICTs at Mandsaur PS. In this way, the loading on outgoing 765kV lines from Mandsaur PS would also be within limits and PSP would compliment the ISTS Grid and help in maximum RE integration without the need for additional system.

Accordingly, NCT opined that for providing connectivity to PSP of Greenko, augmentation of transformation capacity is not required at Mandsaur S/s as the same can be accommodated within the present scope of works. Further, the 2 nos. 400kV line bays for Greenko may be discussed later as a separate scheme based on its cost.

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
1.	Augmentation of transformation capacity at Mandsaur PS by 1x1500 MVA, 765/400 kV ICT (4th) along with associated bays	765/400kV ICT – 1 no. (4th) 765kV ICT bay – 1No. 400kV ICT bay – 1 No.
2.	400kV line bays at 765/400/220kV Mandsaur S/s for Interconnection of PSP of Greenko MP01 IREP Private Limited	400kV line bay – 2 No.

Implementation timeframe: 24 months from date of allocation to implementing agency.

Estimated Cost: Rs. 143 Crores

e) Augmentation of Transformation Capacity at 400/220kV Rajgarh (PG) S/s in MP by 400/220 kV, 1x500 MVA ICT (3rd)

Due to non-availability of margins for injection beyond 300MW from 220kV level of Rajgarh S/s, the 1x500MVA, 400/220kV ICT-III has been planned on extended 220kV bus (segregated from main bus through bus sectionaliser) so as to enable evacuation of RE power from various generation projects which have applied for Connectivity under GNA at Rajgarh S/s directly to 400kV level of Rajgarh S/s. The sectionaliser may also be closed based on system requirement. Schematic is given at **Figure 5-14.**

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	Augmentation of Transformation capacity at 400/220kV Rajgarh S/s by 1x500MVA ICT (3rd) (terminated on the sectionalized 220kV bus)	• 400/220kV, 1x500MVA ICT – 1 No. • 400kV ICT bay – 1 No. (AIS) • 220kV ICT bay – 1 No. (GIS) (on the sectionalized 220kV bus, which is presently under implementation by POWERGRID) • 220 kV GIS duct (m) – 300m. approx.	31.10.2025 or 21 months from date of award to implementing agency (whichever is later).
2.	Implementation of 220kV GIS line bay at Rajgarh 400/220kV (PG) S/s (on extended bus) for RE Interconnection	• 220kV line bay – 1 No. (GIS) (on the sectionalized 220kV bus, which is presently under implementation by POWERGRID) • 220 kV GIS duct (m) – 150m approx.	31.12.2026 or 21 months from date of award to implementing agency (whichever is later).
		Total Estimated Cost:	**₹ 71 Crores**

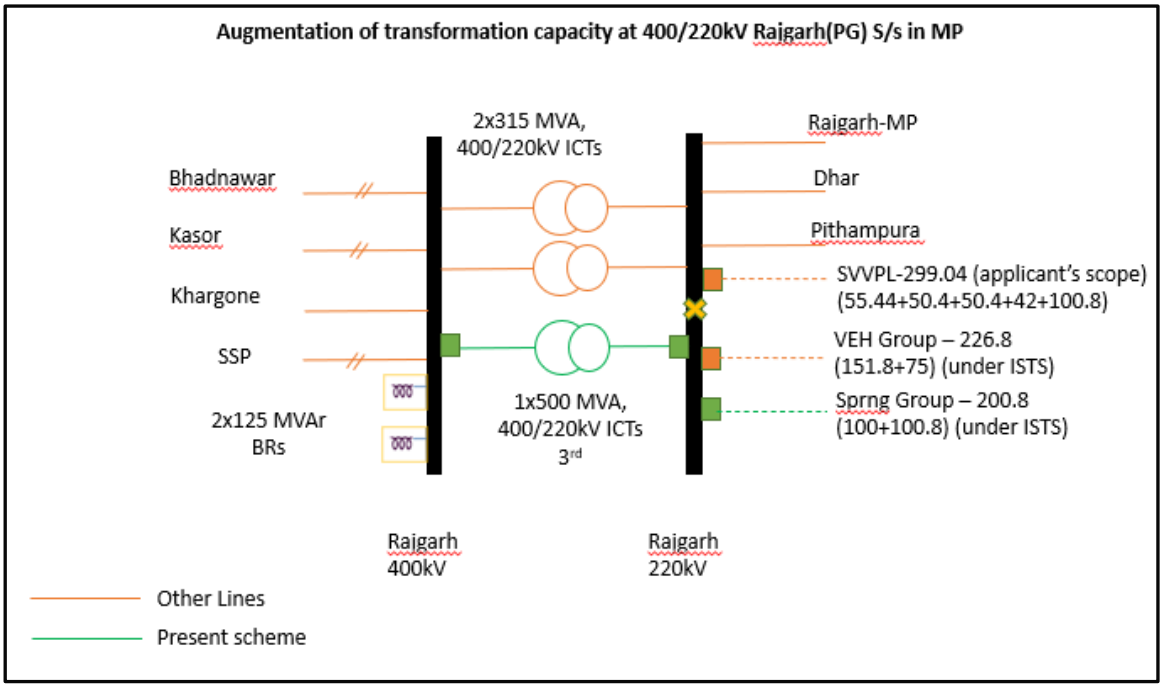


Figure 5-14: Schematic of Augmentation of Transformation Capacity at 400/220kV Rajgarh (PG) S/s

The scheme was awarded to POWERGRID through RTM for implementation vide CTU OM dated 16.02.2024 with an implementation timeframe of 21 months from date of award.

f) Augmentation of Transformation Capacity at 400/220kV Rajgarh (PG) S/s in MP by 400/220 kV, 1x500 MVA ICT (4th)

Due to non-availability of margins for injection at the 220kV level of Rajgarh S/s, the 1x500MVA, 400/220kV ICT-IV has been planned on extended 220kV bus (segregated from main bus through bus sectionaliser) so as to enable evacuation of RE power from various generation projects which have applied for Connectivity under GNA at Rajgarh S/s directly to 400kV level of Rajgarh S/s. The sectionaliser may also be closed based on system requirement.

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Augmentation of Transformation capacity at 400/220kV Rajgarh S/s by 1x500MVA ICT (4th) (terminated on the sectionalized 220kV bus)	400/220kV, 1x500MVA ICT – 1 No. 400kV ICT bay – 1 No. (AIS) 220kV ICT bay – 1 No. (GIS) (on the sectionalized 220kV bus, which is presently under implementation by POWERGRID)
2.	Implementation of 220kV GIS line bay at Rajgarh 400/220kV (PG) S/s (on extended bus) for RE Interconnection	220kV line bay – 1 No. (GIS) (on the sectionalized 220kV bus, which is presently under implementation by POWERGRID) (for AEPL)

Implementation time-frame: 21 months from SPV transfer.

Estimated cost: Rs. 76 Crores

g) Implementation of 400kV line bay at 765/400/220kV Indore (PG) S/s in MP for RE Interconnection

765/400/220kV Indore S/s is an existing substation implemented by POWERGRID, awarded through RTM Route. The proposed system shall enable evacuation of RE power from various generation projects in Indore area which have applied for connectivity under GNA at Indore S/s at 400kV level.

1 no. 400kV bay at Indore (PG) S/s has been allotted to Renew Urja Shachar Pvt. Ltd. (RUSPL) against application No. 2200000070 (300MW). Further, against application No. 2200000298, Renew Samir Urja Private Limited has also been granted Connectivity for 300MW at Indore (PG) S/s through sharing of the bay allotted to M/s RUSPL.

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*
1.	400kV line bay at 765/400/220kV Indore (PG) for Interconnection of RE project	400kV line bay – 1 No. (On bus section A with Indore & Khandwa lines)

Implementation schedule: 30.06.2025

Estimated cost: Rs. 9 Crores

The subject transmission scheme was awarded to POWERGRID through RTM route vide CTU OM dated 02.01.2024. Schematic is given at **Figure 5-15.**

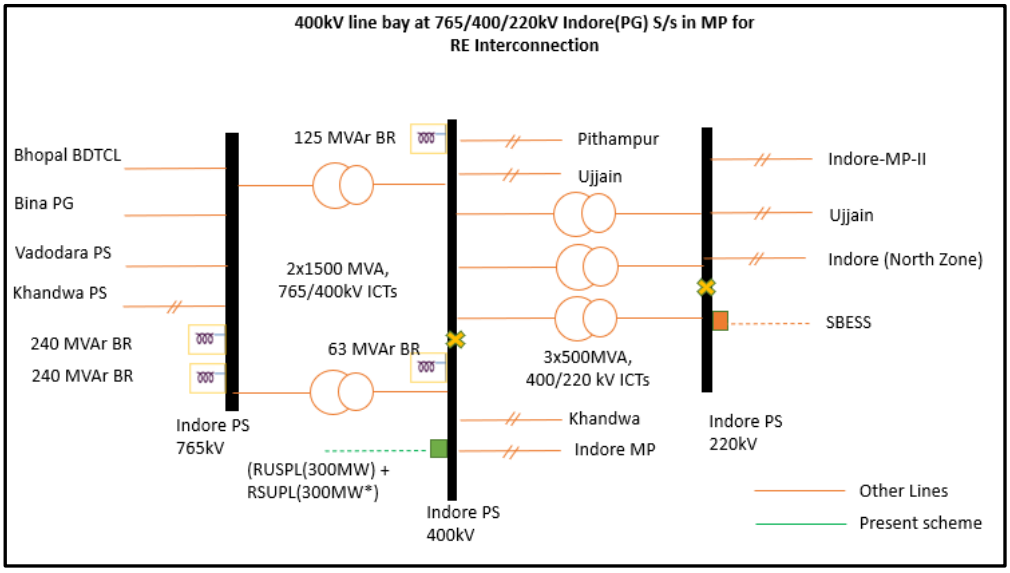


Figure 5-15: Schematic of 400kV line bay at Indore (PG) S/s

5.4.4 UT of DD & DNH

a) Augmentation of transformation capacity at 400/220kV Magarwada GIS S/s in Dadra and Nagar Haveli and Daman and Diu

2x315MVA, 400/220kV ICTs at Magarwada were observed to be overloaded (375MVA) beyond MVA rating under N-1 contingency in 2027-28 time-frame (Scenario-7, Feb Solar Max). To meet the 'N-1' reliability criteria, 1x500 MVA, 400/220 kV ICT (3rd) was planned. The scheme was deliberated & agreed for in 20th CMETS-WR to be held on 04.08.2023 with following scope of work:

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Augmentation of Transformation capacity at 400/220kV Magarwada GIS S/s by 1x500MVA ICT (3rd)	400/220kV, 1x500MVA ICT – 1 No. 400kV bay – 1 No. (GIS) 220kV bay – 1 No. (GIS)

Implementation time-frame: 21 months

The subject transmission scheme was awarded to POWERGRID for implementation through RTM route vide CTU OM dated 26.10.2023.

5.4.5 Green Hydrogen/ Green Ammonia

- Hon'ble Prime Minister of India has announced Hydrogen Mission on 15th August, 2021

which is a major step towards decarbonizing the energy system and thereby complementing other decarburization technologies like renewable power and biofuels. Ministry of Power has issued Hydrogen Policy vide letter dated 17th February 2022 with a motive to facilitate the transition from fossil fuel/ fossil fuel-based feedstock to Green Hydrogen/ Green Ammonia both as energy carriers and chemical feedstock for different sectors.

- Subsequently, MNRE had detailed round of discussions with the Green Hydrogen/ Green Ammonia manufacturers regarding the production capacity to be set up at different locations. Vide letter dated 01.11.2023, MNRE has forwarded the locations of Green Hydrogen/ Ammonia capacities expected to be installed by 2030 along with the electricity demand at these locations.

- Based on above, it emerged that Green Hydrogen/ Ammonia manufacturing is planned in the coastal states of Gujarat, Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal and Odisha. Developer wise details of proposed location for Green Hydrogen/ Ammonia production in Western Region and associated electricity demand by the year 2030 as furnished by the MNRE to CEA is given below:

Sl. No.	State	Location	Developer	Electricity Demand (MW) by 2030
1.	Gujarat	Kandla	Greenko	1500
		Kandla	Renew Power	3000
		Kandla	Welspun New Energy	5000
		Kandla (near Deen Dayal Port)	Ocior Energy	1690
		Kandla (near Deen Dayal Port)	NTPC	2000
		Mundra	Adani New Industries Ltd.	22000
2.	Madhya Pradesh	Bina	BPCL	5

- Subsequently, meeting was also convened by CEA with the Green Hydrogen/Ammonia manufacturers to assess the year wise electricity demand for proper planning of the transmission system. The year wise electricity demand of Green Hydrogen and Green Ammonia plants/industries in WR planned for 2027-2030 is given below:

State	Location	Developer	Electricity Demand in 2026-27 (MW)	Additional Electricity Demand in 2027-28 (MW)	Additional Electricity Demand in 2028-29 (MW)	Additional Electricity Demand in 2029-30 (MW)
Gujarat	Kandla	Greenko	0	1500	0	
		Renew Power	275	0	1370	1370
		Welspun New Energy	500	0	0	4500
		Ocior Energy	190	0	0	1500

State	Location	Developer	Electricity Demand in 2026-27 (MW)	Additional Electricity Demand in 2027-28 (MW)	Additional Electricity Demand in 2028-29 (MW)	Additional Electricity Demand in 2029-30 (MW)
		NTPC	0	0	2000	0
	Mundra	Adani New Industries Ltd.	4000	7000	6000	5000
Madhya Pradesh	Bina	BPCL	5	0	0	0

- BPCL would not require any additional transmission system planning in WR as the power requirement is too small which the existing transmission system can cater to. Further, to, the tentative power demand for Green Hydrogen/ Ammonia production in Gujarat (WR) is summarised below.

State	Location	Electricity Demand in 2026-27 (MW)	Additional Electricity Demand in 2027-28 (MW)	Additional Electricity Demand in 2028-29 (MW)	Additional Electricity Demand in 2029-30 (MW)	Cumulative by 2030
Gujarat	Kandla	965	1500	3370	7370	**13205**
	Mundra	4000	7000	6000	5000	**22000**

- Transmission System to cater to the power demand for Green Hydro/ Green Ammonia production expected by 2027-28 from both Kandla and Mundra is being planned in the first phase. Subsequently, in the second phase, tentative system for Green Hydro/ Green Ammonia production expected by 2028-29 is also being planned, which shall be reviewed later based on visibility of Green Hydro / Green Ammonia in the above areas.

- The Transmission System for Green Hydrogen/ Green Ammonia production expected by 2027-28 was deliberated in the joint study meeting held on 23.02.2024 amongst CEA, CTU, GRID-INDIA, GETCO, GPCL & TPL and in the 26th CMETS-WR held on 28.02.2024 wherein inputs from all the concerned entities have been taken.

  The tentative scope of work is given below.

A. <u>Kandla, Gujarat:</u>

<u>Phase-I:</u> Proposed Transmission network (for meeting electricity demand upto 2465 MW by 2027-28)

- Establishment of 3x1500MVA, 765/400kV Kandla S/s
- Halvad – Kandla 765kV D/c line (~140km.)

<u>Phase-II:</u> Transmission network (for meeting addl. electricity demand of 3370MW (Cumulative 5835 MW by 2028-29)

- Augmentation of transformation capacity at Kandla S/s by 3x1500MVA, 765/400kV ICTs
- Raghanesda – Kandla 765kV D/c line (~250km.) (or) LILO of KPS5 – Halvad 765kV D/c line at Kandla

<u>Phase-III:</u> Transmission network for drawal of additional 7370MW (cumulative 13205MW by 2030) power shall be planned based on evolution of ISTS Grid in the area as well as visibility of Green Hydrogen/Ammonia projects.

B. <u>Mundra, Gujarat:</u>

<u>Phase-I Part A</u>: Proposed Transmission network (for meeting electricity demand upto 1500MW)

- Establishment of 4x1500 MVA, 765/400 kV Navinal (Mundra) (GIS)
- LILO of Bhuj-II – Lakadia 765 kV D/c line at Navinal (Mundra) (GIS) S/s

The transmission system was planned for meeting the demand of bulk consumers (3,000MW) and for meeting the demand of Green Hydrogen/Ammonia manufacturers (1,500MW) in first phase. This scheme is currently under bidding.

<u>Phase-I Part B:</u> Transmission System (for meeting addl. electricity demand of 6000MW at Navinal S/s and 3500MW at Navinal-II S/s) (i.e. balance 9500MW by 2027-28))

- Augmentation of ICT by 5x1500 MVA at Navinal (Mundra) 765/400 kV GIS S/s
- Navinal(Mundra) – Bhuj 765kV D/c line (~70km.)
- Navinal(Mundra) – Bhuj-II 765kV D/c line (~90km.)
- Establishment of 4x1500MVA, 765/400kV Navinal-II S/s (GIS)
- LILO of KPS3 – Lakadia 765kV D/c line at Navinal-II (LILO route length ~60km.)

<u>Phase-II</u>: Transmission network (for meeting addl. electricity demand of 6000MW (upto 17,000 MW by 2029))

- Augmentation of ICT by 5x1500MVA, 765/400kV Navinal-II S/s (on Sec-II)
- LILO of KPS2 – Lakadia 765kV D/c line at Navinal-II (LILO route length ~60km.)

<u>Phase-III</u>: Transmission network for drawal of additional 5000MW (cumulative 22000MW by 2030) power shall be planned based on evolution of ISTS Grid in the area as well as visibility of Green Hydrogen/Ammonia projects.

Of the above, Phase-I of Kandla, Gujarat and Phase-I Part B of Mundra, Gujarat are being planned & taken up for approval with implementation schedule of 24 months.

5.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in section 1.3, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are expected to be commissioned in 2028-29 timeframe are considered for conducting these studies. Results of these studies were analysed and the same are deliberated below-

5.5.1 Power Flow Studies

The base case files for all the 9 scenarios were prepared for 2028-29 timeframe. The study results are detailed in subsequent sections.

5.5.2 Voltage Analysis

Per Unit voltages of all 765 kV and 400 kV buses were monitored in all the nine scenarios. Maximum and minimum voltage of each bus was identified from nine voltages available in nine number of scenarios.

From the studies, voltage exceeding 1.05pu was observed on the 400kV Warora Pool bus and 400kV Wardha Bus in Sc-6. Voltage below 0.95pu was observed on the 400kV buses of Keshod in Gujarat and Julwania in MP during Sc-8. Appropriate remedial measures in the form of installation of bus reactors shall be planned in consultation with respective STUs/Owners to control the overvoltage.

5.5.3 Contingency Analysis

Contingency analysis has been performed on all the 765kV & 400kV transmission lines, and 765/400kV & 400/220kV transformers to ascertain the loading levels under outage of any other 765kV or 400kV transmission element. Results of the analysis are discussed below:

a) Transmission Lines

List of 765kV ISTS lines loaded about 3500MW under N-1 contingency are summarized below at **Table 5-7:**

Table 5-7: 765kV ISTS Transmission lines not meeting N-1 Criteria in WR

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Narendra New - Pune III 765kV D/c line one ckt	Narendra New - Pune III 765kV D/c line other ckt	4	ISTS	2585	3540	3500	101
2.	Vindhyachal Pool – Varanasi 765kV D/c line one ckt	Vindhyachal Pool – Varanasi 765kV D/c line other ckt	5	ISTS	2196	3259	3500	93
3.	KPS1 – KPS2 765kV D/c line one ckt	KPS1 – KPS2 765kV D/c line other ckt	1,4	ISTS	1810	3480	3500	99.42

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
4.	Navinal(Mundra) – Bhuj-II 765kV D/c line one ckt	Navinal(Mundra) – Bhuj-II 765kV D/c line other ckt	1,4	ISTS	2170	3400	3500	97

Due to high generation in Vindhyachal complex and low generation in addition to high demand in Varansi area, the flow on Varanasi- Vindhyachal 765kV D/c corridor is observed to be on higher side. Suitable network augmentation would be planned in consultation with concerned stakeholders.

Due to concentrated generation in Narendra area and high load on western side of Maharashtra in the Pune area, high power flow on the Narendra-Pune-III 765kV D/c line is being observed. To relieve the loading, additional Inter-regional corridor between WR & SR will be planned in consultation with concerned stakeholders.

During Solar Max scenario, as the RE generation is high in the Khavda area and owing to the short length of the KPS1 – KPS2 765kV D/c line, the loading is observed to be on higher side.

The loading observed on the Navinal (Mundra)-Bhuj-II 765kV D/c line is observed to be near the rated capacity. However, additional lines from Bhuj/Bhuj-II up to Navinal (Mundra) S/s are being planned under Phase-I Part B of Green Hydrogen/Ammonia scheme as detailed above.

Further, 400kV ISTS/STU lines loaded beyond 100% of thermal rating under N-1 contingency are summarized below at **Table 5-8:**

Table 5-8: 400kV Transmission lines not meeting N-1 Criteria in WR

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading (max)	Loading under N-1 (max)	Maximum Loading %	Rating
1.	Khargar - Navi Mumbai 400kV line	Khargar - Padghe (PG) 400kV line	1,2,4,5,7, 8	ISTS	532	1155	134	857
2.	Raigarh Pool-Lara STPP 400kV D/c line one ckt	Raigarh Pool-Lara STPP 400kV D/c line other ckt	2,5,6	ISTS	656	1203	114	1050
3.	Jindal- Pithora 400kV D/c line one ckt	Jindal-Pithora 400kV D/c line other ckt	8	JPL	440	881	103	850

Reconductoring of Kharghar - Navi Mumbai 400kV line may be done by MSETCL to mitigate the overloading issue. During low generation at Lara STPP, power flows from Raigarh Pool to Lara and then from Lara to Champa. Raigarh Pool to Lara being line with twin configuration & Lara to Champa being line with quad configuration, Raigarh Pool- Lara 400kV D/c line is

observed to be over loaded under N-1. The above issue also appears in the operational feedback report for Q_3 of 2023-24 from WRLDC. Remedial measures shall be planned in consultation with concerned stakeholders.

Pithora S/s is a new 400/220kV substation being planned by CSPTCL through LILO of JPL – Raipur 400kV D/c line. The issue of high loading on Jindal-Pithora 400kV D/c line would be further analysed and if required, augmentation would be planned.

b) Transformers

List of ICTs loaded beyond MVA rating under N-1 contingency are summarized below at **Table 5-9:**

Table 5-9: ISTS ICTs not meeting N-1 Criteria in WR

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Base Case Flow	Maximum Loading under N-1 of ICT	% Loading	Rating
1	400/220kV, 2x500MVA Karera ICTs	1,4,7	ISTS	450	700	140	500
2	765/400kV, 2x1000MVA Satna ICTs	5	ISTS	703	1010	101	1000
3	765/400kV, 2x1500MVA South Olpad ICTs	2,5,8	ISTS	1128	1736	116	1500
4	400/220kV, 2x315MVA Navi Mumbai ICTs	4,7	ISTS	257	332	105	315
5	400/220kV, 4x500MVA Kallam ICTs	2,3,5,6	ISTS	446	595	119	500
6	400/220kV, 2X315MVA Halvad ICTs	8	GETCO (STU)	262	340	108	315
7	400/220kV, 3x315MVA +1x500MVA Zerda ICTs	8	GETCO (STU)	268	320	102	315
8	765/400kV, 2x1500MVA A'bad-III ICTs	8	MSETCL (STU)	963	1579	105	1500
9	400/220kV, 2x315MVA Mundra APL ICTs	2,3,5,6	APL	262	357	113	315
10	765/400kV, 2x1000MVA Sipat ICTs	4	NTPC	724	1095	109	1000

In MP, following over loadings are observed:

- High loading on Karera 400/220kV ICTs is observed with integration of 2.5GW RE potential at Morena under 181.5GW REZ through Morena PS –Karera 400 kV D/c line under Ph-II. Adequate system augmentation at Karera S/s would be finalised after discussions with concerned stakeholders.
- Under N-1 contingency of one Satna 765/400kV ICT, other ICT is observed to be N-1 non-compliant in evening peak scenario. Adequate system augmentation at Satna S/s would be finalised after discussions with concerned stakeholders.

- High loading on Sipat 765/400kV ICTs shall be analysed and suitable augmentation, if required, would be planned while planning transmission system for Sipat Stage-III (800MW).

In Gujarat, following over loadings are observed:

- High loading on South Olpad 765/400kV ICTs is observed under low solar scenarios when flow on VSC HVDC is kept in reverse direction (i.e. from South Olpad to Khavda). ICT Augmentation shall be planned to cater to such situations, after discussions with stakeholders.
- High loading on Halvad & Zerda 400/220kV ICTs needs to be looked into by GETCO (STU).
- High loading on APL (Mundra) 400/220kV ICTs would be analysed and suitable augmentation would be planned in consultation with stakeholders.

In Maharashtra, following over loadings are observed:

- High loading on Navi Mumbai 400/220kV ICTs is observed due to high demand in western part of Maharashtra and low self-generation. Import capability (ATC) constraints for Maharashtra have been reported by WRLDC and associated system augmentation in consultation with MSETCL would be evolved. The high loading on the ICTs at Navi Mumbai may be attributed to various Data Centres loads in Mumbai area.
- Studies were performed regarding installation of 3rd 400/220kV ICT at Navi Mumbai S/s. However, 3rd ICT was seen to aggravate loading on Navi Mumbai – Kalwa / Taloja 220kV D/c line (Kalwa line LILOed at Printhouse DC). During the joint study meeting held amongst CEA, CTU, GRID-INDIA & MSETCL in Sept'23, MSETCL was requested to review the study files and Connectivity granted in Mumbai area to Data Centres and provide feedback/ remedial measures including grant of Connectivity directly at 400/220kV substations instead of LILOing existing 220kV lines of STU.
- High loading on A'bad-III 765/400kV ICTs of MSETCL has already been reported to MSETCL and ICT-III at the 765/400kV A'bad-III S/s has been planned by MSETCL with implementation schedule of Mar-26.
- In addition to above, Kallam 400/220kV, 4X500MVA ICTs are N-1 non-compliant as the substation was planned for evacuation of 2GW RE potential at Kallam in line with CEA 2013 planning criteria, which stipulates that 'N-1' criteria may not be applied to the immediate connectivity of wind/solar farms with the ISTS/Intra-STS grid.

5.5.4 Short Circuit Analysis

Short circuit level was calculated for all 765 and 400 kV buses of Western Region and buses having fault level more than the 5% of design rating under various scenarios were identified. From the analysis, it emerged that there are 5 nos. of 765kV substations and 33 nos. of 400kV substations in WR having fault level more than 5% of designed capacity. Owner wise

distribution of these buses and scenarios in which these buses are crossing the specified limit are shown in **Figure 5-16** below:

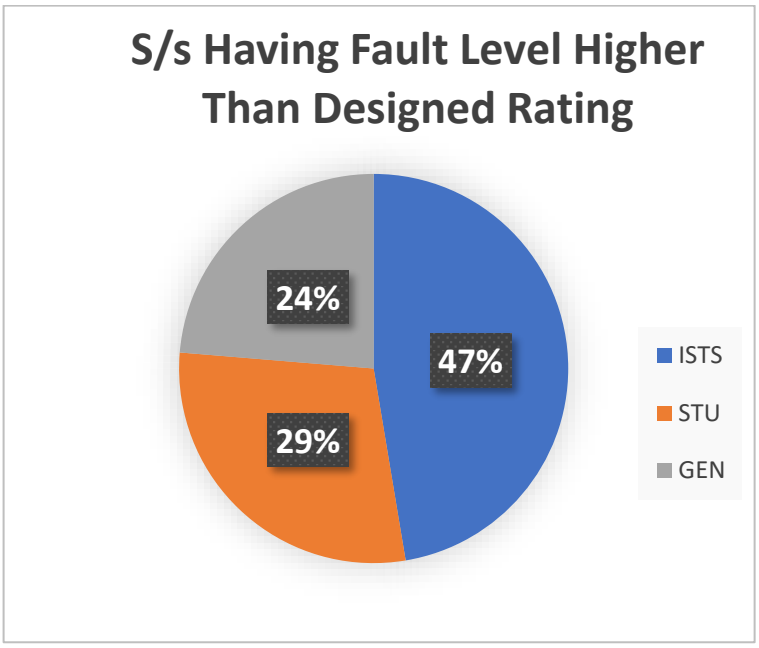


Figure 5-16: Substations crossing the design limit in WR

Details of the ISTS buses exceeding design fault level by more than 5% under different scenarios are tabulated below at **Table 5-10:**

Table 5-10: ISTS Buses Exceeding Designed Fault Level in WR

Sl. No.	Substation Name	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
1.	765kV Bilaspur Pool	1,2,3,5,6,7,8,9	45	40
2.	765kV Gwalior	1,2,3,5,6,7,8,9	43	40
3.	765kV Jabalpur Pool	1,7,8,9	54	50
4.	765kV Wardha	ALL	45	40
5.	765kV Pune (PG) (GIS)	2,3,5,6,7,8,9	44	40
6.	400kV Bilaspur Pool	All	47	40
7.	400kV Pirana (PG)	2,3,5,6,8,9	42	40
8.	400kV Bhachau	All	44	40
9.	400kV Banaskantha	9	53	50
10.	400kV Bina	1,2,3,5,6,7,8,9	44	40
11.	400kV Jabalpur	1,3,6,7,8,9	45	40
12.	400kV Bhadrawati	5,6,7,8,9	44	40
13.	400kV Boisar	All	48	40

Sl. No.	Substation Name	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
14.	400kV Solapur	1,4,7,8,9	44	40
15.	400kV Aurangabad (PG)	1,3,5,6,7,9	54	50
16.	400kV Pune (PG) GIS	All	57	50
17.	400kV Padghe (GIS)	6	53	50
18.	400kV Navi-Mumbai	2,3,5,6,9	43	40

From the above, it can be seen that 18 nos. of buses i.e. 400kV & 765kV buses of Bilaspur PS and Pune (PG) (GIS), 765kV buses of Jabalpur PS, Gwalior & Wardha, 400kV buses of Pirana (PG), Bhachau, Banaskantha, Bina, Jabalpur, Bhadrawati, Boisar, Solapur, Aurangabad (PG), Padghe (GIS) and Navi-Mumbai violate the design fault level by more than 5%. Studies shall be carried out to mitigate the same in consultation with various stakeholders of WR.

Further, following STU buses exceeding the substation design fault level by more than 5% under different scenarios are mentioned at **Table 5-11:**

Table 5-11: STU Buses Exceeding Designed Fault Level in WR

Sl. No.	Substation Name	State	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
1.	400kV Soja	Gujarat	8,9	43	40
2.	400kV Chorania	Gujarat	2,3,5,6,7,8,9	43	40
3.	400kV Ranchodpura	Gujarat	8,9	43	40
4.	400kV Sankhari	Gujarat	7,8,9	43	40
5.	400kV Bina	MP	1,2,3,5,6,7,8,9	44	40
6.	400kV Nagda	MP	1,2,3,5,6,7,8,9	44	40
7.	400kV Kharghar	Maharashtra	All	45	40
8.	400kV Bableshwar	Maharashtra	6,7,8,9	47	40
9.	400kV Aurangabad-I	Maharashtra	All	51	40
10.	400kV Aurangabad-II	Maharashtra	All	50	40
11.	400kV Aurangabad-III	Maharashtra	All	48	40

Following Generator buses exceeding the substation design fault level by more than 5% under different scenarios are mentioned at **Table 5-12**:

Table 5-12: Generator Buses Exceeding Designed Fault Level in WR

Sl. No.	Substation Name	State	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
1.	400kV Mundra-APL	Gujarat	8	42	40
2.	400kV KSK Mahanadi	Chhattisgarh	7,8,9	44	40
3.	400kV Jindal (Tamnar-Ext)	Chhattisgarh	1,2,3,4,5,7,8,9	45	40
4.	400kV CGPL	Gujarat	All	47	40
5.	400kV Gandhar	Gujarat	2,3,5,6,8,9	44	40
6.	400kV Chandrapur-I	Maharashtra	2,3,5,6,7,8,9	49	40
7.	400kV Tarapur 3&4	Maharashtra	All	46	40
8.	400kV Chandrapur-II	Maharashtra	2,3,5,6,7,8,9	49	40
9.	400kV Chandrapur SW	Maharashtra	3,5,6,7,8,9	47	40

With respect to high fault levels at C'pur-I, C'pur-II & Ext, high fault levels are seen at the above MSETCL substations primarily because of very short lines between C’pur-I & C’pur-II and presence of generators in close proximity. MSETCL shall check ratings of breakers at above substations and possibility of upgradation of equipment from 40kA to 50kA (in earlier cases, several old equipment was already found to be rated to 50kA). Otherwise, MSETCL may explore possibility of reducing fault levels at above substations through suitable splitting / bypassing arrangement with or without series bus/ line reactors.

Further, STUs/Generators are required to take necessary actions such as bus splitting, bypassing of lines, fault limiting reactors etc to resolve the issue of high fault level at their buses.

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Chapter 6: Southern Region

Southern Region is connected to Western and Eastern Regions through high capacity 765kV AC links, Back-to-Back HVDC and Bi-pole HVDC links. The thermal generating stations of Southern Region are predominantly concentrated in the States of Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. The States of Tamil Nadu, Karnataka and Andhra Pradesh are rich in RE comprising of large scale Solar & Wind potential. Southern part of Karnataka (Bangalore), Kerala and Central part of Telangana (Hyderabad) has high demand and less internal generation. With the continuous increase in demand and limited conventional generation availability, Southern Region imports power from NEW Grid during peak demand period whereas it exports power to NEW Grid during high RE scenario / off peak demand period.

6.1 Power Supply Scenario as on Jan'24

As on Jan, 2024 total Installed Capacity (IC) of Southern Region was about 128 GW and the peak demand was about 64 GW. Southern Region has touched the maximum export of about 7 GW and maximum import of about 21 GW till Jan'2024. The state-wise breakup of installed capacity and peak demand is summarised below.

Table 6-1: SR Installed Capacity and Peak Demand as on Jan'24

(All Fig in GW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total		
Andhra Pradesh	12.3	4.1	16.3	0.1	1.7	9.4	11.2	27.5	13.0
Telangana	10.2	0.8	11.0	0.1	2.5	5.2	7.8	18.8	15.4
Karnataka	10.8	0.0	10.8	0.7	3.6	18.5	22.8	33.6	17.0
Kerala	2.5	0.5	3.1	0.4	1.9	1.2	3.4	6.5	5.0
Tamil Nadu	15.1	1.0	16.1	1.4	2.2	19.1	22.7	38.9	19.0
Puducherry	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
NLC and Lakshadweep	0.3	0.0	0.3	0.1	0.0	0.0	0.1	0.4	0.5
Central unallocated	2.0	0.0	2.0	0.5	0.0	0.0	0.5	2.4	0.0
SR	**53.2**	**6.5**	**59.7**	**3.3**	**11.8**	**53.3**	**68.5**	**128.2**	**64.1**

Source: CEA monthly report

From above, it can be concluded that share of non-fossil fuel based generation capacity in total present installed capacity (IC) of 128.2 GW is 68.5 GW i.e. 53% of total IC. This share would further increase in envisaged scenario of 2028-29 timeframe.

6.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Southern Region demand for 2028-29 timeframe is expected to increase to about 91 GW. As per the inputs received from various stakeholders, total installed capacity of Southern Region for 2028-29 is expected to be about 229 GW. The state wise bifurcation of installed capacity and peak demand is summarized below.

Table 6-2: SR Installed Capacity and peak demand (2028-29)

(All Fig in GW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Andhra Pradesh	7.1	0.2	7.3	2.9	0.0	9.4	12.3	1.4	20.9	20.5
Telangana	9.2	0.0	9.2	0.9	0.0	2.7	3.6	1.6	14.4	22.5
Karnataka	7.7	0.4	8.1	4.3	0.0	13.5	17.8	0.0	25.8	19.4
Kerala	0.0	0.4	0.4	2.4	0.0	0.2	2.5	0.0	2.9	6.1
Tamil Nadu	10.5	0.6	11.0	1.9	0.0	18.7	20.6	0.9	32.6	24.3
Puducherry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Central	15.3	0.0	15.3	0.0	5.8	0.0	5.8	0.0	21.1	-
IPP	3.2	0.0	3.2	0.0	0.0	92.9	92.9	15.1	111.2	-
SR	**52.9**	**1.5**	**54.4**	**12.4**	**5.8**	**137.3**	**155.5**	**19.0**	**228.9**	**91.3**

From above, it is observed that growth in installed capacity of Southern Region is majorly from non-fossil fuel based generation resources. Share of non-fossil fuel based generation capacity in total present installed capacity (IC) has increased from 54% to 76%.

Compound annual growth rate in peak demand of Southern Region from present time-frame to 2028-29 is around 7.3 %. The state wise peak demand growth is given below :

Table 6-3: Increase in Peak Demand of Various States of SR

(All Fig in MW)

Peak Demand (MW)				
State	**Present**	**2028-29**	**Difference**	**% CAGR**
Andhra Pradesh	13028	20461	7953	9.4%
Telangana	15370	22488	7672	7.9%
Karnataka	16950	19352	2384	2.7%
Kerala	5010	6101	1744	4.0%
Tamil Nadu	19068	24276	6269	4.9%
Puducherry	524	602	106	2.8%
SR	**64103**	**91285**	**27182**	7.3%

Therefore, annual growth rate in peak demand is maximum for Andhra Pradesh (9.4 %) and minimum for Puducherry (2.8%).

6.3 Load Generation Balance for 2028-29 Timeframe

In chapter-3, all India Load Generation Balance (LGB) for identified nine scenarios was prepared as per the methodology finalized in consultation with CTU, CEA and Grid-India (Erstwhile GRID INDIA). This section elaborates the Southern Region Load Generation Balance (LGB) for 2028-29 time-frame. For Southern Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned below for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 6-4: Southern Region Generation Dispatch and Demand Factors

Scenario No & Name	Generation Dispatch Factors						Demand Factors
	Hydro	Nuclear	Solar	Wind	ESS	Gas	
1-Aug Solar Max	40%	80%	80%	55%	-100%	0%	67%
2-Aug Peak Load	70%	80%	0%	75%	60%	50%	68%
3-Aug Night Off Peak	40%	80%	0%	65%	40%	50%	49%
4-Jun Solar Max	40%	80%	85%	55%	-100%	0%	78%
5-Jun Peak Load	70%	80%	0%	75%	50%	50%	69%
6-Jun Night Off Peak	40%	80%	0%	65%	1%	50%	51%
7-Feb Solar Max	20%	80%	90%	0%	-100%	0%	93%
8-Feb Peak Load	40%	80%	0%	20%	100%	50%	68%
9-Feb Night Off Peak	20%	80%	0%	0%	40%	30%	59%

Using the above dispatch and demand factors, PSSE base case files for nine scenarios have been prepared. The despatch from thermal generations have been considered based on merit order. Based on the LGB, import / export of SR and the inter regional flows through various corridors are summarised below. Further, maximum and minimum is also highlighted in table below.

Table 6-5: Surplus/Deficit of Southern Region

All Fig in (MW)

State / UTs	Import / Export of Southern Region								
Scenario No / Corridors	Aug'28 Time Frame			Jun'28 Time Frame			Feb'29 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
SR-ER	167	666	880	-798	924	1825	2538	1643	3503
SR-WR	-11788	-14643	-12374	-14304	-17775	-9109	-2726	-3165	7060
Southern Region	11168	15912	11394	14588	16773	7191	301	1580	-12350

Out of these nine scenarios, Scenario-5 and Scenario-9 corresponds to two extreme cases with respect to export/import i.e. highest export (17 GW) and highest import (12 GW) scenarios respectively. In all other scenarios, import /export from Southern Region to other regions is varying between these two extremes.

Detailed system studies have been carried out on the finalized load flow cases. The study results are discussed in subsequent chapters.

Note : *It is to mention that the above Load Generation Balance (LGB) has been worked on All India basis with various assumptions including the majority RE generation on potential basis, BESS and various despatch factors. This is leading Southern Region towards maximum surplus in power to the extent of 17 GW and deficit to the extent of about 12 GW only. However, the situation of surplus/deficit may significantly differ from the above scenarios, in case of deferment in materialisation of RE generations in SR grid. Further, a number of Green hydrogen / Green Ammonia plants are also planned in Southern Regin for which applications are being received under GNA from various developers. Under such scenarios, SR grid is expected to continue to be in deficit situations during peak load conditions (Feb-Apr/May of a Year) and import requirements from NEW grid are expected to further increase from the present level of 21 GW. Detailed system studies shall be carried out in consultation with constituents for identification of additional inter-regional links to cater to above import requirements of Southern Region.*

6.4 ISTS Network Expansion Schemes Evolved from Mar'23 to Feb'24

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Southern Region (CMETS-SR) from March 2023 to February 2024. Brief of all such deliberated transmission schemes are tabulated below**:**

Table 6-6: Details of the schemes evolved in SR

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in Cr.)
Karnataka			
1.	Transmission Scheme for integration of Davangere/ Chitradurga and Bellary REZ in Karnataka	2026-27	3453
2.	Transmission Scheme for integration of Bijapur REZ in Karnataka	2026-27	1113
3.	System strengthening at Koppal-II for integration of RE generation projects	2025-26	673
4.	System strengthening at Gadag-II for integration of RE generation projects	2026-27	664
5.	Augmentation of transformation capacity by 2x500 MVA (7th & 8th), 400/220 kV ICT at Tumkur PS	2025-26	116

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in Cr.)
6.	Augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Koppal PS	2025-26	58
7.	Augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Gadag PS	2025-26	58
8.	Reconductoring of Somanahalli – Bidadi 400kV D/c line with HTLS conductor	2026-27	43
9.	Augmentation of 1x500 MVA(3rd), 400/220 kV transformation capacity at Hassan S/s	2025-26	43
10.	Implementation of 1 nos. of 220kV line bay at Tumkur (Pavagada) PS for integration of RE generation projects	2026-27	6.6
Telangana			
1.	Reconductoring of the Maheshwaram(PG) – Hyderabad 400kV S/c line with HTLS conductor	2026-27	63
Andhra Pradesh			
1.	Augmentation of 1x500 MVA, 400/220 kV ICT (5th) at NP Kunta Pooling Station and common facility works for providing connectivity to RE generation projects	2025-26	52
2.	Scheme to bypass NGR to use Switchable Line Reactor as Bus Reactor for transmission lines being implemented by WKTL under the scheme "Additional inter-Regional AC link for import into Southern Region	2024-25	2.5
3.	Implementation of 6 nos. of 400kV line bays at Kurnool-III PS for integration of RE generation projects	2026-27	96
4.	Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects	2025-26	46
5.	Transmission system strengthening at Kurnool-III PS for integration of additional RE generation projects	2026-27	2300
6.	Transmission system for grant of GNA to Green Hydrogen / Ammonia in Kakinada area, Andhra Pradesh	2026-27	-
Tamil Nadu			
1.	Transmission System requirement for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW)	2026-27	548
2.	Augmentation of transformation capacity by 1x500 MVA, 400/ 230 kV ICT at Tuticorin-II PS	2025-26	79
3.	Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS	2025-26	115
4.	Implementation of 1 nos. of 230kV line bays at Pugalur (existing) SS for integration of RE generation project	2025-26	6.08
5.	Transmission System for prioritized 1 GW Offshore wind farms in Tamil Nadu	2028-29	11485

Details of the schemes are reproduced below state-wise:

6.4.1 Karnataka

(a) Transmission Scheme for integration of Renewable Energy Zones in Davanagere/ Chitradurga, Bellary and Bijapur areas of Karnataka

Govt. of India has set a target of 500 GW generation capacity from non-fossil fuel resources by 2030. In this direction, MNRE has identified addition of 181.5 GW RE Potential in the States of Andhra Pradesh, Telangana, Karnataka, Rajasthan, Madhya Pradesh and Tamil Nadu (Offshore). Out of the identified 181.5 GW Potential, 86 GW RE Potential is identified in the State of Andhra Pradesh, Telangana, Karnataka and Tamil Nadu (Offshore) in Southern Region.

The transmission system for integration of 181.5 GW RE Potential has been identified by CEA and a report on Transmission System for Integration of over 500 GW RE Capacity has been published by CEA on 07.12.2022.

Out of the identified (86 GW) RE Potential in Southern Region, 17 GW has been identified in the State of Karnataka. MNRE have indicated that out of the 17 GW REZ potential in Karnataka, transmission system for evacuation capacity of about 11 GW may be identified considering the Energy Storage System. The details of district wise potential is as below:

District	Potential (GW)		Total (GW)	Dispatch (90% S + 55% W)	BESS	Evacuation capacity to be planned (GW)
	Wind	Solar				
Koppal	2	2	4	2.9	1	2
Gadag	2	2	4	2.9	1	2
Davanagere / Chitradurga	2	2	4	2.9	1	2
Bijapur	2		2	1.1		2
Bellary		1.5	1.5	1.35		1.5
Tumkur		1.5	1.5	1.35		1.5
Total	**8**	**9**	**17**	**12.5**	**3**	**11**

The transmission system for integration of additional RE potential in Koppal-II and Gadag-II area of Karnataka has already been agreed and is under bidding. Further, for optimal utilization of transmission system, interconnection of RE Zones in Karnataka viz. Gadag-II, Davanagere/Chitradurga, Bijapur and Bellary area were planned earlier at Koppal-II PS itself through 400kV lines for further transfer of power beyond Koppal-II PS.

However, CTU has received large number of applications from various RE developers seeking connectivity at Koppal-II PS and Gadag-II PS beyond the planned evacuation capacity and without BESS. Presently, the total connectivity applications granted / agreed for grant at Koppal-II are about 2950 MW and Gadag-II are about 3900 MW which has already surpassed the capacity of evacuation transmission system identified considering the dispatch factors & BESS in CEA's 500 GW report.

Accordingly, it was observed that the transmission system beyond Koppal-II PS for evacuation of power shall be able to cater to the evacuation requirements of connectivity at Gadag-II PS and Koppal-II PS. Further, the interconnection of Davanagere/Chitradurga, Bijapur and Bellary REZs needs to be reviewed and separate transmission system for evacuation of power may be identified. CTU has already received connectivity of about 300 MW at Bijapur PS and 250 MW at Davanagere/Chitradurga.

Presently, Narendra New – Madhugiri 765kV D/c line is under operation at 400kV level. It is proposed to upgrade Narendra New – Madhugiri 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level. Further, Davanagere REZ is proposed to be integrated with the grid through LILO of Narendra New – Madhugiri 765kV D/c line at Davanagere/Chitradurga 765/400kV PS. Further, for optimal utilization of transmission system, Bellary REZ is proposed to be integrated with Davanagere/Chitradurga PS through Bellary – Davanagere/Chitradurga PS 400kV (Quad ACSR moose) D/c line. Accordingly, Davanagere/Chitradurga PS is being proposed at 765kV level.

Further, Bijapur REZ is being integrated with existing Raichur New through Bijapur PS – Raichur New 400kV (Quad ACSR moose) D/c line.

The schemes were discussed in the 25th CMETS-SR held on 28.11.2023 wherein constituents requested for joint studies for finalization of the scheme. CTU vide letter dated 01.12.2023 submitted the revised transmissions schemes for SRPC views. The revised transmission schemes were discussed in the 49th SRPC meeting held on 09.12.2023 wherein SRPC decided that physical joint studies may be carried out with SR constituents for finalization of the scheme and thereafter, SRPC views shall be submitted to CTU within 45 days from 01.12.2023 for further approval of the scheme in NCT / MoP. Accordingly, Joint Studies were conducted on 21-22nd December 2023 at Yelahanka, Bengaluru with participation from SRPC, CTUIL, SRLDC, KPTCL, KSEBL, APTRANSCO, TSTRANSCO, TANTRANSCO and TANGEDCO. It was decided during the Joint Study meeting that the ICTs may be taken up for implementation in phased manner. Accordingly, it was suggested that 1 no. of 765/400kV, 1500 MVA ICT and 1 no. of 400/220 kV, 500 MVA ICTs at Davanagere / Chitradurga and 1 nos. of 400/220 kV, 500 MVA ICT at Bellary PS may be considered under second phase. The schemes were agreed by all the Southern Region constituents in the above Joint Study meeting.

Detailed scope of the transmission schemes is as follows:

(i) Transmission Scheme for integration of Davanagere / Chitradurga REZ in Karnataka

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
1.	Establishment of 765/400kV 4x1500 MVA, 400/220kV 4x500 MVA Pooling Station near Davanagere / Chitradurga, Karnataka with provision of two (2) sections of 4500 MVA each at 400kV level	• 765/400kV, 1500 MVA, ICTs – 4 nos. (13x500 MVA incl. 1 spare unit) • 765kV ICT bays – 4 nos. • 400kV ICT bays – 4 nos. • 400/220kV, 500 MVA, ICTs – 4 nos.

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
	and provision of four (4) sections of 2500 MVA each at 220kV level **Future Space Provisions:** • 765/400kV, 1500 MVA, ICTs – 2 nos. • 765kV ICT bays – 2 nos. • 400kV ICT bays – 2 nos. • 400/220kV, 500 MVA, ICTs – 6 nos. • 400kV ICT bays – 6 nos. • 220kV ICT bays – 6 nos. • 765kV line bays – 8 nos. (with provision for SLR) • 400kV line bays – 10 nos. (with provision for SLR) • 220kV line bays – 12 nos. • 220kV Bus Sectionalizer : 2 sets • 220 kV Bus Coupler (BC) Bay – 3 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 3 nos. • 400kV Bus Sectionalizer : 1 set	• 400kV ICT bays – 4 nos. • 220kV ICT bays – 4 nos. • 765kV line bays – 4 nos. (at Davanagere / Chitradurga PS for termination of LILO of Koppal-II-Narendra (New) 765kV D/c line) • 220kV line bays – 6 nos. • 220kV Bus Sectionalizer : 1 set • 220 kV Bus Coupler (BC) Bay – 1 no. • 220 kV Transfer Bus Coupler (TBC) Bay – 1 no.
2.	LILO of Narendra New – Madhugiri 765kV D/c line at Davanagere / Chitradurga 765/400kV PS (~40 km) {with 240 MVAr SLR at both ends on Narendra New – Davanagere section (~280 km) and 330 MVAr SLR at Davanagere end on Davanagere – Madhugiri section (~200 km)}	~40 km • 765 kV, 240 MVAr SLR at Davanagere / Chitradurga PS – 2 nos. (7x80 MVAr inc. 1 switchable spare unit) • 765 kV, 240 MVAr SLR at Narendra New – 2 nos. (7x80 MVAr inc. 1 switchable spare unit) • 765 kV, 330 MVAr SLR at Davanagere / Chitradurga PS – 2 nos. (6x110 MVAr)
3.	2x330 MVAr (765kV) bus reactors at Davanagere/ Chitradurga PS	• 765 kV, 330 MVAr Bus Reactor – 2 nos. (7x110 MVAr inc. 1 switchable spare unit for both bus reactor and line reactor) • 765 kV Bus Reactor bays – 2 nos.
4.	Upgradation of Narendra New – Madhugiri 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level	• 765kV line bays – 2 nos. (at Narendra New) • 765kV line bays – 2 nos. (at Madhugiri)
5.	Upgradation of Madhugiri {Tumkur(Vasantnarsapura)} to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors #	• 765/400kV, 1500 MVA, ICTs – 3 nos. (10x500 MVA incl. 1 spare unit) • 765kV ICT bays – 3 nos. • 400kV ICT bays – 3 nos. • 765 kV, 330 MVAr Bus Reactor – 2 nos. {7x110 MVAr inc. 1 spare unit} • 765 kV Bus Reactor bays – 2 nos.

 # Upgradation of Madhugiri {Tumkur(Vasantnarsapura)} to its rated 765kv level was earlier allocated to POWERGRID for implementation through RTM route under the scheme "Common transmission system strengthening in Southern Region for enabling evacuation and export of power from Solar & Wind Energy Zones in Southern Region" vide MOP OM No.15/3/2018-Trans-Pt(1) dated 23.01.2020.

Implementation timeframe : 24 months

Estimated Cost: Rs. 2640 Crore

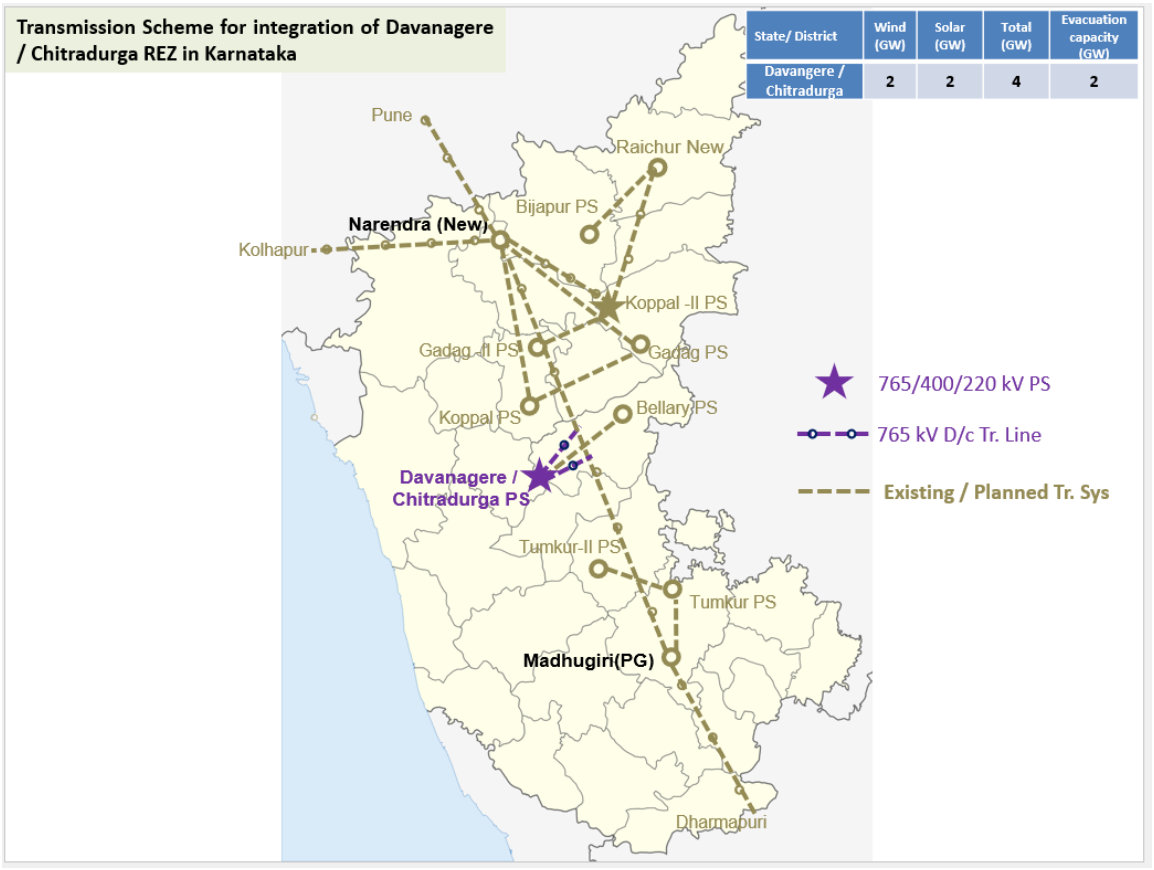


Figure 6-1:Transmission Scheme for integration of Davanagere / Chitradurga REZ in Karnataka

(ii) Transmission Scheme for integration of Bellary REZ in Karnataka

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
1.	Establishment of 4x500 MVA, 400/220kV Pooling Station near Bellary area (Bellary PS), Karnataka **Future Space Provisions:** • 400/220kV, 500 MVA, ICTs – 6 nos. • 400kV ICT bays – 6 nos. • 220kV ICT bays – 6 nos. • 400kV line bays – 6 nos. (with provision for SLR) • 220kV line bays – 12 nos. • 220kV Sectionalizer : 3 sets • 220 kV Bus Coupler (BC) Bay – 3 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 3 nos.	• 400/220kV, 500 MVA, ICTs – 4 nos. • 400kV ICT bays – 4 nos. • 220kV ICT bays – 4 nos. • 400kV line bays – 2 nos. (at Bellary PS for termination of Bellary PS – Davanagere / Chitradurga line)) • 220kV line bays – 6 nos. • 220 kV Bus Coupler (BC) Bay – 1 no. • 220 kV Transfer Bus Coupler (TBC) Bay – 1 no.
2.	Bellary PS – Davanagere / Chitradurga 400kV (Quad ACSR moose) D/c line	~100 km • 400kV line bays – 2 nos. (at Davanagere / Chitradurga)
3.	2x125MVAr 420kV bus reactors at Bellary PS	• 420kV, 125 MVAr bus reactors – 2 nos. • 420kV, 125 MVAr bus reactor bays – 2 nos.

Implementation timeframe : 30 months

Estimated Cost: Rs. 813 Crore

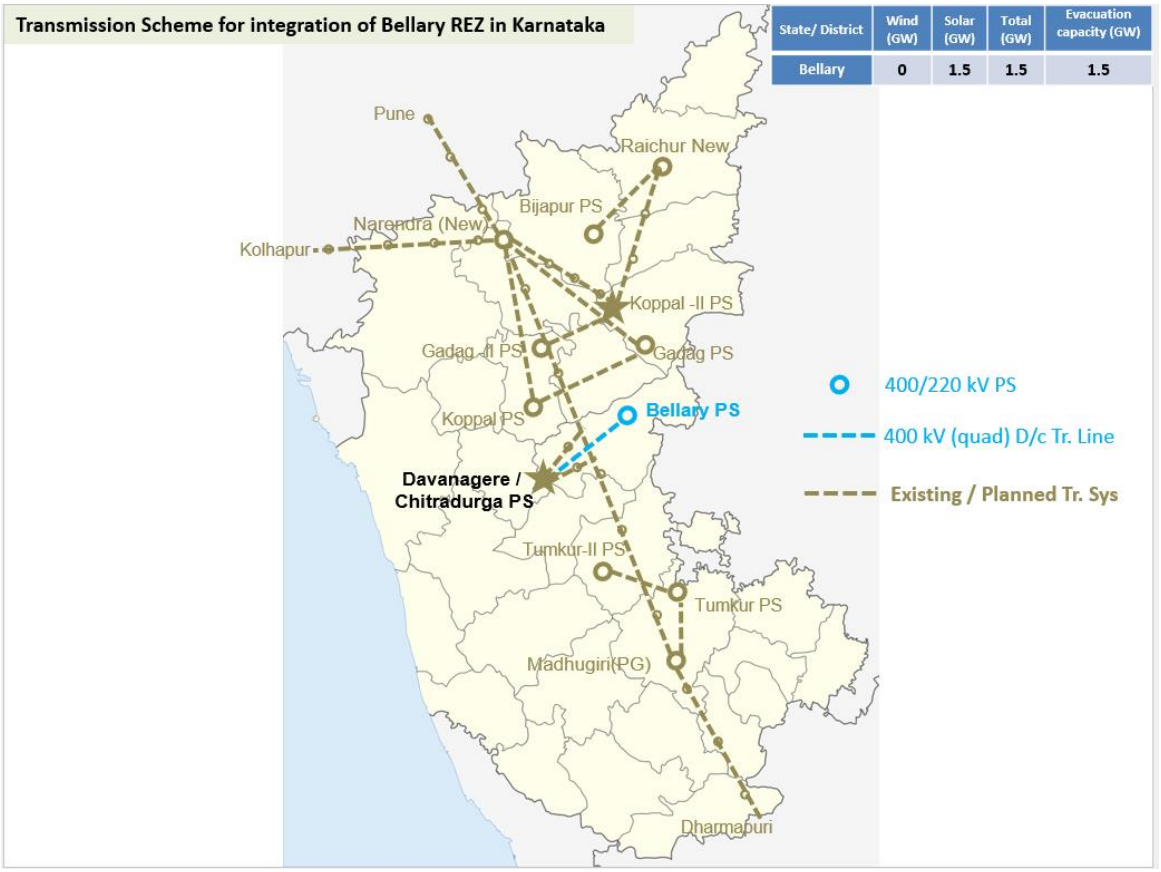


Figure 6-2: : Transmission Scheme for integration of Bellary REZ in Karnataka

(iii)Transmission Scheme for integration of Bijapur REZ in Karnataka

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
1.	Establishment of 400/220kV 5x500 MVA Pooling Station near Bijapur (Vijayapura), Karnataka **Future Space Provisions:** • 400/220kV, 500 MVA, ICTs – 5 nos. • 400kV ICT bays – 5 nos. • 220kV ICT bays – 5 nos. • 400kV line bays – 6 nos. (with provision for SLR) • 220kV line bays – 14 nos. • 220kV Sectionalizer : 2 sets • 220 kV Bus Coupler (BC) Bay – 3 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 3 nos.	• 400/220kV, 500 MVA, ICTs – 5 nos. • 400kV ICT bays – 5 nos. • 220kV ICT bays – 5 nos. • 400kV line bays – 2 nos. (at Bijapur PS for termination of Bijapur PS – Raichur New line)) • 220kV line bays – 10 nos. • 220kV Sectionalizer : 1 set • 220 kV Bus Coupler (BC) Bay – 2 no. • 220 kV Transfer Bus Coupler (TBC) Bay – 2 no.
2.	Bijapur PS – Raichur New 400kV (Quad ACSR moose) D/c line	~150 km • 400kV line bays – 2 nos. (at Raichur New)
3.	2x125MVAr 420kV bus reactors at Bijapur PS	• 420kV, 125 MVAr bus reactors – 2 nos.

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
		• 420kV, 125 MVAr bus reactor bays – 2 nos.

Note : *POWERGRID shall provide space for 2 nos. of 400 kV line bays at Raichur New for termination of Bijapur PS – Raichur New 400kV (Quad ACSR moose) D/c line*

Implementation timeframe : 24 months

Estimated Cost : Rs. 1113 Crore

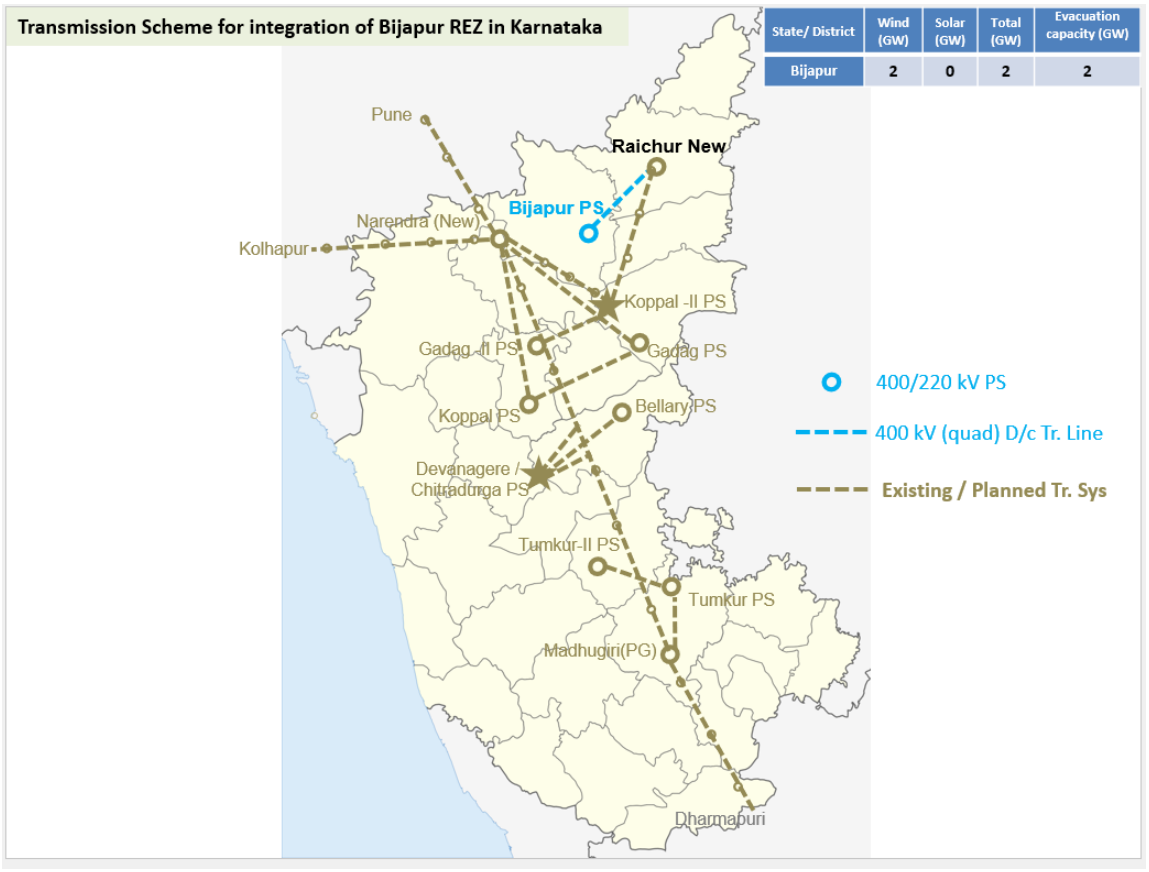


Figure 6-3: : Transmission Scheme for integration of Bijapur REZ in Karnataka

Above transmission schemes viz., Transmission Scheme for integration of Davanagere / Chitradurga REZ in Karnataka, Transmission Scheme for integration of Bellary REZ in Karnataka and Transmission Scheme for integration of Bijapur REZ in Karnataka was approved and recommended under TBCB in the 18th NCT meeting held on 05.03.2024.

(b) System strengthening at Koppal-II and Gadag-II for integration of RE generation projects

Koppal-II 765/400/220kV PS is being established as part of 500 GW RE capacity by 2030 and presently is under construction with implementation schedule of 24 months i.e. Dec'2025. Presently, 2x1500 MVA, 765/400 kV ICTs, 2x500 MVA, 400/220 kV ICTs and 04 nos. of 220 kV line bays under Koppal-II Phase-A and augmentation with 2x1500 MVA, 765/400 kV

ICTs, 2x500 MVA, 400/220 kV ICTs and 04 nos. of 220 kV additional line bays under Koppal-II Phase-B are under implementation.

Gadag-II PS is being established as part of 500 GW RE capacity by 2030 and presently is under construction with implementation schedule of 24 months i.e. Dec'2025. Presently, 2x500 MVA, 400/220 kV ICTs and 04 nos. of 220 kV line bays under Gadag-II Phase-A is under implementation.

CTU has received large number of applications from various RE developers seeking connectivity at Koppal-II PS and Gadag-II PS. Further, as RE potential in Gadag area is being integrated with Koppal-II PS through Gadag-II PS – Koppal-II PS 400kV (Quad Moose) D/c lines and evacuation of power from Gadag-II PS is contingent upon Koppal-II PS. Accordingly, augmentation of transformation capacity at Koppal-II and Gadag-II for evacuation of power from RE generation projects has been identified in a progressive manner as per the receipt of applications in various CMETS-SR meetings. The details of strengthening is as below:

Koppal-II 765/400/220kV PS

- Augmentation of 1x1500 MVA (5^{th}), 765/400 kV ICT at Koppal-II PS and 1 nos. of 220kV line bays for integration of RE generation projects (agreed in 23^{rd} CMETS-SR held on 29.09.2023)

- Augmentation of additional 3x500 MVA, 400/220kV ICTs (5^{th}, 6^{th} & 7^{th}) and 1x1500 MVA 765/400kV ICT (6^{th}) at Koppal-II PS (agreed in 25^{th} CMETS-SR held on 28.11.2023).

- Augmentation of additional 2x500 MVA, 400/220kV ICTs (8^{th} & 9^{th}), 1x1500 MVA 765/400kV ICT (7^{th}) at Koppal-II PS and 3 nos. of 220kV line bays for integration of RE generation projects (agreed in 27^{th} CMETS-SR held on 30.01.2024)

So far connectivity of about 3769 MW has been granted / agreed for grant at 220kV level of Koppal-II PS.

Gadag-II 400/220kV PS

- Augmentation of 3x500 MVA (3^{rd}, 4^{th} & 5^{th}), 400/220kV transformation capacity at Gadag-II PS and 1 nos. of 400kV line bay & 2 nos. 220kV line bays for integration of RE generation projects (agreed in 23^{rd} CMETS-SR held on 29.09.2023)

- Augmentation of 2x500 MVA (6^{th} & 7^{th}), 400/220kV transformation capacity at Gadag-II PS, Gadag-II PS – Koppal-II PS 400kV (Quad) 2^{nd} D/c line and 1 nos. of 220kV line bay for integration of RE generation projects (agreed in 25^{th} CMETS-SR held on 28.11.2023).

- Augmentation of 2x500 MVA, 400/220kV ICTs (8th & 9th) at Gadag-II PS and 1 nos. of 220kV line bay for integration of RE generation projects (agreed in 27th CMETS-SR held on 30.01.2024).

So far connectivity of about 4926 MW (3476 MW at 220 kV and 1450 MW at 400 kV level) has been granted / agreed for grant at Gadag-II PS.

