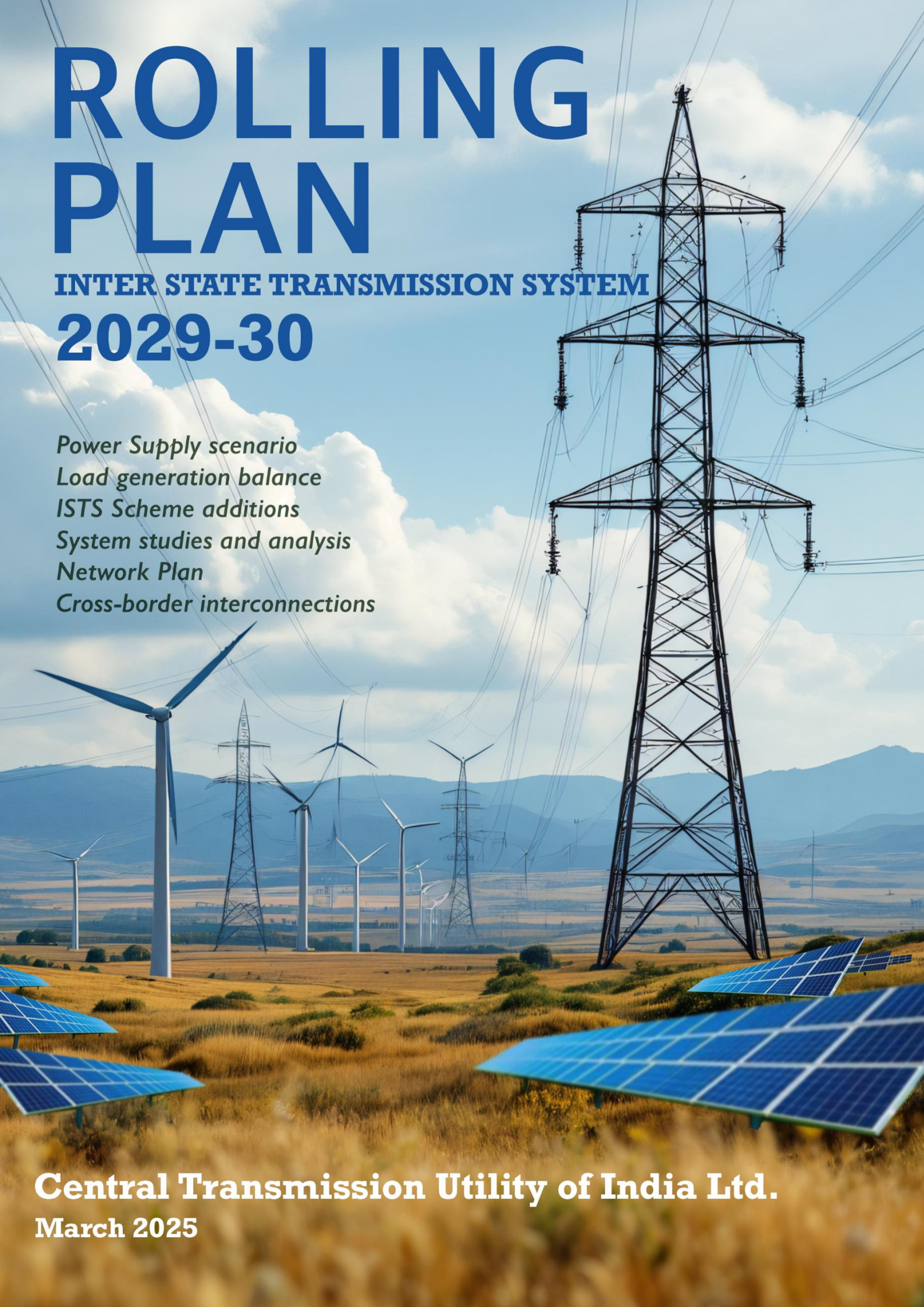
ROLLING PLAN

INTER STATE TRANSMISSION SYSTEM

2029-30

Power Supply scenario
Load generation balance
ISTS Scheme additions
System studies and analysis
Network Plan
Cross-border interconnections



Central Transmission Utility of India Ltd.

March 2025

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ROLLING PLAN 2029-30

INTER-STATE TRANSMISSION SYSTEM (ISTS)

(REPORT)

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Executive Summary

Power is among the most critical components of infrastructure, crucial for the economic growth and welfare of nations. The existence and development of adequate power infrastructure is essential for sustained growth of the Indian economy. The fundamental principle of India's power industry is to provide universal access to affordable power in a sustainable way and providing a stable and reliable energy source for all. In the Budget for 2024, the government's power sector initiatives have been allocated funds (that are 50% higher) to green hydrogen, solar power and green-energy corridors, expediting the rapid energy transition in development of Renewable Energy (RE) in the country. With adaption of Electro Mobility, Sustainable Development Goal 7 and various government approved schemes to reduce greenhouse gas emissions, India has become a major force in the global energy economy. Moreover, at COP28 in December 2023, important strides were made with the Global Renewables and Energy Efficiency Pledge, which include the goal of tripling renewable energy capacity and doubling energy efficiency by 2030. Additionally, at COP29 in November 2024, over 100 countries and organizations pledged to deploy 1,500GW of energy storage, double global grid investments and build 25 million kilometres of grid infrastructure by 2030.

The demand for electricity in the country is steadily increasing. Along with adaption of various central and state government schemes and projects like- PM-Surya Ghar: Muft Bijli Yojana, Green Energy Corridor projects, National Programme on High Efficiency Solar PV Modules, UDAY Yojana, IPDS, SAUBHAGYA Scheme, Deen Dayal Upadhyay Gram Jyoti Yojana- India has revised its Nationally Determined Contributions (NDC) targets, aiming for a 45% reduction in emission intensity and 50% of its total installed electric power capacity to come from non-fossil fuel energy sources by 2030. India is on path to accomplish its international climate change commitments to achieve the global net zero. India is the only country among the G20 nations that is on track to achieve the targets under the Paris Agreement.

To meet energy transition objectives and support the large-scale integration of renewable energy (RE), the Central Electricity Authority (CEA) released a report in December 2022 titled "Transmission System for Integration of over 500GW RE Capacity by 2030." This report outlines the transmission needs for RE integration up to 2030, including energy storage requirements for the grid and the need for new HVDC systems. In line with global best practices in transmission planning, the CEA has also updated and published the "Manual on Transmission Planning Criteria, 2023."

The large-scale integration of renewable energy (RE) generation into the National Grid to achieve energy transition goals requires reliable and secure transfer of power to the country's major load centres. This calls for ongoing development of a resilient National Grid, featuring high-capacity AC and HVDC systems, as well as advanced FACTS devices for controlling power system parameters. India's renewable energy potential, green hydrogen strategy, and climate action plan are key elements in attaining these energy transition goals. The country's approach to integrate RE into its National Grid could serve as a model for other nations in developing modern electricity grids. Furthermore, there is a focus on the development and integration of energy storage solutions- such as batteries and pumped hydro systems- into the

National Grid to provide balancing of power during periods of low or no renewable energy generation and to enhance the utilization of transmission systems linked to RE projects.

The transmission system plays a vital role in connecting generation sources and demand centres to the National Grid, ensuring the smooth integration of generation projects. It is essential that the transmission system is properly planned and developed to provide reliable, secure and affordable power to consumers.

CTUIL undertakes transmission of electricity through Inter State Transmission System (ISTS). Planning studies are undertaken for identification of new ISTS for evacuation of power from generation pockets to the load centres, augmentation /reconfiguration of existing system etc. in coordination with concerned agencies. The schemes are deliberated in monthly consultation meetings and taken up with NCT/RPC/MoP for recommendations/approval and thereon for implementation through RTM or TBCB route by TSP(s). Planning of cross border interconnections with neighbouring countries are also carried out in consultation with the counterparts of respective countries. CTU also draws up plan for ISTS for up to next five years on rolling basis every year in consultation with various stakeholders, which provides visibility of new transmission system for next five years. CTU publishes ISTS Rolling Plan Reports twice a year (an Interim Report in September and a Final Report in March). This exercise was started from 2021 and last final report was released on March 31, 2024. This ISTS Rolling Plan final report evaluates the transmission system needs for the 2029-30 period, considering the "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 met as on Jan’25 and projected installed capacity & demand by FY 2029-30 have been presented. All India installed capacity & peak demand is expected to increase from 466GW (including about 165 GW RE + 47 GW Hydro) & 250GW respectively as on Jan’25 to about 783 GW (including about 416 GW RE + 65 GW Hydro + 20 GW ESS) & 335 GW respectively by FY 2029-30. Furthermore, an additional demand of about 39 GW has been considered as direct drawl from ISTS bulk consumers by 2029-30 (including Green Hydrogen/Ammonia plants of about 23 GW and others of about 16 GW).

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 Night Off-peak demand.

Detailed overview of the load generation balance preparation, challenges observed while balancing the same and study results have been brought out in **Chapter-3**. While preparing

LGB for nine scenarios to cover all possible conditions, in line with provisions under CEA's Manual on Transmission Planning Criteria, merit order economic dispatch of thermal generations and RPO obligations of states have been taken into consideration. While working out the LGBs, maximum and minimum demand of 355GW and 201GW respectively have emerged in 2029-30 timeframe. For solar max scenarios of monsoon, summer and winter season, surplus generation of about 38 GW, 46 GW and 32 GW respectively was observed necessitating the requirement of two-shift operation of thermal generation or equivalent energy storage plants in the grid.

Detailed system studies have been carried out for nine scenarios using PSS®E software after considering all the planned and under construction system. 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 2029-30, and corresponding broad estimated cost has also been brought out in the report. Cumulatively by 2029-30, transmission schemes comprising of 64,136 ckm of transmission lines and transformation capacity of 5,84,800 MVA at estimated cost of Rs 4,30,624 Cr. is expected to be added in the grid in the next five years.

The Inter-Regional (IR) transmission capacity is expected to grow from present level of 1,18,740 MW to about 1,38,740 MW by 2029-30. Due to diurnal and seasonal variation in RE generation, power flow on all IR corridors except ER→NER, is observed in both directions. Maximum change is observed in WR→NR corridor, where power of the order of 23GW is flowing from WR→NR in Summer evening peak scenario and power of the order of 26GW is flowing from NR→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 are also covered in this chapter.

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 between 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.

As a new inclusion in the Rolling Plan 2029-30, a new analysis chapter on Transient Stability has been added of specific areas of Khavda, Gujarat & Rajasthan in **Chapter-10**. In this chapter, transient stability analysis has been carried for a critical RE pockets of Rajasthan and Gujarat. In case of Khavda complex in Gujarat, LVRT case with target voltage of 0.15pu (300ms) has been simulated at KPS1 (Sec-I), KPS2 (Sec-I) and KPS3 (Sec-II). Based on the simulation results, it has been observed that RE Generators within Khavda Complex (as per the assumptions) are able to meet the CEA LVRT Requirements. The RE generators are able to provide reactive power support and capable to recovering pre-fault active power well within 1 second of fault clearance. Also, the STATCOMs at KPS1 & KPS3 are able to provide requisite reactive power (current) support during the subject contingencies.

In case of Rajasthan, the 3-Ph Fault close to Bhadla 765kV bus on one circuit of Bhadla-III – Sikar-II 765kV D/c line and subsequent outage of one circuit of Bhadla-III – Sikar-II 765kV D/c line in 100ms has been simulated and observed that the system able to maintain synchronism.

The summary of the studies carried out, new expansion schemes planned, way forward etc. have been mentioned in **Chapter-11**.

Chapter 1: Background and Objective

India has a rapidly growing economy and an ever-increasing demand for energy. India's power sector dates back to 20th century and since then it has undergone a noteworthy transformation. Over the decades, the country is focused on increasing its power generation capacity and aimed at providing reliable, affordable and sustainable energy to its citizens.

India's renewable energy journey has reached a significant milestone, marked by the impressive achievement of over 200 GW of installed capacity mark, as of Oct'24. This accomplishment is evidence to the nation's commitment to a sustainable energy future, driven by a diverse array of renewable sources. With 47% of its total installed generation capacity i.e., 220 GW out of 466 GW sourced from non-fossil fuel as on Jan'25 out of which Solar and Wind capacity is about 22% (100 GW) and 10% (48 GW) respectively and balance 13% from other non-fossil sources, India is well-positioned to emerge as a global leader in renewable energy, contributing to environmental sustainability and energy security. India envisaged to enhance the non-Fossil fuel based installed generation capacity to 500 GW out of 782 GW total installed capacity by 2030. 65% of the total installed capacity shall be from Non-Fossil Fuel based energy resource comprising of 37% (284 GW) from Solar, 16% (128 GW) from Wind and balance 12% from other resources such as Hydro, Pumped storage plants, Nuclear etc. The several ongoing efforts of India reflect a holistic approach to building a greener economy, ensuring that India not only meets its energy needs but also addresses the pressing challenges of climate change and resource conservation.

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 being 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 evolved in consultation with various stakeholders.

CTU draws up a 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 (Interim Report in Sept and Final Report in March of every financial year), identifying specific transmission projects which are required to be taken up along with their implementation timelines. In this direction, rolling plan reports have been published from 2021 providing the visibility of ISTS system requirements for next five years and the same is available on CTU website. This ISTS Rolling Plan report is being brought out wherein transmission system requirement in ISTS has been identified upto 2029-30 timeframe. For

preparation of this rolling plan, details of nodal officers and status of data received from various stakeholders 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 2029-30 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 250 GW as on Jan'25 and as per 20th EPS it is projected to be about 335 GW by 2029-30. Furthermore, an additional demand of about 39 GW is envisaged to be added as direct drawl from ISTS bulk consumers including Green Hydrogen/ Green Ammonia plants of about 23 GW and others of 16 GW by 2029-30 which will further boost the projected peak demand.

As on Jan'25, Non-fossil fuel based installed generation capacity is around 220.3 GW (47.3% of total installed capacity) and is planned to increase to around 492.5 GW (65% of total installed capacity excluding ESS) by 2029-30 at a CAGR of 17.5%. Further, 19.7 GW of Energy Storage is also planned to integrate in the grid by 2029-30. Installed capacity vis a vis peak demand trend from FY 2014-15 to Jan'25 is depicted in **Figure 2-1** and growth of RE resources is shown in **Figure 2-2**.

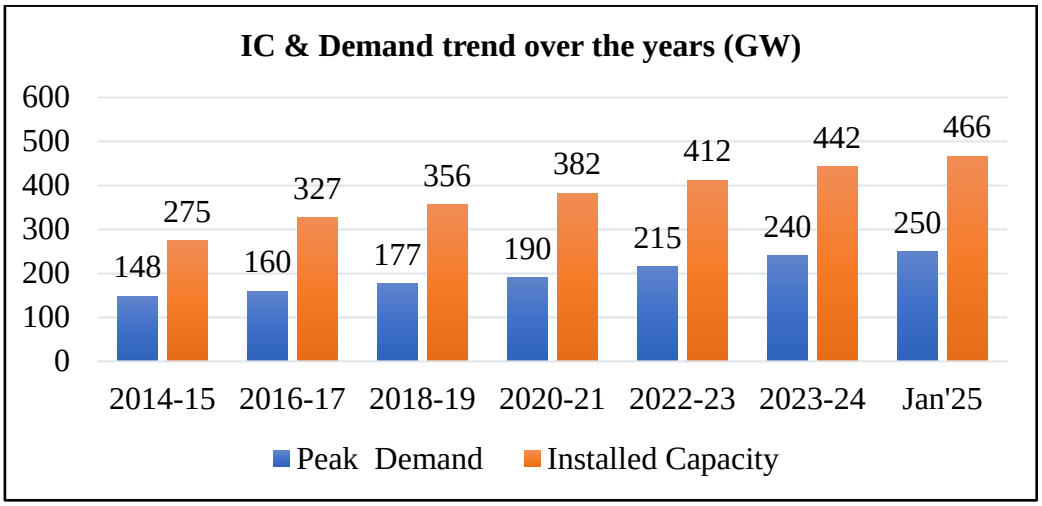


Figure 2-1: Installed Capacity & Demand trend in GW

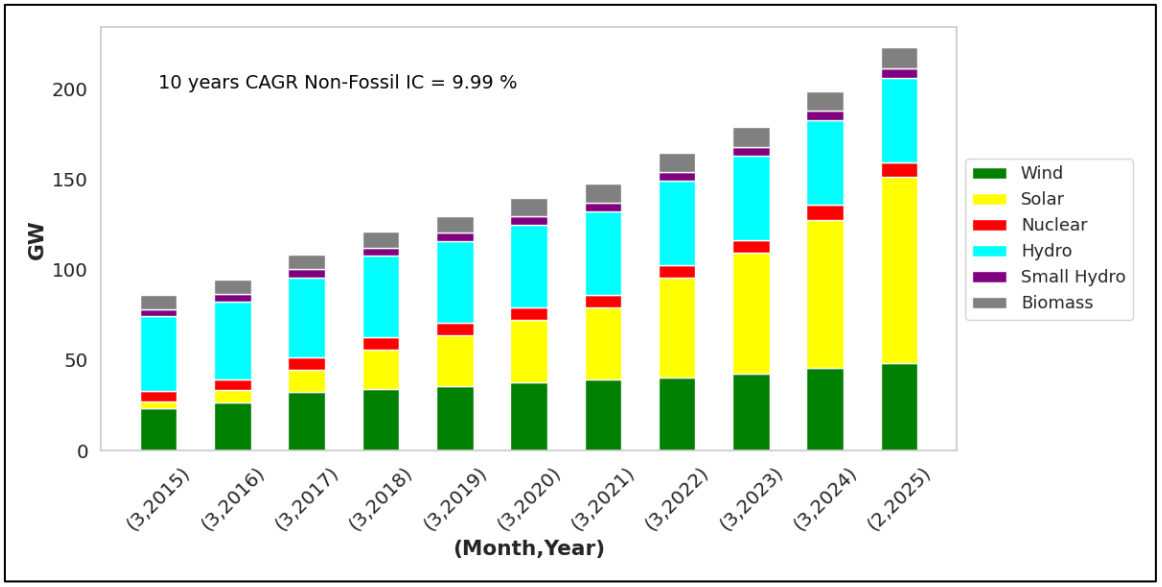


Figure 2-2: Growth of RE resources

Transmission system has played a vital role in catering the country's demand from various generating plants located across the country. Electricity transmission system in India is generally categorised as Inter-StateTransmission System (ISTS) and Intra-State Transmission System (Intra-STS) Transmission system. CTU is the nodal agency for planning and co-ordinating the ISTS system. Growth of ISTS from 2015 till Jan'25 in terms of ckm and MVA is depicted in **Figure 2-3** and **Figure 2-4**.

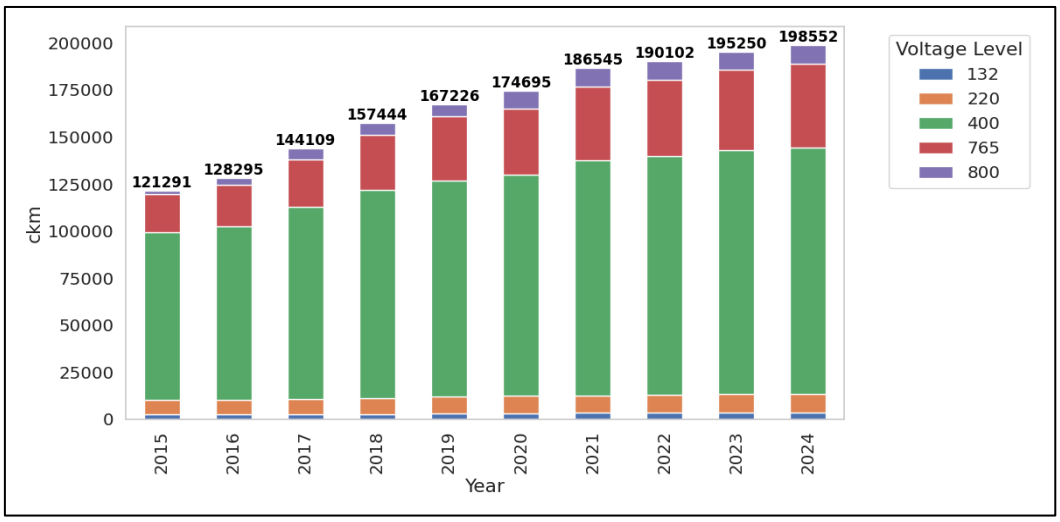


Figure 2-3: ckm growth in past decade

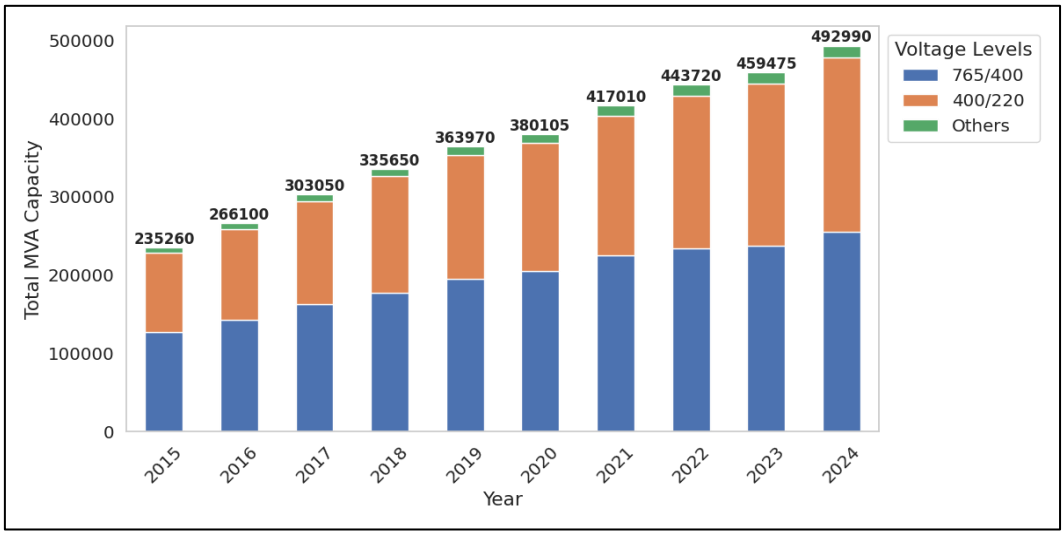


Figure 2-4: MVA growth in past decade

2.1 Power Supply Scenario as of Jan'25

Total installed capacity as on Jan'25 is about 466 GW and the All-India peak demand met is of about 250 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'25 is given in the Table 2-1. Fossil and non-fossil fuel-based generation installed capacity accounts for 52.7% and 47.3% of total installed generation capacity respectively, which is portrayed in **Figure 2-5.**

Table 2-1: Installed Capacity and Peak Demand in GW as of Jan'25

Region	Fossil			Non-Fossil				Grand Total	Peak Demand
	Thermal	Gas/ Diesel	Total	Nuclear	Hydro	RES	Total		
NR	60.2	6.0	**66.2**	1.6	20.8	45.9	**68.3**	134.5	90.75
WR	76.1	10.8	**86.9**	3.2	7.6	58.2	**69.0**	155.8	80.59
SR	54.5	6.3	**60.8**	3.3	11.9	58.1	**73.3**	134.1	66.99
ER	28.9	0.1	**29.0**	0.0	4.8	2.4	**7.1**	36.1	31.40
NER	1.3	1.7	**2.9**	0.0	1.9	0.6	**2.6**	5.5	3.91
All India	221.0	24.8	**245.8**	8.2	47.0	165.2	**220.3**	466.1	249.85*

**with diversity*

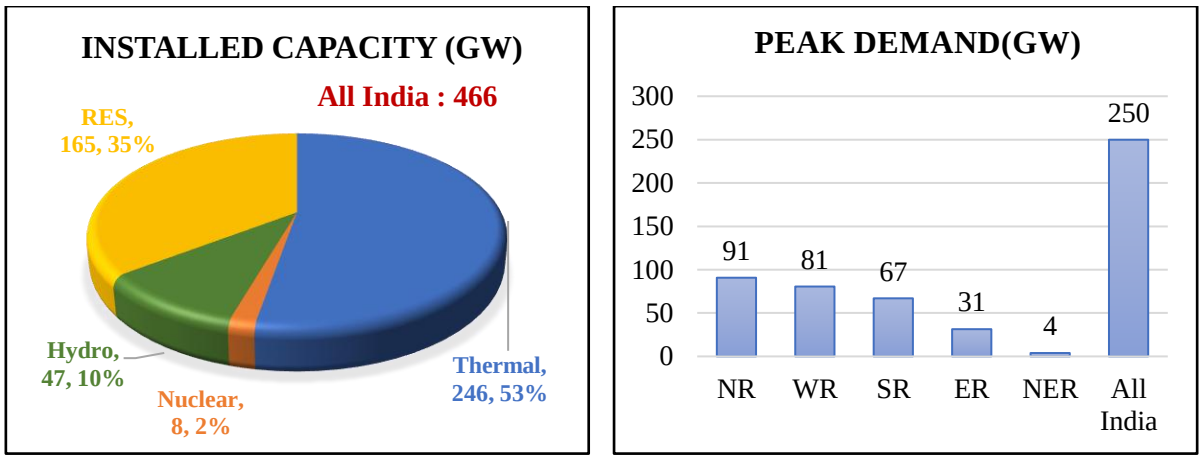


Figure 2-5: Installed Capacity and Peak Demand as of Jan'25

2.2 Envisaged Power Supply Scenario by 2029-30

All India peak demand for 2029-30 is envisaged to be about 335 GW as per 20th Electric Power Survey (EPS) report of CEA. Furthermore, an additional demand of about 39 GW has been considered as direct drawl from ISTS bulk consumers including Green Hydrogen/Ammonia plants of about 23 GW and others of 16 GW is planned to be integrated to the grid by 2029-30. To meet the enhanced demand of about 124 GW from present peak demand met of 250 GW, net generation capacity addition of about 317 GW including ESS is planned to be integrated in the grid after accounting the retirement of thermal generation by 2029-30 as anticipated in draft National Electricity Plan (NEP) of CEA.

Total installed generation capacity for 2029-30 shall be about 783 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 2029-30 are summarised in **Table 2-2**. Renewable Energy resources generation installed capacity is expected to be about 53% of total installed generation capacity, which is shown in **Figure 2-6.**

Table 2-2: Projected Installed Capacity & Peak Demand by FY 2029-30

(All Fig in GW)

Region	Fossil			Non-Fossil				ESS (PSP+ BESS)	Grand Total	Peak Demand
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
NR	53.6	3.6	**57.2**	3.0	25.3	116.8	**145.1**	4.6	207.0	116.7
WR	93.4	10.1	**103.6**	3.2	6.1	148.7	**158.0**	5.3	266.8	107.1
SR	54.5	1.5	**56.0**	5.8	14.0	145.2	**165.1**	8.3	229.4	97.4
ER	51.0	0.0	**51.0**	0.0	14.0	2.5	**16.5**	1.5	69.0	45.8
NER	0.8	2.2	**3.0**	0.0	5.4	2.4	**7.7**	0.0	10.7	5.8
All India	253.3	17.5	**270.7**	12.1	64.7	415.6	**492.5**	19.7	782.9	334.8

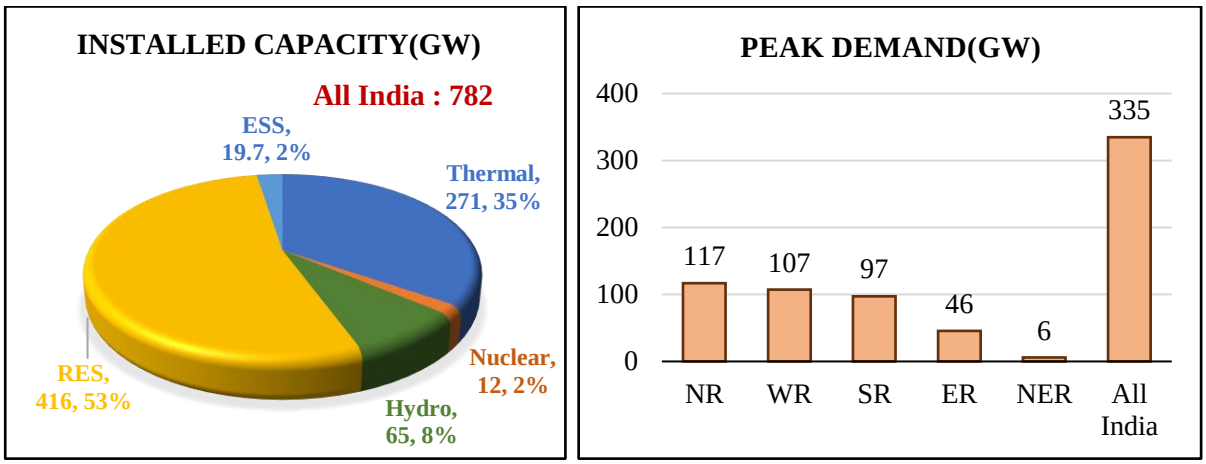


Figure 2-6: Projected Installed Capacity & Peak Demand by FY 2029-30

The region wise growth in demand and fuel type wise increase in installed generation capacity for 2029-30 from Jan'25 is tabulated below in **Table 2-3**.

Table 2-3: Peak demand & Generation IC in Jan'25 and 2029-30

Peak Demand (GW)				
	As on Jan'25	*2029-30*	*Growth*	*CAGR*
NR	90.75	116.75	26.00	5.2%
WR	80.59	107.05	26.47	5.8%
SR	66.99	97.44	30.45	7.8%
ER	31.40	45.75	14.35	7.8%
NER	3.91	5.84	1.92	8.3%
All India	249.85	334.81	84.96	6.0%

Generation IC (GW)				
	As on Jan'25	*2029-30*	*Diff*	*CAGR*
Thermal	220.96	253.25	32.29	2.8%
Gas	24.82	17.46	-7.35	-6.8%
Nuclear	8.18	12.08	3.90	8.1%
Hydro	46.97	64.73	17.76	6.6%
Solar	100.33	284.06	183.73	23.1%
Other RE+ESS	64.83	151.33	86.49	18.5%
Total	**466.09**	**782.91**	**316.82**	10.9%

Chapter 3: All India

Renewable-based generation installed capacity in total installed capacity mix is expected to change from about 35% at present to about 53% by March'30. Further, it is going to change continuously with integration of increasing renewable energy plants in the Indian power sector. To plan transmission network for integrating this RE potential and meet 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 located in eastern part of the India due to availability of coal-reserves. Hydro-potential is mostly concentrated in 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 from eastern part of the country to the major load centre across the country and implemented in past decades. With the advent of renewable-based generation addition, new transmission system is being planned and implemented from northern, western, and southern part of country to cater the load requirements across the country, which is resulting in changed power flow pattern on existing transmission system. It becomes important to understand the change in power flow pattern and regional power exchange in various seasons and in different times of a day depending upon the generation and demand of a region. Therefore, any additional transmission system needs to be planned after considering the new load-generation scenario.

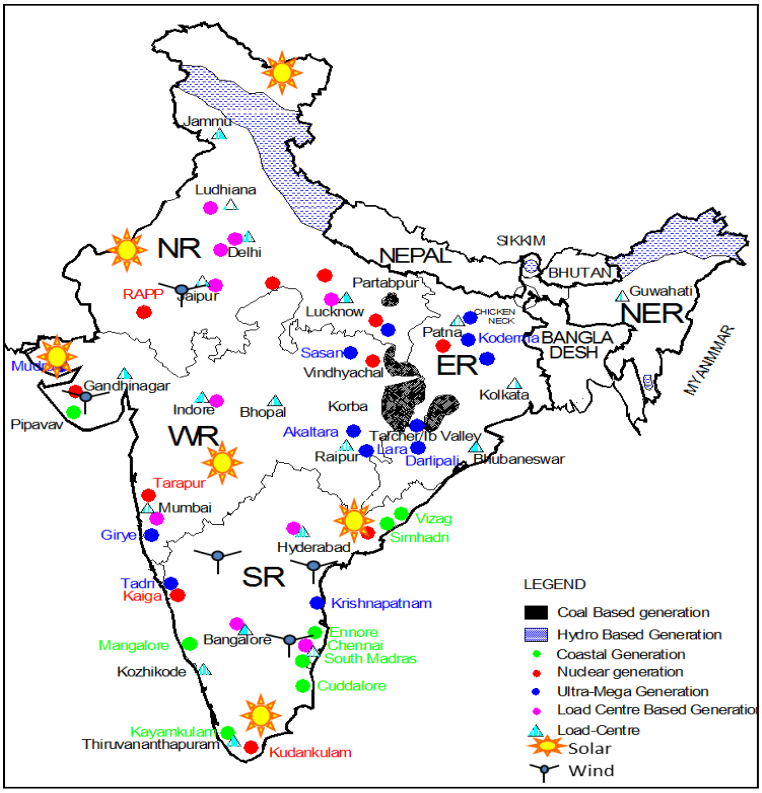


Figure 3-1: India's map showing various generations in different parts of the country

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 2029-30 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 analyse 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

For the study of load generation balance nine different scenarios are taken based on different season and different times of a day, as follows:

- Scenarios 1, 4 and 7 belong to Solar Max Generation scenario for Monsoon (August), Summer (June), and Winter (February) season respectively.
- Scenarios 2, 5 and 8 belong to Evening Peak Load scenario for Monsoon (August), Summer (June), and Winter (February) season respectively.
- Scenarios 3, 6 and 9 belong to Night Off-Peak scenario for Monsoon (August), Summer (June), and Winter (February) season respectively.

To replicate and simulate daily power requirement variations in different seasons in a year, 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’29: Solar max (Scenario-1), Evening Peak (Scenario-2) and Night off-peak (Scenario-3)
- Jun’29: Solar max (Scenario-4), Evening Peak (Scenario-5) and Night off-peak (Scenario-6)
- Feb’30: Solar max (Scenario-7), Evening Peak (Scenario-8) and Night off-peak (Scenario-9)

Load Generation Balance (LGB) for above mentioned nine scenarios considered for the study was prepared. 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. 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 2029-30 is about 335 GW as per 20th EPS. Further an additional demand of about 39 GW has been considered as direct drawl from ISTS. To find out variation of this demand for nine scenarios, demand pattern of calendar year 2024 for the three representative months of three seasons were collected from system operator (Grid-INDIA) for monsoon (Aug-24), summer (Jun-24) and for winter (Feb-24). 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**. For evening peak scenario and night off peak scenario, maximum demand (between 4:00 pm to midnight) 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 2029-30, demand corresponding to these load conditions were divided by maximum All India/regional demand of the corresponding year i.e. 2024. All India/regional demand factors for different scenarios of 2029-30 are shown in **Figure 3-5**.

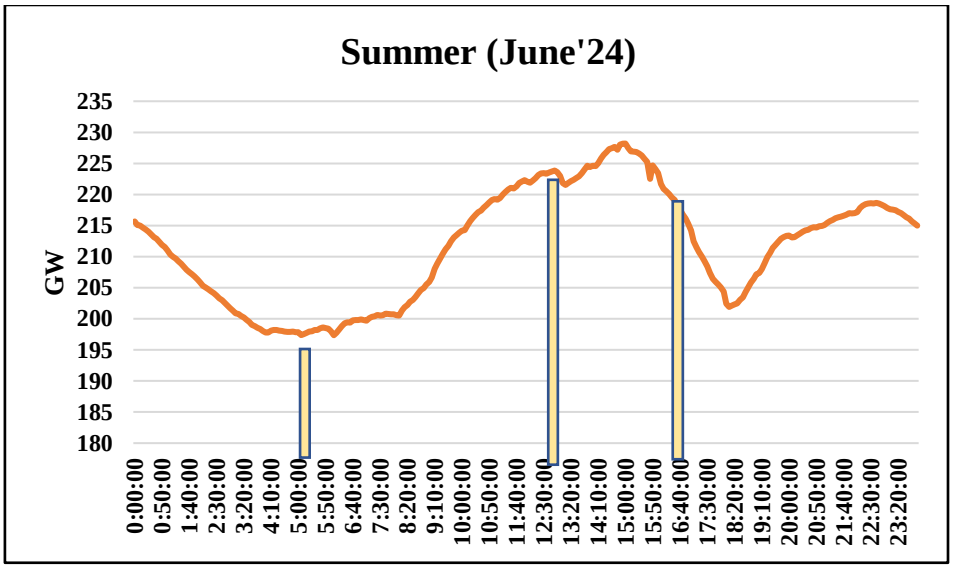


Figure 3-2: Summer (June'24) Load Curve

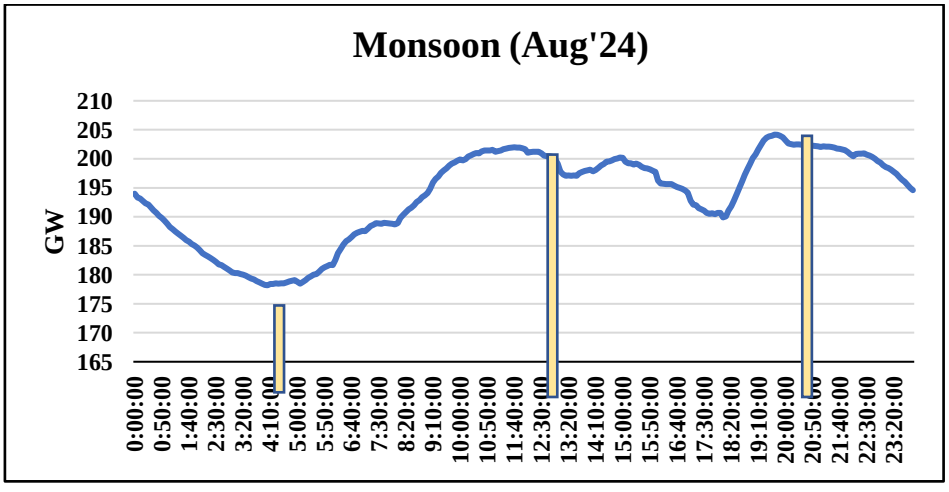


Figure 3-3: Monsoon (Aug'24) Load Curve

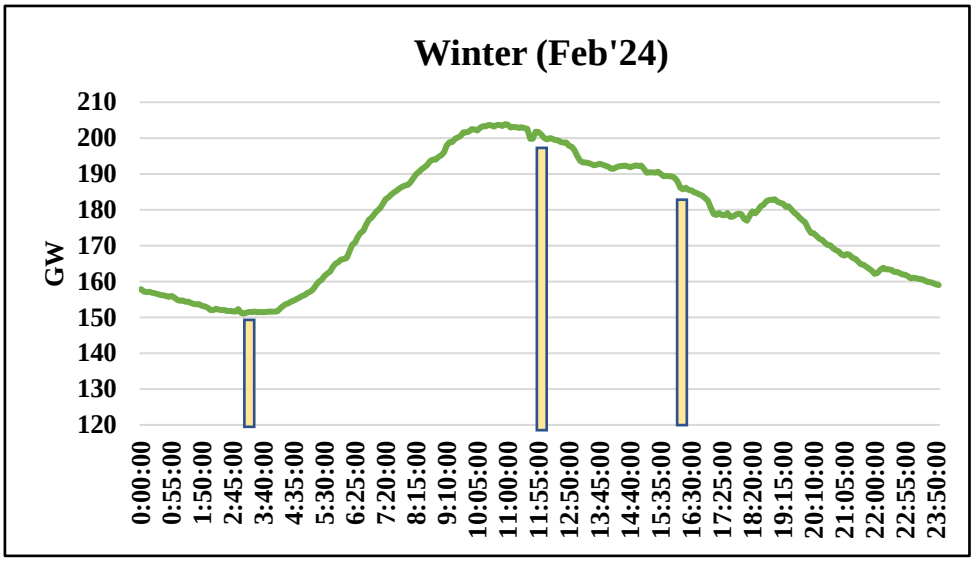


Figure 3-4: Winter (Feb'24) Load Curve

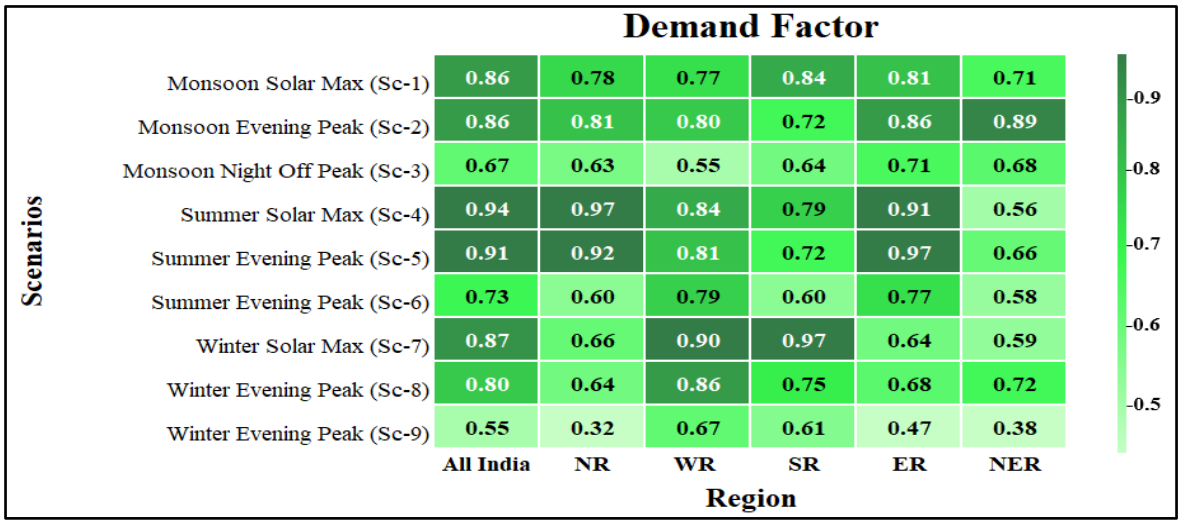


Figure 3-5: Demand factors considered for 2029-30-time frame

To meet the anticipated demand in different scenarios, various sources of generations viz. Thermal, Nuclear, Hydro, Gas, Solar, Wind is 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 generation.