Details of the scheme is summarized as below :

(i) System strengthening at Koppal-II for integration of RE generation projects

Package	*Scope of the Transmission Scheme*	*Capacity /km*	*Schedule*
A	Augmentation of 1x1500 MVA (5th), 765/400 kV transformation capacity at Koppal-II PS	• 1x1500 MVA, 765/400kV ICT • 765kV ICT bay – 1 No. • 400kV ICT bay – 1 No.	Dec'25
B	Augmentation of 1x1500 MVA (6th), 765/400 kV transformation capacity at Koppal-II PS	• 1x1500 MVA, 765/400kV ICT • 765kV ICT bay – 1 No. • 400kV ICT bay – 1 No.	Dec'25
	Augmentation of 3x500 MVA, 400/220kV ICTs (5th 6th & 7th) at Koppal-II PS	• 3x500 MVA, 400/220kV ICTs • 400kV ICT bay – 3 Nos. • 220kV ICT bay – 3 Nos.	Dec'25
	1 no. 220kV line bay at Koppal-II PS for termination of dedicated transmission line of M/s Tata Power Renewable Energy Ltd.	• 220kV line bays – 1 Nos.	01.03.26
C	Augmentation of 1x1500 MVA (7th), 765/400 kV transformation capacity at Koppal-II PS	• 1x1500 MVA, 765/400kV ICT • 765kV ICT bay – 1 No. • 400kV ICT bay – 1 No.	Dec'25
	Augmentation of 2x500 MVA, 400/220kV ICTs (8th & 9th) at Koppal-II PS	• 2x500 MVA, 400/220kV ICTs • 400kV ICT bay – 2 Nos. • 220kV ICT bay – 2 Nos.	Dec'25
	2 nos. 220kV line bays at Koppal-II PS for termination of dedicated transmission line of M/s JSP Green Wind 1 Pvt. Ltd. and Gadag Power India Pvt. Ltd.	• 220kV line bays – 2 Nos.	Dec'25
	1 no. 220kV line bay at Koppal-II PS for termination of dedicated transmission line of M/s Clean Renewable Energy Hybrid Two Pvt. Ltd.	• 220kV line bays – 1 Nos.	31.12.26

Estimated cost: Rs. 673 Crore

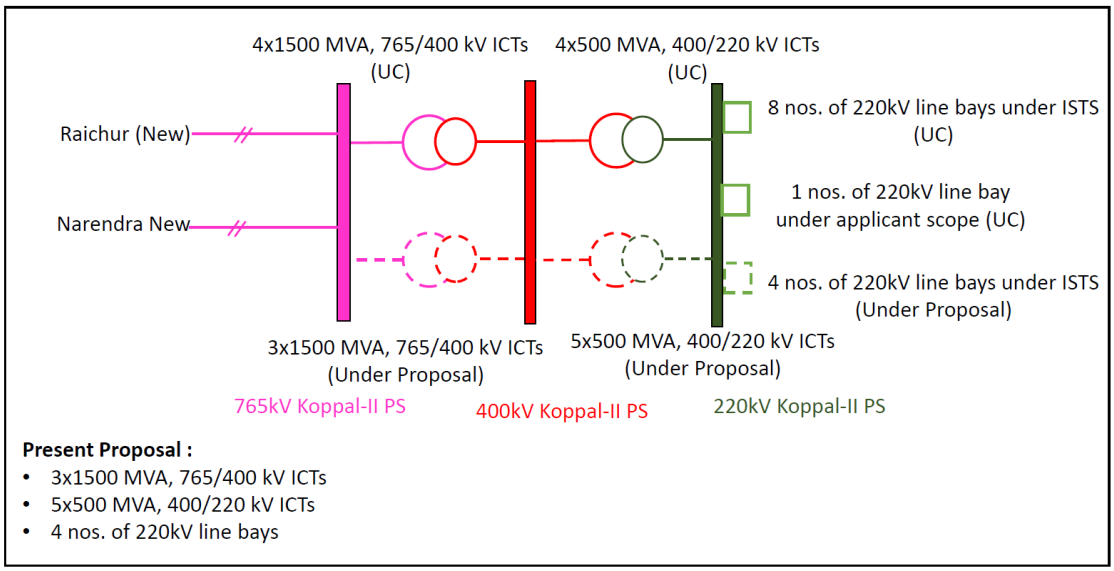


Figure 6-4: System strengthening at Koppal-II for integration of RE generation projects

(ii) System strengthening at Gadag-II for integration of RE generation projects

Package	*Scope of the Transmission Scheme*	*Capacity /km*	*Schedule*
A	Augmentation of 3x500 MVA (3rd, 4th & 5th), 400/220kV transformation capacity at Gadag-II PS	• 3x500 MVA, 400/220kV ICTs • 400kV ICT bay – 3 Nos. • 220kV ICT bay – 3 Nos.400kV ICT bay – 1 No.	Dec'25
	1 no. 400kV line bay at Gadag-II PS for termination of dedicated transmission line of M/s Serentica Renewables India Pvt. Ltd.	• 400kV line bays – 1 Nos.	Dec'25
	2 no. 220kV line bays at Gadag-II PS for termination of dedicated transmission line of M/s Tata Power Renewable Energy Ltd. and M/s Avaada Energy Pvt. Ltd.	• 220kV line bays – 2 Nos.	Dec'25
B	Augmentation of 2x500 MVA (6th & 7th), 400/220kV transformation capacity at Gadag-II PS	• 2x500 MVA, 400/220kV ICTs • 400kV ICT bay – 2 Nos. • 220kV ICT bay – 2 Nos.	24 months
	Gadag-II PS – Koppal-II PS 400kV (Quad) 2nd D/c line	~ 45 km • 400kV line bays – 2 nos. (at Koppal-II PS) • 400kV line bays – 2 nos. (at Gadag-II PS)	24 months
	1 nos. 220kV line bay at Gadag-II PS for termination of dedicated transmission line of M/s Renew Vayu Energy Pvt. Ltd.	• 220kV line bays – 1 Nos.	31.03.27
C	Augmentation of 2x500 MVA, 400/220kV ICTs (8th & 9th) at Gadag-II PS	• 2x500 MVA, 400/220kV ICTs • 400kV ICT bay – 2 Nos. • 220kV ICT bay – 2 Nos.	24 months
	1 nos. 220kV line bay at Gadag-II PS for termination of dedicated transmission line of M/s Green Infra Renewable Projects Ltd.	• 220kV line bays – 1 Nos.	01.06.27

Estimated cost: Rs. 664 Crore

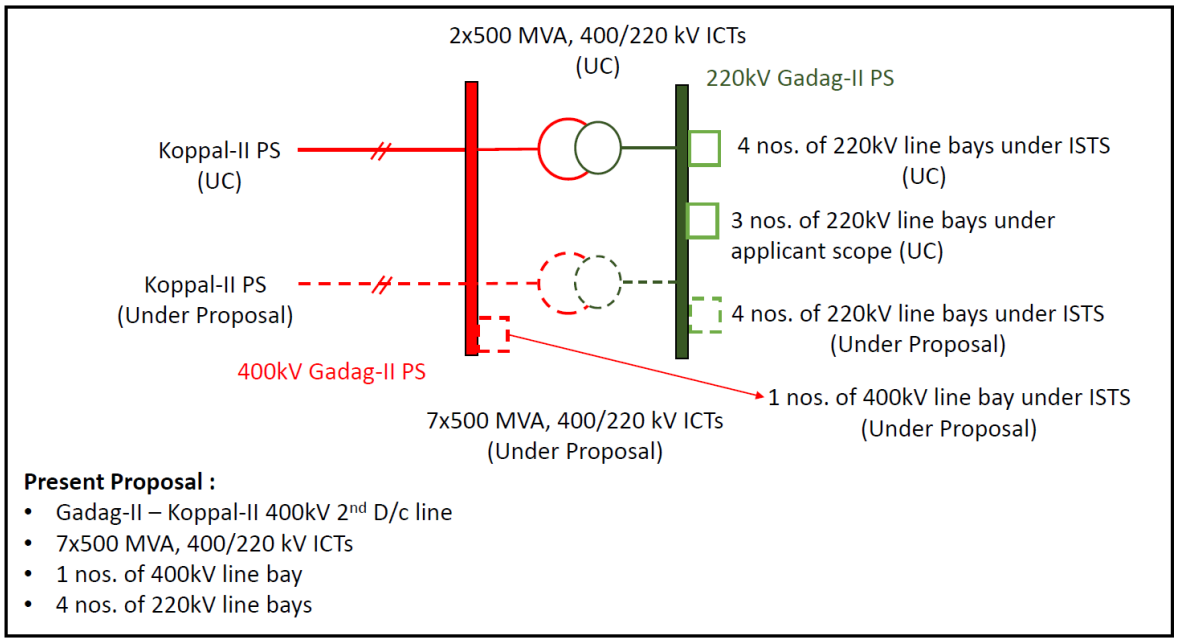


Figure 6-5¨System strengthening at Gadag-II for integration of RE generation projects

Above transmission schemes viz., System strengthening at Koppal-II for integration of RE generation projects and System strengthening at Gadag-II for integration of RE generation projects have been forwarded for SRPC views vide CTU letter dated 08.02.2024.

(c) Augmentation of transformation capacity by 2x500 MVA (7th & 8th), 400/220 kV ICT at Tumkur PS

During the 23rd CMETS SR held on 29.09.2023, CTU informed that presently, Tumkur (Pavagada) PS is under operation with 5x500 MVA, 400/220kV ICTs. Further, additional 1x500 MVA, 400/220kV ICT(6th) is under implementation and is expected by Dec'23. With grant of Connectivity under GNA to M/s Ircon Renewable Power Ltd. During the 21st CMETS-SR meeting, held on 08.08.2023, the total Connectivity/GNA granted/ agreed for grant at Pavagada PS shall became 3050 MW. IN the meeting it was agreed to grant the Connectivity with augmentation of transformation capacity by 1x500 MVA, 400/220kV ICT(7th). Subsequently, in 22nd CMETS-SR, held on 25.08.2023, it was agreed to grant additional connectivity for 100 MW to SECI at Tumkur PS with 7th ICT.

Further, the Manual on Transmission Planning Criteria, 2023 have come into effect from 01.04.2023 wherein it was specified that N-1 reliability criteria may be considered for ICTs at the ISTS / STU pooling stations for renewable energy based generation of more than 1000 MW after considering the capacity factor of renewable generating stations. With 7x500 MVA, 400/220kV ICTs at Tumkur (Pavagada) PS, the transformation capacity is 3500 MVA, however, connectivity of about 3150 MW has been granted / agreed for grant. Accordingly, for meeting the N-1 reliability criteria, 1x500 MVA, 400/220 kV ICT (8th) at Tumkur (Pavagada) PS is also required.

After detailed deliberations, augmentation of transformation capacity by 2x500 MVA (7th & 8th), 400/220 kV ICT at Tumkur PS was agreed. As per the decision in the 17th NCT meeting held on 31.01.2024, the above transmission scheme was approved under RTM to POWERGRID vide letter dated 16.02.2024 and is under implementation with implementation schedule of 18 months.

Estimated cost : Rs. 116 Crore

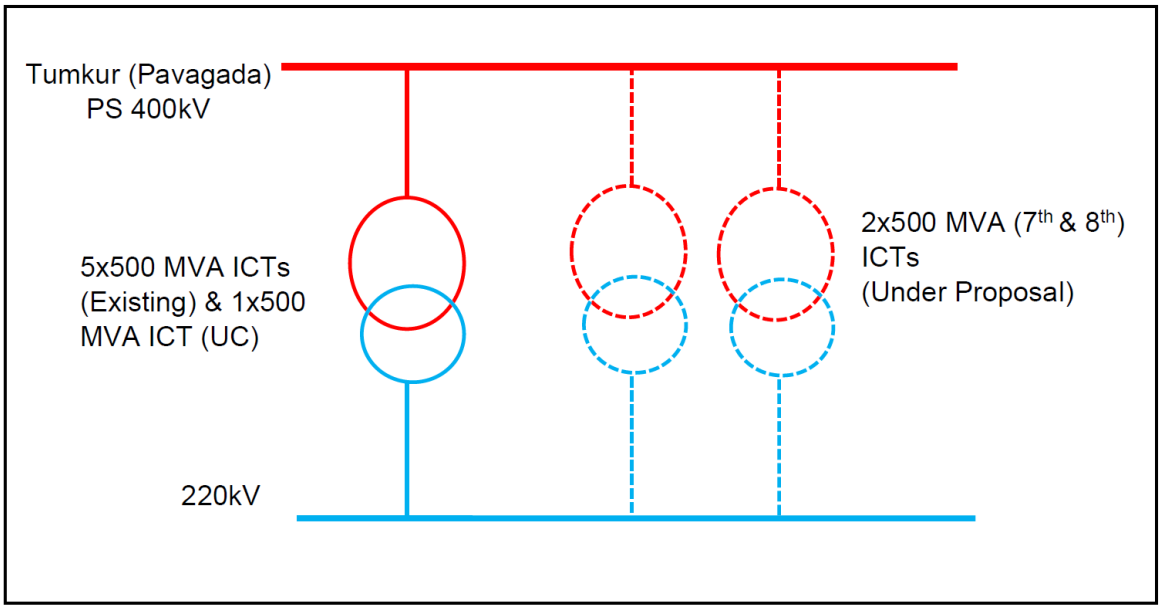


Figure 6-6: Augmentation of transformation capacity by 2x500 MVA (7th & 8th), 400/220kV ICTs at Tumkur (Pavagada) 400/220kV Pooling Station

(d) Augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Koppal PS

During the 23rd CMETS SR held on 29.09.2023, CTU informed that presently, Koppal PS is under implementation with transformation capacity of 2500 MVA (5x500 MVA, 400/220kV ICTs) and 3x500 MVA ICTs are expected by Oct'23 & 2x500 MVA ICTs are expected by Dec'23. Further, connectivity of 2753.6 MW has been granted/ agreed for grant/ considered for grant at Koppal PS. Accordingly, 1x500 MVA, 400/220kV ICT (6th) is required for integration of RE projects for Connectivity quantum upto 2753.6 MW.

Further, the Manual on Transmission Planning Criteria, 2023 have come into effect from 01.04.2023 wherein it was specified that N-1 reliability criteria may be considered for ICTs at the ISTS / STU pooling stations for renewable energy based generation of more than 1000 MW after considering the capacity factor of renewable generating stations. Accordingly, for meeting the N-1 reliability criteria, 1x500 MVA, 400/220 kV ICT (7th) at Koppal PS is also required.

In view of the above, it was proposed to augment transformation capacity by 2x500 MVA (6th & 7th), 400/220 kV ICTs at Koppal PS.

During the meeting, TANGEDCO informed that considering the dispatch factors and short term over load capacity of the ICTs, 6th & 7th ICTs at Koppal PS are not required even after considering the power factor. ICT augmentation if required may be taken up along with the receipt of applications and same may be associated with the RE generation projects. Without any identified beneficiaries / additional generation, the 6th & 7th ICT will increase the tariff burden on the constituents. In case of delay in RE generation the transmission charges liability may be kept on the RE generators.

CTU informed that during the peak RE season, the dispatch from the Wind & Solar generations is near to 100% and same has been observed in Tuticorin area as well. Keeping above in view and considering the power factor, the 6th ICT alone is also not adequate for accommodating the connectivity of 2753 MW. In case of tripping of one ICT, then there might be chances of cascaded tripping and loss of entire generation at that pooling station. Accordingly, the 6th ICT is required for providing connectivity and 7th ICT is required for meeting the N-1 reliability criteria. TANGEDCO informed that 6th ICT may be implemented and same may be associated with the RE generation projects and 7th ICT may not be taken up for the time being. CTU informed that the 6th ICT at Koppal PS may be implemented and same may be associated with the RE generation projects. Further, as Koppal PS is near to commissioning, the generation injection pattern of the RE generation projects may be monitored and based on the injection quantum the 7th ICT may be taken up later as per requirement.

After detailed deliberations, augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Koppal PS was agreed. CTU, in line with MOP order dated 28.10.2021, approved the implementation of above transmission scheme under RTM to KNTL vide letter dated 02.01.2024 and is under implementation with implementation schedule of 18 months.

Estimated cost : Rs. 58 Crore

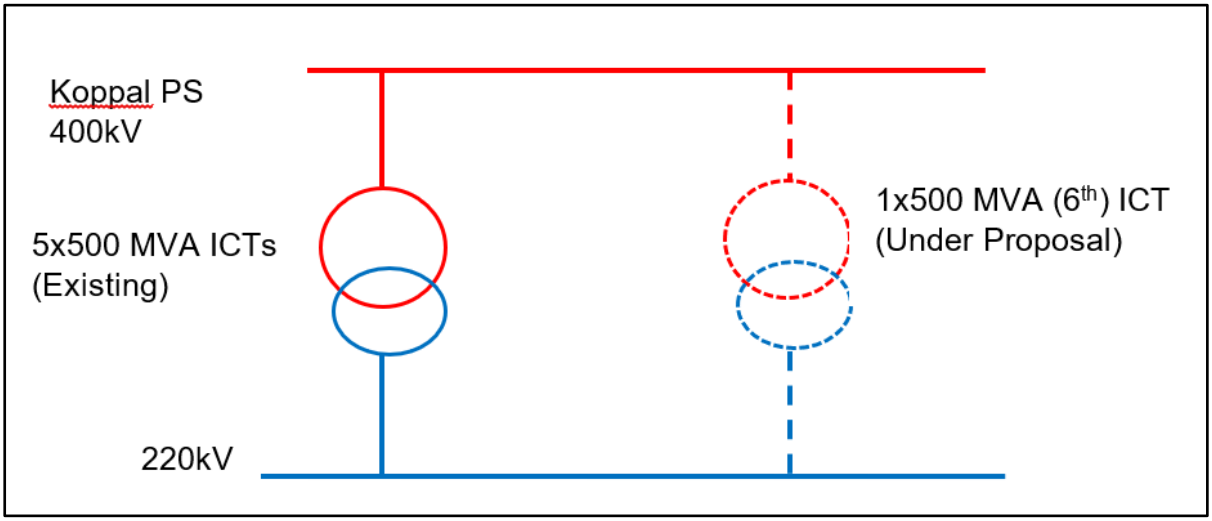


Figure 6-7: Augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Koppal PS

(e) Augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Gadag PS

During the 23rd CMETS SR held on 29.09.2023, CTU informed that presently, Gadag PS is under implementation with transformation capacity of 2500 MVA (5x500 MVA, 400/220kV ICTs) and 2x500 MVA ICTs are expected by Dec'23 & 3x500 MVA ICTs are expected by May'24. Further, connectivity of 2385 MW has been granted at Gadag PS which have already crossed the ICT capacity considering the power factor. Further for meeting the N-1 reliability criteria as per CEA's revised Planning Criteria, augmentation of 1x500 MVA, 400/220 kV ICT (6th) at Gadag PS is required.

After detailed deliberations, augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Gadag PS was agreed. CTU, in line with MOP order dated 28.10.2021, approved the implementation of above transmission scheme under RTM to GTL vide letter dated 02.01.2024 and is under implementation with implementation schedule of 18 months.

Estimated cost : Rs. 58 Crore

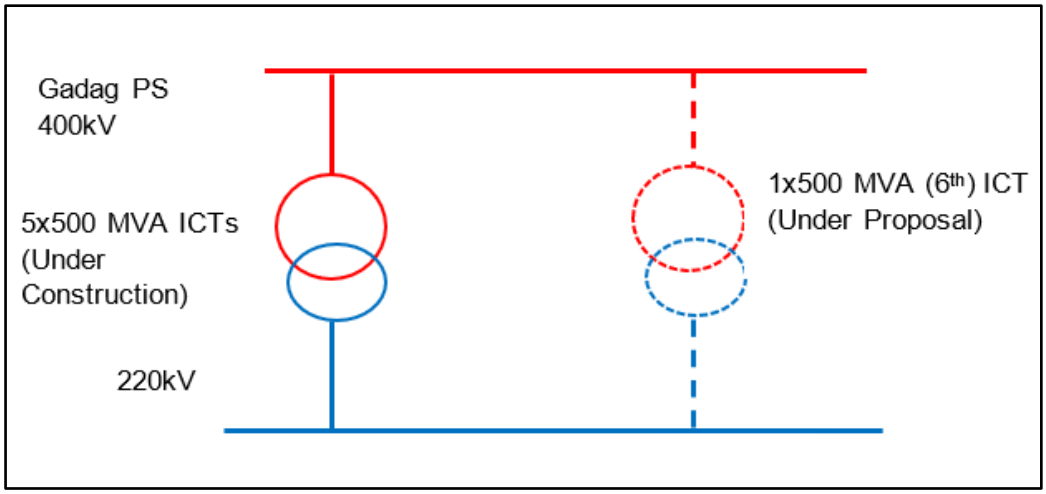


Figure 6-8: Augmentation of transformation capacity by 1x500 MVA (6th), 400/220 kV ICT at Gadag PS

(f) Reconductoring of Somanahalli – Bidadi 400kV D/c line with HTLS conductor

During the 25th CMETS SR held on 28.11.2023, CTU informed that SRLDC, Grid-India in its report for Quarter-02 (Jul'-Sep'22) has highlighted the issue of high loading on Somanahalli – Bidadi 400kV D/c line. The high loading issue was also highlighted during the meeting held on 06.09.2023 CEA, SRPC, CTUIL, SRLDC, APTRANSCO & KPTCL to deliberate on the Intra-State proposals of APTRANSCO and KPTCL. Further, CTU in the ISTS Rolling plan reports for 2027-28 and 2028-29 (Interim) has also highlighted that during peak RE scenario of Karnataka, loading on Somanahalli – Bidadi 400kV D/c line is crossing its thermal rating (850 MVA) under N-1 contingency. Considering the above, it is proposed that reconductoring of the Somanahalli – Bidadi 400kV D/c line with HTLS conductor may be carried out.

During the meeting, SRLDC informed that the transmission line is part of 400 kV ring of Bangalore and high loading of Somanahalli – Bidadi 400kV D/c line is observed in high RE scenario and the same shall increase further with more RE injection in the grid. Accordingly the reconductoring of the subject transmission line may be carried out.

SRPC opined that proposal is acceptable and bay upgradation requirement may also be looked into. CTU informed that the same shall be duly considered while detailing the scope of works for the reconductoring works.

During the meeting POWERGRID informed that, in case of re-conductoring of Transmission line prior to completion of useful life, the part of depreciation for dismantled item (like conductor, hardwares, Insulators etc.) remains un-recovered. In similar cases, CERC at times asked to get consent of beneficiary to bear the cost towards unrecovered depreciation for dismantled items. In this regard, it was informed that upgradation of the transmission line is a technical requirement for the ISTS network. Further approval of the ISTS transmission schemes are accorded by CTU (upto Rs. 100 Crs), NCT (upto Rs. 500 Crs) and the scheme more than Rs. 500 Crs are approved by MoP with recommendation of NCT & views of RPC.

However, for specific approval, if any, POWERGRID may refer the matter to SRPC after technical approval of the upgradation schemes by the members in CMETS.

After detailed deliberations, members agreed for the proposal of reconductoring of the Somanahalli – Bidadi 400kV D/c line with HTLS conductor.

Estimated cost : Rs. 43 Crore

(g) Augmentation of 1x500 MVA(3rd), 400/220 kV transformation capacity at Hassan S/s

POWERGRID, vide letter dated 31.07.2023, has mentioned that Hassan S/s is installed with 2x315 MVA, 400/220 kV transformation capacity. These ICTs are loaded most of the time near to full load capacity and not complying to N-1 contingency criteria. Loading pattern provided by POWERGRID for the CY 2022 and 2023 (till 31.07.2023) is attached at Annexure-1. Further, POWERGRID informed that space is available for augmentation of transformation capacity at Hassan S/s.

From the loading pattern it is observed that in the CY 2023, 2x315MVA ICTs are continuously loaded above 80% of the rating for sufficient duration of time. SRLDC in its Q4 (2022-23) and Q1 (2023-24) reports has also mentioned that about 50% of times during peak demand period, ICTs at Hassan are not complying to N-1 criteria. The matter was also discussed in the 204th OCC meeting, held on 11.07.2023, wherein it was concluded that POWERGRID may submit the request for augmentation of ICT at Hassan so that same may be deliberated in CMETS meeting. In view of above, augmentation of transformation capacity by 1x500 MVA (3rd), 400/220 kV at Hassan S/s was proposed in the 20th CMETS wherein same was agreed. Transmission system is under implementation.

Estimated cost : Rs. 49 Crore

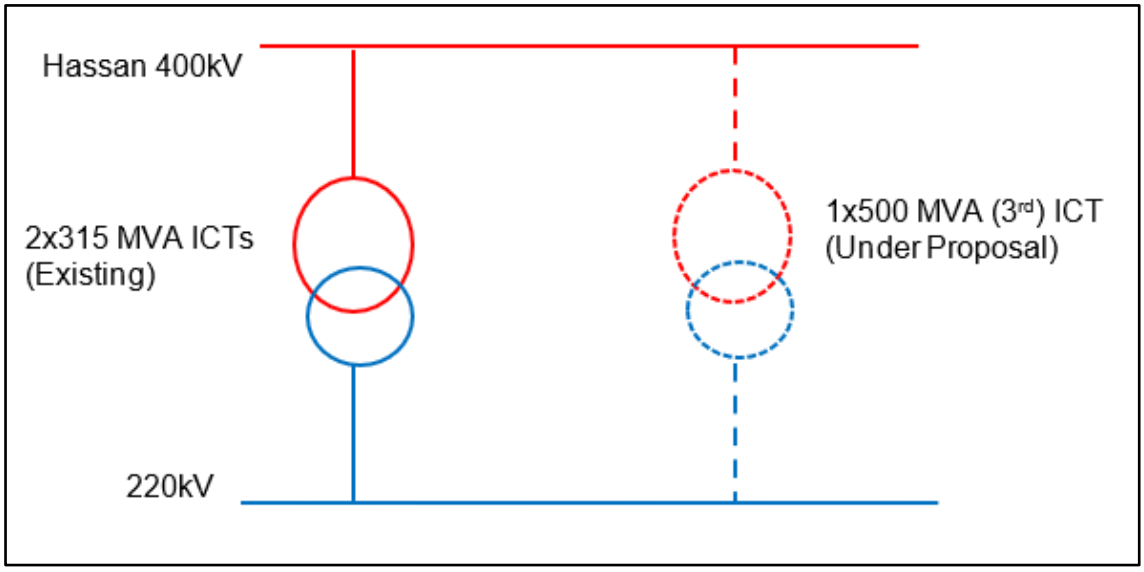


Figure 6-9: Augmentation of 1x500 MVA, 400/220kV transformation capacity at Hassan S/s

(h) Implementation of 1 no. of 220kV line bay at Tumkur (Pavagada) PS for integration of RE generation projects

During the 28th CMETS-SR held on 29.02.2024, it was informed that presently, Tumkur (Pavagada) PS is under operation with 5x500 MVA, 400/220kV ICTs. Further, 1x500 MVA, 400/220kV ICT(6th) is under implementation and is expected by Mar'24. Further, addl. 2x500 MVA (7th & 8th) ICTs are agreed for providing connectivity for RE generation projects. During the 25th CMETS-SR held on 28.11.2023, Connectivity of 200 MW has been agreed for grant to M/s TEQ Green Power XVIII Pvt. Ltd. at 220kV level with 1 nos. of 220kV bay. The above applicant have requested for implementation of 220kV bay at Tumkur (Pavagada) PS under ISTS which was agreed. The details of 220kV bays being implemented under ISTS are as below:

Sl. No.	Description of Transmission Element	Scope of work	Schedule	CMETS-SR
1	1 nos. of 220kV line bay at Tumkur (Pavagada) PS for Connectivity to M/s TEQ Green Power XVIII Pvt. Ltd.	220kV line bays – 1 Nos.	30.06.26	25th held on 28.11.23

Estimated cost: Rs. 6.6 Crore.

6.4.2 Telangana

(a) Reconductoring of Maheshwaram(PG) – Hyderabad 400kV S/c line with HTLS conductor

During the 25th CMETS SR held on 28.11.2023, CTU informed that as per the ISTS Rolling plan reports for 2027-28 and 2028-29 (Interim), it is observed that the loading on

Maheshwaram(PG) – Hyderabad 400kV S/c line is crossing its thermal rating (850 MVA) under N-1 contingency. The high loading is observed during the peak RE time when internal thermal generation of Telangana is low including Ramagundam TPS. Considering the above, it is proposed that reconductoring of Maheshwaram(PG) – Hyderabad 400kV S/c line with HTLS conductor may be carried out.

SRLDC informed that the transmission line is a part of 400 kV ring of Hyderabad and a loading of 550-580 MW is observed in case of non-availability of one of the units of Ramagundam generation. Further, with the proposed series reactor on Maheshwaram – Maheshwaram (PG) 400 kV D/c transmission line, loading on Maheshwaram(PG) – Hyderabad 400kV S/c line shall further enhance.

TSTRANSCO stated that they also recommend the scheme. SRPC also agreed for the proposal. On enquiry from SRPC, it was informed that high line loading has been observed during high RE scenarios under the ISTS Rolling plan report.

During the meeting POWERGRID informed that, in case of re-conductoring of Transmission line prior to completion of useful life, the part of depreciation for dismantled item (like conductor, hardwares, Insulators etc.) remains un recovered. In similar cases, CERC at times asked to get consent of beneficiary to bear the cost towards unrecovered depreciation for dismantled items. In this regard, it was informed that upgradation of the transmission line is a technical requirement for the ISTS network. Further approval of the ISTS transmission schemes are accorded by CTU (upto Rs. 100 Crs), NCT (upto Rs. 500 Crs) and the scheme more than Rs. 500 Crs are approved by MoP with recommendation of NCT & views of RPC. However, for specific approval, if any, POWERGRID may refer the matter to SRPC after technical approval of the upgradation schemes by the members in CMETS.

After detailed deliberations, members agreed for the proposal of reconductoring of the Maheshwaram(PG) – Hyderabad 400kV S/c line with HTLS conductor.

Estimated cost : Rs. 63 Crore

6.4.3 Andhra Pradesh

(a) Augmentation of 1x500 MVA, 400/220 kV ICT (5th) at NP Kunta Pooling Station and common facility works for providing connectivity to RE generation projects

During the 27th CMETS SR held on 30.1.2024, CTU informed that presently, NP Kunta PS is under operation with 4x500 MVA, 400/220kV ICTs. Connectivity of about 1600 MW was granted at NP Kunta. Further, during the 26th CMETS-SR held on 29.12.2023, connectivity of 100 MW to M/s First Energy Pvt. Ltd. was agreed for grant with the 1x500 MVA, 400/220 kV ICT (5th) considering N-1 contingency planning criteria. With this the total Connectivity/GNA granted/ agreed for grant at NP Kunta PS shall became 1700 MW. Further, 1 no. of 220kV bay at NP Kunta has been allocated to NHPC Ltd. for integration of its 100 MW generation project with start date of connectivity as Sep'24.

In view of the above works, 220kV switchyard is to be extended for implementation of 220kV bay(s) for integration of RE generation projects. Accordingly, the common facility works for 220kV switchyard extension has also been associated with the augmentation works of 1x500 MVA 5th ICT at NP Kunta PS. Same was informed in the 28th CMETS-SR held on 29.02.2024.

In view of the above, augmentation of 1x500 MVA, 400/220 kV ICT (5th) at NP Kunta Pooling Station and common facility works for providing connectivity to RE generation projects is being taken up for implementation.

Estimated cost : Rs. 52 Crore

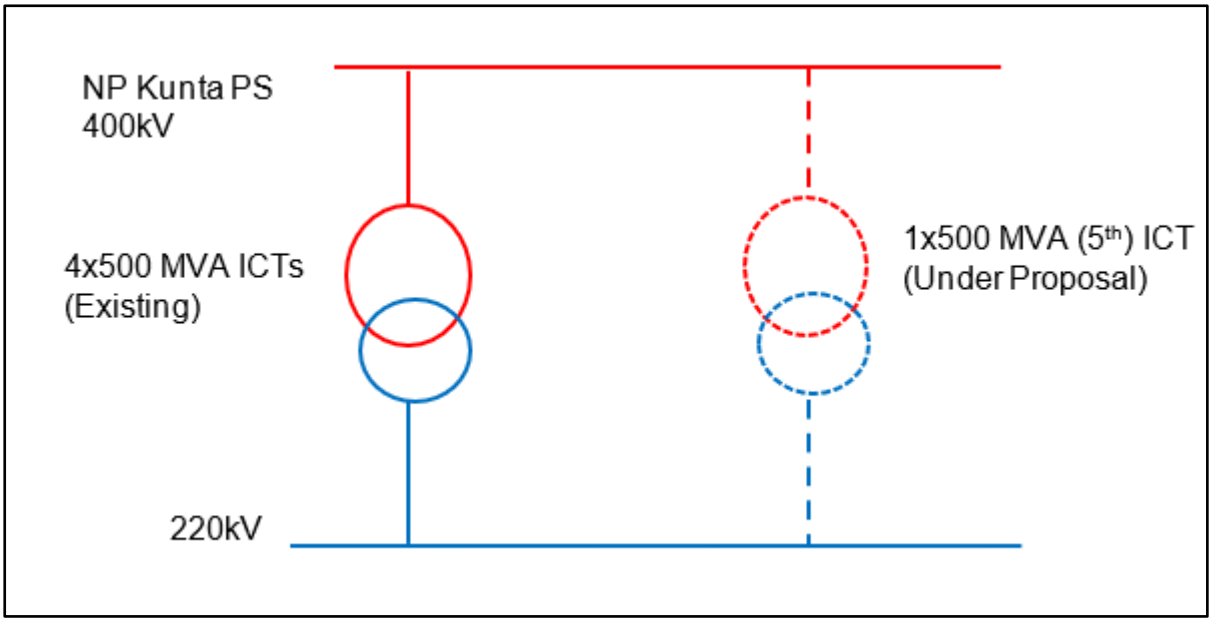


Figure 6-10: Augmentation of 1x500 MVA, 400/220kV transformation capacity at NP Kunta PS

(b) Scheme to bypass NGR to use Switchable Line Reactor as Bus Reactor for transmission lines being implemented by WKTL under the scheme "Additional inter-Regional AC link for import into Southern Region i.e. Warora – Warangal and Chilakaluripeta - Hyderabad - Kurnool 765kV link"

"Additional inter-Regional AC link for import into Southern Region i.e. Warora – Warangal and Chilakaluripeta - Hyderabad - Kurnool 765kV link" is under implementation by M/s Warora-Kurnool Transmission Limited (WKTL) and the details of the broad transmission system is given below:

1. Establishment of 765/400kV substations at Warangal (New) with 2x1500 MVA transformers and 2x240 MVAR bus reactors.
2. Warangal (New) – Warangal (Existing) 400 kV (quad) D/c line.
3. Warangal (New) – Hyderabad 765 kV D/c line with 240 MVAR switchable line reactor at Warangal end of each circuit.

4. Hyderabad – Kurnool 765 kV D/c line with 240 MVAR switchable line reactor at Kurnool end of each circuit.
5. Warora Pool – Warangal (New) 765 kV D/c line with 240 MVAR switchable line reactor at both ends of each circuit.
6. Warangal (New) – Chilakaluripeta 765kV D/c line with 240 MVAR switchable line reactor at both ends of each circuit.
7. 240 MVA Switchable line reactors at Warora Pool end in each circuit of Warora Pool – Rajnandgaon 765 kV D/c line.

SRLDC, GRID-INDIA in its operational feedback has suggested to implement NGR bypass arrangement for switchable line reactors to use them as bus reactor, in case of outage of line. Further, during the 3rd SRPC(TP) meeting held on 24.08.2021, SRLDC informed that if a line is taken out of service, switching of line reactor as bus reactor would be helpful in controlling the grid voltage. However, it was noticed that in some TBCB projects NGR bypass arrangement is not implemented. It was suggested that NGR bypass arrangement should be implemented for all the planned and upcoming schemes.

Further, SRLDC, GRID-INDIA vide email dated 08.08.2023 has informed that as per present arrangement, NGR bypass arrangement has not been provided for the any of the transmission lines covered under the above scheme and WKTL vide email dated 07.08.2023 has confirmed the same. It was requested to consider the implementation of NGR bypass arrangement on the above mentioned transmission lines.

CTU informed that the transmission scheme was awarded through TBCB route during 2016 and NGR bypass arrangement was not specified in the RfP documents, accordingly, the TSP has not implemented the same. However, for the transmission schemes which were planned subsequently, NGR bypass scheme with suitable arrangement is being specified in the RfP documents. Further, the cost of the NGR bypass scheme is very minimal. SRLDC stated that NGR bypass scheme is required. TANGEDCO stated that as this NGR bypass scheme is to be done by the TSP, this should be without prejudice to the TSA entered between the LTTCs & TSPs for the scheme “Additional inter-Regional AC link for import into Southern Region i.e. Warora – Warangal and Chilakaluripeta - Hyderabad - Kurnool 765kV link”.

CTU clarified that this NGR bypass scheme shall not have any impact on the implementation timelines of the scheme “Additional inter-Regional AC link for import into Southern Region i.e. Warora – Warangal and Chilakaluripeta - Hyderabad - Kurnool 765kV link”.

After detailed deliberations, implementation NGR bypass scheme with suitable arrangement for the following lines was agreed:

1. Warangal (New) – Hyderabad 765 kV D/c line with 240 MVAR switchable line reactor at Warangal end of each circuit.
2. Hyderabad – Kurnool 765 kV D/c line with 240 MVAR switchable line reactor at Kurnool end of each circuit.

3. Warora Pool – Warangal (New) 765 kV D/c line with 240 MVAR switchable line reactor at both ends of each circuit.
4. Warangal (New) – Chilakaluripeta 765kV D/c line with 240 MVAR switchable line reactor at both ends of each circuit.

(c) Implementation of 6 nos. of 400kV line bays at Kurnool-III PS for integration of RE generation projects

During the 28th CMETS-SR held on 29.02.2024, it was informed that presently, Kurnool-III 765/400/220kV PS is under implementation by POWERGRID through RTM route and is expected by Nov'24. Connectivity of about 1990 MW at 220kV and 4100 MW at 400kV have been granted at Kurnool-III PS to various RE generation projects. Total 15 nos. of 220kV line bays are under implementation. Connectivity of 600 MW has been granted to M/s Adani Renewable Energy Forty Two Ltd. at 400kV level with 2 nos. of 400kV bays in the 23rd CMETS-SR held on 29.09.2023. Further, Connectivity of 3500 MW (800 MW & 3x900 MW) have been granted to M/s Indosol Solar Pvt. Ltd. at 400kV level with 4 nos. of 400kV bays in the 26th CMETS-SR held on 29.12.2023. The above RE generation projects have requested for implementation of 400kV bays at Kurnool-III under ISTS and same was agreed. The details of 400kV bays being implemented under ISTS are as below:

Sl. No.	***Description of Transmission Element***	***Scope of work***	***Schedule***	***CMETS-SR***
1	2 nos. of 400kV line bays at Kurnool-III PS for Connectivity to M/s Adani Renewable Energy Forty-Two Ltd.	400kV line bays – 2 Nos.	30.06.26	23rd held on 29.09.23
2	4 nos. of 400kV line bay at Kurnool-III PS for Connectivity to M/s Indosol Solar Pvt. Ltd.	400kV line bays – 1 Nos.	30.06.25	26th held on 09.12.23
		400kV line bays – 1 Nos.	31.07.26	
		400kV line bays – 2 Nos.	31.03.27	

Estimated cost : Rs. 92 Crore

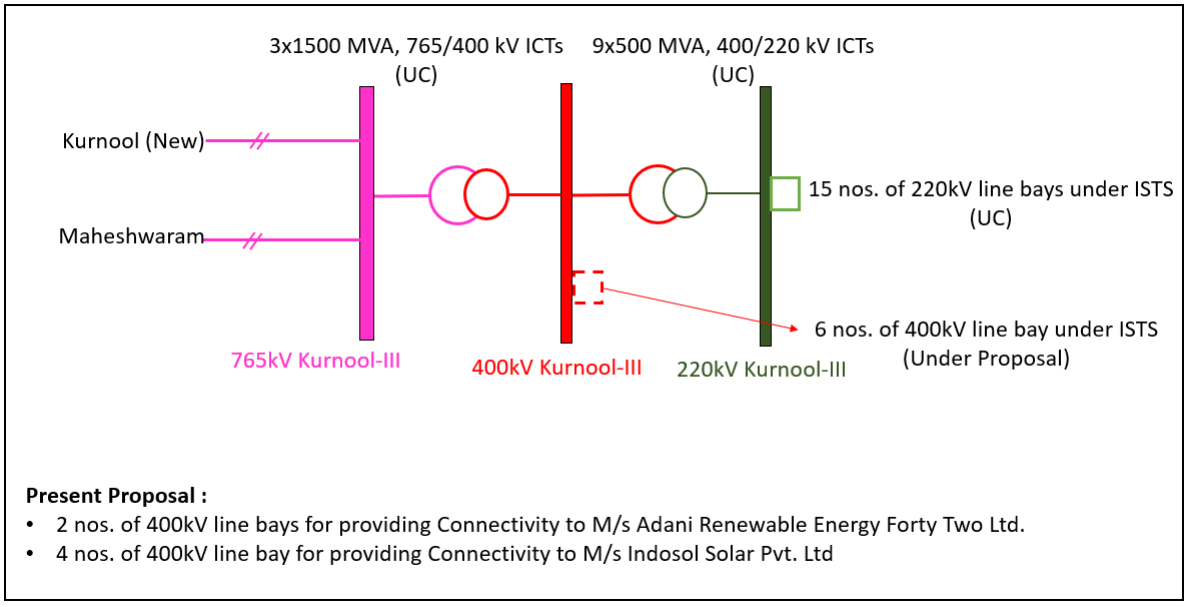


Figure 6-11: 400kV bays at Kurnool-III PS for integration of RE generation projects

Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects

During the 28th CMETS-SR held on 29.02.2024, it was informed that presently, Ananthapuram 400/220kV PS is under implementation by POWERGRID through TBCB route and is expected by Sept'25. Connectivity of about 1055 MW at 220kV and 2710 MW at 400kV have been granted at Ananthapuram to various RE generation projects. Total 12 nos. of 220kV line bays are under implementation. Connectivity of 1710 MW has been granted to M/s Renew Vikram Shakti Pvt. Ltd. at 400kV level with 2 nos. of 400kV bays in the 23rd CMETS-SR held on 29.09.2023. Further, Connectivity of 1000 has been granted to M/s ABC Cleantech Pvt. Ltd. at 400kV level with 1 nos. of 400kV bay in the 25th CMETS-SR held on 28.11.2023. The above RE generation projects have requested for implementation of 400kV line bays at Ananthapuram PS under ISTS which was agreed. The details of 400kV bays being implemented under ISTS are as below:

Sl. No.	***Description of Transmission Element***	***Scope of work***	***Schedule***	***CMETS-SR***
1	2 nos. of 400kV line bays at Ananthapuaram PS for Connectivity to M/s Renew Vikram Shakti Pvt. Ltd.	400kV line bays – 2 Nos.	31.03.26	23rd held on 29.09.23
2	1 nos. of 400kV line bay at Ananthapuaram PS for Connectivity to M/s ABC Cleantech Pvt. Ltd.	400kV line bays – 1 Nos.	31.03.26	25th held on 28.11.23

Estimated cost : Rs. 46 Crore

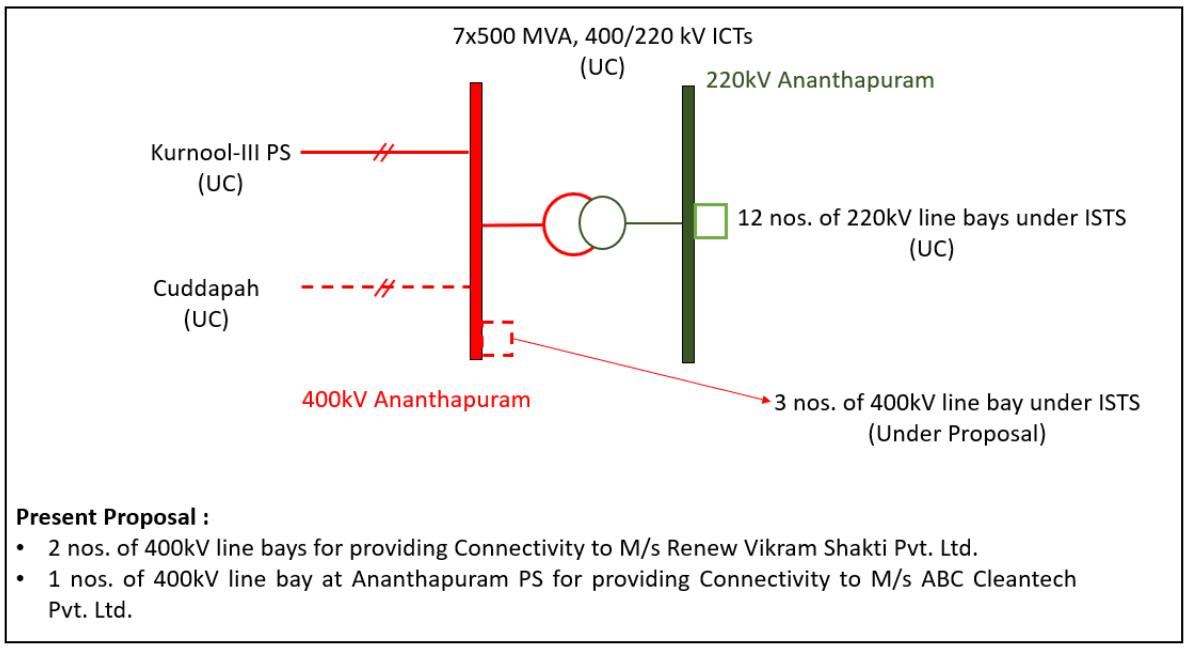


Figure 6-12: 400kV bays at Ananthapuram for integration of RE generation projects

(d) Transmission system strengthening at Kurnool-III PS for integration of additional RE generation projects.

During the 28th CMETS-SR held on 29.02.2024, CTU informed that presently, Kurnool-III 765/400/220kV PS is under implementation by POWERGRID through RTM route and is expected by Nov'24. Further, for optimal utilisation of the pooling station, space provision for integration of additional 4.5 GW has been kept at Kurnool-III. The broad scheme is as below:

- Establishment of 765/400/220kV 3x1500 MVA, 9x500 MVA Kurnool-III PS
- Kurnool-III PS – Kurnool(new) 765 kV D/c line
- Kurnool-III PS – Maheshwaram (PG) 765 kV D/c line

Connectivity of about 2320 MW (1720 MW at 220kV level & 600 MW at 400kV level) have already been granted at Kurnool-III PS with the above under implementation transmission system. Further, CTU has received additional connectivity applications for 3770 MW (Solar: 3650 MW & Wind: 120 MW) seeking connectivity at Kurnool-III in the month of Nov'23. With this, the total connectivity quantum at Kurnool-III shall be about 6090 MW (1990 MW at 220kV level & 4100 MW at 400kV level). However, Kurnool-III PS is being implemented with 3x1500 MVA, 765/400kV transformation capacity. Therefore, grant of connectivity for additional 3770 MW shall require expansion of Kurnool-III PS and further transmission lines for evacuation of power from Kurnool-III PS.

Accordingly, following transmission system was proposed for integration of additional 4.5 GW of RE at Kurnool-III PS in the 26th CMETS-SR held on 29.12.2023 :

- Augmentation of transformation capacity of 3x1500 MVA, 765/400kV ICTs at Kurnool-III PS
- Kurnool-III PS – Chilakaluripeta 765 kV D/c line

Further, CTU is in receipt of additional connectivity application for 1650 MW (PSP: 1250 MW & Solar: 400 MW) seeking connectivity at Kurnool-III in the month of Jan'24. With this, the total connectivity quantum at Kurnool-III shall be about of 7740 MW (2390 MW at 220kV level & 5350 MW at 400kV level). It was also informed that Ananthapuram PS is also being integrated at Kurnool-III through Ananthapuram PS – Kurnool-III PS 400kV (Quad) D/c line. Some quantum of power from Ananthapuram will also be evacuated through Kurnool-III PS. Considering the same, the above transmission system strengthening at Kurnool-III PS for integration of additional RE generation projects is required.

The above transmission system was also deliberated in the Joint Study meeting of Southern Region constituents held on 21.12.2023 & 22.12.2023 at Yelahanka, Bengaluru, wherein it was decided that the proposal and corresponding study files may be shared with the SR constituents for their observations / comments. Accordingly, the proposal and study files were shared with the SR constituents on 05.01.2024 for their observations / comments.

After detailed deliberations, following transmission system was agreed for integration of additional RE generation projects and grant of Connectivity at Kurnool-III PS under the CERC GNA Regulations:

- Augmentation of transformation capacity of 3x1500 MVA, 765/400kV ICTs at Kurnool-III PS
- Kurnool-III PS – Chilakaluripeta 765 kV D/c line

The transmission scheme shall be submitted to SRPC for comments/observations and subsequently to NCT for further action.

(e) Transmission system for grant of GNA to Green Hydrogen/ Ammonia in Kakinada area, Andhra Pradesh

During the 27th CMETS SR, CTU informed that M/s AM Green Ammonia (India) Private Limited [as an eligible entity under Regulation 17.1 (iii)] has applied for GNA as Bulk Consumer for 700MW (Within Region: 0MW & Outside Region: 700MW) seeking connectivity/GNA at Vemagiri 765/400 kV SS in Andhra Pradesh with start and end date as 01-07-2026 & 30-06-2050 respectively.

It was also informed that AM Green Ammonia (India) Private Limited vide email dated 20.01.2024 has indicated that they are in the process of developing a 2 MPTA Green Ammonia Project in Kakinada, Andhra Pradesh in phased manner. The total drawl requirement for the entire Green Ammonia Kakinada project capacity is 3370 MW. The details of the phased development are as follows:

Phase	Capacity (MW)
Phase I	700
Phase II	700
Phase III	1310
Phase IV	660

Accordingly, they have requested to plan the power drawl arrangement for full capacity, with first phase development requiring 700 MW GNA-RE by July 2026.

It was further informed that a meeting was held on 19.10.2023 chaired by Hon'ble Minister with Green Hydrogen stakeholders/association, wherein it was instructed that developers shall share the details of year-wise planned Green Ammonia / Green Methanol capacities and corresponding drawl capacities desired at different locations. Hon'ble minister also instructed that this information should be shared with CTU for planning the required substation capacities at these specified locations. MNRE vide letter dated 01.11.2023 has forwarded the consolidated information of the planned projects and drawl requirements of various developers.

In this regard, a meeting was convened by CEA with Green Hydrogen/ Green Ammonia manufacturers to access the year wise electricity demand for proper planning of transmission system. In Kakinada Area, about 6000 MW demand has been envisaged for the Green Hydrogen/ Green Ammonia projects. The details of the phased development are as follows:

Year	Cumulative Electricity Demand (MW)
By 2027	1775
By 2028	3275
By 2029	4665
By 2030	6015

In view of the upcoming Green Hydrogen/ Green Ammonia plants/industries, planning of transmission system has been done for delivery of power to potential Green Hydrogen/Ammonia manufacturing sites. Following transmission system has been identified by CEA for supply of power at Kakainada for about 6000 MW power drawl by potential Green Hydrogen/Ammonia industries.

Proposed Transmission network (for meeting electricity demand upto 1500 MW)

- Establishment of Kakinada 765/400 kV, 3x1500 MVA S/s
- LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada S/s

Proposed Transmission network (for meeting electricity demand upto 6015 MW) - *To be planned based on the visibility of applications from manufacturers* - Subsequent augmentation

- Angul – Srikakulam 765 kV 2nd D/c line
- Establishment of Khammam 765/400 kV, 3x1500 MVA substation

- Warangal – Khammam – Vemagiri 765 kV D/c line

Accordingly, as per the envisaged electricity demand in Kakinada area and drawl requirement for the Green Ammonia Kakinada project capacity shared by AMGAIPL, above identified transmission system for supply of power to Green Hydrogen/Ammonia industries in Kakinada area may be taken-up in a phased manner. GNA of 700 MW to AMGREL may be granted with first phase of the identified transmission system i.e., Establishment of Kakinada 765/400 kV, 3x1500 MVA S/s and LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada S/s.

APTRANSCO stated that whether the power requirement will be constant load or based on availability of generation. Towards this, AMGAIPL clarified that the same shall be constant load met through RTC power.

SRLDC stated that presently, limiting constraints are seen on Angul-Srikakulam 765 kV D/c line for import ATC-TTC of Southern Region. With above the phased-wise implementation of transmission system for grant of GNA of 700 MW, Angul-Srikakulam 765 kV D/c line shall be further loaded and appropriate planning is required for timely redressal of the limiting constraints. In this regard, CTU stated that as per the deliberations in the SRPC meeting, data has been sought from SR constituents regarding their demad projects by 2030. Based on the same, transmission system adequacy shall be accessed in the joint studies to be carried out with SR constituents and any system strengthening required for the same including identification of additional inter-regional links shall also carried out as part of the joint studies. It was again requested that pending data may be furnished by all the SR constituents so that joint studies may be carried out.

After detailed deliberations, it was agreed to grant GNA to M/s AM Green Ammonia (India) Private Limited for 700 MW with the following transmission system :

Connectivity/GNA Transmission system for M/s AM Green Ammonia (India) Private Limited (application no. 2200000433 for 700 MW)

i. **Dedicated Connectivity Tr. System**

- Pooling Station of M/s AM Green Ammonia (India) Private Limited – Kakinada PS 400 kV D/c line along with line bays at both ends – **under the scope of applicant**

ii. **Associated Transmission System for GNA: Nil**

iii. **Common Transmission system required for effectiveness of connectivity/GNA (augmentation other than ATS) :**

- Establishment of Kakinada 765/400 kV, 2x1500 MVA S/s
- LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada S/s

Start date of Connectivity/GNA: 31.08.2026 (tentative) with the availability of common transmission system required for effectiveness of Connectivity/ GNA.

6.4.4 Tamil Nadu

(a) Transmission system for evacuation of power from Kudankulam NPP for 2000 MW (for Unit 3&4)

Transmission System requirement for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW) and Kudankulam Unit - 5 & 6 (2x1000 MW) was evolved in the Joint Studies conducted from 21st to 22nd February, 2023 at SRPC, Bengaluru and the same was discussed in the 16th SR CMETS. Details of the evolved transmission system agreed in the meeting was as follows :

A. Transmission System requirement for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW)

- KKNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line (~120 km) **{Line & bays at Tuticorin-II GIS under ISTS scope and bays at KKNPP under NPCIL scope}**
- KKNPP 3&4 – Samugarangapuram (TN) 400kV (quad) D/c line (~30 km) **{Line & bays at Samugarangapuram (TN) under TANTRANSCO scope and bays at KKNPP 3&4 under NPCIL scope}**
- Shifting of one circuit of KKNPP 1&2 – Tirunelveli 400kV (quad) D/c line to KKNPP 3&4 to form KKNPP 3&4 – Tirunelveli 400kV (quad) S/c line **{NPCIL scope}**
- Interconnection between KKNPP 1&2 and KKNPP 3&4 generation switchyards through laying of 400kV overhead transmission line or cable and to be kept open under normal operating conditions **{NPCIL scope}**
- 2x125 MVAr (420kV) bus reactors at KKNPP - 3&4 **{NPCIL scope]**
- Upgradation of Tuticorin PS - Salem 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level with 1x330 MVAr switchable Line Reactor on both ends of each circuit **{ISTS scope}**
- Upgradation of Tuticorin PS to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors **{ISTS scope}**
- Upgradation of Dharmapuri (Salem New) to its rated voltage of 765kV level along with 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors **{ISTS scope}**
- Separate arrangement for auxiliary power supply at 230kV level one from KKNPP 1 & 2 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

B. Transmission System requirement for evacuation of power from Kudankulam Unit - 5 & 6 (2x1000 MW)

- Interconnection of KKNPP-3&4 and KKNPP-5&6 switchyards with 400kV quad D/c line **{NPCIL scope}**

- Shifting of KKNPP-3&4 – Tuticorin-II GIS 400kV (quad) D/c line to KKNPP-5&6 to form KKNPP-5&6 – Tuticorin-II GIS 400kV (quad) D/c line and with provision of SLR at terminating bays of KKNPP-5&6 **{NPCIL scope}**

- KKNPP-5&6 – Viruddanagar (TN) 400kV (quad) D/c line with 80 MVAR SLR in each circuit at KKNPP-5&6 (~170 km) **{Line along with reactor at KKNPP-5 & 6 and line bays at Viruddanagar under scope of TANTRANSCO and Line bays & bays for switchable Line Reactor at KKNPP-5&6 under NPCIL scope}**

- 3x125 MVAr (420kV) bus reactors at KNPP - 5&6 **{NPCIL scope}**

- Separate arrangement for auxiliary power supply at 230kV level one from KNPP-3 & 4 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

Subsequently, NPCIL opted for transition of connectivity/under process LTA of 2000 MW from KNPP U-3&4 under the GNA Regulations. NPCIL did not opt for transition for KNPP U-5&6. Accordingly, in the 22nd CMETS-SR held on 25.08.2023 it was agreed to grant connectivity/GNA to NPCIL under the GNA Regulations for Unit-3 &4.

Subsequently, TANGEDCO vide letter dated 21.10.2023 submitted that "Upgradation of Tuticorin PS - Salem 765kV D/c line" was approved in the Joint Studies considering both KKNPP Unit 3&4 as well as Unit-5&6, however in the present scenario when only Unit-3&4 are being taken-up, upgradation of the corridor is not required. System studies in this regard were also submitted by TANGEDGO. Based on the observations received from TANGEDCO and change in scenario of the generations likely to be available in the timeframe of KNPP-3&4 with the transition under GNA Regulations, system studies were carried out by CTUIL for 2026-27 time frame for grant of connectivity under the GNA Regulations to NPCIL for Unit-3&4. The transmission scheme was discussed in the 25th CMETS-SR held on 28.11.2023 wherein it was agreed that upgradation of Tuticorin PS - Salem 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level may not be considered for grant of connectivity under the GNA regulations to NPCIL for KNPP-3&4. Same may be taken-up subsequently as per requirements, as and when depending on the visibility of generation in the Tuticorin Area.

Accordingly, following transmission system was agreed for grant of connectivity under the GNA Regulations to NPCIL for KKNPP U-3 & 4 :

Grant of Connectivity under GNA Regulations for KNPP Unit-3 :

Connectivity Transmission system under GNA for KNPP Unit-3:

I. **Dedicated Connectivity Tr. System**

- Interconnection between KKNPP 1&2 and KKNPP 3&4 generation switchyards through laying of 400kV overhead transmission line or cable and to be kept open under normal operating conditions **{NPCIL scope}**

- Shifting of one circuit of KKNPP 1&2 – Tirunelveli 400kV (quad) D/c line to KKNPP 3&4 to form KKNPP 3&4 – Tirunelveli 400kV (quad) S/c line **{NPCIL scope}**

- 2x125 MVAr (420kV) bus reactors at KKNPP - 3&4 **{NPCIL scope}**

- Separate arrangement for auxiliary power supply at 230kV level one from KKNPP 1 & 2 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

II. **Associated Transmission System for GNA:**

- KKNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line (~120 km) **{Line along with bays at Tuticorin-II GIS under ISTS scope and bays at KKNPP under NPCIL scope}**

III. **Augmentation (other than ATS) :**

Common Transmission system required for effectiveness of connectivity/ GNA (System strengthening without ATS):

- ISTS Network Expansion scheme in Western Region & Southern Region for export of surplus power during high RE scenario in Southern Region.

Transmission scheme for evacuation of power under STU:

- KKNPP 3&4 – Samugarangapuram (TN) 400kV (quad) D/c line (~30 km) **{Line along with bays at Samugarangapuram (TN) under TANTRANSCO scope and bays at KKNPP 3&4 under NPCIL scope}**

Start date of Connectivity : 31.12.2026 with the availability of Associated Transmission System and common transmission system required for effectiveness of GNA

<u>Grant of Connectivity under GNA Regulations for KNPP Unit-4 :</u>

- **Connectivity Transmission system under GNA for KNPP Unit-4:** Same as Connectivity Transmission system under GNA for KNPP Unit-3

Start date of Connectivity : 31.08.2027 with the availability of Associated Transmission System and common transmission system required for effectiveness of GNA

CTU vide letter dated 01.12.2023 submitted the revised transmission scheme (under ISTS) for SRPC views. The revised transmission scheme was discussed and agreed in the 49th SRPC meeting held on 09.12.2023. SRPC vide letter dated 12.01.2024 has forwarded the views on the scheme.

Details of the modified transmission system under ISTS is given below:

Transmission System under ISTS for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW

Sl. No.	***Scope of the Transmission Scheme***	***Capacity / km***
1.	KNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line (~120 km) **{Line & bays at Tuticorin-II GIS under ISTS scope and bays at KNPP under NPCIL scope}**	~120 km • 400kV GIS line bays at Tuticorin-II GIS – 2 nos.

Implementation timeframe : 30 months (Dec'26)

Estimated cost : Rs. 548 Crore

Above transmission scheme viz., Transmission System under ISTS for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW) was approved and recommended under TBCB in the 18th NCT meeting held on 05.03.2024.

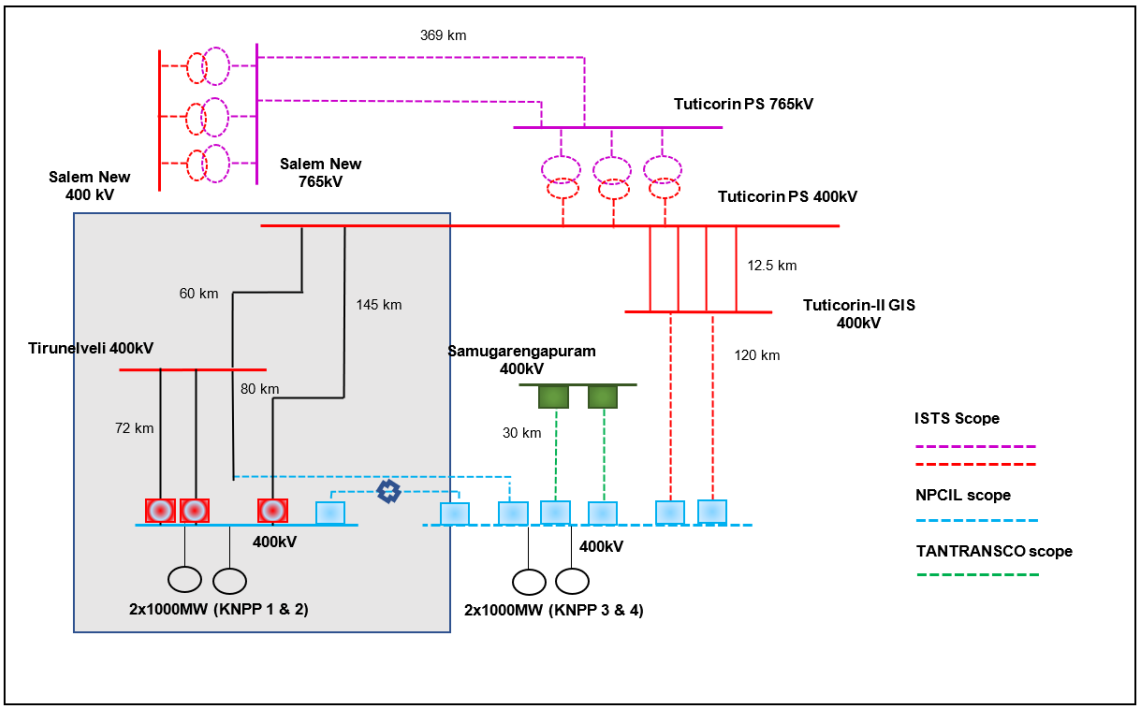


Figure 6-13: Transmission system for evacuation of power from KNPP-3&4

(b) Augmentation of transformation capacity by 1x500 MVA, 400/ 220-230 kV ICT at Tuticorin-II PS to meet N-1 reliability of RE Polling Station

Manual on Transmission Planning Criteria 2023, effective from 01.04.2023, provides that N-1 reliability criteria may be considered for ICTs at the ISTS/ STU pooling stations for renewable energy based generation of more than 1000 MW after capacity factor of renewable generating station. However, same provision was not available under *Manual on Transmission Planning Criteria 2013*.

Tuticorin-II PS was planned as part of Green Energy Corridor with 2x500 MVA, 400/230 kV transformation capacity. Subsequently, 1x500 MVA, 400/230 kV ICT (3rd) has been implemented & under operation and 2x500 MVA, 400/230 kV ICTs (4th and 5th) are under implementation and expected by August/ September 2023.

Presently, RE developers have already granted Connectivity for 2220.1 MW and LTA for 2170 MW at Tuticorin-II PS. Further, LTA corresponding to 1330 MW has already been operationalized and balance 840 MW shall be operationalized with commissioning of 4th and 5th ICTs. To meet the N-1 reliability criteria, 1x500 MVA, 400/230 kV ICT (6th) is required. In view of above, augmentation of 1x500 MVA, 400/230 kV ICT (6th) at Tuticorin-II PS was proposed in the 20th CMETS. As Southern Region constituents had varied views on the scheme, the augmentation of transformation capacity by 1x500 MVA, 400/230 kV ICT (6th) at Tuticorin-II PS for meeting N-1 criteria as per CEA's revised Planning Criteria may be submitted to next higher forum for consideration along with the views of Southern Region constituents.

Accordingly matter was discussed in the meeting held on 05.12.2023 with CEA, CTU, SRPC, Grid-India and TANGEDGO wherein it was decided that augmentation of transformation capacity by 1x500 MVA, 400/230 kV ICT (6th) at Tuticorin-II PS for meeting N-1 criteria and accordingly suitable action in this regard may be taken by CTU.

Estimated cost : Rs. 79 Crore

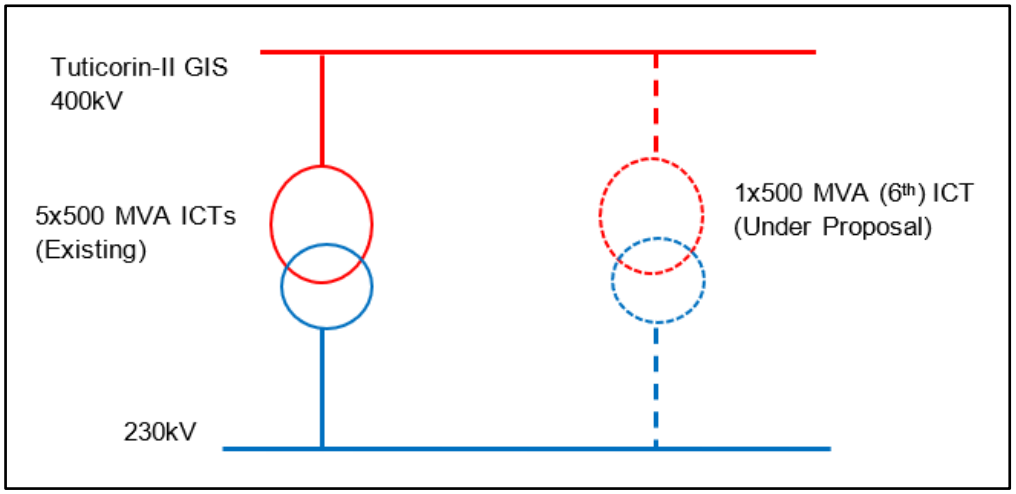


Figure 6-14: Augmentation of 1x500 MVA, 400/230kV transformation capacity at Tuticorin-II GIS

(c) Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS

During the 27th CMETS SR held on 30.01.2024, CTU informed that presently, Karur PS is under operation with 2x500 MVA, 400/230kV ICTs. Connectivity for 618 MW has been granted/ agreed for grant at Karur PS. Further, Connectivity of 300 MW has been agreed for grant to M/s JSP Green Wind 1 Private Limited at Karur PS in the existing margins in the 27th CMETS-SR held on 30.01.2024 (MoM awaited).

Further, connectivity of 100 MW & 93.6 MW to M/s First Energy Pvt. Ltd. & M/s Tata Power Renewable Energy Ltd. respectively has been agreed for grant at Karur PS during the above meeting with the availability of additional 2x500 MVA 400/230 kV ICTs (3rd & 4th). With this the total connectivity granted at Karur PS shall be about 1112 MW. Accordingly, 3rd ICT is required for providing connectivity to RE generation projects and 4th ICT is required for meeting the N-1 contingency criteria.

After detailed deliberations Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS was agreed. Above transmission scheme viz., Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS was approved and recommended under RTM in the 18th NCT meeting held on 05.03.2024.

Estimated cost : Rs 115 Crore

Implementation timeframe: 18 months.

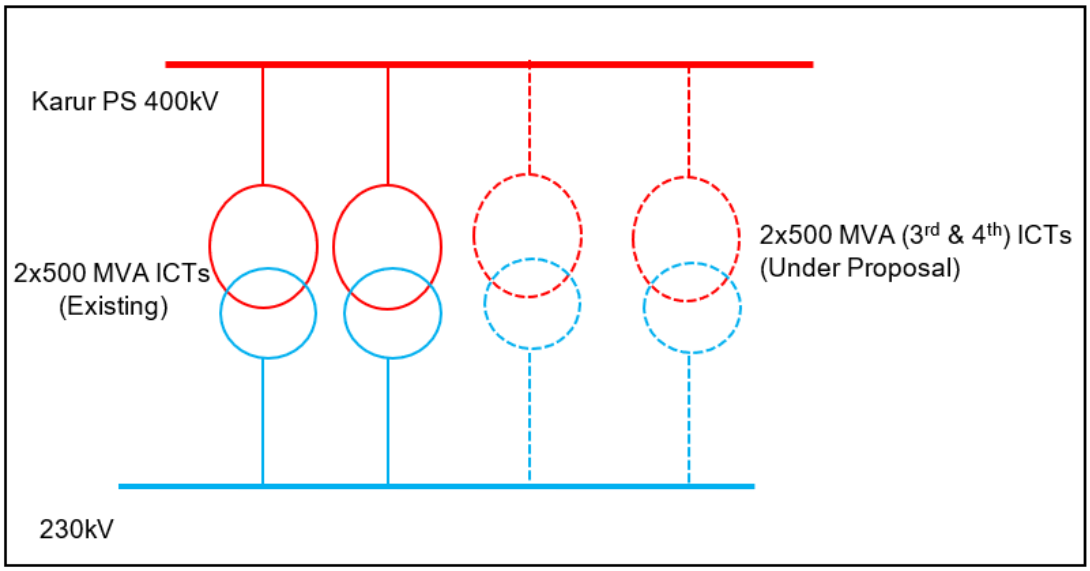


Figure 6-15: Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS

(d) Implementation of 1 nos. of 230kV line bays at Pugalur (existing) SS for integration of RE generation project

During the 28th CMETS SR held on 29.02.2024, CTU informed that presently, Pugalur (Existing) 400/230kV S/s is under operation with 2x315 + 1x500 MVA, 400/230kV ICTs. During the 26th CMETS-SR held on 29.12.2023, Connectivity of 151 MW has been agreed for grant to M/s Tata Power Renewable Energy Ltd. at 230kV level with 1 nos. of 230kV bay. Further, additional connectivity of 151.2 MW has also been agreed for grant to M/s Tata Power Renewable Energy Ltd. during the 27th CMETS-SR held on 30.01.2024. The applicant have requested for implementation of 230kV bay at Pugalur (Existing) under ISTS which was agreed. The details of 230kV bay being implemented under ISTS are as below:

Sl. No.	***Description of Transmission Element***	***Scope of work***	***Schedule***	***CMETS-SR***
1	1 no. 230kV line bay at Pugalur(Existing) 400/230kV S/s for Connectivity to M/s Tata Power Renewable Energy Ltd.	230kV line bays – 1 No.	01.03.26	27th held on 30.01.24

Estimated cost : Rs 6.08 Crore

(e) Transmission System for prioritized 1 GW Offshore wind farms in Tamil Nadu

During the 28th CMETS-SR held on 29.02.2024, CTU informed that Govt. of India has set a target of 500 GW capacity addition from non-fossil fuel based generation capacity by 2030. MNRE has identified about 30 GW Offshore wind potential each in the coast of Gujarat and Tamil Nadu. A report on Transmission System for Integration of over 500 GW RE Capacity has been published by CEA on 07.12.2022 wherein initially 5 GW Offshore wind potential each at Gujarat (CUF – 37%) and Tamil Nadu (CUF – 48%) has been prioritized for implementation by 2030.

Further, a meeting on "Offshore development" was held under chairmanship of Shri R.K. Singh, Hon'ble Minister of Power and New & Renewable Energy on 14.06.2023, to discuss the issues related to grid connection, timelines and bidding of offshore wind energy projects under various models. During the meeting, it was decided that initially 2GW offshore evacuation infrastructure (1 GW in Gujarat and 1 GW in Tamil Nadu) may be developed by PGCIL under RTM and further, 4GW evacuation infrastructure will be developed under TBCB. Same was also decided in the meeting held on 16.08.2023 between MNRE & CTUIL.

Further, in the meeting held on 22.12.2023 in MNRE for finalization of the specifications of the transmission infrastructure, it was decided that 500 MW VGF project off-Tamil Nadu coast to be commissioned by March 2029 for which tender shall be published by March 2025. Further, 4 GW non-VGF project off-Tamil Nadu coast to be commissioned by in FY 029-30 for which tender are to be published on 01.02.2024.

Accordingly, transmission system for integration of initial 1 GW Offshore wind farms was proposed to be taken-up for implementation in the 28th CMETS-SR. During the meeting, CTU informed that MOP vide Order No. 12/07/2023-RCM dated 29.05.2023 have notified that

Offshore wind power projects commissioned on or before 31.12.2032 shall be granted exemption from the payment of ISTS charges for a period of 25 years . Further the transmission system developed for renewable energy projects as identified by the Central Transmission Utility shall be considered under National Component-Renewable Energy in accordance with Regulation 5(2) of the CERC Sharing Regulations, 2020.

During the meeting, it was also informed that the annual transmission charges for the subject scheme for 1 GW with estimated cost of about Rs 11485 Crs. shall be about Rs 1722.75 Crs. The above transmission system shall enable transfer of about 1000 MW of power from the Offshore Wind farms in Tamil Nadu. Such quantum of power shall translate into annual energy of about 4117.2 MU per year [Energy in MU = (1000x0.47x8760)/1000] (assuming Wind offshore CUF of 47%). The tentative transmission tariff shall be about Rs. 4.20 /Unit.

Detailed scope of the transmission system is as follows :

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
A. Transmission System onwards Onshore Pooling Station		
1.	Establishment of 3x500 MVA, 400/230 kV Onshore Pooling Station near Avaraikulam, Tirunelveli District in Tamil Nadu with provision of expansion upto 5 GW **Future Space Provisions:** • 400/230kV, 500 MVA, ICTs – 9 nos. • 400kV ICT bays – 9 nos. • 230kV ICT bays – 9 nos. • 400kV line bays – 12 nos. (with provision for SLR) • 230kV line bays – 16 nos. • 230kV Bus Sectionalizer : 3 sets • 230 kV Bus Coupler (BC) Bay – 3 nos. • 230 kV Transfer Bus Coupler (TBC) Bay – 3 nos.	• 400/230kV, 500 MVA, ICTs – 3 nos. • 400kV ICT bays – 3 nos. • 220kV ICT bays – 3 nos. • 400kV line bays – 2 nos. (at Avaraikulam Onshore PS for termination of Avaraikulam Onshore PS – Tuticorin PS line) • 230kV line bays – 4 nos. • 230 kV Bus Coupler (BC) Bay – 1 no. • 230 kV Transfer Bus Coupler (TBC) Bay – 1 no.
2.	Avaraikulam Onshore PS – Tuticorin PS 400 kV D/c quad line	• Line length ~100 km • 400kV line bays - 2 (at Tuticorin PS)
3.	± 300 MVAr STATCOM along with 2x125 MVAr MSR	• 400 kV bay – 1 no.
B. Transmission System for integration of Offshore Wind Farms with Onshore PS		
	Offshore Substation-1 {500 MW VGF}	
1.	Establishment of 2x315 MVA, 230/66kV Off-Shore Substation-1 with 10 nos. of 66kV line bays for RE integration	• 230/66kV, 315 MVA, ICTs – 2 nos. • 230kV ICT bays – 2 nos. • 66kV ICT bays – 2 nos. • 230kV line bays – 2 nos. (at Off-Shore Substation-1 for termination of Offshore substation 1 (OSS-1) – Avaraikulam Onshore PS line) • 66kV line bays – 10 nos.
2.	Offshore substation 1 (OSS-1) – Avaraikulam Onshore PS 2 nos. 230kV (atleast 300 MVA capacity)	• Cable length ~35 - 40 km

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
A. Transmission System onwards Onshore Pooling Station		
	Submarine cables (~35 - 40 km) with 2x50MVAr switchable line reactors at OSS-1 end	• 230 kV, 50MVAr switchable line reactors at OSS-1 end – 2 nos.
	Offshore substation-2 {500 MW Non-VGF}	
1.	Establishment of 2x315 MVA, 230/66kV Off-Shore Substation-2 with 10 nos. of 66kV line bays for RE integration	• 230/66kV, 315 MVA, ICTs – 2 nos. • 230kV ICT bays – 2 nos. • 66kV ICT bays – 2 nos. • 230kV line bays – 2 nos. (at Off-Shore Substation-2 for termination of Offshore substation 2 (OSS-2) – Avaraikulam Onshore PS line) • 66kV line bays – 10 nos.
2.	Offshore substation 2 (OSS-2) – Avaraikulam Onshore PS 2 nos. 230kV (atleast 300 MVA capacity) Submarine cables (~35 - 40 km) with 2x50MVAr switchable line reactors at OSS-2 end	• Cable length ~35 - 40 km • 230 kV, 50MVAr switchable line reactors at OSS-2 end – 2 nos.

Estimated cost : Rs. 11485 Crore

(Transmission System onwards Onshore Pooling Station - Rs. 1193 Crore + Transmission System for integration of Offshore Wind Farms with Onshore PS - Rs. 10292 Crore)

After detailed discussions, it was decided that the transmission scheme shall be submitted to SRPC for views and subsequently to NCT for further action. CTU vide letter dated 05.03.2024 has forwarded the scheme to SRPC for views.

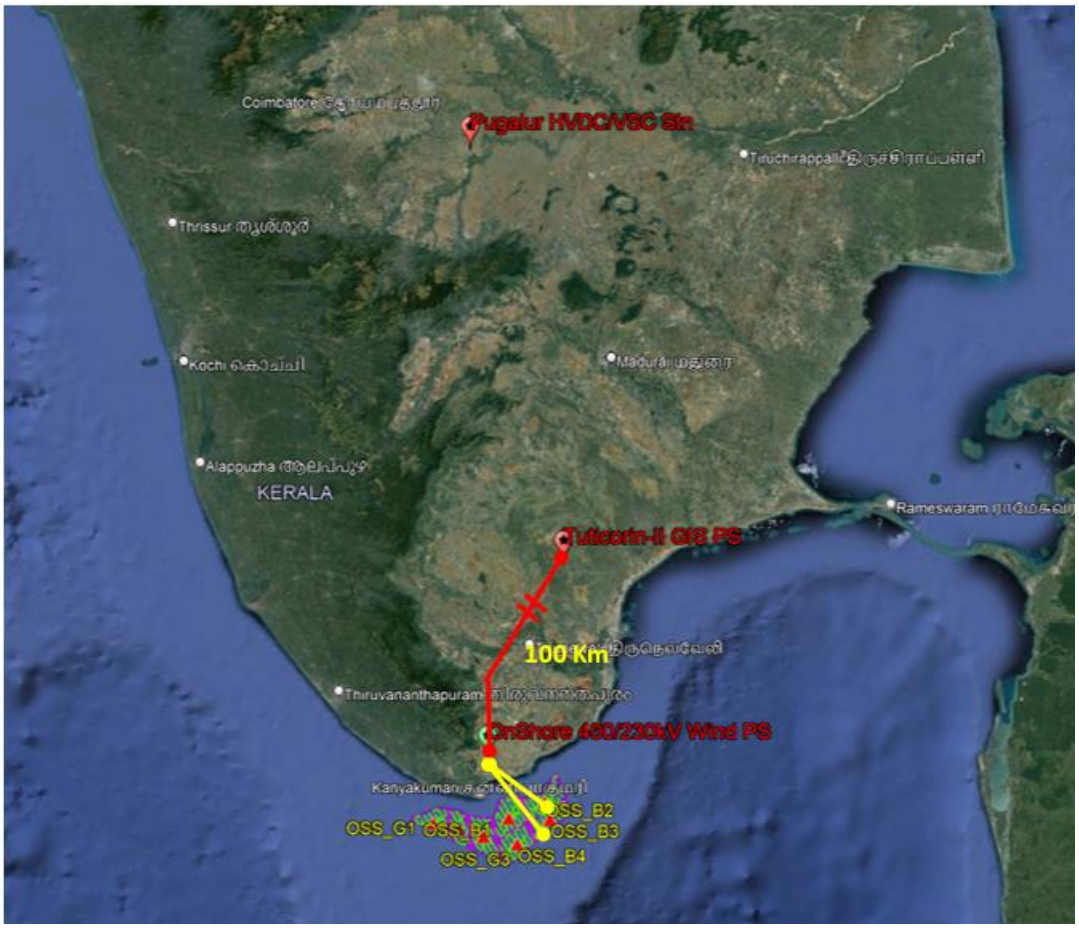


Figure 6-16: Transmission System for 1 GW Offshore wind farm (Phase-I) in Tamil Nadu

6.5 System Studies Results and Analysis

Based on the load-generation scenarios as elaborated in section 6.3, various system studies have been carried out in PSSE. Transmission system which is planned or is under different stages of implementation and is expected to be commissioned in 2028-29 timeframe has been considered for conducting these studies. Further, Govt. of India has set a target of 500 GW generation capacity from non-fossil fuel resources by 2030. In this direction to achieve the target of Govt. of India, MNRE has identified additional 181.5 GW RE potential in the States of Andhra Pradesh, Telangana, Karnataka, Rajasthan, Madhya Pradesh and Tamil Nadu (Offshore). Out of the identified 181.5 GW Potential, 86 GW RE Potential is identified in the State of Andhra Pradesh (51 GW), Telangana (13 GW), Karnataka (17 GW) and Tamil Nadu (5 GW: Offshore) in Southern Region. The transmission system for integration of 181.5 GW RE Potential has been identified by CEA and a report on Transmission System for Integration of over 500 GW RE Capacity has been published by CEA on 07.12.2022. In the report, implementation of transmission system has been phased out in 3 parts; Phase-I by March 2025, Phase-II by December 2027 and Phase-III by December 2030. Therefore, complete phase-I & phase-II potential and associated transmission system has also been considered in the PSSE files prepared for Rolling Plan of 2027-28 timeframe. Off Shore wind potential of 1 GW in Tamil Nadu has also been considered in the files as the same is targeted to be commissioned by Mar'29.

System studies have been conducted on these files prepared in consultation with the constituents for 9 scenarios. Results of these studies were analysed and the same are deliberated below:

6.5.1 Power Flow Analysis

a) Transmission Lines

In the base case file prepared for 2028-29 timeframe, 1 nos. of 765kV and 19 nos. of 400 kV lines are having loading more than 70% of the thermal limit of the line. Scenarios where loading is more than 70% of rating and maximum loading obtained on these transmission lines in the simulation studies are tabulated below.

Table 6-7: Transmission Lines Loading in the Base Cases

(All Fig in MVA)

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating
1.	Maheshwaram - Hyderabad 400kV S/c line	1, 2, 3, 4, 5, 6, 7	ISTS	1430	850
2.	Malekottiyar – Thiruvalam 400kV D/c line	4,7,8	ISTS	752	850
3.	SP Budur – SV Chatram 400kV S/c line	7,8	ISTS	1146	850
4.	Gooty-Neelmangala 400 kV S/c line	7, 8	ISTS	903	850
5.	Gooty-Somanhalli 400 kV S/c line	7, 8	ISTS	731	850
6.	Gooty-Kurnool 400 kV S/c line	8	ISTS	748	850
7.	Nellore -SP Budur 400 kV D/c	7, 8	ISTS	792	850
8.	Vijaywada AP -C'Peta 400 kV D/c	1,4	ISTS	1910	2186
9.	Gooty-Tumkur SP 400 kV D/c	8	ISTS	777	1100
10.	Kolar – Hosur 400 kV D/c	7	ISTS	686	850
11.	Kurnool-V – C'Peta 765kV D/c line	4	ISTS	2471	3500
12.	Cuddapah – Chittoor 400kV S/c line	1, 4, 7, 8	ISTS & STU (AP)	1057	850
13.	Neelmangala – Yelahanka 400 kV S/c	7	ISTS & STU (KPTCL)	678	850
14.	Kurnool – Srisailam LB 400kV S/c line	1, 4	APTRANSCO	968	850
15.	VTPS-IV – Vijaywada PG 400kV S/c line	1, 4	ISTS & STU (AP)	1099	850
16.	Edyarpalayam-Coimbatore 400 kV D/c line	7, 8	TANTRANSCO	689	850
17.	Vemagiri -Vemagiri AP 400 kV D/c line	1	APTRANSCO	748	1100

18.	Vijaywada AP - Thalayapalem 400 kV D/c	1,4,7	APTRANSCO	997	850
19.	VTPS-IV -Thalayapalem 400 kV D/c	1,4	APTRANSCO	705	850
20.	Hoody – Devanhalli 400 kV D/c	7	KPTCL	652	850

b) Transformers

In the base case file prepared for 2028-29 timeframe, transformers at 8 nos. of 400/220kV substations are having loading more than 80% of the ICT rating. Scenarios where loading is more than 80% of rating and maximum loading hit by these transformers in the simulation studies are tabulated below.

Table 6-8: Transformers Loading in the Base Cases

(Max Loading in MVA)

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Loading	Rating (MVA)
1.	400/220kV, 2x315 MVA Cuddapah ICTs	4	ISTS	255	315
2.	400/220kV, 2x500 MVA Narendra ICT	7	ISTS	437	500
3.	400/220kV, 2x500 MVA Yelahanka ICTs	7	ISTS	417	500
4.	400/220kV, 2x315 MVA Davangere ICTs	7	KPTCL	288	315
5.	400/230kV, 2x500 MVA NNTPS ICTs	7,8	NLC	519	500
6.	400/220kV, 2x315 MVA Talaricheruvu ICTs	1,4,7	APTRANSCO	322	315
7.	400/230kV, 2x315 MVA Salem ICTs	7	TANRANSCO	266	315
8.	400/220kV, 2x315 MVA Pondichery ICTs	7,8	PUDUCHERY	269	315

6.5.2 Contingency Analysis

Contingency analysis has been performed on all the 765 kV & 400kV transmission lines, and 765/400 kV & 400/220 kV transformers to ascertain the loading levels under outage of any other 765 kV or 400 kV transmission element. Results of the analysis are discussed below:

a) Transmission Lines

ISTS lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below**.**

Table 6-9: ISTS Transmission lines not meeting N-1 Criteria in SR

(All Fig in MW)

Sl.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Cuddapah-II – Cuddapah 765kV D/c line	Cuddapah-II – Cuddapah 765kV one ckt	7	ISTS	2004	3373	3500	96

Sl.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
Remark: Power from Cuddapah II & Anantpur II is getting pooled at Cuddapah and causing overloading of Cuddapah – Cuddapah 2 765kV D/c line. Additional transmission system shall be planned upon materialization of generation as per the requirement.								
2.	Nizamabad – Nizamabad-II 765kV D/c line	Nizamabad – Nizamabad-II 765kV one ckt	1,2,4,5,7	ISTS	2511	4646	3500	133
Remark: Additional transmission system shall be planned upon materialization of generation as per the requirement.								
3.	Vemagiri-II – C'Peta 765kV D/c line	Vemagiri-II – C'Peta 765kV other ckt	4	ISTS	2224	3210	3500	92
Remark: Drawal of bulk power by Green Hydrogen at Vemagiri is leading to N-1 violation. Same is expected to be resolved with already planned Phase-II of the transmission system for Green hydrogen/ Green Ammonia plants in Vemagiri area and identification of additional system strengthening links for import of power to SR.								
4.	Pugalur HVDC – Karur 400kV D/c line	Pugalur HVDC – Karur 400kV one ckt	1,2,3,5,6, 7	ISTS	1652	2834	2186	129
Remark: In high RE scenario wherein Southern Region is exporting power to NEW Grid and Raigarh – Pugalur HVDC is considered in reverse mode, more power rush towards Pugalur HVDC. This causes overloading of Pugalur HVDC – Karur 400kV D/c line. Pugalur HVDC – Karur 400kV 2nd D/c being planned as a part of system strengthening for enhancing reverse power flow on RPT to 6000 MW.								
5.	Karur – Pugalur 400 kV D/c	Karur – Pugalur 400 kV other ckt	7	ISTS	1302	2233	2186	102
Remark: In high RE scenario wherein Southern Region is exporting power to NEW Grid and Raigarh – Pugalur HVDC is considered in reverse mode, more power rush towards Karur. This causes overloading of Pugalur – Karur 400kV D/c line. Pugalur – Karur 400kV 2nd D/c being planned as a part of system strengthening for enhancing reverse power flow on RPT to 6000 MW.								
6.	Nizamabad – Dichipally 400kV D/c line	Nizamabad – Dichipally 400kV one ckt	1,7	ISTS	1292	2515	2186	115
Remark: Major portion of RE power getting pooled at 765kV Nizamabad from Nizamabad-II PS which is causing overloading of 400 kV downstream network which is getting evacuated through Nizamabad-Dichipally line. Same is expected to be relieved upon identification of additional transmission system from Nizamabad-II upon materialization of generation.								
7.	Somanhally – Bidadi 400kV D/c line	Somanhally – Bidadi 400kV one ckt	7	ISTS	1020	1726	850	202
Remark: Reconducting of Somanhally – Bidadi D/c already agreed in CMETS to resolve the above issue.								
8.	Hyderabad – Maheshwaram 400 kV D/c	Maheshwaram – Maheshwaram TS 400 kV	1,4,7	TSTRANSCO	1454	1545	850	176
Remark: Reconductoring of Hyderabad – Maheshwaram 400 kV D/c reconductoring approved in CMETS to resolve the above issue.								
9.	Kolar – Hosur 400 kV D/c	Kolar – Hosur 400 kV other ckt	7	ISTS	688	983	850	115

Sl.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
Remark: High loading being observed in Scenario-7. Not observed in other scenarios. Suitable strengthening may be planned based on the operational feedback.								
10.	Malekottiyar – Thiruvelam 400 kV D/c line	Malekottiyar – Thiruvelam 400 kV other ckt	1,4,7	ISTS	790	1024	850	120
Remark: High loading being observed in high RE scenarios. Suitable strengthening may be planned based on the operational feedback.								
11.	Gooty-Neelmangala 400 kV S/c line	Gooty-Somanhalli 400 kV S/c line	7	KPTCL	906	1030	850	121
Remark: High loading being observed in high RE scenarios. Suitable strengthening may be planned based on the operational feedback.								
12.	Gooty-Somanhalli 400 kV S/c line	Gooty-Neelmangala 400 kV S/c line	7	ISTS	815	923.63	850	108
Remark: High loading being observed in high RE scenarios. Suitable strengthening may be planned based on the operational feedback.								
13.	Nellore -SP Budur 400 kV D/c	Nellore -SP Budur 400 kV other ckt	7	ISTS	709	897	850	105
Remark: High loading being observed in Scenario-7. Not observed in other scenarios. Suitable strengthening may be planned based on the operational feedback.								

In the rolling plan PSSE files of 2028-29 timeframe, entire Phase-I & Phase-II potential of additional 181.5 GW RE capacity by 2030 has been considered. Overloading of transmission lines and ICTs are observed at locations where this potential is getting pooled. The main cause of overloading of transmission lines is mentioned in the remark below the lines. However, these loadings of transmission lines may significantly differ in case of deferment in materialization of RE generations in SR grid. Therefore, measures to control overloading of the transmission system part of 181.5 GW RE potential would be planned based on materialization of the RE potential.

Further, STU lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below**.**

Table 6-10: STU Transmission lines not meeting N-1 Criteria in SR

(All Fig in MW)

Sl.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Thiruvelam – Ariyalur 765 kV D/c	Thiruvelam – Ariyalur 765 kV other ckt	7	TANTRANSCO	2930	5851	3500	167
2.	Vijaywada AP - Thalayapalem 400 kV D/c	Vijaywada AP -Thalayapalem 400 kV other ckt	1,4,7	APTRANSCO	976	1679	850	197

3.	Hoody – Devanhalli 400 kV D/c	Hoody – Devanhalli 400 other ckt	1,4,7	KPTCL	837	1465	850	172
4.	Edyarpalayam – Coimbatore 400 kV D/c	Edyarpalayam – Coimbatore 400 kV other	7	TANTRANSCO	794	1066	850	124
5.	Vijaywada AP – VTPS-IV 400kV D/c line	Vemagiri-II – C'Peta 765 kV one ckt	1,4	APTRANSCO	1002	1222	850	140
6.	Kurnool – Srisailam LB 400kV S/c line	Vijaywada AP -C'Peta 400 kV D/c	1,4	APTRANSCO	968	1019	1100	98
7.	Vemagiri AP - Vemagiri II 400 kV D/c line	Vemagiri AP - Vemagiri II 400 kV other ckt	1,4	APTRANSCO	814	1260	1100	115
8.	Vijaywada AP - C'Peta 400 kV D/c	Vijaywada AP -C'Peta 400 kV other ckt	1,4,7	APTRANSCO	1921	3209	2186	147
9.	VTPS-IV - Thalayapalem 400 kV D/c	VTPS-IV - Thalayapalem 400 kV other ckt	1,4,7	APTRANSCO	670	1230	961	128
10.	Muddanur – Kondapuram 400 kV D/c	Muddanur – Kondapuram other ckt	7	APTRANSCO	653	1170	961	122
11.	Talarich – Kondapuram 400 kV D/c	Talarich – Kondapuram 400 kV other ckt	1,4	APTRANSCO	540	989	850	115
12.	Devanhalli - Yelahanka 400 kV D/c	Devanhalli - Tumkur SP 400 kV one ckt	1,7	KPTCL	640	1002	850	118

Suitable system strengthening may be planned by STU based on operational feedback and system studies.

b) Transformers

ISTS ICTs loaded beyond 90% of MVA rating under N-1 contingency are summarized below.

Table 6-11: ISTS ICTs not meeting N-1 Criteria in SR

(All Fig in MVA)

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	Rating (MVA)	% Loading
1.	765/400kV, 3x1500 MVA Maheshwaram ICTs	1, 7	PGCIL	1260	1628	1500	109
2.	765/400kV, 2x1500 MVA C Peta ICTs	1, 4	PGCIL	1289	1715	1500	114
3.	765/400kV, 4x1500 MVA Nizamabad ICTs	1, 7	PGCIL	1309	1635	1500	109

4.	765/400kV, 2x1500 MVA Warangal ICTs	1, 7	PGCIL	1142	1796	1500	120
5.	765/400kV, 3x1500 MVA Vemagiri (PG) ICTs	1	PGCIL	1189	1846	1500	123
6.	400/220kV, 2x315 MVA Cuddapah ICTs	1, 4	PGCIL	242	333	315	106
7.	400/220kV, 1X500 MVA MVA Cuddapah ICT	1, 4	PGCIL	384	464	500	93
8.	400/220kV, 2x500 MVA Kudgi ICTs	7	NTPC	430	645	500	129
9.	400/220kV, 2x500 MVA Narendra ICTs	7	PGCIL	458	694	500	139
10.	400/220kV, 2x500 MVA Bidadi ICTs	1, 7	PGCIL	317	478	500	96
11.	400/220kV, 2x500 MVA Yelahanka ICTs	1, 7	PGCIL	425	582	500	116
12.	400/220kV, 3x315 MVA Hosur ICTs	7	PGCIL	245	330	315	105
13.	400/220kV, 1x500MVA Hosur ICTs	7	PGCIL	388	464	500	93
14.	400/220kV, 1x500 MVA Pondichery ICTs	7	PGCIL	363	448	500	90
15.	400/220kV, 2x315 MVA Pondichery ICTs	7	PGCIL	230	329	315	105

Requirement of additional transformation augmentation wherever necessary would be planned subsequently in coordination with respective STUs.

STU ICTs loaded beyond 90% of MVA rating under N-1 contingency are summarized below.

Table 6-12: STU ICTs not meeting N-1 Criteria in SR

(All Fig in MVA)

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	Rating (MVA)	% Loading
1.	765/400kV, 2x1500 MVA Ariyalur ICTs	2, 7, 8	TANTRANSCO	1536	2372	1500	158
2.	765/400kV, 2x1500 MVA Coimbatore ICTs	7	TANTRANSCO	1232	1977	1500	132
3.	400/220kV, 2X315 MVA Kanarpatty ICTs	1 & 4	TANTRANSCO	147	292	315	93
4.	400/110kV, 3X200 MVA Kanarpatty ICTs	1 & 4	TANTRANSCO	156	204	200	102
5.	400/110kV, 2X200 MVA Thenampatty ICTs	1, 4, 7	TANTRANSCO	143	285	200	142

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	Rating (MVA)	% Loading
6.	400/110kV, 2X200MVA Cuddalore ICTs	All	TANTRANSCO	222	337	200	168
7.	400/110kV, 2X200 MVA Velalavidu ICTs	All	TANTRANSCO	186	269	200	134
8.	400/110kV, 2X200 MVA Kamuthi ICTs	1, 4, 7	TANTRANSCO	180	301	200	150
9.	400/110kV, 2X200 MVA Arni ICTs	All	TANTRANSCO	255	334	200	167
10.	400/110kV, 2X200 MVA Palavadi ICTs	2, 4, 8	TANTRANSCO	189	282	200	141
11.	400/110kV, 2X200 MVA Kayathar ICTs	1, 2, 3, 4, 5, 6	TANTRANSCO	143	244	200	122
12.	400/230kV, 3X200MVA Salem ICTs	7	TANTRANSCO	280	335	315	106
13.	400/110kV, 3X200MVA Salem ICTs	1, 2, 3,4 ,5, 6, 7, 8	TANTRANSCO	192	239	200	120
14.	400/110kV, 2X200 MVA Alagarkoil ICTs	2, 7, 8	TANTRANSCO	172	241	200	121
15.	400/230kV, 2X100 MVA Rasipalayam ICTs	2	TANTRANSCO	98	149	100	149
16.	400/110kV, 3X100 MVA Rasipalayam ICTs	3,5,7	TANTRANSCO	77	103	100	103
17.	400/110kV, 3X200 MVA Shollingur ICTs	7,8	TANTRANSCO	159	209	200	105
18.	400/110kV, 2X200 MVA Edayarpalayam ICTs	7 & 8	TANTRANSCO	202	240	200	120
19.	400/110kV, 2x200 MVA S P Badur ICTs	7, 8	TANTRANSCO	173	276	200	138
20.	400/110kV, 2X315 MVA Kamuthi ICTs	1, 4, 7	TANTRANSCO	181	351	315	111
21.	400/230kV, 2X315 MVA Mettur ICTs	8	TANTRANSCO	227	288	315	91

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	Rating (MVA)	% Loading
22.	400/220kV, 2x315 MVA Davangere ICTs	7	KPTCL	301	385	315	122
23.	400/220kV, 3x500 MVA Hoody ICTs	7	KPTCL	363	487	500	97
24.	400/220kV, 3x500 MVA Davanhalli ICTs	7	KPTCL	400	541	500	108
25.	400/220kV, 2x315 MVA Kottayam ICTs	7,8	KSEB	217	296	315	94
26.	400/220kV, 2x315 MVA Edamon ICTs	1,2,4,5,7,8	KSEB	291	396	315	126
27.	400/220kV, 2x315 MVA Nellore AP ICTs	2	APTRANSCO	218	288	315	91
28.	400/220kV, 2x315 MVA Talarich ICTs	1,4,7	APTRANSCO	343	516	315	164
29.	400/230kV, 2x500 MVA NNTPS ICTs	2,7,8	NLC	437	607	500	121

From above, it is observed that 2 nos. of ICT in Kerala, 2 nos. of ICT in AP, 3 nos. of ICT in Karnataka and 21 nos. of ICT in Tamil Nadu are not complying N-1 criteria in 2028-29 timeframe. Some of them are violating the limits in present timeframe also and are continuously flagged by GRID INDIA in their Operational Feedback. Therefore, STUs are required to take immediate measures to mitigate this issue of high transformer loading.

6.5.3 Short Circuit Analysis

Short circuit level was calculated for all 765 and 400 kV buses of Southern Region and buses having fault level more than the design rating under any scenario were identified. From analysis, it is emerged that 7 nos. of 765kV substations and 16 nos. of 400kV substations in SR are having fault level more than designed capacity.

Details of the ISTS buses exceeding design fault level under any scenario are tabulated below.

Table 6-13: ISTS Buses Exceeding Designed Fault Level in SR

(All Fig in kA)

Sl. No.	Substation Name	Owner	Scenario No.	Highest Fault level	Design Rating
1.	765kV Kurnool New*	ISTS	All	54	40
2.	765kV Cuddapah	ISTS	6,9	42	40
3.	765kV Kurnool-III	ISTS	All	48	40

4.	765kV Maheshwaram	ISTS	All	51	40
5.	765kV Nizamabad	ISTS	6,7,8,9	42	40
6.	765kV Warangal	ISTS	6,7,8,9	42	40
7.	765kV Raichur	ISTS	1,3,6,7	41	40
8.	400kV Kurnool New*	ISTS	All	68	50
9.	400kV Cuddapah*	ISTS	All	54	50
10.	400kV Tirunelveli	ISTS	All	52	40
11.	400kV Udumalpet	ISTS	All	50	40
12.	400kV Pugalur	ISTS	All	44	40
13.	400kV Gooty	ISTS	All	46	40
14.	400kV Khammam	ISTS	7,8,9	41	40
15.	400kV Raichur New	ISTS	7,8,9	42	40
16.	400kV Bidadi	ISTS	All	41	40
17.	400kV Hyderabad	ISTS	7,8,9	41	40
18.	400kV Madhugiri	ISTS	All	52	50

***Note :** SC currents at Kurnool are observed excessively high which needs detailed analysis along with the detailed system modelling of the generation projects pooled at Kurnool (new) including hydro PSP generations. Detailed studies and analysis shall be done in due course of time.*

CTU is carrying out detailed system studies for controlling the short circuit level of ISTS buses. The schemes for controlling fault levels would be finalized in a separate joint study meetings with Southern Region Constituents. After finalization, the schemes would be deliberated in the CMETS-SR.

Further, STU buses exceeding the substation design fault level under different scenario are mentioned below.

Table 6-14: STU Buses Exceeding Designed Fault Level in SR

(All Fig in kA)

Sl. No.	Substation Name	Owner	Scenario No.	Highest Fault level	Designed Rating
1.	400kV Kurnool*	AP	All	61	40
2.	400kV Vijaywada	AP	All	49	40
3.	400kV Dichipally	TSTRANSCO	All	51	40
4.	400kV Gajwel	TSTRANSCO	7,8	43	40
5.	400kV Neelmangala	KPTCL	All	45	40

***Note :** SC currents at Kurnool are observed excessively high which needs detailed analysis along with the detailed system modelling of the generation projects pooled at Kurnool (new) including hydro PSP generations. Detailed studies and analysis shall be done in due course of time.*

STUs are also required to take necessary actions such as bus splitting, bypassing of lines, fault limiting reactors etc to resolve the issue of high fault level at their buses.

Chapter 7: Eastern Region

Eastern Region is stretching from Sikkim in the southern Himalayas to the coast of the Bay of Bengal. In this region, the states of Bihar and West Bengal lie on the Indo - Gangetic plain and Jharkhand lies on the Chota-Nagpur Plateau. Odisha lies on the Eastern Ghats and the Deccan Plateau. The region is bounded by Bhutan & Nepal in the north, the states of Uttar Pradesh & Chhattisgarh on the west, the state of Andhra Pradesh in the south and the state of Assam and country of Bangladesh in the east. It has a very important narrow corridor between international border of Nepal and Bangladesh, called "Chicken's Neck", with a size of 18km by 22km, which connects the north Bengal, Sikkim and entire North Eastern Region with the remaining part of National Grid.

The generating stations of Eastern Regions are predominantly concentrated in the coal rich states of Jharkhand, Odisha and West Bengal and hydro generations are concentrated in Sikkim and southern part of Odisha. Cross-border interconnection in the Eastern Region facilitates in optimal utilization of energy resources in South Asian region in a cost effective manner. During wet season (Monsoon period) hydro power is imported from Bhutan and Nepal and during dry season (Winter period), surplus power is exported to these countries to meet their energy requirement. Cross-border interconnection with Bangladesh in Eastern region helps Bangladesh in meeting its energy requirement throughout the year.

7.1 Power Supply Scenario as on Jan'24

As on Jan'2024, total Installed Capacity (IC) of Eastern Region was about 34.6 GW and the peak demand met was about 29.3 GW. The state-wise breakup of installed capacity and peak demand is summarised at **Table 7-1** below.

Table 7-1: ER Installed Capacity and Peak Demand as on Jan'24

(All Fig in MW)

State	Generation (MW)								Peak Demand (MW)
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES* (MNRE)	Total		
Bihar	6724	-	6724	-	110	420	530	7255	7420
DVC	3037	-	3037	-	186	-	186	3223	3451
Jharkhand	2441	-	2441	-	191	142	333	2774	2020
Odisha	5159	-	5159	-	2163	647	2811	7970	6443
Sikkim	104	-	104	-	633	60	693	796	128
West Bengal	8650	80	8730	-	1396	636	2032	10762	11626
Central unallocated	1737	-	1737	-	85	-	85	1822	57
ER	**27852**	**80**	**27932**	**-**	**4764**	**1905**	**6670**	**34602**	**29,299**

Source: CEA monthly report

7.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Eastern Region demand for 2028-29 timeframe is expected to increase to about 42.5 GW. As per the inputs received from various stakeholders, total installed capacity

of Eastern Region for 2028-29 is expected to be about 66.3GW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 7-2.**

Table 7-2: ER Installed Capacity and Peak Demand (2028-29)

(All Fig in MW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS / PSS/ Rooftop	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Bihar	2040	-	2040	-	45	700	745	-	2785	12326
DVC	1340	-	1340	-	147	1415	1562	-	2902	4814
Jharkhand	2820	-	2820	-	130	-	130	-	2950	4297
Odisha	2490	-	2490	-	2192	403	2595	-	5085	8514
Sikkim	-	-	-	-	14	-	14	-	14	201
West Bengal	7100	-	7100	-	574	-	574	900	8574	14530
Central	28140	-	28140	-	5672	-	5672	-	33812	-
IPP	4500	-	4500	-	5252	-	5252	400	10152	-
ER	**48430**		**48430**	**-**	**14026**	**2518**	**16544**	**1300**	**66274**	**42546**

There is a growth in peak demand of Eastern Region from present time-frame (2023-24) to 2028-29 with a CAGR of 7.7%. The state wise peak demand growth is given at **Table 7-3**.

Table 7-3: Increase in Peak Demand of Various States of ER

(All Fig in MW)

State	2023-24	2028-29	Increase in demand	CAGR
Bihar	7420	12326	4906	10.7%
DVC	3451	4814	1363	6.9%
Jharkhand	2020	4297	2277	16.3%
Odisha	6443	8514	2071	5.7%
Sikkim	128	201	73	9.4%
West Bengal	11626	14530	2904	4.6%
Andaman	57	70	13	4.2%
ER	**29299**	**42546**	**13247**	**7.7%**

From the above data it is observed that the CAGR growth of peak demand is maximum for Jharkhand (16.3%) and minimum for West Bengal (4.4%). The CAGR of demand of ER is about 7.7% which is more than the National Average of 5.4%. In addition to above, bulk power demand of about 2200MW has been considered at various upcoming green hydrogen/ green ammonia, bulk consumers/distribution licensees directly connected to ISTS in the following areas: Paradeep: 869MW, Gopalpur: 1050MW, Vedanta: 180MW and Maithon:100MW.

The hydro generations of Bhutan (about 4500MW) and Nepal (3200MW) and demand of Bangladesh (1000MW) have been considered in 2028-29 timeframe as a part of Eastern Region for study purpose.

7.3 Load Generation Balance for 2028-29 timeframe

In the chapter 3, All India Load Generation Balance (LGB) for identified nine scenarios was prepared as per the methodology finalized in a meeting among CTU, CEA and Grid-India. This section elaborates the Eastern Region Load Generation Balance (LGB) for 2028-29 time-

frame. For Eastern Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned at **Table 7-4** for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 7-4: Eastern Region Generation Dispatch and Demand Factors

Scenario No & Name	Generation Dispatch Factors			Demand Factors
	Hydro	Solar	Pump storage	
1-Aug Solar Max	70%	80%	-100%	90%
2-Aug Peak Load	90%	0%	60%	96%
3-Aug Night Off Peak	70%	0%	40%	81%
4-Jun Solar Max	70%	85%	-100%	94%
5-Jun Peak Load	90%	0%	50%	89%
6-Jun Night Off Peak	70%	0%	0%	69%
7-Feb Solar Max	30%	90%	-100%	68%
8-Feb Peak Load	60%	0%	100%	73%
9-Feb Night Off Peak	30%	0%	40%	59%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import / export of ER and the inter-regional flow through various corridors is summarised in **Table 7-5**. Further, both maximum and minimum is also highlighted in table below.

Table 7-5: Import / Export of Eastern Region

(All Fig in MW)

State / UTs	Import / Export of Eastern Region								
Scenario No / Corridors	Aug'28 Time Frame			Jun'28 Time Frame			Feb'29 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
ER-NR	-8994	-1607	-1952	-11737	468	-1551	-7202	-1	-1349
ER-WR	-9377	-5457	-6505	-12207	-4563	-4927	-7189	-1492	-1252
ER-SR	1116	6	335	96	226	1126	2167	2868	3827
ER-NER	-893	-952	-1033	-866	-1354	-1579	-340	737	-184
Cross Border-ER	1534	1980	1534	1533	1943	1517	664	1367	339
Eastern Region (net)	-16614	-6030	-7621	-23181	-3280	-5414	-11900	3479	1381

It can be seen that with the huge penetration of renewables, Eastern Region is net importing region in all of the scenarios. Out of these nine scenarios, Scenario-4 and Scenario-8

corresponds to two extreme cases of import/export requirement of Eastern Region i.e. Maximum import (23.2GW) and export (3.5GW). In all other scenarios, the import/export of Eastern Region varies between these two extremes.

Considering the above LGB for nine scenarios, load flow cases were prepared for 2028-29 timeframe. Detailed system studies have been carried out on the finalized load flow cases. The study results are discussed in subsequent sections.

7.4 ISTS Network Expansion Schemes Evolved from Mar'23 to Feb'24

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Eastern Region (CMETS-ER) from Mar'23 to Feb'24. The brief of all such transmission schemes is tabulated below in **Table 7-6:**

Table 7-6: Approved Transmission Schemes in this Rolling Plan

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in ₹Cr.)
Bihar			
1.	Eastern Region Expansion Scheme-XXXVI (ERES-XXXVI) – Arrah ICT	Oct 24	27
2.	Eastern Region Expansion Scheme-XXXVII (ERES-XXXVII) – Lakhisarai ICT	May 25	121
West Bengal			
1.	Eastern Region Expansion Scheme-XL (ERES-XL) – Malda Line Reactor	Feb 25	32
2.	Eastern Region Expansion Scheme-41 (ERES-41) – Rajarhat ICT	July 25	86
Jharkhand			
1.	Eastern Region Expansion Scheme-XXXVIII (ERES-XXXVIII) – Ranchi Bypass	Oct 25	42
Odisha			
1.	Eastern Region Expansion Scheme-XXXIX (ERES-XXXIX) - Gopalpur	2025-26	2898
2.	Eastern Region Bay Scheme-I (ERBS-I) – Talcher-III Connectivity	Sep 26	82
3.	Eastern Region Generation Scheme-I (ERGS-I) – Talabira Connectivity	May 27	413
Sikkim			
1.	Eastern Region Expansion Scheme-XXXV (ERES-XXXV) – Rangpo Bypass	Dec 24	7
2.	Eastern Region Bay Scheme-II (ERBS-II) – Rammam Connectivity	Jul 26	14

7.4.1 Bihar

(i) ERES-XXXVI - Arrah

Presently, 220/132kV Ara (POWERGRID) S/s is having the transformation capacity of 360MVA (2 x 100MVA + 1 x 160MVA). In 13th CMETS-ER, it was mentioned that the reliability criteria of 'N-1' is not being fulfilled at Ara S/s under outage of 1x160MVA ICT. Further, load demand is expected to increase in coming years. However, commissioning of Buxar TPS (2x660MW) and its connection to Buxar, Dumraon and Ara areas, could relieve the Ara substation. BSPTCL had mentioned in the meeting that they would provide their views on requirement of augmentation of transformation capacity at Ara S/s.

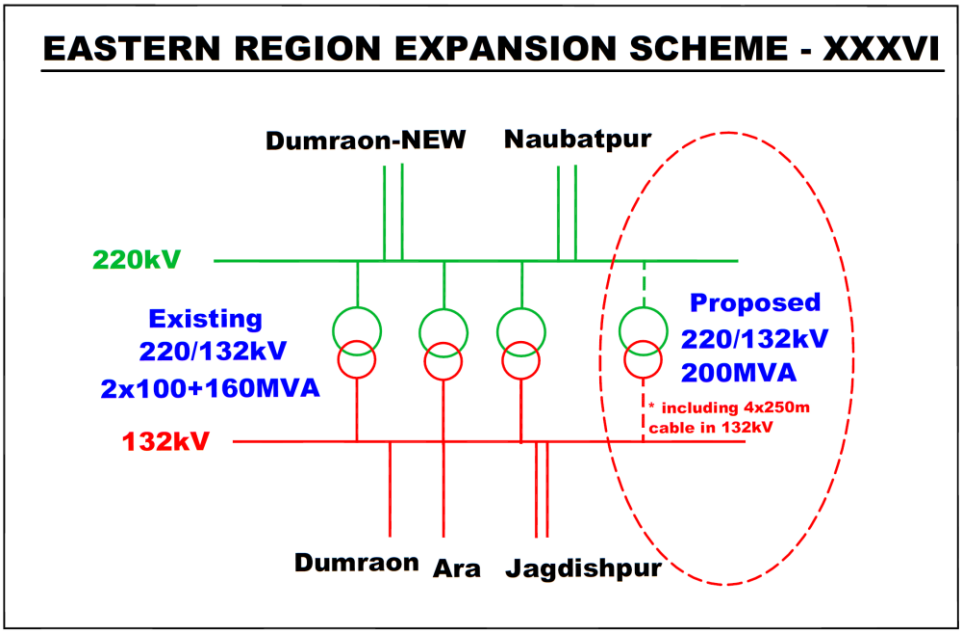


Figure 7-1: Schematic of ERES-XXXVI

Subsequently, upon the review of their load growth, BSPTCL vide letter dated 07-03-2023 informed that there would be requirement of augmentation of transformation capacity at Ara S/s even after commissioning of Buxar TPS.

Thus, keeping in view the power drawl requirement by BSPTCL at Ara (POWERGRID) 220/132kV S/s in present time-frame and keeping in view future power drawl requirements, augmentation of transformation capacity at Ara S/s has been agreed in the 17th CMETS-ER held on 29-03-2023. Schematic is given at **Figure 7-1.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Installation of new 220/132kV, 1x200MVA (4th) ICT at Ara (POWERGRID) S/s with associated bays in AIS (220kV bay no. 203 & 132kV bay no. 6)	220/132kV, 1x200MVA ICT (4th) – 1 no. 220kV ICT bay – 1 no. 132kV ICT bay – 1 no.
2	Interconnection between 132kV side of 4th ICT and 132kV ICT bay (no. 6) through 1C, 1200sqmm XLPE Cu cable	1C, 1200sqmm XLPE Cu cable – 1 km (4 runs, each of 250m)

Implementation time-frame: 24 months from allocation

(ii) ERES-XXXVII - Lakhisarai

Presently, 400/132kV Lakhisarai (POWERGRID) S/s is having the transformation capacity of 715MVA (2 x 200MVA + 1 x 315MVA). About 750MW new solar projects

are expected to come at Kajra, Pirpainti and surrounding areas, and is planned to be injected into intra-state network in the Gaya (POWERGRID) – Khizersarai (BSPTCL) – Narhat (BSPTCL) – Sheikhpur Sarai (BSPTCL) – Haveli Kharagpur (BSPTCL) – Goradih (BSPTCL) 220kV link (refer **Figure 7-2** below).

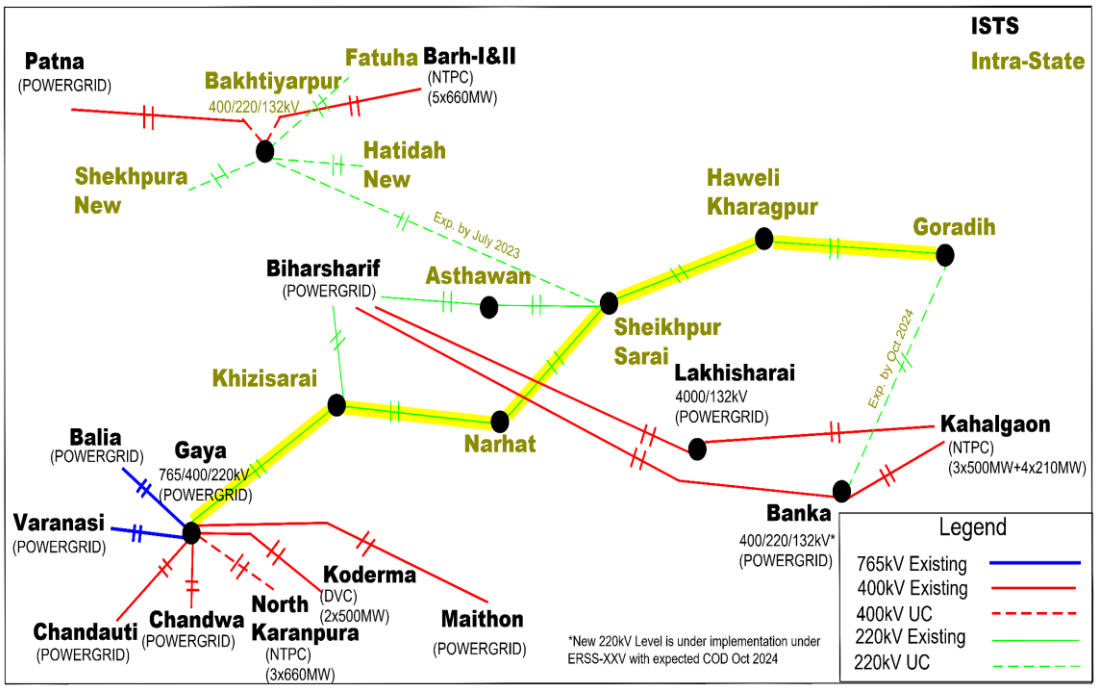


Figure 7-2: Map representing 220kV long corridor in Bihar Corridor

Studies were carried out in consultation with BSPTCL officials for two different load-generation conditions in 2027-28 time-frame viz. Sc-2 (peak demand without solar) and Sc-7 (off-peak demand with all India high solar). It was observed that during peak load condition, power flow on 400/220kV ICTs at Banka and Lakhisarai is towards 220kV level, however, during peak solar generation, power flow would be towards 400kV level from 220kV level. It was observed in the studies that the power transfer requirement in 2027-28 time-frame with additional 750MW solar generation in the above mentioned 220kV link can be fulfilled with only 400/220kV ICTs at Banka. However, BSPTCL mentioned in the 17th CMETS-ER held on 29-03-2023 that in view of present and future power drawl requirement in this area and also to improve reliability & security of power supply through the Gaya (POWERGRID) – Khizersarai (BSPTCL) – Narhat (BSPTCL) – Sheikhpur Sarai (BSPTCL) – Haveli Kharagpur (BSPTCL) – Goradih (BSPTCL) 220kV link, it is essential to establish 220kV level at Lakhisarai 400/132kV S/s along with 220kV interconnection to Haveli Kharagpur. This would system also be required to meet high solar and non-solar power exchange requirement between ISTS and state network.

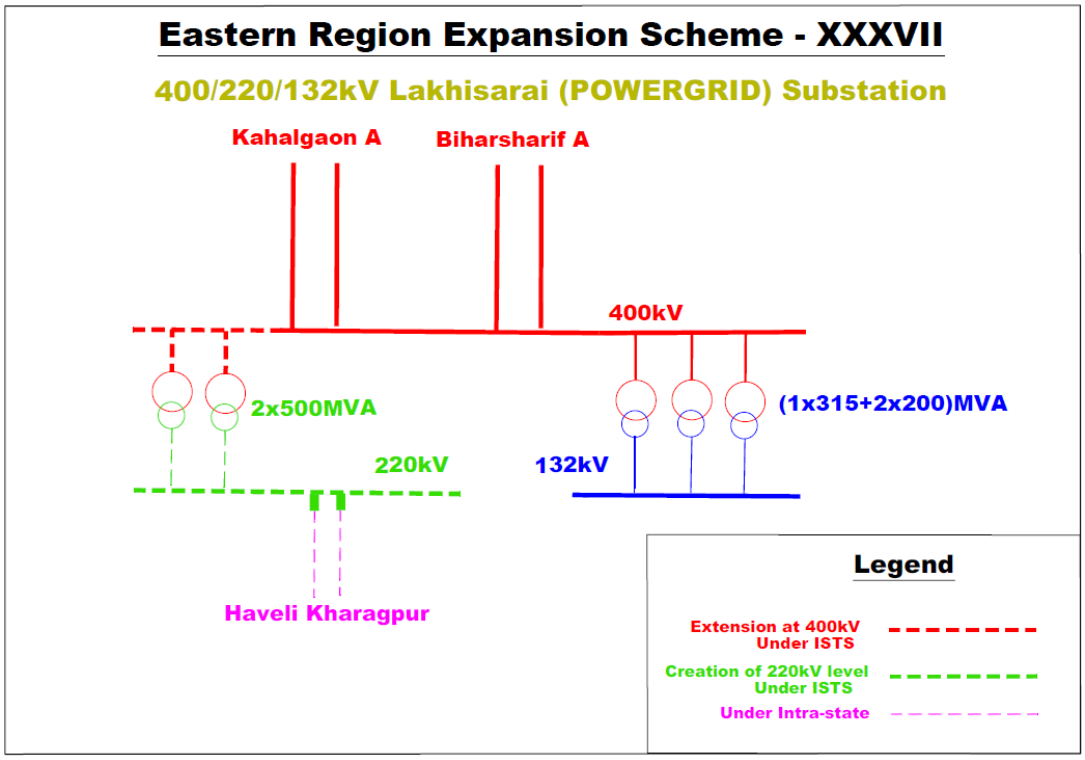


Figure 7-3: Schematic of ERES-XXXVII

Thus, keeping in view the requirement of BSPTCL, creation of 220kV level along with installation of 2x500MVA, 400/220kV ICTs at existing Lakhisarai (POWERGRID) S/s was agreed in the 17th CMETS-ER held on 29-03-2023. Schematic is given at **Figure 7-3**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Creation of 220kV level in GIS (in Double Main Switching Scheme including 1 no. bus coupler bay) at Lakhisarai (POWERGRID) 400/132kV S/s along with 2 no. 220kV line bays *[for termination of Lakhisarai – Haveli Kharagpur 220kV D/c line to be implemented by BSPTCL under intra-state]*	220kV level in GIS 220kV GIS line bays – 2 no. 220kV bus coupler bay – 1 no.
2	Installation of 400/220kV, 2x500MVA ICTs along with associated bays at Lakhisarai (POWERGRID) 400/132kV S/s	400/220kV, 2x500MVA ICTs – 2 no. 400kV ICT bays – 2 no. 220kV ICT bays (in GIS) – 2 no.

Implementation time-frame: 24 months from allocation

7.4.2 Jharkhand

(i) ERES-XXXVIII – Ranchi bypass

Fault level at 400kV bus at Ranchi (POWERGRID) 400/220kV S/s is about 44kA (designed limit is 40kA) in present timeframe which is expected to further increase to about 51kA by 2027-28 timeframe. After studies for 2027-28 timeframe and detailed

analysis, it is observed that after bypassing Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line (of DVC) at Ranchi (POWERGRID) with any two ckts of Ranchi (POWERGRID) – Ranchi New (POWERGRID) 400kV 2xD/c (Quad) lines (of POWERGRID) so as to form Ranchi New (POWERGRID) – Raghunathpur (DVC) 400kV (Quad) D/c line, fault level can be brought down to about 39kA from 51kA. The matter was deliberated in the 17th CMETS-ER held on 29-03-2023 and bypassing of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c line at Ranchi (POWERGRID) S/s so as to form Ranchi New (POWERGRID) – Raghunathpur (DVC) 400kV (Quad) D/c line was agreed.

For implementation of this bypassing scheme from within the substation through switching arrangement following major works is required:

- The bus reactor installed in bay 431 needs to be shifted in bay 413 so that adjacent bays viz. 416 and 419 shall be available for termination of a D/c line in future, if required.
- Shifting of equipment of bay no. 416 *[released upon shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV ckt-3]* to bay no. 434 for completion/establishment of bay no. 434.
- Shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line to bays 431 and 434 in diameters 431-432-433 and 434-435-436: about 1.27km new line section

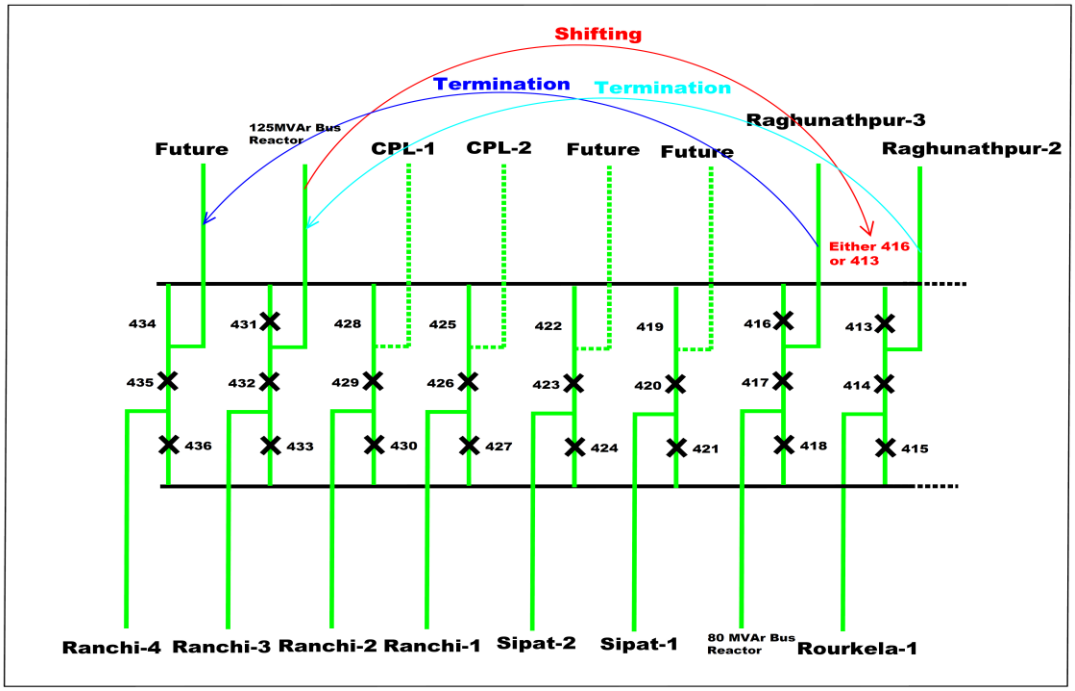


Figure 7-4: Schematic of ERES-XXXVIII

With the said works, the Ranchi New (POWERGRID) – Raghunathpur (DVC) 400kV (Quad) D/c line would be in same diameter with Ranchi – Ranchi (New) 400kV D/c (Quad) ckt-3 & ckt-4. The two lines can be bypassed from Ranchi S/s through tie circuit

breakers of diameters 431-432-433 and 434-435-436. This arrangement shall give operational flexibility.

The matter was deliberated and agreed in the 19th CMETS-ER meeting held on 30th May 2023. Schematic is given at Figure 7-4

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	#Shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line to bays 431 and 434 in diameters 431-432-433 and 434-435-436: about 1.27km new line section.	400kV D/c (Quad) line – 1.27 km
2	$Dismantling of 1355m section of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line of DVC at Ranchi end from location 433 to 438 and scraping of the same.	-
3	Shifting of 420kV, 125MVAr bus reactor installed in bay no. 431 to bay no. 413 [vacated after shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV ckt-2].	-
4	Shifting of equipment of bay no. 416 [released upon shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV ckt-3] to bay no. 434 for completion/establishment of bay no. 434.	
5	Installation of 420kV, 1x80MVAr switchable line reactor, one each in both circuits of Raghunathpur (DVC) – Ranchi-New (POWERGRID) 400kV D/c (Quad) line [formed after bypassing of Ranchi (POWERGRID) – Raghunathpur (DVC) and Ranchi (POWERGRID) – Ranchi-New (POWERGRID) ckt-3 & 4 of 400kV D/c (Quad) lines from Ranchi-New through tie circuit breaker in diameters 431-432-433 and 434-435-436] at Ranchi-New (POWERGRID) end along 400ohm NGR (including NGR bypass scheme).	420kV, 1x80MVAr switchable line reactor with 500ohm NGR (including NGR bypass scheme) – 2 no.

Implementation time-frame: 24 months from allocation

7.4.3 West Bengal

(i) <u>ERES-XL – Malda line reactor</u>

Malda 400/220/132kV and Purnea 400/220kV substations belong to POWERGRID.

The existing 420kV, 63MVAr line reactor (along with associated 542ohm NGR) in each circuit of Purnea – Malda 400kV D/c line at Malda (POWERGRID) end was commissioned in 1994 and after serving close to 30 years, it has been observed by POWERGRID that any major maintenance at this juncture may not be fruitful enough to ensure a further longer service period considering cellulose ageing and fault history. POWERGRID informed that the said line reactors have already experienced designed electrical life and started to deteriorate, which requires replacement as individual component change would not resolve the issues. Further, spare/supports are also very difficult for such ageing reactor from OEM. Moreover, it was observed that presently

there is no bus reactor at Malda S/s, and voltage profile at Malda S/s showed that the average bus voltage is around 406kV and the maximum voltage is 417kV, which is above the nominal voltage level.

After studies, it was observed that without the said line reactors, voltage rise (about 9-12kV) occurs at Malda as well as Purnea ends upon line charging. Accordingly, line reactor in the Malda – Purnea 400kV D/c line is technically required. Further, the new line reactor was planned to be installed as switchable (with NGR bypass arrangement) so that the same can be used as bus reactor also as per instructions of RLDC.

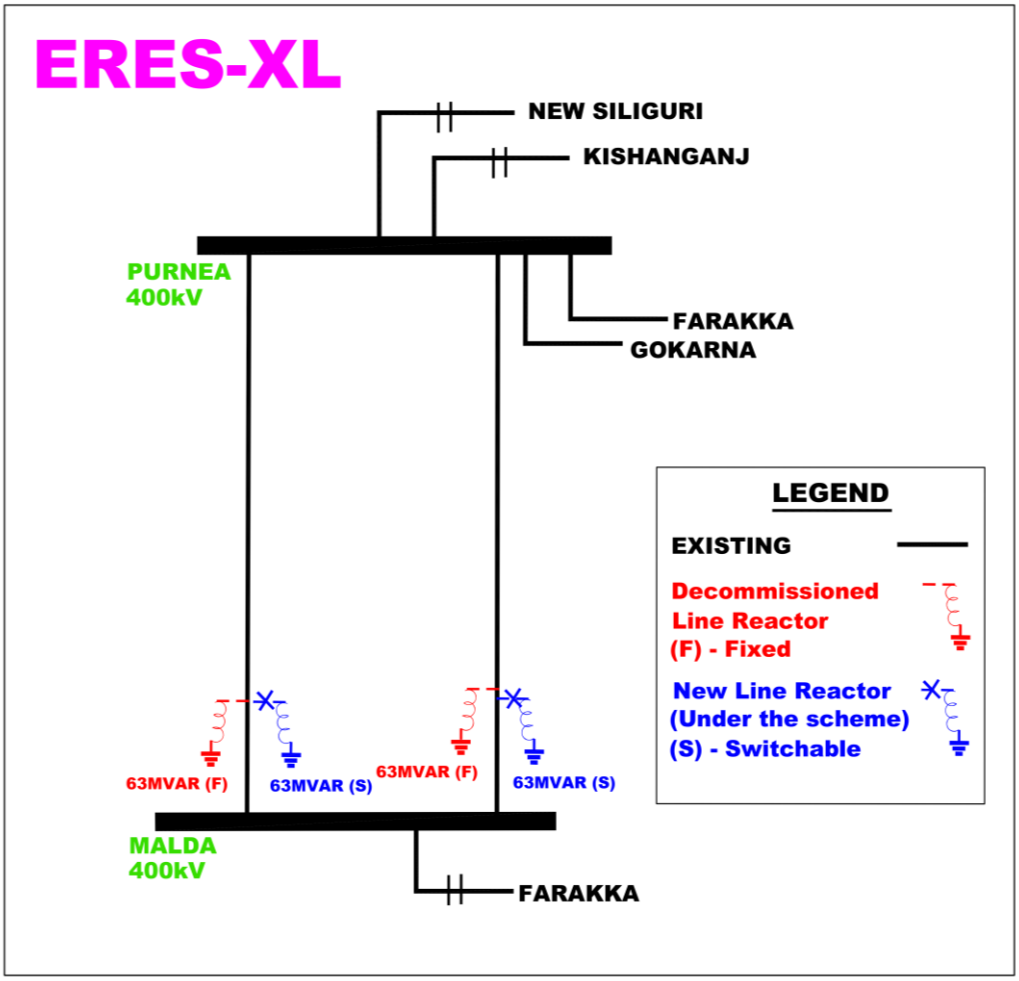


Figure 7-5: Schematic of ERES-XL

In view of the above, in the 19th CMETS-ER held on 30-05-2023, it was agreed that the existing line reactors viz. 1x63MVAr line reactor (along with associated 542ohm NGR) in each circuit may be decommissioned and new 1x63MVAr switchable line reactor [along with 450ohm NGR (including NGR bypassing scheme)] may be installed in each circuit of Purnea – Malda 400kV D/c line upon decommissioning of old line reactors. Schematic is given at **Figure 7-5.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Decommissioning of existing 1x63MVAr line reactor (along with associated 542ohm NGR) at Malda end installed in each circuit of Purnea – Malda 400kV D/c line, and installation of new 1x63MVAr switchable line reactor [along with 450 ohm NGR (including NGR bypassing scheme)] in each circuit of Purnea – Malda 400kV D/c line upon decommissioning of line reactors	1x63MVAr switchable line reactor [along with 450 ohm NGR (including NGR bypassing scheme)] – 2 no.

Implementation time-frame: 18 months from allocation

(ii) ERES-41 – Rajarhat

Rajarhat, 400/220kV, 2x500MVA S/s belong to POWERGRID.

Maximum drawl of about 850MW has been observed at Rajarhat S/s in last one year with N-1 being violated during most of the months (8/12 months), with about 18% time the loading being beyond 500MW. To resolve the N-1 contingency, 3rd 400/220kV, 1x500MVA ICT along with associated bays in GIS may be installed under ISTS at Rajarhat GIS (POWERGRID) S/s in 21 months (in view of GIS) from date of allocation. Due to GIS, it was mentioned that as the Rajarhat substation is GIS complete diameter with three CB (one and half scheme) needs to be implemented for installation of 3rd ICT.

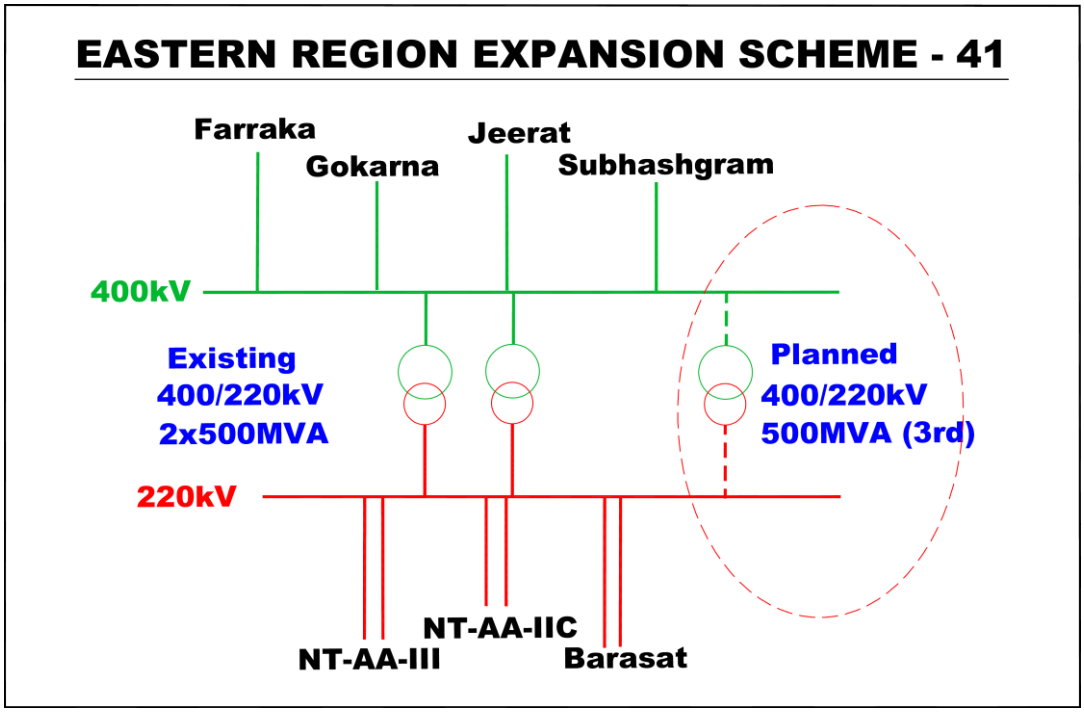


Figure 7-6: Schematic of ERES-41

Further, WBSETCL has already uprated some of its 220kV drawl lines at Rajarhat and some are also under implementation for enhanced drawl. Schematic is given at **Figure 7-6.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Installation of 400/220kV, 1x500MVA (3rd ICT) along with associated bays at Rajarhat GIS (POWERGRID) 400kV S/s	400/220kV, 1x500MVA ICTs – 1 no. 400kV ICT bays* – 1 no. 220kV ICT bays – 1 no.

Implementation time-frame: 21 months from allocation

Note: In view of GIS substation, complete diameter with three Circuit Breakers (one and half switching scheme) needs to be implemented at 400kV level for installation of 3rd ICT in one 400kV bay. Utilization of other 400kV bay of the diameter shall be identified in future.

7.4.4 Odisha

(i) ERES-XXXIX - Gopalpur

Additional Chief Secretary to Government, Department of Energy, Govt. of Odisha vide letter dated 08-02-2023 addressed to Secretary (Power), Ministry of Power, Govt. of Odisha has proposed for construction of Gopalpur 765kV substation under ISTS. As per the said inputs, new industrial demand from Green Hydrogen & Green Ammonia industries in the range of about 3GW is expected in Gopalpur area starting from FY 2025-26 onwards. Gopalpur is emerging as Green Hydrogen hub and various industries have expressed investment intentions to set up Green Hydrogen and Green Ammonia plants in Gopalpur due its location advantage.

There is a requirement of ISTS corridor to supply RE power from outside Odisha to such industries, to meet the RPO. Thus, keeping in view critical nature of large industrial demand and quantum of power requirement it is essential that Gopalpur substation is feed reliably from ISTS, and with high capacity lines. The quantum of power requirement by some of the industries as informed by OPTCL are Avaada Ventures (700MW), and Ocior Energy (1400MW). In addition to above, additional industries by Renew Power, SMP Energy and WAREE Energy are also envisaged. Accordingly, it is proposed to establish a 765/400kV substation at Gopalpur under ISTS.

As Gopalpur is in coastal area and within 60km form coastline, Gopalpur (ISTS) S/s is planned to be implemented in GIS in line with the recommendation of Report of Task Force on Cyclone Resilient Robust Electricity Transmission and Distribution Infrastructure in coastal area published by CEA in May 2021 for construction of new substations upto 60km from the coastline.

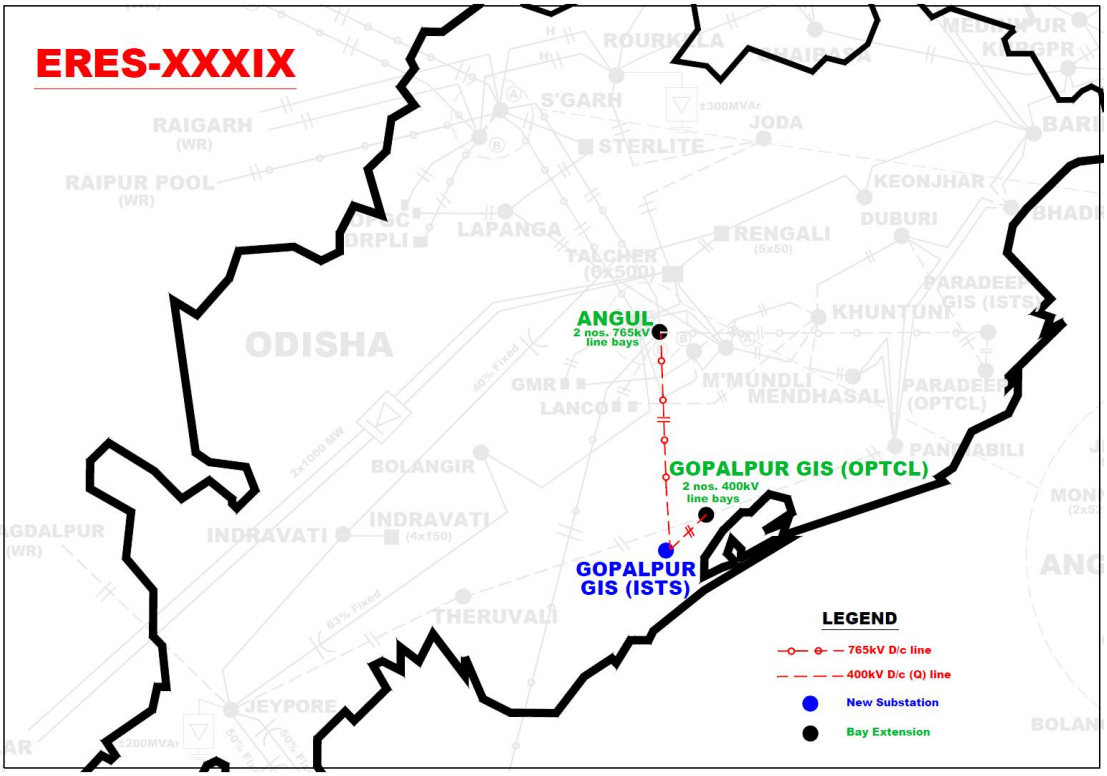


Figure 7-7: Map of ERES-XXXIX

The present scheme is for establishment of Gopalpur 765/400kV new substation along with Angul – Gopalpur 765kV D/c line & Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line, which has been approved in the 18th CMETS-ER held on 27th Apr 2023. Map is given at **Figure 7-7.**

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
1.	Establishment of new 765/400kV, 2x1500MVA GIS substation at Gopalpur in Odisha **Additional space for future expansion**: - 765/400kV, 4x1500MVA ICTs (12x500MVA single phase units) along with associated ICT bays at both voltage levels - 400/220kV, 4x500MVA ICTs along with associated ICT bays at both voltage levels - 765kV, 2x330MVAr (6x110MVAr single phase units) bus reactor along with associated bays - 420kV, 2x125MVAr bus reactor along with associated bays - 8 nos. of 765kV line bays (along with space for switchable line reactor) for future lines - 10 nos. of 400kV line bays (along with space for switchable line reactor) for future lines - 12 nos. of 220kV line bays for future lines	765/400kV, 1500MVA ICTs: 2 nos. (7x500MVA single phase units including one spare) 765kV ICT bays: 2 nos. 400kV ICT bays: 2 nos. 765kV, 330MVAr Bus reactor: 2 nos. (7x110MVAr single phase units including one spare unit for both bus and line reactors) 765kV Bus reactor bays: 2 nos. 420kV, 125MVAr Bus reactor: 2 nos. 400kV Bus reactor bays: 2 nos. 765kV line bays: 2 nos.

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
	- 765kV bus sectionaliser bay: 1 set - 400kV bus sectionaliser bay: 1 set - 220kV bus sectionaliser bay :1 set - 220kV bus coupler bay: 2 no.	*[for termination of Angul (POWERGRID) – Gopalpur 765kV D/c line along with 765kV, 1x330MVAr switchable line reactor at Gopalpur end in both circuits]* 400kV line bays: 2 nos. *[for termination of Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line]* 765kV, 330MVAr (3x110MVAr single phase units) switchable line reactor along with associated bay and 500ohm NGR (with NGR bypass arrangement) *[at Gopalpur end in both circuits of Angul (POWERGRID) – Gopalpur 765kV D/c line]*: 2 nos.
2.	Angul – Gopalpur 765kV D/c line	205km
3.	Extension at 765kV level at Angul (POWERGRID) S/s including bus extension in GIS	765kV AIS line bays (along with space for future switchable line reactor): 2 nos. *[for termination of Angul (POWERGRID) – Gopalpur 765kV D/c line]* Bus extension in GIS: about 3000m
4.	Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line[@]	[@]30km
5.	Extension at 400kV level at [#]Gopalpur (OPTCL) GIS S/s	400kV GIS line bays: 2 nos. *[for termination of Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line]*

Implementation time-frame: 24 months from allocation

Note:

(a) Implementation of this scheme to be taken up only upon receipt of Connectivity/GNA applications by CTU/OPTCL, as agreed in the 18th CMETS-ER.