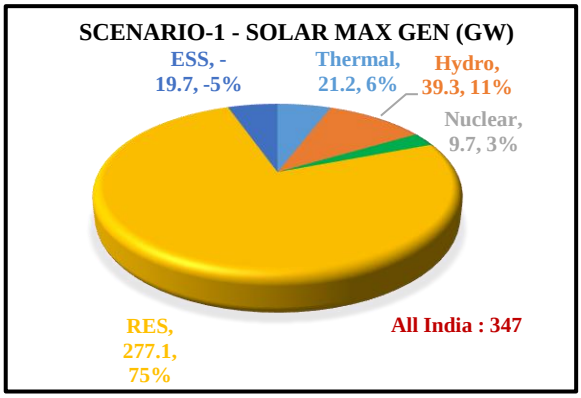
Evening peak scenario of each month was setup first as the number of thermal units required on bar shall be maximum. Total thermal generation requirement for the evening peak scenario was apportioned between State and Central sector thermal generations as per their installed capacity in each region. Further, state thermal generation requirement was divided among the states as per their maximum demand in respective month of 2024. After obtaining state thermal generation requirement, state thermal units were dispatched about 85% of their IC in merit order for each state.

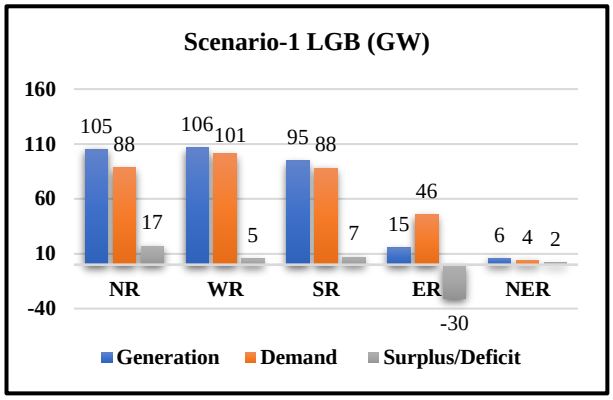
ISGS, CGS & IPP thermal plants with lower variable cost were dispatched about 85% of their IC region wise progressively. To meet the deficit demand of any region thermal generation dispatches from other regions (considering all India merit order for evening peak scenario) was considered. For preparing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

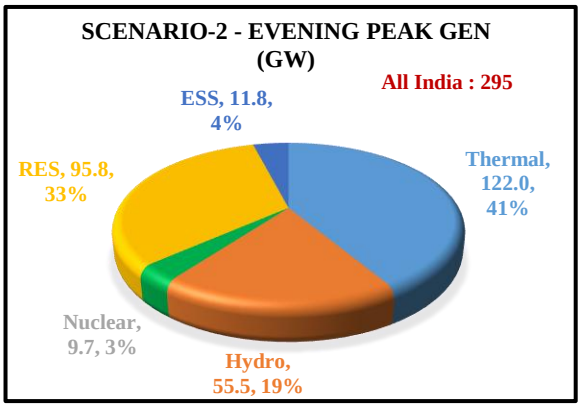
While preparing the LGB for Solar max scenario, all the on-bar thermal plants were dispatched at technical minimum of 40% and it is observed that in the Solar max scenario there is surplus power available in the grid. It is due to availability of peak solar generation and lesser demand in the noon. This 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, 46 GW and 32 GW was observed in solar max scenarios of monsoon, summer and winter scenarios respectively. 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. Accordingly, thermal plants with higher cost (on merit order basis) were switched off progressively till the LGB is balanced.

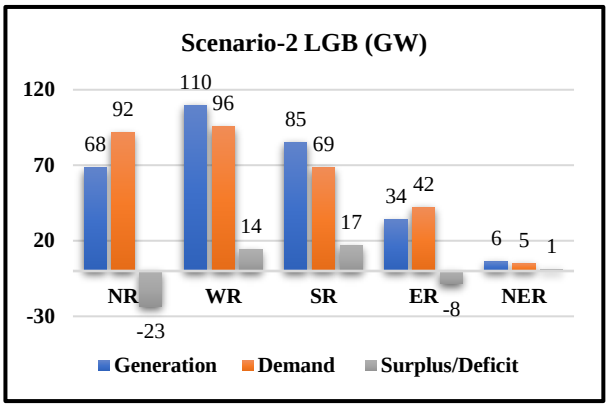
Based on above philosophy, LGBs prepared for different scenarios are depicted in **Figure 3-6**, **Figure 3-7** & **Figure 3-8** along with regional surplus/deficit scenario and details about the same are attached at **Annex-3.1.** Requirement of thermal generation is very less considering the amount of planned RE integration and its dispatches in Solar Max scenario. It is observed that only 6% of IC is getting dispatched in Monsoon/ Summer Solar Max scenario.

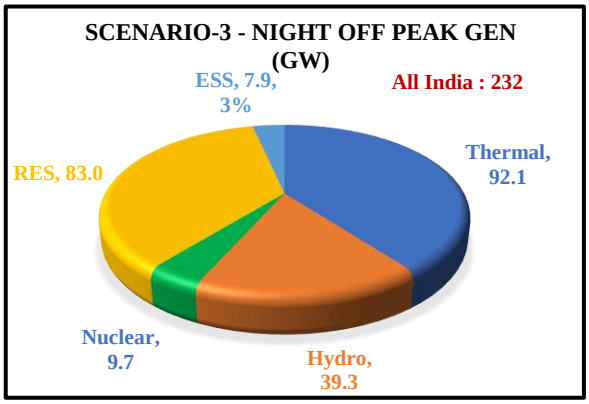
Monsoon Aug'2029











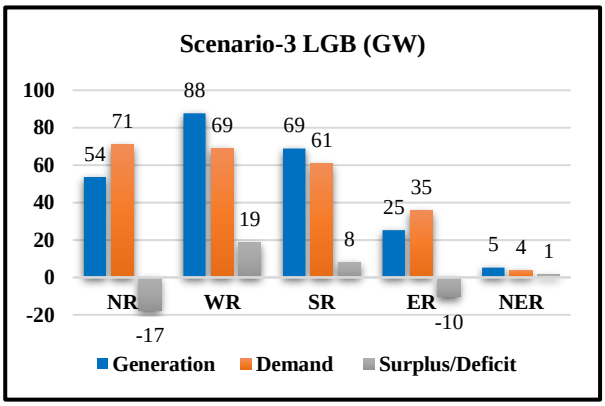


Figure 3-6: LGB for Monsoon (Aug'2029)

Summer June'2029

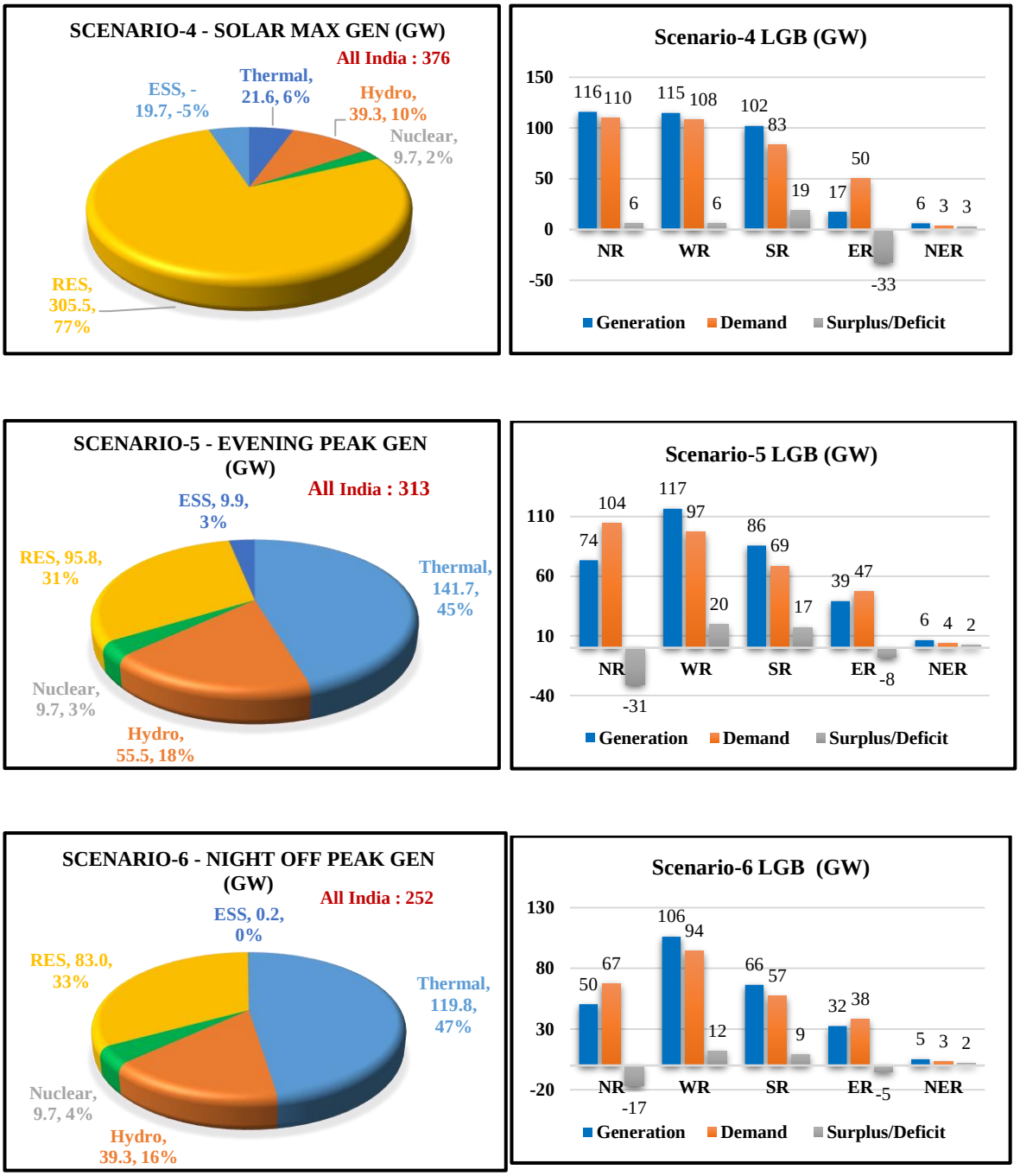
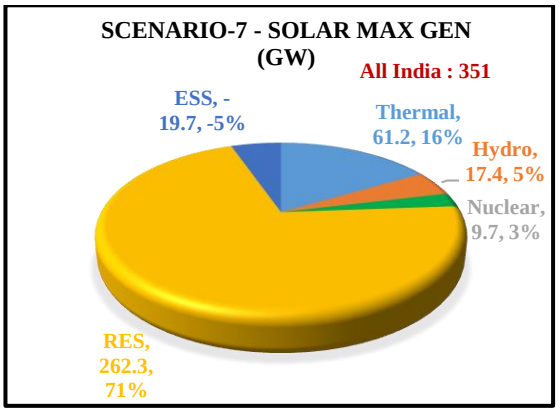
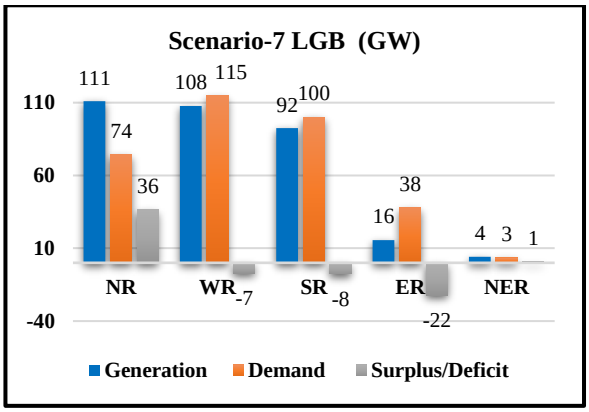
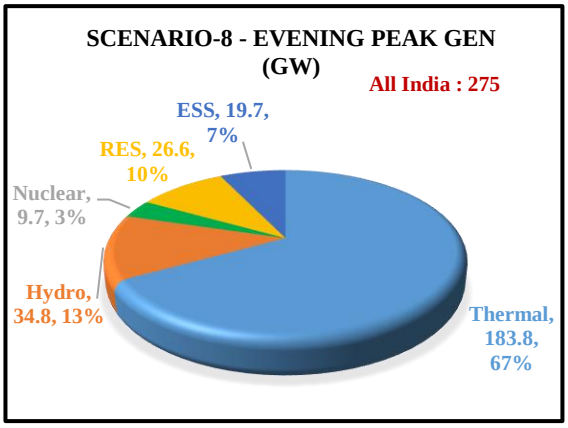


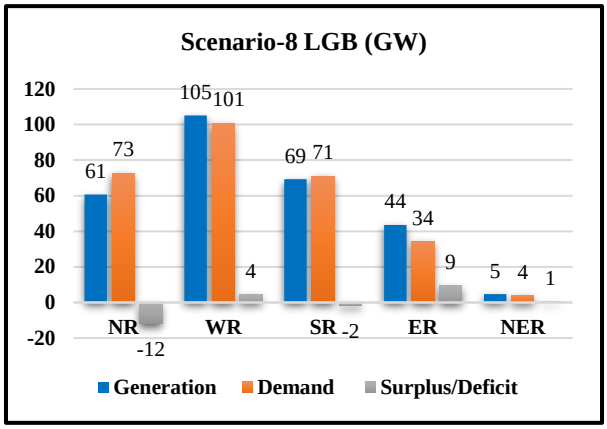
Figure 3-7: LGB for Summer (June'2029)

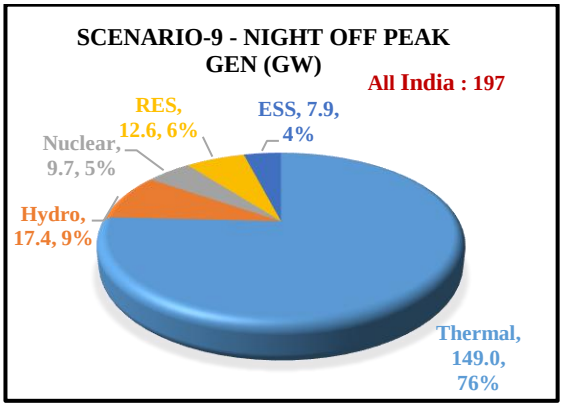
Winter Feb'2030











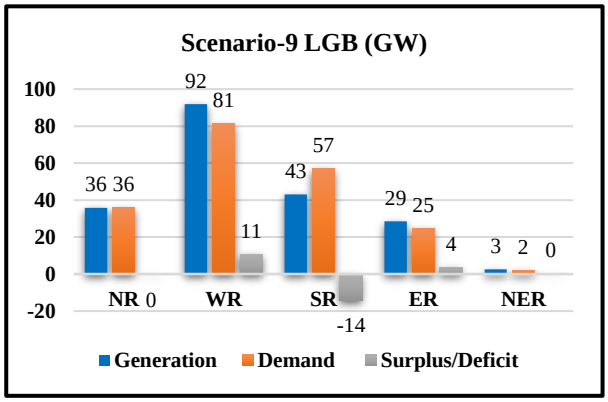


Figure 3-8: LGB for Winter (Feb'2030)

Out of these nine scenarios, Scenario-4 (Aug'29 Solar Max) and Scenario-9 (Feb'30 Night off peak) corresponds to two extreme cases with respect to demand i.e., highest demand (376 GW) and lowest demand (197 GW) scenarios respectively. In all other scenarios, all India demand is varying between these two demands as per demand factors. Further Scenario-1 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'29)**			**Summer (Jun'29)**			**Winter (Feb'30)**		
Scenario No. / Region	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
	Solar Max	**Evening Peak**	**Night Off Peak**	**Solar Max**	**Evening Peak**	**Night Off Peak**	**Solar Max**	**Evening Peak**	**Night Off Peak**
NR	16916	-23212	-17467	5994	**-30731**	-17003	**36477**	-11987	-230
WR	5259	14175	18565	6331	**19647**	11811	**-7052**	4298	10652
SR	6876	16734	8068	**18545**	17162	9211	-7618	-1702	**-14198**
ER	-30430	-8422	-10265	**-32624**	-8118	-5457	-22171	**9283**	3803
NER	1798	1175	1319	**2886**	2490	1889	704	559	**423**

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 Winter (Feb) solar max scenario.
- WR is exporting the power in all the scenarios except winter (Feb) solar max scenario. with Maximum export of 19 GW and maximum import of about 7 GW is observed in Summer (June) evening and in winter (Feb) solar max scenario respectively.
- SR is expected to export power in all scenarios except winter scenario. Maximum export of power is 18 GW in Summer (Jun) solar max scenario, whereas maximum import of the order of 14 GW is taking place in the Winter (February) night off peak scenario.
- ER is mostly importing power in all 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.

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 2029-30. 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 up to current study timeframe of 2029-30 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 2029-30 are summarised below in **Table 3-2** for all the nine scenarios. Maximum and minimum flow between each inter-regional corridor is also highlighted in **Table 3-2**.

Table 3-2: IR flow summary in MW

IR Flows	Monsoon (Aug'29)			Summer (Jun'29)			Winter (Feb'30)		
Scenario No. / Corridor	1	2	3	4	5	6	7	8	9
	Solar Max	Evening Peak	Night Off Peak	Solar Max	Evening Peak	Night Off Peak	Solar Max	Evening Peak	Night Off Peak
WR-NR	-8458	16808	14006	3439	**23449**	10847	**-26126**	5074	-1552
ER-NR	-8866	1497	2727	-6107	5875	**6049**	**-9080**	5639	1632
ER-WR	-18833	-9743	-8860	**-20129**	-9065	-7267	-15021	**1540**	-3368
ER-SR	-367	-896	-670	**-2376**	-567	383	2227	2655	**3216**
WR-SR	-5258	-13678	-5319	**-15922**	-14365	-7892	4321	-391	**10150**
ER-NER	-1712	-1166	-1245	**-2821**	-2404	-1798	-1528	-517	-315

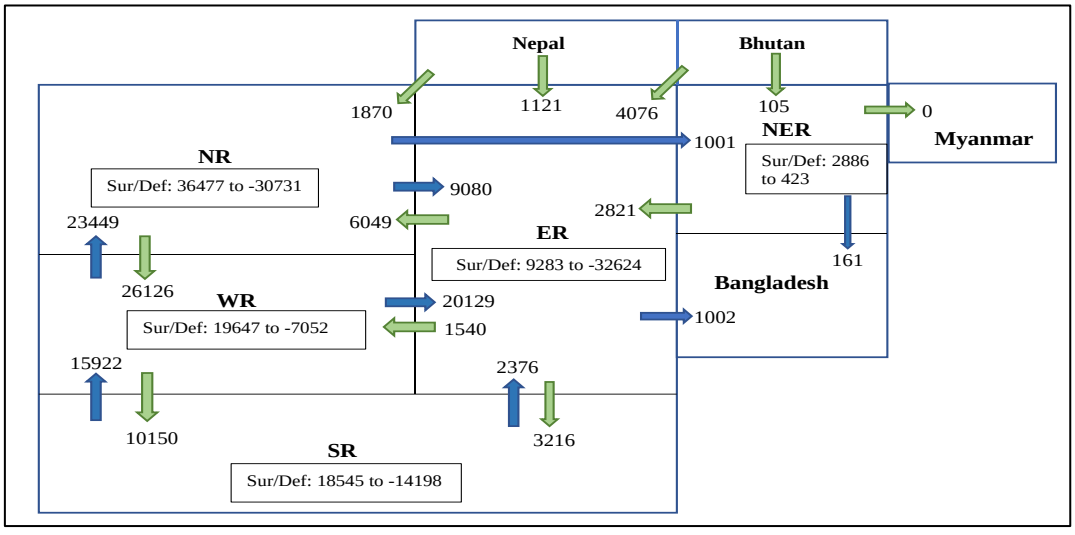


Figure 3-9: Summary of Regional Surplus-Deficit & IR flows in MW

From above it can be seen that-

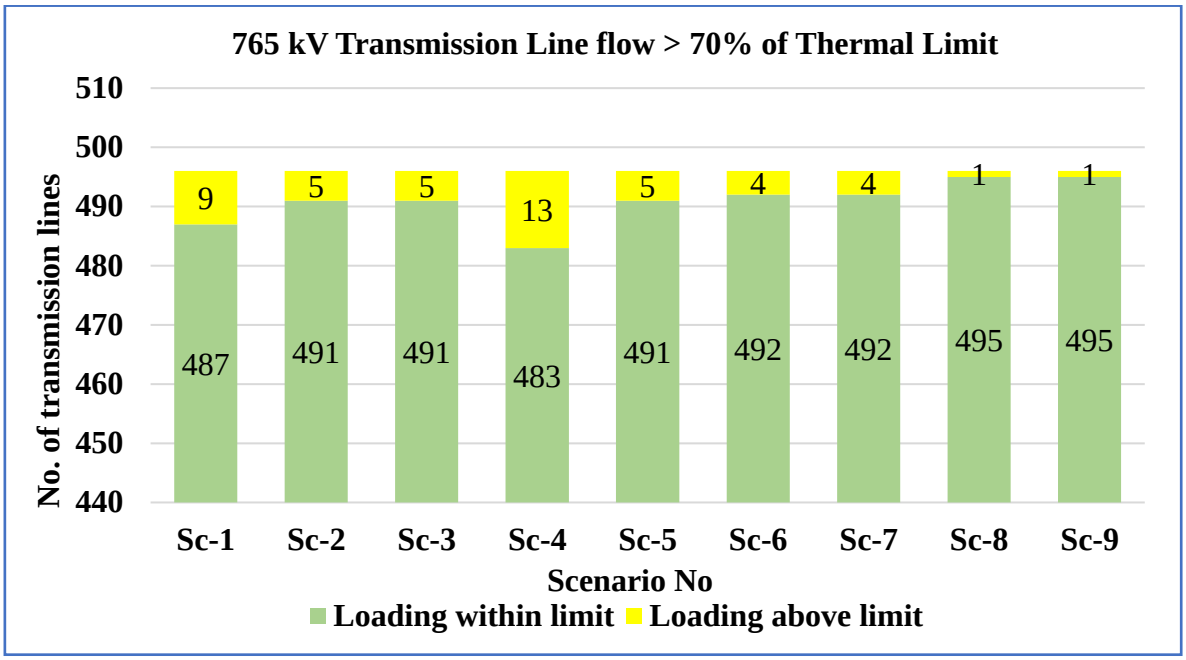
- Power on WR-NR corridor is flowing in both directions in different scenarios. Maximum power of the order of 23 GW is flowing from WR to NR in summer evening peak scenario whereas, maximum power flow of the order of 26 GW is flowing from NR to WR in winter solar max scenario.
- Power on ER-NR corridor is flowing in both directions in different scenarios. But in solar max scenarios the power is flowing from NR to ER. Maximum power of the order of 6 GW is flowing from ER to NR in summer night off peak scenario whereas, maximum power flow of the order of 9 GW is flowing from NR to ER in winter solar max scenario.
- Power on ER-WR corridor is always flowing from WR to ER in all scenarios except in winter evening peak scenario. Maximum power of the order of 1 GW is flowing from ER to WR in winter evening peak scenario.
- Power on ER-SR corridor is flowing in both directions in different scenarios. Maximum power of the order of 3 GW is flowing from ER to SR in winter night off peak scenario whereas, maximum power flow of the order of 2 GW is flowing from SR to ER in summer solar max scenario.
- Power on WR-SR corridor is mostly flowing towards WR from SR with maximum flow of about 16 GW in summer solar peak scenario, except in winter night off peak and winter scenario where it reaches a maximum of 10 GW from WR to SR.
- Power on Biswanath Chariyali-Alipurduar (3000 MW) & Alipurduar-Agra (6000MW) are included within the NER-ER & ER-NR flows. The reverse power flow of about 1000MW Agra-Biswanath Chariyali HVDC line in Solar Max scenario is shown separately in the **Figure 3-9**.

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 except for two 765kV lines and one 400kV line.

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 cases prepared for nine scenarios. There are about 496 nos. of 765 kV lines and about 2535 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**. Few of 765 kV lines were observed to be loaded beyond 70% thermal limit and few 400 kV lines were loaded beyond the limit. If we see in terms of percentage, less than 2% of total no. of lines (400

kV) are loaded beyond 70% of thermal limit. Summary of the results is shown below in **Figure 3-10** & **Figure 3-11:**



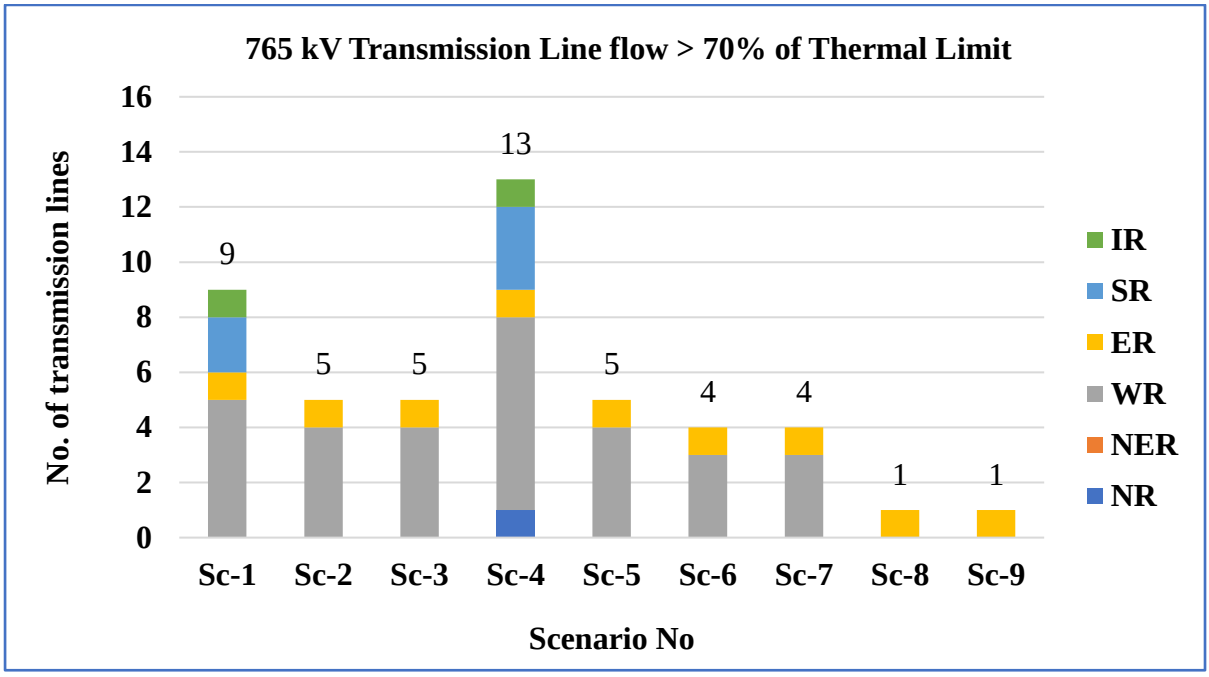
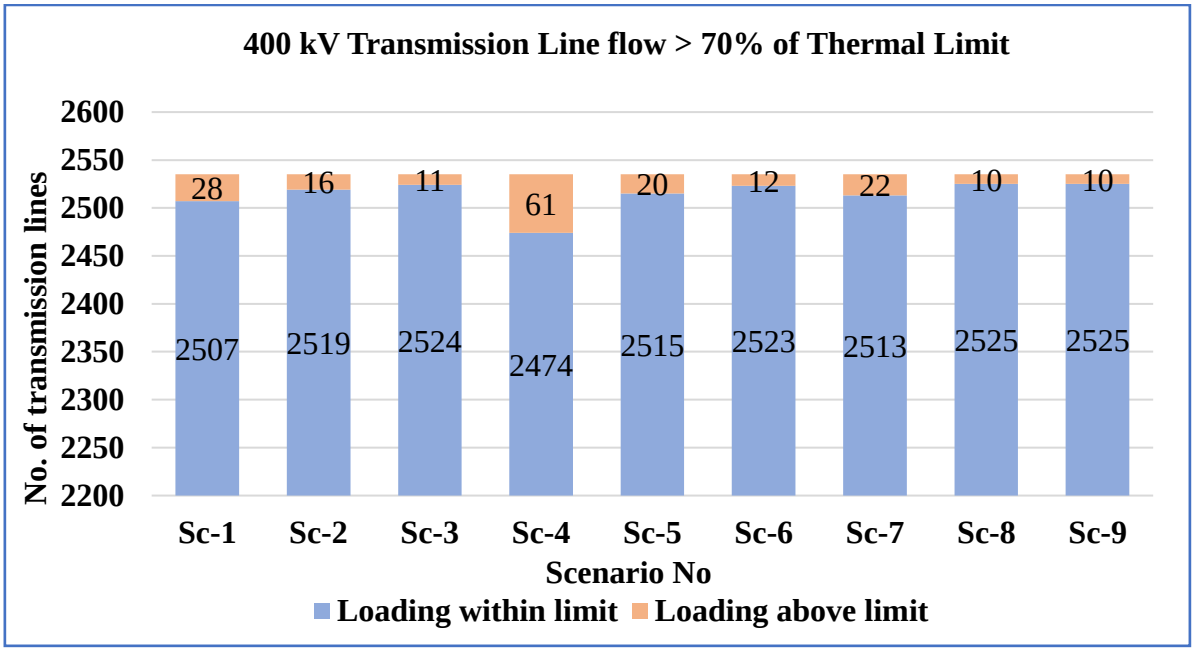


Figure 3-10: 765kV Tr. line flow > 70% of thermal limit under base case



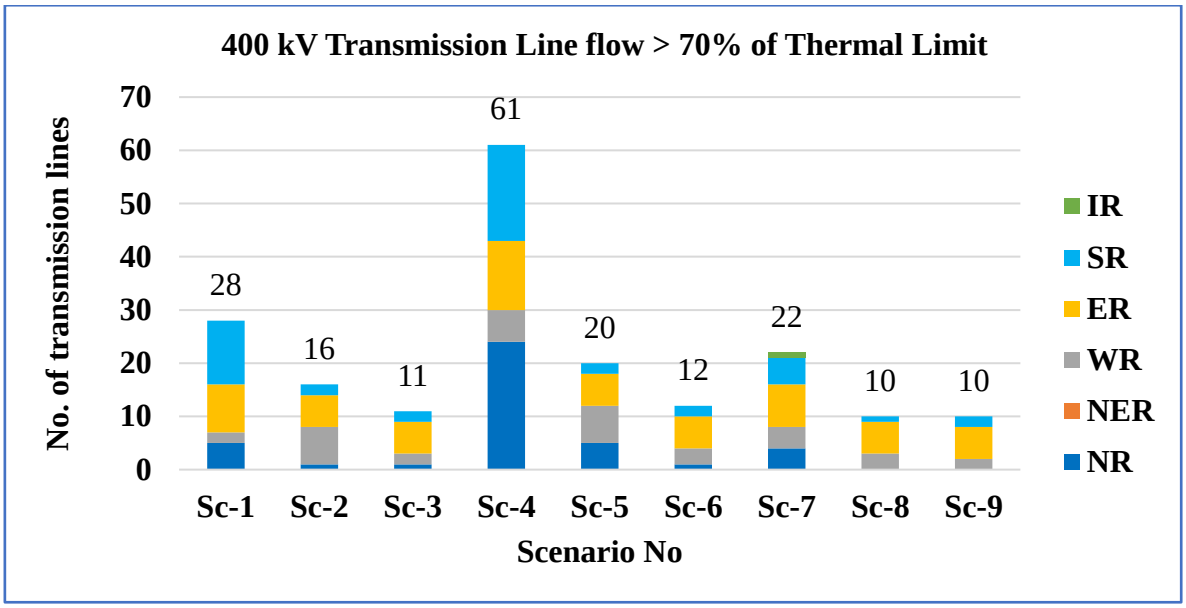


Figure 3-11: 400kV Tr. line flow > 70% of thermal limit under base case

It was observed that 13 of 765 kV lines are loaded beyond 70% of the thermal limit in Scenario-4, however their loading is below 3500 MW. About 61, 28 and 22 nos. of 400 kV lines in Scenarios-4, 1, 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 537 nos. of 765/400 kV transformer at 183 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 3-12** & **Figure 3-13**. However, if we see in terms of percentage, less than about 6% of total no. of transformer locations are loaded beyond 80% of their rating.

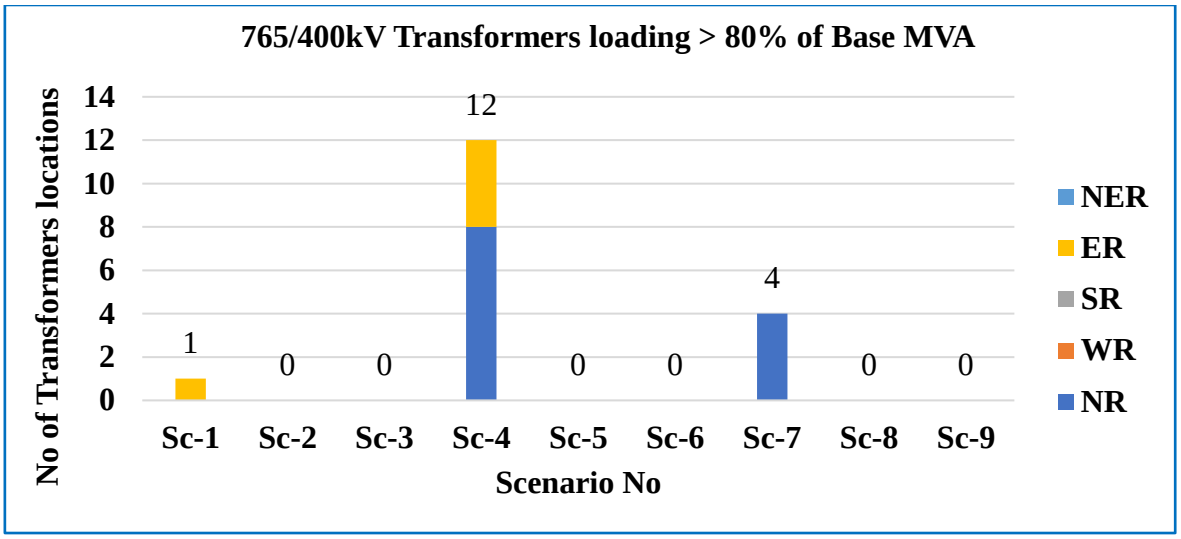


Figure 3-12: 765/400kV ICT Loading under base case

Under solar max scenarios viz. Scenarios 1, 4 and 7 about 1, 12 and 4 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 northern region.

Similar analysis was carried out for 400/220 kV transformers. There are 1684 nos. of transformers located at about 620 nos. of 400/220 kV stations.

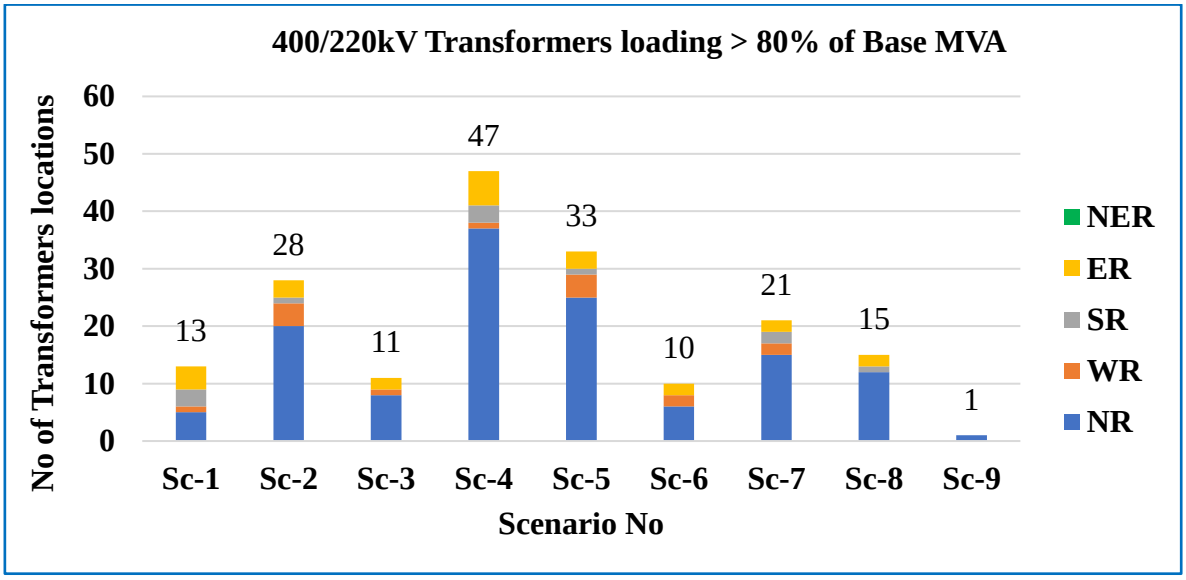


Figure 3-13: 400/220kV ICT loading under Base Case

Under solar max scenarios viz. Scenarios 1, 4 and 7 about 13, 47 and 21 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, about 7% of total no. of transformer locations 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.