(b) [@]To be reviewed based on inputs of OPTCL regarding availability of contagious land for establishment of both 765/400kV (ISTS) and 400/220kV (Intra-state) substations at Gopalpur.

(c) *#The bus scheme of 400kV level at Gopalpur (OPTCL) GIS S/s shall be one and half breaker scheme, 2 nos. full diameter i.e. 4 nos. of GIS bays needs to be implemented in the scheme for requirement of 2 nos. GIS bays for termination of Gopalpur (OPTCL) – Gopalpur 400kV D/c (Quad) line in two different diameters. Utilisation of other 2 nos. GIS bays of these diameters shall be identified in future.*

(d) *OPTCL shall provide space at under implementation Gopalpur (OPTCL) 400/220kV GIS S/s for implementation of 2 nos. of 400kV GIS line bays for termination of Gopalpur (ISTS) – Gopalpur (OPTCL) 400kV D/c (Quad) line. 2 nos. full diameter i.e. 4 nos. GIS bays shall be established.*

(e) *POWERGRID shall provide space at Angul (POWERGRID) 765/400kV S/s for implementation of 2 nos. of 765kV line bays (along with space for future switchable line reactor) along with bus extension in GIS for termination Angul (POWERGRID) – Gopalpur 765kV D/c line.*

(f) *As decided in the CMETS-ER the scheme is being taken up for approval at various forums, but implementation activity viz. bidding/allocation would be taken up only after receipt of Connectivity/GNA applications by CTU/OPTCL.*

(ii) <u>ERBS-I - Talcher-III</u>

NTPC Ltd. applied for 660MW connectivity to ISTS for its 2x660MW generation project. For balance 660MW they applied to OPTCL, Odisha for intra state connectivity. The matter was deliberated and the following transmission system was agreed in the 19th CMETS-ER meeting held on 30-05-2023:

- **For intra state connectivity:** Talcher-III – Meramundali-B 400kV D/c (Quad) line
- **For ISTS connectivity:** Talcher-III – Pandiabili 400kV D/c line

NTPC Ltd. has requested for implementation of terminal bays of DTL at ISTS end under ISTS. Accordingly, the terminal bays at ISTS end were agreed to be implemented under ISTS scheme namely Eastern Region Bay Scheme-I (ERBS-I) with completion schedule of 30-09-2026 i.e. matching with start date of Connectivity.

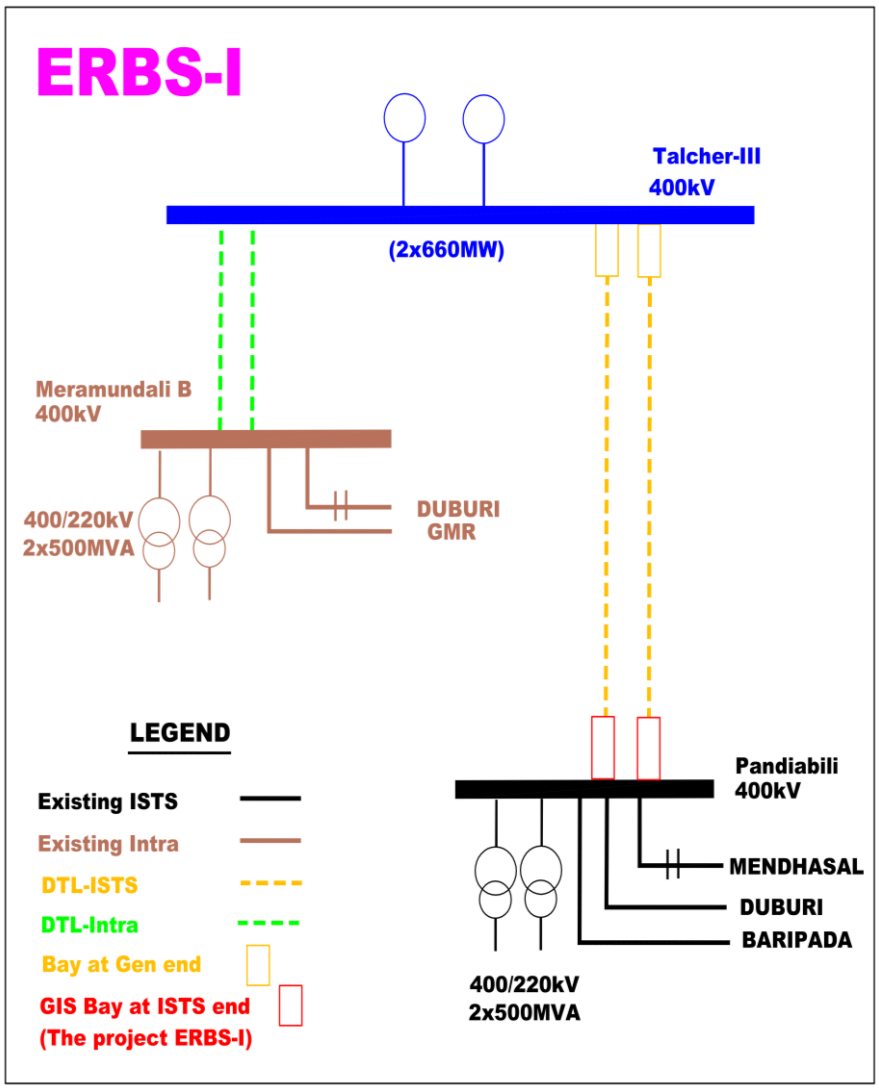


Figure 7-8: Schematic of ERBS-I

Pandiabili (POWERGRID) S/s is GIS having one and half breaker switching scheme. Accordingly, 2 nos. full diameter i.e. 4 nos. of GIS bays needs to be implemented in the scheme for requirement of 2 nos. GIS line bays for termination of Talcher-III – Pandiabili 400kV D/c dedicated transmission line in line bays of two different diameters. Utilisation of other 2 nos. GIS bays of these diameters shall be identified in future. Further, as utilisation of other two bays is presently not identified, which could also be used to terminate even a 400kV D/c (Quad) line, the two nos. full diameters under the scheme may be implemented with 3150A rating. Schematic is given at **Figure 7-8.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Extension at Pandiabili 400/220kV GIS substation	400kV GIS line bays: #2 nos. *[for termination of Talcher-III – Pandiabili 400kV D/c dedicated transmission line (line under the scope of NTPC Ltd.)]*

Implementation time-frame: 30-09-2023

Note: *#Pandiabili (POWERGRID) S/s is GIS having one and half breaker switching scheme. Accordingly, 2 nos. full diameter i.e. 4 nos. of GIS bays needs to be implemented in the scheme for requirement of 2 nos. GIS line bays for termination of Talcher-III – Pandiabili 400kV D/c dedicated transmission line in line bays of two different diameters. Utilisation of other 2 nos. GIS bays of these diameters shall be identified in future. Further, as utilisation of other two bays is presently not identified, which could also be used to terminate even a 400kV D/c (Quad) line, the two nos. full diameters under the scheme may be implemented with 3150A rating.*

(iii) ERGS-I – Talabira Connectivity

NLC India Ltd. had applied ISTS connectivity for 2000MW and intra-state connectivity for 400MW for its upcoming generation plant of 2400MW (3x800MW) at Talabira, Odisha. Alternatives for providing Connectivity to this generation project at nearby ISTS substations viz. Angul (POWERGRID), Sundargarh-A (Jharsuguda) (POWERGRID) & Sundargarh-B (Jharsuguda) (POWERGRID), were explored. Considering future generation project and load demand in Odisha, system studies were carried out for 2027-28 timeframe for providing ISTS Connectivity to Talabira and planning of evacuation system for upcoming intra-state generations in Odisha and discussed in the joint study meeting among ERPC, CTU, ERLDC, OPTCL and NLC on 11-07-2023. As decided in the 20th Consultation Meeting for Evolving Transmission Schemes in Eastern Region (CMETS-ER) held on 28-06-2023 and based on the outcomes of the joint study meeting held on 11-07-2023, ISTS Connectivity of 2000MW was provided to NLCIL for it Talabira generation project through LILO of both circuits of Angul – Sundargarh (Jharsuguda) 765kV 2xS/c lines at NLC-Talabira generation switchyard. It was agreed that the LILO line shall be implemented in ISTS as ATS under the Eastern Region Generation Scheme-I (ERGS-I).

Further, as per request of NLCIL regarding implementation modalities of line reactor (including spare reactor, NGR bypass scheme) and communication /protection related matters, a meeting was held on 24-08-2023 between CTU and NLCIL. Based on discussion, final scope of works under Eastern Region Generation Scheme-I (ERGS-I) was agreed in the 22nd Consultation Meeting for Evolving Transmission Schemes in Eastern Region (CMETS-ER) held on 29-08-2023.

For 400MW intra-state Connectivity, OPTCL has planned Talabira – Lapanga 400kV D/c (Quad) line (to be implemented by NLC). Map is given at **Figure 7-9.**

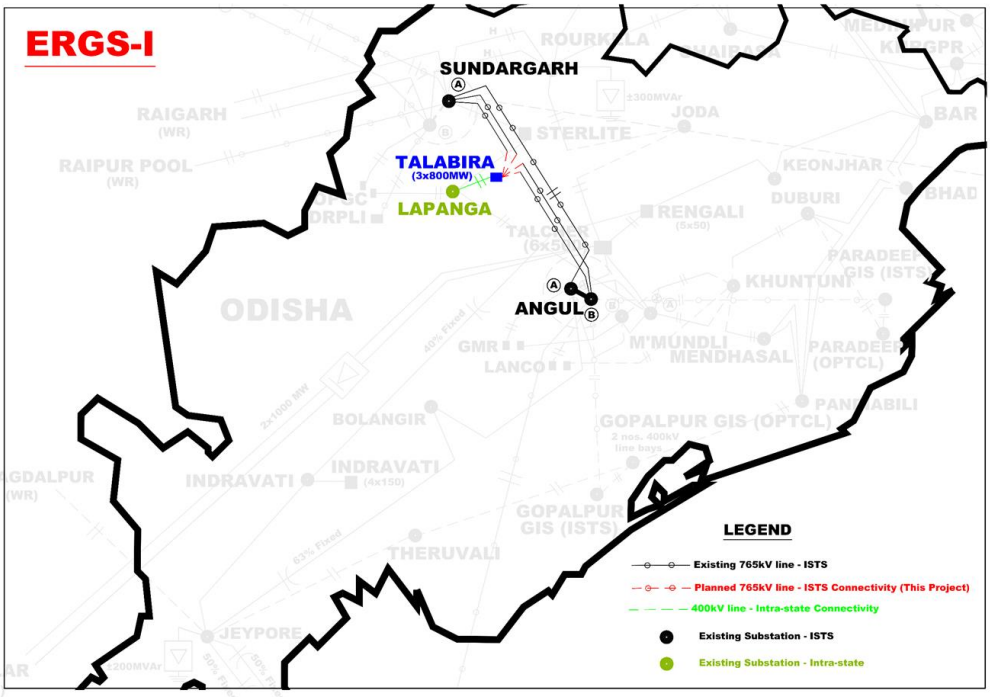


Figure 7-9: Map of ERGS-I

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
1.	LILO of both circuits of Angul – Sundargarh (Jharsuguda) 765kV 2xS/c lines at NLC-Talabira generation switchyard	50km (25km Loop in and 25km Loop out)

Implementation time-frame: 01-05-2027

Note:

NLC India Ltd. shall provide following at 765kV level its Talabira generation switchyard:

(a) 2 no. 765kV GIS line bays with PIR in different diameters for termination of Talabira – Sundargarh (Jharsuguda) 765kV D/c line.

(b) 2 no. of 765kV GIS line bays with PIR in different diameters for termination of Talabira – Angul 765kV D/c line, each with 765kV, 1x240MVAr (3x80MVAr single phase units) switchable line reactor along with 400ohm NGR (with NGR bypass arrangement). There shall be total 7x80MVAr single phase units against 2x240MVAr line reactors and the 7th 1-phase unit shall be spare as hot stand by. The spare 1-phase shunt reactor unit shall be placed and connected in such a way that the spare unit can be utilized without its physical movement. Further, the 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.

7.4.5 Sikkim

(i) ERES-XXXV – Rangpo bypass

Rangpo 400/220/132kV (POWERGRID) substation was commissioned in 2016 as part of transmission system implemented for phase-1 generation projects in Sikkim. In this scheme, split bus arrangement at 132kV bus of Rangpo S/s was planned wherein the Melli and Rangit-III 132kV feeders were planned to be on one side of the split bus section and all other 132kV feeders to be on other side (refer below figure). This arrangement was planned due to anticipated overloading in the Rangit-III & Melli 132kV feeders during high hydro generation scenario. Schematic is given at **Figure 7-10.**

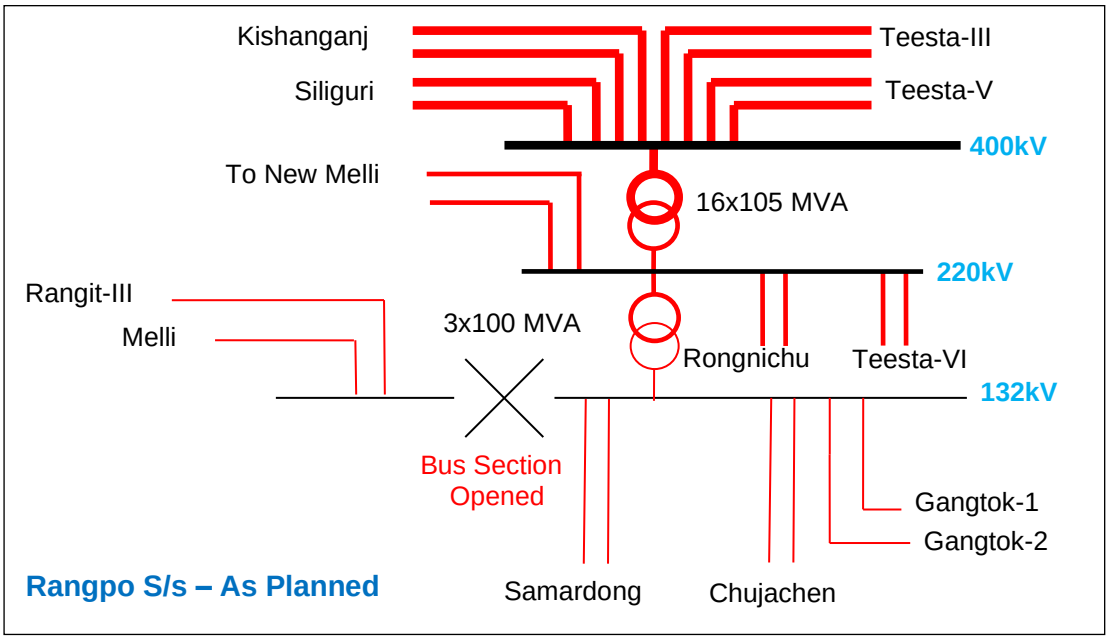


Figure 7-10: Schematic of Planned system at Rangpo S/s

As per inputs from POWERGRID, the bus split arrangement at Rangpo S/s at 132kV level has been implemented differently (refer below figure). Rangpo 132kV bus is having double bus (single CB) switching scheme. It is understood that presently the substation is being operated with two single buses at 132kV level (by keeping the bus couplers open and bus sectionalisers closed) with Rangit-III and Melli feeders in first bus and remaining feeders on the second bus.

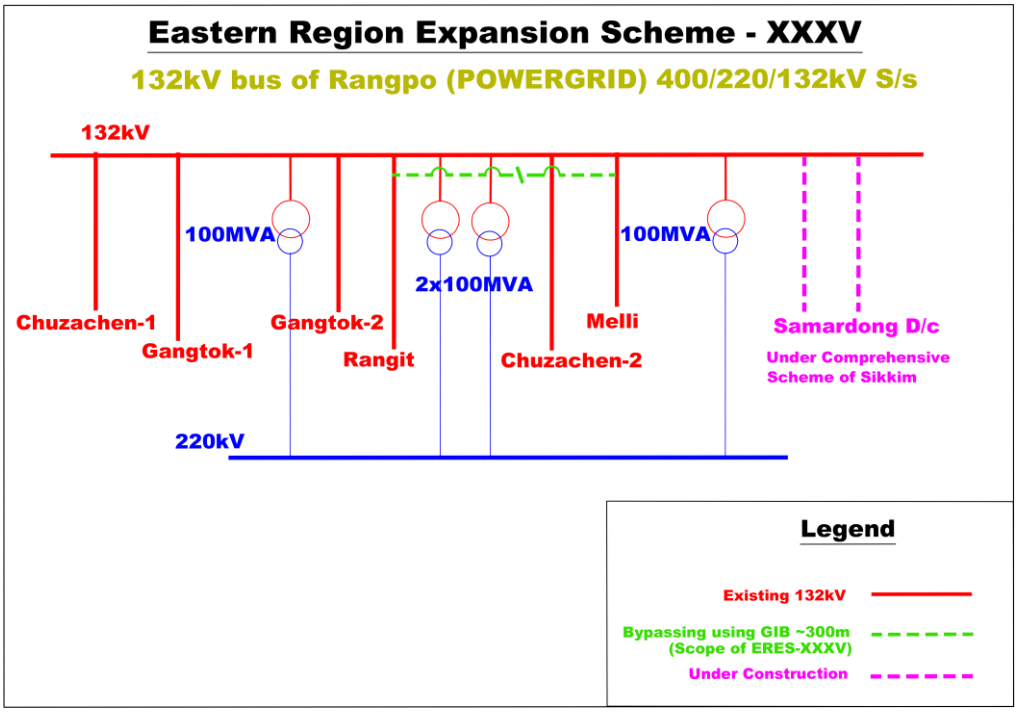


Figure 7-11: Schematic at ERES-XXV

In order to facilitate the operational flexibility requirement of bypassing of Rangpo – Melli and Rangpo – Rangit 132kV S/c lines as per original plan and to rectify the implemented arrangement, a scheme comprising of bypassing of these lines within the substation premises through GIB was discussed and agreed in the 17th CMETS-ER held on 29-03-2023. Schematic is given at **Figure 7-11.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Switching arrangement within the Rangpo (POWERGRID) GIS S/s premises such that Rangpo-Melli and Rangpo-Rangit 132kV S/c lines can be bypassed at Rangpo S/s end, such that the lines can either be terminated at Rangpo 132kV bus or bypassed, as per operational requirement. • 132kV, 1250A, SF_6, 3-Ph GIB – Approx. 250m to 300m length • 3 Phase, 1250A, SF_6 to Air bushing – 02 nos. • 132kV, 1250A, 31.5kA, AIS Disconnector with one E/S – 01 no. • 132kV BPI AIS – Approx. 05 nos.	-

Implementation time-frame: 18 months from allocation

(ii) ERBS-II - Rammam

NTPC Ltd. has applied for 120MW connectivity to ISTS for its Rammam HEP. The matter was deliberated, and the following transmission system was agreed in the 19th CMETS-ER meeting held on 30-05-2023:

➢ **For ISTS connectivity:** Rammam – Rangpo 132kV D/c line

NTPC Ltd. has requested for implementation of terminal bays of DTL at ISTS end under ISTS. Accordingly, the terminal bays at ISTS end were agreed to be implemented under ISTS scheme namely Eastern Region Bay Scheme-II (ERBS-II) with completion schedule of 30-07-2026 i.e. matching with start date of Connectivity.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Extension at Rangpo 400/220/132kV GIS substation	132kV GIS Line bays: 2 nos. (bay no. 117 & 118) *[for termination of Rammam – Rangpo (POWERGRID) 132kV D/c dedicated transmission line (line under the scope of NTPC Ltd.)]*

Implementation time-frame: 30-07-2023

Note: *ISTS licensee should build the 132kV line bays of rating commensurate with rating of the dedicated transmission line.*

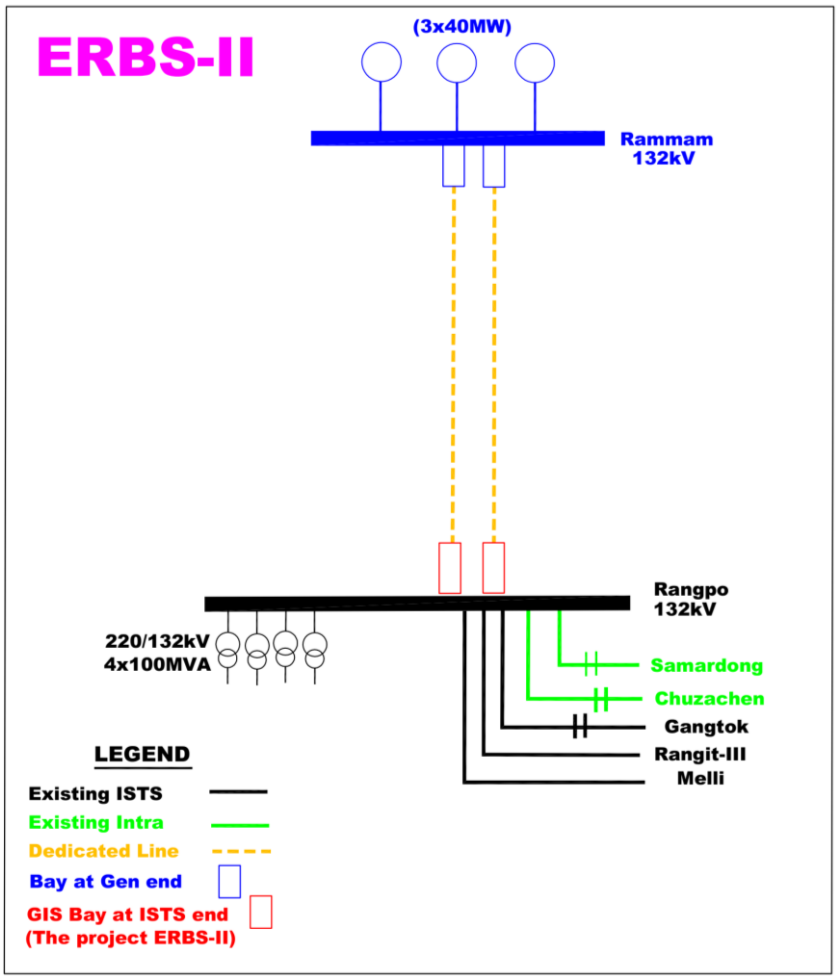


Figure 7-12: Schematic of ERBS-II

7.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in **section 7.3**, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are expected to be commissioned in 2028-29 timeframe are considered for conducting these studies. Results of these studies were analysed and the same are deliberated below-

7.5.1 Power Flow Analysis

a) Transmission lines

In the base case file prepared for 2028-29 timeframe, 5 nos. of 400 kV lines are having loading more than 70% of the thermal limit of the line. Scenarios where loading is more than 70% of rating and maximum loading obtained on these transmission lines in the simulation studies are tabulated below at Table 7-7

Table 7-7 Transmission Lines Loading in the Base Cases

(All Fig in MW)

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating	% Loading
1.	Kahalgaon – Farakka 400kV line-1	4	ISTS	695	850	82%
2.	Rourkela – Chaibasa 400kV line-1	4	ISTS	786	850	92%
3.	Ranchi – Sipat 400kV line-1	4	ISTS	672	850	79%
4.	Ranchi – New Purulia 400kV line-1	1 & 4	ISTS	972	1093	89%
5.	Purulia – New Purulia 400kV line-1	1 & 4	WBSETCL	651	850	77%

b) Transformers

In the base case file prepared for 2028-29 timeframe, transformers at 8 nos. of 400/220kV substations are having loading more than 80% of the ICT rating. Scenarios where loading is more than 80% of rating and maximum loading hit by these transformers in the simulation studies are tabulated below at Table 7-8

Table 7-8 Transformer Loading in the Base Cases

(All Fig in MW)

Sl. No.	Name of ICT	Capacity	Scenario No.	Owner	Maximum Loading per ICT (MW)	% Loading
1.	Duburi 400/220kV	2x315	2,3,4	OPTCL	280	89%
2.	Kolaghat 400/220kV	2x315	1,2,4,5,6,7	WBPDCL	362	115%
3.	Chanditala 400/220kV	3x315	All except 9	WBSETCL	367	117%
4.	Kharagpur 400/220kV	3x315	1,2,4,5	WBSETCL	295	94%

Sl. No.	Name of ICT	Capacity	Scenario No.	Owner	Maximum Loading per ICT (MW)	% Loading
5.	Gokarna 400/220kV	3x315	1,4	WBSETCL	360	114%
6.	Jeerat 400/220kV	4x315	1,2,4,5	WBSETCL	317	101%
7.	Bidhannagar 400/220kV	3x315	1,4	WBSETCL	306	97%
8.	DSTPS 400/220kV	2X500	5,8	DVC	440	88%

c) Voltage Analysis

PU voltages of all 400kV and above buses were observed in all the nine scenarios. Maximum and minimum voltage of each bus were identified from the bus voltages in the nine number of scenarios. It has been observed that all buses at 400kV and above are having voltage between 0.95 pu and 1.05pu

7.5.2 Contingency Analysis

Contingency analysis has been performed on all the 765kV & 400kV transmission lines, and 765/400kV & 400/220kV transformers to ascertain the loading levels under outage of any other 765kV or 400kV transmission element. Results of the analysis are discussed below:

a) Transmission Lines

ISTS lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below at **Table 7-9.**

Table 7-9: ISTS Transmission lines not meeting N-1 Criteria in ER

(All Fig in MW)

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Kahalgaon – Farakka 400kV line-1	Kahalgaon – Farakka 400kV line-2	4, 7, 8	ISTS	640	923	852	108%
2.	Kishanganj – Siliguri 400kV line-1	Kishanganj – Siliguri 400kV line-2	5	ISTS	1364	1925	2086	92%
3.	Rourkela – Chaibasa 400kV line-1	Rourkela – Chaibasa 400kV line-2	4	ISTS	762	1011	1093	93%
4.	Ranchi – New Purulia 400kV line-1	Ranchi – New Purulia 400kV line-2	1, 4, 7	ISTS	960	1332	1093	122%
5.	Ranchi – Sipat 400kV line-1	Ranchi – Sipat 400kV line-2	4	ISTS	680	834	850	98%

From the above, it can be seen that the above-mentioned lines are violating N-1 contingency limit. This is due to high injection of renewable generations leading of less thermal generations

in ER in the Jharkhand, DVC and West Bengal area. These overloadings may be minimized with switching of some of the generations in these areas. Additional inter regional lines from NR/WR to ER is under planning stage, which is expected to reduce the loading of these lines.

STU lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below at **Table 7-10.**

Table 7-10: STU Transmission lines not meeting N-1 Criteria in ER

(All Fig in MW)

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Purulia New – Purulia PS 400kV Line-1	Purulia New – Purulia PS 400kV Line-2	1,4,7	WBSETCL	644	1279	850 (Twin Moose)	150%
2.	Bidhannagar-Durgapur-A 400kV line-1	Bidhannagar-Durgapur-A 400kV line-2	4	WBSETCL	605	1104	1093	101%

WBSETCL may initiate action to control the overloading of the line in 2028-29 timeframe.

b) Transformers

ISTS ICTs loaded beyond 90% of MVA rating under N-1 contingency are summarized below at **Table 7-11**

Table 7-11: ISTS ICTs not meeting N-1 Criteria in ER

(All Fig in MW)

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	Rating (MVA)	% Loading
1.	765/400kV, 4x1500MVA ICTs at Gaya	4	ISTS	1110	1394	1500	93%
2.	400/220kV, 2x500MVA ICTs at Kishanganj	1,2,4,5	ISTS	385	540	500	108%
3.	765/400kV, 2x1500MVA ICTs at Jharsuguda-B	4	ISTS	900	1422	1500	95%
4.	765/400kV, 2X1500 MVA ICTs at Jeerat-New	1,2,4,5	ISTS	1145	1914	1500	128%
5.	400/220kV, 3x500MVA ICTs at Durgapur-B	4,6,8	ISTS	241	306	315	97%
6.	400/220kV, 2X315MVA ICTs at Daltonganj	4	ISTS	186	300	315	95%

Requirement of additional transformation augmentation wherever necessary would be planned subsequently in coordination in the CMETS meeting and the same would be included in the final Rolling Plan.

STU ICTs loaded beyond 90% of MVA rating under N-1 contingency are summarized below at **Table 7-12**

Table 7-12: STU ICTs not meeting N-1 Criteria in ER

(All Fig in MW)

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	Rating (MVA)	% Loading
1.	400/220kV, 2x315MVA ICTs at Duburi	1,2,3,4,5	OPTCL	288	395	315	125%
2.	765/400kV, 2x1500MVA ICTs at Duburi-765	1,3,4,6	OPTCL	1126	1686	1500	113%
3.	400/220kV, 2x315MVA ICTs at Lapanga	4	OPTCL	214	301	315	95%%
4.	400/220kV, 4x315MVA ICTs at Jeerat	1,2,4,5,8	WBSETCL	344	397	315	126%
5.	400/220kV, 1x315MVA ICT (in outage of 400/220kV, 1x315MVA ICT at Gokarna)	4	WBPDCL	362	421	315	134%
6.	400/220kV, 2x315MVA ICTs at Kolaghat TPS	All except 8 & 9	WBPDCL	378	551	315	175%
7.	400/220kV, 3x315MVA ICTs at Chanditala	All except 9	WBSETCL	404	487	315	155%
8.	400/220kV, 3x315MVA ICTs at Kharagpur	1,2,4,5,7	WBSETCL	321	437	315	139%
9.	400/220kV, 3x315MVA ICTs at Gokoarna	1,2,4,5	WBSETCL	415	518	315	164%
10.	400/132kV, 2x315MVA ICTs at New Laxmikantpur	2,4,5	WBSETCL	214	315	315	100%
11.	400/220kV, 3x315MVA ICTs at Bidhannagar	1,4	WBSETCL	338	421	315	134%
12.	400/220kV, 2x315MVA ICTs at BAPL	1,2,4	WBSETCL	253	361	315	115%
13.	400/220kV, 2x500MVA ICTs at Durgapur TPS	All except 1	DVC	472	678	500	136%
14.	400/220kV, 2x315MVA ICTs at Mejia-B TPS	All except 1	DVC	274	375	315	119%

From above, it is observed that 1 nos. of S/s of BSPTCL, 4 nos. of S/s of OPTCL and 8 nos. of S/s of WBSETCL/WBSEDCL and 5 nos. of S/s of DVC are not complying N-1 criteria in 2028-29 timeframe. Some of them are violating the limits in present timeframe also and are

continuously flagged by Grid-India in their Operational Feedback. STUs may initiate action to control the overloading of the ICTs in 2028-29 timeframe.

7.5.3 Short Circuit Analysis

Short circuit level was calculated for all 765 and 400 kV buses of Eastern Region and buses having fault level more than the design rating under any scenario were identified. From analysis, it is emerged that 1 nos. of 400kV ISTS S/s, 1 nos. of 400kV ISGS S/s, 1 nos. of 400kV CPP generation and 1 nos STU S/s in ER have crossed their designed fault level rating.

Details of the buses exceeding the designed fault level under different scenario are tabulated below at **Table 7-13.** Table 7-13: ISTS Buses Exceeding Designed Fault Level in ER

Table 7-13: ISTS Buses Exceeding Designed Fault Level in ER

(All Fig in kA)

Sl. No.	Substation Name	Owner	Scenario No.	Highest Fault level	Designed Rating
1.	400kV Farakka	NTPC	7,8,9	42	40
2.	400kV Siliguri	ISTS	8,9	41	40
3.	400kV Vedanta	CPP	All	53	50
4.	400kV Patratu	JUSNL	8,9	40	40

The fault level control measures for Farakka have been implemented. The maximum fault level at Siliguri and Patratu are near its design limit. Detailed studies are being carried out for the balance 1 no. S/s and the same would be discussed in the upcoming CMETS-ER meeting and the corrective measures shall be proposed.

Chapter 8: North Eastern Region

North Eastern Region is the eastern-most region of India. It comprises seven states, the contiguous Seven Sister States. The region shares an international border with several neighbouring countries, China in the north, Myanmar in the east, Bangladesh in the south-west and Bhutan in the north-west. The NER has immense natural resources, accounting for 34% of the country's water resources and almost 40% of India's hydropower potential. The states in NER are well connected through EHV transmission links at 400kV level. The NER grid is further connected to other parts of the National Grid through 400kV HVAC lines as well as ±800kV, 6000MW Multi terminal Biswanath Chariali – Alipurduar – Agra HVDC link. During wet season (Monsoon period) hydro power is imported from Bhutan and during dry season (Winter period), surplus power is exported to meet their energy requirement. Cross-border interconnection with Bangladesh & Myanmar in North Eastern region helps these countries in meeting their energy requirement throughout the year.

8.1 Power Supply Scenario as on Jan'24

As on Jan'24, total Installed Capacity (IC) of North Eastern Region was 5168MW and the peak demand met was 3678MW. The state-wise breakup of installed capacity and peak demand is summarised at **Table 8-1** below.

Table 8-1: NER Installed Capacity and Peak Demand as on Jan'24

(All Fig in MW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES (MNRE)	Total		
Assam	581	742	1323	-	522	192	714	2037	2413
Arunachal Pradesh	37	47	84	-	545	145	689	773	181
Meghalaya	52	110	161	-	418	73	491	652	405
Tripura	56	487	543	-	69	34	103	646	362
Manipur	83	82	165	-	87	18	106	271	258
Nagaland	32	74	106	-	66	36	102	208	174
Mizoram	31	60	91	-	98	76	174	265	162
Central unallocated	113	64	176	-	140	-	140	316	-
NER	**985**	**1666**	**2649**		**1945**	**574**	**2519**	**5168**	**3678**

Source: CEA monthly report

8.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, North Eastern Region demand for 2028-29 timeframe is expected to increase to 5481MW. As per the inputs received from various stakeholders, total installed capacity of North Eastern Region for 2028-29 is expected to be 8239MW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 8-2.**

Table 8-2: NER Installed Capacity and peak demand (2028-29)

(All Fig in MW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Assam	-	347	347	-	220	192	412	-	759	3449
Arunachal Pradesh	-	-	-	-	24	145	169	-	169	246
Meghalaya	-	-	-	-	490	73	563	-	563	528
Tripura	-	149	149	-	-	34	34	-	183	605
Manipur	-	-	-	-	-	18	18	-	18	383
Nagaland	-	-	-	-	24	36	60	-	60	213
Mizoram	-	-	-	-	28	76	104	-	104	268
Central	750	1253	2003	-	3630	750	4380	-	6383	-
NER	**750**	**1749**	**2499**	**-**	**4416**	**1324**	**5740**	**-**	**8239**	**5481**

There is a massive growth in peak demand of North Eastern Region from present time-frame (2023-24) to 2028-29 with a CAGR of 8.3%. The state wise peak demand growth is given at **Table 8-3.**

Table 8-3: Increase in Peak Demand of Various States of NER

(All Fig in MW)

State	2023-24	2028-29	Increase in demand	CAGR
Assam	2413	3449	1036	7.4%
Arunachal Pradesh	181	246	65	6.3%
Meghalaya	405	528	123	5.4%
Tripura	362	605	243	10.8%
Manipur	258	383	125	8.2%
Nagaland	174	213	39	4.1%
Mizoram	162	268	106	10.6%
NER	**3678**	**5481**	**1803**	**8.3%**

From the above data it is observed that the CAGR growth of peak demand is maximum for Tripura (10.8%) and minimum for Nagaland (4.1%). The CAGR of demand of NER is about 8.3% which is more than the National Average of 5.4%. In addition to above, 250MW demand of Myanmar & 160MW demand of Bangladesh is also considered as a part of North Eastern Region for study purpose.

8.3 Load Generation Balance for 2028-29 timeframe

In the chapter 3, All India Load Generation Balance (LGB) for identified nine scenarios was prepared as per the methodology finalized in consultation with CTU, CEA and Grid India. This section elaborates the North Eastern Region Load Generation Balance (LGB) for 2028-29 time-frame. For North Eastern Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned at **Table 8-4** for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 8-4: North Eastern Region Generation Dispatch and Demand Factors

Scenario No & Name	Generation Dispatch Factors			Demand Factors
	Hydro	Solar	Gas	
1-Aug Solar Max	70%	80%	0%	77%
2-Aug Peak Load	90%	0%	50%	76%
3-Aug Night Off Peak	70%	0%	50%	59%
4-Jun Solar Max	70%	85%	0%	70%
5-Jun Peak Load	90%	0%	50%	73%
6-Jun Night Off Peak	70%	0%	50%	62%
7-Feb Solar Max	30%	90%	0%	58%
8-Feb Peak Load	60%	0%	50%	77%
9-Feb Night Off Peak	30%	0%	30%	41%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import / export of NER and the inter-regional flows through various corridors is summarised in **Table 8-5**. Further, both maximum and minimum is also highlighted in table below.

Table 8-5: Import / Export of North Eastern Region

(All Fig in MW)

State / UTs	Import / Export of North Eastern Region								
Scenario No / Corridors	Aug'27 Time Frame			Jun'27 Time Frame			Feb'28 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
NER-ER	893	952	1033	866	1354	1579	340	-737	184
NER-NR	-500	0	0	-500	0	0	-500	0	0
NER-Cross Border	-80	-111	-80	-80	-97	-63	-41	-121	-55
North Eastern Region (net)	313	841	953	286	1257	1516	-201	-858	129

Out of these nine scenarios, Scenario-8 and Scenario-6 corresponds to two extreme cases with export/import requirement of North Eastern Region i.e. Maximum import (858MW) and maximum export (1516MW) scenarios respectively. In all other scenarios, the import / export of North Eastern Region varies between these two extremes.

Considering the above LGB for nine scenarios, load flow cases were prepared for 2028-29 timeframe. Detailed system studies have been carried out on the finalized load flow cases. The study results are discussed in subsequent sections.

8.4 ISTS Network Expansion Schemes evolved from Mar'23 to Feb'24

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of North Eastern Region (CMETS-NER) from Mar '23 to Feb'24. The details of the schemes are summarized below in **Table 8-6**:

Table 8-6: Approved Transmission Schemes in this Rolling Plan

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in ₹Cr.)
Meghalaya			
1.	NERES-XXI (Part-A) - Khliehriat	Jan 26	48
Assam			
1.	NERES-XXI (Part-B) - Badarpur	2026-27	110
2.	NERGS-I - Bokajan	Dec 26	214
3.	NERES-XXII - Bongaigaon bus reactor	Jul 25	17
4.	NERES-XXV - Bornagar	2026-27	594
Assam & Meghalaya			
1.	NERES-XXIV - Reconductoring of Khandong - Haflong - Jiribam	2025-26	39

8.4.1 Meghalaya

(i) NERES-XXI (Part-A) - Khliehriat

The existing 132kV Khliehriat (POWERGRID) switching station was commissioned in 1999 and shall be completing 25 years in service by 2024. POWERGRID the owner of the substation has informed that they are facing issues in O&M of the switching station and to improve the reliability it would be prudent to upgrade the switching station from single main and transfer bus scheme to double main transfer bus scheme by converting from AIS to GIS.

The scheme was also discussed in the 23rd TCC & NERPC meetings held on 18th-19th Nov 2022 wherein the subject upgradation was agreed to be carried out in GIS. The proposal was deliberated in 16th CMETS-NER held on 24-02-2023 wherein following was decided to be implemented in ISTS:

- Upgradation of Single Main and Transfer Bus to Double Bus arrangement with GIS at 132kV Khliehriat (POWERGRID) switching station

Upon finalization of the above scope a committee with officials from CTU and POWERGRID visited Khliehriat substation for finalization of the implementation modalities of the above agreed scope of works. The committee submitted a report wherein it is suggested the scope of works may be refined as per the actual site conditions. Accordingly, the proposal was once again discussed in the 20th CMETS-NER meeting held on 23rd June 2023 and revised scope of works (as mentioned below) under subject scheme with an implementation schedule of 24 months was agreed. Map is given at **Figure 8-1.**

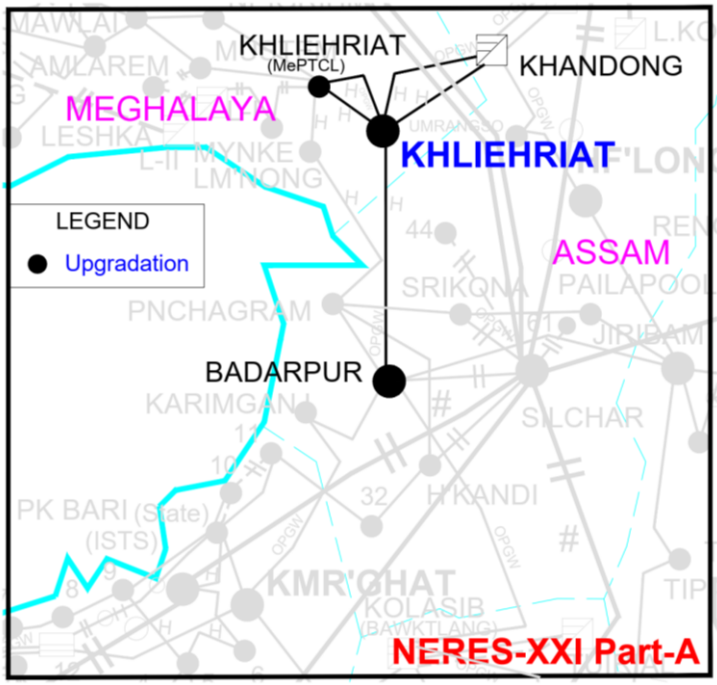


Figure 8-1: Map of NERES-XXI Part-A

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Upgradation of Single Main & Transfer Bus to Double Bus arrangement with GIS at 132kV Khliehriat (POWERGRID) switching station along with upgradation of necessary Control, Protection, Communication, Automation & LT auxiliary system	-

Implementation time-frame: 24 months from allocation

Note: *1 no. 132kV AIS line bay owned by MePTCL of Khlierihat (POWERGRID) – Khliehriat (MePTCL) line-2 is also included for upgradation in GIS under this scheme. The ownership of the new line bay would be with the implementation agency. The existing AIS line bay for the said line may be dismantled and handed over to MePTCL on as is where is basis and the implementing agency will coordinate with MePTCL for the same.*

8.4.2 Assam

(i) NERES-XXI (Part-B) - Badarpur

The existing 132kV Badarpur (POWERGRID) switching station was commissioned in 1999 and shall be completing 25 years in service by 2024. POWERGRID the owner of the substation has informed that they are facing issues in O&M of the switching station and to improve the reliability it would be prudent to upgrade the switching station from single main and transfer bus scheme to double main transfer bus scheme by converting from AIS to GIS.

Further, towards adoption of new technology in the Indian Grid, it was proposed that the upgradation could be carried out as Green GIS instead of conventional GIS owing to the following benefits:

- Green GIS is a new technology in which SF_6 gas is not used and this technology is being adopted by several countries in the world.
- This would help in the reduction of usage of Green House Gas and would be a step towards achieving sustainable development targets.

The scheme was also discussed in the 23rd TCC & NERPC meetings held on 18th-19th Nov 2022 wherein the subject upgradation was agreed to be carried out in Green GIS.

The proposal was deliberated in 16th CMETS-NER held on 24-02-2023 wherein following was decided to be implemented in ISTS:

- Upgradation of Single Main and Transfer Bus to Double Bus arrangement with Green GIS at 132kV Badarpur (POWERGRID) switching station

Upon finalization of the above scope a committee comprising of officials from CTU and POWERGRID visited Badarpur substation for finalization of the implementation modalities of the above agreed scope of works. The committee submitted a report wherein it is suggested the scope of works may be refined as per the actual site conditions. Accordingly, the proposal was once again discussed in the 20th CMETS-NER meeting held on 23rd June 2023 and revised scope of works (as mentioned below) under subject scheme was agreed with an implementation schedule of 30 months keeping in view implementation of new technology of Green GIS in ISTS. Map is given at **Figure 8-2.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Upgradation of Single Main & Transfer Bus to Double Bus arrangement with Green GIS at 132kV Badarpur (POWERGRID) switching station along with upgradation of necessary Control, Protection, Communication, Automation & LT auxiliary system	-

Implementation time-frame: 30 months from allocation

Note: *As the Green GIS is being introduced for first time in ISTS in the Indian network, the ISTS transmission licensee shall involve CTU officials at various stages of implementation such as detailed engineering, design, testing, commissioning etc., and also after commissioning, so as to assess the environmental impact, operational performance, ageing characteristics etc. of the Green GIS.*

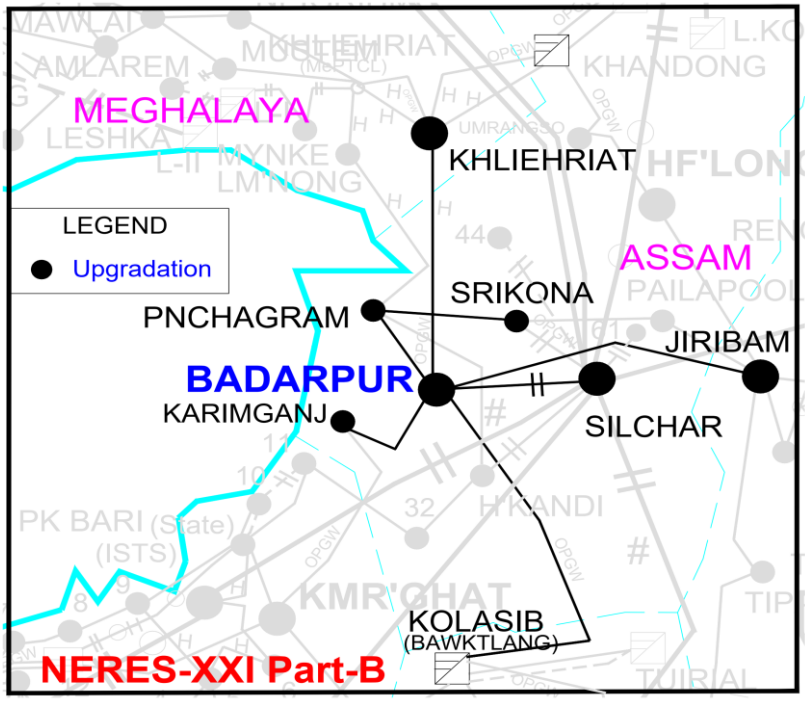


Figure 8-2: Map of NERES-XXI Part-B

(ii) NERGS-I – APDCL Connectivity

M/s Assam Power Distribution Company Limited (APDCL) applied for ISTS Connectivity under GNA Regulations 2022 for its new solar generation of 1000MW to be installed in Karbi Anglong, Bokajan, Assam.

The application was deliberated in the 20th CMETS-NER meeting held on 23-06-2023. Brief of deliberations and outcomes/agreements by the stakeholders including the applicant is given below:

a) SECI mentioned that it has not identified/declared any solar potential in the Karbi Anglog and nearby area.

b) Various alternatives for interconnection of this solar generation with the ISTS was explored:

i. APDCL – Misa 400kV S/c line as DTL

ii. APDCL – New Kohima 400kV S/c line as DTL

iii. Establishment of a new 400kV switching station at Bokajan through LILO of both circuits of Misa – New Mariani 400kV D/c line & connection of generation to this switching station through DTL i.e. Bokajan – APDCL 400kV S/c line, with bay for termination of DTL at Bokajan station to be constructed under ISTS

iv. Establishment of a new 400kV switching station at Bokajan through LILO of both circuits of New Mariani – New Kohima 400kV D/c line & connection of generation to this switching station through DTL i.e. Bokajan – APDCL 400kV S/c line, with bay for termination of DTL at Bokajan station to be constructed under ISTS

c) Considering the forest issues, hilly terrain of NER and completion timeline constraints, the alternative at b)iii. above was agreed for grant of Connectivity under GNA Regulations to M/s APDCL.

d) Presently, 50MVAr fixed line reactor is installed at Misa end in original Misa – New Mariani 400kV D/c line. With the LILO of the line at Bokajan, the tentative length of line sections Misa – Bokajan and Bokajan – New Mariani would be about 120km and 140km respectively. Keeping in view reactive compensation requirements, 50MVAr switchable line reactor is planned at Bokajan end in the Bokajan – New Mariani 400kV line section.

e) AEGCL mentioned that presently there is no requirement for drawal of power in Bokajan area but requested that space for installation of 400/220kV ICTs and creation of 220kV level may be kept for future interconnection to feed the loads in nearby area of Bokajan.

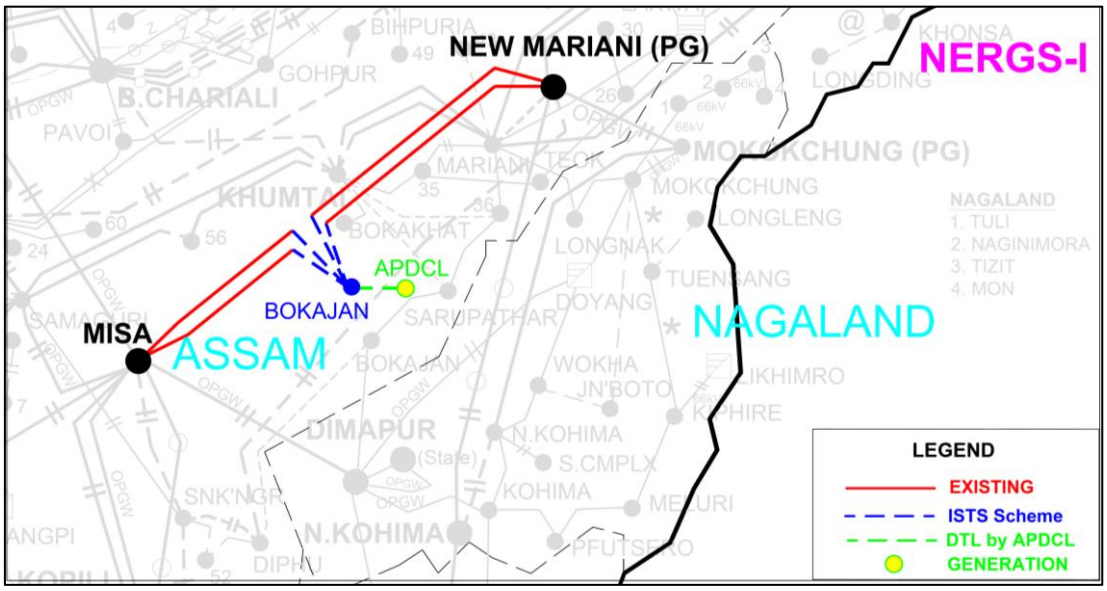


Figure 8-3: Map of NERGS-I

In view of the above, it was decided that connectivity of 1000MW may be granted to M/s APDCL for its solar generation project under GNA Regulations, 2022 with the identified augmentation in ISTS to be carried out under subject scheme and the same to be treated as Associated Transmission System (ATS).

Subsequently, M/s APDCL requested for change in quantum from 1000MW to 750MW and extension of project commissioning timeline from 31-12-2025 to 31-12-2026. The matters were deliberated in 27th CMETS-NER held on 29-01-2024, wherein it was

decided to change the Connectivity quantum from 1000MW to 750MW and revise the start date of Connectivity from 31-12-2025 to 31-12-2026. Map is given at **Figure 8-3**.

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
1	Establishment of new 400kV switching station (to be upgraded to 400/220kV level in future) at Bokajan in Assam **Additional space for future expansion**: - 400/220kV, 4x500MVA ICTs along with associated ICT bays at both voltage levels - 420kV, 2x125MVAr bus reactor along with associated bays - 9 nos. of 400kV line bays (along with space for switchable line reactor) for future lines - 10 nos. of 220kV line bays for future lines - 400kV bus sectionaliser bay: 1 set - 220kV bus sectionaliser bay :1 set - 220kV bus coupler bay: 2 no. - 220kV transfer bus coupler bay: 2 no.	420kV, 80MVAr bus reactor: 2 nos. 400kV bus reactor bays: 2 nos. 420kV, 50MVAr switchable line reactor: 2 nos. (one in each circuit of Bokajan – New Mariani 400kV D/c line formed after LILO of both circuits of Misa (POWERGRID) – New Mariani (POWERGRID) 400kV D/c line at Bokajan) 400kV line bays: 5 nos. *[4 nos. for termination of LILO of both circuits of Misa – New Mariani 400kV D/c line at Bokajan (LILO under this scheme) & 1 no. for termination of APDCL – Bokajan dedicated transmission line (line under scope of M/s APDCL)]*
2	LILO of both circuits of Misa (POWERGRID) – New Mariani (POWERGRID) 400kV D/c line at Bokajan	20km (10km Loop in and 10km Loop out)

Implementation time-frame: 31-12-2026

Note: *The scheme is required by 31-12-2026 matching with start date of Connectivity of M/s APDCL's 750MW solar plant*

(iii) NERES-XXII (Bongaigaon bus reactor)

Presently, 2x50MVAr + 2x80MVAr (installed in parallel) + 1x125MVAr bus reactors are available at Bongaigaon (POWERGRID) S/s at 400kV voltage level. Out of which 50MVAr Bus Reactors - I & II were commissioned in 1987 & 1994 respectively. After serving more than 29 years, it has been observed that the reactors are continuously giving problems. For further assessment of the health, matter was referred by POWERGRID to CPRI, Bangalore for Residual Life Assessment. After reviewing all parameters, CPRI has opined for replacement of the subject bus reactor.

On annual basis at Bongaigaon 400kV bus, average of minimum voltage is about 402kV, and average bus voltage is about 409kV. Accordingly, in order to keep the bus voltage near nominal levels, the existing quantum of reactive compensation is required to be maintained. As per the study, it was observed that new reactors of 50MVAr may not be installed due to their reduced capability in changing bus voltage upon switching. Thus, a new 125MVAr bus reactor has been planned to be installed in one of the vacated bus reactor bays after decommissioning of old 2x50MVAr bus reactors. Further, as the existing 2x80MVAr bus reactors are installed in parallel, one of these 80MVAr bus reactors is planned to be installed in the other vacated bay after decommissioning of 2x50MVAr bus reactors. After decommissioning of old 2x50MVAr bus reactor and commissioning of new 1x125MVAr, there would be 2x80MVAr + 2x125MVAr bus reactors at Bongaigaon (POWERGRID) S/s and all bus reactors would be installed in separate bays.

The above proposal was agreed in the 22nd CMETS-NER held on 28-08-2023. Schematic is given at **Figure 8-4.**

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Decommissioning of existing 420kV, 2x50MVAr bus reactors at Bongaigaon (POWERGRID) S/s	-
2.	Installation of a new 420kV, 1x125MVAr bus reactor at Bongaigaon (POWERGRID) S/s in one of the vacated bays after decommissioning of above mention 420kV, 2x50MVAr bus reactors. ***Note:*** *The new 1x125MVAr bus reactor would be installed in one of the 400kV bays (1st bay) vacated after decommissioning of existing 420kV, 2x50MVAr bus reactors at Bongaigaon (POWERGRID) S/s without any modification/ upgradation in the existing bus reactor bay equipment.*	Bus reactor: 420kV, 1x125MVAr – 1 no.
3.	One of the existing 2x80MVAr bus reactors (presently installed in parallel in same bay) may be installed at Bongaigaon (POWERGRID) S/s in other vacated bay after decommissioning of above mentioned 420kV, 2x50MVAr bus reactors. ***Note:*** *One of the existing 2x80MVAr bus reactor would be installed in other 400kV bay (2nd bay) vacated after decommissioning of existing 420kV, 2x50MVAr bus reactors at Bongaigaon (POWERGRID) S/s without any modification/ upgradation in the existing bus reactor bay equipment.*	-

Implementation time-frame: 18 months from allocation

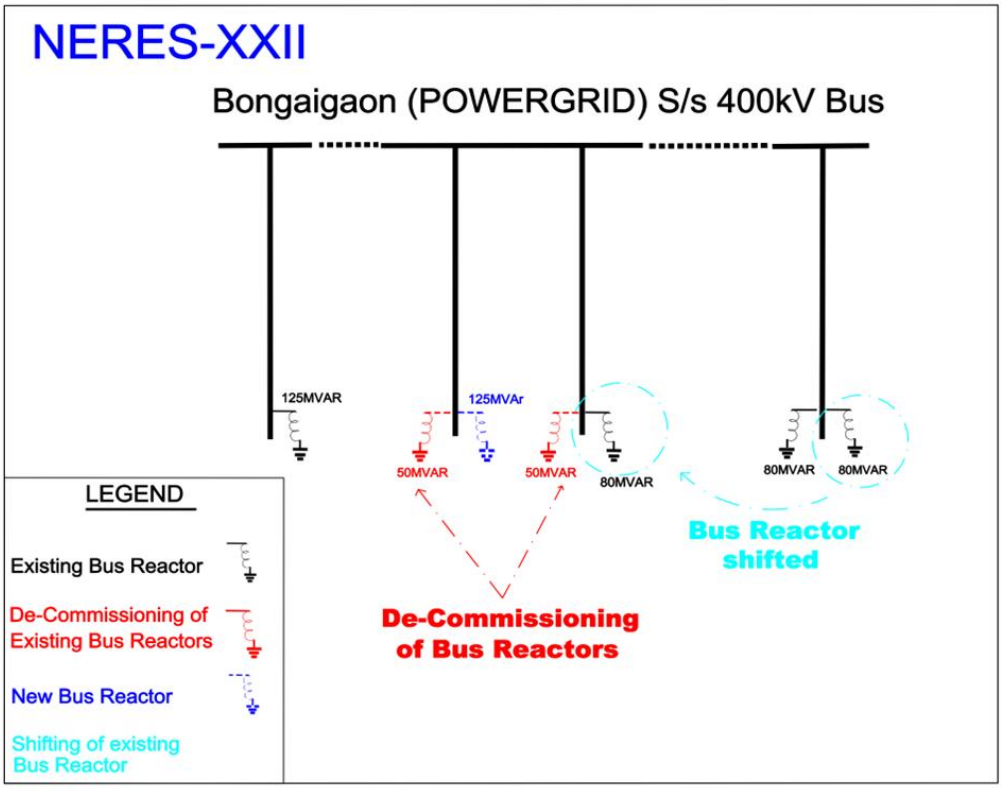


Figure 8-4: Schematic of NERES-XXII

(iv) NERES-XXV (Bornagar)

In the 5th meeting of erstwhile Standing Committee on Power System Planning of NER, it was agreed that there is a need for 2nd 400kV AC node in NER for interconnection with national grid to address the case of any eventuality at Bongaigaon S/s. The same was taken into account, while planning new interconnection between India and Bangladesh viz. Bornagar (Assam, NER) – Parbotipur (Bangladesh) – Katihar (Bihar, ER) 765kV D/c line. Both the schemes viz. High-Capacity India-Bangladesh AC Corridor and formation of second 400kV node in NER-ER corridor were deliberated in the 6th meeting of erstwhile Standing Committee on Power System Planning of NER held on 03-10-2016. In 2nd NERPC-TP it was recorded that *"NERLDC expressed that another 400kV entry point of Bornagar in North Eastern states will be crucial and helpful in system operation."*.

Ministry of Power, Govt. of India vide letter dated 31-12-2020 had assigned implementation of the entire KPB link (Indian and Bangladesh portions) to POWERGRID under Regulated Tariff Mechanism (RTM) with completion schedule as Dec 2022. NER portion of the interconnection has been delinked linked with the Bangladesh interconnection to meet the requirement of Grid operator.

AEGCL has planned a new 220/132kV substation at Bornagar is expected to be implemented in the next 3-4 years i.e. by 2028-29. It was opined by all stakeholders that Bornagar (AEGCL) is yet to be taken up and finalisation of funding and implementation thereafter could mean that substation would be available in next 4-5 years only, however,

implementation of Bornagar S/s for reliability is a long pending matter, which was agreed in the 5th meeting of erstwhile Standing Committee on Power System Planning of NER held on 08-08-2015 wherein it was agreed that there is a need for 2nd 400kV AC node in NER for interconnection with national grid to address the case of any eventuality at Bongaigaon S/s. Accordingly, it was decided that in first phase, Bornagar S/s may be implemented in ISTS as 400kV switching station with space provision for 400kV switchyard along with 400/220kV ICTs; and the 400/220kV ICTs can be installed subsequently as when implementation modalities and timeline for implementation of Bornagar (AEGCL) S/s is finalised. It was decided that AEGCL would regularly update status of Bornagar (AEGCL) 220/132kV S/s in CMETS-NER and at suitable time installation of ICTs at Bornagar (ISTS) S/s can be planned.

Keeping in view RoW issues near Bongaigaon S/s, it is better to keep unutilised line portion anti-theft charged so as to utilise the same for termination of new 400kV line in the future, and there would be no impact on the tariff to be recovered by M/s ENICL for their line including the proposed unutilized line section. Further, tariff of line bays of POWERGRID at Bongaigaon end should also not be affected.

The scheme was agreed in the 26th CMETS-NER held on 27-12-2023. Schematic is given at Error! Reference source not found..

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Establishment of new 400kV Bornagar (ISTS) switching station in Assam (765kV and 220kV levels to be established in future) **Additional space for future expansion:** 6x1500MVA, 765/400kV ICTs (19x500MVA single phase including one spare unit) along with associated ICT bays at both voltage levels 5x500MVA, 400/220kV ICTs along with associated ICT bays at both voltage levels 765kV line bays (along with space for switchable line reactor) for future lines: 8 nos. 400kV line bays (along with space for switchable line reactor) for future lines: 8 nos. 220kV line bays: 10 nos. 4x330MVAr, 765kV Bus Reactors (13x110MVAr single phase including one spare unit) along with associated bays	• 420kV, 1x125MVAr Bus Reactor: 2 no. • 400kV bus reactor bays: 2 no. • 400kV line bays: i) 2 no. with provision for installation of 1x80MVAr switchable line reactor [for termination of Alipurduar (POWERGRID) – Bornagar (ISTS) 400kV D/c (Quad) line formed after shifting of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c (Quad) line from Bongaigaon (POWERGRID) end to Bornagar (ISTS) S/s] ii) 2 no. [for termination of Bongaigaon (POWERGRID) – Bornagar (ISTS) 400kV D/c (Quad) line formed after LILO of both circuits of existing Bongaigaon (POWERGRID) –

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
	3x125MVAr, 420kV Bus Reactors along with associated bays 765kV Bus Sectionaliser: 1 set 400kV Bus Sectionaliser: 1 set 220kV Bus Sectionaliser: 1 set 220kV Bus Coupler bays: 2 no. 220kV Transfer Bus Coupler bays: 2 no.	Balipara (POWERGRID) 400kV D/c (Quad) line at Bornagar (ISTS)] iii) 2 no. with provision for installation of 1x63MVAr switchable line reactor [for termination of Bornagar (ISTS) – Balipara (POWERGRID) 400kV D/c (Quad) line formed after LILO of both circuits of existing Bongaigaon (POWERGRID) – Balipara (POWERGRID) 400kV D/c (Quad) line at Bornagar (ISTS)]
2.	LILO of both circuits of existing Bongaigaon (POWERGRID) – Balipara (POWERGRID) 400kV D/c (Quad) line at Bornagar (ISTS)	About 5 km (2.5km Loop-in + 2.5km Loop-out)
3.	%Shifting of the existing line reactor of 63MVAr (along with NGR and switching equipment) at Bongaigaon (POWERGRID) S/s end in Bongaigaon (POWERGRID) – Balipara (POWERGRID) 400kV D/c (Quad) line and installation of the same as switchable line reactor (along with NGR and NGR bypass arrangement) at Bornagar (ISTS) S/s end in the Bornagar (ISTS) – Balipara (POWERGRID) 400kV D/c (Quad) line formed after above LILO.	• 420kV, 1x63MVAr switchable line reactor (along with NGR and NGR bypass arrangement) - 2 no. [line reactor along with NGR and switching equipment to be shifted from Bongaigaon (POWERGRID) S/s and installed at Bornagar (ISTS) S/s] • Switching equipment for 420kV, 1x63MVAr switchable line reactor (along with NGR and NGR bypass arrangement) - 2 no.
4.	#Disconnection of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c (Quad) line from Bongaigaon (POWERGRID) end and extension of the line for termination at Bornagar (ISTS) S/s so as to form Alipurduar (POWERGRID) – Bornagar (ISTS) 400kV D/c (Quad) line	About 70km
5.	Installation of 420kV, 1x80MVAr switchable line reactor at Bornagar (ISTS) end in each circuit of Alipurduar (POWERGRID) – Bornagar 400kV D/c (Quad) line formed after shifting of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c (Quad) line	• 420kV, 1x80MVAr switchable line reactor - 2 no. • Switching equipment for 420kV, 1x80MVAr switchable line reactor - 2 no.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
	from Bongaigaon (POWERGRID) end to Bornagar (ISTS) S/s	

Note:

(i) [%]The existing Bongaigaon (POWERGRID) – Balipara (POWERGRID) 400kV D/c (Quad) line has line reactor of 63MVAr at both ends of the line along with 30% FSC at Balipara (POWERGRID) end. With LILO of this line at Bornagar (ISTS) S/s, the line reactors (along with NGR and switching equipment) needs to be shifted from Bongaigaon (POWERGRID) end and installed at Bornagar (ISTS) end in the Bornagar (ISTS) – Balipara (POWERGRID) line section as switchable line reactor (with NGR bypass arrangement).

(ii) [#]Siliguri (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c (Quad) line was implemented by M/s East North Interconnection Company Limited (M/s ENICL, SPV of M/s Sterlite). Line bays at both ends were implemented by POWERGRID. Further, this line was LILOed at Alipurduar (POWERGRID) S/s by POWERGRID along with implementation of line bays for termination of line, resulting in formation of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c (Quad) line. The Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c (Quad) line (partly owned by M/s ENICL and partly by POWERGRID) is to be disconnected from Bongaigaon (POWERGRID) end and extended for termination at Bornagar (ISTS) S/s so as to form Alipurduar (POWERGRID) – Bornagar (ISTS) 400kV D/c (Quad) line. Upon shifting of line, the line section left unutilised at Bongaigaon (POWERGRID) end needs to be kept anti-theft charged so that the same can be used in future for termination of new line. Further, upon shifting of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) line from Bongaigaon (POWERGRID) S/s to Bornagar (ISTS) S/s, connectivity of all operational communication links through Bongaigaon has to be ensured. For the same additional OPGW and FOTE needs to be planned as per requirement.

(iii) The line lengths mentioned above are approximate as the exact line length shall be obtained after the detailed survey.

Implementation schedule: 30 months from allocation

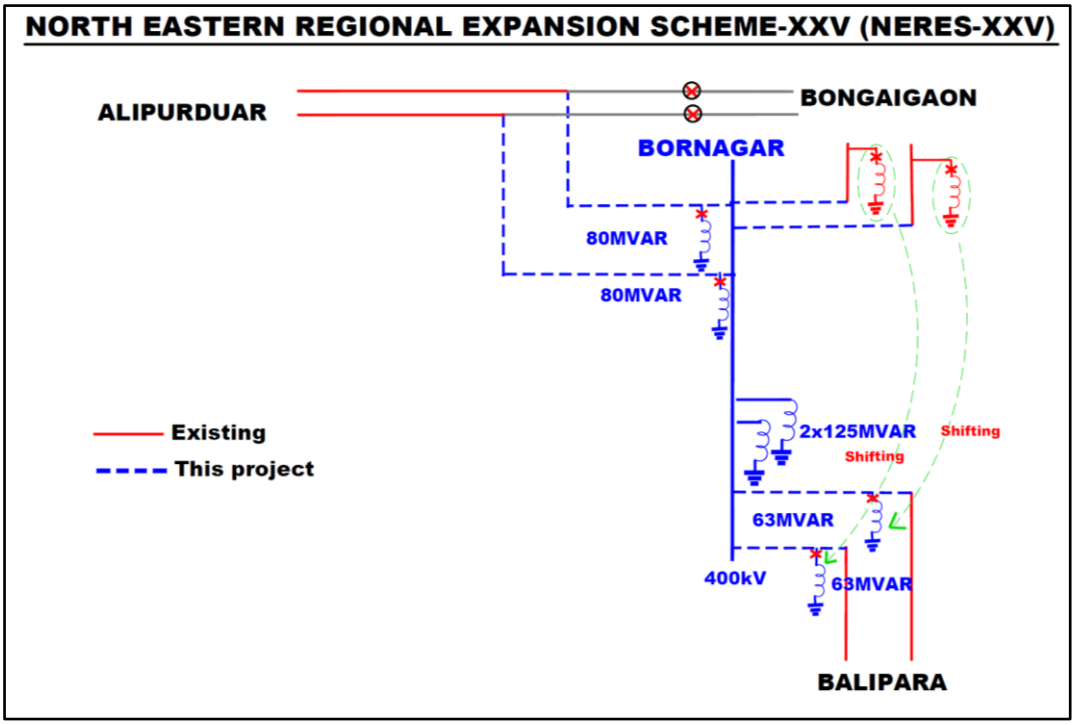


Figure 8-5: Schematic of NERES-XXV

8.4.3 Assam & Meghalaya

(i) NERES-XXIV (Reconductoring of Khandong - Haflong - Jiribam)

Khandong (NEEPCO) – Umrangshu (AEGCL) – Halflong (POWERGRID) – Jiribam (POWERGRID) 132kV corridor is owned by POWERGRID (excluding LILO portion at Umrangshu which is owned by AEGCL).

The load at Umrangshu (AEGCL) S/s is expected to rise to about 37MW (15MW present and 21.75MW new load of cement factory) by 2024 timeframe. With the addition of the load, critical loading & low voltage were observed in the Khandong (NEEPCO) – Umrangshu (AEGCL) – Halflong (POWERGRID) – Jiribam (POWERGRID) 132kV S/c line under normal and outage conditions. It was noted that the thermal limit of this 132kV corridor is about 185A (ACSR Panther) i.e. 42MVA (40MW @ 0.95pf).

Accordingly, to strengthen this corridor and to meet the additional load requirement of AEGCL at its Umrangshu S/s, reconductoring of this 132kV corridor with single HTLS conductor of rating 600A was discussed and agreed in the 25th CMETS-NER held on 29-11-2023.