PU 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 3-14.**

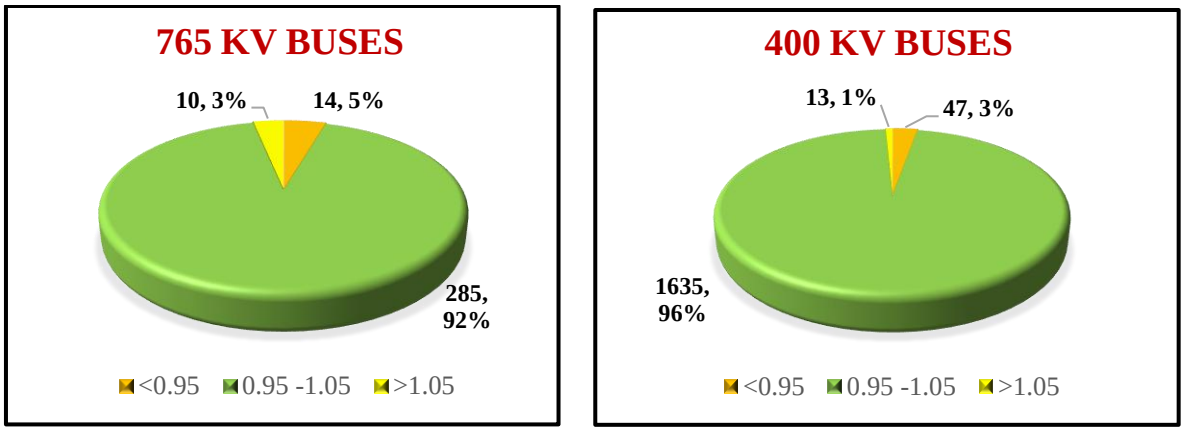


Figure 3-14: Pie-chart showing number of 765 KV & 400 KV buses

From the above voltage plots it can be observed that about 92% of the buses at 765 kV level and 96% of the buses 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 10 buses at 765kV & 13 buses at 400 kV voltage are having voltage beyond 1.05 pu in any of the scenarios. Whereas around 14 nodes at 765 kV and 47 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. Results of the analysis are discussed below:

a) Transmission Line

765kV line loadings beyond 3000 MW under N-1 contingency 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 3-15, Figure 3-16 & Figure 3-17.**

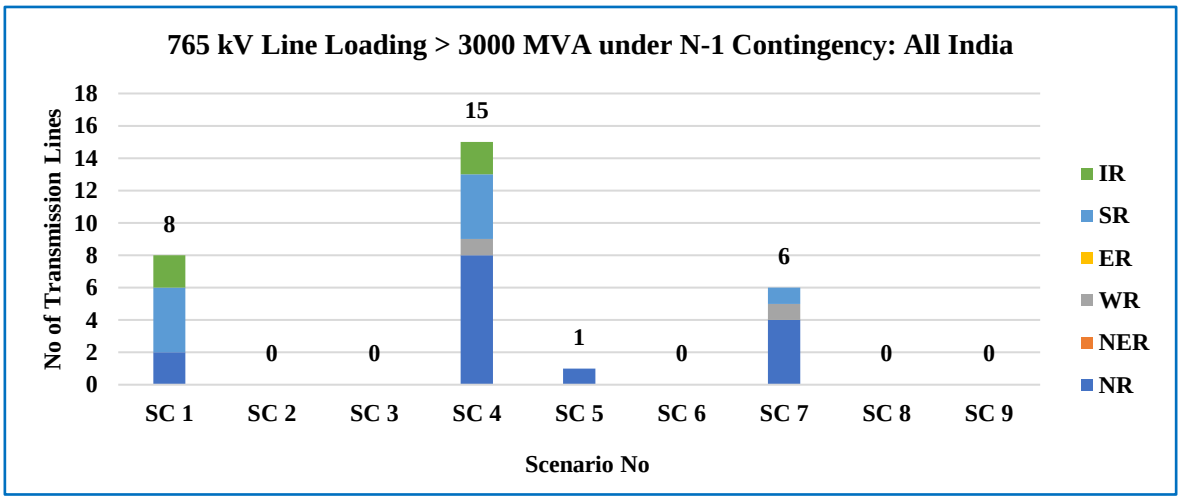


Figure 3-15: 765kV Tr. line loadings>3000MW under N-1 Contingency

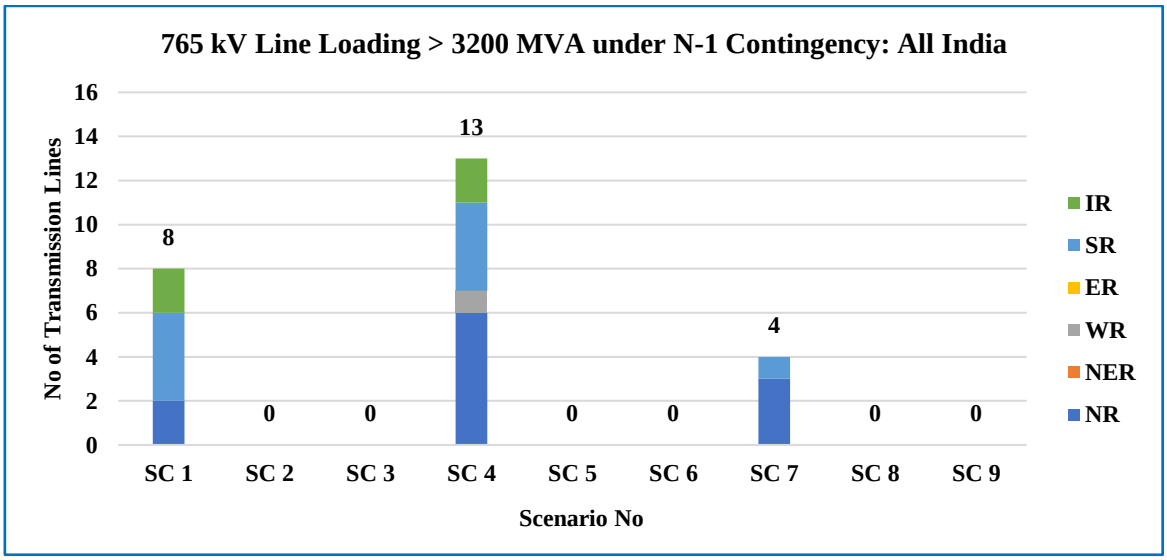


Figure 3-16: 765kV line loading>3200 MW under N-1 Contingency

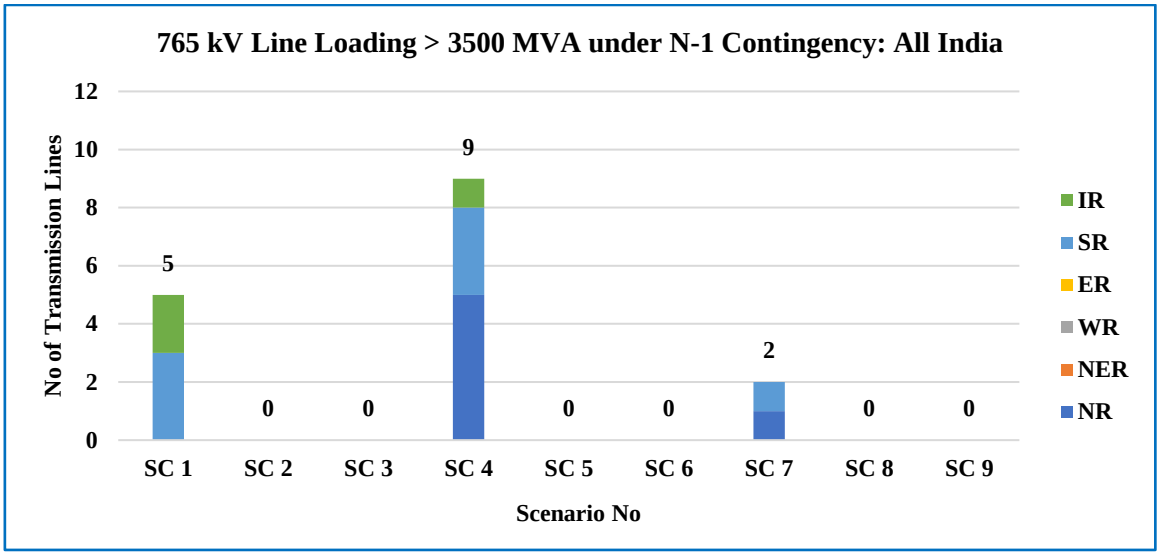


Figure 3-17: 765kV line loading>3500 MW under N-1 Contingency

The most critical 765 kV lines are Kakinada- Vemagiri, Ranchi- Dharamjaigarh, Cuddapah- Anantpur. 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 3-18 & Figure 3-19.**

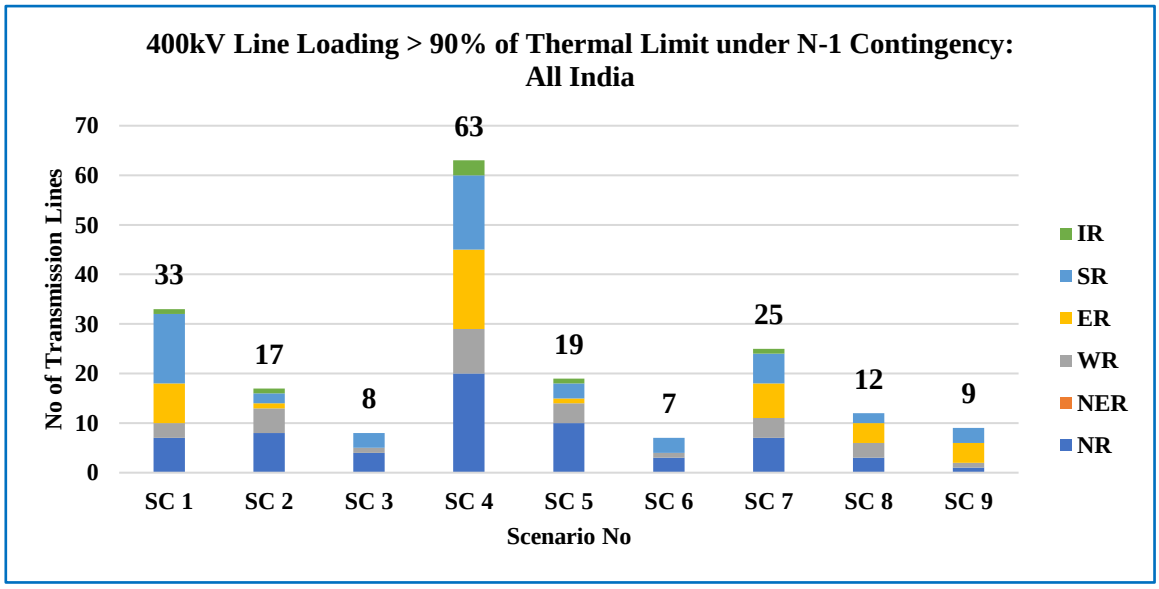


Figure 3-18: 400kV line loading>90% of thermal limit under N-1 Contingency

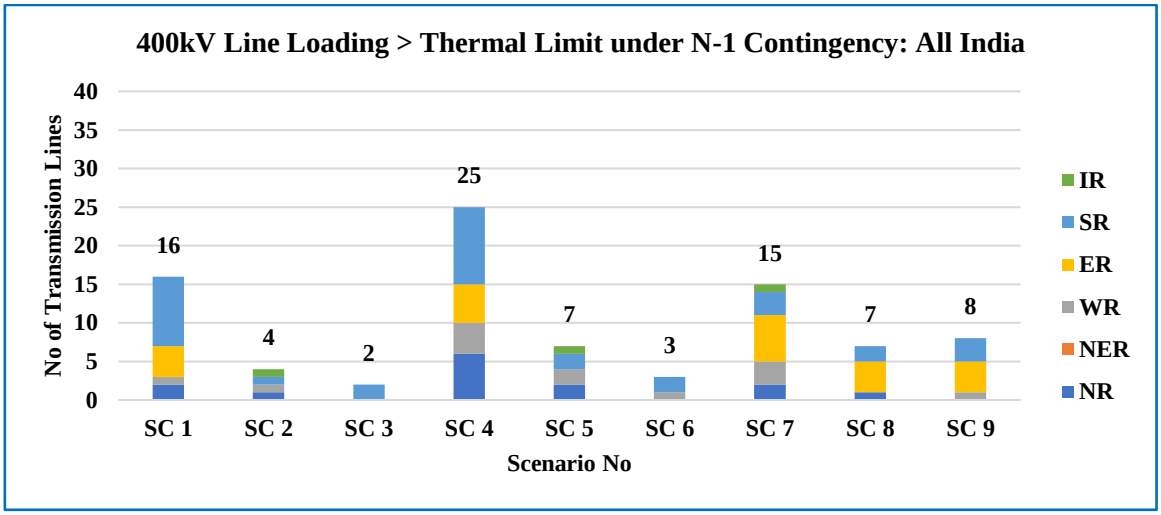


Figure 3-19: 400kV line loading>thermal limit under N-1 Contingency

Max no. of 400kV lines on which loadings exceeds 90% and 100% of thermal limit is 25 Solar max scenario i.e. Scenario-4. 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 3-20** & **Figure 3-21** for 765/400 kV ICT and **Figure 3-22 & Figure 3-23** for 400/220 kV ICT. Detailed results are attached at **Annex-3.7.**

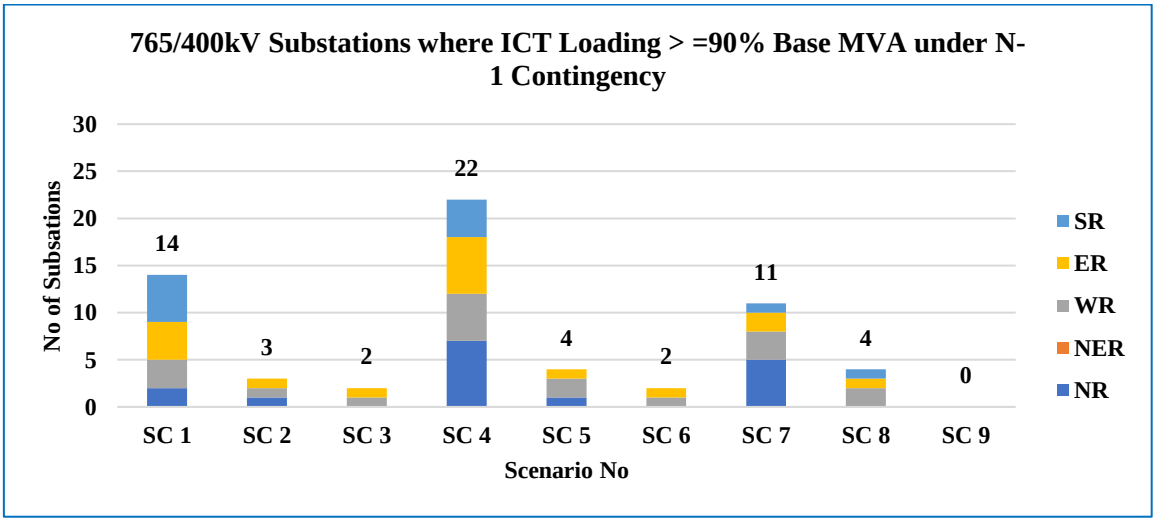


Figure 3-20: 765/400kV ICT loading≥90% of MVA rating under N-1 Contingency

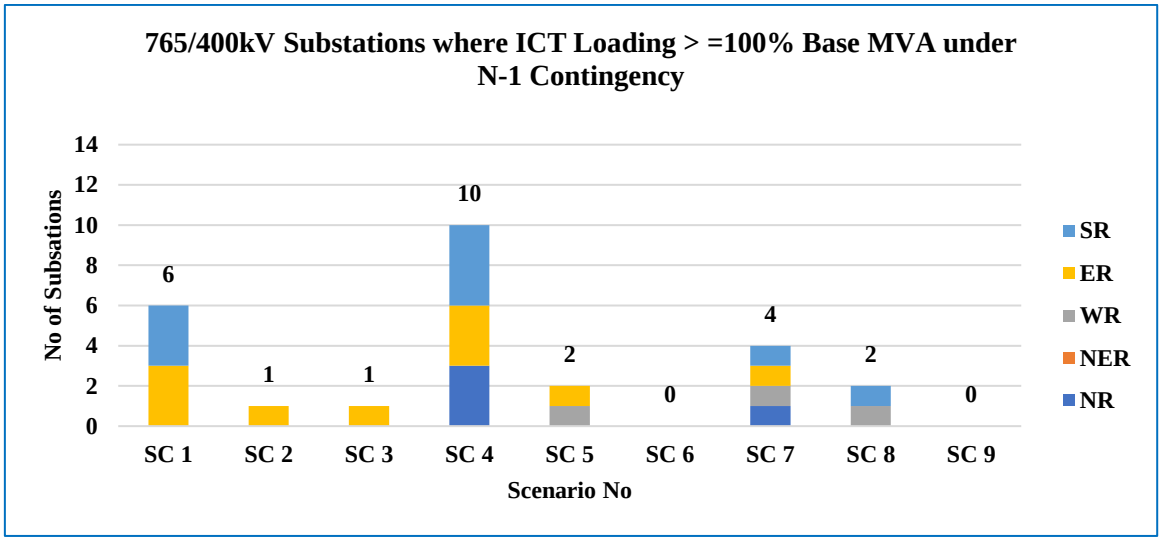


Figure 3-21: 765/400kV ICT loading≥100% of MVA rating under N-1 Contingency

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. The locations corresponding to Scenario-4 where ICT loading violations have been observed are Duburi, Bhiwani, Varanasi, Ramgarh, Moga etc. Thus, detailed analysis and studies are performed in respective regional chapter to plan for remedial measures.

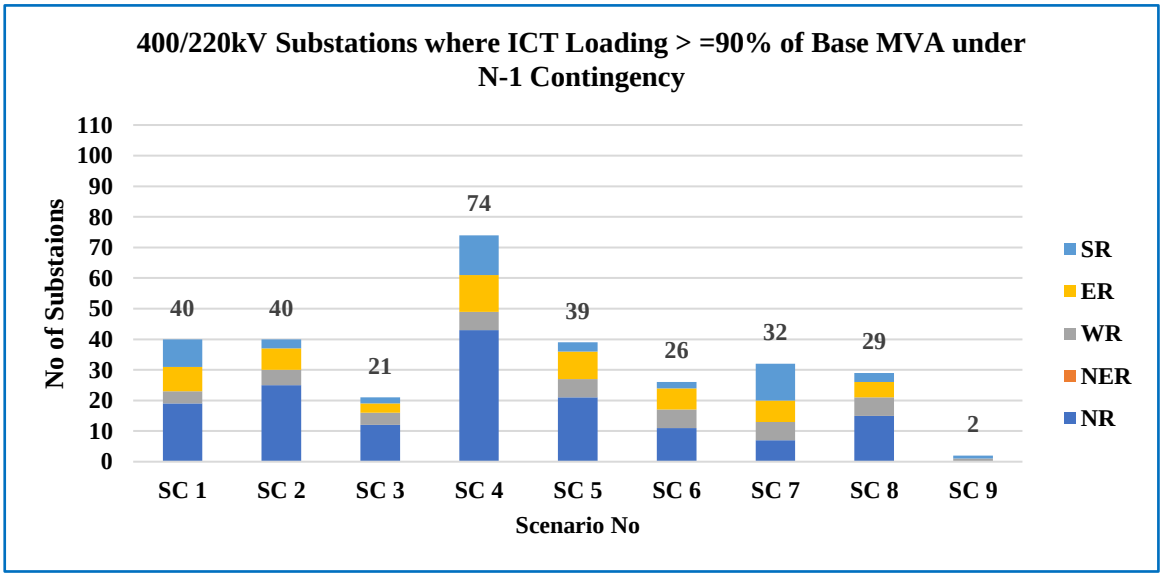


Figure 3-22: 400/220kV ICT loadings≥ 90% of MVA rating under N-1 Contingency

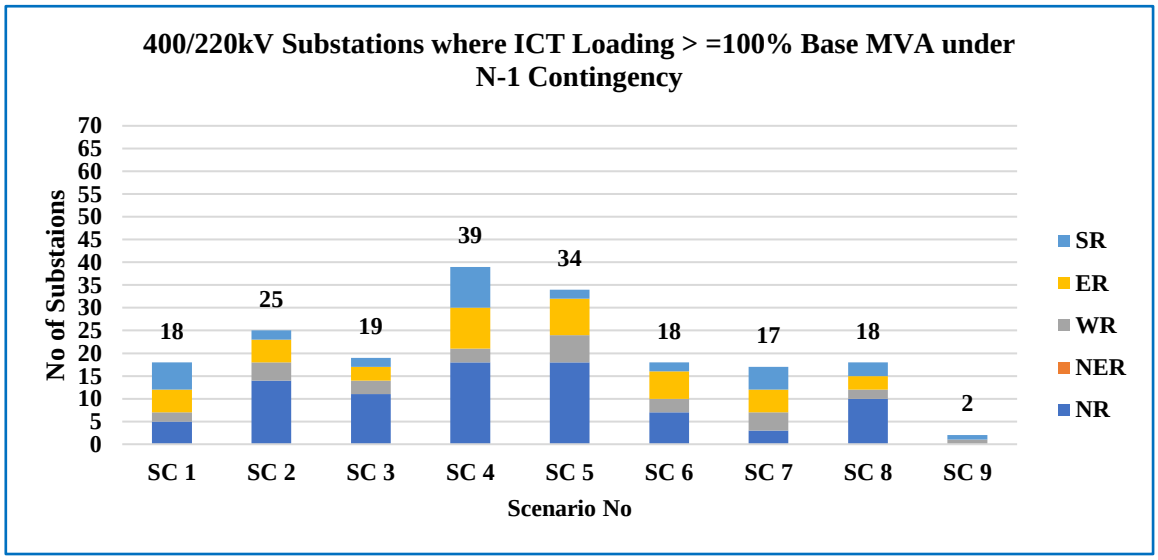


Figure 3-23: 400/220kV ICT loadings≥ 100% of MVA rating under N-1 Contingency

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 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 3-24** 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.

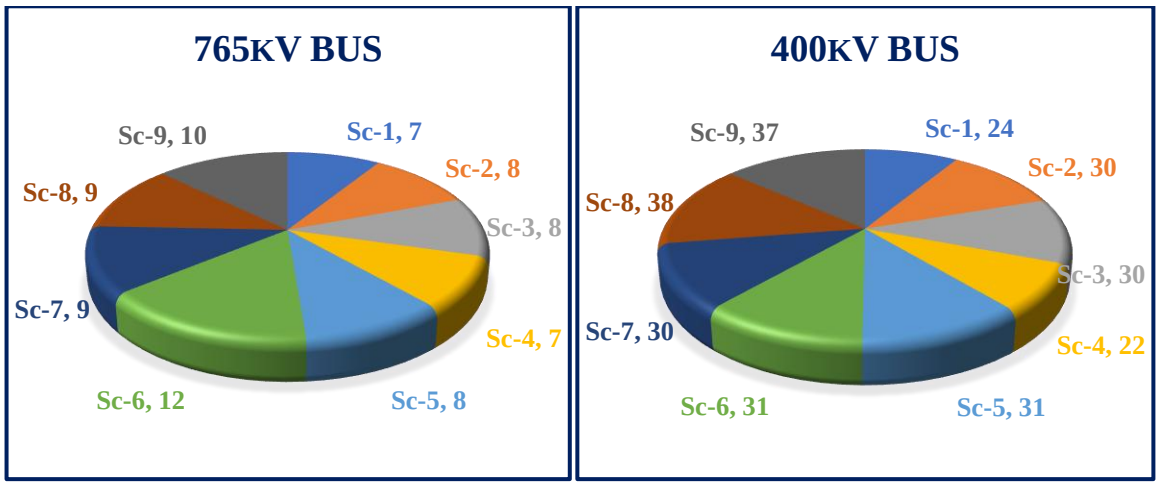


Figure 3-24: Pie-chart showing short circuit level at 765 kV & 400 kV buses on pan India basis

From the above charts it can be seen that number of fault level violations are highest in February scenario i.e. scenario-6, 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 3-25.**

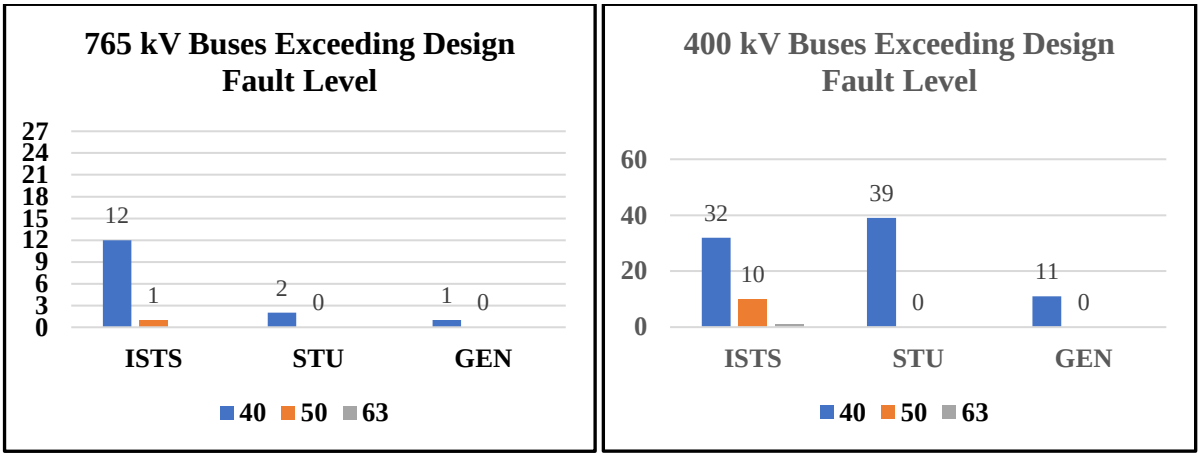


Figure 3-25: Violation of fault level in Sc-8 at ISTS/STU/Gen buses at 765 kV & 400 kV levels

Further to understand the criticality of the case, maximum fault violation at buses is 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): 58kA ▪ Kurnool (40kA): 57kA	➢ 400 kV ISTS ▪ Bareily (50kA): 79kA ▪ Barel-PG (50kA): 78kA ▪ Meerut (40kA): 67kA
➢ 765 kV STU ▪ Jaipur (40kA): 49kA ▪ G. Noida (40kA): 45kA	➢ 400 kV STU ▪ Vedanta (50kA): 53 kA ▪ Aligarh-PG (40kA):74 kA ▪ GNOIDA4 (40kA): 60KA

Detailed analysis regarding the short circuit violations and mitigation measures, if any, proposed are discussed in respective regional chapters.

3.3 ISTS Expansion up to 2029-30

3.3.1 Summary of ISTS network

ISTS network expansion schemes across the country up to FY 2029-30 are enclosed in **Annex-3.9**. Summary of the same i.e. ckm addition, MVA addition and the broad estimated cost are tabulated below in **Table 3-4** , **Table 3-5** & **Table 3-6** respectively.

Table 3-4: Transmission Line addition by 2029-30 (in ckm)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	700	7,367	-	371	**8,438**
2	2025-26	4,420	2,171	6,831	638	250	**14,310**
3	2026-27	5,007	2,623	8,533	-	271	**16,435**
4	2027-28	6,440	3,540	1,149	743	177	**12,049**
5	2028-29	470	0	3,992	0	0	**4,462**
6	2029-30	3,528	280	-	3,424	1,210	**8,442**
	Total	**19,865**	**9,314**	**27,872**	**4,805**	**2,280**	**64,136**

Table 3-5: Transformation Capacity addition by 2029-30 (in MVA)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	9,000	57,185	-	-	**66,185**
2	2025-26	63,000	35,500	53,605	4,550	1,720	**1,58,375**
3	2026-27	59,600	47,500	59,200	500	50	**1,66,850**
4	2027-28	84,500	66,000	6,000	3,000	-	**1,59,500**
5	2028-29	4,630	-	14,130	-	-	**18,760**
6	2029-30	13,500	1,630	-	-	-	**15,130**
	Total	**2,25,230**	**1,59,630**	**1,90,120**	**8,050**	**1,770**	**5,84,800**

Table 3-6: Broad estimated cost of schemes to be added by 2029-30 (in ₹ Cr.)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	23	2,707	23,551	80	863	**27,223**
2	2025-26	22,162	11,183	33,174	4,082	947	**71,548**
3	2026-27	34,599	16,813	45,818	495	122	**97,847**
4	2027-28	43,949	24,725	5,994	3,288	874	**78,830**
5	2028-29	6,921	-	39,667	-	-	**46,588**
6	2029-30	61,836	6,269	-	37,981	2,502	**1,08,588**
	Total	**₹ 1,69,489**	**₹ 61,698**	**₹ 1,48,204**	**₹ 45,925**	**₹ 5,308**	**₹ 4,30,624**

Above summary has been divided in two categories-

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

Table 3-7: Under Construction Transmission Line (in ckm)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	700	7,367	-	371	**8,438**
2	2025-26	4,060	2,171	6,186	638	250	**13,305**
3	2026-27	4,247	803	2,220	-	271	**7,542**
4	2027-28	140	520	-	665	-	**1,325**
5	2028-29	470	-	2,028	-	-	**2,498**
6	2029-30	1,320	280	-	-	-	**1,600**
	Total	**10,237**	**4,474**	**17,801**	**1,303**	**892**	**34,707**

Table 3-8: Under Construction Transformation Capacity (in MVA)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	9,000	57,185	-	-	**66,185**
2	2025-26	57,000	35,500	49,715	4,550	1,720	**148,485**
3	2026-27	56,600	14,500	15,000	500	50	**86,650**
4	2027-28	3,000	9,000	-	3,000	-	**15,000**
5	2028-29	4,630	-	6,630	-	-	**11,260**
6	2029-30	9,000	1,630	-	-	-	**10,630**
	Total	**130,230**	**69,630**	**128,530**	**8,050**	**1,770**	**338,210**

Table 3-9: Broad estimated cost (in ₹ Cr.) (Under Construction)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	2,707	23,551	80	863	**27,200**
2	2025-26	21,079	11,179	30,046	4,082	837	**67,223**
3	2026-27	30,103	3,700	12,609	495	122	**47,029**
4	2027-28	2,907	3,174	-	2,824	8	**8,913**
5	2028-29	6,921	-	26,967	-	-	**33,888**
6	2029-30	24,819	6,269	-	-	-	**31,088**
	Total	**₹ 85,828**	**₹ 27,029**	**₹ 93,173**	**₹ 7,481**	**₹ 1,830**	**₹ 215,341**

- Summary under **planning/bidding/approval** ISTS network - ckm addition, MVA addition and the broad estimated cost of are tabulated below in **Table 3-10**, **Table 3-11** & **Table 3-12** respectively.

Table 3-10: Under planning/bidding/approval Transmission Lines (in ckm)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	-	-	-	-	-
2	2025-26	360	-	645	-	-	**1,005**
3	2026-27	760	1,820	6,313	-	-	**8,893**
4	2027-28	6,300	3,020	1,149	78	177	**10,724**
5	2028-29	-	-	1,964	-	-	**1,964**
6	2029-30	2,208	-	-	3,424	1,210	**6,842**
	Total	**9,628**	**4,840**	**10,071**	**3,502**	**1,387**	**29,428**

Table 3-11: Under planning/bidding/approval Transformation Capacity (in MVA)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	-	-	-	-	-	-
2	2025-26	6,000	-	3,890	-	-	**9,890**
3	2026-27	3,000	33,000	44,200	-	-	**80,200**
4	2027-28	81,500	57,000	6,000	-	-	**144,500**
5	2028-29	-	-	7,500	-	-	**7,500**
6	2029-30	4,500	-	-	-	-	**4,500**
	Total	**95,000**	**90,000**	**61,590**	**-**	**-**	**2,46,590**

Table 3-12: Broad estimated cost (in ₹ Cr.) (under planning/bidding/approval)

Sl. No.	FY	WR	SR	NR	ER	NER	Total
1	2024-25	23	-	-	-	-	**23**
2	2025-26	1,083	4	3,128	-	110	**4,325**
3	2026-27	4,496	13,114	33,209	-	-	**50,819**
4	2027-28	41,042	21,551	5,994	464	866	**69,917**
5	2028-29	-	-	12,700	-	-	**12,700**
6	2029-30	37,017	-	-	37,981	2,502	**77,500**
	Total	**₹ 83,661**	**₹ 34,669**	**₹ 55,031**	**₹ 38,445**	**₹ 3,478**	**₹ 2,15,284**

In this Rolling plan a number of schemes have been evolved, region wise summary of the same in terms of ckm addition, MVA addition, the broad estimated cost and MW of ISTS network are tabulated below in **Table 3-13**.

Table 3-13: Rolling Plan Summary

Sl. No.		WR	SR	NR	ER	NER	Total
1	**ckm**	8,510	5,360	4,847	3,452	335	**22,504**
2	**MVA**	1,08,630	86,130	33,000	500	50	**2,28,310**
3	**Cost**	₹ 77,842	₹ 40,811	₹ 26,023	₹ 38,773	₹ 252	**₹ 1,83,701**
4	**MW**	64,900	43,250	15,474	1,530	-	**1,25,154**

Cumulative ckm and MVA capacity of ISTS network by 2029-30 is depicted in **Figure 3-26**.

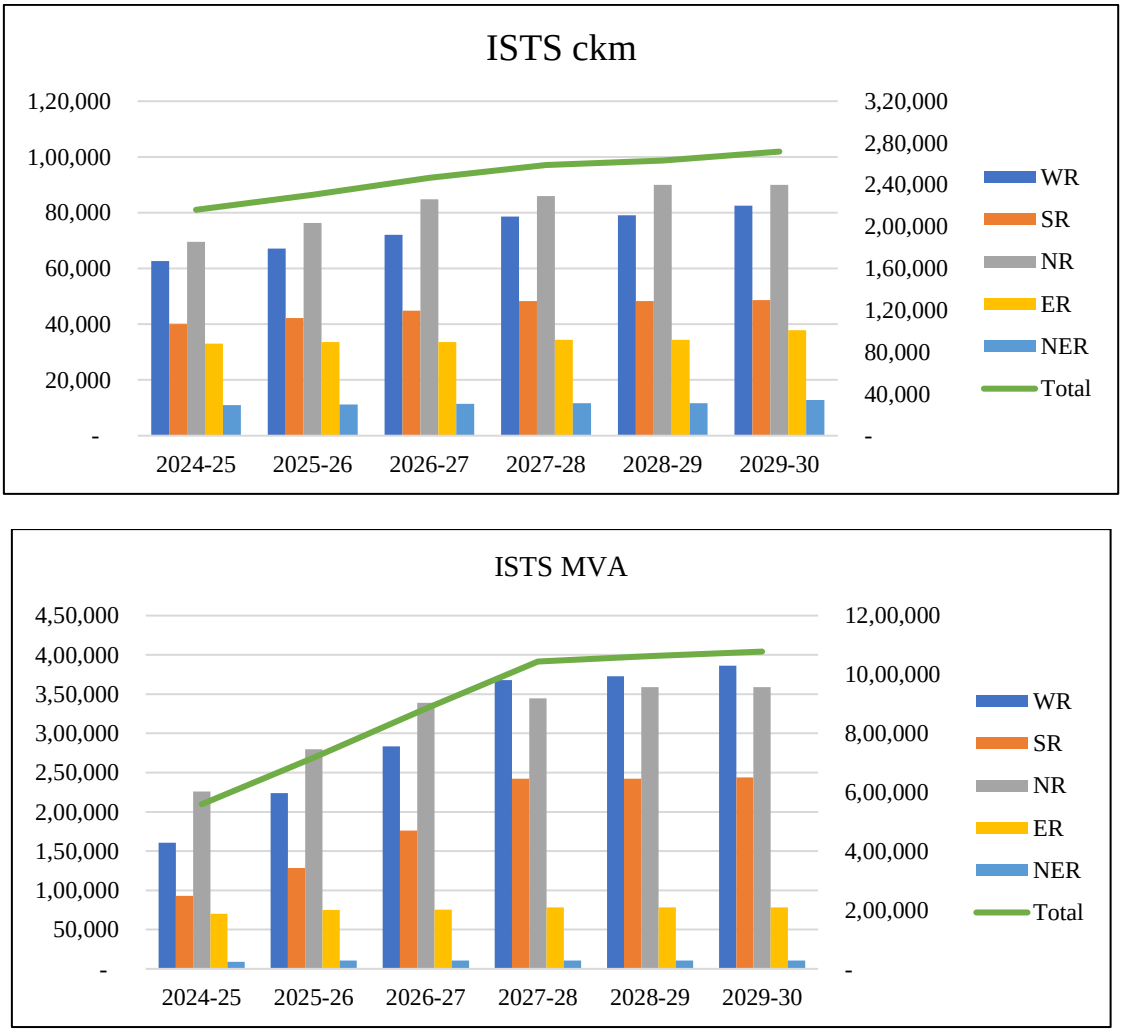


Figure 3-26: Cumulative ckm and MVA of ISTS Network by 2029-30

3.3.2 Inter-Regional (IR) Capacity

The progressive growth in Inter-Regional (IR) transmission capacity from 2013-14 till 2029-30 is given below in **Figure 3-27.** As on Feb'25, IR transmission capacity is about 119 GW which is expected to increase to about 139 GW by 2029-30.

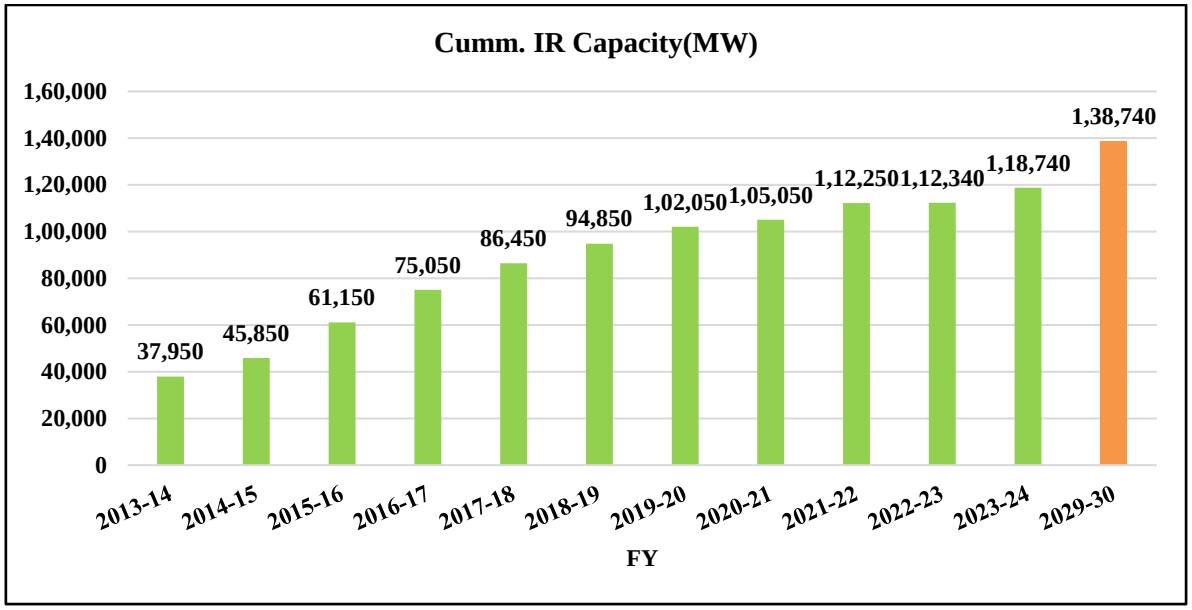


Figure 3-27: IR Capacity

Details of approved Inter Regional corridor capacity are attached at **Annex-3.10** for 2029-30 and the schematic of the same is given below in **Figure 3-28**.

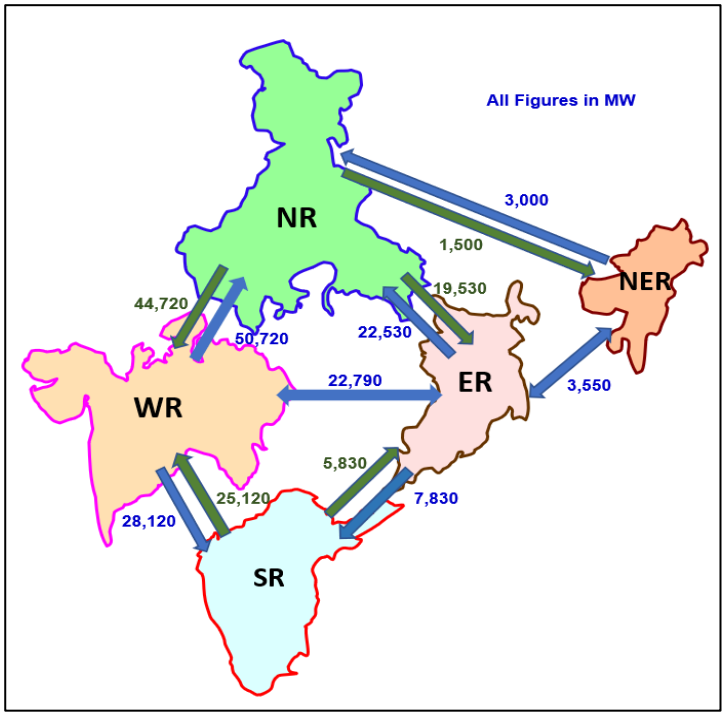


Figure 3-28: Inter-Regional Transmission Capacity by 2029-30

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'25

As on Jan'2025, total Installed Capacity of Northern Region is about 134.5 GW and the peak demand is about 90.7 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'25

(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	0.4	1.2	7.0	8.7
Haryana	8.6	0.6	9.2	0.1	2.3	2.4	4.8	14.0	14.7
Himachal Pradesh	0.1	0.0	0.1	0.0	3.2	1.2	4.5	4.6	2.3
Jammu & Kashmir	0.6	0.3	0.9	0.1	2.3	0.3	2.7	3.6	2.8
Punjab	8.2	0.2	8.4	0.2	3.8	2.2	6.2	14.5	16.1
Rajasthan	14.2	0.8	15.0	0.6	1.9	32.7	35.2	50.2	18.8
UP	22.6	1.0	23.6	0.3	3.4	5.7	9.4	33.0	30.6
Uttrakhand	0.6	0.7	1.4	0.0	2.2	1.0	3.2	4.5	2.9
Chandigarh	0.0	0.0	0.1	0.0	0.1	0.1	0.2	0.2	0.4
Central unallocated	1.5	0.3	1.8	0.2	0.8	0.0	1.0	2.8	97.2
Total	**60.2**	**6.0**	**66.2**	**1.6**	**20.8**	**45.9**	**68.3**	**134.5**	**90.7**

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 134.5 GW is about 68.3 GW i.e. 50.7% of total IC. This share would further increase in envisaged scenario of 2029-30 timeframe.

4.2 Envisaged Power Supply Scenario by 2029-30

As per the 20th EPS, Northern Region demand for 2029-30 timeframe is expected to increase to about 116.7 GW. As per the inputs received from various stakeholders, total installed capacity of Northern Region for 2029-30 is expected to be about 207 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 (2029-30)

(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	0.0	0.0	0.0	0.0	0.0	2.0	11.0
Haryana	3.6	0.0	3.6	0.1	0.0	0.9	1.0	0.0	4.6	19.7
Himachal Pradesh	0.0	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.3	3.0
Jammu & Kashmir*	0.0	0.2	0.2	1.2	0.0	0.0	1.2	0.0	1.4	4.2
Punjab	5.7	0.0	5.7	1.4	0.0	0.0	1.4	0.0	7.0	19.5
Rajasthan	10.0	0.2	10.2	0.5	0.0	20.7	21.3	0.0	31.5	25.0
UP	21.9	0.0	21.9	1.3	0.0	4.2	5.5	0.0	27.4	39.8
Uttrakhand	0.0	0.0	0.0	2.2	0.0	0.0	2.2	0.0	2.2	3.8
Chandigarh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Central	11.9	1.8	13.6	14.2	3.0	77.7	94.9	1.5	110.0	
IPP	0.0	0.0	0.0	4.1	0.0	12.0	16.1	3.1	19.2	
Rooftop / Other RE	0.0	0.0	0.0	0.0	0.0	5.9	5.9	0.0	5.9	
NR	**53.6**	**3.6**	**57.2**	**25.3**	**3.0**	**116.8**	**145.1**	**4.6**	**207.0**	**116.7**

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 50.7% to 70.1%. There is a growth in peak demand of Northern Region from present time-frame (2024-25) to 2029-30 with a CAGR of 5.17%. 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				
	2024-25	**2029-30 (20th EPS)**	**Increase in demand**	**CAGR (%)**
Chandigarh	449	533	84	3.49
Delhi	8,656	11,046	2390	4.99
Haryana	14,662	19,744	5082	6.13
Himachal Pradesh	2,273	2,983	710	5.59
Jammu & Kashmir (including Ladakh)	2,836	4,315	1479	8.76
Punjab	16,058	19,466	3408	3.92
Rajasthan	18,752	25,048	6296	5.96
UP	30,618	39,781	9163	5.38
Uttarakhand	2,863	3,847	984	6.09
NR	**90,747**	**1,16,745**	**25,998**	**5.17**

incl. Ladakh

From the above data it is observed that the CAGR growth of peak demand is maximum for Jammu & Kashmir (8.76%) and minimum for Chandigarh (3.49%).

4.3 Load Generation Balance for 2029-30 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 2029-30 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%	75%	50%	-100%	0%	78%
2-Aug Peak Load	95%	80%	0%	70%	60%	50%	81%
3-Aug Night Off Peak	70%	80%	0%	60%	40%	50%	63%
4-Jun Solar Max	70%	80%	85%	50%	-100%	0%	97%
5-Jun Peak Load	95%	80%	0%	70%	50%	50%	92%
6-Jun Night Off Peak	70%	80%	0%	60%	1%	50%	60%
7-Feb Solar Max	30%	80%	90%	10%	-100%	0%	66%
8-Feb Peak Load	60%	80%	0%	35%	100%	50%	64%
9-Feb Night Off Peak	30%	80%	0%	10%	40%	30%	32%

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'29 (Monsoon)			Jun'29 (Summer)			Feb'30 (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	-8458	16808	14006	3439	23449	10847	-26126	5074	-1552
ER-NR	-8866	1497	2727	-6107	5875	6049	-9080	5639	1632

IR Flows	Aug'29 (Monsoon)			Jun'29 (Summer)			Feb'30 (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
NER-NR	0	0	0	0	0	0	-1001	0	0
NEPAL-NR	1454	1870	0	1454	1869	0	623	1246	0
NR	15870	-20175	-16733	1214	-31193	-16896	35584	-11959	-

Considering the above LGB for nine scenarios, load flow cases were prepared for 2029-30 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 Feb'24/wMar'24 to Feb'25

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Northern Region (CMETS-NR) from March 2024 to February 2025. Brief of all such deliberated transmission schemes are tabulated below:

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Quantum (MW)	Type of Scheme	Tentative Cost (in Cr.)
	Rajasthan				
(i)	Augmentation of Transformation Capacity at 400/220 kV Bassi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th-)	2025-26	-	Conv	49.87
(ii)	Augmentation of Transformation Capacity at 400/220 kV Bhiwadi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th)	2025-26	-	Conv	65.25
(iii)	Augmentation of Transformation Capacity at 400/220 kV Bikaner-II PS in Rajasthan by 400/220 kV, 1x500 MVA ICT (9th)	2025-26	-	RE	54.60
(iv)	Augmentation with 400/220 kV, 3x500 MVA (6th ,7th & 8th) ICTs at Fatehgarh-IV PS(Sec-II)	2026-27	1500	RE	167.79
(v)	Augmentation with 400/220 kV, 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS	2026-27	1000	RE	111.86
(vi)	Transmission system strengthening to facilitate evacuation of power from Bhadla/Bikaner complex	2026-27	-	RE	198.75

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Quantum (MW)	Type of Scheme	Tentative Cost (in Cr.)
(vii)	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5 GW):	2026-27	3500	RE	5,845.93 + 6,394.94
(viii)	Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur] Complex	2027-28	4000	RE	5027.61
(ix)	Implementation of 1 no. of 400 kV line bay at 765/400/220kV Bhadla-III PS for interconnection of M/s ReNew Solar (Shakti Six) Pvt. Ltd.	2025-26	-	RE	13.37
(x)	Augmentation of Transformation Capacity at 765/400/220kV Bikaner PS in Rajasthan by 400/220kV, 1x500 MVA ICT (4^{th})	2025-26	-	RE	57.59
(xi)	Augmentation with 400/220 kV, 1x500 MVA Transformer (10^{th}) at Fatehgarh-2 PS	2025-26	-	RE	50
(xii)	Augmentation of 400/220 kV, 1x500 MVA (10^{th}) ICT at Bikaner-II PS	2026-27	-	RE	50.71
(xiii)	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6^{th}) at 765/400/220kV Bikaner-III PS	2026-27	-	RE	49.60
(xiv)	Implementation of 1 nos. of 400 kV line bay for interconnection of M/s ReNew Solar Power Private Limited (300MW+300MW) RE power project at 765/400/220kV Fatehgarh-IV (sec-2) PS.	2026-27	-	RE	11.42
(xv)	Augmentation of 1x500 MVA, 400/220 kV ICT at Bhadla-II PS (4th ICT at Section-1A) to cater the N-1 contingency requirement at 765/400/220kV Bhadla-II PS	2026-27	-	RE	42.18
(xvi)	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6^{th}) at Bhadla-II PS (Section-1) to cater the N-1 contingency requirement at 765/400/220kV Bhadla-II PS.	2025-26	-	RE	59.58
	Haryana				
•	Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Hissar (PG) substation.	2025-26	-	Conv	49.60
	Punjab				
•	Augmentation of Transformation Capacity at 400/220kV Malerkotla(PG) S/s in Punjab by 400/220kV, 1x500MVA ICT (4th)	2025-26	-	Conv	88
	Himachal Pradesh				

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Quantum (MW)	Type of Scheme	Tentative Cost (in Cr.)
1.	Transmission system for evacuation of power from Luhri Stage-I HEP	2027-28	210	Conv	242
	Jammu and Kashmir				
a)	Transmission system scheme for Ratle HEP (850MW) & Kiru HEP (624 MW)	2026-27	1474		1400
b)	Augmentation of 400/220 kV, 1x315 MVA (3rd) ICT at 400/220 kV New Wanpoh (PG) substation	2027-28	-	Conv	61
c)	Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Samba (PG) substation.	2027-28	-	Conv	42.18
	Uttar Pradesh				
•	Replacement of existing 420kV 50MVAR Bus Reactors at Mandola & Muradnagar substation with 125MVAr bus reactor	2024-25-	-	Conv	61.61
•	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (3rd) at 765/400/220kV Agra (PG) S/s	2026-27	-	Conv	50.72
•	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (5th) at 400/220kV Mandola (PG) S/s	2026-27	-	Conv	61.61
•	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (3rd) at Lucknow (PG) S/s	2027-28	-	Conv	**76.54**
	NR-WR-ER Inter regional corridor				
	Transmission System for Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line.	2027-28	-	Conv	2368.26
	Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District, Uttar Pradesh	2027-28	4000	Pumped Storage	3625.97
	Total		15474		26,023

Details of the schemes are reproduced below state-wise:

4.4.1 Rajasthan

(i) <u>Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at Bassi (PG) S/s</u>

In 28th CMETS-NR meeting held on 27/03/24, it was stated that at present, 400/220kV Bassi Substation has 2x315+1x500MVA ICTs thus makes total transformation capacity

of 1130MVA. POWERGRID in 203rd OCC stated that the loading at ICTs at Bassi is more than 900MW resulting in non-compliance of N-1 Contingency.

From the loading pattern of Bassi ICTs (2x315+1x500) of past one year, it is observed that cumulative maximum loading on 400/220 kV ICTs is about 1100 MW and loading is higher (>850MW) in winter season (Oct'23-Jan'24) for sufficient duration of time. From the analysis, it emerged that loading is breaching N-1 limit for peak Loading of ICTs (total 855 MW on 3 nos. ICTs). Further in CTU planning file for 2026-27 timeframe, ICT loadings are higher (312MW in N-1 Contingency) and may breach the N-1 limit.

As per deliberation held in 213th OCC meeting, with planned a LILO of 220kV Dausa-Sawai Madhopur line at Jaipur South S/s, loading of Bassi ICT is relived marginally (30MW/ICT in N-1 contingency), however 400/220 kV ICTs will still be non-compliant in future.

POWERGRID vide mail dated 22.02.24 confirmed space availability for Augmentation of 400/220kV transformer (4th ICT,1x500MVA) along with transformer bays at 400/220kV Bassi (PG) S/s.

In the meeting, Grid-India stated that at Bassi there is urgent requirement of augmentation of 400/220kV ICT as ICTs were N-1 non-compliant in current winter season. RVPN stated that at present total 6 nos. 220kV feeders are connected to Bassi substation with peak drawl requirement of 1200-1300MW and as per loading pattern, loading is already breaching N-1 limit. Further, with Hindaun ICT and LILO of 220kV Dausa-Sawai Madhopur line at Jaipur South, ICT loading at Bassi may reduce to only some extent. RVPN further stated that considering future drawl requirement at Bassi S/s, ICT augmentation at Bassi may be considered.

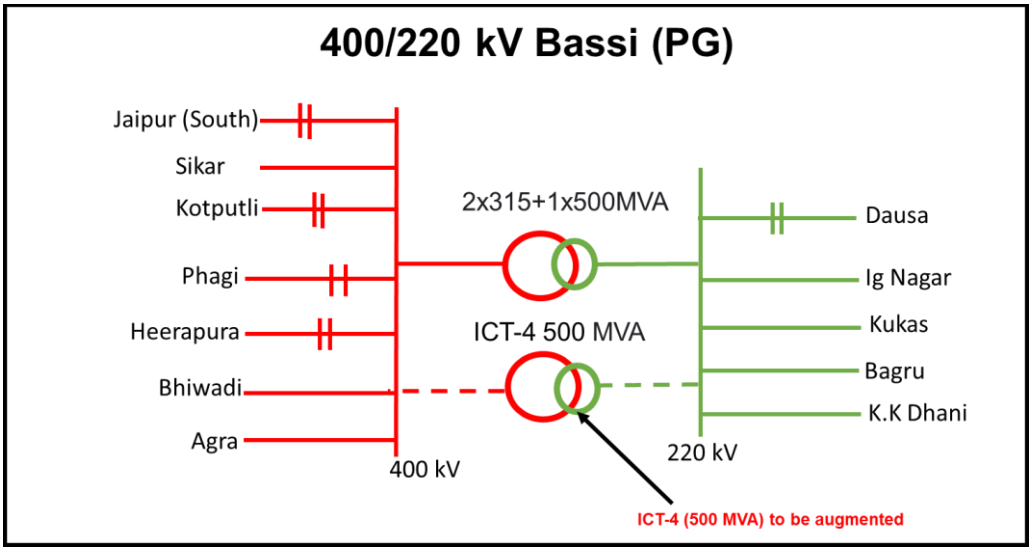


Figure 4-1: Schematic of 400/220 kV Bassi (PG) S/s

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation Capacity at 400/220 kV Bassi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th)

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of Transformation Capacity at 400/220 kV Bassi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th) along with associated transformer bays	• 500 MVA, 400/220 kV ICT- 1 no. • 400 kV ICT bay – 1 no. • 220 kV ICT bay – 1 no.

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 14.06.2024 with an implementation time frame of 18 months i.e. anticipated by 14.12.2025.

Estimated Cost: ₹ 49.87Crs.

(ii) Augmentation with 500 MVA (4th) ICT at 400/220 kV Bhiwadi (Hybrid) substation

It was stated that in 28th CMETS-NR meeting held on 27.03.24, agenda for augmentation of 400/220kV ICT at Bhiwadi Substation was deliberated. In the meeting it was discussed that from the loading pattern of Bhiwadi ICTs (3x315 MVA) , it is observed that cumulative maximum loading on 400/220 kV ICTs is about 820 MW and loading is higher (>600MW) in Jun-Sep'23 & Jan'24-Feb'24 for sufficient duration of time. From the analysis, it emerged that loading is breaching N-1 limit for peak Loading of ICTs (800 MW). Further in CTU planning file, ICT loadings are higher (2x310 MW in case of N-1 Contingency) and may breach the N-1 limit.

POWERGRID vide mail dated 23.02.24 confirmed space availability for Augmentation of 400/220kV transformer (4th,1x500MVA) along with transformer bays at 400/220kV Bhiwadi (PG) S/s. However, 220kV Side of ICT is required to be routed through cable.

In the 29th CMETS-NR held on 17.05.24, Grid-India stated that at Bhiwadi transformer loading are close to N-1 limit and in view of that requirements may be assessed based on future load growth in Bhiwadi complex considering planned interconnections by RVPN/HVPN in future. RVPN stated that at present for Rajasthan, 4 nos. of 220kV feeders are interconnected at Bhiwadi substation and no new interconnection is planned for drawl in future. RVPN also stated that a new 400/220kV substation near Bhiwadi is recently approved by RVPN board to cater future drawl requirement at Bhiwadi complex in view of anticipated load growth. In reply to implementation timeframe of proposed new substation in Bhiwadi, RVPN stated that implementation may take minimum 3 years from now.

POWERGRID stated that loading at Bhiwadi substation are critical and N-1 noncompliant in peak load condition. Further, 2 nos. of 400/220kV ICTs (make 2003 year) already completed 21 years of life and gases are observed to be high due to loading of ICTs. Considering above ICT augmentation is required at Bhiwadi substation. CTU

stated that ICT loadings are close to N-1 limit, however HVPN/RVPN need to concur on requirements of ICT augmentation. CTU stated that decision of ICT augmentation may be expedited as Implementation of 400/220kV ICT may take 18-21 months from award and ICT may be available by mid of 2026 only.

CTU enquired RVPN and HVPN to update on the requirement of Augmentation of 400/220kV transformer (4th,1x500MVA) at Bhiwadi S/s based on their assessment.

RVPN stated that power flow over all the existing drawl feeders from Bhiwadi (PG) is already saturated and to meet the future load of Bhiwadi area, other scheme is being planned. RVPN also stated that 220kV Bhiwadi(PG)-Neemrana (RVPN) is being LILOed at Neemrana (PG) and with above LILO part load (~50-70MW) will be shifted from Bhiwadi(PG) to Neemrana(PG) and RVPN may not drawl additional power from existing feeders of Bhiwadi(PG) S/s.

HVPN stated that at present no additional drawl requirement is envisaged in future from Bhiwadi (PG) S/s. However, for N-1 compliance, HVPN concurred for Augmentation of 400/220 kV, 500 MVA (4th) ICT at Bhiwadi S/s and same was informed vide HVPN letter dated 17.05.24.. HVPN also stated that they are planning some ICT augmentation at 220kV intra state network, however it will not impact 400/220kV ICT loading much.

Grid-India suggested that as N-1 noncompliance occurs for short duration of time, replacement of 315MVA ICT with 500MVA ICT may be considered in place of augmentation with 4th ICT at Bhiwadi S/s. POWERGRID stated that even with load diversion (~50-70MW), ICT loadings are close to N-1 limits and considering type of load (critical) as well as with increasing gases trend in existing ICTs, ICT augmentation may be considered. POWERGRID stated that 2nos. of ICTs at Bhiwadi S/s requires continuous inspection & degassing due to high loading of ICTs and they are not able to get shutdown of ICTs from RVPN side due to continuous load demand in Bhiwadi complex and with long outage of ICTs, load will also be impacted.

RVPN stated that in long outage condition of ICTs, there will be severe issues in serving the critical load of Bhiwadi complex which is mainly industrial load and replacement of ICT may also require shutdown. RVPN stated that in view of issues in existing 400/220kV ICTs, frequent shutdown requirement and possible long outages of above ICTs which will impact critical industrial loads in Bhiwadi area , augmentation with 4th ICT may be considered at Bhiwadi substation. HVPN also concurred on the same.

Grid-India stated that as RVPN and HVPN concurred for ICT augmentation requirement to meet N-1 compliance, same is agreeable to them instead of replacement of ICT.

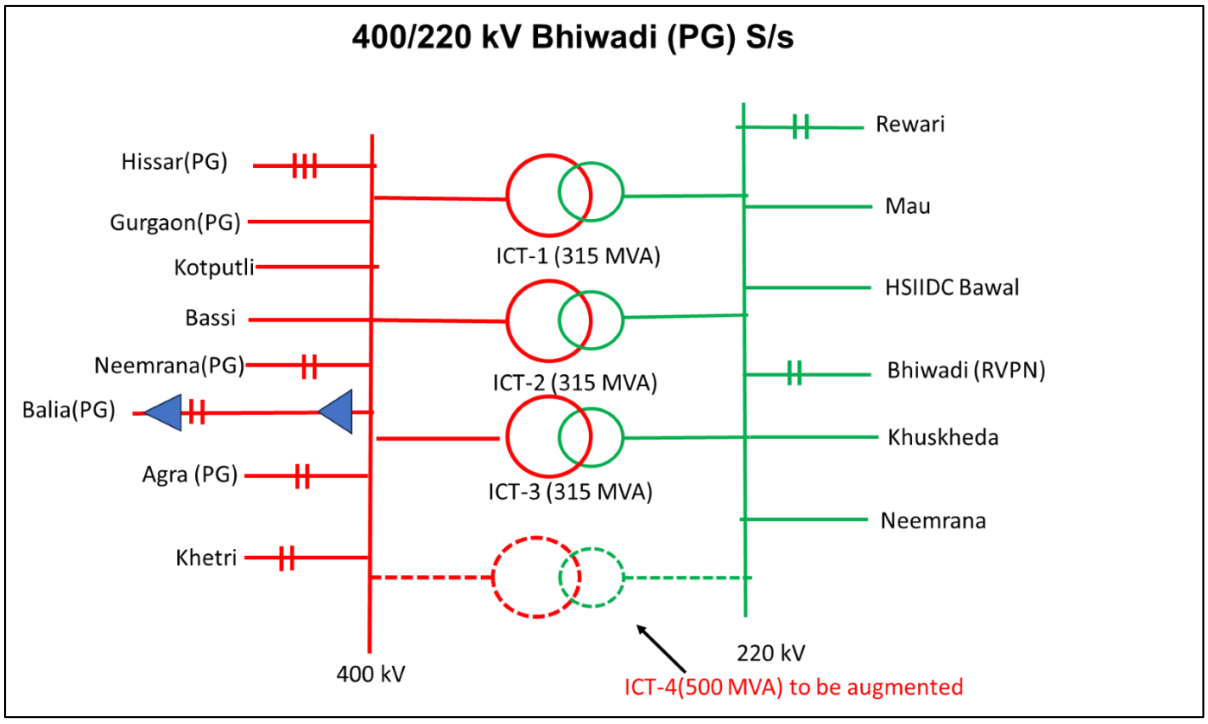


Figure 4-2: Schematic of 400/220 kV Bhiwadi (PG) S/s

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation Capacity at 400/220 kV Bhiwadi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th)

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of Transformation Capacity at 400/220 kV Bhiwadi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th) along with associated transformer bays.	1. 500 MVA, 400/220 kV ICT- 1 no. 2. 400 kV ICT bay – 1 no. 3. 220 kV ICT bay – 1 no 4. 220kV Cable (1 ph)–3200mtr (4x800mtr) (approx.) 5. 220 kV Cable Termination Kit : 8 nos..

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 18.07.2024 with an implementation time frame of 18 months i.e. anticipated by 18.01.2026.

Estimated Cost: ₹ 65.25 Crs.

(iii) <u>Augmentation with 400/220 kV 1x500 MVA(9th) ICT at Bikaner-II to meet N-1 compliance</u>

In the 29th CMETS-NR meeting held on 17/05/24 It was stated that 400/220 kV Bikaner-II PS is an existing RE pooling station with transformation capacity of 1000 MVA(2x500MVA). Further, 6 no. of 500 MVA 400/220kV, ICTs are under

implementation with the schedule progressively from Jun'24 upto Jan'25. Therefore, considering above total transformation capacity at 400/220 kV Bikaner-II PS shall be 4000MVA (8x500MVA) by Jan'25. Considering the total connectivity of 3785 MW granted at 220 kV level at Bikaner-II PS, augmentation of 1x500 MVA, 400/220kV (9th) ICT at Bikaner-II PS shall be required to meet N-1 compliance.

Grid-India (NRLDC) enquired about bus splitting arrangement at 220kV level of Bikaner-II PS. CTUIL stated that there is bus sectionalizer arrangement (normally closed) as per present practise. Grid-India stated that in some of RE pooling stations there are 2 or 3 different 220kV sections with n-1 compliance (400/220kV ICT) in each section. CTU stated that in some pooling stations i.e. Fatehgarh-II PS, Bhadla-II PS where 220kV bus sections are geographically isolated (way apart from each other), accordingly there is no sectionalizer arrangement feasible in two sections and n-1 compliance of 400/220kV ICTs to be ensured Iin both the sections as per planning criteria. CTU also stated that different configuration of 220kV section arrangement i.e. 220kV isolated sections in two different directions or 220kV common bus with sectionalizer arrangement (normally closed) is only decided by the TSP based on GA and layout of substation. Based on above n-1 compliance (400/220kV ICT) requirement will be identified. At Bikaner-II PS there is common 220kV bus with bus sectionalizer arrangement which would be normally in closed position, therefore N-1 compliance is being considered on common 220kV bus. Grid-India stated that some common philosophy should be adopted for Grid operation.

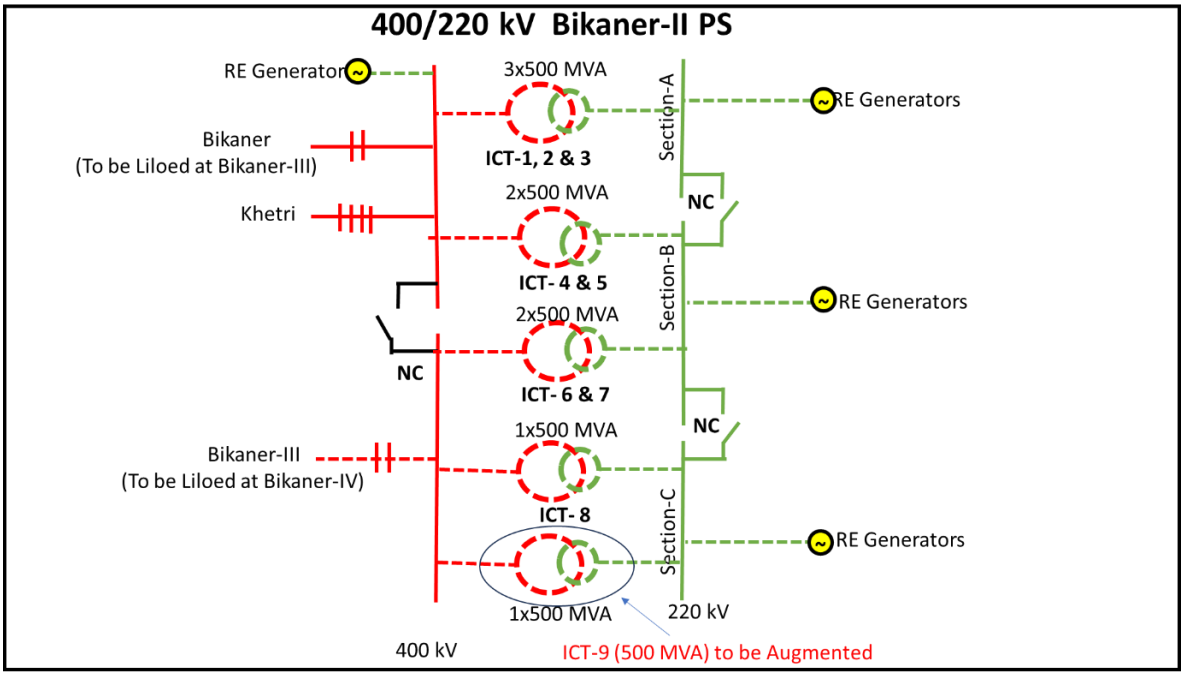


Figure 4-3: Schematic of 400/220 kV Bikaner-II PS

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation Capacity at 400/220 kV Bikaner-II PS in Rajasthan by 400/220 kV, 1x500 MVA ICT (9th)

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1.	Augmentation of Transformation Capacity at 400/220 kV Bikaner-II PS in Rajasthan by 400/220 kV, 1x500 MVA ICT (9th) along with associated transformer bays	6. 500 MVA, 400/220 kV ICT- 1 no. 7. 400 kV ICT bay- 1 no. 8. 220 kV ICT bay- 1 no

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 18.07.2024 with an implementation time frame of 18 months i.e. anticipated by 18.01.2026.

Estimated Cost: ₹ 54.60Crs.

(iv) Augmentation with 400/220 kV 3x500 MVA(6th to 8th) ICTs at Fatehgarh-IV PS(Sec-II)

In the 29th CMETS-NR meeting held on 17/05/24, it was deliberated that at present, total connectivity granted at Fatehgarh-IV PS(Sec-II) is 4980 MW(4880+100 MW on hold due to reallocation matter currently subjudice). Out of this, 3480 MW(3380+100 on hold) is granted at 220 kV and 1500 MW is granted at 400 kV level. Establishment of Fatehgarh-IV PS(Sec-II) and associated transmission system is currently under bidding as part of "Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-2:5.5 GW) (Jaisalmer/ Barmer Complex)" and expected to be awarded in May'24.

The above scheme involves establishment of 765/400/220 kV Fatehgarh-IV PS(Sec-II) along with transformation capacity of 4x1500 MVA 765/400 kV ICTs & 5x500 MVA 400/220 kV ICTs. Considering the connectivity of 3480 MW granted at 220 kV level of Fatehgarh-IV PS(Sec-II), augmentation of 3x500 MVA ICTs are required to be taken up matching with the above scheme for evacuation of power as well as to meet N-1 compliance.

Grid-India enquired about RE generation being interconnected at Fatehgarh-IV PS(Sec-I). CTU stated that at Fatehgarh-IV PS (Sec-I), about 2025MW connectivity is granted and both the sections i.e. section-I & II shall be electrically isolated through sectionalizer (normally open) with compliance will be separate for both the sections. Accordingly, N-1 of 400/220kV ICTs is being ensured in both the sections. CEA agreed for the proposal

Accordingly, the following ICT augmentation scheme is agreed (in 29th CMETS-NR) at Fatehgarh-IV PS(Sec-II) PS in ISTS:

1. Augmentation with 400/220 kV, 3x500 MVA (6th ,7th & 8th) ICTs at Fatehgarh-IV PS(Sec-II) along with associated transformer bays

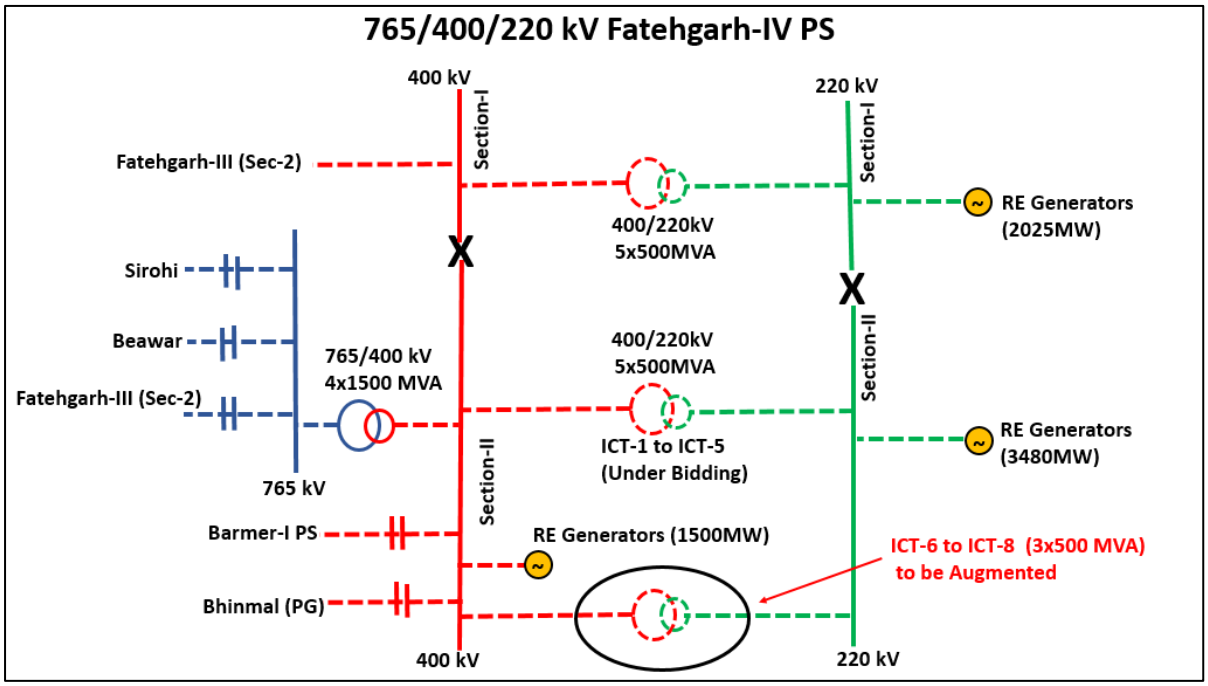


Figure 4-4: Schematic of 765/400/220 kV Fatehgarh-IV PS

Above scheme was also discussed in 21st NCT meeting held on 06/08/24 & NCT approved the scheme of Augmentation with 400/220 kV 3x500 MVA (6th to 8th) ICTs at Fatehgarh-IV PS(Section-II) under TBCB route. The scheme details are as below:

Project Name - Augmentation with 400/220 kV, 3x500 MVA (6th ,7th & 8th) ICTs at Fatehgarh-IV PS(Sec-II)

Sl. No.	Scope of the Transmission Scheme	Item Description
1.	Augmentation with 400/220 kV, 3x500 MVA (6th ,7th & 8th) ICTs at Fatehgarh-IV PS(Sec-II) along with associated transformer bays	• 500 MVA, 400/220 kV ICT – 3 nos. • 400kV ICT bays – 3 nos. • 220 kV ICT bay – 3 nos.

Implementation Timeframe: Matching with Rajasthan REZ Ph-IV (Part-2:5.5 GW) Scheme (Rajasthan REZ Ph-IV (Part-2:5.5 GW) Scheme expected SPV transfer: Aug'24).

Estimated Cost: ₹ 167.79 Crs.

(v) Augmentation with 400/220 kV 1x500 MVA(3rd & 4th) ICT at Barmer-I PS

In the 29th CMETS-NR meeting held on 17/05/24, it was deliberated that At present total connectivity granted at Barmer-I PS is 3050 MW at 220 kV. Out of this 3050 MW, 1350 MW connectivity is granted with Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-2:5.5 GW) (Jaisalmer/ Barmer Complex) scheme. The connectivity beyond 1350 MW(upto 4000 MW) is being granted with Rajasthan REZ Ph-IV (Part-4:3.5 GW) scheme which was recently approved in the 19th NCT meeting held on 29.04.2024.

Establishment of 765/400/220kV Barmer-I PS (765/400KV: 3x1500MVA, 400/220KV: 2x500MVA) and associated system is currently under bidding as part of "Transmission System for evacuation of power from Rajasthan REZ Ph-IV (Part-2:5.5 GW) (Jaisalmer/Barmer Complex)" and is expected to be awarded in May'24. Therefore, considering the connectivity of 1350 MW granted at 220 kV level of Barmer-I PS with Ph-IV Part-2 scheme, augmentation of 1x500 MVA ICT (3rd) is required to be taken up matching with the above scheme (Rajasthan REZ Ph-IV (Part2:5.5 GW)) for reliable evacuation of power.

CEA stated that with 1350MW quantum at Barmer-I PS, N-1 compliance also needs to be taken care and therefore 2 nos. of 400/220kV ICTs (3rd & 4th) shall be required for evacuation as well as to meet N-1 requirement. CTU stated that considering 4000MW RE quantum (Potential) at 220kV level of Barmer-I PS, total 9 no's, of ICTs are required for evacuation as well as to meet N-1 compliance. Out of 9 nos. of ICTs, 2nos. of ICTs (1st & 2nd) were approved as part of Rajasthan REZ Ph-IV (Part-2:5.5 GW) scheme and 5x500MVA ICTs (5th to 9th) is also approved in recent NCT meeting as part of Rajasthan REZ Ph-IV (Part-4:3.5 GW) scheme and with proposed augmentation (3rd ICT), total 8 nos. ICTs is being considered whereas 9th ICT can be taken at later stage to meet N-1 compliance requirement. CEA stated that there is some time gap (5-6 months) in commissioning of two schemes i.e. REZ Ph-IV (Part-2:5.5 GW) & REZ Ph-IV (Part-4:3.5 GW) and for such period 400/220kV ICTs will be n-1 non-compliant. CEA stated that 2x500MVA (3rd & 4th) may be considered. SECI enquired whether GNA Operationalization of RE applicants at Barmer-I PS may also be affected in absence of 4th ICT required to meet N-1 compliance. CTU stated that GNA Operationalization of RE applicants will not be dependent on ICT required to meet N-1 compliance, however considering discussions in meeting, 400/220 kV, 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS is considered to meet power evacuation as well as transformer n-1 requirement.

Accordingly, the following ICT augmentation scheme is agreed (in 29th CMETS-NR) at Fatehgarh-IV PS(Sec-II) PS in ISTS:

2. Augmentation with 400/220 kV, 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS along with associated transformer bays

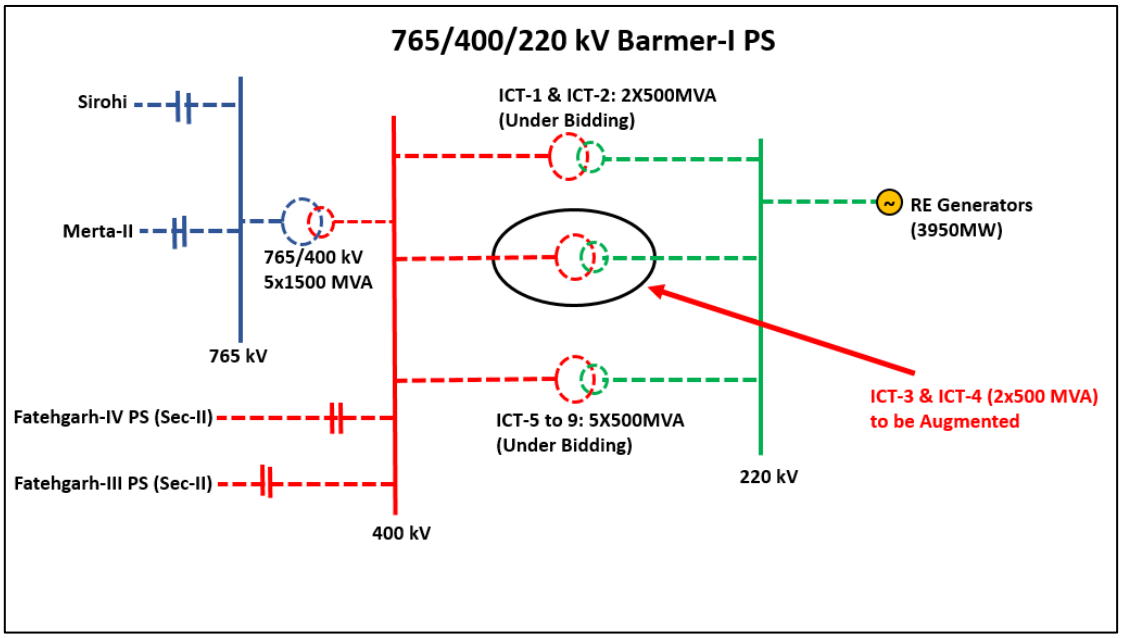


Figure 4-5: Schematic of 765/400/220 kV Barmer-I PS

Above scheme was also discussed in 21st NCT meeting held on 06/08/24 & NCT approved the scheme of Augmentation with 400/220 kV 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS under TBCB route.The scheme details are as below:

Project Name - Augmentation with 400/220 kV, 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS

Sl. No.	Scope of the Transmission Scheme	Item Description
1.	Augmentation with 400/220 kV, 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS along with associated transformer bays	• 500 MVA, 400/220 kV ICT - 2 nos. • 400kV ICT bays – 2 nos. • 220kV ICT bay – 2 nos.

Implementation Timeframe: Matching with Rajasthan REZ Ph-IV (Part-2:5.5 GW) Scheme (Rajasthan REZ Ph-IV (Part-2:5.5 GW) Scheme expected SPV transfer: Aug'24)

Estimated Cost: ₹ 111.86Crs.

(vi) <u>Transmission system strengthening to facilitate evacuation of power from Bhadla/Bikaner complex</u>

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 - SikarII 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).

NCT (19th NCT held on 29/04/2024) decided implementation of the Transmission system strengthening to facilitate evacuation of power from Bhadla/Bikaner complex to be undertaken under TBCB.

Summary of the scheme is given below:

SI No.	Name of the scheme	Remarks
1.	Transmission system strengthening to facilitate evacuation of power from Bhadla/Bikaner complex	Recommended under TBCB route with PFCCL as BPC

Detailed scope of the scheme is given below:

Sl. No.	Scope of the Transmission Scheme	Item Description
1.	400 kV Bareilly (765/400 kV) – Bareilly (PG) D/c line (Quad) (2nd)	Line length : 4 kms • 400 kV line bays -2 Nos. (at Bareilly (765/400 kV) S/s • 400 kV line bays - 2 Nos. (at Bareilly (PG) S/s)
2.	Augmentation with 1x1500 MVA, 765/400 kV ICT (3rd) at Bareilly (765/400 kV) S/s	• 765/400 kV, 1500 MVA ICT - 1 No. • 765 kV ICT bay - 1 No. • 400 kV ICT bay - 1 No.

Note:

- *The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey*
- *POWERGRID to provide space for 2 Nos. of 400 kV line bays each at Bareilly (765/400 kV) and 400 kV Bareilly (PG) S/s*
- *POWERGRID to provide space for 1500 MVA ICT at Bareilly (765/400 kV) along with its associated bays.*

Implementation timeframe: 18 months from the date of SPV transfer

Estimated Cost: ₹ 198.75 Crs.

(vii) <u>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]</u>

Considering grant of connectivity to RE generators in Fatehgarh/Barmer complex as well as for evacuation of power beyond above complex, transmission scheme for evacuation of power from Fatehgarh/Barmer Complex as part of Rajasthan REZ Ph-IV (Part-4 :3.5GW) has been envisaged. The scheme shall also facilitate evacuation of additional RE power evacuation from Nagaur complex (2 GW) which will require some immediate transmission system requirement i.e. 400/220 kV ICTs and 220 kV line bays along with NR-WR inter regional corridors.

The transmission scheme was discussed and technically approved in the 71st NRPC meeting held on 29.01.2024 and recommended to NCT. Further, reactive compensation of some of the lines was modified and the same was approved in 49th TCC/72nd NRPC meeting held on 29th-30th March 2024.