ISTS portion of this corridor is to be reconductored under this scheme. The LILO portion of the corridor at Umrangshu (AEGCL) S/s is owned by AEGCL, accordingly, reconductoring of this LILO portion along with replacement of CTs of 132kV line bays of the LILO line at Umrangshu (AEGCL) S/s is being taken up by AEGCL under intra-state scheme in matching timeframe of ISTS.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Reconductoring of Khandong (NEEPCO) – Halflong (POWERGRID) 132kV S/c line [excluding the LILO portion of this line at Umrangshu (AEGCL) S/s, which is owned by AEGCL] with Single HTLS conductor of ampacity 600A (at nominal voltage level) ***Note:*** *Reconductoring of LILO portion of this line along with replacement of CTs of 132kV line bays of the LILO line at Umrangshu (AEGCL) S/s is to be taken up by AEGCL under intra-state scheme.*	63.036
2.	Reconductoring of Halflong (POWERGRID) – Jiribam (POWERGRID) 132kV S/c line with Single HTLS conductor of ampacity 600A (at nominal voltage level)	100.63

Implementation time-frame: 18 months from allocation

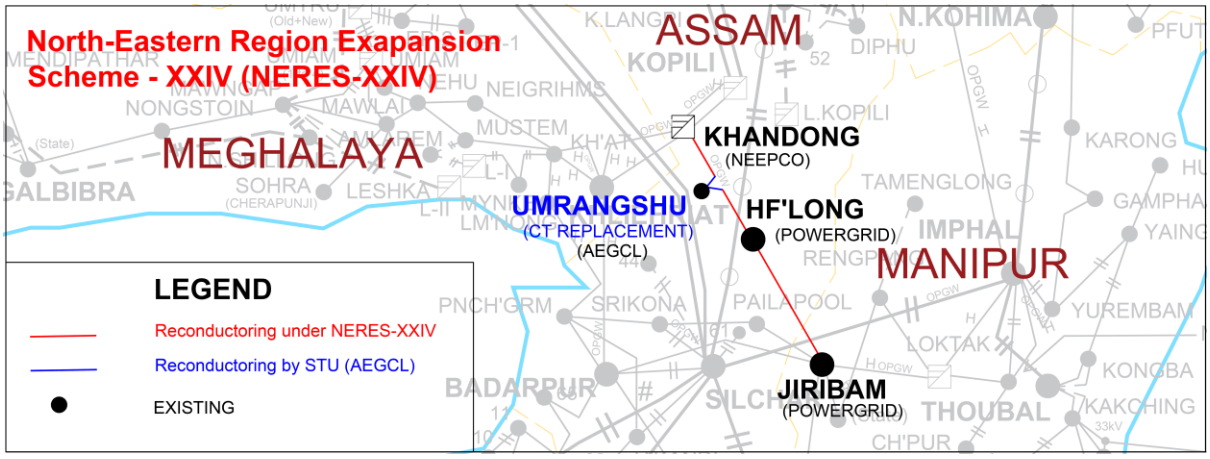


Figure 8-6: Map of NERES-XXIV

8.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in **section 8.3**, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are expected to be commissioned in 2028-29 timeframe are considered for conducting these studies. Results of these studies were analysed and the same are deliberated below-

8.5.1 Power Flow Analysis

a) Transmission lines

In the base case file prepared for 2028-29 timeframe, 2 nos. of 132 kV lines are having loading more than 70% of the thermal limit of the line. Scenarios where loading is more than 70% of rating and maximum loading obtained on these transmission lines in the simulation studies are tabulated below at

Table 8-7**.**

Table 8-7 Transmission Lines Loading in the Base Cases

(All Fig in MW)

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating	% Loading
1.	Khupi – Kimi 132kV S/c line	8	DoP, AP	64	84	76%
2.	Khliehriat (MePTCL) – Mustem 132kV S/c line	2,5	MePTCL	68	84	81%

b) Transformers

In the base case file prepared for 2028-29 timeframe, no transformers at 400kV & 220kV levels are having loading more than 80% of the ICT rating.

c) Voltage Analysis

PU voltages of all 132kV and above buses were observed in all the nine scenarios. Maximum and minimum voltage of each bus were identified from the bus voltages in the nine number of scenarios. It has been observed that there is no overvoltage beyond 1.05pu. However, list of substation where undervoltage below 0.95 is observed is given at Table 8-8.

Table 8-8 List of substations with Voltage less than 0.95 pu in North Eastern Region

Sl. No.	Bus Name	Voltage level (kV)	Owner	Min (pu)	Scenario
1.	LRPP-Lakwa	132	AEGCL	0.95	1,4
2.	Teok	132	AEGCL	0.95	1,4
3.	LTPS-Lakwa	132	AEGCL	0.95	1,4
4.	Dibrugarh	132	AEGCL	0.94	1,4
5.	Moran	132	AEGCL	0.94	1,4
6.	Nazira	132	AEGCL	0.94	1,4
7.	Sibsagar	132	AEGCL	0.93	1,4

8.5.2 Contingency Analysis

Contingency analysis has been performed on all the 400kV, 220kV and 132kV transmission lines, and 400/220kV, 400/132kV & 220/132kV transformers to ascertain the loading levels under outage of any other transmission element. Results of the analysis are discussed below:

a) Transmission Lines

Transmission lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below at **Table 8-9**.

Table 8-9: Transmission lines not meeting N-1 Criteria in NER

(All Fig in MW)

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	BTPS – Kokrajhar 132kV line-1	Gossaigaon – Agamoni 132kV line-1	2, 8	AEGCL	46	87	84	103%
2.	Gossaigaon – Agamoni 132kV line-1	BTPS – Kokrajhar 132kV line-1	2, 8	AEGCL	39	90	84	107%
3.	Dhaligaon – Bijni bypass line-1	Rangia – Nalbari 132kV line-1	2, 8	AEGCL	34	86	84	102%
4.	Rangia – Nalbari 132kV line-1	Bijni bypass – Nathkuchi 132kV line-1	8	AEGCL	48	80	84	95%
5.	Bordubi – NTPS Namrup 132kV line-1	LTPS Lakwa – Moran 132kV line-1	8	AEGCL	57	80	84	95%
6.	Bijni bypass – Nathkuchi 132kV line-1	Rangia – Nalbari 132kV line-1	8	AEGCL	33	81	84	97%
7.	Chabua – Tinsukia 132kV line-1	LTPS Lakwa – Moran 132kV line-1	2, 8	AEGCL	43	93	84	111%
8.	LTPS Lakwa – Moran 132kV line-1	Chabua – Tinsukia 132kV line-1	2, 8	AEGCL	47	93	84	110%
9.	LTPS Lakwa – Nazira 132kV line-1	LTPS Lakwa – Nazira 132kV line-2	8	AEGCL	45	82	84	97%
10.	Salakati – Geleyphu 132kV line-1	Rangia – Motanga 132kV line-1	8	ISTS	64	85	84	101%
11.	Silchar – Srikona 132kV line-1	Silchar – Srikona 132kV line-2	8	AEGCL	48	94	84	112%
12.	Khupi – Kameng 132kV line-1	Gerukamukh – Naharlagun New 132kV line-1	8	DoP, AP	65	81	84	97%
13.	Khlieriat (MePTCL)– Mustem 132kV line-1	Khlieriat (MePTCL)– Neigrihms 132kV line-1	2, 5, 6	MePTCL	69	88	84	105%
14.	Khlieriat (MePTCL)– Mynkre 132kV line-1	Khlieriat (MePTCL)– Mynkre 132kV line-2	1, 2, 3, 4, 5, 6	MePTCL	53	107	84	127%

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
15.	Leksha-MLHEP – Mynkre 132kV line-1	Leksha-MLHEP – Mynkre 132kV line-2	1, 2, 3, 4, 5, 6, 8	MePTCL	57	116	84	138%
16.	Dimapur PG – Dimapur Nagaland 132kV line-1	Dimapur PG – Dimapur Nagaland 132kV line-2	1, 2, 3, 4, 5, 8	DoP, Nagaland	57	115	84	137%

From the above, it can be seen 10 lines of AEGCL, 1 line of DoP Arunachal Pradesh, 3 lines of MePTCL, 1 line of DoP Nagaland and 1 line in ISTS is violating the N-1 contingency. Respective STU / entities may initiate actions to mitigate the overloading on their respective lines.

b) Transformers

From the analysis, it is observed that no ICTs at 400kV & 220kV level is loaded beyond 90% of MVA rating under N-1 contingency.

8.5.3 Short Circuit Analysis

Short circuit level was calculated for all 132 kV & above buses of North Eastern Region and buses having fault level more than the design rating under any scenario were identified. It is observed that the fault level at these substations is within its design limit.

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Chapter 9: Cross-Border Interconnection

Due to geographical location, India shares its boundaries with many South Asian countries and can play an important role in exchange of power to these countries for optimal utilisation of resources in particular and development of economy in general. Transmission of power is economical than transportation of fuel. Towards this, it is important to establish electrical interconnections with neighbouring countries which would be beneficial in meeting growing power demand, sharing of various types of energy resources, decreasing operational cost through better resource management, utilizing renewable energy resources and deferring investment by optimizing spinning reserve.

The details of existing, under-construction and under-discussion interconnections with the neighbouring countries viz. Bangladesh, Bhutan, Myanmar, Nepal & Sri Lanka with Indian grid to facilitate transfer of power for the benefit of both sides is given below:

9.1 India-Bangladesh

(i) Present interconnection

- 1160MW is being transferred to Bangladesh through following two links:
  - ***1000MW*** *through Baharampur (India) – Bheramara (Bangladesh) 400kV 2xD/c line along with 2x500MW HVDC Back-to-Back terminal at Bheramara.*
  - ***160MW*** *through Surajmaninagar (Tripura) – North Comilla (Bangladesh) – South Comilla 400kV D/c radial interconnection (operated at 132kV).*

(ii) Planned interconnection

- Katihar (Bihar) – Parbotipur (Bangladesh) – Bornagar (Assam) 765kV D/c line
  India is going ahead with the financing and construction of the entire cross border link. The Bangladesh side may synchronize through this link at Parbotipur at an appropriate time for 1000MW drawl of power.

9.2 India-Bhutan

(i) Present interconnection

- 2185MW is being transferred from Bhutan to India through following lines in synchronous mode of operation
  - *Kurichu HEP – Geylephu (Bhutan) – Salakati 132kV S/c*
  - *Deothang/Motonga – Rangia 132kV S/c*
  - *Chukha HEP – Birpara 220kV (3 circuits)*
  - *Tala HEP – Siliguri 400kV 2xD/c*
  - *Mangdechu HEP (Bhutan) – Jigmeling (Bhutan) – Punatsangchuu-I&II HEP (bypassed as generations are delayed) – Alipurduar 400kV D/c (Quad) line*

- *Jigmeling (Bhutan) – Alipurduar 400kV D/c (Quad) line*

(ii) Under Construction interconnection

- With the commissioning of Punatsangchu-I and II generation by 2025-26, the power transfer capacity would increase to about 4405MW.

9.3 India-Myanmar

(i) Present interconnection

- About 2-3 MW power is being supplied to Tamu (Myanmar) from Moreh (Manipur) 33/11kV, 5MVA substation through 11kV line in radial mode.

(ii) Under Discussion interconnection

- Imphal (India) - Tamu (Myanmar) high capacity AC line along with 1x500MW HVDC back-to-back
- Nampong (Arunachal Pradesh, India) - Pansong (Myanmar) 11kV S/c radial line
- Behiang (Manipur, India) - Cikha (Myanmar) 11kV S/c radial line
- Zokhawthar (Mizoram, India) - Rikhawdar (Myanmar) 11kV S/c radial line

9.4 India-Nepal

(i) Present interconnection

- 1400MW can be transferred from India to Nepal through following links in radial mode of operation:
  - *About 600MW through 132kV & below radial lines*
  - *About 800MW of power through the first high-capacity link i.e., 400kV D/c Dhalkebar (Nepal) – Muzaffarpur (India) line.*

(ii) Under Construction interconnection

- Additional 1900MW can be transferred from Nepal to India through following links:
  - Sitamarhi (POWERGRID) – Dhalkebar (Nepal) 400kV D/c (Quad) line (associated with Arun-3 HEP, Nepal): Expected by Dec 2023 – 800MW
  - Gorakhpur (India) – New Butwal (Nepal) 400kV D/c (Quad) line: Requisite approvals are being obtained to take up implementation. – 1000MW
  - Nanpara (India) - Kohlapur (Nepal) 132kV D/c line – 50MW
  - *New* Nautanwa (India) - Mainhiya (Nepal) 132kV D/c line – 50MW

(iii) Under Discussion interconnection

- New Purnea (India) - Inaruwa (Nepal) 400kV (Quad) D/c line – 1500MW
- Bareilly New (India) - Lumki (Nepal) 400kV (Quad) D/c line – 1500MW
- Upgradation of Tanakpur – Mahendranagar 132 kV Corridor

9.5 India-Sri Lanka

(i) Under Discussion interconnection

- ±320kV, 1000MW Madurai-New (India) to Mannar (Sri Lanka) HVDC line (overhead) along with 500MW VSC based HVDC terminals at both ends

The cross-border transmission capacity of India with neighbouring countries in present time-frame and through under construction interconnections is summarized below in Table 9-1:

Table 9-1: Cross-border power transfer capacity by 2028-29

(All fig in MW)

Country	Existing	Under Construction	Planned	Total
India-Bangladesh	1160	0	1000	2160
India-Bhutan	2185	2220	0	4405
India-Myanmar	3	0	504	507
India-Nepal	1400	1900	3000	6300
India-Sri Lanka	0	0	500	500
Total	**4748**	**4120**	**5004**	**13872**

A schematic of the existing, under-construction and proposed cross-border interconnections is given in Figure 9-1 below:

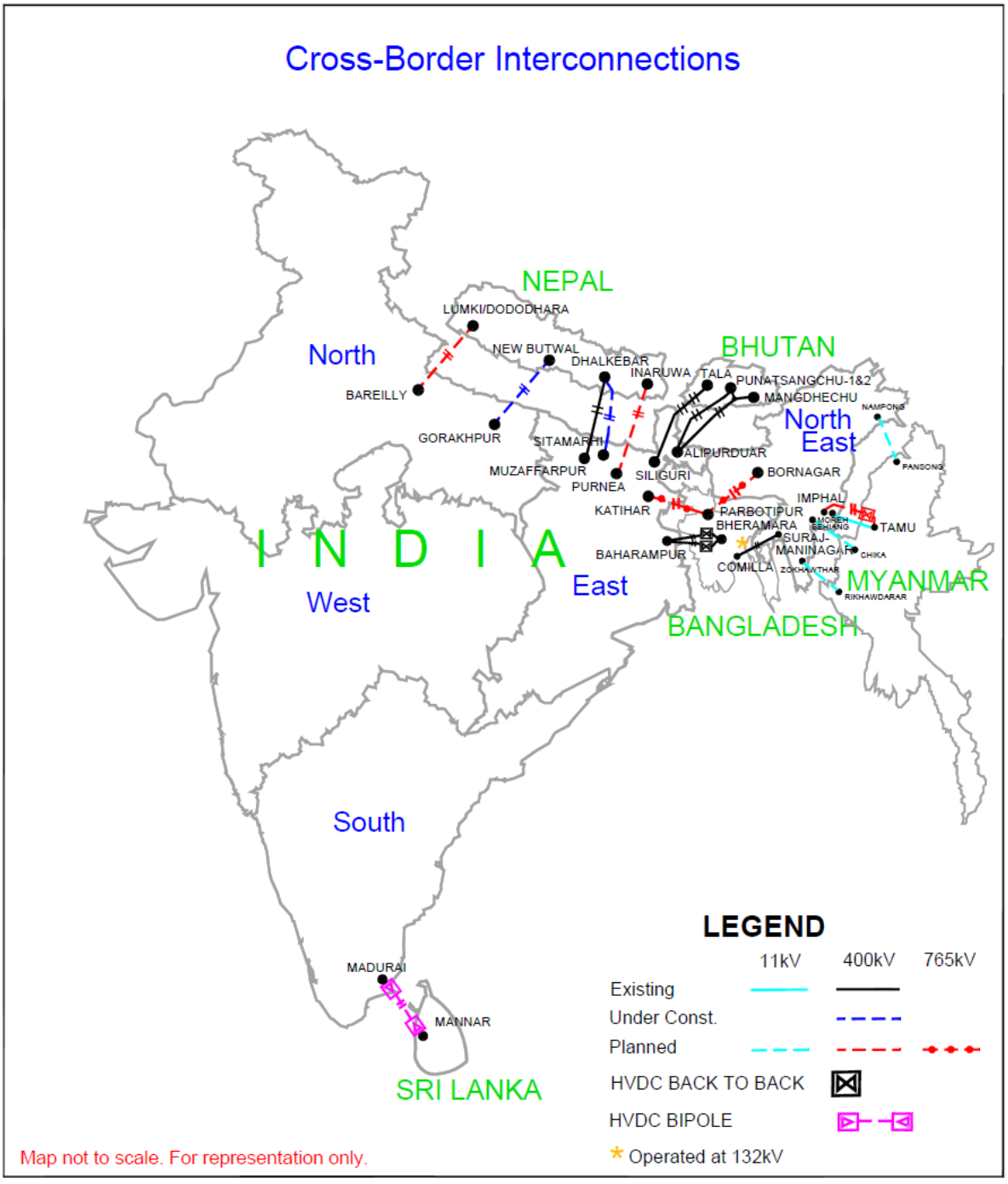


Figure 9-1 Cross-Border interconnections

Chapter 10: Conclusion

The installed capacity of generation in Indian grid is expected to increase to about 729 GW excluding ESS by 2028-29 from 430 GW as on Jan'24. It will witness an increase in contribution of non-fossil fuel-based energy sources from 44% to 62%, whereas contribution of fossil fuel-based energy source will see a decline from 56% to 38% in total installed capacity in same timeframe. This will create a pathway for India's commitment in COP26, wherein India is projected to have total installed capacity of non-fossil fuel-based generation of 500GW by the year 2030.

Power scenario of the country is quite diverse and varies continuously. RE integration with grid further enhance its complexity. Large RE complexes are expected to be established in Northern, Western, and Southern regions by 2028-29 time-frame. The transmission system for integrating the same into the grid has already been planned and is currently under various stages of approval/implementation. As substantial solar generation addition has been envisaged in Rajasthan, this has resulted in NR becoming exporter of power around noon solar max period and importer during the evening peak demand period, in all seasons. Further due to large RE integration in SR also, it is expected to export RE power in maximum scenarios except winter season. Similar situations have been witnessed in other regions as well i.e. the region is surplus under certain load-generation scenario and deficit in other. To study the seasonal and diurnal variations of generations including demand, load generation balance has been prepared for three seasons (Monsoon, Summer, and Winter) in a year with three load conditions (Solar max, Evening peak demand, and Night off-peak demand) of daily load curve for each season. All India maximum and minimum demand of 321 GW and 195 GW after accounting an additional demand of Green Hydrogen/Ammonia of about 13 GW as direct drawl from ISTS has been considered while working out the LGBs for 2028-29 timeframe.

While preparing the LGB, it has been observed that to dispatch maximum RE generation during the noon time, on bar thermal units required to meet evening peak demand are to be operated below the present technical minimum of 40% which highlights the need of energy storage in the grid to facilitate the RE integration by 2028-29. As of now, the portion of energy and peak demand met by RE as compared to total requirement is quite low. However, this will not be the case of future when a large quantum of RE will integrate with grid.

Various system studies and analysis have been conducted like power flow, contingency and short-circuit studies on All India basis as well as on Regional basis to analyse the power flow patterns on existing and planned transmission system in 2028-29 timeframe. This caters to a power transmission network planned in a manner that offers techno-feasible solution considering all the aspects without compromising the Security, Reliability and Robustness of National Grid.

Load flow including N-1 contingency studies have been conducted for all scenarios to check and analyse the power flow pattern on EHV transmission lines and interconnecting transformers. During the studies it was observed that most of the transmission lines and transformers loading are within limits except for few cases which are highlighted in report and

their detailed analysis is included in regional chapters. Further mitigation measures required, if any, for addressing loading observed beyond limit are being taken care or shall be taken care in subsequent transmission planning exercises.

Short circuit studies have also been performed on all the scenarios and fault MVA violations at 765kV and 400kV beyond the design rating are also highlighted in the report. Fault level at many of the 400 kV buses including the STU and generating station buses are observed to be beyond the design limits. Measures like bus split, bypassing of the lines and installation of series reactor to control the fault MVA level are under planning at ISTS buses. However, same also needs to be taken up at STU and generating station level by respective utilities.

In summary, existing and planned/proposed transmission network is found to be adequate for meeting the demand and integrating anticipated generation to be commissioned by 2028-29 timeframe. Further, basic network parameters of the Indian grid are within their operating limits except for few cases which are being studied in detail and necessary mitigation measures will be taken in subsequent transmission planning exercises.

Brief of transmission systems and observations from system studies for each region are as below:

Northern Region (NR)

The total installed generation capacity of NR as on Jan'24 is about 121 GW which constitute capacity from fossil sources (52% share) & balance (52% share) from Non-fossil sources in which (48%) contribution in total regional IC is from renewable generation capacity including hydro and balance (1%) is from nuclear.

NR is connected to WR and ER through 765kV & 400kV high capacity corridors along with HVDC Back to Back / HVDC Bipoles. The thermal generating stations of NR are predominantly located in Uttar Pradesh, Punjab, Rajasthan and Haryana, whereas hydro generation is concentrated in Jammu & Kashmir, Himachal Pradesh and Uttarakhand. Further, Rajasthan is a RE rich state comprising of large Solar & Wind capacity.

To meet the growing demand, NR is continuously progressing in generation capacity addition majorly through hydro and non-conventional/renewable sources. As per the 20th EPS, NR demand for 2028-29 timeframe is expected to increase to about 110 GW. As per the inputs received from various stakeholders, total installed capacity of NR for 2028-29 is expected to be about 217 GW.

Various transmission schemes i..e. transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 : 5.5GW) (Jaisalmer/Barmer Complex), Ph-IV (Part-3:.6GW) (Bikaner complex) and Ph-IV (Part-4 : 3.5GW) (Jaisalmer/Barmer Complex), Transmission system strengthening for interconnections of Bhadla-III & Bikaner-III complex, Augmentation/Replacements of 400/220kV ICTs at Fatehgarh-III, Kankroli, Nalagarh, Amargarh, New Wanpoh Bawana & Allahabad, Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line, Additional Transmission system for evacuation of power from Bhadla-III PS as

part of Rajasthan REZ Phase-III scheme (20GW) planned in the Consultation Meeting for Evolution of Transmission System in Northern Region (CMETS-NR) from Mar'23 to Feb'24 for implementation. In this Rolling Plan, 21 nos. of transmission schemes of about 4,935 ckm of transmission lines and 42,565 MVA of transformation capacity has been formulated at an estimated cost of Rs. 27,498 Cr.

During the system studies for 2028-29 timeframe, Short Circuit issues observed in various substations in Northern region due to large interconnections have been highlighted. Further, some transformers are also observed to be loaded beyond limit majorly in Rajasthan & Uttar Pradesh. Some of the transmission lines are critically loaded in Uttar Pradesh under Base case / N-1 contingency. New network expansions schemes and mitigation measures to address above issues in Northern Region are being taken up on a continuous basis and would be taken up in the subsequent rolling plan after detailed analysis.

Thus, cumulatively by 2029-30, transmission schemes comprising of 23,750 ckm of transmission lines and transformation capacity of 1,61,255 MVA at estimated cost of Rs 1,24,700 Cr. is expected to be added in the grid.

Western Region (WR)

The total installed generation capacity of WR as on Jan'24 is about 141GW which constitute capacity from fossil sources (62% share) & balance (38% share) from Non-fossil sources comprising of nuclear, renewable generation capacity including hydro.

Western Region is connected to Northern, Southern and Eastern Regions through 765kV & 400kV high-capacity corridors along with Back to Back HVDCs and Bi-Pole HVDC links. The thermal generating stations of Western Regions are predominantly concentrated in the coal rich states of Chhattisgarh, Eastern part of Maharashtra and Madhya Pradesh. Further, Gujarat, Maharashtra and Madhya Pradesh are RE rich states comprising of large Solar & Wind capacity. Western part of Maharashtra, southern Gujarat and DD & DNH have high demand and less internal generation.

To meet the growing demand, Western region is continuously progressing in generation capacity addition majorly through thermal and non-conventional/renewable sources. The peak demand of Western Region for 2028-29 timeframe is expected to increase to about 100 GW. In addition to above, the demand of about 10 to 15 GW corresponding to bulk consumer / distribution licensees is expected to be added to the grid by 2028-29. As per the inputs received from various stakeholders, total installed capacity of Western Region for 2028-29 is expected to be about 213 GW.

Various transmission schemes from Mar'23 to Feb'24 have been evolved such as Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW) & Phase-IV (8 GW), Transmission System for Offshore Wind Zone (500MW) Phase-1, Augmentation at Bhuj-II PS, Lakadiya PS, Khambhaliya PS & Network Expansion scheme in Kallam area of Maharashtra and is expected to play a major role in fulfilling India's vision of generating 500 GW of non-fossil generation capacity by 2030.

Further, augmentation of ICTs at Magarwada, Indore, Bhachau Boisar & Network Expansion scheme in Gujarat for drawl of about 3.6 GW load under Phase-I in Jamnagar area have also been evolved to meet the growing demand in WR & to cater to bulk consumer loads. Additionally, transmission system to cater to the power requirement of the upcoming Green Hydrogen and Green Ammonia manufacturing hubs in Western Region by 2028-29 (9.5GW at Navinal (Mundra) and 2.465GW at Kandla) has also been planned as a part of the Hydrogen Mission announced by Hon'ble Prime Minister of India on 15th August 2021.

In this Rolling Plan, 44 nos. of transmission schemes of about 7528 ckm of transmission lines and transformation capacity of 87,730 MVA have been formulated at an estimated cost of Rs. 78, 935Cr. These schemes either have been approved or are under various stages of approval. Further, new network expansions in Western Region are being taken up on a continuous basis and the mitigation measures identified would be taken up for detailed analysis.

Thus, cumulatively by 2028-29, transmission schemes comprising of 14,199 ckm of transmission lines and transformation capacity of 156, 230 MVA at an estimated cost of Rs 107,046 Cr. is expected to be added in the grid.

Southern Region (SR)

The total installed generation capacity of SR as on Jan'24 is about 128 GW which constitute capacity from fossil sources (47% share) & balance (53% share) from Non-fossil sources in which (50%) contribution in total regional IC is from renewable generation capacity including hydro and balance (3%) is from nuclear.

Southern Region is connected to Western and Eastern regions through high capacity 765kV AC links, Back-to-Back HVDC and Bi-pole HVDC links. The thermal generating stations of Southern Region are predominantly concentrated in the States of Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. Further, Tamil Nadu, Karnataka and Andhra Pradesh are RE rich states comprising of large scale Solar & Wind capacity. Southern part of Karnataka (Bangalore), Kerala and Central part of Telangana (Hyderabad) has high demand and less internal generation.

To meet the growing demand, Southern region is continuously progressing in generation capacity addition majorly through thermal and non-conventional/renewable sources. Southern Region demand for 2028-29 timeframe is expected to increase to about 92 GW. As per the inputs received from various stakeholders, total installed capacity of Southern Region for 2028-29 is expected to be about 229 GW.

Various transmission systems of about Rs. 21000 crs. have been evolved in the Consultation Meeting for Evolution of Transmission System in SR (CMETS-SR) from Mar'23 to Feb'24 for implementation. These schemes have either been approved or under various stages of approval. Transmission system for integration of additional RE potential of about 15 GW in Gadag, Koppal, Davangere, Bijapur, Bellary & Tumkur area in Karnataka, 3 GW in Kurnool area in Andhra Pradesh and 2 GW in Tamil Nadu have been evolved. The proposed scheme will facilitate in integration and immediate evacuation of RE potential areas of Karnataka,

Andhra Pradesh and Tamil Nadu which are under various stages of approval. Transmission System for prioritized 1 GW Offshore wind farms in Tamil Nadu has been evolved as a major step towards development of Off shore wind in India. Further, Reconductoring of Maheshwaram(PG) – Hyderabad 400kV S/c line and Somanahalli – Bidadi 400kV D/c line with HTLS conductor has also been approved to relive the overloading of transmission line.

During the system studies for 2028-29 timeframe, Short Circuit issues observed in Tamil Nadu, Telangana, Karnataka and Andhra Pradesh due to large interconnections have been highlighted. Further, some transformers are also observed to be loaded beyond limit in Tamil Nadu, Telangana, Karnataka, Kerala and Andhra Pradesh. Most of these ICTs are located in Tamil Nadu. Some of the transmission lines are critically loaded under Base case / N-1 contingency. New network expansions schemes and mitigation measures to address above issues in Southern Region are being taken up on a continuous basis and would be taken up in the subsequent rolling plan after detailed analysis.

As per the timelines provided in the CEA report for integration of over 500 GW RE capacity by 2030, entire Phase-I & Phase-II potential of additional 181.5 GW RE capacity by 2030 has been considered in this Rolling Plan. Some of the transmission lines and ICTs are observed to be critically loaded at locations where RE potential is getting pooled from various pockets. Measures to control these loadings shall be planned in coordinated manner upon materialization of the RE potential (part of 181.5 GW REZs).

Further, a number of Green hydrogen / Green Ammonia plants are also planned in Southern Regin for which applications are being received under GNA from various developers. Under such scenarios, SR grid is expected to continue to be in deficit situations during peak load conditions (Feb-Apr/May of a Year) and import requirements from NEW grid are expected to further increase from the present level of 21 GW. Detailed system studies shall be carried out in consultation with constituents for identification of additional inter-regional links to cater to above import requirements of Southern Region.

Cumulatively by 2028-29, transmission schemes comprising of 8,524 ckm of transmission lines and transformation capacity of 127,760 MVA at estimated cost of Rs 52,155 Cr. is expected to be added in the grid.

Eastern Region (ER)

The total installed generation capacity of ER as on Jan’24 is about 35GW which constitute capacity from fossil sources (81% share) & balance (19% share) from Non-fossil sources comprising of renewable generation capacity including hydro.

Eastern Region is connected to all other regions though 765kV & 400kV high-capacity corridors along with HVDC Back to Back/ HVDC Bipole lines. The thermal generating stations of ER are predominantly located in Bihar, Jharkhand and Odisha whereas hydro generation are concentrated primarily in Sikkim. Eastern region is also connected to other countries such as Nepal, Bhutan and Bangladesh through high-capacity AC and HVDC links.

To meet the growing demand, Eastern region is continuously progressing in generation capacity addition majorly through thermal and hydro generation sources. The peak demand of Eastern Region for 2028-29 timeframe is expected to increase to about 42.5 GW. In addition to above, the demand of about 2.2GW corresponding to bulk consumer / distribution licencees is expected to added to the grid by 2028-29. As per the inputs received from various stakeholders, total installed capacity of Eastern Region for 2028-29 is expected to be about 66 GW (including 3.2GW in Nepal and 4.5GW in Bhutan).

Various transmission schemes such as establishment of Gopalpur 765/400kV (ISTS) GIS S/s through Angul – Gopalpur 765kV D/c corridor & Gopalpur (ISTS) – Gopalpur (OPTCL) 400kV D/c (quad) line, augmentation of ICTs at Arrah, Lakhisarai & Rajarhat S/s, line reactors at Malda, bypassing at Ranchi & Rangpo and lines bays at ISTS end for Talcher-III and Rammam HEP have been evolved in the Consultation Meeting for Evolution of Transmission System in Eastern Region (CMETS-ER) from Mar'23 to Feb'24. In this Rolling Plan, 10 nos. of transmission schemes of about 503 ckm of transmission lines and 4,700 MVA of transformation capacity have been formulated at an estimated cost of Rs. 3,722 Cr. These schemes either have been approved or are under various stages of approval. Further, new network expansions in Eastern Region are being taken up on a continuous basis and the mitigation measures identified would be taken up for detailed analysis in the subsequent rolling plan.

Thus, cumulatively by 2028-29, transmission schemes comprising of 1088 ckm of transmission lines and transformation capacity of 8,750 MVA at estimated cost of Rs 8,077 Cr. is expected to be added in the grid.

North Eastern Region (NER)

The total installed generation capacity of NER as on Jan'24 is about 5GW which constitute capacity from fossil sources (51% share) & balance (49% share) from Non-fossil sources comprising of renewable generation capacity including hydro.

North Eastern Region is connected to Eastern Region and North Region though 400kV high-capacity corridors along with multi-terminal HVDC. The thermal generating stations of Northern Eastern Region are located in Assam, gas generations are situated in Assam and Tripura whereas hydro generation is concentrated primarily in Arunachal, Manipur & Meghalaya.

To meet the growing demand, NER is continuously progressing in generation capacity addition majorly through hydro generation sources. The peak demand of North Eastern Region for 2028-29 timeframe is expected to increase to about 5.5 GW. As per the inputs received from various stakeholders, total installed capacity of Northern Eastern Region for 2028-29 is expected to be about 8.2 GW.

Various transmission schemes i.e. transmission system for evacuation of power from 750MW APDCL Solar at Bokajan, Bornagar S/s and associated transmission system, upgradation of Khliehriat 132kV switching station from AIS to GIS and Badarpur 132kV Switching Station

from AIS to Green GIS, Bongaigaon bus reactor, reconductoring of Khandong - Haflong – Jiribam corridor have been approved in the Consultation Meeting for Evolution of Transmission System in North Eastern Region (CMETS-NER) from Mar'23 to Feb'24. In this Rolling Plan, 6 nos. of transmission schemes of about 115 ckm of transmission lines and reconductoring of 163 ckm of transmission lines have been formulated at an estimated cost of Rs. 903 Cr. These schemes have either been approved or are under various stages of approval.

Thus, cumulatively by 2028-29, transmission schemes comprising of 1,056 ckm of transmission lines and transformation capacity of 2,040 MVA at estimated cost of Rs 3,331 Cr. is expected to be added in the grid.

Further, evacuation of power from future hydro projects primarily in Arunachal Pradesh would be planned after firm commission schedule and significant progress in the hydro generation projects. New network expansion schemes in North Eastern Region are being taken up on a continuous basis and the mitigation measures identified would be taken up for detailed analysis in the subsequent rolling plan.

Cross Border Interconnections (CB)

The existing cross-border interconnections facilitate power transfer of about 4748MW (2185MW: Bhutan, 1160MW: Bangladesh, 1400MW: Nepal and 3MW: Myanmar) with the neighbouring countries. With the commissioning of under-construction cross-border interconnections which are expected in 2-3 years, the power transfer would enhance by about 4120MW resulting in total of about 8868MW (4405MW: Bhutan, 1160MW: Bangladesh, 3300MW: Nepal and 3MW: Myanmar).

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Annexures

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Annex-1.1

Data Collection

For initiating Rolling plan associated activities for upcoming cycle i.e., Oct'23 to Mar'24 for 2028-29 timeframe, a letter dated 04.10.2023 from CTU was sent to all the concerned stakeholders via email dated 05.10.2023 and the same was also published on CTUIL website for providing necessary inputs for preparation of Rolling plan report in this cycle. Status of inputs received from stakeholders is as under:

NR	Inputs received from NLDC
WR	Inputs received from Gujarat, Madhya Pradesh, Maharashtra
SR	Inputs received from all SR states
ER	Inputs received from West Bengal
NER	Inputs received from NERLDC

Further the updated list of nominations of nodal officers received from various stakeholders for association in preparation of Rolling plan report are as under:

Sr. No	State/Organisation	Name	Designation
NR			
1.	Rajasthan/RVPN	Sh. Sanjay Mathur	SE
2.	Rajasthan/RVPN	Dr. Om Prakash Mahela	Executive Engineer (PP&D)
3.	Haryana/HVPN	Shri Sanjay Verma	SE (Planning)
4.	Haryana/HVPN	Shri Deepak Sarit	XEN (SS)
5.	Punjab/PSTCL	Shri Vivek Khanna	Dy CE
6.	Punjab/PSTCL	Shri Nitin Kumar	Sr. XEN (Planning)
7.	Uttar Pardesh/UPPTCL	Shri Satyendra Kumar	SE (Planning)
8.	Uttrakhand/PTCUL	Shri Lalit Kumar	SE
9.	Uttrakhand/PTCUL	Shri Ashok Kumar	Executive Engineer
10.	Himachal Pardesh/HPPTCL	Shri Suresh Sharma	DGM (Planning)
11.	Himachal Pardesh/HPPTCL	Shri Harmanjeet Singh	AE
12.	J&K/JKPTCL	Shri Ehtisham Andrabi	Assistant EE
13.	J&K/JKPTCL	Shri K. K. Thappa	SE
14.	Delhi/DTL	Shri Dinesh	Manager (Planning)
WR			
15.	Gujarat/GETCO	Shri K. J. Bhuva	Additional Chief Engineer(R&C)
16.	Gujarat /GETCO	Shri Shri S. M. Soni	Superintending Engineer

Sr. No	State/Organisation	Name	Designation
17.	Gujarat/GETCO	Shri Dipak H. Patel	Dy. Engineer
18.	Madhya Pradesh /MPPTCL	Shri Sanjay Kulshreshtha	Chief Engineer (Planning & Design)
19.	Madhya Pradesh /MPPTCL	Shri M.M.Dhoke	Supreintending Engineer
20.	Chhattisgarh /CSPTCL	Shri Shri Manoj Verma	Executive Engineer O/o ED (Planning & Project)
21.	Chhattisgarh /CSPTCL	Shri C.K.S. Thakur	Executive Engineer O/o CE (C&RA)
22.	Maharashtra/MSETCL	Shri Mr. Amit Naik	Superintending Engineer, STU
23.	Maharashtra/MSETCL	Shri Vinay Khedekar	ADEE, STU
SR			
24.	Andhra Pradesh	Shri L. Pardha Sarathi	DEE4/SS1
25.	Andhra Pradesh	Shri K. Vamsi Krishna	DEE2/SS2
26.	Karnataka/KPTCL	Smt. Gayathri B Kulkarni	Executive Engineer (Elec)
27.	Karnataka/KPTCL	Shri B. P Madhu	Executive Engineer (Elec)
28.	Tamil Nadu /TANTRANSCO	Shri L. Porchelvi	Asst. Executive Engineer
29.	Tamil Nadu /TANTRANSCO	Shri D. Narendran	Asst. Engineer
30.	Telangana	Shri P Srinivasu	ADE
31.	Telangana	Smt. P. Saritha Kumari	ADE
32.	KSEB	Smt. Amritha Sasi	AEE (PSE)
33.	Puducherry	Shri M Ramesh	EE
ER			
34.	ERPC	Sh. N. S. Mondal	MS, ERPC
35.	ERPC	P.P. Jena	EE
36.	ERPC	Alik De	
37.	Bihar	Sunil Agrwal	Director (Projects)
38.	Bihar	Kumar Prasant	CE (P&E), BSPTCL
39.	Bihar	Pervez Alam	CE (STU), BSPTCL
40.	Bihar	Rakesh Kumar	ESE(P&E), BSPTCl
41.	Bihar	Abhishek Kumar	EEE(P&E), BSPTCL

Sr. No	State/Organisation	Name	Designation
42.	Jharkhand	Manoj Karmali	Director (Project)
43.	Jharkhand	Ajit Kumar Bhagat	Sr Mgr (C&M)
44.	Jharkhand	Atilesh Gautam	Sr Mgr (STU)
45.	Jharkhand	Shailesh	DGM SLDC
46.	Jharkhand	Rishi Nandan	GM comm
47.	West Bengal	Debashis Chaki	Chief Engineer
48.	West Bengal	Ranjan Das	Addl. CE
49.	Odisha	S.K.Panigrahi	CGM (CP)
50.	Odisha	A.K. Banerjee	DGM (CP)
51.	Sikkim	Sunil Rai	Chief Engineer (Transmission)
52.	Sikkim	Ashish Lamichaney	AE (EHV)
53.	Sikkim	Sonam Wongchuk Lepcha	AE (SLDC)
54.	DVC	Jayanta Dutta	Sr. GM, Engineering
55.	DVC	Sushil Kumar	Senior Manager(E), SPM
56.	DVC	Amiyaranjan Swain	Manager(E), SPM
57.	DVC	Preetosh Ghosh	Dy. Manager(E), SLDC
58.	ERLDC	Shyamal Konar	GM
59.	ERLDC	Saugato Mondal	Sr. DGM
60.	ERLDC	Bilash Achari	DGM
NER			
61.	NERPC	K.B.Jagtap	Member Secretary
62.	NERPC	S.M. Aimol	Director
63.	NERPC	Abhijit Agrawal	DD
64.	NERPC	Vikash Shankar	AD
65.	NERLDC	Amaresh Mallick	CGM(I/C)
66.	NERLDC	S C De	Sr. GM (SO-II)
67.	NERLDC	Biswajit Sahu	Sr. GM (MO)

Sr. No	State/Organisation	Name	Designation
68.	NERLDC	Palash Jyoti Borah	Manager, NERLDC
69.	NERLDC	Sachin Singh	Dy Manager, NERLDC
70.	NERLDC	Manjeet Choudhary	
71.	Assam	Debasish Choudhury,	DGM(Operation), SLDC
72.	Assam	Tridip Borah	AGM(T), AEGCL
73.	Assam	Neelkamal Sarma	DM (P&D), AEGCL
74.	Assam	Dipmoni Nath	AM (T), AEGCL
75.	Arunachal Pradesh	T. K. Tara	S.E.(Trans.)
76.	Arunachal Pradesh	Moli Kamki	Assistant Engineer (Electrical)
77.	Meghalaya	J. Hynniewta	C.E.(Trans)
78.	Meghalaya	H.F.Shangpliang	A.C.E.(Trans.)
79.	Meghalaya	W.Wanrieh	A.C.E.(P&D)
80.	Meghalaya	T.Gidon	S.E.(SLDC)
81.	Meghalaya	D J Lyngdoh	SLDC Meghalaya
82.	Nagaland	A. Jakhalu	S.E.(Trans.)
83.	Nagaland	Nitovi Wotsa	S.E.(SLDC)
84.	Nagaland	Asangba Tikhir	E.E.(Trans)
85.	Manipur	Pangambam Yaiphaba	DGM (Trans Planning)
86.	Manipur	J.H. Malsawma	S.E.(Planning)
87.	Manipur	Lalruatkima	E.E.(SLDC)
88.	Tripura	Ranjan Debbarman	GM(Trans.) TPTL
89.	Tripura	Nirupam Guha	AGM
90.	Tripura	Anil Debbarma	DGM(SLDC)

Annex-3.1

Load Generation Balance (LGB)

Monsoon (Aug'28)

Installed Capacity

Region	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas	Total	EPS Peak Demand	App. Peak Demand	ISTS Demand
NR	11880	41838	0	53718	4420	25269	95320	15401	1360	13000	3583	216570	109714	98351	**0**
WR	20600	35760	36802	93162	3240	6078	55958	41249	0	3602	10139	217928	100246	89864	**10900**
SR	15270	34448	3180	52898	5820	12380	78031	57443	2119	18980	1512	233682	91285	81831	**0**
ER	29480	14450	4500	48430	0	14026	2518	0	0	900	0	66274	42546	38140	**2199**
NER	750	0	0	750	0	4375	1100	0	0	0	1854	8179	5481	4913	**0**
	77980	**126495**	**44482**	**248957**	**13480**	**62127**	**232927**	**114093**	**3479**	**36482**	**17087**	**742633**	**313098**	313098	13099
		248957					**426627**						349272	**326197**	

Scenario 1 : Solar Max Aug 2028

factor	Thermal	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other	ESS	Gas		National DF	DF
NR	22%	25%	0%	25%	80%	70%	90%	50%	0%	-100%	0%		86%	92%
WR	27%	9%	28%	13%	80%	40%	80%	55%	0%	-100%	0%		92%	98%
SR	14%	17%	25%	42%	80%	40%	80%	55%	0%	-100%	0%		89%	96%
ER	20%	14%	26%	6%	80%	70%	80%	0%	0%	-100%	0%		84%	90%
NER	40%	0%	0%	44%	80%	70%	80%	0%	0%	-100%	0%		72%	77%
	21%	17%	28%	20%									98%	307637

Availability	Central	State	IPP	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	2628	10548	0	13199	3536	17688	85788	7701	90560	-13000	0	114889	94295	20593	114889	94295	0
WR	5504	3331	10348	12151	2592	2431	44766	22687	92017	-3602	0	88057	103159	-15101	88057	92259	10900
SR	2212	5959	792	22229	4656	4952	62425	31594	73586	-18980	0	93610	81491	12119	93610	81491	0
ER	5996	2054	1164	2718	0	9818	2014	0	36012	-900	0	20147	37830	-17683	20147	35631	2199
NER	300	0	0	329	0	3063	880	0	3631	0	0	4243	3960	282	4243	3960	0
Total	**16640**	**21892**	**12304**	**50627**	**10784**	**37952**	**195874**	**61981**	**295807**	**-36482**	**0**	**320945**	**320736**	**210**	**320945**	**307637**	**13099**
		50836					**295807**						329245				

Scenario 2 : Peak load Aug 2028

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas	0	National DF	Regional DF
NR	60%	64%	0%	75%	80%	95%	0%	70%	0%	60%	50%		87%	93%
WR	57%	47%	60%	42%	80%	70%	0%	75%	0%	60%	50%		81%	87%
SR	14%	30%	25%	28%	80%	70%	0%	75%	0%	60%	50%		72%	77%
ER	36%	54%	55%	47%	80%	90%	0%	0%	0%	60%	50%		90%	96%
NER	40%	0%	0%	166%	80%	90%	0%	0%	0%	60%	50%		71%	76%
	41%	49%	57%	48%									91%	**284987**

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	7115	26820	0	40349	3536	24005	0	10781	42336	7800	1791	81848	95812	-13964	81848	95812	0
WR	11696	16806	21990	39256	2592	4254	0	30937	43017	2161	5069	95505	92096	3410	95505	81196	10900
SR	2212	10277	792	14753	4656	8666	0	43083	34401	11388	756	81829	65953	15875	81829	65953	0
ER	10733	7795	2474	22978	0	12623	0	0	16835	540	0	34164	40353	-6189	34164	38154	2199
NER	300	0	0	1248	0	3938	0	0	1697	0	927	5164	3872	1292	5164	3872	0
Total	**32055**	**61698**	**25255**	**118583**	**10784**	**53487**	**0**	**84800**	**138287**	**21889**	**8543**	**298511**	**298086**	**425**	**298511**	**284987**	**13099**
		119008					**138287**						304868				

Scenario 3 : off peak load Aug 2028

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	60%	46%	0%	55%	80%	70%	0%	60%	0%	40%	50%		68%	72%
WR	50%	30%	54%	31%	80%	40%	0%	65%	0%	40%	50%		62%	66%
SR	14%	23%	25%	29%	80%	40%	0%	65%	0%	40%	50%		61%	66%
ER	28%	41%	55%	42%	80%	70%	0%	0%	0%	40%	50%		76%	81%
NER	40%	0%	0%	99%	80%	70%	0%	0%	0%	40%	50%		55%	59%
	36%	35%	52%	38%									73%	227096

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	7115	19452	0	29471	3536	17688	0	9241	34087	5200	1791	64022	74085	-10063	64022	74085	0
WR	10382	10726	19767	29095	2592	2431	0	26812	34635	1441	5069	79219	72833	6387	79219	61933	10900
SR	2066	7908	792	15180	4656	4952	0	37338	27698	7592	756	66060	55882	10178	66060	55882	0
ER	8321	5869	2474	20447	0	9818	0	0	13555	360	0	26842	34362	-7521	26842	32163	2199
NER	300	0	0	739	0	3063	0	0	1367	0	927	4289	3033	1256	4289	3033	0
Total	**28184**	**43954**	**23032**	**94932**	**10784**	**37952**	**0**	**73391**	**111343**	**14593**	**8543**	**240433**	**240195**	**238**	**240433**	**227096**	
		95170					**111343**						243133				

Summer (Jun'28)

Installed Capacity

Region	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas	Total	EPS Peak Demand	App. Peak Demand	ISTS Demand	
NR	11880	41838	0	53718	4420	25269	95320	15401	1360	13000	3583	216570	109714	98351	**0**	
WR	20600	35760	36802	93162	3240	6078	55958	41249	0	3602	10139	217928	100246	89864	**10900**	
SR	15270	34448	3180	52898	5820	12380	78031	57443	2119	18980	1512	233682	91285	81831	**0**	
ER	29480	14450	4500	48430	0	14026	2518	0	0	900	0	66274	42546	38140	**2199**	
NER	750	0	0	750	0	4375	1100	0	0	0	1854	8179	5481	4913	**0**	
	77980	**126495**	**44482**	**248957**	**13480**	**62127**	**232927**	**114093**	**3479**	**36482**	**17087**	**742633**	**313098**	313098	13099	
		248957					**426627**						349272	**326197**		

Scenario 4 : Solar Max Jun 2028

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	18%	9%	0%	4%	80%	70%	90%	50%	0%	-100%	0%		78%	83%
WR	21%	3%	18%	4%	80%	40%	85%	55%	0%	-100%	0%		85%	91%
SR	0%	0%	0%	23%	80%	40%	85%	55%	0%	-100%	0%		80%	86%
ER	11%	6%	26%	8%	80%	70%	85%	0%	0%	-100%	0%		88%	94%
NER	40%	0%	0%	-20%	80%	70%	85%	0%	0%	-100%	0%		65%	70%
	13%	4%	18%	8%									91%	284735

Availability	Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	2100	3857	0	1936	3536	17688	85788	7701	92667	-13000	0	107670	85139	22531	107670	85139	0
WR	4336	900	6745	3304	2592	2431	47564	22687	94157	-3602	0	83654	96451	-12798	83654	85551	10900
SR	0	0	0	12051	4656	4952	66326	31594	75298	-18980	0	88548	73025	15523	88548	73025	0
ER	3328	900	1164	3707	0	9818	2140	0	36850	-900	0	16450	39657	-23206	16450	37458	2199
NER	300	0	0	-153	0	3063	935	0	3715	0	0	4298	3563	735	4298	3563	0
Total	**10064**	**5657**	**7909**	**20845**	**10784**	**37952**	**202754**	**61981**	**302687**	**-36482**	**0**	**300619**	**297834**	**2785**	**300619**	**284735**	
		23630					**302687**						304874				
24%	**StateTh**																

Scenario 5 : Peak Load Jun 2028

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	60%	64%	0%	81%	80%	95%	0%	70%	0%	50%	50%		89%	95%
WR	57%	44%	61%	42%	80%	70%	0%	75%	0%	50%	50%		81%	86%
SR	10%	30%	44%	26%	80%	70%	0%	75%	0%	50%	50%		69%	74%
ER	38%	50%	55%	42%	80%	90%	0%	0%	0%	50%	50%		84%	89%
NER	40%	0%	0%	152%	80%	90%	0%	0%	0%	50%	50%		69%	73%
	41%	48%	59%	47%									**90%**	**280783**

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	7115	26820	0	43580	3536	24005	0	10781	42336	6500	1791	80548	97743	-17195	80548	97743	0
WR	11696	15846	22524	39157	2592	4254	0	30937	43017	1801	5069	94720	91636	3084	94720	80736	10900
SR	1560	10277	1386	13668	4656	8666	0	43083	34401	9490	756	79873	62970	16902	79873	62970	0
ER	11247	7208	2474	20485	0	12623	0	0	16835	450	0	34002	37770	-3768	34002	35571	2199
NER	300	0	0	1138	0	3938	0	0	1697	0	927	5164	3763	1402	5164	3763	0
Total	**31918**	**60151**	**26384**	**118027**	**10784**	**53487**	**0**	**84800**	**138287**	**18241**	**8543**	**294307**	**293882**	**425**	**294307**	**280783**	
		118452					**138287**						300162				
51%	**StateTh**																

Scenario 6 : Off peak Load Jun 2028

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	60%	44%	0%	53%	80%	70%	0%	60%	0%	1%	50%		62%	66%
WR	50%	29%	55%	30%	80%	40%	0%	65%	0%	1%	50%		59%	63%
SR	10%	27%	25%	36%	80%	40%	0%	65%	0%	1%	50%		58%	62%
ER	25%	32%	55%	33%	80%	70%	0%	0%	0%	1%	50%		65%	69%
NER	40%	0%	0%	119%	80%	70%	0%	0%	0%	1%	50%		58%	62%
	34%	34%	52%	37%									67%	210406

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	7115	18301	0	28204	3536	17688	0	9241	34087	130	1791	57802	67748	-9947	57802	67748	0
WR	10382	10368	20065	27980	2592	2431	0	26812	34635	36	5069	77756	70313	7443	77756	59413	10900
SR	1533	9377	792	19228	4656	4952	0	37338	27698	190	756	59594	52527	7067	59594	52527	0
ER	7512	4571	2474	16169	0	9818	0	0	13555	9	0	24383	29733	-5350	24383	27534	2199
NER	300	0	0	890	0	3063	0	0	1367	0	927	4289	3184	1106	4289	3184	0
Total	**26842**	**42617**	**23331**	**92471**	**10784**	**37952**	**0**	**73391**	**111343**	**365**	**8543**	**223824**	**223505**	**319**	**223824**	**210406**	
		92790					**111343**						225277				
46%	**StateTh**																

Winter (Feb'29)

Installed Capacity

Region	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas	Total	EPS Peak Demand	App. Peak Demand	ISTS Demand
NR	11880	41838	0	53718	4420	25269	95320	15401	1360	13000	3583	216570	109714	98351	**0**
WR	20600	35760	36802	93162	3240	6078	55958	41249	0	3602	10139	217928	100246	89864	**10900**
SR	15270	34448	3180	52898	5820	12380	78031	57443	2119	18980	1512	233682	91285	81831	**0**
ER	29480	14450	4500	48430	0	14026	2518	0	0	900	0	66274	42546	38140	**2199**
NER	750	0	0	750	0	4375	1100	0	0	0	1854	8179	5481	4913	**0**
	77980	**126495**	**44482**	**248957**	**13480**	**62127**	**232927**	**114093**	**3479**	**36482**	**17087**	**742633**	**313098**	313098	13099
		248957					**426627**						349272	**326197**	

Scenario 7 : Solar max Feb 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	22%	22%	0%	26%	80%	30%	90%	10%	0%	-100%	0%		69%	73%
WR	33%	25%	40%	28%	80%	20%	90%	10%	0%	-100%	0%		87%	93%
SR	26%	40%	40%	68%	80%	20%	90%	0%	0%	-100%	0%		87%	93%
ER	37%	20%	40%	4%	80%	30%	90%	0%	0%	-100%	0%		63%	68%
NER	40%	0%	0%	13%	80%	30%	90%	0%	0%	-100%	0%		54%	58%
	31%	28%	40%	31%									87%	271258

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Availability	Demand	ISTS Demand
NR	2628	9295	0	13713	3536	7581	85788	1540	71054	-13000	0	97367	75303	22064	97367	75303	0
WR	6784	8835	14721	26526	2592	1216	50362	4125	72197	-3602	0	85032	97713	-12681	85032	86813	10900
SR	3988	13933	1272	35907	4656	2476	70228	0	57736	-18980	0	77573	79319	-1746	77573	79319	0
ER	10784	2926	1800	1722	0	4208	2266	0	28255	-900	0	21084	29077	-7993	21084	26878	2199
NER	300	0	0	96	0	1313	990	0	2849	0	0	2603	2945	-342	2603	2945	0
Total	**24484**	**34988**	**17793**	**77963**	**10784**	**16792**	**209634**	**5665**	**232092**	**-36482**	**0**	**283659**	**284357**	**-698**	**283659**	**271258**	
		77265					**232092**						290379				

45% StateTh

Scenario 8 : Peak Load Feb 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	65%	58%	0%	69%	80%	60%	0%	35%	0%	100%	50%		67%	61%
WR	80%	73%	85%	81%	80%	40%	0%	20%	0%	100%	50%		94%	85%
SR	45%	60%	85%	57%	80%	40%	0%	20%	0%	100%	50%		76%	69%
ER	85%	60%	85%	59%	80%	60%	0%	0%	0%	100%	50%		81%	73%
NER	85%	0%	0%	399%	80%	60%	0%	0%	0%	100%	50%		85%	77%
	73%	63%	85%	70%									88%	**275527**

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	7709	24347	0	36918	3536	15161	0	5390	17975	13000	1791	70934	73220	-2286	70934	73220	0
WR	16516	26165	31282	75584	2592	2431	0	8250	18264	3602	5069	95907	105111	-9205	95907	94211	10900
SR	6945	20604	2703	30140	4656	4952	0	11489	14606	18980	756	71084	69138	1946	71084	69138	0
ER	25058	8738	3825	28470	0	8416	0	0	7148	900	0	46937	36518	10418	46937	34319	2199
NER	638	0	0	2991	0	2625	0	0	721	0	927	4189	4638	-449	4189	4638	0
Total	**56864**	**79854**	**37810**	**174103**	**10784**	**33585**	**0**	**25129**	**58714**	**36482**	**8543**	**289051**	**288626**	**425**	**289051**	**275527**	
		174528					**58714**						250093				

46% StateTh

Scenario 9: Off peak Load Feb 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	65%	38%	0%	45%	80%	30%	0%	10%	0%	40%	30%		39%	41%
WR	77%	62%	75%	64%	80%	20%	0%	20%	0%	40%	30%		64%	69%
SR	26%	48%	59%	58%	80%	20%	0%	0%	0%	40%	30%		55%	59%
ER	59%	41%	69%	45%	80%	30%	0%	0%	0%	40%	30%		55%	59%
NER	40%	0%	0%	160%	80%	30%	0%	0%	0%	40%	30%		38%	41%
	58%	48%	73%	55%									58%	181895

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus/ Deficit	Net Availability	Net Demand	ISTS Demand
NR	7709	16057	0	24400	3536	7581	0	1540	8138	5200	1075	42697	42349	348	42697	42349	0
WR	15872	22028	27476	59664	2592	1216	0	8250	8269	1441	3042	81916	75007	6909	81916	64107	10900
SR	3988	16696	1866	30717	4656	2476	0	0	6613	7592	454	37728	50031	-12303	37728	50031	0
ER	17327	5905	3110	21927	0	4208	0	0	3236	360	0	30909	25523	5387	30909	23324	2199
NER	300	0	0	1201	0	1313	0	0	326	0	556	2169	2083	85	2169	2083	0
Total	**45196**	**60687**	**32452**	**137909**	**10784**	**16792**	**0**	**9790**	**26582**	**14593**	**5126**	**195419**	**194994**	**425**	**195419**	**181895**	
		138334					**26582**						195029				

44% StateTh

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Annex-3.2

Inter-Regional AC transmission Lines Flow

From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
RISHABDEO	BANASKANTHA	765	1685	176	29	1290	-54	-15	1955	2919	1765	3500

Note: Highlighted cell indicates Power flow > 70% of Thermal limit

HVDC Transmission Lines Flow

Area	From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9
IR	AGRA	BISWANATH-CH	800	250	0	0	250	0	0	250	0	0
IR	AGRA	BISWANATH-CH	800	250	0	0	250	0	0	250	0	0
IR	ALIPURDUAR	AGRA	800	0	300	300	0	300	300	0	300	300
IR	ALIPURDUAR	AGRA	800	0	300	300	0	300	300	0	300	300
NORTH	BAL74-PG	BHIWADI	1	0	501	501	0	501	501	0	501	501
NORTH	BAL74-PG	BHIWADI	1	0	501	501	0	501	501	0	501	501
NORTH	BHADLA-3 HVD	FATEH VSC	800	2999	300	300	2999	300	300	2999	300	300
NORTH	BHADLA-3 HVD	FATEH VSC	800	2999	300	300	2999	300	300	2999	300	300
IR	BHADR4	CHANDRAPR-SR	70	0	0	0	0	0	0	0	0	251
IR	BHADR4	CHANDRAPR-SR	70	0	0	0	0	0	0	0	0	251
NORTH	BHIWADI	BAL74-PG	500	1006	0	0	1006	0	0	1006	0	0
NORTH	BHIWADI	BAL74-PG	500	1006	0	0	1006	0	0	1006	0	0
NORTH	BIKANER-3	BATHINDA	800	0	0	0	0	0	0	0	0	0
NORTH	BIKANER-3	BATHINDA	800	0	0	0	0	0	0	0	0	0
IR	BISWANATH-CH	ALIPURDUAR	800	0	150	150	0	150	150	0	150	150
IR	BISWANATH-CH	ALIPURDUAR	800	0	150	150	0	150	150	0	150	150
IR	CHAMPA SPLT	KURUKSHETR	800	501	2512	2008	501	2512	2512	501	2512	2512
IR	CHAMPA_POOL	KURUKSHETR	800	501	2512	2008	501	2512	2512	501	2512	2512
IR	CHANDRAPR-SR	BHADR4	70	251	251	251	251	251	251	251	251	0
IR	CHANDRAPR-SR	BHADR4	70	251	251	251	251	251	251	251	251	0
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702

Area	From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9
NORTH	FATEHG-5	MODIPURAM(PG	800	0	0	0	0	0	0	0	0	0
NORTH	FATEHG-5	MODIPURAM	800	0	0	0	0	0	0	0	0	0
IR	GAZUWAKA-ER	GAZU-SR	70	0	0	0	0	0	0	0	0	327
IR	GAZUWAKA-ER	GAZU-SR	70	0	0	0	0	0	0	0	0	327
IR	GAZU-SR	GAZUWAKA-ER	70	301	301	301	301	301	301	301	301	0
IR	GAZU-SR	GAZUWAKA-ER	70	301	301	301	301	301	301	301	301	0
WEST	KHAVDA-II	NAGPUR-B	800	2260	0	0	2260	0	0	2513	0	0
WEST	KHAVDA-IIS	NAGPUR-A	800	2512	0	0	2512	0	0	2513	0	0
WEST	KUDUS	ARAY-220	320	1000	1000	1000	1000	1000	1000	1000	1000	1000
IR	MAHIN_HV	MUNDRA-APL	500	626	0	0	626	0	0	626	0	0
IR	MAHIN_HV	MUNDRA-APL	500	626	0	0	626	0	0	626	0	0
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	1003	0	1003	1003	0	1003	501
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	1003	0	1003	1003	0	1003	501
IR	PUGALUR-NEW	RAIGARH_POOL	800	1505	1505	1505	1505	1505	1505	1505	1505	0
IR	PUGALUR-NEW	KOTRA SPLT	800	1505	1505	1505	1505	1505	1505	1505	1505	0
SOUTH	PUGALUR-NEW	TCR-HVDC	600	1003	1003	1003	1003	1003	1003	1003	1003	1003
SOUTH	PUGALUR-NEW	TCR-HVDC	600	1003	1003	1003	1003	1003	1003	1003	1003	1003
IR	RAIGARH_POOL	PUGALUR-NEW	800	0	0	0	0	0	0	0	0	3018
IR	KOTRA SPLT	PUGALUR-NEW	800	0	0	0	0	0	0	0	0	3018
NORTH	RIHAN-HV	DADR-HVD	500	753	753	753	753	753	753	753	753	753
NORTH	RIHAN-HV	DADR-HVD	500	753	753	753	753	753	753	753	753	753
EAST	SASARAM-ER	SASARAM-NR	70	251	251	251	251	251	251	251	251	251
IR	TALCHER	KOLAR	500	577	577	577	577	577	577	577	577	1005
IR	TALCHER	KOLAR	500	577	577	577	577	577	577	577	577	1005

Area	From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9
IR	VINDH_1-2-3	VINDHYBT	70	125	125.15	125.146	125.146	125.146	125.15	125.14577	125.14577	125.14577
IR	VINDH_1-2-3	VINDHYBT	70	125	125.15	125.146	125.146	125.146	125.15	125.14577	125.14577	125.14577
Area	From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9
IR	AGRA	BISWANATH-CH	800	250	0	0	250	0	0	250	0	0
IR	AGRA	BISWANATH-CH	800	250	0	0	250	0	0	250	0	0
IR	ALIPURDUAR	AGRA	800	0	300	300	0	300	300	0	300	300
IR	ALIPURDUAR	AGRA	800	0	300	300	0	300	300	0	300	300
NORTH	BAL74-PG	BHIWADI	1	0	501	501	0	501	501	0	501	501
NORTH	BAL74-PG	BHIWADI	1	0	501	501	0	501	501	0	501	501
NORTH	BHADLA-3 HVD	FATEH VSC	800	2999	300	300	2999	300	300	2999	300	300
NORTH	BHADLA-3 HVD	FATEH VSC	800	2999	300	300	2999	300	300	2999	300	300
IR	BHADR4	CHANDRAPR	70	50	50	50	50	50	50	50	50	50
IR	BHADR4	CHANDRAPR	70	50	50	50	50	50	50	50	50	50
NORTH	BHIWADI	BAL74-PG	500	1006	0	0	1006	0	0	1006	0	0
NORTH	BHIWADI	BAL74-PG	500	1006	0	0	1006	0	0	1006	0	0
NORTH	BIKANER-3	BATHINDA	800	0	0	0	0	0	0	0	0	0
NORTH	BIKANER-3	BATHINDA	800	0	0	0	0	0	0	0	0	0
IR	BISWANATH-CH	ALIPURDUAR	800	0	150	150	0	150	150	0	150	150
IR	BISWANATH-CH	ALIPURDUAR	800	0	150	150	0	150	150	0	150	150
IR	CHAMPA SPLT	KURUKSHETR	800	500	2512	2008	500	2512	2512	500	2512	2512
IR	CHAMPA_POOL	KURUKSHETR	800	500	2512	2008	500	2512	2512	500	2512	2512
IR	CHANDRAPR-SR	BHADR4	70	0	0	0	0	0	0	0	0	0
IR	CHANDRAPR-SR	BHADR4	70	0	0	0	0	0	0	0	0	0
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702

Area	From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9
NORTH	FATEHG-5	MODIPURAM (PG)	800	0	0	0	0	0	0	0	0	0
NORTH	FATEHG-5	MODIPURAM (PG)	800	0	0	0	0	0	0	0	0	0
IR	GAZUWAKA-ER	GAZU-SR	70	327	327	327	327	327	327	327	327	327
IR	GAZUWAKA-ER	GAZU-SR	70	327	327	327	327	327	327	327	327	327
WEST	KHAVDA-II	NAGPUR-B	800	2513	0	0	2513	0	0	2512	0	0
WEST	KHAVDA-IIS	NAGPUR-A	800	2514	0	0	2514	0	0	2513	0	0
WEST	KUDUS	ARAY-220	320	1000	1000	1000	1000	1000	1000	1000	1000	1000
IR	MAHIN_HV	MUNDRA-APL	500	626	0	0	626	0	0	626	0	0
IR	MAHIN_HV	MUNDRA-APL	500	626	0	0	626	0	0	626	0	0
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	1003	0	1003	1003	0	1003	501
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	1003	0	1003	1003	0	1003	501
IR	PUGALUR-NEW	RAIGARH_POOL	800	1002	1505	1002	0	1505	1002	501	0	0
IR	PUGALUR-NEW	KOTRA SPLT	800	1002	1505	1002	0	1505	1002	501	0	0
SOUTH	PUGALUR-NEW	TCR-HVDC	600	1003	1003	1003	1003	1003	1003	1003	1003	1003
SOUTH	PUGALUR-NEW	TCR-HVDC	600	1003	1003	1003	1003	1003	1003	1003	1003	1003
IR	RAIGARH_POOL	PUGALUR-NEW	800	0	0	0	1002	0	0	0	3018	1505
IR	KOTRA SPLT	PUGALUR-NEW	800	0	0	0	1002	0	0	0	3018	1505
NORTH	RIHAN-HV	DADR-HVD	500	753	753	753	753	753	753	753	753	753
NORTH	RIHAN-HV	DADR-HVD	500	753	753	753	753	753	753	753	753	753
EAST	SASARAM-ER	SASARAM-NR	70	251	251	251	251	251	251	251	251	251
IR	TALCHER	KOLAR	500	501	250	401	250	501	501	250	501	501
IR	TALCHER	KOLAR	500	501	250	401	250	501	501	250	501	501
IR	VINDH_1-2-3	VINDHYBT	70	125	125	125	125	125	125	125	125	125
IR	VINDH_1-2-3	VINDHYBT	70	125	125	125	125	125	125	125	125	125

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Annex-3.3

765 kV Transmission Line loadings above 70% of thermal limit

Area	From Name	To Name	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
IR	RISHABDEO	BANASKANTHA	1685	176	29	1290	-54	-15	1955	2919	1765	3500
SOUTH	CUDP800	TIRUVLM	1454	784	491	1886	669	420	2813	1944	-87	3500
SOUTH	CUDP800	TIRUVLM	1454	784	491	1886	669	420	2813	1944	-87	3500
SOUTH	CPETA800	KURN5_7	-2349	-1592	-1388	-2471	-1511	-1105	-1790	-731	-266	3500
SOUTH	CPETA800	KURN5_7	-2349	-1592	-1388	-2471	-1511	-1105	-1790	-731	-266	3500

Note: Highlighted cell indicates Power flow > 70% of Thermal limit

400kV Transmission Line loadings above 70% of thermal limit

Area	From Name	To Name	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
WEST	KANDAL	CHIMANGAON13	-87	-141	-150	-66	-112	-143	39	86	18	111
NORTH	BARMER-4	RAJWEST	591	-126	-53	658	-167	-81	332	-154	-247	857
NORTH	RAMGARH	BHADLA	184	606	533	168	606	403	-95	479	154	857
NORTH	RAMGARH	BHADLA	184	606	533	168	606	403	-95	479	154	857
NORTH	CHIT-NEW	SIROHI	-535	-314	-236	-518	-281	-172	-448	-344	-155	560
NORTH	CHIT-NEW	SIROHI	-535	-314	-236	-518	-281	-172	-448	-344	-155	560
NORTH	MEJA	ALLAHABA	467	665	318	375	614	258	453	647	377	857
NORTH	MEJA	ALLAHABA	467	665	318	375	614	258	453	647	377	857
NORTH	AGRAUP4	AGRA	-400	-658	-545	-596	-712	-409	-213	-327	-133	857
NORTH	BARELI4	BAREL-PG	-419	-212	-120	-628	-100	-69	-346	-110	-75	857
NORTH	BARELI4	BAREL-PG	-419	-212	-120	-628	-100	-69	-346	-110	-75	857
NORTH	LUCK74-P	KANPRNEW	-575	-352	-276	-698	-323	-196	-477	-138	-118	857
NORTH	LUCK74-P	KANPRNEW	-575	-352	-276	-698	-323	-196	-477	-138	-118	857
NORTH	ANPARA4	SINGRL4	-212	-433	-760	-493	-332	-764	-354	-773	-839	857
NORTH	KHURJA TPS	ALIGARH	479	325	250	648	328	156	348	90	-11	857
NORTH	SIDCL HARDWR	ROORKEE	268	425	332	232	428	212	84	307	91	560
NORTH	SIDCL HARDWR	RISHIKE4_PT	-334	-492	-393	-318	-529	-275	-205	-463	-177	560
WEST	ZERDA	BANASKANTHA	-508	-626	-446	-451	-576	-387	-216	-224	39	857
WEST	BACHAU	HALVAD NEW	929	1021	845	890	976	850	555	498	241	1283
WEST	KHANDWA-4	CHEGAON	529	734	559	214	698	424	613	509	151	857
WEST	KARAD4	JEJ4	488	654	568	482	693	483	219	325	246	857
WEST	DHULE4	BABLESWAR	593	178	142	614	221	208	572	248	223	857
EAST	KAHALGAON-B	FARAKKA	485	259	95	695	96	139	591	416	228	852
EAST	KAHALGAON-B	FARAKKA	485	259	95	695	96	139	591	416	228	852

Area	From Name	To Name	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
EAST	ROURKELA	CHAIBASA	574	746	609	786	720	502	430	411	252	1106
EAST	ROURKELA	CHAIBASA	574	746	609	786	720	502	430	411	252	1106
EAST	PPSP_NEW	PURULIAPS	600	67	72	651	76	176	555	-122	25	850
EAST	PPSP_NEW	PURULIAPS	600	67	72	651	76	176	555	-122	25	850
EAST	PPSP_NEW	RANCHI-NEW	-865	-496	-382	-972	-480	-450	-744	-274	-250	1093
EAST	PPSP_NEW	RANCHI-NEW	-865	-496	-382	-972	-480	-450	-744	-274	-250	1093
EAST	RANCHI	RNC-SIPT FSC	-469	-554	-567	-672	-529	-441	-327	-213	-234	850
EAST	RANCHI	RNC-SIPT FSC	-467	-552	-361	-669	-527	-440	-326	-213	-145	850
SOUTH	VIJW	VIJTP-IV	-859	-411	-460	-1099	-404	-418	-552	-114	82	874
SOUTH	CUDP	CHITOR	840	395	353	1051	371	332	1057	674	1	852
SOUTH	GOOT	KURNOOL4	83	-117	36	23	-67	121	-409	-784	-176	850
SOUTH	GOOT	FSC-1	440	341	203	433	306	165	809	851	269	948
SOUTH	GOOT	FSC-2	412	332	218	425	304	200	728	731	193	948
SOUTH	GOOT	TUMKUR SP	-318	253	114	-360	227	69	-39	777	173	1100
SOUTH	GOOT	TUMKUR SP	-318	253	114	-360	227	69	-39	777	173	1100
SOUTH	KURNOOL4	SSLBPH4	968	278	349	883	259	340	495	-336	-26	850
SOUTH	VEMAGIR4	VEMAG-II	-813	-236	-278	-703	-235	-338	-518	-55	-118	1093
SOUTH	VEMAGIR4	VEMAG-II	-813	-236	-278	-703	-235	-338	-518	-55	-118	1093
SOUTH	NELLORE4	SPBUDUR4	123	345	117	96	296	149	626	792	203	852
SOUTH	NELLORE4	SPBUDUR4	123	345	117	96	296	149	626	792	203	852
SOUTH	VIJ-AP	THALAYAPALEM	971	450	487	997	411	393	696	194	99	852
SOUTH	VIJ-AP	THALAYAPALEM	971	450	487	997	411	393	696	194	99	852
SOUTH	VIJ-AP	CPETA400	-1910	-892	-908	-1868	-831	-838	-1368	-400	-287	2186
SOUTH	VIJ-AP	CPETA400	-1910	-892	-908	-1868	-831	-838	-1368	-400	-287	2186
SOUTH	VIJTP-IV	THALAYAPALEM	-633	-250	-306	-705	-222	-215	-517	-114	-12	874
SOUTH	VIJTP-IV	THALAYAPALEM	-633	-250	-306	-705	-222	-215	-517	-114	-12	874