Scheme was deliberated in 27th CMETS-NR meeting held on 10.01,24. In the meeting RVPN stated that they do not have any drawl requirement in future from proposed Merta-

2 S/s. In view of envisaged RE potential in Nagaur distt., space provision to be kept for 220kV scope i.e. 400/220kV ICTs., 220 kV line bays for drawl & 220kV Sectionalization bay for RE injection

Considering grant of connectivity to RE generators in Fatehgarh/Barmer complex as well as for evacuation of power beyond above complex, 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]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. The scheme shall also facilitate evacuation of additional power evacuation from Nagaur complex (2GW) for which some immediate transmission system requirement from Nagaur complex and Inter regional corridors requirement shall be assessed

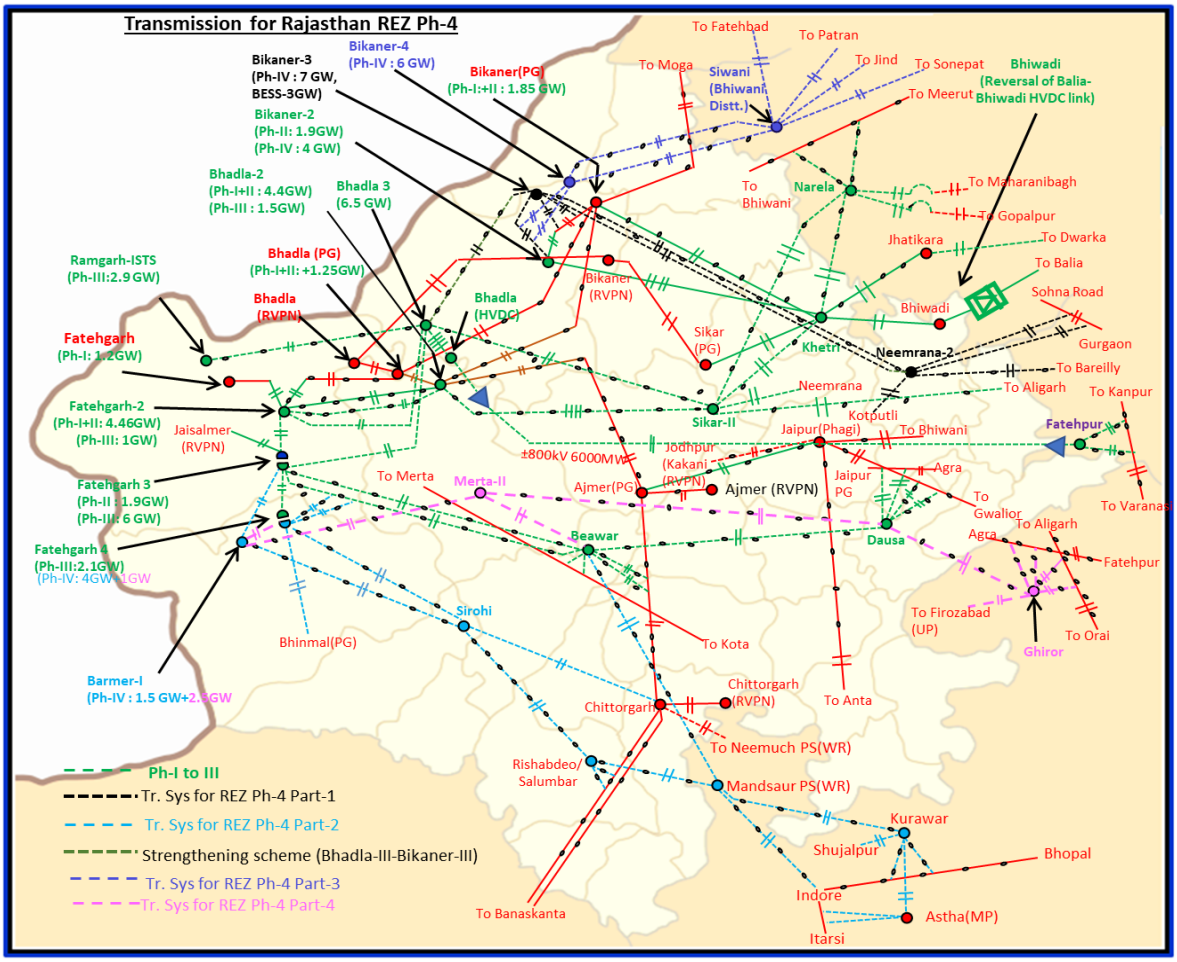


Figure 4-6: Transmission system for Rajasthan REZ Ph-IV (Part-4 :3.5GW) [Fatehgarh/Barmer complex]

NCT (in 19th NCT held on 29/04/2024) recommended implementation of the Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5 GW): Part A and Part B to be undertaken under TBCB.

Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5 GW): Part A

Summary of the scheme is given below:

SI No.	Name of the scheme	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5 GW):	Recommended under TBCB route with RECPDCL as BPC

Detailed scope of the scheme:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Augmentation with 765/400 kV, 2x1500 MVA Transformer (4th & 5th) at Barmer-I PS	• 765/400 kV 1500 MVA ICTs- 2 nos. • 765 kV ICT bays-2 no. • 400 kV ICT bays- 2 no.
2	Augmentation of 5x500 MVA (5th to 9th), 400/220 kV ICTs at Barmer-I PS	• 400/220 kV 500 MVA ICTs- 5 nos. • 400 kV ICT bays-5 nos. • 220 kV ICT bays- 5 nos.
3	220kV line bays (6 nos.) for RE connectivity at Barmer-I PS	• 220 kV line bays- 6 nos.
4	400kV Sectionalizer bay (1 set), 220kV Sectionalizer bay (1 set) along with 220kV BC (1 nos.) and 220 kV TBC (1 nos.) at Barmer-I PS	• 400 kV Sectionalier bay: 1 set • 220 kV Sectionalizer bay: 1 set • 220 kV BC (1 nos.) bay and 220 kV TBC (1 nos.) bay
5	STATCOM (2x±300MVAr) along with MSC (4x125 MVAr) & MSR (2x125 MVAr) along with 2 nos. 400 kV bays at Barmer-I PS	• STATCOM (2x±300MVAr) MSC (4x125 MVAr) & MSR (2x125 MVAr) • 400kV bays at Barmer-I PS – 2 nos.
6	Fatehgarh-IV PS (Sec-2) – Barmer-I PS 400kV D/c line (Quad)	Line Length ~45 km (Quad) • 400 kV line bays at Fatehgarh-IV PS (Sec-2) – 2 nos. • 400 kV line bays at Barmer-I PS – 2 nos.
7	Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Ghiror (Distt. Mainpuri) along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) bus reactor at Ghiror S/s (UP) **Future provisions at** Ghiror **S/s:** **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.) bays and 220 kV TBC (2 nos.) bays	Ghiror S/s- AIS • 765/400 kV 1500 MVA ICTs- 2 nos. (7x500 MVA including one spare unit) • 765 kV ICT bays-2 no. • 400 kV ICT bays- 2 no. • 765kV line bays : 8 nos. (for LILO of Aligarh(PG)-Orai(PG) D/c, LILO of Agra (PG) – Fatehpur(PG) S/c & 765kV interconnection with Dausa S/s) • 400kV line bays: 2 nos. (for 400kV interconnection with Firozabad (UPPTCL) S/s) • 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. • 110MVAr spare reactor unit (single phase)-1 no.

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
	• STATCOM (2x±300MVAr, 4x125MVAr MSC, 2x125MVAr MSR) along with 400kV bays (2 nos.)	
8	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	Line Length -305 km • 765 kV, 240 MVAr switchable line reactors at Dausa S/s end– 2 nos. • 765 kV, 330 MVAr switchable line reactors at Ghiror S/s S/s end– 2 nos. • Switching equipment for 765kV, 240 MVAr switchable line reactors at Dausa S/s end – 2 nos. • Switching equipment for 765kV, 330 MVAr switchable line reactors at Ghiror S/s end – 2 nos.
9	LILO of both ckt of 765 kV Aligarh (PG) - Orai (PG) D/c line at Ghiror S/s along with 240 MVAr switchable line reactor for each circuit at Ghiror S/s end of 765 kV Ghiror - Orai (PG) D/c line	Length -15km (LILO length) • 765 kV, 240 MVAr switchable line reactors at Ghiror S/s end– 2 nos. • Switching equipment for 765kV, 240 MVAr switchable line reactors at Ghiror S/s end – 2 nos.
10	LILO of one ckt of 765kV Agra (PG) – Fatehpur (PG) 2xS/c line at Ghiror along with 240 MVAr switchable line reactor at Ghiror end of 765 kV Ghiror -Fatehpur (PG) line	Length -30km (LILO length) • 765 kV, 240 MVAr switchable line reactors at Ghiror S/s end– 1 no. • Switching equipment for 765kV, 240 MVAr switchable line reactor at Ghiror S/s end – 1 no.
11	400kV Ghiror-Firozabad (UPPTCL) D/c line (Quad)	Line Length ~50 km (Quad)
12	2 nos. 765kV line bays at Dausa S/s	• 765 kV line bays at Dausa S/s – 2 nos
13	2 nos. 400kV line bays at Firozabad (UPPTCL) S/s	• 400 kV line bays at Firozabad (UPPTCL) S/s – 2 nos

Note:

- *The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey*
- *Developer of Fatehgarh-IV PS (Sec-2) & Barmer-I PS shall provide space for 2 Nos. of 400 kV line bays each at Fatehgarh-IV PS (Sec-2) & Barmer-I PS*
- *Developer of Barmer-I PS shall provide space for 765/400 kV ICTs(2x1500 MVA), 400/220 kV ICTs (5x500 MVA), 220 kV line bays(6 Nos.), 400 kV Sectionalizer bay (1 set), 220 kV Sectionalizer bay (1 set), 220kV BC (1 Nos.), 220 kV TBC (1 Nos.), STATCOM & associated 2 Nos. of 400 kV bays at Barmer-I PS*
- *UPPTCL shall provide space for 2 Nos. of 400 kV line bays at Firozabad S/s*
- *POWERGRID shall provide space for 2 Nos. of 765 kV line bays at Dausa S/s along with space for 2 Nos. of 240 MVAR switchable line reactors*

Implementation Timeframe: 24 months from the date of SPV transfer

Estimated Cost: ₹ 5,845.93Crs.

Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5 GW): Part B:

Summary of the scheme is given below:

SI No.	Name of the scheme	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4 :3.5 GW): Part A	Recommended under TBCB route with RECPDCL as BPC

Detailed scope of the scheme:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	Establishment of 765/400 kV, 2x1500 MVA S/s at suitable location near Merta (Merta-II Substation) along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) bus reactor at Merta-II S/s **Future provisions at Merta-II S/s:** **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 nos. • 400 kV line bays – 2 nos. • 400 kV Bus Reactor along with bays: 1 no. • 400kV Sectionalizer bay: 2 sets • 400/220kV ICTs along with bays -4 nos. • 220 kV line bays for RE injection -5 nos. • 220kV Sectionalizer bay: 2 set • 220 kV BC (2 nos.) bays and 220 kV TBC (2 nos.) bays • STATCOM (2x±300MVAr, 4x125MVAr MSC, 2x125MVAr MSR) along with 400kV bays (2 nos.)	**Merta-II S/s -AIS** • 765/400 kV 1500 MVA ICTs- 2 nos. (7x500 MVA including one spare unit) • 400/220 kV 500 MVA ICTs -2 Nos. • 765 kV ICT bays-2 no. • 400 kV ICT bays- 4 no. • 220 kV ICT bays- 2 no. • 765kV line bays: 4 nos. (for 765kV interconnection with Dausa S/s & Barmer-I PS) • 400kV line bays: 2 nos. (for 400kV interconnection with Beawar S/s) • 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: 3 nos. (for RE connectivity) • 220 kV BC (1 nos.) bay and 220 kV TBC (1 nos.) bay • 110MVAr spare reactor unit (single phase)-1 no.
2	Barmer-I PS – Merta-II 765 kV D/c line along with 330 MVAr switchable line reactor for each circuit at each end of Barmer-I PS – Merta-II 765 kV D/c line	Line Length -345 km • 765 kV, 330 MVAr switchable line reactors at Barmer-I PS end– 2 nos. • 765 kV, 330 MVAr switchable line reactors at Merta-II S/s end– 2 nos. • Switching equipment for 765kV, 330 MVAr switchable line reactors at Barmer-I PS end – 2 nos. • Switching equipment for 765kV, 330 MVAr switchable line reactors at Merta-II S/s end – 2 nos.

		• 110MVAr spare reactor unit at Barmer-I PS (single phase)-1 no.
3	Merta-II – Beawar 400 kV D/c line (Quad)	Line Length ~55 km (Quad)
4	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 765kV D/c line line	Line Length -250 km • 765 kV, 240 MVAr switchable line reactors at Dausa S/s end– 2 nos. • 765 kV, 240 MVAr switchable line reactors at Merta-II S/s end– 2 nos. • Switching equipment for 765kV, 240 MVAr switchable line reactors at Dausa S/s end – 2 nos. • Switching equipment for 765kV, 240 MVAr switchable line reactors at Merta-II PS end – 2 nos.
5	2 nos. 765kV line bays each at Barmer-I PS & Dausa S/s	• 765 kV line bays at Barmer-I PS – 2 nos. • 765 kV line bays at Dausa S/s – 2 nos
6	2 nos. 400kV line bays at Beawar S/s	• 400 kV line bays at Beawar S/s – 2 nos.

Note:

- *The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey*
- *Developer of Barmer-I PS shall provide space for 2 Nos. of 765 kV line bays along with space for 2 Nos. of 330 MVAR switchable line reactor and space for spare reactor unit (110 MVAr) at Barmer -I PS*
- *Sterlite shall provide space for 2 Nos. of 400 kV line bays at Beawar S/s*
- *POWERGRID shall provide space for 2 Nos. of 765 kV line bays at Dausa S/s along with space for 2 Nos. of 240 MVAR switchable line reactor*

Implementation Timeframe: 24 months from the date of SPV transfer

Estimated Cost: ₹ 6,394.94 Crs

(viii) <u>Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur] Complex, Transmission scheme</u>

In 30th CMETS -NR meeting held on 18/06/2024 It was deliberated that Renewable Energy Zones (REZs) were identified by MNRE/SECI with a total capacity of 181.5 GW for likely benefits by the year 2030 in eight states, which includes 75GW REZ potential in Rajasthan comprising of 15 GW Wind and 60 GW Solar. In this regard a Committee on Transmission Planning for RE was constituted by MOP for planning of the requisite Inter State Transmission System required for the targeted RE capacity by 2030 for which a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan was evolved.

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

Sl. No.	Transmission Scheme	RE Potential	Status
A	**Under Bidding/ Approved**		

Sl. No.	Transmission Scheme	RE Potential	Status
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 :6GW) (Bikaner Complex)	6 GW (Solar) Bikaner-IV:6GW	Under Bidding
B	**Planned/Under Planning**		
1	Rajasthan REZ Ph-IV (Part-4 :3.5GW) (Jaisalmer/Barmer Complex)	3.5 GW (Solar) Fatehgarh-IV: 1 GW Barmer-I: 2.5 GW	Recently approved in NCT
2	Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex)	6 GW (Solar) Barmer-II : 6GW	Timeframe:2029 (HVDC)
3	Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bhadla/Bikaner Complex)	6 GW (Solar) Bhadla-IV: 2 GW Bikaner-V: 4 GW*	
4	Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex)	4 GW (Solar) Sirohi: 2 GW Nagaur: 2 GW	Present proposal Timeframe:2027 (HVAC)

Note: *To evolve the transmission scheme, studies are carried out in two timeframes:*

1. *Phase-1 (2027) for 4GW: Transmission scheme for Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex)*
2. *Phase-2 (2029) for 12GW : Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bhadla/Bikaner Complex)*
3. *It was stated that a Joint study meeting was held on 09.05.24 with stakeholders in NR to deliberate & finalize the Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur] Complex, Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bhadla/Bikaner Complex). As part of Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur], following ISTS scheme was proposed in the Joint study meeting*

Immediate Evacuation of Power from Sirohi PS (2GW)

3. 5x500MVA, 400/220kV ICTs at Sirohi S/s along with transformer bays

Common Evacuation of Power from Sirohi PS (2GW) & Merta-II PS (2GW) NR-WR Inter regional corridor

4. Sirohi – Mandsaur PS 765KV D/c line (~ 320kms) along with 240 MVAr switchable line reactor at Sirohi S/s end and 330 MVAr switchable line reactor at Mandsaur PS end for each circuit of Sirohi – Mandsaur PS 765KV D/c line

Western region

5. Mandsaur PS – Khandwa (New) 765kV D/c line (~230km.) along with 240MVAr switchable line reactor for each circuit at each end of Mandsaur PS – Khandwa (New) 765kV D/c line

In the above Joint study meeting, Grid-India observations on proposed transmission schemes as well as on All India Study files (2027 & 2029 time frame) were deliberated and same was also communicated by Grid-India vide their mail dated 09.05.24

Major observations on 2027 timeframe files are as under:

i. LGB of All India file – Higher demand considered in NR,WR & ER region, Merit order of thermal generating units
ii. Blocking of Reactive support from units with no generation
iii. High loading and low voltages in the ER grid in solar peak hours
iv. N-1 non compliance of ICTs in Rajasthan (Intra state and Inter state)
v. N-1 non compliance of ICTs in Western region
vi. Critical loading in 400 kV Farakka – Kahalgaon D/C, 400 kV New Ranchi – PPSP D/C and ICTs in West Bengal in real time
vii. Off loading of 765kV Ghiror – Aligarh D/c line
viii. Critical loading and higher angular separation (>20 degree) under N-1 contingency in few EHVAC lines in NR as well as Low SCR of Sirohi PS
ix. Very low voltages at various nodes in the system including in NR RE Complex
x. Provide Study cases for other scenarios (other than solar maximized scenario)

In the above Joint study meeting, it was decided that comprehensive schemes discussed may be segregated in two phases (Phase-1: Transmission scheme for Rajasthan REZ Ph-V (Part-1: 4GW) (Sirohi/Nagaur Complex) & Phase-2: Transmission scheme for Rajasthan REZ Ph-IV (Part-5 : 6GW) (Barmer Complex) & Rajasthan REZ Ph-IV (Part-6 : 6GW) (Bhadla/Bikaner Complex).

In Phase-1, PSS/E files shall be modified w.r.t discussion and comments received from Grid-India on 2027 time frame study files. Revised PSS/E files will be circulated to NR stakeholders for finalization of proposed scheme in next Joint study/CMETS-NR meeting (Jun'24).

Accordingly as part of Phase-1, revised PSS/E files for solar maximized scenario (SC-4 & 7) along with Scenario 8 (evening peak) & Scenario 9 (night off peak) files for 2027 time frame along with reply to Grid-India observations on 2027 timeframe files was sent on 04.06.24 to all stakeholders.

Subsequently, Grid India vide their mail dated 13.06.24 sent observations on revised PSS/E files. In the CMETS-NR meeting, CEA agreed to the proposed transmission scheme. Grid-India stated that they do not have any specific comment on proposed transmission scheme, however their observation on other issues on 2027 timeframe files are as under:

1. Higher demand considered in WR & ER region
2. High loading in EHVAC lines in ER and in WR-ER in solar peak hours
3. N-1 non compliance of ICTs in Rajasthan (Intra state and Inter state)
4. Dynamic simulation studies incl. inertia studies for various contingency scenarios
5. Critical loading and higher angular separation (>20 degree) under N-1/N-1-1 contingency of 765kV Bikaner-Moga D/c line as well as Low SCR of Sirohi PS

It was deliberated in CMETS-NR meeting that Transmission planning is carried out for peak load scenario. In view of that CTU analyze the historical data (Feb'23 to Feb'24) for solar maximized time and it is observed that load growth of more than 7 % is observed in winter solar peak hours in All India & most of the regions. Green Hydrogen and bulk consumer load is considered over and above to EPS demand in planning studies .

For high loading in EHVAC lines in ER, Grid-India stated that 400 kV Farakka – Kahalgaon D/c & 400 kV New Ranchi – PPSP D/c is overloaded in real time also. In view of RE addition in NR and WR and backing down of thermal units in ER, critical loading is observed in ER and WR-ER corridors in planning studies. In view of that strengthening is being taken up on priority with progressive addition of solar generation in next 2-3 years so that schemes in ER are available for absorption of RE power in Eastern region.

In the meeting, CTU stated that Reconductoring of some of the lines i.e. 400kV Farakka – Kahalgaon and 400kV Talcher – Meramundali is recently agreed in CMETS-ER meeting with a completion schedule of 18 months from allocation. In real time, loading of 400 kV New Ranchi – PPSP D/c is in order as line rating was considered lower, however in planning studies loadings are higher. Reconductoring of Ranchi New – New PPSP 400kV D/c line and any other augmentation in ISTS and commensurate STU network would be identified based on the joint study meeting scheduled next month with WBSETCL. Reconductoring of 400kV Farakka – Sagardighi and 400kV Rourkela – Chaibasa 400kV D/c line would be taken up for discussion in CMETS-ER meeting (Jul'24). An additional corridor from WR to ER needs to be envisaged for relieve the loading around Ranchi area considering LGB of 2027 and 2029 timeframe and change in power flow pattern due to envisaged Green hydrogen load. Augmentation of ICTs in WBSETCL, DVC & Odisha area have been already informed to respective STUs in various CMETS-ER meetings and joint meetings. Matter will be further emphasized to STUs/DVC to take up augmentation of ICTs within time.

It was also decided that due to huge power flow in solar peak hours from NR-ER and WR-ER, and thermal backdown in ER, there may be other system strengthening requirement within ER incl. requirement discussed above. Such transmission strengthening requirements will be planned shortly and taken up for stakeholder consultation based on study results under various scenarios.

For intra state ICT overloading in Rajasthan, RVPN stated that for Hindaun ICT work awarded in Mar'24 (24 months schedule) and for Chittorgarh, Heerapura and Deedwana

ICTs proposal is in process. CTU requested RVPN to expediate the approval of augmentation of ICTs so that same is available in 2027 timeframe.

CTU stated that Loading of 400/220kV Kota (PG) ICT is higher due to low dispatch of KTPS generation units. Loading of Bhinmal ICT is higher in Sc-7 due to increasing demand. Implementation of ICTs may take less time (18 months from approval) as compared to transmission schemes for RE evacuation (30 months from approval). It was stated that necessary augmentation (Kota and Bhinmal ICT) will be carried out in ISTS in consultation with stakeholders once space availability from TSP for Bhinmal and real time loading data from NRLDC is received for implementation in 2027 timeframe or earlier. NRLDC agreed for the same

For dynamic simulation studies and stability studies, CTU stated presently there are convergence issues being faced in dynamic simulation for 2027 scenario for which consultation with IIT Mumbai is also under progress. In view of that, Dynamic simulation studies for planning scenario may take some time.

In 30th CMETS-NR meeting, CTU requested that Grid-India may also share present time frame converged dynamic file which will help to resolve convergence issues in dynamics file for 2027 timeframe w.r.t Generator models (conventional/RE) used by Grid-India. In the CMETS-NR meeting Grid-India stated that they are also facing convergence issues for present timeframe file and prepared dynamics file with some assumptions. They also shared some dynamic data with CTU in the past but only dynamic data will not help to resolve convergence issue. However, for preparation for planning stage dynamic file, CTU and Grid-India can work together to prepare load flow first w.r.t dynamics file and subsequent Dynamic data file (Dyr) shall be prepared with help of models available with Grid-India.

CTU also stated that considering the severe convergence issues in dynamics file, it will be converged on truncated network specific to RE pockets in Rajasthan rather than to converge the file on All India level. NRLDC stated that for transient studies, truncated network modelling will be sufficient.

Further, in the meeting CTU stated that to resolve the issue of higher angular separation (>20 degree) under N-1/N-1-1 contingency of 765kV Bikaner-Moga D/c line, suitable strengthening scheme is already under planning. As part of above scheme LILO of 765kV Bikaner -Moga line is envisaged which will reduce the angular separation (< 30 degree).

Regarding observation for Inertia response of units, NRLDC stated that it may be checked in dynamics file once prepared for critical contingencies i.e. outage of large generation say 5-10GW in RE pockets. In the above condition, inertial response of generation units, Grid frequency variation, df/dt, synchronous condenser response may be analyzed. Same was agreed.

For low SCR at Sirohi PS(4.2), CTU stated that no additional connectivity will be granted beyond 2 GW at 220kV level of Sirohi PS with proposed system (400/220kV ICTs at Sirohi PS+765kV Sirohi - Mandsaur). With growing interconnection and planned network in future, SCR at Sirohi may increase.

Grid-India also enquired about space for STATCOM at Sirohi PS. CTU stated that 765/400kV Sirohi S/s are under bidding and to be implemented as part of Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part 2: 5.5 GW) (Jaisalmer/Barmer Complex).CTU stated that provision of space was kept at Sirohi PS for installation of STATCOM in future based on requirement.

No other comments were received from Stakeholders on proposed scheme. Considering receipt of connectivity application of new RE generators in Sirohi & Nagaur/Merta complexes & based on discussion, following connectivity transmission scheme is agreed as part of Rajasthan REZ Ph-V (Part-1 :4 GW) scheme:

1. <u>Transmission system for immediate Evacuation of Power from Sirohi S/s (2GW)</u>

6. 5x500MVA, 400/220kV ICTs at Sirohi S/s along with associated transformer bays
7. 6 nos. 220kV line bays at Sirohi S/s for RE interconnection
8. 220 kV Sectionalizer bay (1 set) along with 220 kV BC (2 Nos.) bay and 220 kV TBC (2 Nos.) bay at Sirohi S/s

2. <u>Transmission system for immediate Evacuation of Power from Merta-II S/s (2GW*)</u>

9. 3x500MVA, 400/220kV ICTs at Merta-II S/s along with associated transformer bays
10. 4 nos. 220kV line bays at Merta-II S/s for RE interconnection
11. 220 kV Sectionalizer bay (1 set) along with 220 kV BC (1 No.) bay and 220 kV TBC (1 No.) bay at Merta-II S/s

3. <u>Transmission system for Common Evacuation of Power from Sirohi PS (2GW) & Merta-II PS (2GW*)</u>

a. NR-WR Inter regional corridor

12. Sirohi – Mandsaur PS 765KV D/c line (~ 320kms) along with 240 MVAr switchable line reactor at Sirohi S/s end 330MVAr switchable line reactor at Mandsaur PS end for each circuit of Sirohi – Mandsaur PS 765KV D/c line

b. Western region

13. Mandsaur PS – Khandwa (New) 765kV D/c line (~230km.) along with 240MVAr switchable line reactor for each circuit at each end of Mandsaur PS – Khandwa (New) 765kV D/c line

Further, for Sirohi and Nagaur complexes, scheme for Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1: 4 GW) [Sirohi/Nagaur] Complex was recommended by NCT(in the 21st NCT held on 6/08/24) under TBCB with above mentioned changes in the scheme.

Summary of the scheme is given below:

SI No.	Name of the scheme	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1: 4 GW) [Sirohi/Nagaur] Complex	Recommended under TBCB route with RECPDCL as BPC

Detailed scope of the scheme is given below:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
Transmission system for immediate Evacuation of Power from Sirohi S/s (2 GW)		
1	5x500 MVA, 400/220 kV ICTs at Sirohi S/s along with transformer bays	9. 400/220 kV 500 MVA ICTs- 5 Nos. 10. 400 kV ICT bays-5 Nos. 11. 220 kV ICT bays- 5 Nos.
2	6 Nos. 220 kV line bays at Sirohi S/s for RE interconnection	12. 220 kV line bays – 6 Nos.
3	220 kV Sectionalizer bay (1 set) along with 220 kV BC (2 Nos.) bay and 220 kV TBC (2 Nos.) bay at Sirohi S/s	13. 220 kV Sectionalizer bay (1 set) 14. 220 kV BC (2 Nos.) bay and 220 kV TBC (2 Nos.) bay
Transmission system for Common Evacuation of Power from Sirohi PS (2 GW) & Merta-II PS (2 GW*)		
4	Sirohi – Mandsaur PS 765KV D/c line along with 240 MVAr switchable line reactor at Sirohi end and 330 MVAr switchable line reactor at Mandsaur PS end for each circuit of Sirohi – Mandsaur PS 765KV D/c line	Line Length -320 km (Approx) 15. 765 kV line bays at Sirohi S/s – 2 Nos. 16. 765 kV line bays at Mandsaur PS – 2 Nos. 17. 765 kV, 240 MVAr switchable line reactors at Sirohi S/s end– 2 Nos. 18. 765 kV, 330 MVAr switchable line reactors at Mandsaur PS end– 2 Nos. 19. Switching equipment for 765kV, 240 MVAr switchable line reactors at Sirohi S/s end – 2 Nos. 20. Switching equipment for 765kV, 330 MVAr switchable line reactors at Mandsaur PS end – 2 Nos.

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
5	Mandsaur PS – Khandwa (New) 765kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end of Mandsaur PS – Khandwa (New) 765kV D/c line	Line Length ~260 km (Approx) 21. 765 kV line bays at Mandsaur PS – 2 Nos. 22. 765 kV line bays at Khandwa (New) – 2 Nos. 23. 765 kV, 240 MVAr switchable line reactors at Mandsaur PS end– 2 Nos. 24. 765 kV, 240 MVAr switchable line reactors at Khandwa (New) end– 2 Nos. 25. Switching equipment for 765kV, 240 MVAr switchable line reactors at Mandsaur PS end – 2 Nos. 26. Switching equipment for 765kV, 240 MVAr switchable line reactors at Khandwa (New) end – 2 Nos.

Note:

- *Developer of Sirohi S/s shall provide space for 2 Nos. of 765 kV line bays, 400/220 kV ICTs, 220 kv line bays. 220 kV Sectionalizer bay along with 220 kV BC bay and 220 kV TBC bay, switchable line reactors (along with switching equipment) at Sirohi S/s as per the scope*
- *Developer of Mandsaur PS shall provide space for 4 Nos. of 765 kV line bays, switchable line reactors (along with switching equipment) at Mandsaur PS*
- *M/s Sterlite shall provide space for 2 Nos. of 765 kV line bays switchable line reactor (along with switching equipment) at Khandwa S/s*
- *The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey*

Implementation Timeframe: 24 months from allocation of project

Estimated Cost: ₹ 5027.61 Crs (NR Portion: ₹2897.4 Cr & WR Portion : ₹2130.21 Cr)

(ix) Implementation of 1 no. of 400 kV line bay at 765/400/220kV Bhadla-III PS for interconnection of M/s ReNew Solar (Shakti Six) Private Limited (450+550MW) RE project

In the 23rd CMETS-NR meeting held on 29.08.2023, it was decided to grant connectivity under GNA with one no. of 400 kV bay under ISTS scope at Bhadla-III PS for interconnection of RE Project of M/s ReNew Solar (Shakti Six) Private Limited (450+550 MW).

M/s ReNew Solar (Shakti Six) Private Limited sought the start date of connectivity from 31.12.25 for 550 MW & 31.03.2025 for 450 MW. However, considering the schedule of common transmission as well as bay implementation schedule, connectivity under GNA was granted to M/s ReNew Solar (Shakti Six) Private Limited with the interim start date of 30.09.25. M/s ReNew Solar (Shakti Six) Private Limited has also submitted the Con-BGs.

M/s Renew vide letter 10.05.24 informed the revised commissioning schedule of their solar power projects (550MW+450MW) to 31.03.26 and requested to change the start date of connectivity & bay implementation date for both the applications (550+450 MW) to 31st March 2026 in the final grant of Connectivity.

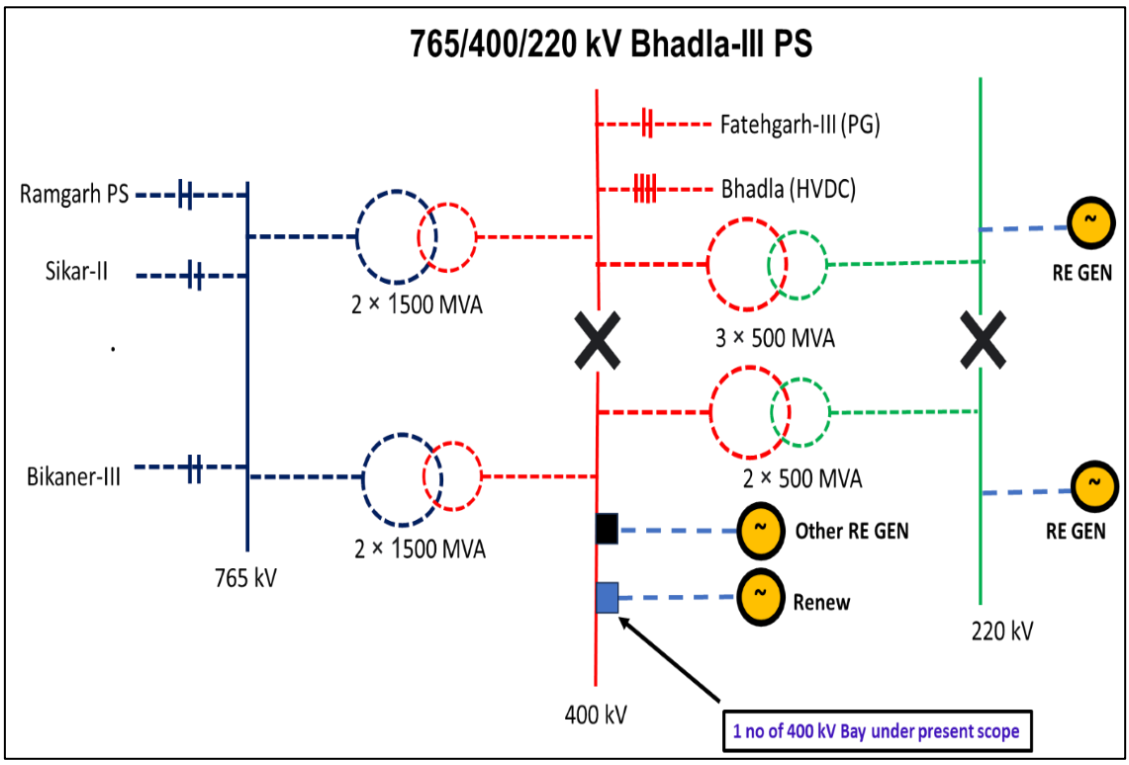


Figure 4-7: Schematic of 765/400/220 kV Bhadla-III PS

The scheme is under implementation with following details:

Project Name - Implementation of 1 no. of 400 kV line bay at 765/400/220kV Bhadla-III PS for interconnection of M/s ReNew Solar (Shakti Six) Pvt. Ltd.

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	1 no. of 400 kV line bay at 765/400/220 kV Bhadla-III PS for interconnection of RE project (M/s ReNew Solar (Shakti Six) Private Limited)	400 kV line bay – 1 no.

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 14.06.2024 with an implementation time frame of 31.03.2026.

Estimated Cost: ₹ 13.37Crs.

(x) <u>Augmentation of 400/220kV, 1x500 MVA ICT (4th) to cater the N-1 contingency requirement at 765/400/220kV Bikaner PS</u>

In the 8th CMETS-NR meeting held on 30.06.22 and 56th NRPC meeting held on 29.07.22, agenda for Implementation of "N-1" contingency at RE pooling substations in NR was deliberated. In the meeting ICTs at RE pooling stations incl. 400/220kV, 500MVA (4th) ICT at Bikaner PS was agreed to be taken up for implementation with timeframe of 15 months from the date of allocation of project or evacuation requirement beyond 1000 MW at 220kV level of Bikaner PS whichever is later.

Further agenda for implementation of "N-1" contingency at RE pooling substations in NR was deliberated in 73rd NRPC meeting held on 21.05.24. In the meeting it was mentioned that under Connectivity Regulations 2009, Connectivity & LTA were different products. However, subsequent to notification of GNA regulations, connectivity has become a single merged product which is granted along with equal quantum of GNA.

At present, Bikaner (PG) S/s has 400/220 kV transformation capacity of 1000 MVA(2x500MVA). Further, 3rd 500MVA ICT is currently under implementation and is expected to be commissioned by Jun'24. At present, 935 MW of RE is already interconnected at Bikaner PS at 220 kV level and additional connectivity of 300 MW (70+105MW+125MW) is also granted to M/s Shikhar Surya (One) Pvt. Ltd. and applicant have completed the necessary transition requirement of connectivity of 300MW from Connectivity regulations 2009 to GNA Regulations 2022.

Considering above, total connectivity of 1235 MW is granted at 220kV level of Bikaner (PG). Therefore, there is requirement of 4th, 500MVA ICT at Bikaner (PG) to meet N-1 compliance beyond 1000 MW at 220kV level.

In the 73rd NRPC meeting, It was also deliberated that considering project timelines of ICT augmentation, implementation timeframe for above augmentation may be kept as 18 months instead of 15 months due to practical issues. In view of the deliberations, Augmentation with 400/220 kV, 500 MVA (4th) ICT at Bikaner PS along with associated transformer bays was agreed in 73rd NRPC meeting held on 21.05.24.

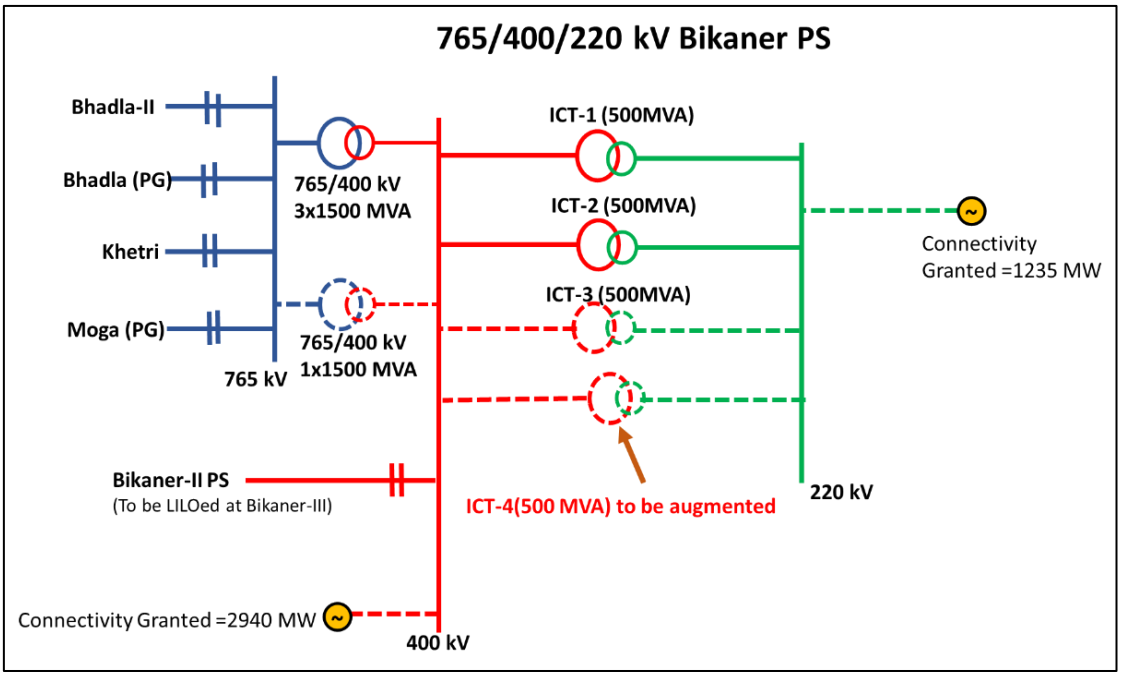


Figure 4-8: Schematic of 765/400/220 kV Bikaner PS

The scheme is under implementation with following details:

Project Name: Augmentation of Transformation Capacity at 765/400/220kV Bikaner PS in Rajasthan by 400/220kV, 1x500 MVA ICT (4th)

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of Transformation Capacity at 765/400/220kV Bikaner PS in Rajasthan by 400/220kV, 1x500 MVA ICT (4th) along with associated transformer bays	27. 500 MVA, 400/220 kV ICT- 1 no. 28. 400 kV ICT bay – 1 no. 29. 220 kV ICT bay – 1 no

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 18.07.2024 with an implementation time frame of 18 months from the date of issuance of OM by CTUIL i.e. 18.01.2026.

Estimated Cost: ₹ 57.59 Crs.

(xi) <u>Augmentation with 400/220 kV, 1x500 MVA Transformer (10th) at Fatehgarh-2 PS</u>

Augmentation with 400/220 kV, 1x500 MVA, Transformer (10th) at Fatehgarh-2 PS was agreed as part of "transmission system for evacuation of power from REZ in Rajasthan (20 GW) under Phase-III Part J" in 5th NCT meeting held on 25.08.2021 and 02.09.2021. In that meeting, it was also agreed that Implementation of above ICT shall be taken up after LTA of 4490 MW at 220 kV level of Fatehgarh-2 PS. Subsequently, based on NCT recommendation, MoP vide OM dated 01.12.2021 awarded above transmission scheme to CTUIL with implementation timeframe of 15 months from MoP OM or evacuation requirement beyond 4490 MW at 220 kV level of Fatehgarh-2 PS, whichever is later.

Further, CTUIL vide letter dated 02.12.2021 allocated above scheme to POWERGRID based on MoP OM dated 01.12.2021.

220 kV level of Fatehgarh-2 PS is implemented in two sections i.e. Section-I & II. Further, both the 220kV sections are implemented in geographically opposite sides (way apart from each other and not electrically connected) as per GA and layout of pooling station. However, 400 kV & 765 kV bus remained common for both the yards. At present, RE Connectivity of 2490MW under GNA is granted at Section-I and 1970MW is granted at Section-II, thus making total connectivity at Fatehgarh-2 PS as 4460MW which is less than 4490 MW.

Subsequently, Manual on Transmission Planning Criteria was published by CEA in Mar'23. As per the above, '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. As both the 220kV sections of Fatehgarh-2 PS are electrically isolated and have more than 1000MW RE connectivity in respective sections, 'N-1' criteria to be fulfilled at both the sections. Keeping above in view, 1x500MVA, 400/220kV ICT (6th) at Section-I was awarded which is under implementation (Jul'24).

Considering requirement of 400/220kV ICT (in Fatehgarh-II Section-II) for N-1 compliance in Fatehgarh-II PS |(Section-II), it was proposed that 1x500 MVA, 400/220 kV ICT (now 11th ICT) at Fatehgarh-II PS as approved by MoP vide OM dated 01.12.2021 based on recommendation in 5th NCT meeting may be taken up for implementation with 18 month implementation schedule considering present timeline for ICT augmentation (instead of earlier 15 months) to fulfil 'N-1' criteria as per CEA Manual on Transmission Planning Criteria, 2023.

After deliberations, NCT (in 20th NCT meeting dated 25/06/2024) approved modification in the transmission scheme for "Augmentation with 400/220 kV, 1x500 MVA Transformer (10th) at Fatehgarh-2 PS" as mentioned below so that same can be taken up for implementation:

Earlier (as per MOP OM dated 01.12.21)	Amendment
30. Augmentation with 400/220 kV, 1x500 MVA Transformer (10th) at Fatehgarh-2 PS 31. 400/220 kV 500 MVA ICT:1 no 32. 400 kV ICT bays – 1 Nos. 33. 220 kV ICT bays - 1 Nos. **Implementation Timeframe-** 15 months from MOP OM or evacuation requirement beyond 4490 MW at 220 kV level of Fatehgarh-2, whichever is later	34. Augmentation with 400/220 kV, 1x500 MVA Transformer (11th) at Fatehgarh-II PS (5th ICT in Fatehgarh-II section-II) 35. 400/220 kV 500 MVA ICT:1 no 36. 400 kV ICT bays – 1 no. 37. 220 kV ICT bays - 1 no.

Implementation Timeframe: 18 months [for N-1 compliance in Fatehgarh-II PS (Section-II)]

Estimated Cost: ₹ 54.60Crs.

(xii) Augmentation of 400/220 kV, 1x500 MVA (10th) ICT at Bikaner-II PS

In the 35th CMETS-NR held on 29/10/24, it was stated that 400/220 kV Bikaner-II PS is an existing RE pooling station with transformation capacity of 2000 MVA (4x500MVA). Further, 5 no. of 500 MVA 400/220kV, ICTs are under implementation with the schedule progressively from Dec'24 up to Jan'26. At present, total connectivity granted at Bikaner-II PS is 5460 MW, out of this, 4460 MW is granted at 220 kV level and 1000 MW is granted at 400 kV level.

As per manual on Transmission planning criteria 2023 "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. Considering the total connectivity granted of 4460 MW at 220 kV level at Bikaner-II PS, augmentation of 1x500 MVA ICT (10th) is required to be taken up to meet N-1 compliance.

In view of the deliberations, Augmentation with 400/220 kV, 1x500 MVA (10th) ICT at Bikaner-II PS along with associated transformer bays was agreed in 35th CMETS-NR meeting held on 29/10/2024.

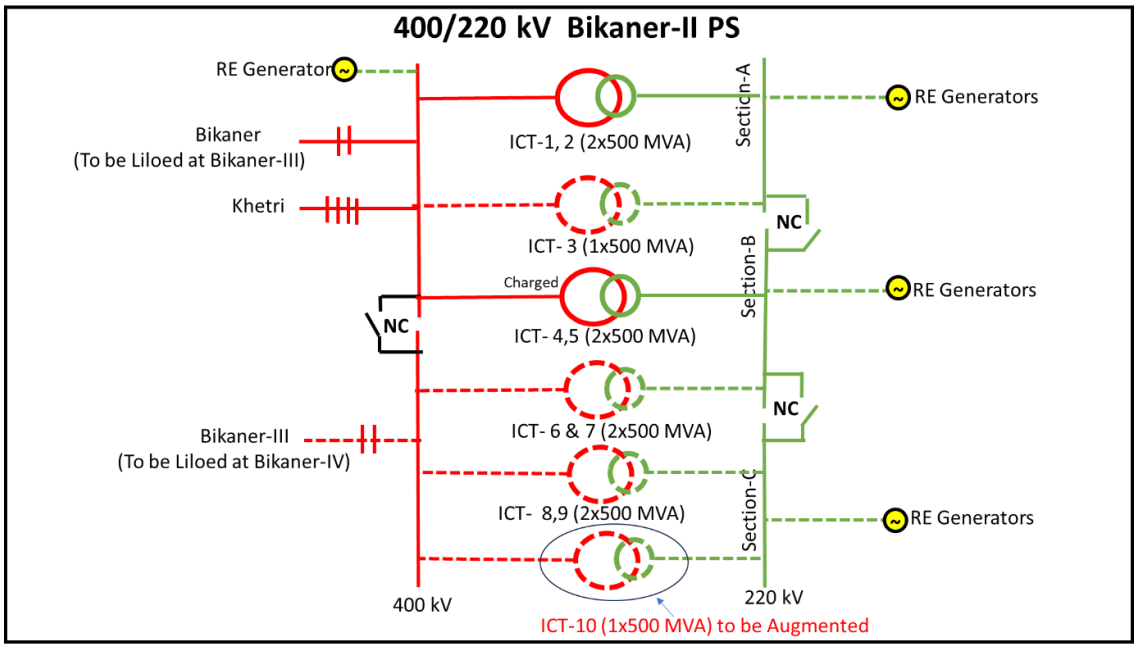


Figure 4-9: Schematic of 400/220 kV ICT(10th) Bikaner-II PS

The scheme is under implementation with following details:

Project Name: Augmentation of 400/220 kV, 1x500 MVA (10th) ICT at Bikaner-II.

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of 400/220 kV, 1x500 MVA (10th) ICT at Bikaner-II PS along with associated transformer bays *400kV Bus extension for 1 nos. future 400kV Bay	38. 500 MVA, 400/220 kV ICT- 1 no. 39. 400 kV ICT bay- 1 no. 40. 220 kV ICT bay- 1 no

Implementation Timeframe: This scheme was awarded to POWERGRID Bikaner Transmission System Limited through RTM mode vide CTU OM dated 20/01/2025 with an implementation time frame of 18 months i.e., anticipated by 20/07/2026.

Estimated Cost: ₹ 50.71Crs.

(xiii) Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6th) at 765/400/220kV Bikaner-III PS

In the 34th CMETS-NR meeting held on 20/09/20.24, it was deliberated that at present, total connectivity granted at Bikaner-III PS is 4667 MW, out of this, 2267 MW is granted at 220 kV level and 2400 MW is granted at 400 kV level. Establishment of Bikaner-III PS and associated transmission system is currently under implementation as part of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex)" and is expected to be commissioned progressively from Dec'25.

The above scheme involves establishment of 765/400/220 kV Bikaner-III PS along with transformation capacity of 6x1500 MVA 765/400 kV ICTs & 5x500 MVA 400/220 kV ICTs. As per manual on Transmission planning criteria 2023 "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. Considering the connectivity granted of 2267 MW at 220 kV level at Bikaner-III PS, augmentation of 1x500 MVA ICT is required to be taken up to meet N-1 compliance.

In view of the above deliberations, Augmentation with 400/220 kV, 500 MVA (6th) ICT at Bikaner-III PS along with associated transformer bays was agreed in the 34th CMETS-NR meeting held on 20.09.2024.

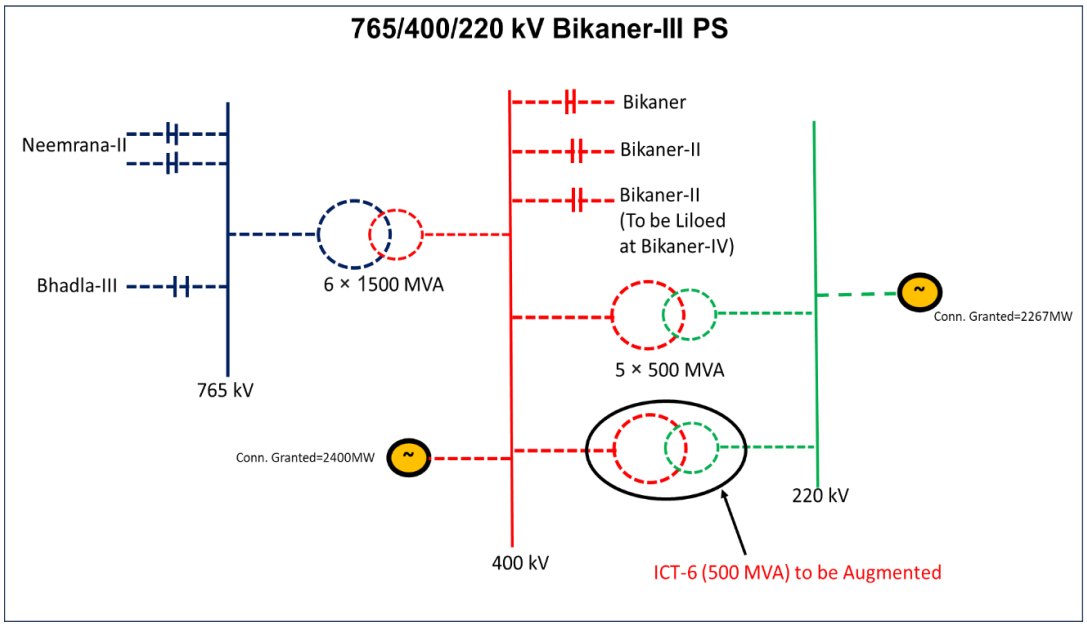


Figure 4-10: Schematic of 400/220 kV ICT(6th) Bikaner-III PS

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6th) at 765/400/220kV Bikaner-III PS

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of 400/220 kV, 1x500 MVA (6th) ICT at Bikaner-III PS along with associated transformer bays	500 MVA, 400/220 kV ICT- 1 no. 400 kV ICT bay - 1 no. 220 kV ICT bay- 1 no.

Implementation Timeframe: This scheme was awarded to POWERGRID Bikaner Neemrana Transmission Limited through RTM mode vide CTU OM dated 20/01/2025 with an implementation time frame of 18 months i.e. anticipated by 20/07/2026.

Estimated Cost: ₹ 49.60 Crs.

(xiv) <u>Implementation of 1 nos. of 400 kV line bay for interconnection of M/s ReNew Solar Power Private Limited (300MW+300MW) RE power project at 765/400/220kV Fatehgarh-IV (sec-2) PS.</u>

In the 25th CMETS-NR meeting held on 31.10.2023, it was agreed to grant connectivity to M/s ReNew Solar Power Private Limited for its (2200000186- 300MW & 2200000187-300MW) Solar power project through 1 nos. of 400kV line bay at Fatehgarh-IV PS(Sec-2) PS. M/s ReNew Solar agreed for the same with 400 kV line bay at Fatehgarh-IV PS(Sec-2) PS end under ISTS scope. M/s ReNew Solar Power Private Limited was granted in principle grant of connectivity vide CTU letter dated 13.12.23

with the interim start date of 28.02.26 for each 300MW RE Power project. M/s ReNew Solar Power Private Limited has also submitted the requisite Con-BGs.

Therefore, considering above implementation of 1 no. of 400 kV line bay at Fatehgarh-IV (Sec-II) PS is to be taken up for interconnection of RE projects of M/s ReNew Solar Power Private Limited.

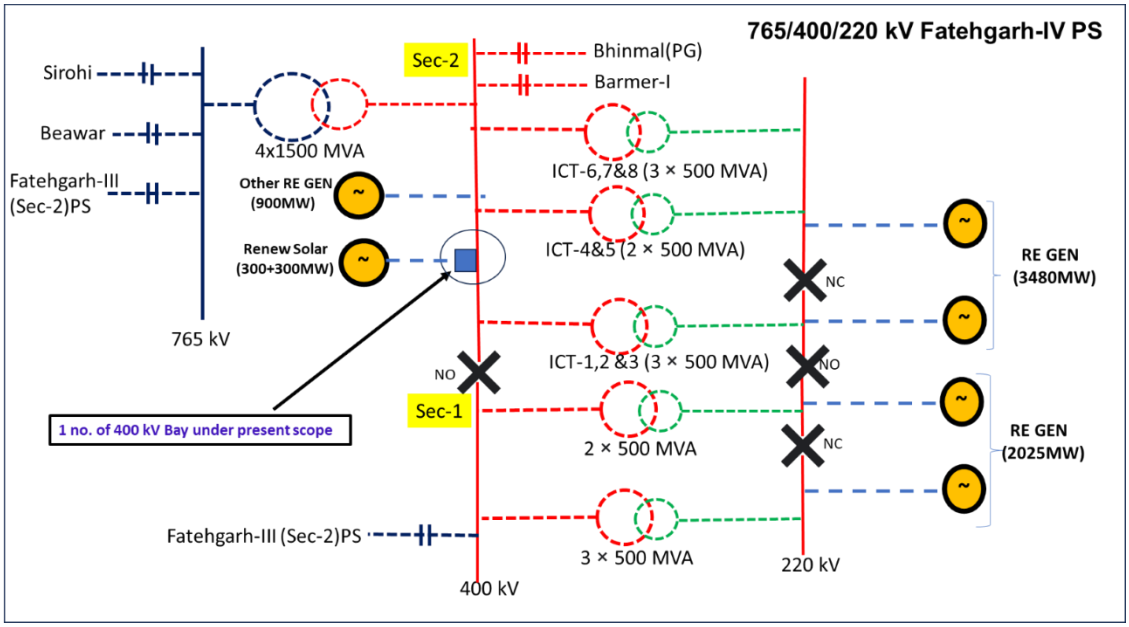


Figure 4-11: Schematic of bay extension at Fetehgarh-IV PS

The scheme is under implementation with following details:

Project Name - Implementation of 1 nos. of 400 kV line bay for interconnection of M/s ReNew Solar Power Private Limited (300MW+300MW) RE power project at 765/400/220kV Fatehgarh-IV (sec-2) PS.

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	1 nos. of 400 kV line bay at 765/400/220 kV Fatehgarh-IV (sec-2) PS for interconnection of M/s ReNew Solar Power Private Limited (300MW+300MW) RE power projects	41. 400 kV line bay – 1 no.

Implementation Timeframe: This scheme was awarded to Rajasthan IV A Power Transmission Limited through RTM mode vide CTU OM dated 20/01/2025 with an implementation time frame of 07.11.2026.

Estimated Cost: ₹ 11.42Crs.

(xv) <u>Augmentation of 1x500 MVA, 400/220 kV ICT at Bhadla-II PS (4th ICT at Section-1A) to cater the N-1 contingency requirement at 765/400/220kV Bhadla-II PS</u>

In the 8th CMETS-NR meeting held on 30/06/2022 and 56th NRPC meeting held on 29.07.22, agenda for Implementation of "N-1" contingency at RE pooling substations in NR was deliberated. In the meeting Augmentation with 400/220kV, 1x500MVA Transformer at Bhadla-II PS (4th ICT at Section-1A) was agreed to be taken up for implementation with 15 months from the date of allocation of project or evacuation requirement beyond 1000 MW at 220kV level of Bhadla-2(Section-1A) whichever is later.

Further agenda for implementation of "N-1" contingency at RE pooling substations in NR was again deliberated in the 73rd NRPC meeting held on 21.05.24. In the meeting it was mentioned that under Connectivity Regulations 2009, Connectivity & LTA were different products. However, subsequent to notification of GNA regulations, connectivity has become a single merged product which is granted along with equal quantum of GNA.

In the 73rd NRPC meeting, proposal was technically agreed for taking up implementation of 400/220kV, 1x500MVA Transformer at Bhadla-II PS (4th ICT at Section-1A) based on the trigger point requirement i.e. 18 months from the date of allocation of project (immediate evacuation requirement beyond 1000 MW at 220kV level of Bhadla-2(Section-1A)) or N-1 implication, whichever condition arrives earlier. It was agreed that above ICT will be taken up for implementation for which CTUIL will take up for the approval of above ICT based on its delegation of power without approaching the NRPC forum.

The proposal was further deliberated in 34th Consultation Meeting for Evolving Transmission Schemes in Northern Region held on 20.09.2024

In the meeting it was stated that at present Bhadla-II PS (Sec-1A) has 400/220 kV transformation capacity of 1500 MVA(3x500MVA) whereas connectivity granted is 1520 MW and all the connectivity grantees have already completed the transition requirement of connectivity from Connectivity regulations 2009 to GNA Regulations 2022. Therefore, with 1520 MW of Connectivity at 220kV level of Bhadla-II PS(Sec-1A), implementation of 4th, 400/220 kV ICT needs to be taken up to meet N-1 reliability compliance at 220kV level.

In view of the deliberations, Augmentation with 400/220 kV, 500 MVA (4th) ICT at Bhadla-II PS (Sec-1A) along with associated transformer bays was agreed in the 34th CMETS-NR meeting held on 20.09.2024

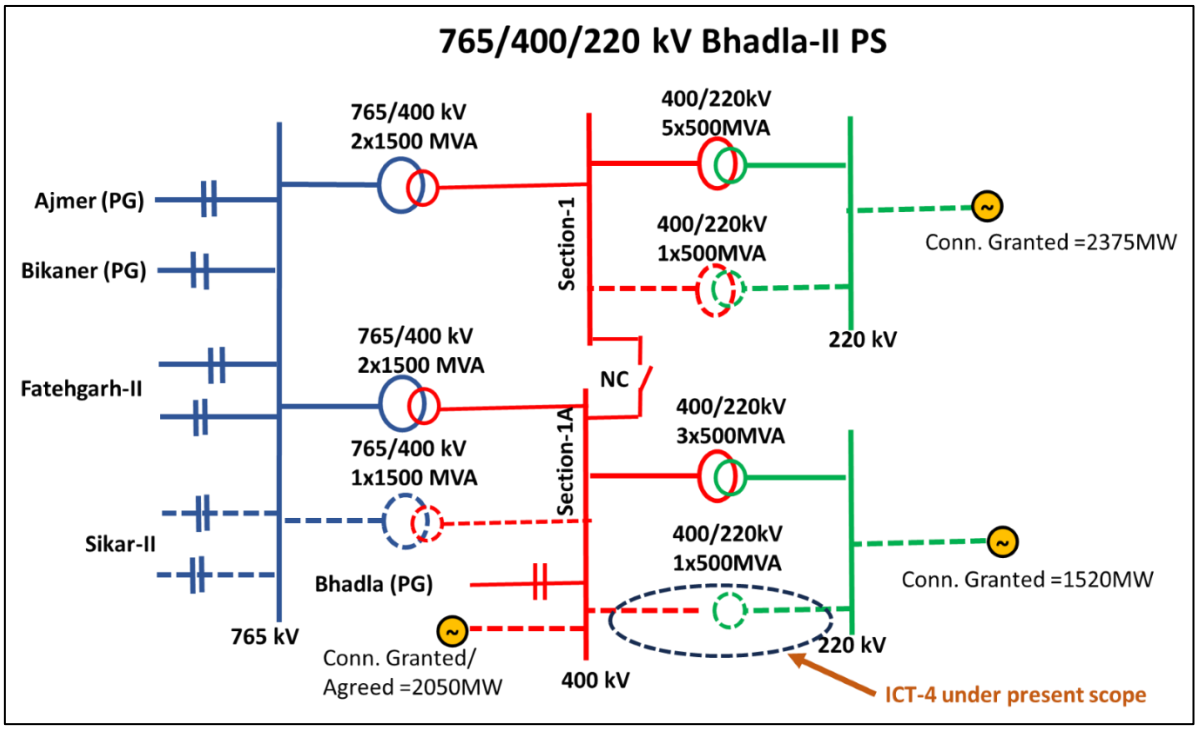


Figure 4-12: Schematic of 400/220 kV ICT(4h) Bhadla-II PS

The scheme is under implementation with following details:

Project Name - Augmentation of 1x500 MVA, 400/220 kV ICT at Bhadla-II PS (4th ICT at Section-1A) to cater the N-1 contingency requirement at 765/400/220kV Bhadla-II PS

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (4th) at Bhadla-II PS (Section-1A) along with associated transformer bays	42. 500 MVA, 400/220 kV ICT- 1 no. 43. 400 kV ICT bay- 1 no. 44. 220 kV ICT bay- 1 no.

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 20.01.2025 with an implementation time frame of 18 months i.e. anticipated by 20.07.2026.

Estimated Cost: ₹ 42.18Crs.

(xvi) <u>Augmentation of 1x500 MVA, 400/220 kV ICT at Bhadla-II PS (4th ICT at Section-1A) to cater the N-1 contingency requirement at 765/400/220kV Bhadla-II PS</u>

In the 8th CMETS-NR meeting held on 30.06.22 and 56th NRPC meeting held on 29.07.22, agenda for Implementation of "N-1" contingency at RE pooling substations in NR was deliberated. In the meeting ICTs at RE pooling stations incl. 400/220kV, 500MVA (6th) ICT at Bhadla-II PS was agreed to be taken up for implementation with

timeframe of 15 months from the date of allocation of project or evacuation requirement beyond 2075 MW at 220kV level of Bhadla-II PS whichever is later.

Further agenda for implementation of "N-1" contingency at RE pooling substations in NR was deliberated in 73rd NRPC meeting held on 21.05.24. In the meeting it was mentioned that under Connectivity Regulations 2009, Connectivity & LTA were different products. However, subsequent to notification of GNA regulations, connectivity has become a single merged product which is granted along with equal quantum of GNA.

At present Bhadla-II PS (Sec-1) has 400/220 kV transformation capacity of 2500 MVA(5x500MVA) whereas connectivity granted is 2375 MW and all the connectivity grantees have already completed the transition requirement of connectivity from Connectivity regulations 2009 to GNA Regulations 2022.

Therefore, with 2375 MW of Connectivity at 220kV level of Bhadla-II PS(Sec-1), implementation of 6th, 400/220 kV ICT needs to be taken up to meet N-1 reliability compliance at 220kV level.

In the 73rd NRPC meeting held on 21.05.24 Augmentation with 400/220 kV, 500 MVA (6th) ICT at Bhadla-II PS (Sec-1) along with associated transformer bays was agreed.

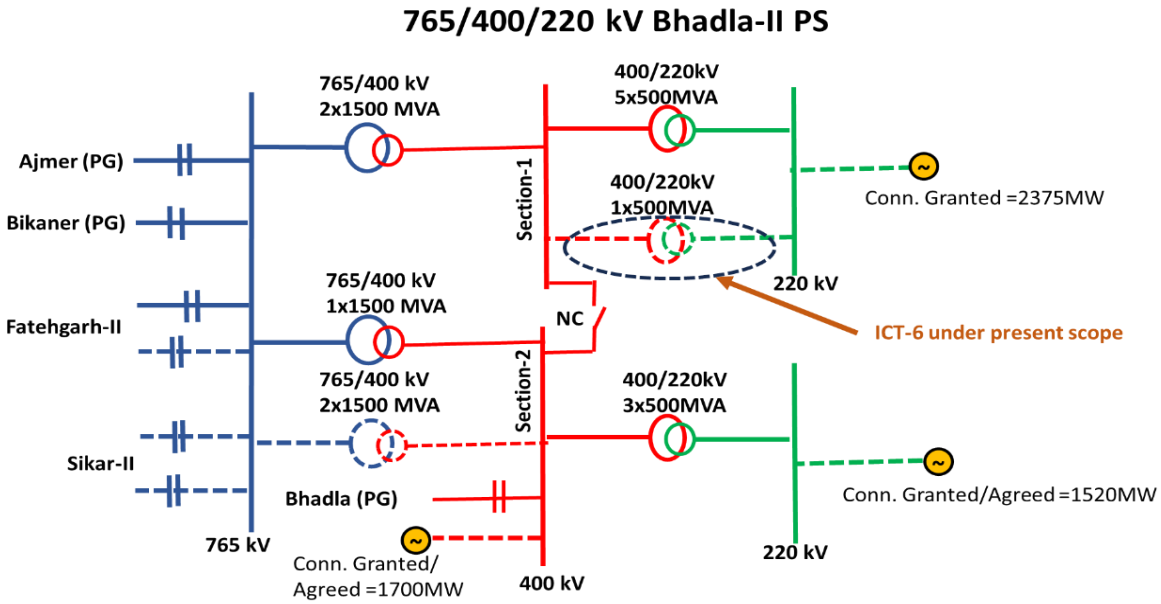


Figure 4-13: Schematic of 400/220 kV ICT(6th) Bhadla-II S/s

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6th) at Bhadla-II PS (Section-1) to cater the N-1 contingency requirement at 765/400/220kV Bhadla-II PS.

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6th) at Bhadla-II PS (Section-1) along with associated transformer bays	45. 500 MVA, 400/220 kV ICT- 1 no. 46. 400 kV ICT bay- 1 no. 47. 220 kV ICT bay- 1 no. 48. 220kV Cable (1ph) -1 Km (approx.) 49. 220kV Cable termination Kit - 1 Set

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 13/09/2024 with an implementation time frame of 18 months.

Estimated Cost: ₹ 59.58Crs.

4.4.2 Haryana

1. <u>Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Hissar (PG) substation.</u>

The proposal was deliberated in the 33rd CMETS-NR meeting held on 05.08.24. In the meeting It was deliberated that in 74th Northern Regional Power Committee (NRPC) meeting, held on 29.06.2024, NRLDC agenda for N-1 non-compliance in real-time at 400/220kV Hisar ICTs was deliberated and it was decided that capacity augmentation may be planned at Hisar (PG) to meet the N-1 compliance issue.

At present, 400/220kV Hisar (PG) Substation have 3x315 MVA ICTs thus makes total transformation capacity of 945 MVA. From the loading pattern of Hisar ICTs (3x315 MVA), it is observed that maximum loading on 400/220 kV ICTs is about 965 MW (ICT-1-333MW, ICT-2-333 MW & ICT-3MW-297MW) in past one year. From the analysis, it emerged that peak loading of ICTs are breaching N-1 limit (about 770 MW) in Summer season (May'24-Jul'24) for sufficient duration of time.

POWERGRID vide mail dated 10.07.2024 confirmed space availability for Augmentation of 400/220kV transformer along with transformer bays at 400/220kV Hisar (PG) S/s. CEA and NRLDC agreed for the requirement of ICT augmentation at Hisar (PG).

Considering to meet the N-1 criteria of loading of ICTs, it was agreed to implement one no. of 400/220kV, 500 MVA ICT (4th) at Hissar (PG) S/s under ISTS in 33rd CMETS-NR meeting held on 05.08.24.

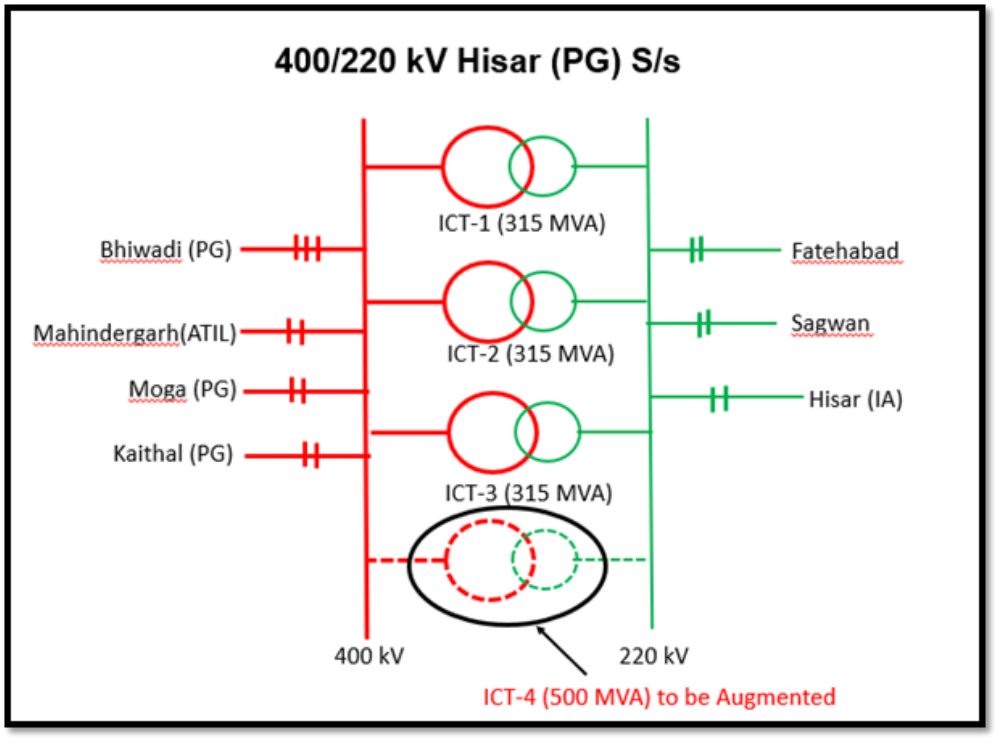


Figure 4-14: Schematic of 400/220 kV ICT(4th) Hisar S/s

Detailed scope of work for implementation:

Project Name - Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Hissar (PG) substation.

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of 400/220 kV ,1x500 MVA (4th) ICT at Hissar (PG) S/s along with transformer bays	• 500 MVA, 400/220 kV ICT - 1 no. • 400 kV ICT bays – 1 • 220 kV ICT bay – 1 no.

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 13/09/2024` with an implementation time frame of 18 months from the date of issuance of OM by CTUIL.

Estimated Cost: ₹ 49.60Crs

4.4.3 Himachal Pradesh

1. <u>Augmentation of 1x500 MVA (4th) ICT at 400/220 kV Nallagarh substation</u>

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:

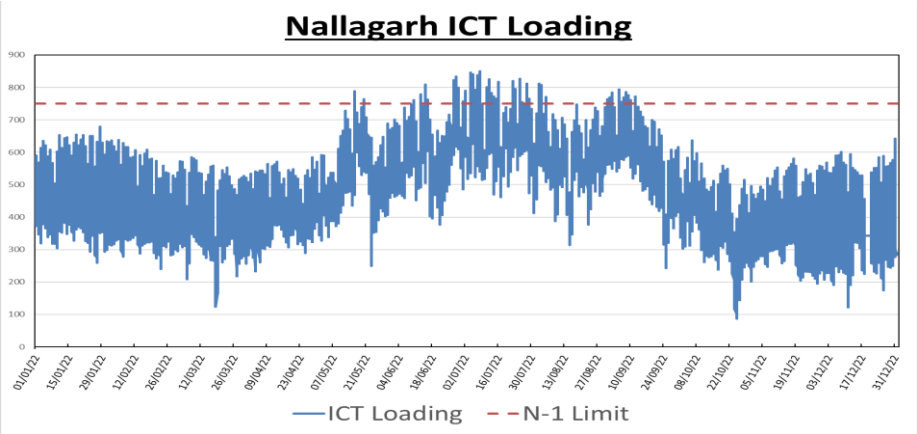


Figure 4-15: Loading of Nallagarh ICTs of Past one year (Source: Grid-India)

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
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)

Implementation Timeframe: 24 months from the issue of OM by CTUIL (Best efforts shall be carried out to implement the transmission scheme within 18 months from the issue of OM by CTUIL)

Estimated Cost: ₹ 63.08Crs.

2. Modification in Transmission system for evacuation of power from Luhri Stage-I HEP

Transmission system for evacuation of power from Luhri Stage-I HEP was discussed and agreed in the 8th NCT meeting held on 25/03/2022. Scheme was notified in Gazette dated 02/06/2022 and RECPDCL was appointed as the BPC of the transmission scheme. The timeframe of the above transmission scheme was revised to 31/08/2026 in the 14th NCT meeting held on 09/.06/.2023. During the course of bidding, the logistics issues in transportation of large size equipment was highlighted by bidders. Regarding this matter, multiple meetings were held.

In the meeting taken by Addl. Secretary (Trans), MoP on 07./06/.2024 to discuss the Logistics issues in the ongoing bidding of Luhri Stage -I HEP Transmission scheme, SJVN suggested to shift the location of Nange (ISTS) Pooling Station (presently proposed at Ogli village) to a suitable location near Koldam area adjacent to National Highway (NH) in order to remove the hurdles associated with transportation of heavy equipment to the proposed location of pooling station and accordingly, SJVN would bring 220 kV dedicated line from Luhri-I & Sunni Dam to the new ISTS Pooling station near Koldam.

Accordingly, the proposal was further deliberated in 20th NCT meeting held on 25/06/2024 wherein it was stated that in view of revised location of Pooling station (near Koldam), line length of Pooling station (near Koldam)-Ropar section is reduced and therefore 50 MVAr line reactor at Ropar S/s is not required due to reactive overcompensation (~95%). Overall, there will be reduction in cost of the scheme from Rs. 432 cr to Rs. 305 cr. After deliberations, NCT approved modified Transmission system for evacuation of power from Luhri Stage-I HEP scheme.

Further to finalize the suitable locations for the ISTS Pooling station near Koldam, various meetings among stakeholders were convened to finalize the location of proposed Pooling station. In this regard, a meeting was held on 15/07/2024, wherein RECPDCL was directed to explore land alternatives near Bilaspur for the location of the proposed 400/220 kV ISTS Koldam pooling station. Accordingly, RECPDCL has carried out the survey works in consultation with HPPTCL & SJVN has identified feasible land locations.

Subsequently, CEA vide mail 30./07/20.24 informed that in the meeting held on 25./07/.2024 wherein location for establishment of pooling station under the transmission scheme "Establishment of Inter- State Transmission System for Evacuation of Power from Luhri Stage-I HEP" is finalized near Bilaspur area (HP).Accordingly, modification in the scheme was also proposed wherein instead of Nange (GIS) Pooling Station – Koldam 400 kV D/c line (only one circuit is to be terminated at Koldam while second circuit would be connected to bypassed circuit of Koldam – Ropar/Ludhiana 400kV D/C line), LILO of one circuit of Koldam – Ropar/Ludhiana 400kV D/C line at Pooling station (now near Bilaspur) was proposed.

In view of new proposed location near Bilaspur and above proposal, studies were again carried out for evacuation of power from Luhri Stage-I HEP. The proposal was

deliberated in 33rd CMETS-NR meeting held on 05.08.24. In the meeting PSTCL stated that with revised proposal, 400/220kV Ropar ICTs (2x500MVA) may become N-1 non-compliant in case of no thermal generation considered at Ropar GGSSTP units (4*210MW). PSTCL stated that Ropar GGSSTP thermal plants are about to complete their useful life and there is uncertainty on availability of above thermal units in future. CTU stated that in planning studies such contingencies cannot be considered as per Manual on Transmission Planning criteria, however PSTCL views may be noted in the meeting. PSTCL stated that they will provide their management decision on the above proposal w.r.t. consideration of GGSSTP thermal plants in studies and requirement of Ropar ICT augmentation in case of GSSTP thermal units out of system.

Accordingly, Iit was concluded in above CMETS-NR meeting that as 400/220kV ICTs are yet to commission at Ropar S/s and therefore based on real time loading and status Ropar GGSSTP thermal generation in future, augmentation of ICT at Ropar S/s will be taken up by PSTCL. Further as per deliberation in the meeting held on 25/07/2024 of 220kV line bays (future scope) at polling station near Bilaspur are also being reduced to 8 nos. Details of approved transmission scheme w.r.t. earlier approved scheme in 20th NCT is as under:

The scheme is under implementation with following details:

Project Name - Transmission system for evacuation of power from Luhri Stage-I HEP

Sl. No.	Earlier Transmission Scheme (As per 20th NCT)	-Modified Transmission Scheme
1	Establishment of 7x105 MVA, 400/220kV **Pooling Station near Koldam** (**GIS)** along with 125 MVAR (420kV) Bus Reactor (1-Ph units along with one spare unit) • 315MVA, 400/220 kV ICT: 2 Nos. (7x105 MVA including 1 spare ICT) • 400kV ICT bays: 2 Nos. • 220 kV ICT bays: 2 Nos. • 400 kV, 125 MVAr Bus Reactor – 1 No. • 400 kV Bus Reactor bay- 1 No. • 400 kV Line Bays- 2 Nos. **Future provisions: Space for** • 400/220kV ICTs (315 MVA with single phase units) along with associated bays: 3 Nos. • 400 kV line bays along with switchable line reactor: 3 Nos. • 220 kV line bays: **10 Nos.** • 220kV bus sectionalizer: 1 set	Establishment of 7x105 MVA, 400/220kV **Pooling Station near Bilaspur** (**GIS)** along with 125 MVAR (420kV) Bus Reactor (1-Ph units along with one spare unit) • 315MVA, 400/220 kV ICT: 2 Nos. (7x105 MVA including 1 spare ICT) • 400kV ICT bays: 2 Nos. • 220 kV ICT bays: 2 Nos. • 400 kV, 125 MVAr Bus Reactor – 1 No. • 400 kV Bus Reactor bay- 1 No. • 400 kV Line Bays- 2 Nos. **Future provisions: Space for** • 400/220kV ICTs (315 MVA with single phase units) along with associated bays: 3 Nos. • 400 kV line bays along with switchable line reactor: 3 Nos. • 220 kV line bays: **8 Nos.** • 220kV bus sectionalizer: 1 set
2	Pooling Station near Koldam (GIS)– Koldam (NTPC) 400 kV D/C line (Triple snowbird) (only one circuit is to be terminated at Koldam(NTPC) while second	• **LILO of one ckt of 400kV Koldam (NTPC) – Ropar (Triple snowbird) D/c line at Pooling Station near Bilaspur (GIS)– 1 km**

Sl. No.	Earlier Transmission Scheme (As per 20th NCT)	-Modified Transmission Scheme
	circuit would be connected to bypassed circuit of Koldam(NTPC) – Ropar/Ludhiana 400kV D/C line) – 7 km	
3	1 no. of 400kV line bay at Koldam S/s for termination of Pooling Station near Koldam (GIS)– Koldam(NTPC) 400 kV line along with 125 MVAR (420kV) Bus Reactor at Koldam(NTPC) S/s (1-Ph units along with one spare unit) • 400 kV Line Bay- 1 no. • 400 kV, 125 MVAr Bus Reactor# - 1 no. (to be terminated in existing line bay at Koldam(NTPC), which would be available due to bypassing of one circuit of Koldam – Ropar/Ludhiana 400 kV D/c line at Koldam(NTPC) S/s)	• **1x125 MVAR (420kV) Bus Reactor at Koldam(NTPC) S/s (1-Ph units along with one spare unit)** • **125 MVAR, 420kV Bus Reactor – 1 no.** • **400kV Bus Reactor Bay – 1 no**.
4	• Bypassing one ckt of Koldam(NTPC) – Ropar/Ludhiana 400kV D/C line (Triple snowbird) at Koldam(NTPC) and connecting it with one of the circuit of **Pooling Station near Koldam (GIS)**– Koldam(NTPC) 400kV D/c line (Triple snowbird), thus forming **Pooling Station near Koldam** – Ropar/ Ludhiana one line (Triple snowbird)	**-To be Deleted -**
	Estimated Cost: ₹ 305 Cr	**Estimated Cost:** ₹ 242 Cr

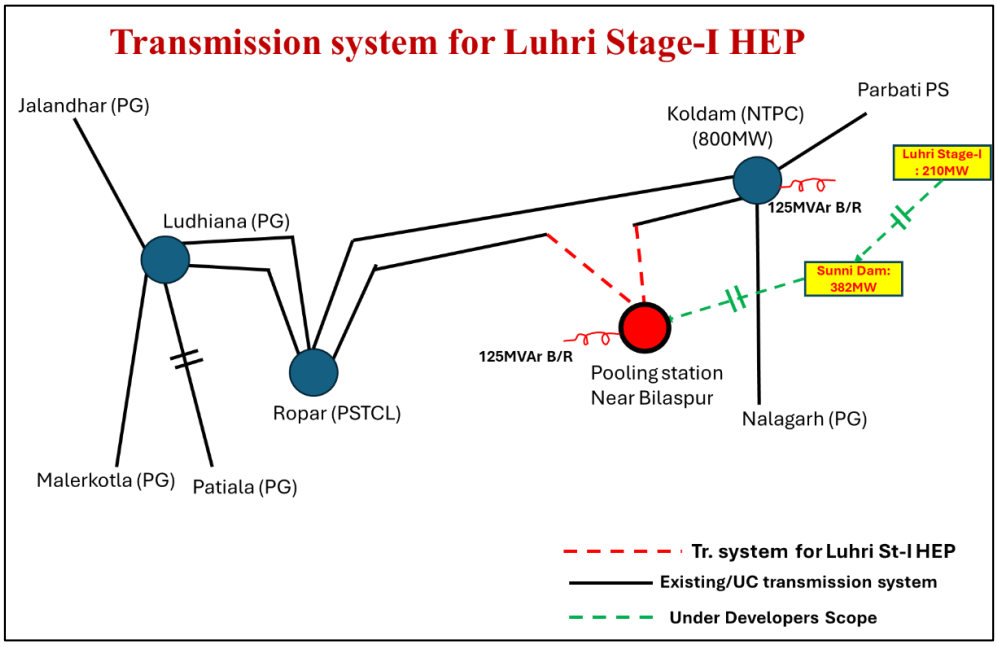


Figure 4-16: Schematic of Transmission system for evacuation of power from Luhri Stage-I HEP

This scheme is under implementation through REC(BPC) in TBCB mode with an implementation time frame of May 2027.