Area	From Name	To Name	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
SOUTH	FSC-1	NELMANG4	440	341	203	433	306	165	809	851	269	948
SOUTH	FSC-2	SMNH	412	332	218	425	304	200	728	731	193	948
SOUTH	HYDERABAD	MAHESWRM	-1430	-670	-750	-1256	-646	-625	-1024	-151	-279	874
SOUTH	SMNH	BIDADI	-648	-437	-376	-783	-410	-416	-903	-595	33	852
SOUTH	SMNH	BIDADI	-648	-437	-376	-783	-410	-416	-903	-595	33	852
SOUTH	HOODI4	DHANLLI	-483	-213	-160	-560	-190	-175	-652	-294	196	852
SOUTH	HOODI4	DHANLLI	-483	-213	-159	-560	-190	-175	-652	-294	195	852
SOUTH	NELMANG4	YELAHNKA	-473	-87	-47	-517	-41	11	-678	-393	-203	852
SOUTH	KOLAR	HOSUR4	349	291	283	547	282	298	686	550	121	852
SOUTH	KOLAR	HOSUR4	349	291	283	547	282	298	686	550	121	852
SOUTH	SPBUDUR4	SVCHTRM	465	460	201	583	412	253	1146	1021	162	852
SOUTH	MALEKTT	TIRUVLM SE-A	-587	-417	-334	-676	-405	-320	-752	-661	-203	850
SOUTH	MALEKTT	TIRUVLM SE-A	-587	-417	-334	-676	-405	-320	-752	-661	-203	850
SOUTH	EDARPLYM	COIMBTR4	-340	-290	-257	-384	-276	-249	-689	-656	49	857
SOUTH	EDARPLYM	COIMBTR4	-340	-290	-257	-384	-276	-249	-689	-656	49	857

Note: Highlighted cell indicates Power flow > 70% of Thermal limit

Annex-3.4

765/400 kV ICT loadings above 80% of MVA rating

Area	From Name	Voltage	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
NORTH	FATH4 SPL	400	FATEHG-4	765	1011	1217	871	1015	1103	650	577	1044	380	1500
NORTH	FATH4 SPL	400	FATEHG-4	765	1011	1217	871	1015	1103	650	577	1044	380	1500
SOUTH	CPETA400	400	CPETA800	765	-1280	-596	-607	-1252	-555	-560	-915	-267	-191	1500
SOUTH	CPETA400	400	CPETA800	765	-1280	-596	-607	-1252	-555	-560	-915	-267	-191	1500
SOUTH	NIZAMABAD	400	NIZAMABAD	765	-1303	-557	-688	-1109	-532	-604	-1229	-637	-589	1500
SOUTH	NIZAMABAD	400	NIZAMABAD	765	-1303	-557	-688	-1109	-532	-604	-1229	-637	-589	1500
SOUTH	NIZAMABAD	400	NIZAMABAD	765	-1303	-557	-688	-1109	-532	-604	-1229	-637	-589	1500
SOUTH	MAHESWRM	400	MAHESHWARAM	765	-1242	-592	-571	-1044	-479	-481	-1161	-510	-452	1500
SOUTH	MAHESWRM	400	MAHESHWARAM	765	-1242	-592	-571	-1044	-479	-481	-1161	-510	-452	1500
SOUTH	ARIYALUR4	400	ARIYALUR7	765	-751	-697	-545	-971	-689	-562	-1393	-1448	-324	1500

Note: Highlighted cell indicates Power flow > 80% of MVA rating

400/220 kV ICT loadings above 80% of MVA rating

Area	From Name	Voltage	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
NORTH	KISHENPUR	220	KISHENPUR	400	-233	-104	-123	-175	-161	-118	-257	-197	-115	315
NORTH	PANG220SP2	220	PANG400SP2	400	264	0	0	266	0	0	263	0	0	315
NORTH	PANG220SP3	220	PANG400SP3	400	264	0	0	266	0	0	263	0	0	315
NORTH	PATRAN42	220	PATRAN4	400	-416	-110	-184	-299	-223	-171	-323	-91	-51	500
NORTH	JINDPG	220	JINDPG	400	-422	-321	-270	-344	-329	-245	-334	-228	-139	500
NORTH	KURUKSHETRA	220	KURUKSHETR	400	-249	-413	-300	-216	-387	-321	-173	-301	-233	500
NORTH	BIKANER-IV	220	BIKANER-IV	400	950	0	0	956	0	0	946	0	0	500
NORTH	HINDAU-4	220	HINDAU-4	400	-260	-241	-180	-220	-223	-148	-238	-205	-146	315
NORTH	HIRAPURA	220	HERAPU-4	400	-235	-207	-156	-203	-189	-125	-212	-163	-111	250
NORTH	CHITTOR-42	220	CHITTOR4	400	-280	-258	-175	-250	-220	-128	-271	-171	-124	315
NORTH	SURATGARH-42	220	SURATG-4	400	-172	-260	-189	-103	-239	-158	-162	-237	-183	315
NORTH	BASSI	220	BASSI	400	-403	-340	-254	-360	-309	-204	-363	-264	-180	500
NORTH	BHADLA-S	220	BHADLA	400	380	-96	-63	403	-56	-43	349	-123	-108	500
NORTH	KALISIND	220	KALISI-4	400	-426	-429	-294	-268	-375	-249	-379	-509	-379	500
NORTH	AJMER42	220	AJMER	400	-245	-276	-201	-207	-239	-160	-232	-220	-160	315
NORTH	BHIWADI	220	BHIWADI	400	-200	-260	-207	-160	-247	-180	-154	-204	-139	315
NORTH	BHADLA-PG	220	BHADLA PG	400	446	0	0	449	0	0	444	0	0	500
NORTH	RAMGARH-I	220	RAMG-I	400	428	0	0	430	0	0	426	0	0	500
NORTH	FATEHG-3	220	FATEHG-3	400	460	0	0	463	0	0	458	0	0	500
NORTH	BHADLA-3	220	BHADLA-3	400	428	0	0	430	0	0	426	0	0	500
NORTH	BHADLA-2	220	BHADLA-2	400	462	0	0	465	0	0	460	0	0	500
NORTH	BHAD-2 SPLT	220	BHADLA-2	400	450	0	0	453	0	0	448	0	0	500
NORTH	BARMER-I	220	BARMER1_4	400	757	252	252	762	240	229	583	150	43	500
NORTH	KOTA	220	KOTA	400	-325	-292	-218	-282	-252	-172	-325	-236	-168	315

Area	From Name	Voltage	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
NORTH	FATEHG4-SPL	220	FATH4 SPL	400	1740	932	706	1752	872	748	1254	420	120	500
NORTH	BHADLA3-SPL	220	BHADLA-3	400	428	0	0	430	0	0	426	0	0	500
NORTH	OBRA2	220	OBRA4	400	-132	-204	-141	-124	-192	-120	-107	-162	-106	240
NORTH	KANPU-PG	220	KANPUR	400	-242	-215	-158	-294	-209	-117	-182	-103	-45	315
NORTH	REWAROAD	220	REWA	400	-241	-308	-206	-251	-296	-169	-204	-274	-147	315
WEST	MUNDRA-APL	220	MUNDRA-APL	400	1	260	238	13	267	257	-109	36	27	315
WEST	HALWAD NEW	220	HALVAD NEW	400	-187	-88	-41	-161	-64	-19	-212	-258	-177	315
WEST	JAM KHAMB PS	220	JAM KHAMB PS	400	272	408	355	268	408	375	48	107	117	500
WEST	DATIYA NEW2	220	DATIYA NEW4	400	-389	-160	-116	-341	-134	-114	-450	-270	-165	500
WEST	KALLAM	220	KALLAM	400	304	441	377	296	438	396	55	121	118	500
EAST	DUBRI NEW	220	DUBURI	400	-213	-255	-279	-280	-197	-194	-147	-168	-171	315
EAST	SAGARDIGHI_2	220	SAGARDIGHI_4	400	-279	-206	-158	-312	-213	-176	-177	-181	-137	315
EAST	KTPS220	220	KOLAGHAT	400	-326	-346	-252	-362	-360	-264	-257	-184	-112	315
EAST	CHANDITALA_N	220	CHANDITALA_N	400	-333	-356	-272	-367	-354	-275	-266	-273	-195	315
EAST	KHARAGPR-WB	220	KHARAGPR-WB	400	-263	-279	-195	-295	-280	-197	-199	-193	-117	315
EAST	GOKARNA	220	GOKARNA	400	-319	-240	-189	-360	-244	-214	-211	-197	-157	315
EAST	JEERAT	220	JEERAT	400	-286	-304	-238	-317	-301	-233	-228	-246	-179	315
EAST	BIDHANNGR-WB	220	BIDHAN NGR	400	-265	-186	-159	-306	-184	-174	-213	-155	-133	315
EAST	DURGAPUR TPS	220	DURGAPUR TPS	400	-283	-385	-355	-259	-432	-355	-310	-440	-359	500
SOUTH	CHINAKAMPALL	220	CUDP	400	-383	-176	-170	-406	-169	-161	-289	-179	-117	500
SOUTH	TALARI_CRV 2	220	TALARICH	400	315	0	0	323	0	0	333	0	0	315
SOUTH	GUTTUR	220	DAVAN4	400	-181	-62	-51	-124	-41	-48	-288	-228	-145	315
SOUTH	NARENDRA	220	NAREND-4	400	-251	-45	-49	-171	5	-28	-437	-308	-239	500
SOUTH	YELAH220	220	YELAHNKA	400	-377	-235	-181	-343	-217	-175	-417	-308	-183	500
SOUTH	SALEM42	230	SALE	400	-168	-147	-141	-221	-139	-145	-266	-238	-54	315
SOUTH	NNTPS2	230	NEY(REP)4	400	-273	-354	-287	-304	-300	-249	-402	-519	-187	500

Note: Highlighted cell indicates Power flow > 80% of MVA rating

Annex-3.5

Over Voltage Nodes

765kV and 400kV Bus Voltage >1.05 PU

Area Name	Bus Name	Base kV	V-Sc1	V-Sc2	V-Sc3	V-Sc4	V-Sc5	V-Sc6	V-Sc7	V-Sc8	V-Sc9	Max
WEST	MAUDA	400	1.03	1.02	1.03	1.04	1.03	1.05	1.02	1.00	1.01	1.05
WEST	WARORA POOL	400	1.03	1.03	1.04	1.03	1.04	1.06	1.02	1.01	1.02	1.06
WEST	WARDHA SPLT	400	1.03	1.03	1.04	1.03	1.04	1.05	1.02	1.00	1.02	1.05
EAST	RNC-SIPT FSC	400	1.04	1.02	1.01	1.05	1.00	1.00	0.98	0.97	0.98	1.05
SOUTH	NSAGAR	400	0.99	1.01	1.02	1.00	1.04	1.05	1.00	1.01	1.03	1.05
SOUTH	MUDN400	400	1.02	1.02	1.03	1.01	1.03	1.04	1.01	1.00	1.05	1.05
SOUTH	RAMGUNDM STP	400	1.00	1.02	1.02	1.03	1.04	1.05	1.00	1.00	1.00	1.05
SOUTH	HYDERABAD	400	1.00	1.01	1.02	1.02	1.04	1.06	1.00	1.00	1.01	1.06
SOUTH	KHAMMAM	400	0.99	1.01	1.02	1.01	1.04	1.06	1.00	1.01	1.02	1.06
SOUTH	MAMIDIPALLY	400	1.00	1.02	1.03	1.02	1.05	1.07	0.99	1.00	1.00	1.07
SOUTH	DICHPAL4	400	1.00	1.02	1.02	1.02	1.04	1.05	0.99	1.00	1.02	1.05
SOUTH	GAJWEL4	400	1.00	1.01	1.01	1.04	1.03	1.05	0.99	1.00	1.00	1.05
SOUTH	KAKTIA-G	400	0.99	1.02	1.02	1.02	1.04	1.06	0.98	1.00	1.00	1.06
SOUTH	KOTH-VI	400	1.00	1.01	1.02	1.02	1.04	1.06	1.00	1.01	1.02	1.06
SOUTH	SHANKARPALLY	400	1.00	1.02	1.03	1.03	1.05	1.07	0.99	1.01	1.01	1.07
SOUTH	MALKARM4	400	1.00	1.02	1.03	1.03	1.05	1.07	1.00	1.01	1.01	1.07
SOUTH	SURYPET4	400	1.01	1.02	1.03	1.03	1.05	1.07	1.01	1.02	1.03	1.07
SOUTH	NIZAMABAD	400	1.00	1.02	1.02	1.02	1.03	1.05	0.99	1.00	1.02	1.05
SOUTH	NIRMAL	400	1.00	1.04	1.03	1.04	1.05	1.07	0.99	1.01	1.02	1.07
SOUTH	RAIDURG	400	1.00	1.03	1.04	1.04	1.07	1.09	0.98	1.02	1.01	1.09
SOUTH	KAMALAPURAM	400	1.00	1.01	1.02	1.02	1.04	1.06	1.00	1.00	1.01	1.06
SOUTH	DAMARACHRLA	400	1.00	1.02	1.03	1.03	1.05	1.07	1.00	1.00	1.00	1.07

Area Name	Bus Name	Base kV	V-Sc1	V-Sc2	V-Sc3	V-Sc4	V-Sc5	V-Sc6	V-Sc7	V-Sc8	V-Sc9	Max
SOUTH	WARANGAL NEW	400	1.00	1.02	1.03	1.02	1.04	1.06	1.00	1.01	1.02	1.06
SOUTH	WARANGAL	400	0.99	1.02	1.02	1.02	1.04	1.06	0.99	1.01	1.01	1.06
SOUTH	KOTH-VII	400	1.00	1.01	1.02	1.02	1.04	1.06	1.00	1.01	1.02	1.06
SOUTH	JULURUPADU	400	1.00	1.02	1.02	1.03	1.04	1.06	1.01	1.01	1.02	1.06
SOUTH	NARSAPUR	400	1.00	1.02	1.02	1.04	1.04	1.06	0.99	1.00	1.00	1.06
SOUTH	MAHESWRM	400	0.99	1.02	1.03	1.01	1.03	1.05	1.00	1.01	1.02	1.05
SOUTH	MAH-TS SEC-A	400	0.98	1.01	1.02	1.01	1.04	1.05	0.99	1.00	1.01	1.05
SOUTH	MAH-TS SEC-B	400	1.00	1.02	1.03	1.02	1.05	1.06	0.99	1.00	1.01	1.06
SOUTH	KETHIREDDYPA	400	1.00	1.03	1.04	1.04	1.06	1.08	0.99	1.01	1.01	1.08
SOUTH	DINDI	400	0.99	1.01	1.03	1.01	1.03	1.05	1.00	1.00	1.00	1.05
SOUTH	JANAGAON	400	1.00	1.02	1.02	1.04	1.04	1.06	0.99	1.00	1.00	1.06
SOUTH	YADADRI TPP	400	1.00	1.02	1.03	1.02	1.05	1.07	1.00	1.00	1.00	1.07
SOUTH	CHOUTTUPPAL	400	1.00	1.02	1.03	1.03	1.05	1.07	0.99	1.01	1.01	1.07
SOUTH	SUNDILLA LI	400	0.99	1.02	1.02	1.04	1.03	1.05	0.98	1.00	1.00	1.05
SOUTH	MAHESHWARAM	765	1.01	1.02	1.03	1.01	1.03	1.05	1.01	1.02	1.03	1.05
SOUTH	WARANGAL NEW	765	1.01	1.02	1.03	1.01	1.03	1.05	1.01	1.01	1.03	1.05
SOUTH	AVARAIKALM_4	400	0.98	0.99	0.97	0.98	0.98	0.98	1.02	1.00	1.05	1.05
CROSS BORDER	BUTWAL	400	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.05	1.05

Highlighted cell indicates Bus Voltage >1.05 P.U.

Under Voltage Nodes

765kV and 400kV Bus Voltage <0.95 PU

Area Name	Bus Name	Base kV	V-Sc1	V-Sc2	V-Sc3	V-Sc4	V-Sc5	V-Sc6	V-Sc7	V-Sc8	V-Sc9	Min
WEST	KESHOD4	400	0.95	0.96	1.00	0.98	1.00	1.03	0.99	0.95	0.99	0.95
WEST	JULWNIA-4	400	1.00	0.98	0.99	1.02	0.99	1.02	0.99	0.95	0.98	0.95
EAST	JEY-BOL_FSC	400	0.93	0.94	0.95	0.94	0.93	0.94	0.93	0.93	0.94	0.93
SOUTH	HDURGA	400	0.99	1.00	1.01	0.99	1.01	1.03	0.96	0.95	1.01	0.95
SOUTH	TIRUVLM SE-A	400	1.00	0.99	0.99	0.98	0.99	1.01	0.97	0.94	1.01	0.94
SOUTH	ARIYALUR4	400	1.00	0.99	0.99	0.98	0.99	1.01	0.99	0.95	1.00	0.95
SOUTH	NORTH CHN PS	765	0.98	0.96	0.96	0.96	0.98	0.97	0.98	0.94	0.97	0.94
SOUTH	NCTPS-STG3	765	0.98	0.96	0.96	0.96	0.98	0.97	0.98	0.94	0.97	0.94
SOUTH	TIRUVLM	765	0.99	0.97	0.98	0.97	0.98	0.99	0.98	0.92	1.00	0.92
SOUTH	ETPSREP7	765	0.98	0.96	0.96	0.96	0.98	0.97	0.98	0.94	0.97	0.94
SOUTH	ARIYALUR7	765	0.99	0.97	0.98	0.97	0.98	0.99	0.98	0.92	1.00	0.92
SOUTH	COIMBTR7	765	1.01	0.98	0.99	1.00	0.99	1.00	1.04	0.94	1.01	0.94
SOUTH	VIRUDHNAGAR	765	0.98	0.97	0.97	0.98	0.97	0.99	1.05	0.95	1.00	0.95

Highlighted cell indicates Bus Voltage <0.95 P.U.

Annex-3.6

N-1 Contingency of 765 kV Transmission Lines

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	2378.24	4415.83	3500	125.98	SC-1
358129 MUL 765 765.00 358199 BHUJ-II PS-7765.00 2	OPEN LINE FROM BUS 358129 [MUL 765 765.00] TO BUS 358199 [BHUJ-II PS-7765.00] CKT 3	2169.33	3508.35	3500	97.15	SC-1
358200 KHAVDA 765 765.00 358202 KHAVDA-II 765.00 1	OPEN LINE FROM BUS 358200 [KHAVDA 765 765.00] TO BUS 358202 [KHAVDA-II 765.00] CKT 2	1809.49	3464.97	3500	99.42	SC-1
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	1756.06	3194.67	3500	92.82	SC-2
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	2510.95	4634.25	3500	132.77	SC-4
378901 PUNE-III 765.00 528002 NARENDRA NW 765.00 1	OPEN LINE FROM BUS 378901 [PUNE-III 765.00] TO BUS 528002 [NARENDRA NW 765.00] CKT 2	2584.57	3562.53	3500	101.14	SC-4
358129 MUL 765 765.00 358199 BHUJ-II PS-7765.00 2	OPEN LINE FROM BUS 358129 [MUL 765 765.00] TO BUS 358199 [BHUJ-II PS-7765.00] CKT 3	2166.07	3507.1	3500	96.98	SC-4
358200 KHAVDA 765 765.00 358202 KHAVDA-II 765.00 1	OPEN LINE FROM BUS 358200 [KHAVDA 765 765.00] TO BUS 358202 [KHAVDA-II 765.00] CKT 2	1750.97	3354.76	3500	96.21	SC-4
508092 VEM-II80 765.00 508099 CPETA800 765.00 1	OPEN LINE FROM BUS 508092 [VEM-II80 765.00] TO BUS 508099 [CPETA800 765.00] CKT 2	2223.51	3239.77	3500	91.73	SC-4
177000 VARNASI8 765.00 368025 VIN-POOL 765.00 1	OPEN LINE FROM BUS 177000 [VARNASI8 765.00] TO BUS 368025 [VIN-POOL 765.00] CKT 2	2196.2	3224.84	3500	93.13	SC-5
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	1761.03	3184.73	3500	92.69	SC-5
548087 TIRUVLM 765.00 548127 ARIYALUR7 765.00 1	OPEN LINE FROM BUS 548087 [TIRUVLM 765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 2	2930.11	6001.52	3500	167.17	SC-7
508007 CUDP800 765.00 548087 TIRUVLM 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 548087 [TIRUVLM 765.00] CKT 2	3024.3	4621.31	3500	125.32	SC-7
508007 CUDP800 765.00 508888 CUDP2_7 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508888 [CUDP2_7 765.00] CKT 2	2003.82	3418.33	3500	96.38	SC-7
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	1805.17	3365.19	3500	95.47	SC-7
378021 WARDHA 765.00 378902 NAGPUR 765.00 5	OPEN LINE FROM BUS 378021 [WARDHA 765.00] TO BUS 378902 [NAGPUR 765.00] CKT 6	2040.63	3340.63	3500	93.39	SC-7

N-1 Contingency of 400 kV Transmission Lines

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
504026 VIJ-AP 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	975.77	1692.15	852	197.03	SC-1
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 514104 [MAH-TS SEC-A400.00] CKT 1	1453.99	1553.64	874	176.88	SC-1
504026 VIJ-AP 400.00 504099 CPETA400 400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504099 [CPETA400 400.00] CKT 2	1920.59	3231.78	2186	146.81	SC-1
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 1	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 2	600.08	1174.1	850	140.30	SC-1
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	532.48	1181.77	857	134.89	SC-1
524001 SMNH 400.00 524077 BIDADI 400.00 1	OPEN LINE FROM BUS 524001 [SMNH 400.00] TO BUS 524077 [BIDADI 400.00] CKT 2	657.86	1117.46	852	130.80	SC-1
504030 VIJTP-IV 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504030 [VIJTP-IV 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	659.46	1219.66	961	125.95	SC-1
504005 VIJW 400.00 504030 VIJTP-IV 400.00 1	OPEN LINE FROM BUS 508092 [VEM-II80 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	872.46	1072.22	874	121.54	SC-1
444010 SAGARDIGHI_4400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	739.82	1331.51	1093	121.82	SC-1
504017 VEMAGIR4 400.00 504092 VEMAG-II 400.00 1	OPEN LINE FROM BUS 504017 [VEMAGIR4 400.00] TO BUS 504092 [VEMAG-II 400.00] CKT 2	813.81	1279.3	1093	115.26	SC-1
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1487.09	2548.02	2186	116.56	SC-1
514021 DICHPAL4 400.00 514061 NIZAMABAD 400.00 1	OPEN LINE FROM BUS 514021 [DICHPAL4 400.00] TO BUS 514061 [NIZAMABAD 400.00] CKT 2	1292.32	2529.03	2186	115.05	SC-1
504007 CUDP 400.00 504024 CHITOR 400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 1	840.38	941.78	852	110.40	SC-1
504083 TALARICH 400.00 504132 KONDPRM 400.00 1	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 504132 [KONDPRM 400.00] CKT 2	522.72	945.43	857	111.63	SC-1
444074 PPSP_NEW 400.00 474047 RANCHI-NEW 400.00 1	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 474047 [RANCHI-NEW 400.00] CKT 2	881.53	1204.59	1093	112.14	SC-1
174424 DADR-NCR 400.00 174454 DADR-HVD 400.00 1	OPEN LINE FROM BUS 174424 [DADR-NCR 400.00] TO BUS 174454 [DADR-HVD 400.00] CKT 2	867.23	1726.02	1600	107.88	SC-1
174438 LUCK4-PG 400.00 174451 LUCK74-P 400.00 1	OPEN LINE FROM BUS 174438 [LUCK4-PG 400.00] TO BUS 174451 [LUCK74-P 400.00] CKT 2	934.18	1765.6	1714	105.94	SC-1
524005 HOODI4 400.00 524025 DHANLLI 400.00 1	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 524025 [DHANLLI 400.00] CKT 2	487.55	870.02	852	100.50	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
314029 RAIGARH_POOL400.00 314045 LARA STPP 400.00 1	OPEN LINE FROM BUS 314029 [RAIGARH_POOL400.00] TO BUS 314045 [LARA STPP 400.00] CKT 2	777.97	1433.45	1050	136.52	SC-2
174000 MEJA 400.00 174474 ALLAHABA 400.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 2	680.05	1121.7	857	130.89	SC-2
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1651.76	2834.57	2186	129.67	SC-2
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114542 [PAKALDUL 400.00] TO BUS 114597 [KWAR 400.00] CKT 1	479.07	1062.07	857	123.93	SC-2
524001 SMNH 400.00 524077 BIDADI 400.00 1	OPEN LINE FROM BUS 524001 [SMNH 400.00] TO BUS 524077 [BIDADI 400.00] CKT 2	572.88	963.27	852	114.00	SC-2
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	451.5	955.66	857	107.93	SC-2
174927 GORAKHPU 400.00 644002 BUTWAL 400.00 1	OPEN LINE FROM BUS 174927 [GORAKHPU 400.00] TO BUS 644002 [BUTWAL 400.00] CKT 2	934.82	1886.73	1714	110.08	SC-2
134406 RAJPURA_TH4 400.00 134407 RAJPURA4 400.00 1	OPEN LINE FROM BUS 134406 [RAJPURA_TH4 400.00] TO BUS 134407 [RAJPURA4 400.00] CKT 2	488.39	932.86	857	108.85	SC-2
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	776.57	1114.29	857	130.02	SC-3
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1630.77	2796.43	2186	127.92	SC-3
504026 VIJ-AP 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	928.86	1614.83	852	187.45	SC-4
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 1	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 2	643.64	1334.11	850	150.50	SC-4
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 514104 [MAH-TS SEC-A400.00] CKT 1	1216.43	1271.33	874	146.88	SC-4
504005 VIJW 400.00 504030 VIJTP-IV 400.00 1	OPEN LINE FROM BUS 508092 [VEM-II80 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	1002.01	1239.29	874	139.89	SC-4
444010 SAGARDIGHI_4400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	877.09	1516.65	1093	129.44	SC-4
174484 KANPRNEW 400.00 175484 KANPUR_SR1 400.00 1	OPEN LINE FROM BUS 177000 [VARNASI8 765.00] TO BUS 177990 [FATEHPUR 765765.00] CKT 1	153.2	1180.68	857	112.19	SC-4
174484 KANPRNEW 400.00 175485 KANPUR_SR2 400.00 1	OPEN LINE FROM BUS 177000 [VARNASI8 765.00] TO BUS 177990 [FATEHPUR 765765.00] CKT 1	153.2	1180.68	857	112.19	SC-4
504026 VIJ-AP 400.00 504099 CPETA400 400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504099 [CPETA400 400.00] CKT 2	1744.72	2946.06	2186	133.27	SC-4
174402 BARELI4 400.00 174410 BAREL-PG 400.00 1	OPEN LINE FROM BUS 174402 [BARELI4 400.00] TO BUS 174410 [BAREL-PG 400.00] CKT 2	621.26	1126.48	857	132.04	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
444074 PPSP_NEW 400.00 474047 RANCHI-NEW 400.00 1	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 474047 [RANCHI-NEW 400.00] CKT 2	959.66	1416.59	1093	121.83	SC-4
504030 VIJTP-IV 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504030 [VIJTP-IV 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	670.31	1241.5	961	127.98	SC-4
174438 LUCK4-PG 400.00 174451 LUCK74-P 400.00 1	OPEN LINE FROM BUS 174438 [LUCK4-PG 400.00] TO BUS 174451 [LUCK74-P 400.00] CKT 2	1130.32	2195.38	1714	128.09	SC-4
524001 SMNH 400.00 524077 BIDADI 400.00 1	OPEN LINE FROM BUS 524001 [SMNH 400.00] TO BUS 524077 [BIDADI 400.00] CKT 2	577.11	980.75	852	114.82	SC-4
504083 TALARICH 400.00 504132 KONDPRM 400.00 1	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 504132 [KONDPRM 400.00] CKT 2	539.88	976.54	857	115.36	SC-4
174410 BAREL-PG 400.00 174483 BAREILY 400.00 1	OPEN LINE FROM BUS 174410 [BAREL-PG 400.00] TO BUS 174483 [BAREILY 400.00] CKT 2	969.31	1903.13	1714	111.52	SC-4
444421 BIDHAN NGR 400.00 444423 DURGAPUR-A 400.00 1	OPEN LINE FROM BUS 444421 [BIDHAN NGR 400.00] TO BUS 444423 [DURGAPUR-A 400.00] CKT 2	605.23	1208.46	1093	100.98	SC-4
524005 HOODI4 400.00 524025 DHANLLI 400.00 1	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 524025 [DHANLLI 400.00] CKT 2	517.07	922.57	852	106.65	SC-4
504007 CUDP 400.00 504024 CHITOR 400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 1	818.92	904.29	852	106.02	SC-4
414010 KAHALGAON-B 400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 414010 [KAHALGAON-B 400.00] TO BUS 444019 [FARAKKA 400.00] CKT 2	612.9	896.71	852	106.82	SC-4
314029 RAIGARH_POOL400.00 314045 LARA STPP 400.00 1	OPEN LINE FROM BUS 314029 [RAIGARH_POOL400.00] TO BUS 314045 [LARA STPP 400.00] CKT 2	765.65	1410.53	1050	134.34	SC-5
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1651.68	2832.13	2186	129.56	SC-5
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114542 [PAKALDUL 400.00] TO BUS 114597 [KWAR 400.00] CKT 1	470.34	1042.95	857	121.70	SC-5
174000 MEJA 400.00 174474 ALLAHABA 400.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 2	621.13	1025.28	857	119.64	SC-5
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	482.6	1014.19	857	115.85	SC-5
174927 GORAKHPU 400.00 644002 BUTWAL 400.00 1	OPEN LINE FROM BUS 174927 [GORAKHPU 400.00] TO BUS 644002 [BUTWAL 400.00] CKT 2	923.76	1864.64	1714	108.79	SC-5
174400 AGRAUP4 400.00 174922 AGRA 400.00 2	OPEN LINE FROM BUS 174414 [AGRANEW 400.00] TO BUS 174922 [AGRA 400.00] CKT 2	717.55	873.47	857	101.92	SC-5
134406 RAJPURA_TH4 400.00 134407 RAJPURA4 400.00 1	OPEN LINE FROM BUS 134406 [RAJPURA_TH4 400.00] TO BUS 134407 [RAJPURA4 400.00] CKT 2	450.95	862.5	857	100.37	SC-5
314029 RAIGARH_POOL400.00 314045 LARA STPP 400.00 1	OPEN LINE FROM BUS 314029 [RAIGARH_POOL400.00] TO BUS 314045 [LARA STPP 400.00] CKT 2	802.74	1478.95	1050	140.85	SC-6

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	786.81	1124.04	857	131.16	SC-6
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1624.18	2781.21	2186	127.23	SC-6
524001 SMNH 400.00 524077 BIDADI 400.00 1	OPEN LINE FROM BUS 524001 [SMNH 400.00] TO BUS 524077 [BIDADI 400.00] CKT 2	1019.6	1809.41	852	202.69	SC-7
524005 HOODI4 400.00 524025 DHANLLI 400.00 1	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 524025 [DHANLLI 400.00] CKT 2	837.48	1548.12	852	171.98	SC-7
504007 CUDP 400.00 504024 CHITOR 400.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 548087 [TIRUVLM 765.00] CKT 1	1135.16	1341.42	852	148.50	SC-7
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 1	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 2	576.37	1145.92	850	134.74	SC-7
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	493.92	1152.14	857	132.19	SC-7
504026 VIJ-AP 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	654.96	1108.26	852	132.30	SC-7
544086 MALEKTT 400.00 544087 TIRUVLM SE-A400.00 1	OPEN LINE FROM BUS 544086 [MALEKTT 400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 2	789.77	1073.8	850	120.53	SC-7
544122 EDARPLYM 400.00 544128 COIMBTR4 400.00 1	OPEN LINE FROM BUS 544122 [EDARPLYM 400.00] TO BUS 544128 [COIMBTR4 400.00] CKT 2	793.57	1074.75	857	124.35	SC-7
524025 DHANLLI 400.00 524084 YELAHNKA 400.00 1	OPEN LINE FROM BUS 524025 [DHANLLI 400.00] TO BUS 524087 [TUMKUR SP 400.00] CKT 1	640.49	1060.87	852	117.61	SC-7
504057 MUDN400 400.00 504132 KONDPRM 400.00 P1	OPEN LINE FROM BUS 504057 [MUDN400 400.00] TO BUS 504132 [KONDPRM 400.00] CKT P2	652.52	1173.34	961	121.73	SC-7
524011 KOLAR 400.00 544007 HOSUR4 400.00 1	OPEN LINE FROM BUS 524011 [KOLAR 400.00] TO BUS 544007 [HOSUR4 400.00] CKT 2	687.87	1016.08	852	115.45	SC-7
174424 DADR-NCR 400.00 174454 DADR-HVD 400.00 1	OPEN LINE FROM BUS 174424 [DADR-NCR 400.00] TO BUS 174454 [DADR-HVD 400.00] CKT 2	949.6	1886.19	1600	117.89	SC-7
524007 NELMANG4 400.00 524084 YELAHNKA 400.00 1	OPEN LINE FROM BUS 524025 [DHANLLI 400.00] TO BUS 524084 [YELAHNKA 400.00] CKT 1	681.12	1001.38	852	111.89	SC-7
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 514104 [MAH-TS SEC-A400.00] CKT 1	941.1	1019.12	874	116.61	SC-7
414010 KAHALGAON-B 400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 414010 [KAHALGAON-B 400.00] TO BUS 444019 [FARAKKA 400.00] CKT 2	640.18	916.3	852	108.29	SC-7
504019 NELLORE4 400.00 544002 SPBUDUR4 400.00 2	OPEN LINE FROM BUS 504019 [NELLORE4 400.00] TO BUS 544002 [SPBUDUR4 400.00] CKT 1	718.13	911.55	852	106.36	SC-7
504996 FSC-1 400.00 524007 NELMANG4 400.00 1	OPEN LINE FROM BUS 504997 [FSC-2 400.00] TO BUS 524001 [SMNH 400.00] CKT 2	853.18	1007.34	948	100.91	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
504019 NELLORE4 400.00 544002 SPBUDUR4 400.00 1	OPEN LINE FROM BUS 504019 [NELLORE4 400.00] TO BUS 544002 [SPBUDUR4 400.00] CKT 2	708.76	901.03	852	105.23	SC-7
504008 GOOT 400.00 504996 FSC-1 400.00 1	OPEN LINE FROM BUS 504008 [GOOT 400.00] TO BUS 504997 [FSC-2 400.00] CKT 2	906.42	998.24	948	108.70	SC-7
514021 DICHPAL4 400.00 514061 NIZAMABAD 400.00 1	OPEN LINE FROM BUS 514021 [DICHPAL4 400.00] TO BUS 514061 [NIZAMABAD 400.00] CKT 2	1165.15	2296.27	2186	103.70	SC-7
174438 LUCK4-PG 400.00 174451 LUCK74-P 400.00 1	OPEN LINE FROM BUS 174438 [LUCK4-PG 400.00] TO BUS 174451 [LUCK74-P 400.00] CKT 2	929.23	1775.7	1714	105.12	SC-7
544013 PUGALUR4 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544013 [PUGALUR4 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1301.51	2251.99	2186	102.15	SC-7
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	1299.26	2251.16	2186	101.89	SC-7
504026 VIJ-AP 400.00 504099 CPETA400 400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504099 [CPETA400 400.00] CKT 2	1318.61	2171.97	2186	100.77	SC-7
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	812.63	1150.78	857	134.28	SC-8
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	512.29	1130.49	857	127.39	SC-8
174000 MEJA 400.00 174474 ALLAHABA 400.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 2	678.17	1114.27	857	130.23	SC-8
174468 ANPARA4 400.00 174472 OBRA4 400.00 1	OPEN LINE FROM BUS 177406 [ANPARA-D 765.00] TO BUS 177712 [OBRAC 765.00] CKT 1	529.01	985.44	857	114.99	SC-8
424018 ANGUL-A 400.00 424030 JINDAL-JITPL400.00 1	OPEN LINE FROM BUS 424018 [ANGUL-A 400.00] TO BUS 424030 [JINDAL-JITPL400.00] CKT 2	608.87	1184.36	1093	108.36	SC-8
314014 JINDAL-B1 400.00 314101 PITHORA 400.00 1	OPEN LINE FROM BUS 314014 [JINDAL-B1 400.00] TO BUS 314101 [PITHORA 400.00] CKT 2	440	881.31	850	103.68	SC-8
414010 KAHALGAON-B 400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 414010 [KAHALGAON-B 400.00] TO BUS 444019 [FARAKKA 400.00] CKT 2	603.81	863.71	852	102.20	SC-8
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	859.68	1196.77	857	139.65	SC-9

Annex-3.7

N-1 Contingency of 765/400 kV Transformers

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
504092 VEMAG-II 400.00 508092 VEM-II80 765.00 1	OPEN LINE FROM BUS 504092 [VEMAG-II 400.00] TO BUS 508092 [VEM-II80 765.00] CKT 2	1188.81	1846.26	1500	123.08	SC-1
514078 WARANGAL NEW400.00 518079 WARANGAL NEW765.00 1	OPEN LINE FROM BUS 514078 [WARANGAL NEW400.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 2	1142.21	1796.32	1500	119.75	SC-1
504099 CPETA400 400.00 508099 CPETA800 765.00 1	OPEN LINE FROM BUS 504099 [CPETA400 400.00] TO BUS 508099 [CPETA800 765.00] CKT 2	1289.35	1714.84	1500	114.32	SC-1
164484 BHADLA-3 400.00 167484 BHADLA-3 765.00 1	BLOCK TWOTERMDC BHADL-FATEH1	751.02	1645.26	1500	109.68	SC-1
514061 NIZAMABAD 400.00 518062 NIZAMABAD 765.00 1	OPEN LINE FROM BUS 514061 [NIZAMABAD 400.00] TO BUS 518062 [NIZAMABAD 765.00] CKT 2	1308.78	1634.75	1500	108.98	SC-1
514101 MAHESWRM 400.00 518051 MAHESHWARAM 765.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 518051 [MAHESHWARAM 765.00] CKT 2	1259.57	1628.24	1500	108.55	SC-1
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.97	1596.85	1500	106.46	SC-1
444090 JEERAT-NEW 400.00 448008 JEERAT7 765.00 1	OPEN LINE FROM BUS 444090 [JEERAT-NEW 400.00] TO BUS 448008 [JEERAT7 765.00] CKT 2	936.24	1531.39	1500	102.09	SC-1
354290 SOUTH OLPAD 400.00 358210 SOUTH OLPAD 765.00 1	OPEN LINE FROM BUS 354290 [SOUTH OLPAD 400.00] TO BUS 358210 [SOUTH OLPAD 765.00] CKT 2	1127.77	1735.88	1500	115.73	SC-2
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.24	1595.28	1500	106.35	SC-2
444090 JEERAT-NEW 400.00 448008 JEERAT7 765.00 1	OPEN LINE FROM BUS 444090 [JEERAT-NEW 400.00] TO BUS 448008 [JEERAT7 765.00] CKT 2	923.21	1519.1	1500	101.27	SC-2
164486 FATH4 SPL 400.00 167482 FATEHG-4 765.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 167482 [FATEHG-4 765.00] CKT 2	1226.47	1500.47	1500	100.03	SC-2
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.26	1595.33	1500	106.36	SC-3
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 2	1023.81	1541.82	1500	102.79	SC-3

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164484 BHADLA-3 400.00 167484 BHADLA-3 765.00 1	OPEN LINE FROM BUS 177000 [VARNASI8 765.00] TO BUS 177990 [FATEHPUR 765765.00] CKT 1	742.43	2577.06	1500	171.80	SC-4
444090 JEERAT-NEW 400.00 448008 JEERAT7 765.00 1	OPEN LINE FROM BUS 444090 [JEERAT-NEW 400.00] TO BUS 448008 [JEERAT7 765.00] CKT 2	1145.01	1914.15	1500	127.61	SC-4
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 2	1126.38	1696.26	1500	113.08	SC-4
314008 SIPAT4 400.00 318007 SIPAT 765.00 1	OPEN LINE FROM BUS 314008 [SIPAT4 400.00] TO BUS 318007 [SIPAT 765.00] CKT 2	724.16	1095.31	1000	109.53	SC-4
174484 KANPRNEW 400.00 177882 KANPURPG 765.00 1	OPEN LINE FROM BUS 177000 [VARNASI8 765.00] TO BUS 177990 [FATEHPUR 765765.00] CKT 1	756.27	1598.91	1500	106.59	SC-4
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1181.07	1597.08	1500	106.47	SC-4
144998 KAITHAL_VSC 400.00 147705 KAITHAL VSC 765.00 1	OPEN LINE FROM BUS 144998 [KAITHAL_VSC 400.00] TO BUS 147705 [KAITHAL VSC 765.00] CKT 2	1107.6	1569.14	1500	104.61	SC-4
504099 CPETA400 400.00 508099 CPETA800 765.00 1	OPEN LINE FROM BUS 504099 [CPETA400 400.00] TO BUS 508099 [CPETA800 765.00] CKT 2	1168.12	1553.1	1500	103.54	SC-4
174990 FATEH VSC 400.00 177990 FATEHPUR 765765.00 1	OPEN LINE FROM BUS 174990 [FATEH VSC 400.00] TO BUS 177990 [FATEHPUR 765765.00] CKT 2	1184.75	1515.44	1500	101.03	SC-4
354290 SOUTH OLPAD 400.00 358210 SOUTH OLPAD 765.00 1	OPEN LINE FROM BUS 354290 [SOUTH OLPAD 400.00] TO BUS 358210 [SOUTH OLPAD 765.00] CKT 2	1075.03	1627.83	1500	108.52	SC-5
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.08	1594.93	1500	106.33	SC-5
444090 JEERAT-NEW 400.00 448008 JEERAT7 765.00 1	OPEN LINE FROM BUS 444090 [JEERAT-NEW 400.00] TO BUS 448008 [JEERAT7 765.00] CKT 2	962.08	1593.71	1500	106.25	SC-5
364012 SATNA-74 400.00 368012 SATNA-7 765.00 1	OPEN LINE FROM BUS 364012 [SATNA-74 400.00] TO BUS 368012 [SATNA-7 765.00] CKT 2	703.29	1009.94	1000	100.99	SC-5
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.41	1595.63	1500	106.38	SC-6
544127 ARIYALUR4 400.00 548127 ARIYALUR7 765.00 1	OPEN LINE FROM BUS 544127 [ARIYALUR4 400.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 2	1536.98	2371.79	1500	158.12	SC-7
544128 COIMBTR4 400.00 548128 COIMBTR7 765.00 1	OPEN LINE FROM BUS 544128 [COIMBTR4 400.00] TO BUS 548128 [COIMBTR7 765.00] CKT 2	1232.14	1977.01	1500	131.80	SC-7
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.79	1596.49	1500	106.43	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.63	1596.13	1500	106.41	SC-8
374048 AURANGBD-III400.00 378048 AURANGBD-III765.00 1	OPEN LINE FROM BUS 374048 [AURANGBD-III400.00] TO BUS 378048 [AURANGBD-III765.00] CKT 2	963.3	1579.74	1500	105.32	SC-8
354290 SOUTH OLPAD 400.00 358210 SOUTH OLPAD 765.00 1	OPEN LINE FROM BUS 354290 [SOUTH OLPAD 400.00] TO BUS 358210 [SOUTH OLPAD 765.00] CKT 2	1017.85	1568.32	1500	104.55	SC-8
354129 MUL 400.00 358129 MUL 765 765.00 1	OPEN LINE FROM BUS 354129 [MUL 400.00] TO BUS 358129 [MUL 765 765.00] CKT 2	1180.71	1596.31	1500	106.42	SC-9

N-1 Contingency of 400/220 kV Transformers

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 167481 [FATEHG-3 765.00] TO BUS 167502 [BEAWAR 765.00] CKT 1	1819.3	1826.56	500	365.31	SC-1
164000 BIKANER-IV 400.00 162001 BIKANER-IV 220.00 1	OPEN LINE FROM BUS 164000 [BIKANER-IV 400.00] TO BUS 162001 [BIKANER-IV 220.00] CKT 2	965.11	1163.02	500	232.60	SC-1
164883 BARMER1_4 400.00 162883 BARMER-I 220.00 1	OPEN LINE FROM BUS 164883 [BARMER1_4 400.00] TO BUS 162883 [BARMER-I 220.00] CKT 2	776.98	908.97	500	181.79	SC-1
164422 RAMG-I 400.00 162422 RAMGARH-I 220.00 1	OPEN LINE FROM BUS 164422 [RAMG-I 400.00] TO BUS 162422 [RAMGARH-I 220.00] CKT 2	428.18	860.12	500	172.02	SC-1
504083 TALARICH 400.00 502312 TALARI_CRV 2220.00 2	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 502312 [TALARI_CRV 2220.00] CKT 3	323.48	486.7	315	154.51	SC-1
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	329.96	485.08	315	153.99	SC-1
504083 TALARICH 400.00 502312 TALARI_CRV 2220.00 1	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 502312 [TALARI_CRV 2220.00] CKT 2	308.65	463.75	315	147.22	SC-1
164459 BHADLA PG 400.00 162659 BHADLA-SPLT 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162659 [BHADLA-SPLT 220.00] CKT 2	347.42	696.93	500	139.39	SC-1
164498 BHADLA-2 400.00 162499 BHAD-2 SPLT 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162499 [BHAD-2 SPLT 220.00] CKT 2	450.45	677.03	500	135.41	SC-1
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	325.94	419.96	315	133.32	SC-1
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	334.49	404.34	315	128.36	SC-1
444024 GOKARNA 400.00 442566 GOKARNA 220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 2	320.11	399.9	315	126.95	SC-1
364189 DATIYA NEW4 400.00 362189 DATIYA NEW2 220.00 1	OPEN LINE FROM BUS 364189 [DATIYA NEW4 400.00] TO BUS 362189 [DATIYA NEW2 220.00] CKT 2	392.61	612.42	500	122.48	SC-1
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	260.78	385.41	315	122.35	SC-1
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	275.41	380.42	315	120.77	SC-1
164428 CHITTOR4 400.00 162228 CHITTOR-42 220.00 1	OPEN LINE FROM BUS 164428 [CHITTOR4 400.00] TO BUS 162228 [CHITTOR-42 220.00] CKT 2	280.75	365.23	315	115.95	SC-1
164498 BHADLA-2 400.00 162498 BHADLA-2 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162498 [BHADLA-2 220.00] CKT 2	462.54	578.73	500	115.75	SC-1
164481 FATEHG-3 400.00 162481 FATEHG-3 220.00 1	OPEN LINE FROM BUS 164481 [FATEHG-3 400.00] TO BUS 162481 [FATEHG-3 220.00] CKT 2	461.26	577.31	500	115.46	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164415 DEEDWANA 400.00 162093 DEEDWANA-42 220.00 1	OPEN LINE FROM BUS 164415 [DEEDWANA 400.00] TO BUS 162093 [DEEDWANA-42 220.00] CKT 2	235.88	355.14	315	112.74	SC-1
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	251.11	350.63	315	111.31	SC-1
164406 HERAPU-4 400.00 162211 HIRAPURA 220.00 2	OPEN LINE FROM BUS 164406 [HERAPU-4 400.00] TO BUS 162211 [HIRAPURA 220.00] CKT 1	236.33	276.22	250	110.49	SC-1
444010 SAGARDIGHI_4400.00 442010 SAGARDIGHI_2220.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	279.44	344.89	315	109.49	SC-1
164431 BASSI 400.00 162283 BASSI 220.00 1	OPEN LINE FROM BUS 164431 [BASSI 400.00] TO BUS 162283 [BASSI 220.00] CKT 3	254.69	342.46	315	108.72	SC-1
134484 PATRAN4 400.00 132241 PATRAN42 220.00 1	OPEN LINE FROM BUS 134484 [PATRAN4 400.00] TO BUS 132241 [PATRAN42 220.00] CKT 2	420.73	540.69	500	108.14	SC-1
164459 BHADLA PG 400.00 162359 BHADLA-PG 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162359 [BHADLA-PG 220.00] CKT 2	447.05	536.94	500	107.39	SC-1
164484 BHADLA-3 400.00 162484 BHADLA-3 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 162484 [BHADLA-3 220.00] CKT 2	428.18	535.66	500	107.13	SC-1
164484 BHADLA-3 400.00 163484 BHADLA3-SPL 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 163484 [BHADLA3-SPL 220.00] CKT 2	428.18	535.66	500	107.13	SC-1
164413 RAJWEST 400.00 162278 RAJWEST 220.00 1	OPEN LINE FROM BUS 164402 [BARMER-4 400.00] TO BUS 164413 [RAJWEST 400.00] CKT 1	137.84	336.66	315	106.88	SC-1
164406 HERAPU-4 400.00 162211 HIRAPURA 220.00 1	OPEN LINE FROM BUS 164406 [HERAPU-4 400.00] TO BUS 162211 [HIRAPURA 220.00] CKT 2	297.78	336.32	315	106.77	SC-1
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	289.41	334.63	315	106.23	SC-1
164405 BHINMAL 400.00 162914 BHINM-PG 220.00 1	OPEN LINE FROM BUS 164405 [BHINMAL 400.00] TO BUS 162914 [BHINM-PG 220.00] CKT 2	245.74	333.54	315	105.89	SC-1
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.35	528.74	500	105.75	SC-1
504007 CUDP 400.00 502216 CHINAKAMPALL220.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 502216 [CHINAKAMPALL220.00] CKT 3	241.8	332.6	315	105.59	SC-1
444421 BIDHAN NGR 400.00 442686 BIDHANNGR-WB220.00 1	OPEN LINE FROM BUS 444421 [BIDHAN NGR 400.00] TO BUS 442686 [BIDHANNGR-WB220.00] CKT 3	267.8	332.49	315	105.55	SC-1
524084 YELAHNKA 400.00 522084 YELAH220 220.00 1	OPEN LINE FROM BUS 524084 [YELAHNKA 400.00] TO BUS 522084 [YELAH220 220.00] CKT 2	380.52	521.4	500	104.28	SC-1
144480 JINDPG 400.00 142286 JINDPG 220.00 1	OPEN LINE FROM BUS 144480 [JINDPG 400.00] TO BUS 142286 [JINDPG 220.00] CKT 2	423.73	516.76	500	103.35	SC-1
414071 KISHANGANJ 400.00 412101 KISHENGAN-PG220.00 1	OPEN LINE FROM BUS 414071 [KISHANGANJ 400.00] TO BUS 412101 [KISHENGAN-PG220.00] CKT 2	363.48	508.18	500	101.64	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
544132 KAMUTHI4 400.00 542130 KAMUDHI42 230.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 542130 [KAMUDHI42 230.00] CKT 2	161.07	319.74	315	101.50	SC-1
524025 DHANLLI 400.00 523025 DHALLI 220.00 1	OPEN LINE FROM BUS 524025 [DHANLLI 400.00] TO BUS 523025 [DHALLI 220.00] CKT 2	376.17	506.28	500	101.26	SC-1
534952 EDAMAN4 400.00 532003 EDAMON2 220.00 2	OPEN LINE FROM BUS 534952 [EDAMAN4 400.00] TO BUS 532003 [EDAMON2 220.00] CKT 1	234.46	317.88	315	100.91	SC-1
114013 PANG400SP3 400.00 114011 PANG220SP3 220.00 1	OPEN LINE FROM BUS 114013 [PANG400SP3 400.00] TO BUS 114011 [PANG220SP3 220.00] CKT 2	264.34	317.47	315	100.78	SC-1
114012 PANG400SP2 400.00 114010 PANG220SP2 220.00 1	OPEN LINE FROM BUS 114012 [PANG400SP2 400.00] TO BUS 114010 [PANG220SP2 220.00] CKT 2	264.34	317.44	315	100.77	SC-1
114008 PANG 400 SP1400.00 114009 LEH_PANG SP 220.00 1	OPEN LINE FROM BUS 114008 [PANG 400 SP1400.00] TO BUS 114009 [LEH_PANG SP 220.00] CKT 2	264.34	317.4	315	100.76	SC-1
134918 JALANDHAR4 400.00 132918 JALANDHAR42 220.00 1	OPEN LINE FROM BUS 134918 [JALANDHAR4 400.00] TO BUS 132918 [JALANDHAR42 220.00] CKT 3	240.18	315.1	315	100.03	SC-1
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 163482 [FATEHG4-SPL 220.00] CKT 2	940.1	1182.12	500	236.42	SC-2
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	350.67	519.72	315	164.99	SC-2
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	370.05	450.07	315	142.88	SC-2
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	279.3	389.97	315	123.80	SC-2
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	279.07	383.21	315	121.65	SC-2
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	446.31	594.65	500	118.93	SC-2
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	285.27	367.41	315	116.64	SC-2
164434 JODH KANKANI400.00 162334 JODHPURN-42 220.00 1	OPEN LINE FROM BUS 164434 [JODH KANKANI400.00] TO BUS 162334 [JODHPURN-42 220.00] CKT 2	282.46	365.79	315	116.12	SC-2
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	400.5	573.82	500	114.76	SC-2
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	310.83	360.41	315	114.42	SC-2
354015 MUNDRA-APL 400.00 352015 MUNDRA-APL 220.00 1	OPEN LINE FROM BUS 354015 [MUNDRA-APL 400.00] TO BUS 352015 [MUNDRA-APL 220.00] CKT 2	262.35	357.05	315	113.35	SC-2
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	240.91	356.94	315	113.31	SC-2

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164457 SURATG-4 400.00 162257 SURATGARH-42220.00 1	OPEN LINE FROM BUS 164457 [SURATG-4 400.00] TO BUS 162257 [SURATGARH-42220.00] CKT 2	255.97	352	315	111.75	SC-2
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	255.99	351.05	315	111.44	SC-2
174265 REWA 400.00 172112 REWAROAD 220.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 1	315.22	349.32	315	110.90	SC-2
174472 OBRA4 400.00 172062 OBRA2 220.00 3	OPEN LINE FROM BUS 174472 [OBRA4 400.00] TO BUS 172062 [OBRA2 220.00] CKT 1	205.05	263.44	240	109.77	SC-2
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	390.48	542.74	500	108.55	SC-2
534952 EDAMAN4 400.00 532003 EDAMON2 220.00 2	OPEN LINE FROM BUS 534952 [EDAMAN4 400.00] TO BUS 532003 [EDAMON2 220.00] CKT 1	246.36	334.82	315	106.29	SC-2
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-2
174512 ALIGARH 400.00 172087 ALIGARH 220.00 1	OPEN LINE FROM BUS 174512 [ALIGARH 400.00] TO BUS 172087 [ALIGARH 220.00] CKT 2	380.65	527.78	500	105.56	SC-2
164412 KALISI-4 400.00 162300 KALISIND 220.00 2	OPEN LINE FROM BUS 164412 [KALISI-4 400.00] TO BUS 164485 [SANGOD 400.00] CKT 1	435.27	515.78	500	103.16	SC-2
164428 CHITTOR4 400.00 162228 CHITTOR-42 220.00 1	OPEN LINE FROM BUS 164428 [CHITTOR4 400.00] TO BUS 162228 [CHITTOR-42 220.00] CKT 2	249.02	324.11	315	102.89	SC-2
144483 KURUKSHETR 400.00 142287 KURUKSHETRA 220.00 1	OPEN LINE FROM BUS 144483 [KURUKSHETR 400.00] TO BUS 142287 [KURUKSHETRA 220.00] CKT 2	414.63	514.12	500	102.82	SC-2
164400 MERTA 400.00 162200 MERTA-42 220.00 1	OPEN LINE FROM BUS 164400 [MERTA 400.00] TO BUS 162200 [MERTA-42 220.00] CKT 2	232.38	323.7	315	102.76	SC-2
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	232.61	317.43	315	100.77	SC-2
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 163482 [FATEHG4-SPL 220.00] CKT 2	709.79	890.13	500	178.03	SC-3
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	288.12	394.66	315	125.29	SC-3
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	254.79	375.59	315	119.23	SC-3
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	386.87	554.7	500	110.94	SC-3
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	275.38	334.08	315	106.06	SC-3
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-3

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
354015 MUNDRA-APL 400.00 352015 MUNDRA-APL 220.00 1	OPEN LINE FROM BUS 354015 [MUNDRA-APL 400.00] TO BUS 352015 [MUNDRA-APL 220.00] CKT 2	239.83	326.39	315	103.62	SC-3
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	389.17	516.21	500	103.24	SC-3
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 177000 [VARNASI8 765.00] TO BUS 177990 [FATEHPUR 765765.00] CKT 1	1814.54	1825.84	500	365.17	SC-4
164000 BIKANER-IV 400.00 162001 BIKANER-IV 220.00 1	OPEN LINE FROM BUS 164000 [BIKANER-IV 400.00] TO BUS 162001 [BIKANER-IV 220.00] CKT 2	960.13	1156.99	500	231.40	SC-4
164883 BARMER1_4 400.00 162883 BARMER-I 220.00 1	OPEN LINE FROM BUS 164883 [BARMER1_4 400.00] TO BUS 162883 [BARMER-I 220.00] CKT 2	775.64	907.35	500	181.47	SC-4
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	378.94	551.39	315	175.04	SC-4
164422 RAMG-I 400.00 162422 RAMGARH-I 220.00 1	OPEN LINE FROM BUS 164422 [RAMG-I 400.00] TO BUS 162422 [RAMGARH-I 220.00] CKT 2	426.84	857.4	500	171.48	SC-4
444024 GOKARNA 400.00 442566 GOKARNA 220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 2	412.52	517.94	315	164.43	SC-4
504083 TALARICH 400.00 502312 TALARI_CRV 2220.00 2	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 502312 [TALARI_CRV 2220.00] CKT 3	330.74	497.89	315	158.06	SC-4
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	404.24	487.17	315	154.66	SC-4
504083 TALARICH 400.00 502312 TALARI_CRV 2220.00 1	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 502312 [TALARI_CRV 2220.00] CKT 2	315.88	474.71	315	150.70	SC-4
164459 BHADLA PG 400.00 162659 BHADLA-SPLT 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162659 [BHADLA-SPLT 220.00] CKT 2	346.64	695.25	500	139.05	SC-4
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	321.46	437.02	315	138.74	SC-4
164498 BHADLA-2 400.00 162499 BHAD-2 SPLT 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162499 [BHAD-2 SPLT 220.00] CKT 2	449.04	674.91	500	134.98	SC-4
444010 SAGARDIGHI_4400.00 442010 SAGARDIGHI_2220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 1	362.82	421.02	315	133.66	SC-4
444421 BIDHAN NGR 400.00 442686 BIDHANNGR-WB220.00 1	OPEN LINE FROM BUS 444421 [BIDHAN NGR 400.00] TO BUS 442686 [BIDHANNGR-WB220.00] CKT 3	337.82	420.64	315	133.54	SC-4
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	344.04	397.18	315	126.09	SC-4
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	286.87	392.54	315	124.62	SC-4
174431 KANPUR 400.00 172103 KANPU-PG 220.00 1	OPEN LINE FROM BUS 174431 [KANPUR 400.00] TO BUS 172103 [KANPU-PG 220.00] CKT 2	295.02	374.37	315	118.85	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	283.06	365.01	315	115.88	SC-4
164498 BHADLA-2 400.00 162498 BHADLA-2 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162498 [BHADLA-2 220.00] CKT 2	461.1	576.92	500	115.38	SC-4
164481 FATEHG-3 400.00 162481 FATEHG-3 220.00 1	OPEN LINE FROM BUS 164481 [FATEHG-3 400.00] TO BUS 162481 [FATEHG-3 220.00] CKT 2	460.22	576	500	115.20	SC-4
448022 BAPL_400 400.00 442530 ANDAL 220.00 1	OPEN LINE FROM BUS 448022 [BAPL_400 400.00] TO BUS 442530 [ANDAL 220.00] CKT 2	253.26	361	315	114.60	SC-4
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	256.74	349.73	315	111.03	SC-4
414071 KISHANGANJ 400.00 412101 KISHENGAN-PG220.00 1	OPEN LINE FROM BUS 414071 [KISHANGANJ 400.00] TO BUS 412101 [KISHENGAN-PG220.00] CKT 2	385.47	540	500	108.00	SC-4
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	227.27	338.2	315	107.37	SC-4
164484 BHADLA-3 400.00 162484 BHADLA-3 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 162484 [BHADLA-3 220.00] CKT 2	428.35	535.98	500	107.20	SC-4
164484 BHADLA-3 400.00 163484 BHADLA3-SPL 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 163484 [BHADLA3-SPL 220.00] CKT 2	428.35	535.98	500	107.20	SC-4
164459 BHADLA PG 400.00 162359 BHADLA-PG 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162359 [BHADLA-PG 220.00] CKT 2	445.68	535.13	500	107.02	SC-4
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-4
364189 DATIYA NEW4 400.00 362189 DATIYA NEW2 220.00 1	OPEN LINE FROM BUS 364189 [DATIYA NEW4 400.00] TO BUS 362189 [DATIYA NEW2 220.00] CKT 2	338.16	528.16	500	105.63	SC-4
544132 KAMUTHI4 400.00 542130 KAMUDHI42 230.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 542130 [KAMUDHI42 230.00] CKT 2	167.08	332.2	315	105.46	SC-4
374217 NAVI-MUM 400.00 372365 NAVI-MUM220 220.00 1	OPEN LINE FROM BUS 374217 [NAVI-MUM 400.00] TO BUS 372365 [NAVI-MUM220 220.00] CKT 2	256.67	331.75	315	105.32	SC-4
164428 CHITTOR4 400.00 162228 CHITTOR-42 220.00 1	OPEN LINE FROM BUS 164428 [CHITTOR4 400.00] TO BUS 162228 [CHITTOR-42 220.00] CKT 2	253.6	330.55	315	104.94	SC-4
164415 DEEDWANA 400.00 162093 DEEDWANA-42 220.00 1	OPEN LINE FROM BUS 164415 [DEEDWANA 400.00] TO BUS 162093 [DEEDWANA-42 220.00] CKT 2	215.13	324.65	315	103.06	SC-4
164404 BHADLA 400.00 162285 BHADLA-S 220.00 1	OPEN LINE FROM BUS 164404 [BHADLA 400.00] TO BUS 162285 [BHADLA-S 220.00] CKT 2	401.71	506.91	500	101.38	SC-4
504007 CUDP 400.00 502216 CHINAKAMPALL220.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 502216 [CHINAKAMPALL220.00] CKT 3	231.86	319.25	315	101.35	SC-4
164405 BHINMAL 400.00 162914 BHINM-PG 220.00 1	OPEN LINE FROM BUS 164405 [BHINMAL 400.00] TO BUS 162914 [BHINM-PG 220.00] CKT 2	234.82	318.87	315	101.23	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
114008 PANG 400 SP1400.00 114009 LEH_PANG SP 220.00 1	OPEN LINE FROM BUS 114008 [PANG 400 SP1400.00] TO BUS 114009 [LEH_PANG SP 220.00] CKT 2	264.22	317.12	315	100.67	SC-4
114012 PANG400SP2 400.00 114010 PANG220SP2 220.00 1	OPEN LINE FROM BUS 114012 [PANG400SP2 400.00] TO BUS 114010 [PANG220SP2 220.00] CKT 2	264.06	316.94	315	100.62	SC-4
114013 PANG400SP3 400.00 114011 PANG220SP3 220.00 1	OPEN LINE FROM BUS 114013 [PANG400SP3 400.00] TO BUS 114011 [PANG220SP3 220.00] CKT 2	263.97	316.84	315	100.58	SC-4
534952 EDAMAN4 400.00 532003 EDAMON2 220.00 2	OPEN LINE FROM BUS 534952 [EDAMAN4 400.00] TO BUS 532003 [EDAMON2 220.00] CKT 1	233.11	316.51	315	100.48	SC-4
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 163482 [FATEHG4-SPL 220.00] CKT 2	877.12	1100.24	500	220.05	SC-5
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	366.75	542.67	315	172.28	SC-5
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	363.31	441.9	315	140.29	SC-5
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	462.75	664.13	500	132.83	SC-5
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	283.21	388.98	315	123.49	SC-5
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	445.17	592.63	500	118.53	SC-5
354015 MUNDRA-APL 400.00 352015 MUNDRA-APL 220.00 1	OPEN LINE FROM BUS 354015 [MUNDRA-APL 400.00] TO BUS 352015 [MUNDRA-APL 220.00] CKT 2	270.27	367.78	315	116.76	SC-5
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	306.28	355.11	315	112.73	SC-5
174265 REWA 400.00 172112 REWAROAD 220.00 1	OPEN LINE FROM BUS 177262 [MAINPURIUP 765.00] TO BUS 177263 [BARA 765.00] CKT 1	306.46	343.12	315	108.93	SC-5
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	244.71	340.98	315	108.25	SC-5
174512 ALIGARH 400.00 172087 ALIGARH 220.00 1	OPEN LINE FROM BUS 174512 [ALIGARH 400.00] TO BUS 172087 [ALIGARH 220.00] CKT 2	381.43	529.07	500	105.81	SC-5
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	225.18	333.23	315	105.79	SC-5
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-5
164457 SURATG-4 400.00 162257 SURATGARH-42220.00 1	OPEN LINE FROM BUS 164457 [SURATG-4 400.00] TO BUS 162257 [SURATGARH-42220.00] CKT 2	240.1	329.81	315	104.70	SC-5
174472 OBRA4 400.00 172062 OBRA2 220.00 3	OPEN LINE FROM BUS 174472 [OBRA4 400.00] TO BUS 172062 [OBRA2 220.00] CKT 1	193.33	248.39	240	103.50	SC-5

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	252.42	324.71	315	103.08	SC-5
174058 ORAI 400.00 172124 ORAI 42 220.00 3	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 2	163.62	245.18	240	102.16	SC-5
414071 KISHANGANJ 400.00 412101 KISHENGAN-PG220.00 1	OPEN LINE FROM BUS 414071 [KISHANGANJ 400.00] TO BUS 412101 [KISHENGAN-PG220.00] CKT 2	359.78	502.86	500	100.57	SC-5
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 163482 [FATEHG4-SPL 220.00] CKT 2	751.8	942.96	500	188.59	SC-6
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	272.46	403.67	315	128.15	SC-6
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	407.9	585.57	500	117.11	SC-6
354015 MUNDRA-APL 400.00 352015 MUNDRA-APL 220.00 1	OPEN LINE FROM BUS 354015 [MUNDRA-APL 400.00] TO BUS 352015 [MUNDRA-APL 220.00] CKT 2	259.45	353.02	315	112.07	SC-6
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	418.63	552.49	500	110.50	SC-6
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	253.78	346.7	315	110.06	SC-6
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	283.85	345.14	315	109.57	SC-6
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-6
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 163482 [FATEHG4-SPL 220.00] CKT 2	1272.04	1606.56	500	321.31	SC-7
164000 BIKANER-IV 400.00 162001 BIKANER-IV 220.00 1	OPEN LINE FROM BUS 164000 [BIKANER-IV 400.00] TO BUS 162001 [BIKANER-IV 220.00] CKT 2	958.72	1155.29	500	231.06	SC-7
164422 RAMG-I 400.00 162422 RAMGARH-I 220.00 1	OPEN LINE FROM BUS 164422 [RAMG-I 400.00] TO BUS 162422 [RAMGARH-I 220.00] CKT 2	426.21	856.13	500	171.23	SC-7
504083 TALARICH 400.00 502312 TALARI_CRV 2220.00 2	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 502312 [TALARI_CRV 2220.00] CKT 3	342.98	516.17	315	163.86	SC-7
504083 TALARICH 400.00 502312 TALARI_CRV 2220.00 1	OPEN LINE FROM BUS 504083 [TALARICH 400.00] TO BUS 502312 [TALARI_CRV 2220.00] CKT 2	326.09	490.68	315	155.77	SC-7
364189 DATIYA NEW4 400.00 362189 DATIYA NEW2 220.00 1	OPEN LINE FROM BUS 364189 [DATIYA NEW4 400.00] TO BUS 362189 [DATIYA NEW2 220.00] CKT 2	449.48	699.38	500	139.88	SC-7
524047 NAREND-4 400.00 522047 NARENDRA 220.00 1	OPEN LINE FROM BUS 524047 [NAREND-4 400.00] TO BUS 522047 [NARENDRA 220.00] CKT 2	457.5	693.87	500	138.77	SC-7
164459 BHADLA PG 400.00 162659 BHADLA-SPLT 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162659 [BHADLA-SPLT 220.00] CKT 2	345.84	693.4	500	138.68	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164883 BARMER1_4 400.00 162883 BARMER-I 220.00 1	OPEN LINE FROM BUS 164883 [BARMER1_4 400.00] TO BUS 162883 [BARMER-I 220.00] CKT 2	587.71	686.66	500	137.33	SC-7
164498 BHADLA-2 400.00 162499 BHAD-2 SPLT 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162499 [BHAD-2 SPLT 220.00] CKT 2	448.38	673.91	500	134.78	SC-7
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	326.72	419.29	315	133.11	SC-7
524034 KUDGI-NT 400.00 522144 KUDGI-NTPC 220.00 1	OPEN LINE FROM BUS 524034 [KUDGI-NT 400.00] TO BUS 522144 [KUDGI-NTPC 220.00] CKT 2	430.2	644.73	500	128.95	SC-7
544073 PONDY4 400.00 542100 PONDY42 230.00 2	OPEN LINE FROM BUS 544073 [PONDY4 400.00] TO BUS 542100 [PONDY42 230.00] CKT 3	229.6	404.91	315	104.57	SC-7
524004 DAVAN4 400.00 522004 GUTTUR 220.00 1	OPEN LINE FROM BUS 524004 [DAVAN4 400.00] TO BUS 522004 [GUTTUR 220.00] CKT 2	301.45	385.37	315	122.34	SC-7
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	259.23	380.84	315	120.90	SC-7
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	425.17	592.72	500	118.54	SC-7
524084 YELAHNKA 400.00 522084 YELAH220 220.00 1	OPEN LINE FROM BUS 524084 [YELAHNKA 400.00] TO BUS 522084 [YELAH220 220.00] CKT 2	424.96	582.46	500	116.49	SC-7
164498 BHADLA-2 400.00 162498 BHADLA-2 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162498 [BHADLA-2 220.00] CKT 2	460.42	576.07	500	115.21	SC-7
164481 FATEHG-3 400.00 162481 FATEHG-3 220.00 1	OPEN LINE FROM BUS 164481 [FATEHG-3 400.00] TO BUS 162481 [FATEHG-3 220.00] CKT 2	458.5	573.65	500	114.73	SC-7
534952 EDAMAN4 400.00 532003 EDAMON2 220.00 2	OPEN LINE FROM BUS 534952 [EDAMAN4 400.00] TO BUS 532003 [EDAMON2 220.00] CKT 1	262.04	356.22	315	113.09	SC-7
164428 CHITTOR4 400.00 162228 CHITTOR-42 220.00 1	OPEN LINE FROM BUS 164428 [CHITTOR4 400.00] TO BUS 162228 [CHITTOR-42 220.00] CKT 2	271.69	352.19	315	111.81	SC-7
544132 KAMUTHI4 400.00 542130 KAMUDHI42 230.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 542130 [KAMUDHI42 230.00] CKT 2	180.5	351.14	315	111.47	SC-7
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	238.05	350.18	315	111.17	SC-7
544073 PONDY4 400.00 542100 PONDY42 230.00 1	OPEN LINE FROM BUS 544073 [PONDY4 400.00] TO BUS 542100 [PONDY42 230.00] CKT 3	229.6	346.75	315	104.57	SC-7
524025 DHANLLI 400.00 523025 DHALLI 220.00 1	OPEN LINE FROM BUS 524025 [DHANLLI 400.00] TO BUS 523025 [DHALLI 220.00] CKT 2	399.69	540.71	500	108.14	SC-7
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	248.43	338.71	315	107.53	SC-7
164459 BHADLA PG 400.00 162359 BHADLA-PG 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162359 [BHADLA-PG 220.00] CKT 2	445.41	535.01	500	107.00	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164484 BHADLA-3 400.00 162484 BHADLA-3 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 162484 [BHADLA-3 220.00] CKT 2	426.21	533.2	500	106.64	SC-7
164484 BHADLA-3 400.00 163484 BHADLA3-SPL 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 163484 [BHADLA3-SPL 220.00] CKT 2	426.21	533.2	500	106.64	SC-7
544003 SALE 400.00 542025 SALEM42 230.00 1	OPEN LINE FROM BUS 544003 [SALE 400.00] TO BUS 542025 [SALEM42 230.00] CKT 2	280.44	334.57	315	106.21	SC-7
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.08	528.12	500	105.62	SC-7
544007 HOSUR4 400.00 542076 HOSUR42 230.00 1	OPEN LINE FROM BUS 544007 [HOSUR4 400.00] TO BUS 542076 [HOSUR42 230.00] CKT 4	244.76	329.84	315	104.71	SC-7
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	233.16	324.88	315	103.14	SC-7
374217 NAVI-MUM 400.00 372365 NAVI-MUM220 220.00 1	OPEN LINE FROM BUS 374217 [NAVI-MUM 400.00] TO BUS 372365 [NAVI-MUM220 220.00] CKT 2	252.52	324.74	315	103.09	SC-7
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	267.8	324.66	315	103.07	SC-7
114001 LEH_PANG 400.00 112001 LEH_PANG 220.00 1	OPEN LINE FROM BUS 114001 [LEH_PANG 400.00] TO BUS 112001 [LEH_PANG 220.00] CKT 2	155.44	316.54	315	100.49	SC-7
114013 PANG400SP3 400.00 114011 PANG220SP3 220.00 1	OPEN LINE FROM BUS 114013 [PANG400SP3 400.00] TO BUS 114011 [PANG220SP3 220.00] CKT 2	263.13	316.01	315	100.32	SC-7
114012 PANG400SP2 400.00 114010 PANG220SP2 220.00 1	OPEN LINE FROM BUS 114012 [PANG400SP2 400.00] TO BUS 114010 [PANG220SP2 220.00] CKT 2	263.12	315.98	315	100.31	SC-7
114008 PANG 400 SP1400.00 114009 LEH_PANG SP 220.00 1	OPEN LINE FROM BUS 114008 [PANG 400 SP1400.00] TO BUS 114009 [LEH_PANG SP 220.00] CKT 2	263.13	315.94	315	100.30	SC-7
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	472.6	678.28	500	135.66	SC-8
534952 EDAMAN4 400.00 532003 EDAMON2 220.00 2	OPEN LINE FROM BUS 534952 [EDAMAN4 400.00] TO BUS 532003 [EDAMON2 220.00] CKT 1	290.75	396.26	315	125.80	SC-8
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	437.3	607.14	500	121.43	SC-8
164434 JODH KANKANI400.00 162334 JODHPURN-42 220.00 1	OPEN LINE FROM BUS 164434 [JODH KANKANI400.00] TO BUS 162334 [JODHPURN-42 220.00] CKT 2	293.05	379.5	315	120.48	SC-8
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	274.02	375.1	315	119.08	SC-8
164412 KALISI-4 400.00 162300 KALISIND 220.00 2	OPEN LINE FROM BUS 164412 [KALISI-4 400.00] TO BUS 164485 [SANGOD 400.00] CKT 1	505.45	582.07	500	116.41	SC-8
354036 HALVAD NEW 400.00 352140 HALWAD NEW 220.00 1	OPEN LINE FROM BUS 354036 [HALVAD NEW 400.00] TO BUS 352140 [HALWAD NEW 220.00] CKT 2	262.07	340.74	315	108.17	SC-8

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	277.3	336.63	315	106.87	SC-8
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-8
164486 FATH4 SPL 400.00 163482 FATEHG4-SPL 220.00 1	OPEN LINE FROM BUS 164486 [FATH4 SPL 400.00] TO BUS 163482 [FATEHG4-SPL 220.00] CKT 2	420.57	526.13	500	105.23	SC-8
164457 SURATG-4 400.00 162257 SURATGARH-42220.00 1	OPEN LINE FROM BUS 164457 [SURATG-4 400.00] TO BUS 162257 [SURATGARH-42220.00] CKT 2	236.93	325.7	315	103.40	SC-8
354019 ZERDA 400.00 352019 ZERDA2 220.00 1	OPEN LINE FROM BUS 354019 [ZERDA 400.00] TO BUS 352019 [ZERDA2 220.00] CKT 2	267.61	319.9	315	101.56	SC-8
174265 REWA 400.00 172112 REWAROAD 220.00 1	OPEN LINE FROM BUS 177262 [MAINPURIUP 765.00] TO BUS 177263 [BARA 765.00] CKT 1	279.18	319.09	315	101.30	SC-8
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	227.59	317.2	315	100.70	SC-8
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	388.51	556.51	500	111.30	SC-9
354022 HAZIRA4 400.00 352022 HAZIRA2 220.00 1	OPEN LINE FROM BUS 354022 [HAZIRA4 400.00] TO BUS 352022 [HAZIRA2 220.00] CKT 2	347.24	528.44	500	105.69	SC-9
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	234.66	319.91	315	101.56	SC-9

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Annex 3.8

765kV Buses Exceeding Design Fault Current

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
NORTH	JHATI-PG 765.00	39	41	41	36	41	41	39	40	41	41	40	ISTS
NORTH	BHADLA-2 765.00	41	36	36	39	36	37	41	36	37	41	40	ISTS
NORTH	JAIPUR 765.00	46	46	46	41	46	47	46	46	47	47	40	STU
NORTH	DAUSA 765.00	45	45	45	41	45	46	46	45	46	46	40	ISTS
NORTH	GNOIDAUP 765.00	42	44	44	39	44	44	42	43	43	44	40	STU
NORTH	ALIGARH 765.00	46	48	48	42	48	48	46	47	48	48	40	ISTS
NORTH	AGRA-PG 765.00	40	41	41	37	40	41	40	40	41	41	40	ISTS
WEST	BLPSR WR 765.00	44	43	43	41	43	42	45	44	45	45	40	ISTS
WEST	VATAMAN 765.00	39	41	41	38	40	40	40	41	41	41	40	ISTS
WEST	BANASKANTHA 765.00	40	40	41	39	40	39	41	41	41	41	40	ISTS
WEST	GWALIOR 765.00	42	42	42	40	42	43	43	42	43	43	40	ISTS
WEST	BINA-PG-7 765.00	40	39	40	38	39	40	40	39	40	40	40	ISTS
WEST	JABALPR-POOL765.00	53	52	52	47	52	52	54	53	54	54	50	ISTS
WEST	WARDHA 765.00	44	43	44	42	43	44	44	44	45	45	40	ISTS
WEST	AURANG-CHTPM765.00	41	40	41	40	41	42	41	40	41	42	40	ISTS
WEST	PUNE-PG-GIS 765.00	42	44	43	42	43	44	43	43	43	44	40	ISTS
WEST	PADGHEGIS 765.00	39	41	40	38	40	40	39	39	40	41	40	ISTS
SOUTH	CUDP800 765.00	40	40	40	38	40	41	40	40	42	42	40	ISTS
SOUTH	KURL800 765.00	54	52	53	51	52	54	54	53	54	54	40	ISTS
SOUTH	MAHESHWARAM 765.00	49	47	48	47	47	49	51	48	50	51	40	ISTS
SOUTH	NIZAMABAD 765.00	40	40	40	39	40	41	42	41	42	42	40	ISTS
SOUTH	WARANGAL NEW765.00	40	40	40	39	40	41	42	41	42	42	40	ISTS

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
SOUTH	RAIC800 765.00	41	40	41	40	40	41	41	40	40	41	40	ISTS

400kV Buses Exceeding Design Fault Current

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
NORTH	KISHENPUR 400.00	42	42	43	41	43	43	43	43	45	45	40	ISTS
NORTH	WANGTOO 400.00	40	40	41	39	40	40	40	41	41	41	40	STU
NORTH	KARCHAMW 400.00	40	40	41	40	40	40	41	41	41	41	40	ISTS
NORTH	NAKODAR4 400.00	40	41	41	36	41	42	40	41	44	44	40	STU
NORTH	PATIALA4 400.00	49	50	50	46	50	50	49	50	51	51	40	ISTS
NORTH	PATRAN4 400.00	45	46	46	43	46	47	45	46	47	47	40	ISTS
NORTH	JALANDHAR4 400.00	43	43	44	41	44	44	43	44	45	45	40	ISTS
NORTH	MALERKOTLA4 400.00	41	42	42	39	42	43	41	43	43	43	40	ISTS
NORTH	SONAROAD 400.00	41	42	42	38	42	42	41	42	42	42	40	STU
NORTH	DAULATABAD4 400.00	47	51	51	43	51	51	46	50	51	51	40	STU
NORTH	JHAJAR_N 400.00	46	48	48	38	48	48	41	48	48	48	40	GEN
NORTH	KABULPUR 400.00	44	46	45	39	46	46	42	45	46	46	40	STU
NORTH	DHANONDA 400.00	56	58	58	49	58	58	52	58	58	58	40	STU
NORTH	FATEHABAD 400.00	42	44	44	40	44	44	42	44	45	45	40	ISTS
NORTH	BAHADURGARH 400.00	38	40	40	36	40	40	38	40	40	40	40	ISTS
NORTH	GURGAON 400.00	49	52	52	45	52	52	49	52	52	52	50	ISTS
NORTH	PANCHKULA-PG400.00	48	48	49	46	48	49	48	49	49	49	40	ISTS
NORTH	BHIWANI-PG 400.00	55	55	55	51	55	55	54	55	55	55	50	ISTS
NORTH	JINDPG 400.00	44	48	48	42	48	48	44	48	48	48	40	ISTS
NORTH	KURUKSHETR 400.00	48	50	51	46	51	51	48	51	51	51	50	ISTS
NORTH	ABDULLAP 400.00	51	52	53	48	52	53	51	53	53	53	40	ISTS

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
NORTH	KAITHAL 400.00	42	43	43	40	43	43	42	43	44	44	40	ISTS
NORTH	BALLABHG 400.00	47	49	49	44	49	49	47	49	49	49	40	ISTS
NORTH	BAWANA-G 400.00	46	54	54	43	54	54	46	53	52	54	40	STU
NORTH	BAWANA 400.00	46	54	54	43	54	54	46	53	52	54	40	STU
NORTH	MANDOLA 400.00	41	45	45	39	45	45	42	44	45	45	40	ISTS
NORTH	MUNDKA 400.00	38	42	41	36	42	42	38	41	41	42	40	STU
NORTH	JHATIKALA-PG400.00	37	41	40	35	40	41	38	40	40	41	40	ISTS
NORTH	MANDOLASP2 400.00	41	45	45	39	45	45	42	44	45	45	40	ISTS
NORTH	MANDOLASP3 400.00	41	45	45	39	45	45	42	44	45	45	40	ISTS
NORTH	TUGHLAKABAD 400.00	40	41	41	37	41	41	40	41	41	41	40	ISTS
NORTH	GOPAL PUR 400.00	42	45	45	40	45	46	43	45	46	46	40	STU
NORTH	JHATIKARASP 400.00	40	42	41	38	41	42	41	41	42	42	40	ISTS
NORTH	BHADLA 400.00	44	39	38	42	39	39	44	38	39	44	40	STU
NORTH	CHIT-NEW 400.00	40	42	40	39	40	41	41	39	40	42	40	ISTS
NORTH	BASSI 400.00	52	51	51	48	51	52	52	51	52	52	40	ISTS
NORTH	NEEMR-PG 400.00	53	55	55	49	55	55	53	55	55	55	40	ISTS
NORTH	SIKAR 400.00	43	43	43	39	43	43	43	43	44	44	40	ISTS
NORTH	JAIPUR_RS 400.00	54	54	53	50	54	54	54	54	54	54	40	STU
NORTH	BIKANER-NW 400.00	61	53	52	59	52	53	61	52	53	61	40	ISTS
NORTH	BHADLA PG 400.00	52	44	43	50	44	44	52	44	44	52	50	ISTS
NORTH	JAIPUR_PG 400.00	41	40	39	39	40	40	42	40	40	42	40	ISTS
NORTH	FATEHG-2 400.00	55	44	44	53	43	44	55	44	45	55	50	ISTS
NORTH	FATEHG-3 400.00	56	53	52	55	53	53	57	53	53	57	40	ISTS
NORTH	BIKANER-II 400.00	56	48	47	55	48	49	56	47	48	56	40	ISTS
NORTH	BHADLA-2 400.00	54	45	45	52	45	45	54	45	46	54	50	ISTS
NORTH	BHIWADI 400.00	48	50	50	45	50	51	49	50	51	51	40	ISTS

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
NORTH	DAUSA 400.00	49	38	38	46	38	38	50	38	38	50	40	ISTS
NORTH	MEJA 400.00	48	48	48	42	48	49	49	48	49	49	40	GEN
NORTH	MAINPURIUP 400.00	40	39	40	37	39	40	40	39	40	40	40	STU
NORTH	BARA 400.00	44	44	44	40	44	45	45	44	45	45	40	STU
NORTH	REWA 400.00	40	40	40	37	40	40	40	40	40	40	40	STU
NORTH	GNOIDAUP 400.00	57	60	59	51	59	60	56	59	59	60	40	STU
NORTH	HAPUR 400.00	42	43	43	39	43	43	42	43	43	43	40	STU
NORTH	GAZIABAD 400.00	43	44	44	40	44	44	43	43	44	44	40	STU
NORTH	AGRAUP4 400.00	40	40	40	37	40	40	40	39	40	40	40	STU
NORTH	UNNAO4 400.00	43	42	43	39	42	43	42	42	43	43	40	STU
NORTH	SIKANDERABAD400.00	42	43	43	38	43	44	43	43	44	44	40	STU
NORTH	BAREL-PG 400.00	52	52	52	47	51	52	52	52	52	52	50	ISTS
NORTH	AGRANEW 400.00	46	46	46	43	46	47	46	45	46	47	40	STU
NORTH	DADR-NCR 400.00	50	60	59	46	60	59	50	59	59	60	40	GEN
NORTH	GNOIDA4 400.00	53	59	58	49	58	58	53	58	58	59	40	STU
NORTH	LUCK4-PG 400.00	54	54	54	48	54	54	54	54	54	54	40	ISTS
NORTH	MUZAFRN4 400.00	39	39	40	37	39	40	40	40	40	40	40	ISTS
NORTH	LUCK74-P 400.00	52	52	52	46	52	52	52	52	52	52	40	ISTS
NORTH	DADR-HVD 400.00	49	58	58	46	58	58	49	57	58	58	40	GEN
NORTH	FATEH-PG 400.00	48	50	51	45	50	51	48	50	51	51	50	ISTS
NORTH	SHAHJ-PG 400.00	40	39	40	33	39	40	40	40	40	40	40	ISTS
NORTH	ANPARA4 400.00	53	53	53	49	53	53	52	51	52	53	40	GEN
NORTH	ANPARA-D 400.00	47	47	47	43	47	47	46	45	46	47	40	GEN
NORTH	ANPARAC 400.00	52	52	52	48	52	52	51	50	50	52	40	GEN
NORTH	ALLAHABA 400.00	51	51	51	46	51	51	51	50	51	51	40	ISTS
NORTH	BAL74-PG 400.00	45	46	46	42	46	47	46	47	47	47	40	ISTS

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
NORTH	VARANASI 400.00	50	50	50	46	50	50	50	50	51	51	40	ISTS
NORTH	SARNATH4 400.00	44	43	44	40	43	44	44	44	44	44	40	STU
NORTH	BAREILY 400.00	51	51	51	47	51	51	51	51	52	52	50	ISTS
NORTH	KANPRNEW 400.00	49	50	50	45	50	50	48	48	49	50	50	ISTS
NORTH	ALIGARH 400.00	42	42	42	37	42	42	42	42	42	42	40	ISTS
NORTH	MEERUT 400.00	63	66	66	59	66	66	63	66	66	66	40	ISTS
NORTH	AGRA 400.00	57	57	57	53	57	58	57	57	57	58	40	STU
NORTH	SINGRL4 400.00	43	43	43	41	43	43	43	43	43	43	40	GEN
NORTH	TIKRI KHURD 400.00	42	48	47	39	48	47	41	47	46	48	40	STU
WEST	KSK MAHNADI 400.00	25	25	25	25	25	25	43	43	44	44	40	GEN
WEST	JINDAL_EX 400.00	44	43	44	43	44	41	44	44	45	45	40	GEN
WEST	BIL-POOL 400.00	47	47	47	42	47	47	47	47	47	47	40	ISTS
WEST	RAIPUR_POOL 400.00	42	41	41	36	41	39	41	40	41	42	40	ISTS
WEST	ASOJ4 400.00	38	40	40	37	40	40	38	41	41	41	40	STU
WEST	GANCS4 400.00	39	44	44	39	44	44	39	44	44	44	40	GEN
WEST	DEHGM4 400.00	36	38	38	35	38	38	37	41	41	41	40	ISTS
WEST	SOJA4 400.00	38	40	40	38	40	40	39	43	43	43	40	STU
WEST	CHORN4 400.00	41	43	43	41	43	43	42	43	43	43	40	STU
WEST	PIRANA_P 400.00	40	42	43	40	42	42	41	42	42	43	40	ISTS
WEST	MUNDRA-APL 400.00	23	23	24	23	24	24	42	42	42	42	40	GEN
WEST	RANCHODPURA 400.00	40	42	42	40	41	42	42	43	43	43	40	STU
WEST	CGPL 400.00	46	47	47	46	46	46	47	47	46	47	40	GEN
WEST	BACHAU 400.00	43	43	44	43	43	43	44	44	44	44	40	ISTS
WEST	VADODARA 400.00	49	52	52	48	52	52	50	52	52	52	50	ISTS
WEST	BANASKANTHA 400.00	50	51	52	50	51	51	53	53	53	53	50	ISTS
WEST	SANKHARI 400.00	41	42	42	41	41	42	43	43	43	43	40	STU

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
WEST	INDORE-4 400.00	41	41	41	40	41	41	41	41	41	41	40	STU
WEST	BHOPAL-4 400.00	40	40	40	39	40	41	41	39	40	41	40	STU
WEST	BINA-4 400.00	44	43	43	41	43	43	44	42	43	44	40	STU
WEST	NAGDA-4 400.00	43	43	42	42	42	43	43	43	44	44	40	STU
WEST	JABALPUR-4 400.00	43	42	42	38	42	43	45	43	44	45	40	ISTS
WEST	KHANDWA-4 400.00	39	38	38	38	38	39	41	41	42	42	40	ISTS
WEST	SATNA-74 400.00	40	39	39	39	39	39	40	38	39	40	40	ISTS
WEST	BINA-PG-74 400.00	44	43	43	41	43	44	44	42	43	44	40	ISTS
WEST	KHARGAR 400.00	43	44	45	43	45	45	44	44	44	45	40	STU
WEST	LONIKAND I 400.00	40	40	41	40	41	42	41	40	41	42	40	STU
WEST	CHANDRAPUR I400.00	34	43	44	29	47	48	49	48	49	49	40	GEN
WEST	BHADR4 400.00	32	38	39	27	43	44	44	43	44	44	40	ISTS
WEST	BABLESWAR 400.00	41	41	42	41	42	43	42	46	47	47	40	STU
WEST	AURANGBD-I 400.00	48	48	49	47	48	50	50	50	51	51	40	STU
WEST	TAPS4 400.00	45	46	46	45	46	47	45	45	45	47	40	GEN
WEST	BOISAR 400.00	46	47	47	46	47	48	46	46	46	48	40	ISTS
WEST	CHANDRPR-II 400.00	34	43	44	29	47	48	49	48	49	49	40	GEN
WEST	SOLAPUR-PG 400.00	42	38	39	42	39	40	43	44	44	44	40	ISTS
WEST	PUNE-PG-AIS 400.00	41	41	41	41	41	42	41	40	41	42	40	ISTS
WEST	AURANG-CHTPM400.00	53	52	53	52	53	54	54	52	54	54	50	ISTS
WEST	PUNE-PG-GIS 400.00	55	56	56	55	56	57	56	55	56	57	50	ISTS
WEST	AURANGABD-II400.00	47	47	48	46	47	49	49	49	50	50	40	STU
WEST	AURANGBD-III400.00	45	45	46	44	45	47	47	46	48	48	40	STU
WEST	PADGHEGIS 400.00	51	52	52	50	52	53	51	51	51	53	50	ISTS
WEST	KUDUS 400.00	39	39	40	39	40	40	39	39	39	40	40	STU
WEST	LONIKANDII 400.00	40	40	41	40	40	41	40	40	40	41	40	STU

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
WEST	CHNDPUR_SW 400.00	33	41	42	28	45	46	47	46	47	47	40	GEN
WEST	VIKROLI400 400.00	38	39	39	38	39	40	38	38	39	40	40	STU
WEST	SOLAPUR STPP400.00	37	34	35	37	34	35	37	40	40	40	40	GEN
WEST	NAVI-MUM 400.00	41	42	43	41	43	44	42	42	42	44	40	ISTS
EAST	VEDANTA 400.00	51	51	51	50	51	51	52	52	53	53	50	STU
EAST	FARAKKA 400.00	39	40	40	38	40	40	41	42	42	42	40	ISTS
EAST	SILIGURI-PG 400.00	38	38	39	37	38	39	39	40	41	41	40	ISTS
EAST	PATRATU 400.00	40	39	40	37	40	40	40	40	40	40	40	GEN
SOUTH	CUDP 400.00	54	51	52	52	52	53	54	50	53	54	50	ISTS
SOUTH	GOOT 400.00	45	45	45	44	45	46	45	43	45	46	40	ISTS
SOUTH	KURNOOL4 400.00	60	59	59	59	59	61	60	59	61	61	40	STU
SOUTH	VIJ-AP 400.00	47	47	47	45	48	49	48	48	49	49	40	STU
SOUTH	KURL-NEW 400.00	67	66	66	65	66	68	67	66	68	68	50	ISTS
SOUTH	RAMGUNDM STP400.00	29	29	29	28	29	30	40	39	40	40	40	ISTS
SOUTH	HYDERABAD 400.00	38	38	38	37	38	40	41	41	41	41	40	ISTS
SOUTH	KHAMMAM 400.00	39	39	39	37	40	41	41	41	41	41	40	ISTS
SOUTH	DICHPAL4 400.00	49	48	48	47	49	50	51	50	51	51	40	STU
SOUTH	GAJWEL4 400.00	39	39	39	36	39	41	43	42	42	43	40	STU
SOUTH	RAIC 400.00	41	41	41	40	41	42	42	41	42	42	40	STU
SOUTH	NELMANG4 400.00	44	44	44	42	44	45	44	43	44	45	40	STU
SOUTH	BIDADI 400.00	40	40	40	39	40	41	40	39	41	41	40	ISTS
SOUTH	TUMKUR SP 400.00	49	48	48	48	48	49	51	48	44	51	50	ISTS
SOUTH	MADHUGI4 400.00	51	50	51	49	51	52	51	49	49	52	50	ISTS
SOUTH	UDMP 400.00	47	48	48	46	47	48	46	48	50	50	40	ISTS
SOUTH	PUGALUR4 400.00	42	42	42	40	41	42	40	42	44	44	40	ISTS
SOUTH	TIRUNEL4 400.00	48	47	47	48	47	47	47	50	52	52	40	ISTS

Highlighted cell indicates 400 kV Bus Fault Current > Design level

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Annex 3.9

ISTS Network Expansion Plan upto 2028-29

1. Transmission lines

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
1.	2023-24	NER	Lower Subansiri – Biswanath Chariyali 400kV 2 x D/c (Twin Lapwing) line (341.5km): Matching with Lower Subansiri (2000MW) HEP	400	D/c	371		
2.	2023-24	NR	220kV D/c line from UT Chandigarh to 400/220kV Panchkula(PG) substati	220	D/c	50		
3.	2023-24	NR	Koteshwar Pooling Station - Rishikesh 400kV D/C (twin) line	400	D/c	83		
4.	2023-24	NR	Babai (RRVPNL) – Bhiwani (PG) 400kV D/C line	400	D/c	221		
5.	2023-24	SR	Gadag PS - Narendra (New) PS 400 kV (high capacity equivalent to quad moose) D/C Line	400	D/c	200		
6.	2023-24	SR	Gadag PS - Koppal PS 400 kV (high capacity equivalent to quad moose) D/C Line	400	D/c	120		
7.	2023-24	WR	Re-conductoring of Kolhapur (PG) – Kolhapur 400 kV D/c line with conductor of minimum capacity of 2100 MVA/Ckt at nominal voltage along with bay up-gradation work at Kolhapur (MSETCL). - 60KM	400	D/c	120		
8.	2023-24	WR	Neemuch PS – Chhittorgarh (PG) S/s 400 kV D/C line (conductor with minimum capacity of 2100 MVA/Ckt at nominal voltage)	400	D/c	260		
9.	2023-24	WR	Neemuch PS- Mandsaur S/stn 400 kV D/c line (conductor with minimum capacity of 2100 MVA/Ckt at nominal voltage)	400	D/c	240		
10.	2023-24	WR	Pachora SEZ PP -Bhopal (Sterlite) 400 kV D/c line (Quad/HTLS) (320ckm) (with minimum capacity of 2100 MVA/ckt at nominal voltage) along with 80MVAr switchable line reactors on each circuit at Pachora end	400	D/c	320	80	
11.	2023-24	WR	LILO of both circuits of Parli (PG) – Pune (GIS) 400kV D/c line at Kallam PS (40ckm)	400	2xD /c	40		
12.	2023-24	WR	Provision of new 50MVAr switchable line reactor at Kallam PS end of Kallam – Pune(GIS) 400kV D/c line	400			50	
13.	2024-25	ER	Installation of 400kV, 2x63MVAr switchable line reactors, one in each circuit of Kahalgaon - Durgapur 400kV D/c line	400	D/c		126	
14.	2024-25	ER	NKSTPP – Gaya 400kV D/c (quad) line (185ckm)	400	D/c	185		
15.	2024-25	ER	Installation of 420kV, 63 MVAr switchable line reactor with 500Ohm NGR at Kahalagaon (NTPC) end, one each in both circuits of Kahalgaon(NTPC) – Durgapur (POWERGRID) 400kV D/c line.	400kV	D/c		126	

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
16.	2024-25	ER	Malda - New Purnea 400kV D/c line	400	D/c	0	126	
17.	2024-25	NER	Bongaigaon (POWERGRID) – Nangalbibra 400kV D/c line (initially operated at 220kV) – 280ckm	400	D/c	280		
18.	2024-25	NER	Hatsinghmari (Assam) – Ampati (Meghalaya) 132kV D/c line – 60 ckm	132	D/c	60		
19.	2024-25	NR	Removal of LILO of Bawana – Mandola 400kV D/c (Quad) line at Maharani Bagh /Gopalpur S/s. Extension of above LILO section from Maharani Bagh/ Gopalpur upto Narela S/s so as to form Maharanibagh – Narela 400kV D/c(Quad) and Maharanibagh-Gopalpur-Narela 400kV D/c (Quad) lines	400	D/c	28		
20.	2024-25	NR	Fatehgarh II - Bhadla II 765kV D/C Line (2nd)	765	D/c	375	240	240
21.	2024-25	NR	Bhadla II - Sikar II 765 kV D/C line	765	D/c	612	240	330
22.	2024-25	NR	Sikar II - Neemrana 400kV D/c line (Twin HTLS)	400	D/c	274		
23.	2024-25	NR	Sikar-II - Aligarh 765kV D/C Line	765	D/c	408	330	330
24.	2024-25	NR	Bhadla II - Sikar II 765 kV D/C line (2nd)	765	D/c	620	240	330
25.	2024-25	NR	Khetri – Narela 765 kV D/c line	765	D/c	180		330
26.	2024-25	NR	LILO of 765 kV MeerutBhiwani S/c line at Narela	765	D/c	50		
27.	2024-25	NR	400 kV D/c Khandukhal(Srinagar) - Rampura (Kashipur) line (Twin HTLS*)	400	D/c	390		80
28.	2024-25	NR	Laying of cable about 15km provided between Minamarg and Zojila Top section of Alusteng –Drass 220kV section	220	S/c	15		
29.	2024-25	NR	Fatehgarh-4- Fatehgarh-3 400 kV D/c twin HLTS line	400	D/c	100		
30.	2024-25	NR	Fatehgarh 3- Bhadla-3 400kV D/c line(Quad)	400	D/c	400	50	50
31.	2024-25	NR	Fatehgarh-2 – Bhadla-3 400kV D/c line (Quad)	400	D/c	400	50	50
32.	2024-25	NR	Bhadla-3 – Sikar-II 765 kV D/c line	765	D/c	760	330	330
33.	2024-25	NR	Ramgarh – Bhadla-3 765kV D/c line	765	D/c	360	240	
34.	2024-25	NR	Sikar-II – Khetri 765 kV D/c line	765	D/c	180		
35.	2024-25	NR	Sikar-II – Narela 765 kV D/c line	765	D/c	520	240	340
36.	2024-25	NR	Jhatikara – Dwarka 400kV D/c line	400	D/c	40		
37.	2024-25	NR	LILO of both circuit of Ajmer-Chittorgarh 765 kV D/c at Beawar	765	D/c	180		
38.	2024-25	NR	LILO of 400kV Kota –Merta line at Beawar	400	S/c	40		
39.	2024-25	NR	Fatehgarh-3– Beawar 765 kV D/c	765	D/c	350	330	330

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
40.	2024-25	NR	Fatehgarh-3– Beawar 765 kV D/c(2nd)	765	D/c	700	330	330
41.	2024-25	NR	LILO of both circuits of Jaipur (Phagi)-Gwalior 765 kV D/c at Dausa	765	D/c	160		240
42.	2024-25	NR	LILO of both circuits of Agra – Jaipur (South) 400kV D/c at Dausa	400	D/c	120		50
43.	2024-25	NR	Beawar – Dausa 765 kV D/c line	765	D/c	480	240	240
44.	2024-25	SR	Mangalore (Udupi PCL) – Kasargode 400kV (Quad) D/c line	400	D/c	231		
45.	2024-25	SR	Narendra New (GIS) - Pune (GIS) 765 kV D/c line with 1x330 MVAr switchable Line Reactor on each circuit at both end	765	D/c	680	330	330
46.	2024-25	SR	Kurnool-III Pooling station - Kurnool (new) 765 kV D/c Line	765	D/c	200		
47.	2024-25	SR	Kurnool-III Pooling station - Maheshwaram(PG) 765 kV D/c Line	765	D/c	500	240	240
48.	2024-25	WR	LILO of one ckt. of Narendra (existing) – Narendra (New) 400kV D/c quad line at Xeldem -240ckm	400	D/c	187.35		
49.	2024-25	WR	Xeldem – Mapusa 400kV D/c (quad) line - 80ckm	400	D/c	109.6		
50.	2024-25	WR	Xeldem (existing) - Xeldem (new) 220kV D/c line	220	D/c	40		
51.	2024-25	WR	LILO of Apta – Kalwa/Taloja 220kV D/c line (i.e. Apta – Kalwa and Apta – Taloja 220kV lines) at Navi Mumbai (PG)-2km	220	2xD/c	4		
52.	2024-25	WR	LILO of one ckt. of KPS1- Bhuj PS 765 kV D/c line at KPS2	765	D/c	2		
53.	2024-25	WR	KPS1-Khavda PS GIS (KPS2) 765 kV D/C line (to be established with bypassing of LILO of one ckt. of KPS1-Bhuj at KPS2 and utilisation of LILO section) - 20Km	765	D/c	40		
54.	2024-25	WR	LILO of KAPP – Vapi 400kV D/c line at Vapi-II	400	2xD/c	24		
55.	2024-25	WR	Vapi II – Sayali 220kV D/c line	220	D/c	44		
56.	2024-25	WR	Padghe (PG) – Kharghar 400kV D/c (quad) line to be terminated into one ckt. of Kharghar – Ghatkopar 400kV D/c (quad) line (thus forming Padghe (PG) – Kharghar 400kV S/c (quad) line, Padghe (PG) – Ghatkopar 400kV S/c (quad) line) - 60km	400	D/c	120		
57.	2024-25	WR	LILO of Padghe (PG) – Ghatkopar 400kV S/c line at Navi Mumbai GIS (PG) (with quad conductor) - 10km	400	D/c	20		
58.	2024-25	WR	Navsari (new) (South Gujarat) (GIS)- Kala (GIS) 400 kV D/c line (conductor with minimum capacity of 2100 MVA/Ckt at nominal voltage) with 63MVAr switchable line reactor on each ckt at Navsari (new) (GIS) end.	400	D/c	220	63	0
59.	2024-25	WR	Navsari(New) (South Gujarat) (GIS) – Magarwada (GIS) 400 kV D/c line (conductor with minimum capacity of 2100 MVA/Ckt at nominal voltage)	400	D/c	160	0	0

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
60.	2024-25	WR	Navsari (New) (South Gujarat) (GIS) – Padghe (GIS) 765 kV D/c line with 330 MVAr, 765 kV Switchable line reactor on each ckt at Navsari(New) (South Gujarat) end	765	D/c	400	330	0
61.	2024-25	WR	Jeypore – Jagdalpur 400kV D/c line (conductor with minimum capacity of 2100 MVA/Ckt at nominal voltage) along with associated bays at both ends	400	D/c	160	0	0
62.	2024-25	WR	Raipur Pool – Dhamtari 400 kV D/c line (conductor with minimum capacity of 2100 MVA/Ckt at nominal voltage) along with associated bays at both ends	400	D/c	160	0	0
63.	2024-25	WR	KPS3- KPS2 765 kV D/c line - 20km	765	D/c	40		
64.	2024-25	WR	KPS2 (GIS) – Lakadia 765 kV D/C line with 330 MVAr switchable line reactors at KPS2 end - 159KM	765	D/c	320	330	
65.	2024-25	WR	Ahmedabad – South Gujarat/Navsari (new) 765 kV D/c line with 240 MVAr switchable line reactor at both ends (~line length 220 km)	765	D/c	440	240	240
66.	2024-25	WR	Lakadia PS – Ahmedabad 765kV D/c line with 240 MVAR switchable line reactors on both ends (500ckm)	765	D/c	500	240	240
67.	2024-25	WR	LILO of Pirana (PG) – Pirana (T) 400kV D/c line at Ahmedabad S/s with twin HTLS along with reconductoring of Pirana (PG) – Pirana(T) line with twin HTLS conductor	400	D/c	88		
68.	2024-25	WR	Banaskantha – Ahmedabad 765 kV D/c line with 330MVAr, 765 kV Switchable line reactor on each ckt at Ahmedabad S/s end	765	D/c	400	0	330
69.	2025-26	ER	Angul - Paradeep 765 kV D/c line	765kV	D/c	380	-	330
70.	2025-26	ER	Paradeep - Paradeep (OPTCL) 400kV D/c (Quad) line	400kV	D/c	20	-	330
71.	2025-26	ER	Angul - Gopalpur 765 kV D/c line	765kV	D/c	410	-	330
72.	2025-26	ER	Gopalpur - Gopalpur (OPTCL) 400kV D/c (Quad) line	400kV	D/c	40	-	330
73.	2025-26	ER	Shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line to bays 431 and 434 in diameters 431-432-433 and 434-435-436 at Ranchi	400	D/c	2.54		
74.	2025-26	ER	Installation of 420kV, 1x80MVAr switchable line reactor, one each in both circuits of Raghunathpur (DVC) – Ranchi-New (POWERGRID) 400kV D/c (Quad) line at Ranchi New end	400	D/c	0		160
75.	2025-26	NER	Kathalguri (NEEPCO) – Namsai (POWERGRID) 220kV D/c line	220	D/c	150		
76.	2025-26	NER	Gogamukh - Gerukamukh 132kV D/c line	132	D/c	40		
77.	2025-26	NER	LILO of one D/c (ckt-1 & ckt-2 of line-1) of Lower Subansiri – Biswanath Chariali 400kV (Twin Lapwing) 2xD/c lines at Gogamukh S/s	400	D/c	40		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
78.	2025-26	NER	LILO of both circuits of Misa - Mariani 400kV D/c line at Bokajan	400	D/c	40		100
79.	2025-26	NR	LILO of one circuit of Kishenpur – Dulhasti 400kV D/c (Quad) line	400	D/c	20		
80.	2025-26	NR	Stringing of 2nd circuit of Kishenpur – Dulhasti 400kV D/c line (Kishtwar – Kishenpur Section)	400	D/c	130		
81.	2025-26	NR	LILO of both 400 kV D/c Amargarh - Samba line at 400/220 kV Siot S/s	400	D/c	30		
82.	2025-26	NR	Nange (GIS) Pooling Station – Koldam 400 kV D/c line (Triple snowbird)	400kV	D/c	80		
83.	2025-26	NR	Bypassing one ckt of Koldam – Ropar/Ludhiana 400kV D/c line (Triple snowbird) at Koldam and connecting it with one of the circuit of Nange- Koldam 400kV D/c line(Triple snowbird), thus forming Nange- Ropar/ Ludhiana one line (Triple snowbird)	400kV	S/c	0		50
84.	2025-26	NR	LILO of both ckts of 400kV Bikaner (PG)-Bikaner-II D/c line at Bikaner-III PS	400kV	D/c	80		
85.	2025-26	NR	Bikaner-II PS – Bikaner-III PS 400 kV D/c line (Quad)	400kV	D/c	60		
86.	2025-26	NR	LILO of both ckts of 400 kV Sohna Road(GPTL)-Gurgaon(PG) D/c line at Neemrana-II S/s	400kV	D/c	340		
87.	2025-26	NR	Neemrana-II -Kotputli 400 kV D/c line (Quad	400kV	D/c	140		
88.	2025-26	NR	Bikaner-III – Neemrana-II 765 kV 2xD/c line	765kV	D/c	1400	660	660
89.	2025-26	NR	Neemrana-II- Bareilly(PG) 765 kV D/c line	765kV	D/c	700	330	330
90.	2025-26	NR	Fatehgarh-IV (Section-2) PS – Bhinmal (PG) 400 kV D/c line (Twin HTLS)	400kV	D/c	400	50	50
91.	2025-26	NR	LILO of both ckts of 765 kV Fatehgarh-III- Beawar D/c line(2nd) at Fatehgarh-IV (Section-2) PS along with 330 MVAr switchable line reactors at Fatehgarh-IV PS end of each ckt of 765 kV Fatehgarh-IV- Beawar D/c line (formed after LILO)	765kV	D/c	60	330	-
92.	2025-26	NR	Fatehgarh-III (Section-2) PS – Barmer-I PS 400 kV D/c line (Quad)	400kV	D/c	100	-	-
93.	2025-26	NR	Fatehgarh-IV (Section-2) PS – Sirohi PS 765 kV D/c line	765kV	D/c	480	240	240
94.	2025-26	NR	Barmer-I PS– Sirohi PS 765 kV D/c line	765kV	D/c	400	240	240
95.	2025-26	NR	Sirohi PS-Chittorgarh (PG) 400 kV D/c line	400kV	D/c	320	80	
96.	2025-26	NR	Sirohi PS- Rishabdeo/Salumbar 765 kV D/c line	765kV	D/c	340	330	
97.	2025-26	NR	Rishabdeo/Salumbar - Mandsaur PS 765 kV D/c line	765kV	D/c	320		330
98.	2025-26	NR	LILO of one circuit of 765 kV Chittorgarh-Banaskanta D/c line at Rishabdeo/Salumbar S/s	765kV	S/c	20		
99.	2025-26	NR	Beawar- Mandsaur PS 765 kV D/c line	765kV	D/c	520	240	240

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
100.	2025-26	NR	Generation switchyard of Shongtong HEP to Wangtoo (HPPTCL) 400 kV D/c [Quad] line	400kV	D/c	36	-	-
101.	2025-26	NR	Extension of Wangtoo (HPPTCL) - Shongtong HEP 400 kV (Quad)$ D/c line upto Jhangi PS with one circuit through Shongtong HEP generation switchyard	400kV	D/c	74	-	-
102.	2025-26	NR	Wangtoo (HPPTCL) - Panchkula (PG) 400 kV D/c (Twin HTLS)	400kV	D/c	420	-	80
103.	2025-26	NR	765 kV Bhadla-III – Bikaner-III D/c line	765	D/c	300	240	
104.	2025-26	NR	Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line with HTLS conductor (with minimum 1050 ampere current requirement) along with bay equipment upgradation at 220kV Hisar (PG) end	220	D/c	28		
105.	2025-26	NR	400 kV Bareilly(765/400kV) – Bareilly(PG) D/c line (Quad) (2nd)	400	D/c	4		
106.	2025-26	NR	Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line (Single Zebra) with HTLS conductor (with minimum 1050Ampere/ckt requirement) along with bay equipment upgradation at 220kV Hisar (PG) end	220	D/c	28		
107.	2025-26	SR	Bidar PS – Maheshwaram (PG) 765kV D/C line along with 1x240 MVAr switchable Line Reactor on Bidar end of both ckts	765	D/c	320	240	0
108.	2025-26	SR	Ananthpuram PS - Kurnool-III PS 400 kV (High capacity equivalent to quad moose) D/c Line	400	D/c	200		
109.	2025-26	SR	Anantapuram PS - Cuddapah 400 kV (High capacity equivalent to quad moose) D/c Line with 80 MVAr switchable line reactor on Ananthapuram PS end of each circuit	400	D/c	300	80	0
110.	2025-26	SR	Koppal-II - Narendra New 765kV D/c line with 240 MVAr SLR at Koppal-II PS end	765kV	D/c	150	240	
111.	2025-26	SR	Gadag-II PS - Koppal-II PS 400kV (Quad Moose) D/c line	400kV	D/c	100		
112.	2025-26	SR	Koppal-II - Raichur 765kV D/c linw with 330 MVAr SLR at Koppal-II PS end	765kV	D/c	190	240	
113.	2025-26	SR	Reconductoring of raichur-Veltoor 400kV D/c line with HTLS Conductor	400kV	D/c	0	-	-
114.	2025-26	WR	LILO of Satna - Bina 400 kV (1st) D/c line at Chhatarpur PS*~ 60 km *out of Satna – Bina 2xD/c lines, one circuit of 2nd D/c line has been LILOed at Sagar (MPPTCL) substation. The proposed LILO is to be made on the other (1st) D/c line between Satna & Bina.	400	2xD/c	240		
115.	2025-26	WR	Banaskantha – Sankhari 400 kV 2nd D/c line	400	D/c	52	0	0
116.	2025-26	WR	Solapur pooling point - Solapur (PG) 400 kV D/c line (twin HTLS) (with minimum capacity of 2100 MVA/ckt at nominal voltage) - 50KM	400	D/c	100		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
117.	2025-26	WR	LILO of Satna-Gwalior 765 kV S/c line at Karera	765	S/c	140	330	
118.	2025-26	WR	LILO of one circuit of Jabalpur - Orai 765 kV D/c line at Ishanagar 765 kV S/s (New)	765	D/c	10		
119.	2025-26	WR	Pachora PS – Ujjain (MPPTCL) 400kV D/c line (Quad ACSR/AAAC/AL59 Moose equivalent)	400	D/c	120		
120.	2025-26	WR	Mandsaur PS – Indore(PG) 765 kV D/c Line (200km) along with 1x330MVAr switchable line reactor (SLR) on each ckt at Mandsaur end	765	D/c	400	330	
121.	2025-26	WR	Mandsaur – Kurawar 765kV D/c line (~235km.) with 240MVAr switchable line reactors (SLRs) at both ends	765	D/c	470	240	240
122.	2025-26	WR	LILO of Indore – Bhopal 765kV 765kV S/c line at Kurawar (LILO length 15km.)	765	S/c	30		
123.	2025-26	WR	Kurawar – Ashtha 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (65km.)	400	D/c	130		
124.	2025-26	WR	LILO of one circuit of Indore – Itarsi 400kV D/c line at Astha (LILO length 30km.)	400	D/c	60		
125.	2025-26	WR	Shujalpur – Kurawar 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (40km.)	400	D/c	80		
126.	2025-26	WR	KPS2- Halvad 765 kV D/c line (~220 km length) with 240 MVAr switchable line reactor at both ends and 80 MVAr single phase spare reactor unit at KPS2 end.	765	D/c	440	320	240
127.	2025-26	WR	LILO of Lakadia – Ahmedabad 765 kV D/c line at Halvad (LILO length~50 km)	765	D/c	100		
128.	2025-26	WR	Halvad – Vataman 765 kV D/c line (~170 km length) with 1x330 MVAr switchable line reactor at Vatman end on each ckt	765	D/c	340	330	330
129.	2025-26	WR	LILO of Lakadia – Vadodara 765 kV D/c line at Vataman 765 kV switching station (~10 km LILO length).	765	D/c	40		
130.	2025-26	WR	Vataman switching station – Navsari (New) 765 kV D/c line (~200 km length) with 330MVAr switchable line reactors on each ckt at Navsari (New) end	765	D/c	400		330
131.	2025-26	WR	Dhule PS – Dhule (BDTCL) 400 kV D/c Line (Quad Moose) (60 km)	400	D/c	120		
132.	2025-26	WR	(i) LILO of Tarapur/Velgaon – Padghe (M) 400kV D/c line at Kudus(M) S/s in following manner so as to form Padghe(PG)(GIS) – Padghe(M) 400kV D/c line and Tarapur/Velgaon - Kudus(M) 400kV D/c line: 1. Line-out portion for interconnection of Padghe(M) with Kudus(M) S/s to be constructed with twin HTLS conductor with minimum capacity of 2100MVA per ckt at nominal voltage and terminated directly into Padghe(PG)(GIS) – Kudus(M) 400kV D/c (quad) line at	400	D/c	40		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
			outskirts of Kudus(M) S/s (with bypassing at Kudus(M) end) so as to form Padghe(PG)(GIS) – Padghe(M) 400kV D/c line(2 nos. 400kV bays at Kudus(M) shall get vacated with above arrangement). (Length ~10km.) 2. Reconductoring of Padghe(M) – Kudus (outskirt) 400kV D/c balance line section (i.e. of existing line portion upto the proposed LILO point) with twin HTLS conductor with minimum capacity of 2100MVA per ckt at nominal voltage (Length : ~20km.) 3. Line-in portion for interconnection of Tarapur/Velgaon with Kudus(M) S/s to be terminated into 2 nos. bays vacated at Kudus (M) S/s (at Sl. 1 above) (Length ~10km.) 3. (ii) Shifting of Padghe(PG)(GIS) – Padghe(M) 400kV D/c line from 400kV Section A to Section B(GIS) at Padghe(M) end and termination into 2 nos. 400kV line bays to be constructed at Padghe(M) Section B(GIS) under ISTS					
133.	2026-27	NR	400kV Kishenpur Kishtwar D/c (2nd) (Quad)	400kV	D/c	260		
134.	2026-27	NR	400kV New Wanpoh - Samba D/c (existing) line (bypassing of 400kV New Wanpoh – Kishenpur D/c & Samba – Kishenpur D/c at Kishenpur)	400kV	D/c	0		
135.	2026-27	NR	LILO of both ckts of 400kV Bikaner II PS- Bikaner III PS (Quad) direct line at Bikaner-IV PS	400	D/c	20	0	0
136.	2026-27	NR	Bikaner-IV PS – Siwani 765 kV 2xD/c line along with 240 MVAr switchable line reactor for each circuit at each end	765	D/c	1040	240	240
137.	2026-27	NR	Siwani – Sonipat (PG) 400 kV D/c line (Quad) along with 63 MVAr switchable line reactor for each circuit at Siwani S/s end	400	D/c	300	63	0
138.	2026-27	NR	Siwani – Fatehabad (PG) 400 kV D/c line (Quad)	400	D/c	160	0	0
139.	2026-27	NR	Siwani – Jind (PG) 400 kV D/c line (Quad Moose)	400	D/c	220	0	0
140.	2026-27	NR	Siwani – Patran (Indi Grid) 400 kV D/c line (Quad) (~160 km) (400kV GIS duct :700m) along with 80 MVAr switchable line reactor for each circuit at Siwani S/s end	400	D/c	320	80	0
141.	2026-27	NR	Fatehgarh-IV PS (Sec-2) – Barmer-I PS 400kV D/c line (Quad)	400	D/c	90		
142.	2026-27	NR	Barmer-I PS – Merta-II 765 kV D/c line along with 330MVAr switchable line reactor for each circuit at each end of Barmer-I PS – Merta-II 765 kV D/c line	765	D/c	690	330	330
143.	2026-27	NR	Merta-II – Beawar 400 kV D/c line (Quad) (~55 km)	400	D/c	110		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
144.	2026-27	NR	Merta-II – Dausa 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Merta-II – Dausa 765 kV D/c line line (~250 km)	765	D/c	500	240	240
145.	2026-27	NR	Dausa - Ghiror 765 kV D/c line along with 330MVAr switchable line reactor at Ghiror end and 240 MVAr switchable line reactor at Dausa end for each circuit of Dausa - Ghiror 765 kV D/c line (~305 km)	765	D/c	610	240	330
146.	2026-27	NR	LILO of both ckt of 765 kV Aligarh (PG) -Orai (PG) D/c line (~15 km) at Ghiror S/s along with 240 MVAr switchable line reactor for each circuit at Ghiror S/s end of 765 kV Ghiror -Orai D/c line	765	D/c	60	240 at Ghiror end	
147.	2026-27	NR	LILO of one ckt of 765kV Agra (PG) – Fatehpur(PG) 2xS/c line at Ghiror along with 240 MVAr switchable line reactor at Ghiror S/s end of 765 kV Ghiror -Fatehpur line (~30 kms)	765	S/c	60	240 at Ghiror end	
148.	2026-27	NR	400kV Ghiror-Firozabad (UPPTCL) D/c line (Quad)	400	D/c	100		
149.	2026-27	NR	400 kV Kishenpur-Samba D/c line (Quad) (2nd)	400	D/c	70		
150.	2026-27	NR	Bypassing of 400kV Kishtwar – Kishenpur line (Quad) (Under implementation as part of Pakaldul transmission scheme) at Kishenpur and connecting it with one of the circuit of Kishenpur-Samba 400kV D/c line(Quad), thus forming 400kV Kishtwar-Samba (Quad) direct line (one ckt)	400				
151.	2026-27	NR	Termination of another circuit of 400 kV Kishenpur-Samba D/c line(Quad) at Kishenpur at 400kV bay vacated at Kishenpur (After bypassing of one ckt of 400 kV Kishtwar-Kishenpur at Kishenpur) –160km	400				
152.	2026-27	NR	Bypassing both ckts of 400kV Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin) at Samba and connecting them together to form Kishenpur– Jalandhar D/c direct line (Twin)	400				
153.	2026-27	NR	400kV Samba- Jalandhar D/c line(Quad) (only one circuit is to be terminated at Jalandhar while second circuit would be connected to bypassed circuit of Jalandhar –Nakodar 400kV D/c line) – 205km	400		205		
154.	2026-27	NR	Bypassing 400kV Jalandhar – Nakodar line (Quad) at Jalandhar and connecting it with one of the circuit of Samba-Jalandhar 400kV D/c line(Quad Moose), thus forming Samba –Nakodar line	400				
155.	2026-27	NR	Termination of another circuit of 400 kV Samba -Jalandhar D/c line (Quad) at Jalandhar at bay vacated at Jalandhar (After bypassing of one ckt of 400 kV Jalandhar - Nakodar at Jalandhar)-177km	400				
156.	2026-27	NR	LILO of 400 kV Kishenpur- Dulhasti line (Twin Zebra) at Kishtwar S/s (one ckt	400		20		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
			already LILOed as part of Pakaldul transmission system)					
157.	2026-27	NR	Reconductoring of 400 kV Kishenpur-Kishtwar line (Twin HTLS) (minimum 2100 MVA capacity) (formed after LILO of Kishenpur-Dulhasti line at Kishtwar S/s) along with bay upgradation works (2000A to 3150A) at Kishenpur end for above line.	400				
158.	2026-27	SR	Davangere/Chitradurga PS - Koppal-II PS 400kV (QM equivalent) D/c line	400	D/c	200	-	-
159.	2026-27	SR	Tumkur-II PS - Tumkur (Pavagada) 400kV (QM equivalent) D/c line	400	D/c	200	-	-
160.	2026-27	SR	Bijapur PS - Koppal-II PS 400kV (QM equivalent) D/c line	400	D/c	200	-	-
161.	2026-27	SR	Nizamabad-II PS - Nizamabad (PG) 765kV 2XD/c line	765	D/c	120	-	-
162.	2026-27	SR	Medak PS - Nizamabad-II 400kV (QM equivalent) D/c line	400	D/c	120	-	-
163.	2026-27	SR	Rangareddy PS - Nizamabad-II 400kV (QM equivalent) D/c line with 80 MVAr SLR at Rangareddy PS	400	D/c	310	80	-
164.	2026-27	SR	Bellary PS - Koppal-II 400kV (QM equivalent) D/c line	400	D/c	200	-	-
165.	2026-27	SR	Anantapur-II - Cuddapah 765kV D/c line with 240 MVAr SLR at Anantapur-II PS	765	D/c	500	240	-
166.	2026-27	SR	KNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line	400	D/c	240	-	-
167.	2026-27	SR	Gadag-II PS - Koppal-II PS 400kV (Quad Moose) 2nd D/c line	400	D/c	90		
168.	2026-27	SR	Reconductoring of Somanahalli – Bidadi 400kV D/c line with HTLS conductor	400	D/c	17		
169.	2026-27	SR	Reconductoring of Maheshwaram(PG) – Hyderabad 400kV S/c line with HTLS conductor	400	D/c	56		
170.	2026-27	SR	Kurnool-IV - Kurnool-III PS 765kV D/c line	765	D/c	200		
171.	2026-27	SR	Kurnool-III PS – Chilakaluripeta 765 kV D/c line	765	D/c	560	240	240
172.	2026-27	WR	Halvad – Jamnagar 765kV D/c line (170km.) with 330MVAr switchable line reactors on each ckt at Jamnagar end	765	D/c	340		330
173.	2026-27	WR	LILO of Jam Khambhaliya PS – Lakadia 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage] (LILO route length: 5 km] with 50MVAr, 420kV switchable line reactors on each ckt at Jamnagar end of Jamnagar – Lakadia 400kV D/c line (with NGR bypass arrangement)	400	D/c	20	50	
174.	2026-27	WR	Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (50km.)	400	D/c	100		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
175.	2026-27	WR	LILO of CGPL – Jetpur 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage] (LILO route length: 65 km] with 80MVAr, 420kV switchable line reactors on each ckt at Jamnagar end of Jamnagar – CGPL 400kV D/c line (with NGR bypass arrangement)	400	D/c	260	80	
176.	2026-27	WR	LILO of both ckts of Kalavad – Bhogat 400kV D/c line (Twin AL-59) at Jam Khambhaliya PS with Twin AL59 Moose equivalent conductor	400	D/c	40		
177.	2026-27	WR	LILO of both circuits of Parli(M) – Karjat(M)/Lonikand-II (M) 400 kV D/c alongwith 63 MVAR, 420 kV switchable line reactor (with NGR bypassing arrangement) on each ckt at Kallam PS end of Karjat – Kallam 400 kV D/c line (~140km.)	400	D/c	60	63	
178.	2026-27	WR	KPS3 (GIS) – Lakadia (AIS) 765 kV D/C line	765	D/c	370	330	0
179.	2026-27	WR	KPS1 (GIS)– Bhuj PS 765 kV 2nd D/C line	765	D/c	220	0	0
180.	2026-27	WR	Vadodara (GIS) –South Olpad (GIS) 765 kV D/C line	765	D/c	280	240	0
181.	2026-27	WR	LILO of Gandhar – Hazira 400 kV D/c line at South Olpad (GIS) using twin HTLS conductor with minimum capacity of 1700 MVA per ckt at nominal voltage	400	D/c	40		
182.	2026-27	WR	Ahmedabad – South Olpad (GIS) 765 kV D/c line	765	D/c	500	240	240
183.	2026-27	WR	South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line	765	D/c	450	240	240
184.	2026-27	WR	LILO of Navsari (New) – Padghe (PG) 765 kV D/c line at Boisar-II	765	D/c	100	0	0
185.	2026-27	WR	Boisar-II (Sec-II) – Velgaon (MH) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	400	D/c	20	0	0
186.	2026-27	WR	LILO of Babhaleswar – Padghe (M) 400 kV D/c line at Boisar-II (Sec-I) using twin HTLS conductor with a minimum capacity of 1700 MVA per ckt at nominal voltage	400	D/c	260	80	0
187.	2026-27	WR	Boisar-II – Pune-III 765 kV D/c line	765	D/c	400	330	0
188.	2026-27	WR	LILO of Narendra (New) – Pune (GIS) 765 kV D/c line at Pune-III	765	D/c	40	330	0
189.	2026-27	WR	LILO of Hinjewadi-Koyna 400 kV S/c line at Pune-III (GIS) S/s	400	S/c	80	80	0
190.	2026-27	WR	Mahan (existing bus) – Rewa PS (PG) 400kV D/c (quad) line	400	D/c	220		
191.	2026-27	WR	LILO of Bhuj-II – Lakadia 765 kV D/c line at Navinal(Mundra) (GIS) S/s with associated bays at Navinal (Mundra) (GIS) S/s	765	D/c	70	330	
192.	2027-28	ER	LILO of both circuits of Angul – Sundargarh (Jharsuguda) 765kV 2xS/c	765	2xS /c	50		

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
			lines at NLC-Talabira generation switchyard					
193.	2027-28	NER	LILO of both circuits of existing Bongaigaon (POWERGRID) – Balipara (POWERGRID) 400kV D/c (Quad) line at Bornagar (ISTS)	400	D/c	5		126
194.	2027-28	NER	extension of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c line for termination at Bornagar (ISTS) S/s	400	D/c	70		160
195.	2027-28	SR	Nizamabad-II PS - Warangal (New) 765kV D/c line with 330 MVAr SLR at Nizamabad-II PS	765	D/c	360	330	-
196.	2027-28	SR	Karimnagar PS - Nizamabad-II 400kV (QM equivalent) D/c line	400	D/c	200	-	-
197.	2027-28	SR	Kurnool-IV - Bidar PS 765kV D/c line with 240 MVAr SLR at both ends	765	D/c	560	240	240
198.	2027-28	SR	Anantapur-II - Kurnool-IV 765kV D/c line	765	D/c	200	-	-
199.	2027-28	SR	Kurnool-IV - Kurnool-V PS 765kV D/c line	765	D/c	200		
200.	2027-28	SR	LILO of both circuits of Anantapur-II - Cuddapah 765kV D/c line at Kadapa-II PS	765	D/c	20	-	-
201.	2027-28	SR	Kurnool-V PS – Chilakaluripeta 765 kV D/c line	765	D/c	420	330	
202.	2028-29	NR	Bhadla-3 - Bhadla(HVDC) 400kV 2xD/c quad moose line(2km)	400	D/c	4		
203.	2028-29	NR	±800KV HVDC line (Hexa lapwing)(4x1500 MW) between Bhadla-3 & Fatehpur (950km) with DMR.	±800	D/c	1900		
204.	2028-29	NR	LILO of both ckts of 765kV Varanasi – Kanpur (GIS) D/c at Fatehpur(30km)	765	D/c	60		
205.	2028-29	NR	400kV PS-1 - Pang D/c (quad moose) line	400	D/c	14		
206.	2028-29	NR	400kV PS-2 -Pang D/c (quad moose) line	400	D/c	54		
207.	2028-29	NR	400kV PS-3 -Pang D/c (quad moose) line	400	D/c	82		
208.	2028-29	NR	220kV Pang – Leh (Phyang) S/c line (Deer conductor) (S/c line on D/c tower)	220	S/c	158		
209.	2028-29	NR	Kaithal – Bahadurgarh (PG) 400 kV D/c Line (Twin HTLS)	400	D/c	340		
210.	2028-29	NR	Kaithal-Modipuram (Meerut) (UPPTCL) 765 kV D/c Line	400	D/c	420		240
211.	2028-29	NR	±350kV HVDC line between Pang & Kaithal PS (combination of 465km overhead line (Quad) and 15 km underground cable)	HVDC (350KV)	D/c	960		
212.	2028-29	SR	Avaraikulam Onshore PS – Tuticorin PS 400 kV D/c quad line	400	D/c	200	0	0
213.	2028-29	SR	Offshore substation 1 (OSS-1) – Avaraikulam Onshore PS 2 nos. 230kV (atleast 300 MVA capacity) Submarine cables (~35 - 40 km) with 2x50MVAr switchable line reactors at OSS-1 end Offshore substation 2 (OSS-2) – Avaraikulam Onshore PS 2 nos. 230kV (atleast 300 MVA capacity) Submarine	230	S/c	160	200	0

Sr. No.	Time Frame	Region	Transmission Line	Voltage level (kV)	S/c, D/c, M/c	Line length (ckm)	From end reactor	To end reactor
			cables (~35 - 40 km) with 2x50MVAr switchable line reactors at OSS-2 end					
214.	2028-29	WR	±800 kV HVDC Bipole line (Hexa lapwing) between KPS2 (HVDC) and Nagpur (HVDC) (1200 km)	±800		1200		
215.	2028-29	WR	LILO of Wardha – Raipur 765 kV one D/c line (out of 2xD/c lines) at Nagpur	765	D/c	120	240	0
216.	2028-29	WR	KPS3 – KPS3 (HVDC) 400 kV 2xD/c (Quad ACSR/AAAC/AL59 moose equivalent) line along with the line bays at both substations	400	D/c	8	0	0
217.	2028-29	WR	±500 kV HVDC Bipole line between KPS3 (HVDC) and South Olpad (HVDC) (with Dedicated Metallic Return) (capable to evacuate 2500 MW)	±500		600	0	0
218.	2028-29	WR	LILO of Pune-III - Boisar -II 765kV D/c line at South Kalamb S/s (LILO route length: 40Km)	765	D/c	160	2x240 at S' Kalamb end on S' Kalamb - Boisar line	
219.	2028-29	WR	Mahuva Onshore PS (GIS) – Vataman 400 kV D/c line (190 km) (Quad Moose) with 63MVAr & 50MVAr, 420kV switchable line reactors on each ckt at Mahuva & Vataman ends respectively	400	D/c	380	126	100
220.	2028-29	WR	B3-OSS-1 – Mahuva Onshore PS (GIS) 220kV 2xS/c (3 core) cables (45 km*- under sea cable of about 35 km & under ground cable of about 10 km) alongwith associated line bays at both ends (with capacity of 300MVA/ckt at nominal voltage) with 1x50MVAr switchable line reactors at B3-OSS-1 end on each cable	220	2xS /c	90	100	