4.4.4 Jammu and Kashmir

1. <u>Transmission system scheme for Ratle HEP (850MW)</u>

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:

14. 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)
15. 125 MVAR, 420 kV bus reactor at Ratle HEP - To be implemented by applicant (RHPCL)
16. 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 circuits 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 circuits 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 receive 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 check 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 circuits 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 circuits of Kishenpur-Samba 400kV D/c line (Quad))	• 420 kV, 63 MVAr switchable line reactors at Samba S/s end– 1 no. • Switching equipment for 420kV, 63 MVAr switchable line reactors at Samba S/s end – 1 no

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
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 nos
7	400kV Samba- Jalandhar D/c line(Quad) (2nd) (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 circuits of Samba-Jalandhar 400kV D/c line (Quad Moose), thus forming Samba –Nakodar line (Quad))	• 420 kV, 63 MVAr switchable line reactors at Samba S/s end– 1 no. 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 circuits 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

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
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

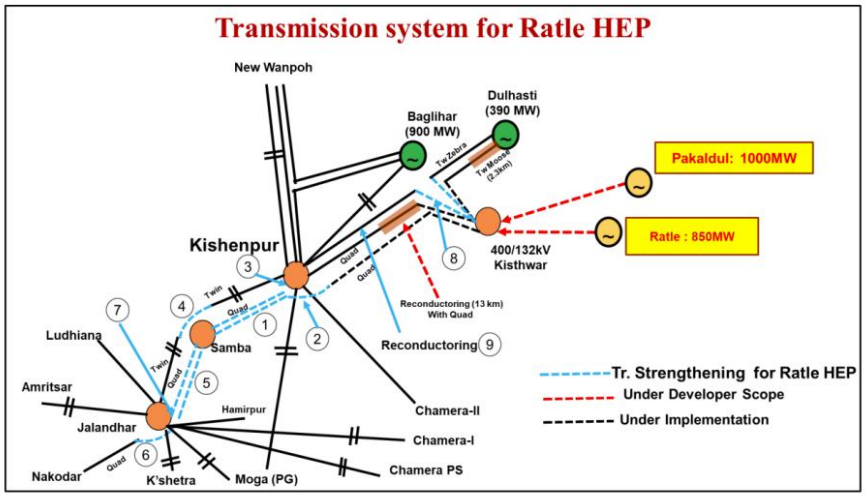


Figure 4-17: Transmission scheme for Ratle HEP

The scheme is being taken up for approval in NRPC meeting.

2. 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 months' 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
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	50. 315 MVA, 400/220 kV ICT (3x105 MVA single phase units)- 1 no. 51. 400 kV ICT bay (AIS) – 1 no. (in existing dia) 52. 220 kV ICT bay (AIS) – 1 no.

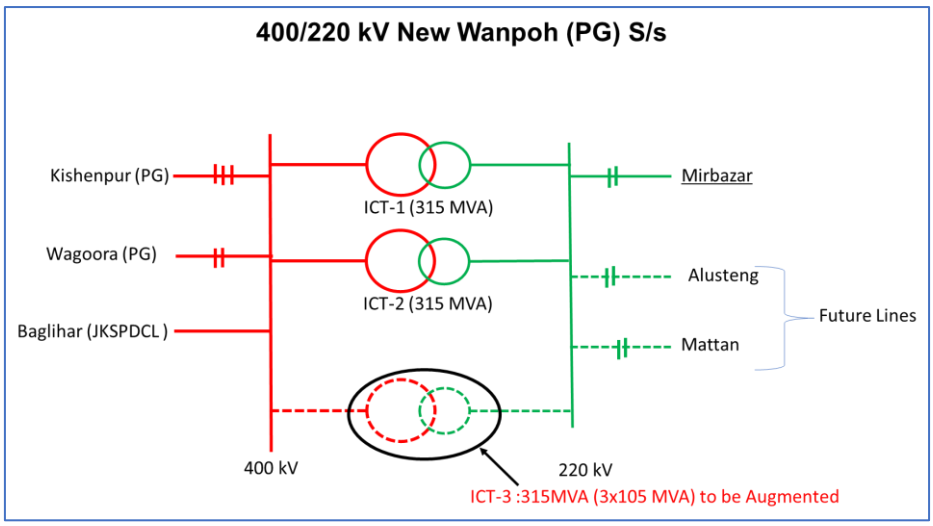


Figure 4-18: Schematic of 400/220 kV New Wanpoh (PG) S/s

Implementation Timeframe: 31.12.2025

Estimated Cost: ₹ 61.08Crs.

3. Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Samba (PG) substation

In the 33rd CMETS-NR meeting on 05/.08/20.24, it was deliberated that in the 220th OCC meeting held on 19./06/20.24, requirement of additional 500 MVA, 400/220kV ICT at Samba (PG) Substation to meet increasing load demand of Jammu city was discussed. In the meeting, NRPC representative apprised forum that JKPTCL has informed that presently ICT capacity at 400/220kV Samba substation is 945 MVA (3x315 MVA). Peak loading observed at 400/220kV ICTs at Samba substation is 720

MVA (3x240 MVA). Further in the OCC meeting, JKPTCL has intimated that following new load is expected:

364 MW industrial load in New 220/66kV substation Kathua

120 MW Load expected in case tripping of 220kV Jammu – Salal

In the meeting, it was stated that JKPTCL vide their letter dated 02/07/2024 to CEA informed that with the announcement of Industrial Policy in the UT of J&K, many Industrialists have shown interest in setting up Industrial Units in Jammu and Kashmir. Industrial Estate Bhagthali is one of the estates to be developed under this Policy. For this, requirement of 320MVA, 220/66 KV, Grid Sub-Station along with its 220kV D/c interconnection to Samba (PG) & LILO of existing 220KV Sarna-Hiranagar Transmission Line at Bhagthali with the commissioning target of 18 Months is suggested to meet the load requirement of 226.29MW at Bhagthali and 138.5 MW at existing GSS Ghatti Kathua (augmented from 160 MVA to 320MVA).

Grid India vide mail 17/.07/20.24 informed that from the loading, it is observed that maximum load is approx. 235MW each on 315 MVA ICTs with sensitivity of approx. 28.5% (302MW) on other two ICTs for n-1 contingency. However, while availing the shutdown of 315MVA ICT-3 on 11-07-2024, sensitivity was observed as 50%. Grid India also informed on JKPTCL's proposal that Cumulative maximum loading of approx. 700MW on 945MVA ICTs shows that augmentation of ICT is required to allow 500MVA load to be drawn by Jammu and Kashmir.

CTU analysed the loading pattern of Samba ICTs and its loading in planning studies w.r.t the JKPTCL proposal. From the loading pattern it is envisaged that ICTs loading in present timeframe are very close to N-1 limits. Further in CTU planning file for 2026-27 timeframe, ICT loadings are higher (300 MW in N-1 Contingency without considering additional load of Kathua/ Bhagthali).

In the meeting, JKPTCL stated that for 220kV Bhagthali S/s and associated transmission system, LOA is issued (but yet to award) with 18 months implementation schedule to cater envisaged load at Bhagthali/Kathua complex. On NRLDC query for replacement of existing 315MVA ICTs with 500MVA ICTs, JKPTCL stated that considering upcoming new load and load growth in above area, new ICTs must be taken at Samba (PG) S/s instead of replacement of existing ICTs with 18 months implementation schedule.

Accordingly, proposal for 400/220kV ICT augmentation at Samba (PG) S/s was agreed in 33rd CMETS-NR meeting for N-1 compliance as well as to meet JKPTCL requirement to cater additional new load at (Kathua/ Bhagthali).

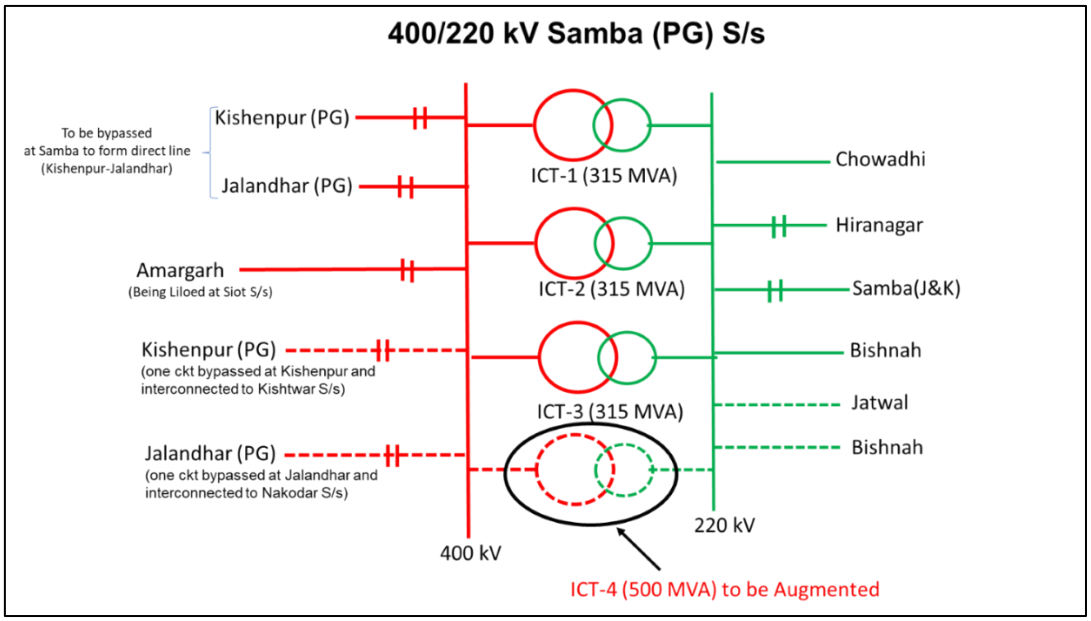


Figure 4-19: Schematic of 400/220 kV ICT(4h) Samba S/s

The scheme is under implementation with following details:

Project Name - Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Samba (PG) substation.

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of 400/220 kV ,1x500 MVA (4th) ICT at Samba (PG) S/s along with associated transformer bays	53. 500 MVA, 400/220 kV ICT - 1 no. 54. 400 kV ICT bay – 1 no. 55. 220 kV ICT bay – 1 no.

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 23/10/2024 with an implementation time frame of 18 months i.e. anticipated by 23/04/2026.

Estimated Cost: ₹ 42.18Crs.

4.4.5 Uttar Pradesh

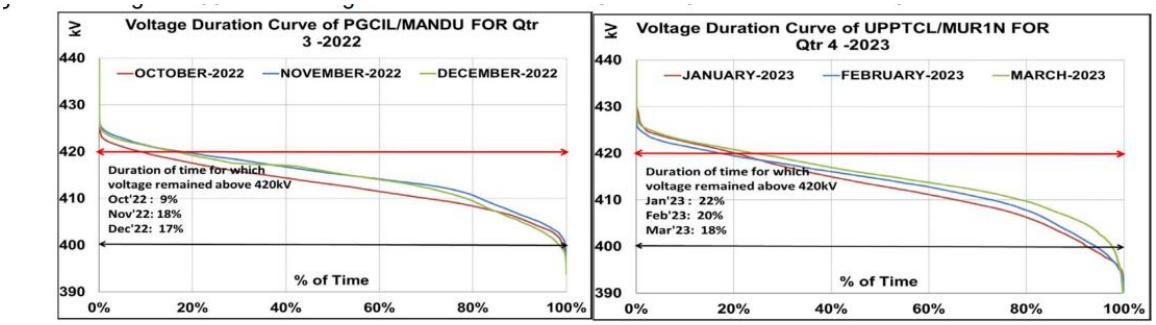
- **Replacement of existing 420kV 50MVAR Bus Reactors at Mandola & Muradnagar substation with 125MVAr bus reactor**

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.

- **Augmentation of Transformation capacity by 1x500MVA , 400/220kV ICT (3rd) at 765/400/220kV Agra (PG) S/s**

In the 35th CMETS-NR meeting held on 29./10./2024, it was deliberated that in 50th TCC & 74th NRPC Meeting held on 28-29th June 2024, NRLDC agenda for N-1 non-compliance of 400/220kV Agra (PG) ICT (2x315MVA) was deliberated. In the meeting CTUIL was asked to take up ICT augmentation at 400/220kV Agra (PG).

In 221st OCC meeting held 19.07.2024, POWERGRID agenda for increasing capacity of various ICT's including. 400/220kV Agra (PG) ICT in Northern region was deliberated. In the meeting POWERGRID apprised forum that 400/220kV Agra (PG) ICT are not complying N-1 contingency criteria under the peak loading scenario. In above OCC meeting, NRLDC mentioned that they have highlighted in quarterly feedback to CTUIL their concern regarding N-1 non-compliant ICTs at 400kV Agra and 400 kV Lucknow S/s. Further POWERGRID mentioned that regarding addition of new ICT at Agra S/s, space requirement was identified and observed that space for new ICT is available at 765/400/220kV Agra (PG) (with provision of outdoor GIS bays).

Further, UPPTCL vide letter dated 30.08.2024 stated that, load flow study is done on various Substations in UP and accordingly additional 500 MVA ICT is required at Agra (PG) S/s before year 2026-27.

Further, in the Grid-India Quarterly operational feedback report (Q1 2024-25) of July 2024, issue of N-1 non compliance of ICTs at Agra (PG) S/s was highlighted.

POWERGRID vide mail dated 24.07.2024 confirmed space availability for Augmentation of 400/220 kV transformer (3rd, 500MVA) along with transformer bays at 765/400/220kV Agra (PG) S/s. Further POWERGRID also informed that Space for ICT augmentation is available near ICT-1. However, Space & Land for 400kV and 220kV Bays to be developed by Land development which also includes dismantling & shifting of Open store structure, dismantling of colony maintenance office (old A type Quarter building), dismantling of other petty/temporary structure as well as required connection between ICT and 220kV is considered on GIB Duct/EHV Cable.

Further CTU requested RVPN and UPPTCL to provide their comments on Increasing capacity of ICT's at 400 kV Agra S/s. RVPN stated they are drawing power from Agra(PG) S/s through 220kV Agra-Bharatpur line and no additional drawl requirement is envisaged in future as the capacity of line is already saturated. Additionally, RVPN has also planned 400/220kV Kumher S/s to meet their future load requirement at Bharatpur area. RVPN also stated that implementation of above intra state scheme, loading of Agra ICT may also relieve, however at present scheme is under board approval. UPPTCL stated that demand growth of 4-5% is expected in above complex and based on analysis they already communicated requirement of ICT augmentation at Agra (PG) S/s.

Grid-India stated that 400/220kV ICTs are already N-1 non-compliant in peak demand scenario and augmentation of ICTs required immediately. Based on above, in 35th CMETS-NR meeting, it was concluded that as intra state scheme of Rajasthan may take

3-3.5 years in implementation and with increasing drawl requirement of UP as well as to meet N-1 compliance at Agra (PG) S/s, ICT augmentation at Agra (PG) S/s is required on urgent basis.

Considering above deliberations, proposal for 400/220kV ICT augmentation at Agra (PG) S/s was agreed in 35th CMETS-NR meeting.

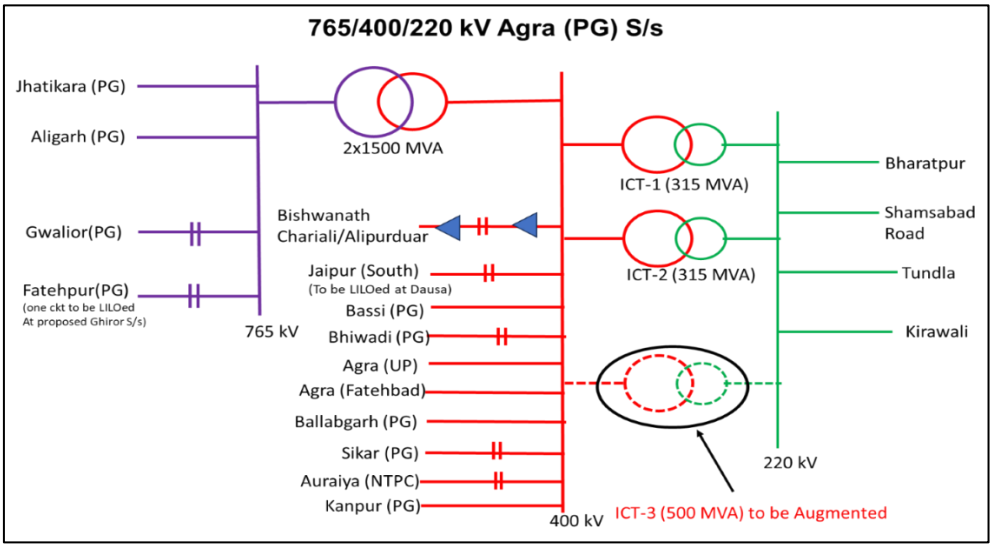


Figure 4-20: Schematic of 400/220 kV, 500MVA ICT(3rd) at Agra S/s

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (3rd) at 765/400/220kV Agra (PG) S/s

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	Augmentation of 400/220 kV ,1x500 MVA (3rd) ICT at 765/400/220kV Agra (PG) S/s along with associated transformer bays ***Note:*** • *220kV ICT bay is of Hybrid GIS type* • *220kV Cable/GIS duct requirement for interconnection*	• 500 MVA, 400/220 kV ICT- 1 no. • 400 kV ICT bay- 1 no. • 220 kV ICT bay- 1 no. (Hybrid GIS type) • 220kV Cable/GIS Duct for interconnection - 2kM (approx.)

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 20/01/2025 with an implementation time frame of 21months i.e. anticipated by 20/10/2026

Estimated Cost: ₹ 50.72Crs.

- **Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (5th) at 400/220kV Mandola (PG) S/s**

In the 35th CMETS-NR meeting held on 29/10/2024, it was deliberated that at present, 400/220kV (Mandola (PG) S/s has total transformation capacity of 2000 MVA (4x500 MVA). A meeting was held with DTL/CEA officials on 11/07/2024 & 07/08/2024 to collect & analyse Delhi network data, deliberate upon various issues in intra state transmission network as well as status of award of planned intra state system. In the meeting DTL stated that at present, loading of 220kV and downstream transmission lines are in order, however some of the ICTs at interstate and intra state are critically loaded (including 400/220kV Mandola ICTs) & may require augmentation to cater future demand of Delhi.

In the report prepared by CTUIL(Aug'24) on Transmission System Planning for Delhi (2027-28), it was mentioned that though present loading on ICTs at Maharani Bagh, Mandola and Tughlakabad S/s are on higher side (in summer season), but ICTs are still N-1 compliant. In view of under implementation ISTS schemes (765kV Narela & associated transmission system, 400kV Jhatikara - Dwarka line and ICT augmentation at Jhatikara) and to cater future demand of Delhi, 400/220kV ICT augmentation (ISTS) may be required on Maharani Bagh, Mandola and Tughlakabad S/s. In the report considering DTL suggestions, Augmentation of 400/220kV, 1x500 MVA ICT (5th) at Mandola (PG) Substation DTL was proposed as part of upgradation works identified in ISTS network for taken up to meet the future load growth with reliability & security.

In CMETS-NR meeting It was also stated that POWERGRID vide letter dated 27./08/.2024 regarding issue of N-1 contingency criteria in some of the substation of NR, informed that ICTs in few of the substations (including Mandola S/s) in NR are having high utilization and violating N-1 contingency criteria. POWERGRID also mentioned that for Mandola ICTs Threshold limit 75% & peak Utilization Jun'24 is 83%.

In the meeting DTL stated that as per their data Mandola ICT loading is already reached up to 98% in peak demand scenario and in view of delay in establishment of 400kV Gopalpur S/s, ICT augmentation at Mandola (PG) is required on urgent basis.

POWERGRID vide mail dated 24.07.2024 confirmed space availability for Augmentation of 400/220 kV transformer (5th, 500MVA) along with transformer bays at 400/220kV Mandola (PG) S/s.

Considering above deliberations, proposal for 400/220kV ICT augmentation at Mandola (PG) S/s was agreed in 35th CMETS-NR meeting.

Detailed scope of work for implementation:

Project Name - Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (5th) at 400/220kV Mandola (PG) S/s

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	• Augmentation of 400/220 kV ,1x500 MVA (5th) ICT at 400/220kV Mandola (PG) S/s along with associated transformer bays* *incl. 220 Cable requirement for interconnection	500 MVA, 400/220 kV ICT- 1 no. 400 kV ICT bay- 1 no. 220 kV ICT bay- 1 no. 220kV Cable –2800m (4x700m) (approx.) & Cable Termination Kit 220kV (AIS) Cable : 8 nos..

Implementation Timeframe: This scheme was awarded to POWERGRID through RTM mode vide CTU OM dated 20/01/2025 with an implementation time frame of 18 months from the date of issuance of OM by CTUIL i.e. 20/07/2026.

Estimated Cost: ₹ 61.61Crs.

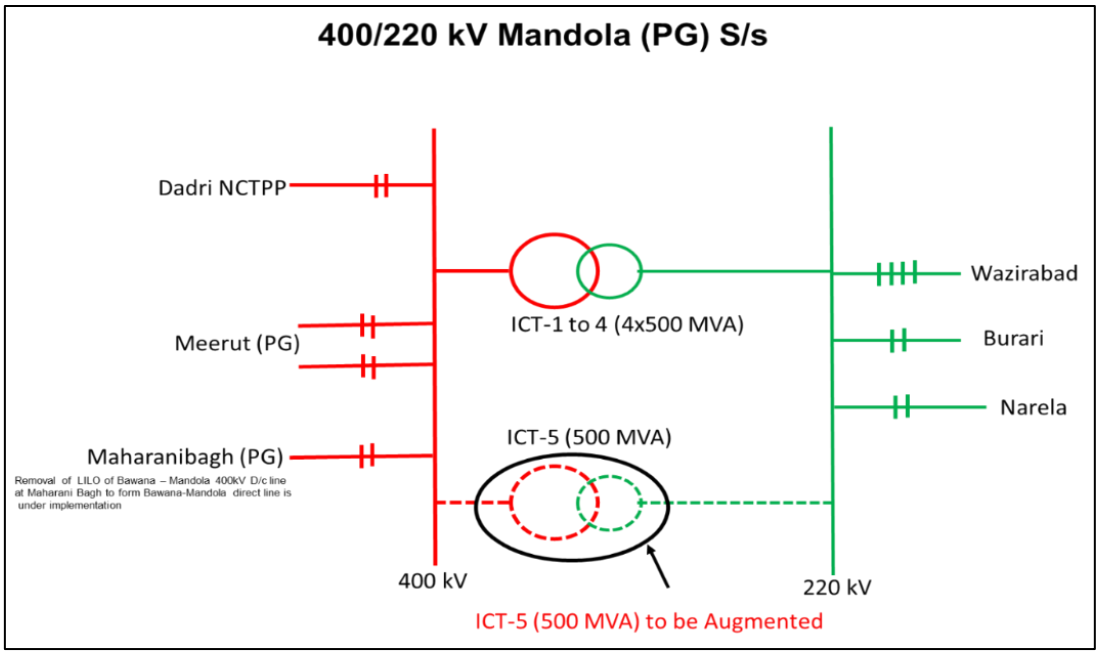


Figure 4-21: Schematic of 400/220 kV ICT(5th) at Mandola (PG) S/s

- **<u>Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (3rd) at 400/220kV Lucknow (PG) S/s</u>**

The proposal was deliberated in the 34th CMETS-NR meeting held on 20.09.24. In the meeting It was deliberated that in 50th TCC & 74th NRPC Meeting held on 28-29th June 2024, NRLDC agenda for N-1 non-compliance of 400/220kV Lucknow (PG) ICT was deliberated. In the meeting it was informed that, for 400/220kV Lucknow (PG) ICT augmentation, confirmation from UPPTCL to be provided as Mohanlalganj is also commissioned near Lucknow. UPPTCL agreed to study requirement of ICT augmentation at 400/220kV Lucknow (PG) and revert before next NRPC meeting.

In the Grid-India Quarterly operational feedback report (Q1 2024-25) of July 2024, issue of N-1 noncompliance of ICTs at Lucknow (PG) S/s was highlighted.

In 221st OCC meeting held 19.07.2024, POWERGRID agenda for increasing capacity of various ICT's incl. 400/220kV Lucknow (PG), in Northern region was deliberated. In the meeting POWERGRID apprised forum that 400/220kV Lucknow (PG) ICT are not complying N-1 contingency criteria under the peak loading scenario. Further POWERGRID mentioned that regarding addition of new ICT at Lucknow S/s, space requirement was identified and observed that space for new ICT is available at 400/220kV Lucknow (PG) (with provision of outdoor GIS bays).

UPPTCL vide letter dated 30.08.2024 stated that, load flow study is done on various Substations in UP and accordingly additional 500 MVA ICT is required at Lucknow PG S/s.

POWERGRID vide mail 13.09.24 informed that 400/220kV ICT-3 at Lucknow S/s is feasible with optimized space. However, following constraints/ issues to be taken care while approval of scheme.

As there is no space in the existing 400kV yard, hence, Proposed 400kV ICT bay shall be Outdoor GIS type.

Further Connectivity for 400kV Bus Extension to GIS Bays is to be achieved through GIB Duct having multiple road crossings in duct route from 400kV Bus to GIS bay.

220kV Side of ICT-3 bay shall be AIS type [Future Extension of 220kV Bays will be limited to 2 numbers future feeders]. Further, High Voltage Test of 400kV GIS bay may require complete shut Down of bus.

UPPTCL reiterated the requirement of Augmentation of 400/220 kV ,1x500 MVA (3rd) ICT at Lucknow (PG) S/s as load of Lucknow ICT will not be shared by other 400kV substations nearby. In the 34th CMETS-NR meeting, UPPTCL also stated that 2 nos. of 220kV line bays (future space) at Lucknow (PG) S/s are sufficient to meet their future drawl requirement from above S/s as they are already planning for new 400kV S/s at Barapanki and Sitapur in near vicinity to serve the future demand requirement.

Considering above including UPPTCL request for augmentation, proposal for 400/220kV ICT augmentation at Lucknow (PG) S/s was agreed in 34th CMETS-NR meeting (Scope as per S.No 2) for N-1 compliance as well as to meet UPPTCL future drawl requirement.

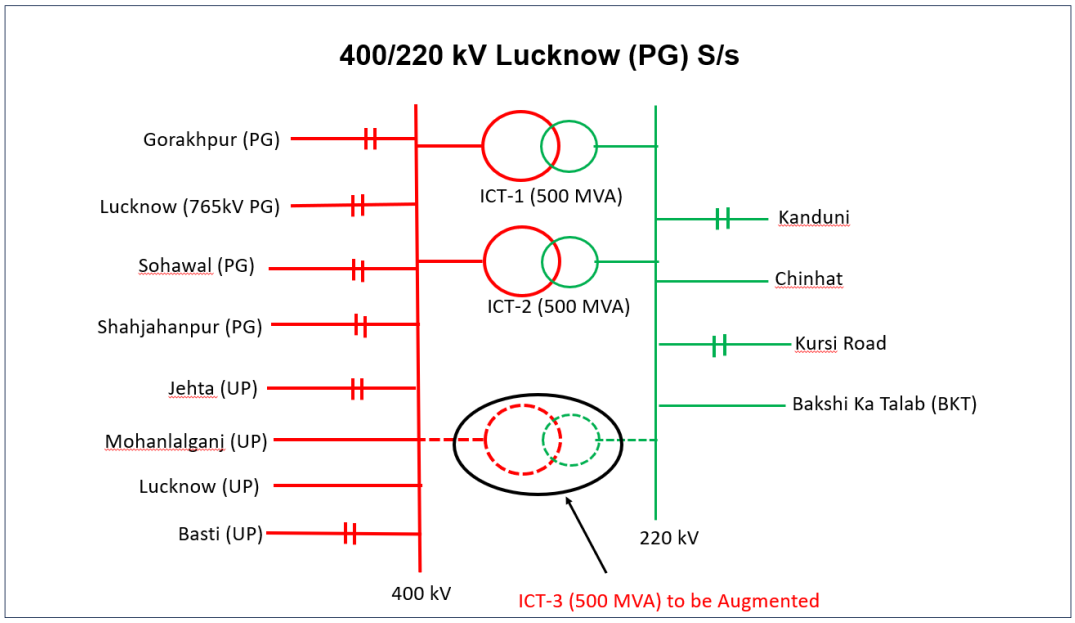


Figure 4-22: Schematic of 400/220 kV ICT(3rd) at Lucknow (PG)

The scheme is under implementation with following details:

Project Name - Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (3rd) at Lucknow (PG) S/s

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1	• Augmentation of 400/220 kV, 1x500 MVA (3rd) ICT at 400/220kV Lucknow (PG) S/s along with associated transformer bays (1 no. additional 400kV line bay is also being implemented for GIS diameter completion) • 400kV ICT bay shall be Outdoor GIS type & 220kV ICT bay shall be AIS type • Connectivity for 400kV Bus Extension to GIS Bays is to be achieved through GIB Duct having multiple road crossings in duct route from 400kV Bus to GIS bay	• 500 MVA, 400/220 kV ICT- 1 no. • 400kV ICT Bay (GIS) - 1 No. Main bay + 1 No. Tie Bay • 220 kV ICT bay- 1 no. (AIS) • 220kV Bus works for future bays - 1 SET • 400kV Bus extension with GIB Duct - 1100 m (approx.) • Interconnection from 220kV Bay to 220kV ICT side through Duct 245kV GIB Duct – 300 (m) (approx.) • Associated 400kV & 220kV interconnection works.

Implementation Timeframe: This scheme is proposed to be awarded through CTU OM with an implementation time frame of 21months from the date of issuance of OM.

Estimated Cost: ₹ 76.54Crs.

4.4.6 NR-WR-ER Inter regional corridor

- **Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line**

It is noted that the flow on WR-NR corridor is very high and issues related to high loading of 765 kV Vindhyachal – Varanasi D/C during high NR import are being observed in real-time at the time of high demand in UP.

Due to this high loading of 765kV Vindhyachal-Varanasi D/c, violation of WR-NR ATC and NR simultaneous import is also being observed in real-time. WR-NR ATC violations in real-time would lead to situation wherein NR states would not be able to draw further power from Western region and as a result, may need to resort to over drawl or load shedding in case internal generation in NR is not available. It was informed that under N-1 contingency of one circuit of 765kV Vindhayachal-Varanasi D/c line may overload the other circuit during high NR import. Accordingly, comprehensive transmission scheme was evolved to resolve critical loading of 765kV Vindhyachal-Varanasi D/c line in N--1 Contingency condition as well as for evacuation of PSP projects in UP.

Grid-India stated that 765kV Fatehpur – Prayagraj section may get overcompensated with existing line reactor configuration. CTUIL stated that the line length is tentative and will be reviewed upon finalisation of location of Prayagraj S/s. In the case of reduction of line length considerably, the possibility of converting Fixed line reactor at Fatehpur S/s end of 765kV Fatehpur – Prayagraj into Switchable line reactor shall be explored & shall be taken up as separate scheme.

Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line was agreed in CMETS-NR, CMETS-WR, NRPC & WRPC meetings. The transmission scheme is also discussed and agreed in ERPC meeting held on 10-11th Feb’25.

After deliberations, NCT approved the scheme “Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line” under TBCB route as mentioned below:

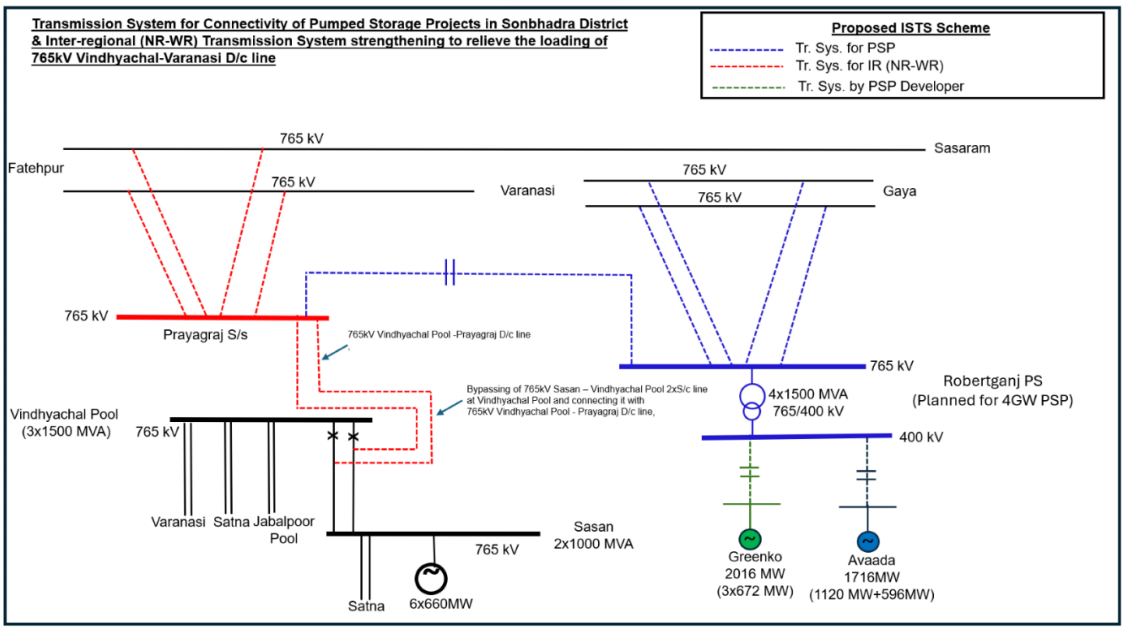


Figure 4-23: Transmission System for Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line

The scheme is under implementation with following details:

Project Name - Transmission System for Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line.

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	• Establishment of 765 kV Prayagraj S/s near Prayagraj(Uttar Pradesh) along with 2x330 MVAr 765 kV Bus reactors **Future provisions** **Space for** • 765/400kV ICTs along with bays- 4 nos. • 765 kV line bays along with switchable line reactors – 84 nos. • 765kV Bus Reactor along with bay: 1 nos. • 400 kV line bays along with switchable line reactor –4 nos. • 400kv line bays : 2 nos. • 400 kV Bus Reactor along with bays: 2 no. • 400kV Sectionalization bay: 1 set	• Prayagraj S/s -AIS • 330 MVAr Bus Reactor-2 nos. (7x110 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no. • 765 kV line bays – 6 nos. (for LILO of 765 kV Fatehpur-Varanasi S/c line, LILO of 765 kV Fatehpur-Sasaram S/c line & Vindhyachal Pool - Prayagraj D/c line)
2	• LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj	• Line Length ~15 km (LILO length 15km)
3	• LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj	• Line Length ~14 km (LILO length 14km)

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
4	• 765kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765kV Vindhyachal Pool - Prayagraj D/c line	• Line Length – (~220 km) • 765 kV, 330 MVAr switchable line reactors at Prayagraj end – 2 nos. • Switching equipment for 765kV 330 MVAr switchable line reactors at Prayagraj S/s – 2 nos.
5	• Bypassing of both ckts of 765kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765kV Sasan - Prayagraj D/c line	• Line Length - 1km (~0.5x2)

Implementation Timeframe: The scheme has been approved in 27th NCT meeting held on 06/02/2025 & likely to awarded to BPC at the earliest

Estimated Cost: ₹ 2368.26Crs.

- **Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District, Uttar Pradesh**

Cconnectivity applications of cumulative quantum of 3732 MW (drawl:3732 MW, injection: 3250) from two developers i.e. M/s Greenko (3 nos. of applications with cumulative quantum of 2016 MW(3x672MW)) & M/s Avaada WB (2 application of 1,716MW(1120MW+596MW)) were received for Robertganj area in Sonbhadra district. As per the schedule indicated in the applications, these PSP projects are expected to be commissioned progressively from Nov'26 upto Mar'28. Further M/s Avaada requested extension in start date of connectivity for their PSP projects with revised timeline of 31/12/2030. Further, M/s Greenko informed that their generation schedule has been revised and likely to be commissioned progressively from June, 2028.

In view of schedule of generation projects and for optimal utilization of transmission scheme, comprehensive transmission scheme is planned considering M/s Greenko and M/s Avaada PSP's present evacuation & future requirement. Transmission system being lumped elements, the planned scheme can cater upto 4 GW PSP connectivity quantum.

CEA confirmed that the Sonbhadra area may be considered as a potential zone for pumped storage projects. Accordingly, the transmission system for connectivity of M/s Greenko & M/s Avaada at Roberstganj PS shall be considered as common transmission system.

Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District, Uttar Pradesh was agreed in CMETS-NR, CMETS-ER & NRPC meetings. The transmission scheme is also discussed and agreed in ERPC meeting held on .10-11th Feb'25

Considering delay in scheduled commissioning of PSP projects of M/s Greenko & M/s Avaada, it is agreed to consider schedule of the comprehensive transmission system as 32 months from allocation of project. However, schedule of 4th 765/400kV, 1x1500MVA ICT at Sonbhadra may be considered as December, 2030.

After deliberations, NCT approved the scheme "Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District, Uttar Pradesh" under TBCB route as mentioned below:

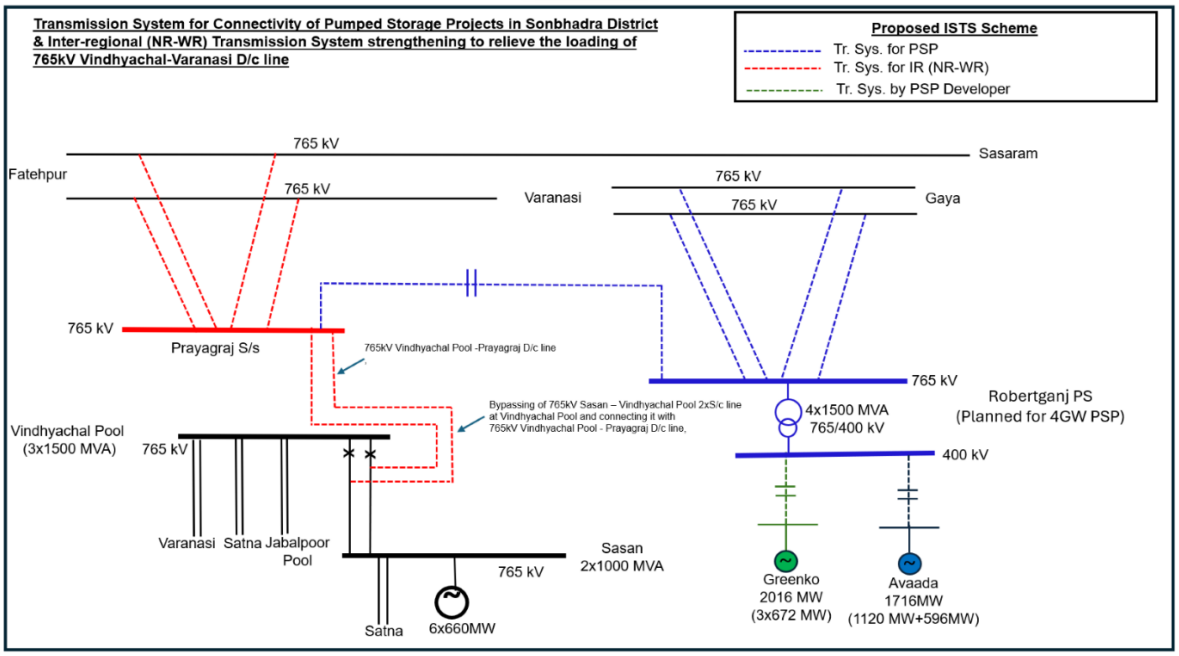


Figure 4-24: Transmission System for Connectivity of Pumped Storage Projects in Sonbhadra District

The scheme is under implementation with following details:

Project Name: Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District, Uttar Pradesh.Detailed scope of the scheme is given below:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
1	• Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors **Future provisions:** • 765/400kV ICTs along with bays- 2 nos. • 765 kV line bays along with switchable line reactors – 6 nos.	• Robertsganj PS - AIS • 765/400 kV 1500 MVA ICT- 4 nos. (13x500 MVA including one spare unit) • 765 kV ICT bays-4 no. • 400 kV ICT bays- 4 no. • 240 MVAr Bus Reactor-2 no. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no.