2. Transformers

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
1.	2023-24	NR	Creation of 2x160MVA, 220/66 kV GIS S/s at UT Chandigarh (320MVA)	220/66	2	160	320
2.	2023-24	NR	Augmentation with 765/400 kV,1x1500 MVA Transformer (6th) at Fatehgarh-II PS (1500MVA)	765/400	1	1500	1500
3.	2023-24	NR	Augmentation with 400/220 kV, 4x500 MVA Transformer (6th to 9th) at Fatehgarh-II PS with suitable Bus sectionalisation at 400 and 220	400/220	4	500	2000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
			kV level and 7 nos. of 220 kV line bays (2000MVA)				
4.	2023-24	NR	Augmentation with 400/220kV, 3x500MVA Transformer (6th to 8th) at Bhadla-II PS with suitable Bus sectionalisation at 400 and 220 kV level and 5 nos. of 220kV line bays (1500MVA)	400/220	3	500	1500
5.	2023-24	NR	Augmentation with 765/400 kV ,1x1500 MVA transformer (4th) at Bhadla-II PS (1500MVA)	765/400	1	1500	1500
6.	2023-24	NR	Shifting and installation of 400/220 kV, 315 MVA ICT at Bhinmal (PG) S/s spared from Ludhiana (PG)	400/220	1	315	315
7.	2023-24	SR	Augmentation with 400/220kV, 1x500 MVA Transformer (3rd) at Palakkad (PG) (2x 315 MVA already existing)	400/220	1	500	500
8.	2023-24	SR	Augmentation with 400/220 kV, 1x500 MVA Transformer (3rd) at Kolar (PG) (2x 500 MVA already existing)	400/220	1	500	500
9.	2023-24	SR	Augmentation with 765/400 kV, 1x1500 MVA Transformer (3rd) at Nizamabad (PG) (2x 1500 MVA already existing)	765/400	1	1500	1500
10.	2023-24	SR	Establishment of 400/220 kV, 2x500 MVA Gadag Pooling Station	400/220	2	500	1000
11.	2023-24	SR	Augmentation of transformation capacity at Pavagada by 1x500 MVA, 400/220 kV ICT (6th)	400/220	1	500	500
12.	2023-24	SR	Augmentation of transformation capacity at Arasur by 1x500MVA, 400/230 kV ICT (4th)	400/230	1	500	500
13.	2023-24	SR	Augmentation of transformation capacity at Hosur by 1x500MVA, 400/230kV ICT (4th)	400/230	1	500	500
14.	2023-24	WR	Establishment of 2x500 MVA, 400/220kV Pooling Station (AIS) at Neemuch	400/220	2	500	1000
15.	2023-24	WR	Establishment of 400/220 kV, 3x500MVA at Pachora SEZ PP	400/220	3	500	1500
16.	2023-24	WR	Establishment of 2x500MVA, 400/220kV at Kallam PS along with 4 nos. 220kV line bays at Kallam PS	400/220	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
17.	2023-24	WR	Augmentation of 1x500 MVA, 400/220 kV ICT (3rd) at Raigarh(PG) S/s along with associated ICT bays (400& 220kV bay each -01nos)	400/220	1	500	500
18.	2023-24	WR	Augmentation of transformation capacity at Kallam PS by 2x500MVA, 400/220kV ICTs (3rd & 4th) along with 220kV bays for RE interconnection	400/220	2	500	1000
19.	2024-25	ER	400/220kV, 2x500MVA ICTs along with associated bays (220kV bays in GIS and 400kV bays in AIS) at Banka	400/220	2	500	1000
20.	2024-25	ER	Installation of existing spare 132/66kV, 1x50MVA ICT (already stationed ata Gangtok) as 3rd ICT at Gangtok (POWERGRID) S/s along with conversion of existing 132kV TBC bay as 132kV ICT bay for 3rd ICT and construction of new 66kV ICT bay in Hybrid/Outdoor GIS with suitable modifictaion in the gantry structure of 66kV side	132/66	1	50	50
21.	2024-25	ER	installation of new 220/132kV, 1x200MVA (4th) ICT at Ara (POWERGRID) S/s with associated bays in AIS (220kV bay no. 203 & 132kV bay no. 6)	220/132	1	200	200
22.	2024-25	NER	Establishment of new 220/132kV, 2x160MVA substation at Nangalbibra	220/132	2	160	320
23.	2024-25	NR	Augmentation with 765/400 kV,1x1500 MVA Transformer (5th) at Fatehgarh-II PS (1500MVA)	765/400	1	1500	1500
24.	2024-25	NR	Establishment of 765/400 kV, 2x1500 MVA at Sikar – II	765/400	2	1500	3000
25.	2024-25	NR	Establishment of 765/400 kV, 3X1500 MVA GIS substation at Narela	765/400	3	1500	4500
26.	2024-25	NR	Augmentation with 1x500MVA, 400/220kV transformer (3rd) at 400/220kV Jind (PG) S/s	400/220	1	500	500
27.	2024-25	NR	Establishment of 2x500 MVA 400/220 kV pooling station at Fatehgarh-4 along with 2x125 MVAr Bus Reactor	400/220	2	500	1000
28.	2024-25	NR	Augmentation of 3x500 MVA400/220 kV pooling station at Fatehgarh-4	400/220	3	500	1500
29.	2024-25	NR	Establishment of 2x1500 MVA 765/400kV at Bhadla-3	765/400	2	1500	3000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
30.	2024-25	NR	3x500 MVA 400/220 kV pooling station at Bhadla-3	400/220	3	500	1500
31.	2024-25	NR	Augmentation of 7x500 MVA 400/220 kV transformation capacity at Bhadla-3	400/220	7	500	3500
32.	2024-25	NR	Establishment of 2x1500 MVA 765/400kV at Ramgarh	765/400	2	1500	3000
33.	2024-25	NR	2x500 MVA 400/220 kV pooling station at Ramgarh	400/220	2	500	1000
34.	2024-25	NR	Augmentation of 1x1500 MVA 765/400kV at Ramgarh PS	765/400	1	1500	1500
35.	2024-25	NR	Establishment of 3x1500 MVA 765/400kV at Fatehgarh-3(new section)	765/400	3	1500	4500
36.	2024-25	NR	3x500 MVA 400/220 kV pooling station at Fatehgarh-3(new section)	400/220	3	500	1500
37.	2024-25	NR	Augmentation of 3x1500 MVA 765/400kV at Fatehgarh-3(new section)	765/400	3	1500	4500
38.	2024-25	NR	2x500 MVA 400/220 kV pooling station at Fatehgarh-3(new section)	400/220	2	500	1000
39.	2024-25	NR	Establishment of 2x1500MVA 765/400kV Substation at suitable location near Beawar	765/400	2	1500	3000
40.	2024-25	NR	Establishment of 2x1500 MVA 765/400kV substation at suitable location near Dausa	765/400	2	1500	3000
41.	2024-25	NR	Augmentation with 400/220kV, 1x500MVA Transformer (10th) at Fatehgarh-2 PS	765/400	1	1500	1500
42.	2024-25	NR	Augmentation with 765/400kV, 1x1500MVA Transformer (5th) at Bhadla-2 PS	765/400	1	1500	1500
43.	2024-25	NR	Augmentation with 765/400kV, 1x1500MVA Transformer (3rd) at Bikaner (PG)	765/400	1	1500	1500
44.	2024-25	NR	Augmentation of 1x1500 MVA ICT (3rd), 765/400kV ICT at Jhatikara Substation (Bamnoli/Dwarka section)	765/400	1	1500	1500
45.	2024-25	NR	Augmentation with 1x500MVA, 400/220kV transformer (3rd) at 400/220kV Bahadurgarh (PG) S/s	400/220	1	500	500
46.	2024-25	NR	Augmentation with 400/220kV, 1x500MVA Transformer at Fatehgarh-2 PS (6th ICT at Section-1 with cable/GIS duct connection at 220kV side)	400/220	1	500	500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
47.	2024-25	NR	Augmentation with 400/220kV, 1x500MVA Transformer at Bikaner PS (3rd ICT)	400/220	1	500	500
48.	2024-25	NR	Replacement of 1x315 MVA 400/220kV ICT (ICT-1) at 400/220 kV Ludhiana (PG) S/s with 1x500 MVA 400/220kV ICT	400/220	1	185	185
49.	2024-25	NR	Replacement of 1x250 MVA, 400/220 kV ICT to 500 MVA at 765/400/220 kV Moga (PG) S/s along with associated works at 220 kV level	400/220	1	250	250
50.	2024-25	NR	Augmentation of Transformation Capacity by 1x500 MVA, 400/220kV ICT (3rd) at 400/220 kV Patran (GIS) S/s	400/220	1	500	500
51.	2024-25	NR	400/220 kV, 1x500 MVA ICT augmentation (4th) at Nallagarh	400/220	1	500	500
52.	2024-25	NR	400/220 kV, 1x500 MVA ICT augmentation (3rd) at Amargarh	400/220	1	500	500
53.	2024-25	NR	Augmentation of 1x500 MVA (3rd) ICT at 400/220 kV Bikaner-II PS	400/220	1	500	500
54.	2024-25	NR	Augmentation of 400/220 kV, 1x500 MVA ICT at 400/220 kV New Wanpoh substation	400/220	1	500	500
55.	2024-25	NR	Augmentation of 400/220 kV, 1x500 MVA ICT at 400/220 kV Malerkotla substation	400/220	1	500	500
56.	2024-25	NR	Replacement of 1x250 MVA 400/220 kV ICT with 1x500 MVA ICT at Moga(PG)	400/220	1	250	250
57.	2024-25	SR	Establishment of 2x500MVA, 400/220 kV GIS substation at Kasargode	400/220	2	500	1000
58.	2024-25	SR	Augmentation of 400/220 kV, 3x500 MVA Gadag Pooling Station	400/220	3	500	1500
59.	2024-25	SR	Augmentation of 3x500 MVA, 400/230 kV at Karur PS	400/230	1	500	500
60.	2024-25	SR	Upgradation of Narendra (New) (GIS) to its rated voltage of 765kV level alongwith 4x1500 MVA, 765/400kV ICTs and 2x330 MVAr Bus Reactor	765/400	4	1500	6000
61.	2024-25	SR	Establishment of 2x1500 MVA, 765/400 KV Pooling station at suitable location in Kurnool Distt. (Kurnool-III)	765/400	2	1500	3000
62.	2024-25	SR	Establishment of 5x500 MVA 400/220kV Pooling station at suitable location in Kurnool Distt. (Kurnool-III)	400/220	5	500	2500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
63.	2024-25	SR	Augmentation of transformation capacity by 1x1500 MVA, 765/400 KV at Kurnool-III Pooling Station (in matching time frame of Kurnool Part-B)	765/400	1	1500	1500
64.	2024-25	SR	Augmentation of transformation capacity by 4x500 MVA 400/220kV at Kurnool-III Pooling Station (in matching time frame of Kurnool Part-B)	765/400	4	500	2000
65.	2024-25	SR	Augmentation of transformation capacity at Mysore by 1x500 MVA, 400/220 kV ICT (4th)	400/220	1	500	500
66.	2024-25	WR	Establishment of 2x500MVA, 400/220kV substation at Xeldem	400/220	2	500	1000
67.	2024-25	WR	Establishment of 765/400 kV, 4x1500MVA, KPS2 (GIS)	765/400	4	1500	6000
68.	2024-25	WR	Augmentation of Khavda PS1 by 765/400 kV transformation capacity * (max. upto 4x1500 MVA)	765/400	4	1500	6000
69.	2024-25	WR	Establishment of 2x500MVA, 400/220kV GIS S/s near Vapi / Ambheti (Vapi-II)	400/220	2	500	1000
70.	2024-25	WR	Augmentation of transformation capacity at Padghe (GIS) 765/400 kV substation by 1x1500 MVA ICT	765/400	1	1500	1500
71.	2024-25	WR	Establishment of 765/400/220 kV Navsari (new) (South Gujarat) S/s (GIS)	765/400	2	1500	3000
72.	2024-25	WR	Establishment of 765/400/220 kV Navsari (new) (South Gujarat) S/s (GIS)	400/220	3	500	1500
73.	2024-25	WR	Augmentation of transformation capacity at Raigarh(Kotra) by 1x1500MVA, 765/400kV ICT at Section-A (3rd ICT on Section A) and by 2x1500MVA, 765/400kV ICTs at Section-B (3rd & 4th ICTs on Section B) along with associated ICT bays	765/400	3	1500	4500
74.	2024-25	WR	Creation of 220kV level (GIS) at 765/400kV Shikrapur (PGCIL) (GIS) Substation with 2x500MVA, 400/220kV ICTs and 4 nos. of 220kV line bays.	400/220	2	500	1000
75.	2024-25	WR	Creation of 220 kV level (GIS) at 765/400 kV Raipur Pool S/s with Installation of 2x500 MVA, 400/220 kV ICTs along	400/220	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
			with associated ICT bays (220kV-GIS)				
76.	2024-25	WR	Augmentation of 1x500 MVA, 400/220 kV ICT at Raipur Pool S/s along with associated ICT bays (220kV-GIS)	400/220	1	500	500
77.	2024-25	WR	Creation of 220 kV level at 765/400 kV Dharamjaigarh S/s with Installation of 2x500 MVA, 400/220 kV ICTs along with associated ICT bays	400/220	2	500	1000
78.	2024-25	WR	Establishment of 765/400 kV, 3x1500 MVA, KPS3 (GIS) with 1x330 MVAR 765 kV bus reactor and 1x125 MVAR 400 kV bus reactor.	765/400	3	1500	4500
79.	2024-25	WR	Establishment of 3x1500 MVA, 765/400 kV Ahmedabad S/s	765/400	3	1500	4500
80.	2024-25	WR	Augmentation of 765/400 kV Navsari (new) (South Gujarat) S/s (GIS)	765/400	1	1500	1500
81.	2024-25	WR	Creation of 220 kV level at 765/400 kV Jabalpur PS with Installation of 2x500 MVA, 400/220 kV ICTs along with associated ICT bays	400/220	2	500	1000
82.	2024-25	WR	Installation of 1x500 MVA, 400/220 kV ICT (4th) along with associated ICT bays at Satna(PG)	400/220	1	500	500
83.	2024-25	WR	Augmentation of transformation capacity at Pune (GIS) 765/400 kV substation by 1x1500 MVA ICT (3^{rd})	765/400	1	1500	1500
84.	2025-26	ER	Establishment of Paradeep 765/400kV, 2x1500MVA GIS substation	765/400	2	1500	3000
85.	2025-26	ER	Installation of 400/220kV, 2x500MVA ICTs along with associated bays at Lakhisarai (POWERGRID) 400/132kV S/s.	400/220	2	500	1000
86.	2025-26	ER	Establishment of Gopalpur 765/400kV, 2x1500MVA GIS substation	765/400	2	1500	3000
87.	2025-26	ER	Augmentation of 1x500MVA (3rd) ICT at Rajarhat	400/220	1	500	500
88.	2025-26	NER	Upgradation of existing 132kV Namsai (POWERGRID) S/s to 220kV (with 220kV side as GIS)	220/132	2	160	320
89.	2025-26	NER	400/220kV, 2x500MVA ICTs at Gogamukh	400/220	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
90.	2025-26	NER	220/132kV, 2x200MVA ICTs at Gogamukh	220/132	2	200	400
91.	2025-26	NR	Implementation of 2x200 MVA, 400/132 kV transformer at Kishtwar Pooling Station along with 4 no. of 132 kV line bays	400/132	2	200	400
92.	2025-26	NR	Establishment of 2x315MVA, 400/220kV Siot(Rajouri) S/s with 1x125 MVAR (420 kV) bus reactors	400/220	2	315	630
93.	2025-26	NR	Establishment of 7x105 MVA, 400/220kV Nange GIS Pooling Station	400/220	2	315	630
94.	2025-26	NR	Establishment of 6x1500 MVA, 765/400kV & 5x500 MVA 400/220kV Bikaner-III Pooling Station at a suitable location near Bikaner	765/400	6	1500	9000
95.	2025-26	NR	Establishment of 6x1500 MVA, 765/400kV & 5x500 MVA 400/220kV Bikaner-III Pooling Station at a suitable location near Bikaner	400/220	5	500	2500
96.	2025-26	NR	Establishment of 765/400 kV, 4x1500 MVA Neemrana-II S/s at a suitable location near Neemrana	765/400	4	1500	6000
97.	2025-26	NR	Augmentation with 400/220 kV, 5x500 MVA^ ICT at Bikaner-II PS	400/220	5	500	2500
98.	2025-26	NR	Augmentation with 765/400 kV, 1x1500MVA ICT (4th) at Bikaner (PG)	765/400	1	1500	1500
99.	2025-26	NR	Augmentation by 400/220 kV, 1x500 MVA (3rd) ICT at Kotputli (PG)	400/220	1	500	500
100.	2025-26	NR	Establishment of 4x1500 MVA, 765/400 kV & 5x500 MVA, 400/220 kV Fatehgarh-IV (Section-2) Pooling Station	765/400	4	1500	6000
101.	2025-26	NR	Establishment of 4x1500 MVA, 765/400 kV & 5x500 MVA, 400/220 kV Fatehgarh-IV (Section-2) Pooling Station	400/220	5	500	2500
102.	2025-26	NR	Establishment of 3x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Barmer-I Pooling Station	765/400	3	1500	4500
103.	2025-26	NR	Establishment of 3x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Barmer-I Pooling Station	400/220	2	500	1000
104.	2025-26	NR	Establishment of 2x1500 MVA, 765/400 kV Substation at suitable location near Sirohi PS	765/400	2	1500	3000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
105.	2025-26	NR	Establishment of, 765 kV Substation at suitable location near Rishabdeo/Salumbar (Distt. Udaipur) along with 2x240 MVAr (765 kV) Bus Reactor	765			
106.	2025-26	NR	Augmentation by 1x1500 MVA, 765/400 kV ICT at Fatehgarh-II PS (7th)	765/400	1	1500	1500
107.	2025-26	NR	Establishment of 2x315 MVA (7x105 MVA 1-ph units including a spare unit) 400/220 kV GIS Pooling Station at Jhangi	400/220	2	315	630
108.	2025-26	NR	Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Allahabad (PG) substation	400/220	1	500	500
109.	2025-26	NR	Augmentation of Transformation capacity at 400/220kV Fatehgarh-III PS by 400/220kV 1x500MVA ICT (3rd)	400/220	1	500	500
110.	2025-26	NR	Augmentation of 400/220 kV, 1x500 MVA (4 th) ICT at 400/220kV Kankroli substation	400/220	1	500	500
111.	2025-26	NR	Augmentation with 1x1500 MVA, 765/400 kV ICT(3rd) at Bareilly (765/400kV) S/s	765/400	1	1500	1500
112.	2025-26	NR	Augmentation of 2x500 MVA (4th & 5th) 400/220 kV ICTs at Bhadla-III PS	400/220	2	500	1000
113.	2025-26	NR	Augmentation of 2x1500 MVA 765/400kV (3rd & 4th) ICTs at Bhadla-III PS	765/400	2	1500	3000
114.	2025-26	NR	Replacement of 1x315 MVA (ICT-3), 400/220 kV ICT to 500 MVA at 400/220 kV Bawana S/s	400/220	1	315	315
115.	2025-26	SR	Establishment of 3x1500MVA (765/400kV) Bidar PS	765/400	3	1500	4500
116.	2025-26	SR	Establishment of 5x500MVA (400/220kV) Bidar PS	400/220	5	500	2500
117.	2025-26	SR	Establishment of 400/220 kV, 7x500 MVA, Ananthpuram pooling station at suitable border location between Anantapur & Kurnool Distt	400/220	7	500	3500
118.	2025-26	SR	Establishment of 765/400kV , 2X1500 MVA transformer at Koppal-II	765/400	2	1500	3000
119.	2025-26	SR	Establishment of 400/220kV , 2X500 MVA transformer at Koppal-II	400/220	2	500	1000
120.	2025-26	SR	Establishment of 400/220kV , 2X500 MVA transformer at Gadag-II	400/220	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
121.	2025-26	SR	Augmentation of transformation capacity at Koppal-II with 765/400kV , 2X1500 MVA transformers	765/400	2	1500	3000
122.	2025-26	SR	Augmentation of transformation capacity at Koppal-II with 400/220kV , 2X500 MVA transformers	400/220	2	500	1000
123.	2025-26	SR	Augmentation of transformation capacity at Maheshwaram by 1x1500 MVA, 765/400 kV ICT (3rd)	765/400	1	1500	1500
124.	2025-26	SR	Augmentation of 1x1500 MVA (3rd), 765/400kV transformation capacity at Kurnool New S/s	765/400	1	1500	1500
125.	2025-26	SR	Augmentation of 2x500 MVA, 400/220kV transformation capacity at Tumkur (Pavagada) PS	400/220	2	500	1000
126.	2025-26	SR	Augmentation of 1x500 MVA, 400/220kV ICT(6th) at Koppal PS	400/220	1	500	500
127.	2025-26	SR	Augmentation of 1x500 MVA, 400/220kV ICT(6th) at Gadag PS	400/220	1	500	500
128.	2025-26	SR	Augmentation of 1x500 MVA, 400/220kV ICT(3rd) at Hassan S/s	400/220	1	500	500
129.	2025-26	SR	Augmentation of 1x500 MVA, 400/230kV ICT (6th) at Tuticorin-II GIS	400/230	1	500	500
130.	2025-26	SR	Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS	400/230	2	500	1000
131.	2025-26	SR	Augmentation of 1x500 MVA, 400/220 kV ICT (5th) at NP Kunta Pooling Station	400/220	1	500	500
132.	2025-26	SR	Augmentation of 3x1500 MVA (5th, 6th & 7th), 765/400 kV ICTs at Koppal-II PS	765/400	3	1500	4500
133.	2025-26	SR	Augmentation of additional 5x500 MVA, 400/220kV ICTs (5th, 6th, 7th, 8th & 9th) at Koppal-II PS	400/220	5	500	2500
134.	2025-26	SR	Augmentation of additional 5x500 MVA, 400/220kV ICTs (5th, 6th, 7th, 8th & 9th) at Gadag-II PS	400/220	5	500	2500
135.	2025-26	WR	Establishment of 3x500 MVA, 400/220 kV Pooling Station at Chhatarpur	400/220	3	500	1500
136.	2025-26	WR	Augmentation of transformation capacity at Banaskantha 765/400 kV S/s by 1x1500 MVA ICT	765/400	1	1500	1500
137.	2025-26	WR	Establishment of 400/220 kV, 3x500 MVA at Solapur PP (near Mohol)	400/220	3	500	1500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
138.	2025-26	WR	Establishment of 765/400 kV, 2x1500 MVA	765/400	2	1500	3000
139.	2025-26	WR	Establishment of 400/220 kV, 2x500 MVA ICTs at Karera (near Datiya)	400/220	2	500	1000
140.	2025-26	WR	Establishment of 765/400 kV, 2x1500 MVA ICTs at Ishanagar (New)	765/400	2	1500	3000
141.	2025-26	WR	Establishment of 400/220 kV, 2x500 MVA ICTs at Ishanagar (New)	400/220	2	500	1000
142.	2025-26	WR	Installation of 3x1500MVA, 765/400kV at Mandasaur PS + 1 spare unit of 500MVA 765/400kV ICT	765/400	3	1500	4500
143.	2025-26	WR	Installation of 5x500MVA, 400/220kV at Mandasaur PS	400/220	5	500	2500
144.	2025-26	WR	400/220 kV, 3x500 MVA ICT augmentation (4th 5th & 6th) at Pachora PS	400/220	3	500	1500
145.	2025-26	WR	Establishment of 2x1500MVA 765/400kV ICTs at Kurawar	765/400	2	1500	3000
146.	2025-26	WR	Establishment of 2x500MVA 400/220kV ICTs at Kurawar	400/220	2	500	1000
147.	2025-26	WR	Establishment of 3x200MVA 220/132kV ICTs at Kurawar	200/132	3	200	600
148.	2025-26	WR	Establishment of 4x500 MVA, 400/220kV ICTs in pooling station near Dhule, Maharashtara.	400/220	4	500	2000
149.	2025-26	WR	Augmentation of transformation capacity at KPS1 (GIS) by 1x1500 MVA, 765/400 kV ICT (8th) on bus section-I	765/400	1	1500	1500
150.	2025-26	WR	Augmentation of transformation capacity at KPS2 (GIS) by 2x1500 MVA, 765/400 kV ICT on Bus section-I (5th & 6th)	765/400	2	1500	3000
151.	2025-26	WR	Augmentation of transformation capacity at KPS2 (GIS) by 2x1500 MVA, 765/400 kV ICT on Bus section-II (7th & 8th)	765/400	2	1500	3000
152.	2025-26	WR	Augmentation of transformation capacity at KPS3 (GIS) by 1x1500 MVA, 765/400 kV ICT (7th) on Bus section-I	765/400	1	1500	1500
153.	2025-26	WR	Augmentation of transformation capacity at Padghe (PG) (GIS) by 1x1500 MVA, 765/400 kV ICT (4th)	765/400	1	1500	1500
154.	2025-26	WR	Augmentation of Transformation capacity at 400/220kV Bhachau S/s in	400/220	1	500	500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
			Gujarat by 400/220kV 1x500MVA ICT (3rd)				
155.	2025-26	WR	Augmentation of Transformation capacity at 400/220kV Magarwarda GIS S/s by 400/220kV 1x500MVA ICT (3rd)	400/220	1	500	500
156.	2025-26	WR	Augmentation of transformation capacity at Boisar (PG) S/s by 1x500MVA, 400/220kV ICT (5th)	400/220	1	500	500
157.	2025-26	WR	Augmentation of Transformation capacity at 400/220kV Rajgarh S/s by 1x500MVA ICT (3rd) (terminated on the sectionalized 220kV bus)	400/220	1	500	500
158.	2025-26	WR	Augmentation of Transformation capacity at 400/220kV Rajgarh S/s by 1x500MVA ICT (4th) (terminated on the sectionalized 220kV bus)	400/220	1	500	500
159.	2025-26	WR	Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS) by 1x500MVA 400/220kV ICT (3rd)	400/220	1	500	500
160.	2025-26	WR	Augmentation of transformation capacity at Bhuj-I PS by 1x500MVA, 400/220kV ICT (9th)	400/220	1	500	500
161.	2025-26	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 2x500MVA, 400/220kV ICT (5th & 6th) (to be terminated at New 220kV Bus Section)	400/220	2	500	1000
162.	2025-26	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (3rd)	765/400	1	1500	1500
163.	2025-26	WR	Installation of 2x500 MVA, 400/220 kV ICTs (1st & 2nd) at Lakadia PS along with associated ICT bays	400/220	2	500	1000
164.	2025-26	WR	Augmentation of Transformation capacity at 765/400kV Indore S/s by 1x1500MVA, 765/400kV ICT (3rd) [terminated on 400kV Bus section A with Indore & Khandwa 400kV D/c lines]	765/400	1	1500	1500
165.	2026-27	NR	Upgradation of Kishenpur S/s at 765kV level (4x800MVA)	765/400	4	800	3200

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
166.	2026-27	NR	Establishment of 6x1500 MVA, 765/400 kV & 6x500 MVA, 400/220 kV Bikaner-IV Pooling Station along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) Bus Reactors at a suitable location near Bikaner	765/400	6	1500	9000
167.	2026-27	NR	Establishment of 6x1500 MVA, 765/400 kV & 6x500 MVA, 400/220 kV Bikaner-IV Pooling Station along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) Bus Reactors at a suitable location near Bikaner	400/220	6	500	3000
168.	2026-27	NR	Establishment of 765/400 kV, 6x1500 MVA S/s at suitable location near Siwani (Distt. Bhiwani) along with 2x240 MVAr (765kV) Bus Reactor & 2x125 MVAr (420kV) Bus Reactor	765/400	6	1500	9000
169.	2026-27	NR	Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Merta (Merta-II Substation) along with 2x125 MVAr & 2x240 MVAr bus reactor at Merta-II S/s	765/400	2	1500	3000
170.	2026-27	NR	Augmentation with 765/400 kV, 2x1500 MVA Transformer (4th & 5th) at Barmer-I PS	765/400	2	1500	3000
171.	2026-27	NR	Augmentation of 5x500 MVA (5^{th} to 9^{th}), 400/220 kV ICTs at Barmer-I PS	400/220	5	500	2500
172.	2026-27	NR	Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Ghiror (Distt. Mainpuri) along with 2x125 MVAr & 2x240 MVAr bus reactor at Ghiror S/s (UP)	765/400	2	1500	3000
173.	2026-27	SR	Establishment of 400/220kV 3x500 MVA Pooling Station near Davangere/Chitradurga	400/220	3	500	1500
174.	2026-27	SR	Establishment of 400/220kV 4x500 MVA Tumkur-II Pooling Station	400/220	4	500	2000
175.	2026-27	SR	Establishment of 400/220kV 2x500 MVA Bijapur Pooling Station	400/220	2	500	1000
176.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA Pooling Station near Nizamabad (Nizamabad-II)	765/400	4	1500	6000
177.	2026-27	SR	Establishment of 400/220kV 2x500 MVA Pooling Station at Nizamabad-II	400/220	2	500	1000
178.	2026-27	SR	Establishment of 400/220kV 2x500 MVA Medak Pooling Station	400/220	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
179.	2026-27	SR	Establishment of 400/220kV 2x500 MVA Rangareddy Pooling Station	400/220	2	500	1000
180.	2026-27	SR	Establishment of 400/220kV 4x500 MVA Bellary-II Pooling Station	400/220	4	500	2000
181.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	765/400	4	1500	6000
182.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA Anantapur-II Pooling Station	765/400	4	1500	6000
183.	2026-27	SR	Establishment of 400/220kV 5x500 MVA Anantapur-II Pooling Station	400/220	5	500	2500
184.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	400/220	5	500	2500
185.	2026-27	SR	Augmentation of transformation capacity at 400/220kV Kurnool-IV by 2X500 MVA	765/400	3	1500	4500
186.	2026-27	WR	Establishment of 2X1500 MVA 765/400 kV Jamnagar(GIS) with 2X330 MVAR 765 kV bus reactor and 2X125 MVAR 420 kV bus reactor	765/400	2	1500	3000
187.	2026-27	WR	Creation of 765 kV bus section-II at KPS3 (GIS), 765/400kV ICT, 3x1500MVA	765/400	3	1500	4500
188.	2026-27	WR	Establishment of 2x1500 MVA, 765/400 kV ICT GIS SS South Olpad	765/400	2	1500	3000
189.	2026-27	WR	Establishment of 2x500 MVA, 400/220 kV ICT GIS SS South Olpad	400/220	2	500	1000
190.	2026-27	WR	Establishment of 4x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Boisar-II (GIS) S/s	765/400	4	1500	6000
191.	2026-27	WR	Establishment of 2x500 MVA, 400/220 kV Boisar-II (GIS) S/s	400/220	2	500	1000
192.	2026-27	WR	Establishment of 2x1500 MVA, 765/400 kV Pune-III (GIS) S/s	765/400	2	1500	3000
193.	2026-27	WR	Establishment of 3x500 MVA, 400/220 kV Pune-III (GIS) S/s	400/220	3	500	1500
194.	2026-27	WR	Augmentation of transformation capacity at Mandsaur PS by 1x1500 MVA, 765/400 kV ICT (4th) along with associated bays	765/400	1	1500	1500
195.	2026-27	WR	Augmentation of transformation capacity at at Jam Khambhaliya PS (GIS) by 2x500MVA, 400/220kV ICT (5th & 6th) terminated on New 220kV bus section	400/220	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
196.	2026-27	WR	Augmentation of transformation capacity at Jam Khambhaliya PS (GIS) by 1x500MVA, 400/220kV (7th) ICT terminated on New 220kV bus section-2	400/220	1	500	500
197.	2026-27	WR	Augmentation of transformation capacity at Jam Khambhaliya PS (GIS) by 2x500MVA, 400/220kV ICT (8th & 9th) terminated on New 220kV bus section-3	400/220	2	500	1000
198.	2026-27	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 3x500MVA, 400/220kV ICT (7th, 8th & 9th)	400/220	3	500	1500
199.	2026-27	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (4th)	765/400	1	1500	1500
200.	2026-27	WR	Installation of 2x500 MVA, 400/220 kV ICTs (3rd & 4th) at Lakadia PS along with associated ICT bays	400/220	2	500	1000
201.	2026-27	WR	Augmentation of transformation capacity at Lakadia PS by 4x500MVA, 400/220kV ICTs (5th 6th, 7th & 8th) terminated on new 220kV Bus Section	400/220	4	500	2000
202.	2026-27	WR	Augmentation of transformation capacity at Lakadia PS by 1x1500MVA, 765/400kV ICT (3rd)	765/400	1	1500	1500
203.	2026-27	WR	Establishment of 4x1500 MVA, 765/400 kV Navinal (Mundra) S/s (GIS)	765/400	4	1500	6000
204.	2027-28	NER	Establishment of new 400kV Bornagar (ISTS) switching station in Assam	400kV switching station	0	0	0
205.	2027-28	SR	Augmentation of transformation capacity at 765/400kV Nizamabad (PG) by 1X1500 MVA (4th) ICT	765/400	1	1500	1500
206.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Nizamabad-II by 1X500 MVA	400/220	1	500	500
207.	2027-28	SR	Augmentation of transformation capacity at 765/400 kV Nizamabad-II by 2X1500 MVA	765/400	2	1500	3000
208.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Medak by 1X500 MVA	400/220	1	500	500
209.	2027-28	SR	Augmentation of transformation capacity at	400/220	1	500	500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
			400/220kV Rangareddy by 1X500 MVA				
210.	2027-28	SR	Establishment of 400/220kV 3x500 MVA Karimnagar Pooling Station	400/220	3	500	1500
211.	2027-28	SR	Augmentation of transformation capacity at 765/400kV Kurnool-IV by 1X1500 MVA	765/400	1	1500	1500
212.	2027-28	SR	Augmentation of transformation capacity at 765/400kV Anantapur-II by 1X1500 MVA	765/400	1	1500	1500
213.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Anantapur-II by 2X500 MVA	400/220	2	500	1000
214.	2027-28	SR	Establishment of 765/400kV 3x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	765/400	3	1500	4500
215.	2027-28	SR	Establishment of 765/400kV 3x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	400/220	5	500	2500
216.	2027-28	SR	Establishment of 765/400kV 3x1500 MVA Kadapa-II Pooling Station	765/400	3	1500	4500
217.	2027-28	SR	Establishment of 400/220kV 4x500 MVA Kadapa-II Pooling Station	400/220	4	500	2000
218.	2027-28	SR	Augmentation of transformation capacity at 765/400 kV Kurnool-V by 1X1500 MVA	765/400	1	1500	1500
219.	2027-28	SR	Augmentation of transformation capacity at 765/400 kV C'Peta by 1X1500 MVA	765/400	1	1500	1500
220.	2028-29	NR	Establishment of 5x1500MVA, 765/400KV ICTs at Fatehpur(HVDC)	765/400	5	1500	7500
221.	2028-29	NR	400/220/33kV, 315 MVA transformer at pang S/s	400/220	2	315	630
222.	2028-29	NR	765/400/33kV, 1500 MVA transformer at Kaithal S/s	765/400	3	1500	4500
223.	2028-29	NR	Augmentation of 765/400kV, 1500 MVA transformer of Bhiwani S/s	765/400	1	1500	1500
224.	2028-29	SR	Establishment of 3x500 MVA, 400/230 kV Onshore Pooling Station near Avaraikulam, Tirunelveli District in Tamil Nad + 300 MVAr STATCOM along with 2x125 MVAr MSRu with provision of expansion upto 5 GW.	400/220	3	500	1500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
225.	2028-29	SR	Establishment of 2x315 MVA, 230/66kV Off-Shore Substation-1 with 10 nos. of 66kV line bays for RE integration Establishment of 2x315 MVA, 230/66kV Off-Shore Substation-2 with 10 nos. of 66kV line bays for RE integration	400/220	4	315	1260
226.	2028-29	WR	Establishment of 6x1500MVA, 765/400 kV ICT at Nagpur SS	765/400	6	1500	9000
227.	2028-29	WR	Establishment 4x1500 MVA, 765/400kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor	765/400	4	1500	6000
228.	2028-29	WR	Installation of 2x1500MVA, 765/400 kV ICTs at Vataman along with 1x125 MVAr (420kV) Bus Reactor	765/400	2	1500	3000
229.	2028-29	WR	Establishment of 2x500 MVA, 400/220kV Mahuva Onshore Pooling Station (GIS) (Mahuva PS) alongwith 1x125 MVAR, 420kV bus reactor	400/220	2	500	1000
230.	2028-29	WR	Establishment of 2x315MVA, 220/66kV Gujarat Offshore B3 Sub-Station Station-1 (B3-OSS-1) with 66kV line bays – 9 nos. for RE Interconnection	220/66	2	315	630
231.	2028-29	WR	Augmentation of transformation capacity at KPS2 by 1x1500MVA, 765/400kV ICT (9th) on Bus Section I	765/400	1	1500	1500
232.	2028-29	WR	Augmentation of transformation capacity at KPS3 by 1x1500MVA, 765/400kV ICT (8th) on Bus Section II	765/400	1	1500	1500

3. Bus Reactors

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
1.	2023-24	ER	Installation of 420kV, 1x125MVAr bus reactor along with associated bay at Biharsharif (POWERGRID) S/s in the bus section having 1x80MVAr existing bus reactor.	1	125	125
2.	2023-24	SR	1x125 MVAr (400 kV) bus reactor at Gadag PS	1	125	125
3.	2023-24	WR	Establishment of 1x125 MVAr Bus Reactor at Neemuch PS	1	125	125

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
4.	2023-24	WR	Establishment of 420kV 125 MVAR bus at reactor at Pachora SEZ PP	1	125	125
5.	2023-24	WR	Establishment of 1x125MVAr bus reactor at Kallam PS	1	125	125
6.	2024-25	ER	1x125 MVAr Bus Reactor at Alipurduar (3rd)	1	125	125
7.	2024-25	ER	Installation of new 420kV, 1x125MVAr bus reactor along with associated bay at Jamshedpur (POWERGRID) S/s	1	125	125
8.	2024-25	ER	1X125MVAr Bus Reactors at 400kV Durgapur section-A	1	125	125
9.	2024-25	NER	2 nos 31.5MVAr Bus reactor at Nangalbibra	2	32	63
10.	2024-25	NR	1x125 MVAr(400 kV) Bus Reactor at Sikar-II	1	125	125
11.	2024-25	NR	2x330 MVAr(765 kV) Bus Reactor at Sikar-II	2	330	660
12.	2024-25	NR	2x330 MVAr(765 kV) Bus Reactor at Narela	2	330	660
13.	2024-25	NR	1x125 MVAr(400 kV) Bus Reactor at Narela	1	125	125
14.	2024-25	NR	2x25 MVAR, 220kV bus reactors at 220/66kV Drass S/s	2	25	50
15.	2024-25	NR	1x25 MVAR, 220kV bus reactors at 220/66kV Alusteng S/s	1	25	25
16.	2024-25	NR	Establishment of 2x500 MVA 400/220 kV pooling station at Fatehgarh-4 along with 2x125 MVAr Bus Reactor	2	125	250
17.	2024-25	NR	2x330 MVAr(765 kV) Bus Reactor at Bhadla-3	2	330	660
18.	2024-25	NR	2x125 MVAr(400 kV) Bus Reactor at Bhadla-3	2	125	250
19.	2024-25	NR	2x240 MVAr(765 kV) Bus Reactor at Ramgarh	2	240	480
20.	2024-25	NR	2x125 MVAr(400 kV) Bus Reactor at Ramgarh	2	125	250
21.	2024-25	NR	STATCOM at Ramgarh S/s: ± 2x300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR	2	125	250
22.	2024-25	NR	STATCOM : ± 2x300 MVAr, 4x125 MVAr MSC, 2x125 MVAr MSR at Fatehgarh-III	2	125	250
23.	2024-25	NR	2x330 MVAr(765 kV) Bus Reactor at Beawar	2	330	660
24.	2024-25	NR	2x125 MVAr(400 kV) Bus Reactor at Beawar	2	125	250
25.	2024-25	NR	2x330 MVAr(765 kV) Bus Reactor at Dausa	2	330	660
26.	2024-25	NR	2x125 MVAr(400 kV) Bus Reactor at Dausa	2	125	250
27.	2024-25	SR	2X63 MVAr bus reactors at Kasargode Ss	2	63	126
28.	2024-25	SR	2x330 MVAr (765kV) bus reactor at Narendra (New) (GIS)	2	330	660
29.	2024-25	SR	1x330 MVAr (765kV) bus reactor at Kurnool-III PS	1	330	330

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
30.	2024-25	SR	1x125MVAr (400kV) bus reactor at Kurnool-III PS	1	125	125
31.	2024-25	WR	Establishment of 1x125MVAR Bus Reactor at Xeldem S/s	1	125	125
32.	2024-25	WR	Establishment of 2x330 MVAR 765 kV bus reactor at KPS2	2	330	660
33.	2024-25	WR	Establishment of 2x125 MVAR 400 kV bus reactor at KPS2	2	125	250
34.	2024-25	WR	Augmentation of Khavda PS1 with 1x330 MVAR 765 kV bus reactor on 2nd 765 kV bus section	1	330	330
35.	2024-25	WR	Augmentation of Khavda PS1 with 1x125 MVAR 420 kV bus reactor on 2nd 400 kV bus section	1	125	125
36.	2024-25	WR	Establishment of 125MVAR Bus reactor at Vapi / Ambheti (Vapi-II)	1	125	125
37.	2024-25	WR	2x330 MVAr (765kV) bus reactor at Navsari (New) South Gujarat (GIS) S/s	2	330	660
38.	2024-25	WR	125 MVAr (400kV) bus reactor at Navsari (New) South Gujarat (GIS) S/s	1	125	125
39.	2024-25	WR	Establishment of 1x330 MVAR 765 kV bus reactor at KPS3(GIS)	1	330	330
40.	2024-25	WR	Establishment of 1x125 MVAR 400 kV bus reactor at KPS3(GIS)	1	125	125
41.	2024-25	WR	Establishment of 1x330 MVAR 765 kV bus reactor at Ahmedabad S/s	1	330	330
42.	2024-25	WR	Establishment of 1x125 MVAR 400 kV bus reactor at Ahmedabad S/s	1	125	125
43.	2025-26	ER	2X125MVAr Bus Reactors at 400kV Paradeep GIS substation	2	125	250
44.	2025-26	ER	2X330MVAr Bus Reactors at 765kV Paradeep GIS substation	2	330	660
45.	2025-26	ER	2X125MVAr Bus Reactors at 400kV Gopalpur GIS substation	2	125	250
46.	2025-26	ER	2X330MVAr Bus Reactors at 765kV Gopalpur GIS substation	2	330	660
47.	2025-26	NER	2x125 MVAr, 400 kV Bus reactors at Gogoamukh	2	125	250
48.	2025-26	NER	1 no 50MVAr Bus reactor at Namsai	1	50	50
49.	2025-26	NER	2X80MVAr Bus Reactors at 400kV Bokajan substation	2	80	160
50.	2025-26	NER	1x125MVAr Bus Reactor at 400kV Bongaigaon	1	125	125
51.	2025-26	NER	Decommissioning of 2x50MVAr Bus Reactor at 400kV Bongaigaon	-2	50	-100
52.	2025-26	NR	Implementation of 2x200 MVA, 400/132 kV transformer at Kishtwar Pooling Station along with 4 no. of 132 kV line bays	1	125	125
53.	2025-26	NR	Establishment of 2x315MVA, 400/220kV Siot(Rajouri) S/s with 1x125 MVAR (420 kV) bus reactors	1	80	80
54.	2025-26	NR	125 MVAR (420kV) Bus Reactor at Nange (GIS) PS (1-Ph units along with one spare unit)	1	125	125

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
55.	2025-26	NR	125 MVAR (420kV) Bus Reactor at Koldam S/s (1-Ph units along with one spare unit)	1	125	125
56.	2025-26	NR	2X330 MVAr Bus Reactors at 765kV Bikaner-III	2	330	660
57.	2025-26	NR	2X125MVAr Bus Reactors at 765kV Bikaner-III	2	125	250
58.	2025-26	NR	2X330 MVAr Bus Reactors at 765kV Neemrana-2	2	330	660
59.	2025-26	NR	2X125MVAr Bus Reactors at 765kV Neemrana-2	2	125	250
60.	2025-26	NR	2X240MVAr Bus Reactors at 765kV Fatehgarh- IV (Section-2)	2	240	480
61.	2025-26	NR	2X125MVAr Bus Reactors at 765kV Fatehgarh- IV (Section-2)	2	125	250
62.	2025-26	NR	2X240MVAr Bus Reactors at 765kV Barmer-I PS	2	240	480
63.	2025-26	NR	2X125MVAr Bus Reactors at 400kV Barmer-I PS	2	125	250
64.	2025-26	NR	2X240MVAr Bus Reactors at 765kV Jalore PS	2	240	480
65.	2025-26	NR	2X125MVAr Bus Reactors at 400kV Jalore PS	2	125	250
66.	2025-26	NR	1X125MVAr Bus Reactors at 400kV Jhangi	1	125	125
67.	2025-26	NR	2x240 MVAr (765kV) Bus Reactor at Bikaner-IV PS 2x240 MVAr (765kV) Bus Reactor Bus Reactor at Siwani	4	240	960
68.	2025-26	NR	2x125 MVAr (420kV) Bus Reactor at Bikaner-IV PS 2x125 MVAr (420kV) Bus Reactor at Siwani	4	125	500
69.	2025-26	SR	1x240 MVAr Bus Reactor at Bidar	1	240	240
70.	2025-26	SR	1x125 MVAr Bus Reactor at Bidar	1	125	125
71.	2025-26	SR	2x125 MVAr (400kV) bus reactor at Anantapur PS	2	125	250
72.	2025-26	SR	2X330 MVAr Bus Reactors at 765kV Koppal-II	2	330	660
73.	2025-26	SR	2X125 MVAr Bus Reactors at 400kV Koppal-II	2	125	250
74.	2025-26	SR	2X125 MVAr Bus Reactors at 400kV Gadag-II	2	125	250
75.	2025-26	WR	Establishment of 1X125 MVAR, 420 kV bus reactor at Chhatarpur PS	1	125	125
76.	2025-26	WR	Establishment of 125MVAR, 420kV Bus Reactor at Solapur PP (near Mohol)	1	125	125
77.	2025-26	WR	1x330 MVAr 765 kV bus reactor at Karera (near Datiya)+1 spare unit	1	330	330
78.	2025-26	WR	1x330 MVAr , 765 kV Bus reactor with 1 spare unit of 110MVAr at Ishanagar (New)	1	330	330
79.	2025-26	WR	Establishment of 765kV Mandsaur Pooling Station	2	330	660

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
			along with 2x330MVAr (765kV) Bus Reactor			
80.	2025-26	WR	Establishment of 2x125MVAr 765kV bus reactor at Mandsaur	2	125	250
81.	2025-26	WR	Establishment of 1x125MVAr 420kV bus reactor at Kurawar	1	125	125
82.	2025-26	WR	Establishment of 2x330MVAr, 765kV Bus reactor at Kurawar	2	300	600
83.	2025-26	WR	Establishment of 765 kV Halvad switching station with 765 kV, 2x330 MVAr bus reactors [with 110 MVAr & 80 MVAr 765kV single phase reactor (spare unit for bus/line reactors at Halvad)]	2	330	660
84.	2025-26	WR	Establishment of 765 kV switching station near Vataman with 2x330MVAr, 765 kV bus reactor [with 110 MVAr 765 kV single phase reactor (spare unit for bus/line reactor)]	2	330	660
85.	2025-26	WR	Establishment of 2x125MVAr, 420kV bus reactors at pooling station near Dhule, Maharashtra.	2	125	250
86.	2025-26	WR	1x330MVAr Bus Reactor at KPS-3 (GIS) Section-II	1	330	330
87.	2025-26	WR	1x125MVAr Bus Reactor at KPS-3 (GIS) Section-II	1	125	125
88.	2025-26	WR	2x330MVAr Bus Reactor at South Olpad	2	330	660
89.	2025-26	WR	1x125MVAr Bus Reactor at at South Olpad	1	125	125
90.	2025-26	WR	2x330MVAr Bus Reactor at Boisar-II (GIS) SS	2	330	660
91.	2025-26	WR	2x125MVAr Bus Reactor at Boisar-II (GIS) SS	2	125	250
92.	2025-26	WR	2x330MVAr Bus Reactor at Pune-III (GIS) SS	2	330	660
93.	2025-26	WR	2x125MVAr Bus Reactor at Pune-III (GIS) SS	2	125	250
94.	2025-26	WR	2x330MVAr Bus Reactor at Nagpur SS	2	330	660
95.	2025-26	WR	2x125MVAr Bus Reactor at Nagpur SS	2	125	250
96.	2025-26	WR	2x125MVAr Bus Reactor at KPS3 (HVDC)	2	125	250
97.	2025-26	WR	Replacement of 420kV, 63 MVAr Bus reactor with 420kV, 125MVAr bus reactor at Jabalpur (PG) S/s along with associated civil works	1	125	125
98.	2026-27	NR	2x80 MVAr (420kV) Bus Reactors at Kaza PS	2	80	160
99.	2026-27	NR	2x240 MVAr bus reactor at Merta-II S/s	2	240	480
100.	2026-27	NR	2x125 MVAr bus reactor at Merta-II S/s	2	125	250

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
101.	2026-27	NR	110MVAr spare reactor unit (1 no.) at Barmer-I PS (single phase)	1	110	110
102.	2026-27	NR	2x240 MVAr bus reactor at Ghiror S/s (UP)	2	240	480
103.	2026-27	NR	2x125 MVAr bus reactor at Ghiror S/s (UP)	2	125	250
104.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Davangere/Chitradurga	2	125	250
105.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Tumkur-II	2	125	250
106.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Bijapur	2	125	250
107.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Nizamabad-II	2	125	250
108.	2026-27	SR	2X330MVAr Bus Reactors at 765kV Nizamabad-II	2	330	660
109.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Medak	2	125	250
110.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Rangareddy	2	125	250
111.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Bellary-II	2	125	250
112.	2026-27	SR	2X330MVAr Bus Reactors at 765kV Anantapur-II	2	330	660
113.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Anantapur-II	2	125	250
114.	2026-27	WR	2X330MVAr Bus Reactors at 765kV Jamnagar GIS substation	2	330	660
115.	2026-27	WR	2X125MVAr Bus Reactors at 400kV Jamnagar GIS substation	2	125	250
116.	2026-27	WR	Installation of 1x330MVAr 765kV Bus Reactor (2nd) along-with associated bay	1	330	330
117.	2026-27	WR	Installation of 2x330MVAr, 765kV Bus Reacto at Navinal (Mundra) S/s (GIS)	2	330	660
118.	2026-27	WR	Installation of 1x125MVAr, 420kV Bus Reactor at Navinal (Mundra) S/s (GIS)	1	125	125
119.	2026-27	WR	Installation of 1x330MVAr, 765kV switchable line reactor on each ckt at Navinal end of Lakadia – Navinal 765 kV D/c line formed after LILO	1	330	330
120.	2027-28	SR	2X125MVAr Bus Reactors at 400kV karimnagar	2	125	250
121.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Kurnool-IV	2	125	250
122.	2027-28	SR	2X330MVAr Bus Reactors at 765kV Kurnool-IV	2	330	660
123.	2027-28	SR	2X330MVAr Bus Reactors at 400kV Kadapa-II	2	330	660
124.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Kadapa-II	2	125	250
125.	2028-29	NR	2x330MVAr (765kV) bus reactor at Fatehpur	2	330	660
126.	2028-29	WR	2x330MVAr 765kV Bus Reactor at South Kalamb S/s (MH)	2	330	660

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
127.	2028-29	WR	2x125MVAr 400kV Bus Reactor at South Kalamb S/s (MH)	2	125	250
128.	2028-29	WR	220KV, 1x125MVAR Variable Bus Shunt Reactor (with control range between 25 – 125MVAr for each VSR) with 1 No. of 220 kV bay	1	125	125

4. Other Schemes

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
1.	2023-24	ER	Modification of 132kV SMT bus scheme to DM bus scheme in GIS and 2 no additional 132kV GIS line bays at Malda (400/220/132kV)	132
2.	2023-24	NER	Re-conductoring of Siliguri – Bongaigaon 400kV D/c line along wioth suitable modification in line bays equipment at both ends	400
3.	2023-24	NR	2 nos. of 400kV line bays at Koteshwar	400
4.	2023-24	NR	1 no. of 220 kV line bay at 400/220 kV Amritsar (PG) S/s (for 220kV Amritsar (PG) – Rashiana line)	220
5.	2023-24	NR	4 nos. of 220 kV line bay at 400/220 kV Jind (PG) S/s	220
6.	2023-24	NR	Installation of 50 MVAR switchable line reactor at Mainpuri end and fixed 50 MVAR line reactor at Ballabgarh end on 400 kV Mainpuri- Ballabgarh D/c line	400
7.	2023-24	NR	Installation of 50 MVAR switchable line reactor at Allahabad end on 400 kV Kanpur- Allahabad S/c line	400
8.	2023-24	NR	Installation of fixed 50 MVAR line reactor at Bhiwadi end for uncompensated circuit of 400 kV Agra- Bhiwadi D/c line	400
9.	2023-24	SR	One spare unit (1-Ph) of 80 MVAR reactor each at 765 kV Warangal New and Chilikaluripeta substation	765
10.	2023-24	WR	Re-conductoring of Kolhapur (PG) – Kolhapur 400 kV D/c line with conductor of minimum capacity of 2100 MVA/Ckt at nominal voltage along with bay up-gradation work at Kolhapur (MSETCL). -60KM	400
11.	2023-24	WR	Conversion of 50MVAr fixed Line Reactors on each ckt of Parli (PG) – Pune (GIS) 400kV D/c line at Parli (PG) end into switchable.	400
12.	2023-24	WR	Bypassing of Parli(PG) – Parli(M) 400kV D/c line (~5km.) and Parli(PG) – Parli(New) 400kV D/c (quad) line (~18km.) at Parli(PG) S/s at outskirts of the Parli(PG) S/s so as to form Parli(M) – Parli(New) 400kV D/c direct line	400
13.	2023-24	WR	Reconductoring of Parli(PG) – Parli(M) 400kV D/c line section of above line (at Sl. 1) with twin HTLS conductor with a minimum capacity of 1940MVA per circuit at a nominal voltage	400
14.	2023-24	WR	400kV Bay Upgradation work at Parli(M) S/s (Parli(M) S/s has a DMT scheme. The current rating of existing bays is 2000A which would be upgraded to 3150A to suit the reconductoring with Twin HTLS conductor)	400
15.	2024-25	ER	Creation of 220kV GIS bus at Banka (POWERGRID) S/s	220
16.	2024-25	ER	400kV Bus extension works at Banka (PGCIL) 400/132kV Substation	400
17.	2024-25	ER	Installation of new 420kV, 1x63MVAr line reactor at Maithon-A end of Maithon-A – Kahalgaon-B ckt-1 400kV line along with new 700ohm NGR (with NGR bypass arrangement for operation of line reactor as a bus reactor	400
18.	2024-25	ER	Reconductoring of Rango-Gangtok 132kV D/c line	132
19.	2024-25	ER	Construction of new 132kV TBC bay in Hybrid/Outdoor GIS	132

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
20.	2024-25	ER	Switching arrangement within the Rangpo (POWERGRID) GIS S/s premises such that Rangpo - Melli and Rangpo-Rangit 132kV S/c lines can be bypassed at Rangpo S/s end	132
21.	2024-25	ER	(b) Interconnection between 132kV side of 4th ICT and 132kV ICT bay (no. 6) through 1C, 1200sqmm XLPE Cu cable-1km (4 runs, each of 250m)	132
22.	2024-25	NER	Conversion of 132kV level of 400/132kV Imphal S/s to Double Main Transfer Bus Scheme preferably with Bus Sectionalisation on AIS depending on layout or alternatively on GIS/ Hybrid GIS if layout does not permit AIS Bus sectionalisation	132
23.	2024-25	NER	Reconductoring of Loktak (NHPC) – Imphal (POWERGRID) 132kV S/c line with HTLS conductor (with Ampacity of single HTLS as 800A at nominal voltage) along with strengthening of associated structure in NHPC switchyard, if necessary	132
24.	2024-25	NER	Replacement of existing CT of 600-400-200/1A at Loktak HEP end in Loktak – Imphal 132kV S/c line with rating commensurate with ampacity (800A) of HTLS conductor	132
25.	2024-25	NER	Reconductoring of existing Single ACSR Panther Kopili (NEEPCO) – Khandong (NEEPCO) 132kV S/c line-1 (10.9km) of POWERGRID with Single HTLS conductor of ampacity of 800A (at nominal voltage level & considering 40°C ambient temp.) along with replacement of existing wave trap at Kopili end and CT at Khandong end with rating commensurate with ampacity (800A) of HTLS conductor.	132
26.	2024-25	NER	Reconductoring of existing Single ACSR Panther Khandong (NEEPCO) – Khliehriat (POWERGRID) 132kV S/c line-1 (42.48km) of POWERGRID with Single HTLS conductor of ampacity of 800A (at nominal voltage level & considering 40°C ambient temp.) along with replacement of existing CTs at both ends with rating commensurate with ampacity (800A) of HTLS conductor.	132
27.	2024-25	NER	Reconductoring of existing Single AAAC Panther Khandong (NEEPCO) – Khliehriat (POWERGRID) 132kV S/c line-2 (40.93km) of POWERGRID with Single HTLS conductor of ampacity of 800A (at nominal voltage level & considering 40°C ambient temp.) along with replacement of existing CTs at both ends & wave trap at Khandong end with rating commensurate with ampacity (800A) of HTLS conductor, and strengthening of requisite tower members (approx. 0.348 MT).	132
28.	2024-25	NER	Reconductoring of existing Single ACSR Panther Khliehriat (POWERGRID) – Khliehriat (MePTCL) 132kV S/c POWERGRID line-1 (7.8km) of POWERGRID with Single HTLS conductor of ampacity of 800A (at nominal voltage level & considering 40°C ambient temp.) along with replacement of existing CTs at both ends with rating commensurate with ampacity (800A) of HTLS conductor, and strengthening of requisite tower members (approx. 0.121 MT).	132

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
29.	2024-25	NER	Reconductoring of existing Single AAAC Panther Khliehriat (POWERGRID) – Badarpur (POWERGRID) 132kV S/c line (76.64km) with Single HTLS conductor of ampacity of 900A (at nominal voltage level & considering 40°C ambient temp.) along with replacement of existing CTs at both ends with rating commensurate with ampacity (900A) of HTLS conductor.	132
30.	2024-25	NER	Replacement of existing bus coupler bay CT at Khandong HEP (NEEPCO) switchyard from 600A to 800A	132
31.	2024-25	NR	1 no. of 400 kV line bay at Rampura (Kashipur) S/s	400
32.	2024-25	NR	Upgradation of existing 400kV bays at Khandukhal (Srinagar)	400
33.	2024-25	NR	Upgradation of existing 1 no. of 400 kV diameter comprising line bay (Srinagar) and ICT bay alongwith associated Tie bay at Rampura (Kashipur)	400
34.	2024-25	NR	2 nos of 220 kV line bays at 400/220 kV Bahadurgarh (PG) S/s	220
35.	2024-25	NR	2 nos of 220 kV line bays at 400/220 kV Bahadurgarh (PG) S/s	220
36.	2024-25	NR	2 nos of 220 kV line bays at 400/220 kV Sonepat (PG) S/s	220
37.	2024-25	NR	Reconductoring of 400 kV Jodhpur (Surpura)(RVPN) – Kankroli S/c (twin moose) line with twin HTLS conductor	400
38.	2024-25	NR	Bypassing of 400 kV Kankroli - BhinmalZerda line at Bhinmal to form 400 kV Kankroli – Zerda (direct) line	400
39.	2024-25	NR	2 Nos. of 220 kV bays at 400/220 kV Panchkula (Barwala) S/s	220
40.	2024-25	NR	1 Set of Bus sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)	400
41.	2024-25	SR	• NGR bypass arrangement to use 240 MVAr SLR as bus reactors installed at Warangal end on each circuit of Warangal (New) – Hyderabad 765 kV D/c line • NGR bypass arrangement to use 240 MVAr SLR as bus reactors installed at Warora and Warangal New ends on each circuit of Warora Pool – Warangal (New) 765 kV D/c line • NGR bypass arrangement to use 240 MVAr SLR as bus reactors installed at Warangal New and Chilakaluripeta ends on each circuit of Warangal (New) – Chilakaluripeta 765kV D/c line • NGR bypass arrangement to use 240 MVAr SLR as bus reactors installed at Kurnool end on each circuit of Hyderabad – Kurnool 765 kV D/c line	765
42.	2024-25	WR	400kV Wardha Sub--station extension (400kV Bus splitting at Wardha SS)	400
43.	2024-25	WR	Upgradation of 40% FSC associated with Wardha – Aurangabad 400kV D/c (Quad) line at Wardha S/s from 40kA (1s) to 50kA (1s) SC level	400
44.	2024-25	WR	1 number of 400kV bay at Solapur (PG) for St-II connectivity to M/s Toramba	400

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
45.	2024-25	WR	4 No. of 220 kV line bays at Jabalpur PS for LILO of Narsinghpur - Jabalpur (MP) 220 kV D/c line at Jabalpur Pool	220
46.	2024-25	WR	2 No. of 220kV line bays at Satna for LILO of Satna 220kV - Maihar 220kV line at Satna (PG) S/s	220
47.	2024-25	WR	220kV bus extension (GIS) of Rajgarh 400/220 kV (PG) S/s along with 220kV Bus Coupler bay for extended bus.	220
48.	2024-25	WR	220kV bus sectionaliser bay (GIS) between existing & extended 220 kV bus of Rajgarh S/s.	220
49.	2024-25	WR	220kV GIS line bay at Rajgarh 400/220 kV (PG) S/s (on extended bus) for RE interconnection.	220
50.	2024-25	WR	1 no. 220kV line bay at Bhuj PS associated with M/s NTPC Renewable Energy Ltd. (300MW)	220
51.	2025-26	ER	Reconductoring of Jharsuguda/Sundargarh (POWERGRID) – Rourkela (POWERGRID) 400kV 2xD/c Twin Moose line with Twin HTLS conductor (with ampacity Single HTLS as 1228A at nominal voltage).	400
52.	2025-26	ER	Bay upgradation at Rourkela (POWERGRID) end for 3150A rating – 04 nos. diameters in one and half breaker scheme (except 09 nos. existing circuit breakers which are of minimum 3150 A rating).	400
53.	2025-26	ER	Extension at Angul (POWERGRID) S/s with 2 no. of 765kV line bays (along with space for future switchable line reactors)	765
54.	2025-26	ER	Extension at Paradeep (OPTCL) GIS S/s with 2 no. of 400kV GIS line bays	400
55.	2025-26	ER	Creation of 220kV level in GIS (in Double Main Switching Scheme including 1 no. bus coupler bay) at Lakhisarai (POWERGRID) 400/132kV S/s along with 2 no. 220kV line bays *[for termination of Lakhisarai – Haveli Kharagpur 220kV D/c line to be implemented by BSPTCL under intra-state]*	220
56.	2025-26	NER	Reconductoring of Melriat (GIS) (POWERGRID) – Zuangtui (Mizoram) 132kV ACSR Panther S/c line with Single HTLS rating of 900A (at nominal voltage level) along with new one (1) 132kV line bay at Melriat (POWERGRID) S/s (of rating commensurate with rating of HTLS viz. 900A) for termination of this HTLS line from existing bay and termination in the new bay	132
57.	2025-26	NER	Replacement of existing CT of 600/1A at Zuangtui (Mizoram) end in Melriat GIS (POWERGRID) – Zuangtui (Mizoram) 132kV S/c line with rating commensurate with ampacity (900A) of HTLS conductor	132
58.	2025-26	NER	Reconductoring of Aizawl (POWERGRID) – Luangmual (Mizoram) 132kV ACSR Panther S/c line with Single HTLS rating of HTLS conductor of 800A (at nominal voltage level) along with upgradation of line bay equipment at Aizawl (POWERGRID) end commensurate with rating of HTLS, as required	132
59.	2025-26	NER	Replacement of existing CT of 600/1A at Luangmual (Mizoram) end in Aizawl (POWERGRID) – Luangmual (Mizoram) 132kV S/c line with rating commensurate with ampacity (800A) of HTLS conductor	132
60.	2025-26	NER	Upgradation of Single Main and Transfer Bus to Double Bus arrangement with GIS at 132kV Khliehriat (POWERGRID) switching station	132

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
61.	2025-26	NER	Upgradation of Single Main and Transfer Bus to Double Bus arrangement with Green GIS at 132kV Badarpur (POWERGRID) switching station	132
62.	2025-26	NER	Reconductoring of Khandong (NEEPCO) – Umrangshu (AEGCL) – Halflong (POWERGRID) – Jiribam (POWERGRID) 132kV corridor	163.666
63.	2025-26	NR	One set of bus sectionalizer at 400kV level of 400/220kV BikanerII PS	400
64.	2025-26	NR	Requirement of one set of Bus Sectionalizer at 220kV level of 400/220kV Fatehgarh-IV PS (Section-1)	220
65.	2025-26	NR	Requirement of 1x80 MVAr (1-Ph) spare reactor unit at Beawar S/s under Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/ Barmer Complex): Part D scheme	400
66.	2025-26	NR	220 kV bus sectionalizer (1 set) along with 220kV BC (1 no.) bay and 220kV TBC (1 no.) bay at Bhadla-III PS	220
67.	2025-26	SR	Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects i) 2 nos. of 400kV line bays at Ananthapuram PS for Connectivity to M/s Renew Vikram Shakti Pvt. Ltd. ii) 1 nos. of 400kV line bay at Ananthapuram PS for Connectivity to M/s ABC Cleantech Pvt. Ltd.	400
68.	2025-26	SR	1 nos. of 230kV line bay at Pugalur (Existing) 400/230kV S/s for Connectivity to M/s Tata Power Renewable Energy Ltd. RE generation project	230
69.	2025-26	SR	4 nos. of 220kV line bays for integration of RE generation projects	230
70.	2025-26	WR	Conversion of 1x240 MVAr, 765 kV Fixed line reactor at Gwalior end to Switchable line reactor (with NGR bypass arrangement) along with implementation of Inter-tripping scheme	765
71.	2025-26	WR	Conversion of 1x330 MVAR, 765 kV Fixed line reactor at Orai end of Ishanagar – Orai 765 kV line (formed after LILO at Sl. 2) to Bus reactor at Orai S/s	765
72.	2025-26	WR	2 no. of 400 kV line bays at Ujjain (MPPTCL) for Pachora – Ujjain 400kV D/c line	400
73.	2025-26	WR	Installation of 240 MVAr 765 kV switchable line reactor on each ckt at Halvad end of Halvad – Ahmedabad 765 kV D/c line (~220 km length)	765
74.	2025-26	WR	Establishment of 765 kV switching station near Vataman	765
75.	2025-26	WR	Conversion of 240 MVAr 765 kV switchable line reactor on each ckt at Lakadia end of Lakadia – Ahmedabad 765 kV D/c line (being LILOed at Halvad) into bus reactors with NGR bypassing arrangement.	765
76.	2025-26	WR	Conversion of 330 MVAr 765 kV switchable line reactor on each ckt at Vadodara end of Lakadia – Vadodara 765 kV D/c line (being LILOed at Vataman) into bus reactors with NGR bypassing arrangement.	765
77.	2025-26	WR	± 300MVAr STATCOM with 1x125 MVAr MSC, 2x125 MVAr MSR at KPS1 400kV Bus section-1	400

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
78.	2025-26	WR	± 300MVAr STATCOM with 1x125 MVAr MSC, 2x125 MVAr MSR at KPS1 400kV Bus section-2	400
79.	2025-26	WR	± 300MVAr STATCOM with 1x125 MVAr MSC, 2x125 MVAr MSR at KPS3 400kV Bus section-1	400
80.	2025-26	WR	± 300MVAr STATCOM with 3x125 MVAr MSC, 1x125 MVAr MSR at 400kV level of Navsari (New)(PG) S/s	400
81.	2025-26	WR	±300 MVAR STATCOM with 1x125 MVAR MSC, 2x125 MVAR MSR at KPS3 400 kV Bus section-II	400
82.	2025-26	WR	±200 MVAR STATCOM with 2x125 MVAR MSC, 1x125 MVAR MSR at 400 kV bus section-I of Boisar-II	400
83.	2025-26	WR	±200 MVAR STATCOM with 2x125 MVAR MSC, 1x125 MVAR MSR at 400 kV bus section-II of Boisar-II	400
84.	2025-26	WR	± 300 MVAR STATCOM with 3x125 MVAR MSC, 1x125 MVAR MSR at 400 kV level of Navsari (New)(PG) S/s with 1 No. of 400 kV bay (GIS)	400
85.	2025-26	WR	Conversion of 330 MVAR Fixed LR at Wardha (on each ckt of Wardha – Raipur 765 kV D/c line being LILOed at Nagpur) into Bus Reactors at Wardha S/s	765
86.	2025-26	WR	400kV line bay at 765/400kV Parli (New) S/s for interconnection of RE Project.	400
87.	2025-26	WR	400kV line bay at 765/400/220kV Indore (PG) for Interconnection of RE project	400
88.	2025-26	WR	Implementation of additional line bay equipment including other miscellaneous works required for physical interconnection of Dedicated Transmission Line of RE Developer at bay no. 416 of KPS-2 (400kV Bus Section-1)	400
89.	2025-26	WR	Implementation of additional line bay equipment including other miscellaneous works required for physical interconnection of Dedicated Transmission Line of RE Developer at bay no. 412 of KPS-1 (400kV Bus Section-1)	400
90.	2025-26	WR	400kV line bay at Khavda-I PS (KPS1) (GIS) for interconnection of RE project of Sarjan Realities Pvt. Ltd. (1150MW)	400
91.	2025-26	WR	220kV line bay at Parli(PG) S/s for interconnection of Renew Tej Shakti Pvt. Ltd. (RTSPL)	220
92.	2025-27	WR	Provision of NGR bypass arrangement and inter tripping scheme on 240 MVAR Switchable Line Reactor at Bhopal end of Kurawar – Bhopal 765 kV S/c line (~Route length: 60 km)	765
93.	2026-27	NR	i) 220kV line bays (6 nos.) for RE connectivity at Bikaner-IV PS ii) 400kV line bays (3 no.) for RE connectivity at Bikaner-IV PS	
94.	2026-27	NR	i)220kV Sectionalizer bay (1 set) along with BC (2 nos.) bays and 220 kV TBC (2 nos.) bays at Bikaner-IV PS ii) 400kV Sectionalizer bay (1 set) at Bikaner-IV PS	
95.	2026-27	NR	i) STATCOM (2x+300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 2 nos. 400kV bays at Bikaner-IV PS ii) STATCOM (2x+300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 2 nos. 400kV bays at Siwani S/s	
96.	2026-27	NR	400kV Sectionalizer bay (1 set) at at Siwani S/s	

Sr. No.	Time frame	Region	Scope (each element as separate row)	Voltage Ratio (kV)
97.	2026-27	NR	STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 2 nos. 400kV bays at Barmer-I PS	
98.	2026-27	NR	220kV line bays (6 nos.) for RE connectivity at Barmer-I PS	
99.	2026-27	NR	220kV Sectionalizer bay (1 set) along with 220 kV BC (1 nos.) bay and 220 kV TBC (1 nos.) bay at Barmer-I PS	
100.	2026-27	NR	400kV Sectionalizer bay (1 set) at Barmer-I S/s	
101.	2026-27	SR	Implementation of 2 no. of 220 kV bays at Pavagada PS under ISTS	220
102.	2026-27	SR	Implementation of 6 nos. of 400kV line bays at Kurnool-III PS for integration of RE generation projects. i) 2 nos. of 400kV line bays at Kurnool-III PS for Connectivity to M/s Adani Renewable Energy Forty Two Ltd. ii) 4 nos. of 400kV line bays at Kurnool-III PS for Connectivity to M/s Indosol Solar Pvt. Ltd.	400
103.	2026-27	SR	1 nos. of 220kV line bay at Tumkur (Pavagada) 400/220kV PS for Connectivity to M/s TEQ Green Power XVIII Pvt. Ltd. RE generation project	220
104.	2026-27	SR	i) 1 nos. of 400kV line bay for integration of RE generation project ii) 4 nos. 220kV line bays for integration of RE generation projects	230
105.	2026-27	WR	±400MVAr STATCOM with 3x125 MVAr MSC & 2x125 MVAr MSR at Jamnagar 400kV Bus section	400
106.	2027-28	NER	Reconductoring of Khandong (NEEPCO) – Umrangso (AEGCL) – Jiribam (POWERGRID) – Halflong (POWERGRID) 132kV corridor	132
107.	2027-28	NER	Shifting of the existing 63MVAr fixed LR at Bongaigaon (POWERGRID) S/s end in Bongaigaon – Balipara line and installation of the same as switchable line reactor at Bornagar (ISTS) S/s end in the Bornagar (ISTS) – Balipara (POWERGRID) line	400
108.	2027-28	NER	Installation of 420kV, 1x80MVAr switchable line reactor at Bornagar (ISTS) end in each circuit of Alipurduar (POWERGRID) – Bornagar 400kV D/c (Quad) line	400
109.	2028-29	WR	± 300 MVAr STATCOM at 220kV level of Mahuva PS (GIS) with 1 No. of 220 kV bay	220

Annex 3.10

Inter-Regional Transmission Capacity (MW)

Transmission line	Present	Capacity at the End of 2029
EAST - NORTH		
Dehri/Sasaram - Sahupuri 220kV S/c	130	130
Sasaram HVDC back-to-back	500	500
Muzaffarpur - Gorakhpur 400kV D/c (with Series Comp.+TCSC)	2000	2000
Patna - Balia 400kV D/c (Quad)	1600	1600
Biharshariff - Balia 400kV D/c (Quad)	1600	1600
Barh/Patna - Balia 400kV D/c (Quad)	1600	1600
Gaya - Balia 765kV S/c	2100	2100
Sasaram bypassing (additional capacity)	500	500
Sasaram - Fatehpur 765kV S/c	2100	2100
Barh-II/Motihari - Gorakhpur 400kV D/c (Quad)	1600	1600
Gaya-Varanasi 765kV 2xS/c	4200	4200
Biharsharif-Varanasi 400kV D/c (Quad)	1600	1600
LILO of Biswanath Chariali - Agra ±800kV HVDC Bipole at new pooling station in Alipurduar and addition of 3000MW module	3000	3000
Sub-total	**22,530**	**22,530**
EAST - WEST		
Budhipadar-Korba 220kV S/c	130	130
Budhipadar-Korba 220kV D/c	260	260
Rourkela/Jharsuguda - Raigarh/Raipur 400kV D/c (with Series Comp.+TCSC)	1400	1400
Ranchi - Sipat 400 kV D/c with series comp.	1200	1200
Rourkela/Jharsuguda - Raigarh/Raipur 400kV (2nd) D/c (with Series Comp.)	1400	1400
Ranchi - Dharamjayagarh/WR Pooling Station 765kV S/c	2100	2100
Ranchi - Dharamjaygarh 765kV (2nd) S/c	2100	2100
Jharsuguda - Dharamjaygarh 765kV D/c	4200	4200
Jharsuguda - Dharamjaygarh 765kV (2nd) D/c	4200	4200
Jharsuguda - Raipur Pool 765kV D/c	4200	4200
Jypore-Jagdalpur 400 kV D/c	-	1600
Sub-total	**21,190**	**22,790**
EAST - SOUTH		
Balimela - Upper Sileru 220kV S/c	130	130
Gazuwaka HVDC back-to-back	1000	1000
Talcher - Kolar HVDC bipole	2000	2000
Upgradation of Talcher-Kolar HVDC Bipole	500	500
Angul - Srikakulum 765kV D/c	4200	4200
Sub-total	**7,830**	**7,830**
EAST - NORTH EAST		
Birpara/Alipurduar - Salakati 220kV D/c	350	350
Siliguri - Bongaigaon 400kV D/c	1000	1600
Siliguri/Alipurduar - Bongaigaon 400kV D/c (Quad)	1600	1600
Sub-total	**2,950**	**3,550**
NORTH EAST - NORTH		
Biswanath Chariali - Agra ±800kV HVDC Bipole with 3000MW converter	3000	3000
Sub-total	**3,000**	**3,000**
WEST - NORTH		
Auriya - Malanpur 220kV D/c	260	260
Kota - Ujjain 220kV D/c	260	260
Vindhyachal HVDC back-to-back	500	500
Gwalier - Agra 765kV 2xS/c	4200	4200
Zerda - Kankroli 400kV D/c	1000	1000

Transmission line	Present	Capacity at the End of 2029
Gwalior - Jaipur 765kV 2xS/c	4200	4200
Adani (Mundra) - Mahendranagar ±500kV HVDC bipole	2500	2500
RAPP - Sujalpur 400kV D/c	1000	1000
Champa Pool - Kurukshetra ±800kV HVDC Bipole	4500	4500
Jabalpur - Orai 765kV D/c	4200	4200
LILO of Satna - Gwalior 765kV S/c line at Orai	4200	4200
Upgradation of Champa Pool - Kurukshetra ±800kV HVDC Bipole	1500	1500
Banaskantha - Chittorgarh 765kV S/c	2100	2100
LILO of one ckt of 765kV Banaskantha – Chittorgarh D/c at Rishabhdeo*	2100	2100
Vindhyachal - Varanasi 765kV D/c	4200	4200
Neemuch-Chittorgarh 400 kV D/c	-	1,600
Mandsaur PS - Rishabhdeo 765 kV D/c	-	4,200
Mandsaur PS -Beawar 765 kV D/c	-	4,200
Sub-total	**36,720**	**46,720**
WEST - SOUTH		
Chandrapur HVDC back-to-back	1000	1000
Kolhapur - Belgaum 220kV D/c	260	260
Ponda - Nagajhari 220kV D/c	260	260
Raichur - Sholapur 765kV S/c	2100	2100
Raichur - Sholapur 765kV (2nd) S/c	2100	2100
Narendra - Kolhapur 765kV D/c (operated at 400kV)	2200	2200
Wardha - Nizamabad 765kV D/c	4200	4200
Warora Pool - Warangal (New) 765kV D/c	4200	4200
Raigarh - Pugulur ±800kV HVDC Bipole	6000	6000
LILO of Narendra - Narendra (New) 400kV (Quad) line at Xeldam (Goa)	-	1600
Narendra-Pune-III 765 kV D/c	-	4,200
Sub-total	**22,320**	**28,120**
TOTAL	**1,16,540**	**1,34,540**
** Banaskantha-Chhitorgarh is presently 765 D/c out of which one ckt is proposed to be LILOed at Rishabhdeo by 2027.*		

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"सौदामिनी" प्रथम तल, प्लाट सं. 2, सेक्टर-29, गुरुग्राम -122001 (हरियाणा), दूरभाष :0124-2822547, सीआईएन: U40100HR2020GOI091857
"Saudamini", 1st Floor, Plot No. 2, Sector-29, Gurugram-122001, (Haryana) Tel.: 0124-2822547, CIN: U40100HR2020GOI091857
Website: https://www.ctuil.in