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation/Conductor capacity/km/no. of bays etc.)
	• 765kV Bus Reactor along with bay: 1 no. • 400 kV line bays along with switchable line reactor –6 nos. • 400kV line bays : 6 nos. • 400 kV Bus Reactor along with bays: 1 no. • 400kV Sectionalization bay: 2 sets	• 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 no. • 765 kV line bays at Robertsganj PS – 6 nos. (for Robertsganj PS – Prayagraj S/s D/c line & LILO of both circuits of Varanasi- Gaya 2xS/c line at Robertsganj PS) • 400kV line bays– 2 nos. (for PSP interconnection)
2	LILO of both circuits of 765 kV Varanasi- Gaya 2xS/c line at Robertsganj PS along with 240MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)	• Line Length ckt1 ~ 65 km (LILO length) • Line Length ckt2 ~ 75 km (LILO length) • 240 MVAr switchable line reactors at Robertsganj PS end – 2 nos. • Switching equipment for 240 MVAr switchable line reactors at Robertsganj PS end – 2 nos.
3	Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line	• Line Length – (~185 km) • 765 kV line bays at Prayagraj S/s – 2 nos. • 765 kV, 330 MVAr switchable line reactors at Robertsganj PS – 2 nos. • Switching equipment for 765kV 330 MVAr switchable line reactors at Robertsganj PS – 2 nos. • 110 MVAr (765 kV) spare reactor single phase unit at Robertsganj PS end – 1 no.
	Total Estimated Cost:	**Rs. 3625.97 Cr.**
	Implementation Time Frame	Tentative implementation timeframe: 32 months from the date of allocation * **except for 765/400kV, 1x1500MVA ICT(4th) at Robertsganj PS.* Tentative implementation timeframe for 765/400kV, 1x1500MVA ICT(4th) at Robertsganj PS is Dec, 2030

Note: Developer of Prayagraj S/s shall provide space for 2 Nos. of 765 kV line bays at 765kV Prayagraj S/s for termination of Robertsganj PS – Prayagraj S/s 765 kV D/c line.

Implementation Timeframe: The scheme has been approved in 27th NCT meeting held on 06/02/2025 & likely to awarded to BPC at the earliest.

Estimated Cost: ₹ 3625.97 Crs.

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 48 nos. of substations (765kV-4 nos., 400kV- 44 nos) in NR having fault level more than 10% of designed capacity

Out of above, 23 nos. of ISTS substations and 25 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.	400kV Jalandhar	Most	44	40

Sl. No.	Substation Name	Scenario No.	Highest Fault level (kA)	Design Rating (kA)
2.	400kV Mandola	Most	45	40
3.	400kV Mandola SP2	Most	45	40
4.	400kV Mandola SP3	Most	45	40
5.	400kV Patiala	All	46	40
6.	400kV Jind	Most	47	40
7.	400kV Balia	All	48	40
8.	400kV Ballabgarh	All	49	40
9.	400kV Allahabad	All	51	40
10.	400kV Lucknow	All	52	40
11.	400kV Bhiwadi	All	52	40
12.	400kV Bassi	All	53	40
13.	400kV Abdullapur	All	53	40
14.	400kV Lucknow	All	54	40
15.	400kV Neemrana	All	55	40
16.	400kV Bikaner New	Three	58	40
17.	400kV Fathegarh	Three	59	40
18.	400kV Meerut	All	67	50
19.	400kV Barel-PG	Most	78	40
20.	400 kV Bareily	Most	79	40
21.	400kV Bikaner-NW	Three	58	50
22.	765kV Varanasi	Two	44	40
23.	765kV Aligarh	Most	50	40

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 Sarnath	UP	Most	44	40
2.	400kV Sikanderabad	UP	Most	44	40
3.	400kV Gaziabad	UP	Most	44	40

Sl. No.	Substation Name	Owner State	Scenario No.	Highest Fault level (kA)	Design Rating(kA)
4.	400kV Bara	UP	Most	45	40
5.	400kV Gopalpur	Delhi	Most	46	40
6.	400kV Kabulpur	Haryana	Most	46	40
7.	400kV Bhadla	Rajasthan	All	46	40
8.	400kV Agra	UP	All	47	40
9.	400kV Tikri Khurd	Delhi	Most	47	40
10.	400kV Bareli	Rajasthan	Most	51	40
11.	400kV Daulatabad	Haryana	Most	51	40
12.	400kV Bawana-G	Delhi	Most	54	40
13.	400kV Bawana	Delhi	Most	54	40
14.	400kV Jaipur	Rajasthan	All	55	40
15.	400kV Dhanonda	Haryana	All	58	40
16.	400kV Agra	UP	All	60	40
17.	400kV Greater Noida	UP	All	60	40
18.	400kV Greater Noida	UP	All	61	40
19.	400kV Aligarh PG	UP	Most	74	40
20.	400kV Jhajar(Generator)	Haryana	Most	48	40
21.	400kV Meja(Generator)	UP	All	48	40
22.	400kV Dadri HVDC (Generator)	UP	All	59	40
23.	400kV Dadri NCR (Generator)	UP	All	60	40
24.	765kV Jaipur	Rajasthan	Most	49	40
25.	765kV Greater Noida	UP	One	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 2029-30 timeframe, in NR, 9 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.	Jhajjar-Dhanonda 400 kV Line	1,4	STU	556	943	857	110
2.	Mundka-Jhatikara-PG 400kV Line	4	STU	1159	2111	1988	106
3	Lucknow (400kV) - Lucknow(765kV) Line	1,4,7	ISTS	1392	2704	1714	158
4.	Sikar-Bikaner (RVPN) 400kV Line	4,7	STU	792	943	857	110
5.	Jaipur (PG) - Dausa 400 kV Line	5	ISTS	637	876	857	102
6.	Meja-Allahabad 400kV Line	2,5	ISTS	562	1108	857	129
7.	Bagpat-Meerut 400kV Line	4	ISTS	642	892	857	104
8.	Orai-Garautha 400kV Line	1,4	STU	917	1477	857	172
9.	Rosa-Badaun 400kV Line	8	STU	570	942	857	110

Additional system strengthening may be planned to feed the growing demand.

b) Transformers

In the base case file prepared for 2029-30 timeframe, following 400/220kV ICTs are having critical loading. Details of transformers is as under

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

Sl. No.	Name of the Element	Scenario No.	Owner	Base Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
1	Kishenpur 400/220kV ICT 1	4,5	ISTS	264.69	322.69	102.44	315
2	Ropar 400/220kV ICT 1	4	STU	392.80	553.99	110.80	500
3	Moga 400/765kV ICT 1	4,7	ISTS	1148.89	1977.14	131.81	1500
4	Moga SPLT4 400/220kV ICT 1	4	ISTS	435.62	530.12	106.24	500
5	Patran 400/220kV ICT 1	4,7	ISTS	551.26	712.26	142.45	500
6	Jalandhar 400/220kV ICT 1	4	ISTS	453.50	533.38	119.13	500
7	Jind-PG 400/220kV ICT 1	4	ISTS	499.90	604.19	120.84	500
8	Dwarka 400/220kV ICT 3	4	ISTS	426.12	578.36	115.67	500
9	Narela ISTS 400/765kV ICT 1	4	ISTS	1268.77	1660.91	110.73	1500
10	Bhinmal 400/220kV ICT 1	2,4,5	ISTS	313.12	428.82	136.13	315
11	Heerapura 400/220kV ICT 2	2,3,4,5,8	STU	458.47	520.27	171.18	315
12	Alwar 400/220kV ICT 1	2,4,5	STU	309.05	437.42	138.86	315
13	Ratangarh 400/220kV ICT 1	2,5	STU	316.34	390.92	124.10	315
14	Hindaun 400/220kV ICT 1	1,2,3,4,5,6,8	STU	396.39	591.04	187.63	315
15	Bhilwara 400/220kV ICT 1	2,3,5,6,8	STU	428.69	570.31	181.05	315
16	Deedwana 400/220kV ICT 1	1,2,3,4,5,7	STU	328.60	500.81	158.99	315
17	Ajmer 400/220kV ICT 1	2,3,4,5,6,8	STU	525.27	737.85	234.24	315
18	Kota 400/220kV ICT 1	1,2,3,4,5,6,7,8	ISTS	497.96	644.67	204.66	315
19	Babai 400/220kV ICT 1	2,5,8	STU	322.60	440.57	139.86	315

20	Chittorgarh 400/220kV ICT 1	1,2,3,4,5,6,8	STU	467.53	606.86	192.65	315
21	Jodhpur Surpura 400/220kV ICT 1	2,3,5,6,8	STU	415.46	554.58	176.06	315
22	Bikaner-RVPN 400/220kV ICT 1	2,3,5,6,8	STU	403.78	570.13	180.99	315
23	Suratgarh 400/42220kV ICT 1	2,3,5	STU	385.89	534.87	169.80	315
24	Sangod 400/220kV ICT 1	5	STU	373.12	581.82	116.36	500
25	Kanpur 400/220kV ICT 1	1,4	ISTS	388.89	493.56	156.69	315
26	Varanasi 400/765kV ICT 1	4	ISTS	1416.90	2029.80	135.32	1500
27	Kashipur 400/220kV ICT 1	5	STU	245.14	339.19	107.68	315

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, 765kV & 400kV buses were observed to be having voltage more than 1.03 pu (≥1.03pu in minimum 2 scenarios is depicted in **Table 4-10**

Table 4-10: Over Voltage buses in NR

Sl. No.	Bus Name	Voltage Level (kV)	Owner	Max(pu)	Scenario
1	Unnao	765	STU	1.05	3,6,9
2	Jaisalmer	765	STU	1.06	2,3,5,6,8,9
3	Jaisalmer	400	STU	1.05	2,6,8,9
4	Jodhpur Kankani	400	STU	1.05	8,9

From the voltage analysis, it is emerged that some of substations i.e. Jaisalmer & Jodhpur Kankani are located close to Solar/RE power generation 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 at ISTS substations in this regard.

High voltage is observed at Unnao in off peak scenarios due to low demand in NR.

Low voltages are observed at various stations in Northern Region in various Scenarios due to increase load & suitable measures shall be planned. 765kV & 400kV buses were observed to be having voltage less than 0.97 pu (≤0.97pu in minimum 2 scenarios is depicted in **Table 4-9.**

Table 4-11: Under-voltage buses in NR

Sl. No.	Bus Name	Voltage Level (kV)	Owner	Min(pu)	Scenario
1	Moga	765	ISTS	0.92	4,7
2	Bamnauli	400	STU	0.96	1,4
3	Dwarka	400	ISTS	0.96	1,4
4	Jhatikara	400	ISTS	0.96	1,4
5	Jhati	765	ISTS	0.93	1,4,7
6	Dholpur	400	STU	0.96	2,3,5
7	Herapu	400	STU	0.95	1,3,4,5
8	Alwar	400	STU	0.96	2,3,4,5,6
9	Hindau	400	STU	0.97	2,3,4,5,6
10	Deedwana	400	STU	0.94	1,2,3,4,5
11	Ajmer	400	STU	0.96	4,5
12	Bassi	400	ISTS	0.96	1,3,4,5
13	Jaipur	400	ISTS	0.96	1,3,4,5
14	Ajmer	765	ISTS	0.97	4,7
15	Sikar	765	ISTS	0.93	4,7
16	Merta	765	ISTS	0.97	4,7

Studies for improvement of voltage profile under various scenarios will be carried out and taken up in next rolling plan. STUs are also required to take necessary actions for improvement of voltage profile by providing suitable reactive power compensation.

4.5.4 Reactive Power Analysis

Transmission lines originating from renewable-rich regions like Rajasthan experience high loading when renewable generation peaks during summer noons. This is causing voltage stress at substations located near load centres like capital region. To assess the voltage profile & reactive power compensation requirements in 2029-30 timeframe, a detailed study of reactive power at load centres is carried out through QV analysis for Northern Region.

Transmission lines may act as source or sink of reactive power according to their loading. A lightly loaded line may act as a source of reactive power leading to a voltage rise, whereas an overloaded line may cause undervoltage at nearby buses. To maintain stable voltages under both light and heavy loading conditions, switchable shunt reactors are deployed to suitably compensate for line charging MVAr. Voltage control is further enhanced through the coordinated switching of bus reactors, line reactors, and nearby generators under varying system conditions.

To analyze the voltage variation in response to load changes for a 765kV transmission line, a simulation was conducted using a Fictitious Generator and a 300 km-long line. The voltage variation for the uncompensated line is presented below:

Fictiuos Load(MW)	Voltage (765kV System)	Difference in Voltage Drop	% Voltage Drop
1300	789.3		
1700	778.7	-10.6	-1.34%
2100	764.98	-13.72	-1.76%
2400	746.8	-18.18	-2.38%
2800	729.5	-17.3	-2.32%
3200	698.6	-30.9	-4.24%
3600	648.3	-50.3	-7.20%

A similar study was conducted for a compensated line with 330 MVAr compensation at both ends. The voltage variation with load is presented below:

Fictiuos Load (MW)	Voltage (765kV System)	Difference in Voltage Drop	% Voltage Drop
500	767.9		
900	762.1	-5.8	-0.76%
1300	753.9	-8.2	-1.08%
1700	742.9	-11	-1.46%
2100	728.3	-14.6	-1.97%
2400	714.4	-13.9	-1.91%
2800	690.3	-24.1	-3.37%
3200	655.2	-35.1	-5.08%
3600	585.5	-69.7	-10.64%

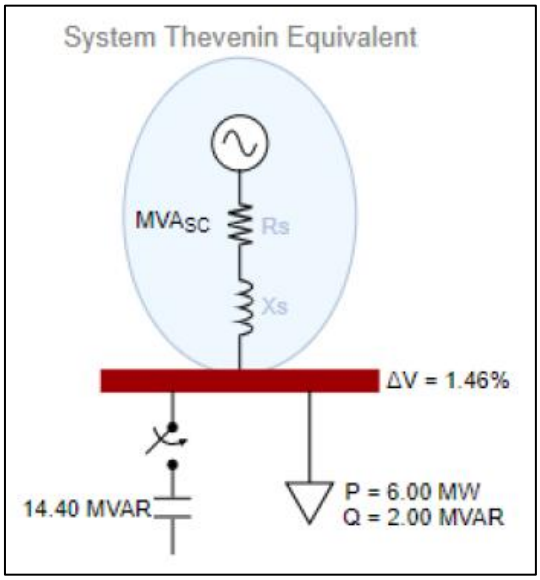
From the above results, it is evident that the voltage profile at the remote end of an uncompensated line drops sharply beyond its surge impedance loading. For a compensated line, a voltage drop is observed even much before reaching surge

impedance loading. Consequently, it is observed that remote-end buses of transmission lines originating from renewable energy pockets are experiencing low voltage.

To analyse the voltage stability at buses where low voltage is observed in Northern Region QV analysis has been carried out.

QV Analysis:

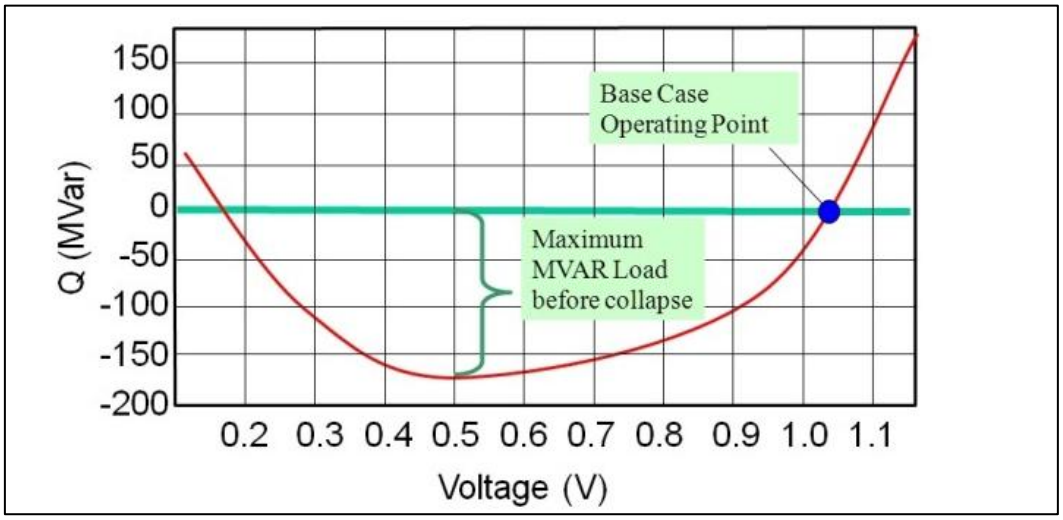
The QV curve is a fundamental tool used to comprehend how reactive power (Q) injections impact voltage levels (V) at a specific bus in an electrical power system. This method is critical for assessing voltage stability and ensuring the reliable operation of a grid under varying load conditions. Additionally, it offers insights into system behavior during contingencies.



The creation of a QV curve involves introducing a hypothetical generator, such as a synchronous condenser, at the bus of interest. This simulated generator's voltage set-point is adjusted across a range, while its reactive power output is allowed to vary freely to maintain the target voltage. It provides power flow solution with unlimited reactive power support at some bus while it suffers from various contingencies. Bus reactive support can be either capacitive, in case of increase in bus voltage or inductive, in case of decrease in bus voltage. Thus, QV analysis determines the reactive power required at a bus to maintain certain range of bus voltages (for both normal and contingency conditions).

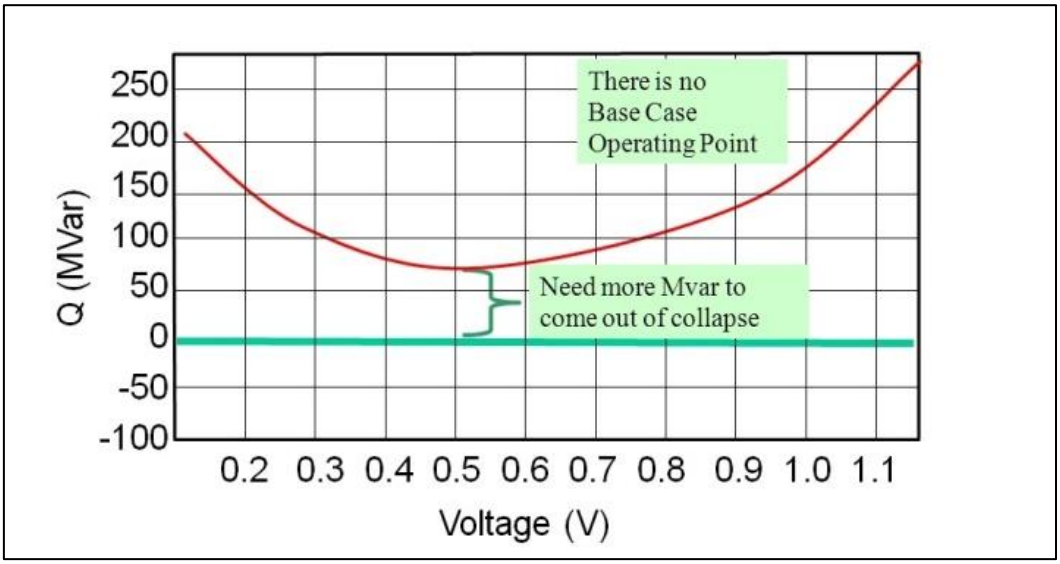
On a QV curve, the reactive power output of this generator (measured in MVAR) is plotted on the vertical axis, and the corresponding voltage levels are shown on the horizontal axis. The intersection of the curve with the horizontal axis, where reactive power output from fictious synchronous generator is zero, denotes the grid's initial operating condition, referred to as the base case.

Tracing the QV curve downward, from higher voltage set-points to lower ones, represents a decrease in the reactive power output of the generator, analogous to an increase in reactive power load at the studied bus. The curve illustrates the voltage response to rising reactive power demand. The lowest point of the curve marks the threshold where the system reaches its maximum reactive power demand before voltage collapse occurs. This critical point is invaluable to identify stability limits and plan reactive power compensations.



Some inferences that can be observed QV curves are mentioned as under:

QV curves must cross Q=0 line is necessary condition for voltage stability. It indicates that the bus under observation is capable of absorbing reactive power up to some extent.



The point Q=0 indicates the nominal operating point as the net injection or absorption of the fictitious generator is 0 MVAr under normal operating conditions.

The point dQ/dV=0 indicates the voltage stability margin. It is the lowest voltage below which no amount of drawl reduction can improve the voltage profile of the bus and the phenomenon of voltage collapse takes place.

The value of Q @ dQ/dV=0 indicates reactive power margin which is the maximum reactive power that can be additionally drawn from the bus before voltage collapse takes place. Higher value of reactive power margin indicates better voltage stability as larger amount of reactive power drawl is needed to drive the bus towards voltage collapse. Thus, to consider worst case scenario, the contingency with the least reactive power margin is of highest significance.

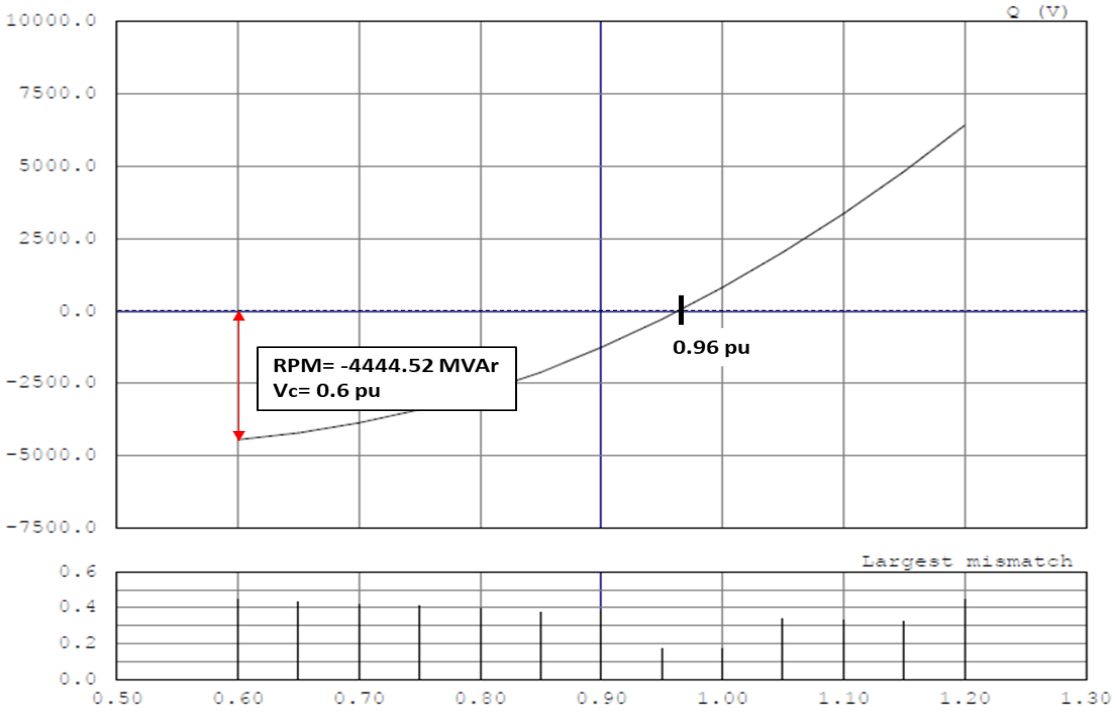
The value of dQ/dV @ Q=0 indicates the voltage sensitivity wrt. reactive power injection at nominal operating conditions. Higher value of slope indicates better voltage stability at nominal operating point.

It has been reported that few buses close to capital region are experiencing low voltage in summer noons when solar generation is peaks. This is resulting in high loading of compensated transmission lines & leading to low voltages at load centres. To ensure compliance of with grid voltage limits some of the bus reactors and line reactors were switched off during simulations. On conducting power flow studies, a few buses were identified which could potentially experience low voltage in as per the simulations conducted for the duration 2029-30. The voltage profile of the subjected buses is enumerated as under:

Buses Experiencing Low Voltage:

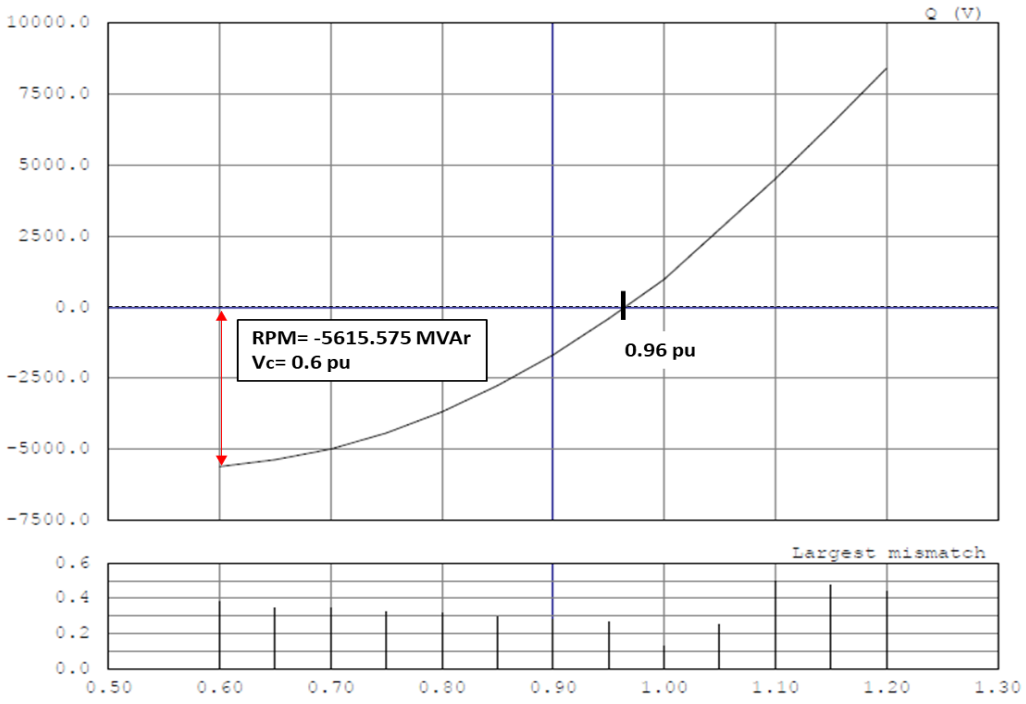
Bus Number	Bus Name	Base Voltage (kV)	Nominal Voltage(pu)	Nominal Voltage(kV)
154428	BAMNAULI4	400	0.9649	385.94
154496	GOPAL PUR	400	0.9661	386.45
154497	DWARKA	400	0.9646	385.84
154708	JHATIKARASP	400	0.9661	386.45
154928	MAHARANIBAGH	400	0.9666	386.65
164407	ALWAR	400	0.9634	385.35
164409	HINDAU-4	400	0.9695	387.79

QV Curve for Bamnoli 400 kV bus(Contingency: Bamnoli-Jhatikara 400kV line)

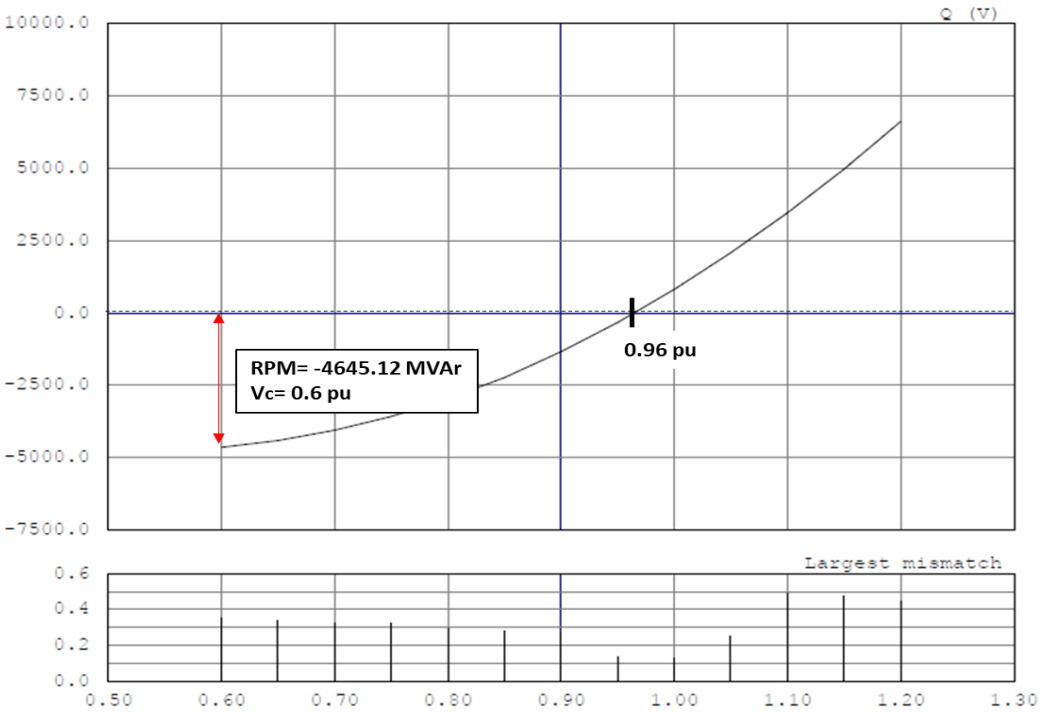


Plots of QV Analysis:

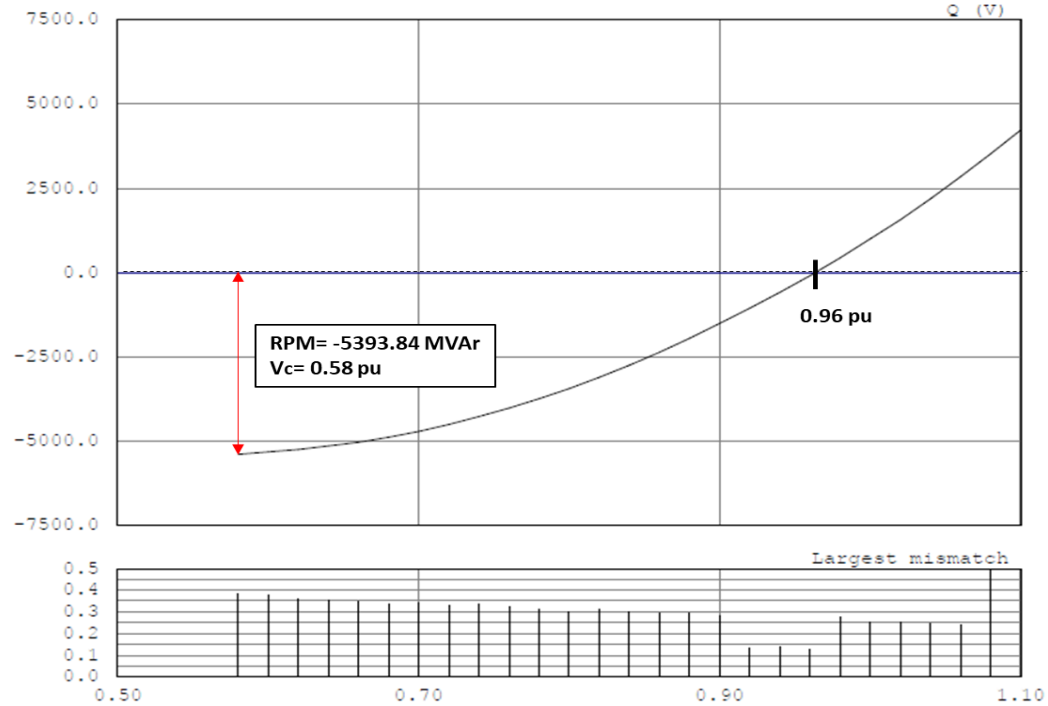
QV Curve for Gopalpur 400 kV bus(Contingency:Gopalpur Narela 400kV line)



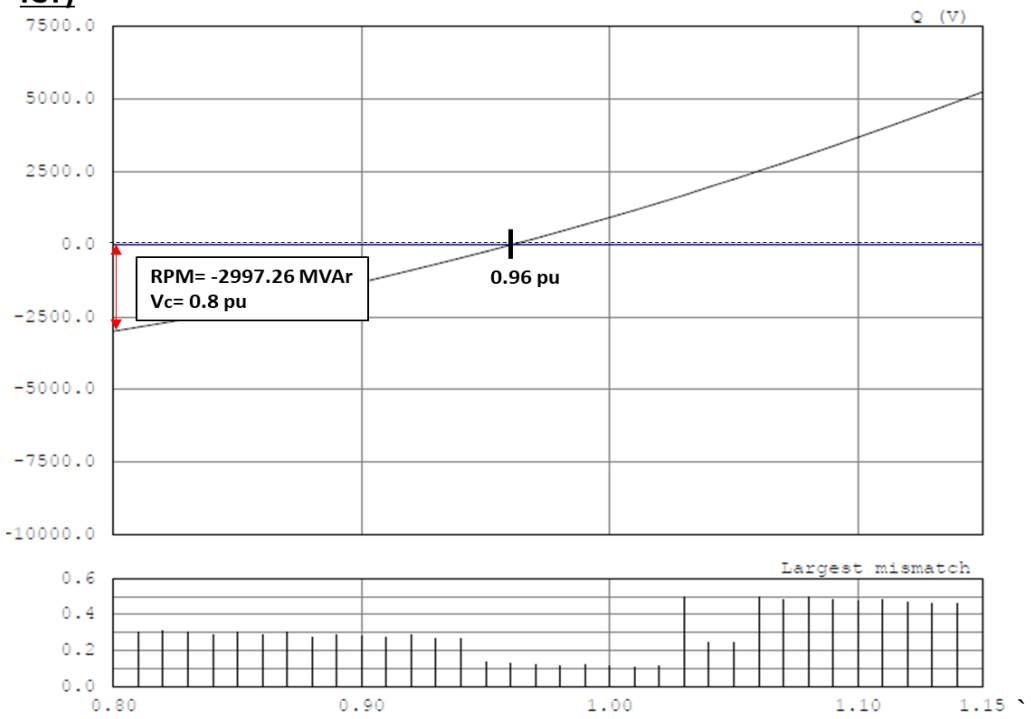
QV Curve for Dwarka 400 kV bus(Contingency: Dwarka-Bamnoli 400kV line)



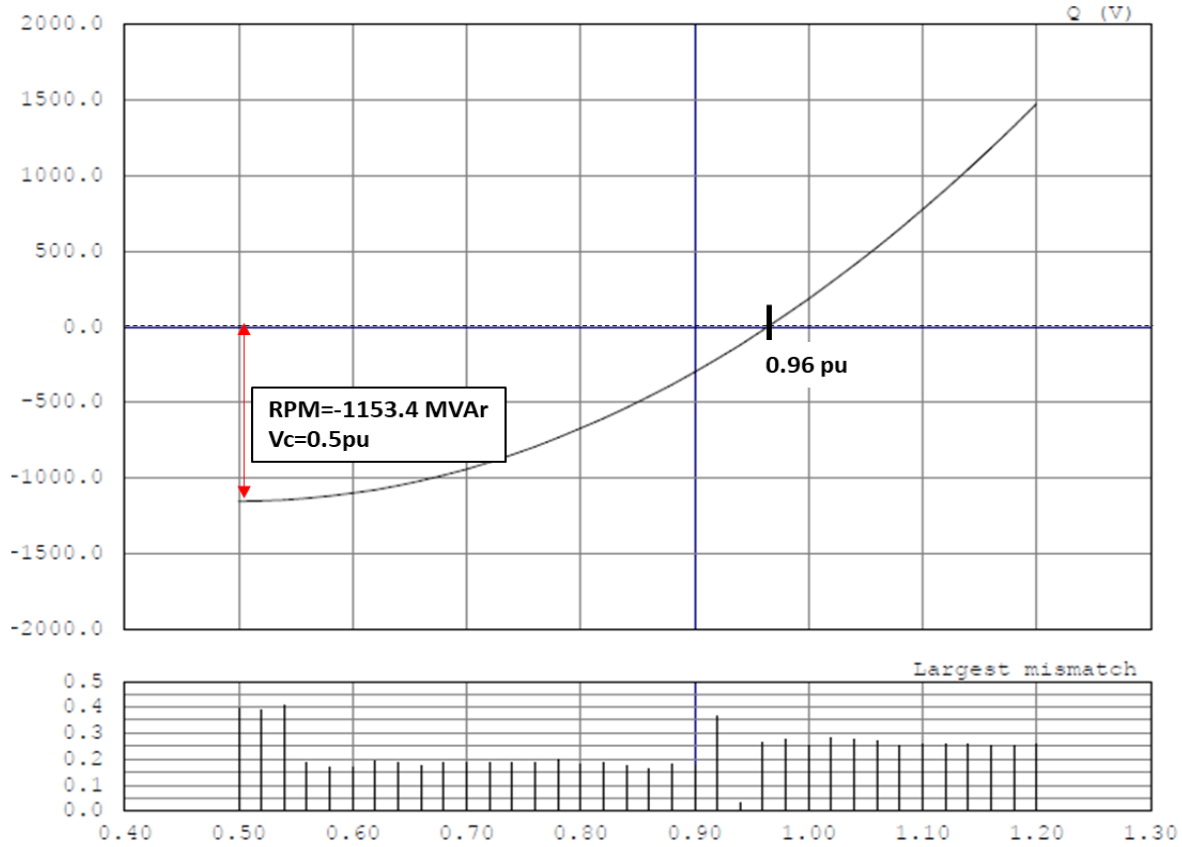
QV Curve for Maharanibagh 400 kV bus(Contingency:Maharanibagh Dadri NCR 400kV line)



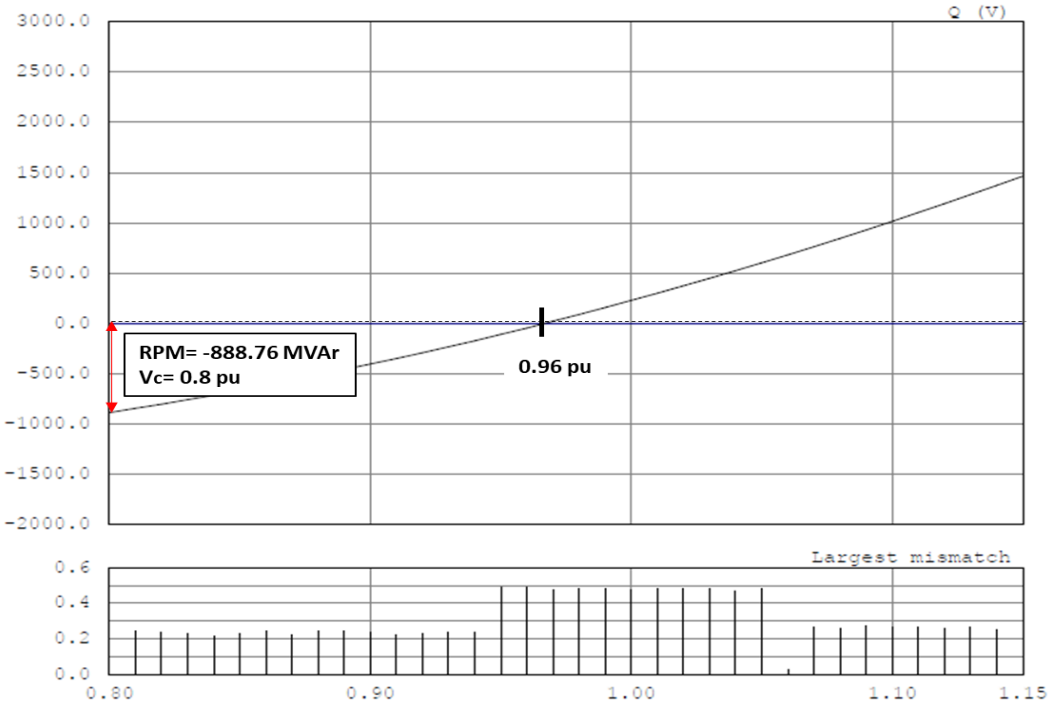
QV Curve for Jhatikara 400 kV bus(Contingency: Jhatikara 400/220kV ICT)



QV Curve for Alwar 400 kV bus(Base Case)



QV Curve for Hindaun 400 kV bus(Contingency:Hindaun Chhabra 400kV line)



Results of QV analysis:

Bus	Nominal Operating Voltage	Nominal Operating Voltage(kV)	Qmin (RPM) - MVAr	V @ Qmin (Voltage Collapse)	Most Severe Contingency
Bamnoli 400kV	0.96	385.94	-4444.55	0.6	Bamnoli-Jhatikara 400kV line
Gopalpur 400kV	0.96	386.45	-5615.57	0.6	Gopalpur Narela 400kV line
Dwarka 400kV	0.96	385.84	-4645.12	0.6	Dwarka-Bamnoli 400kV line
Jhatikara 400kV	0.96	386.45	-2997.26	0.8	Jhatikara 400/220kV ICT
Maharanibagh 400kV	0.96	386.65	-5393.8	0.58	Maharanibagh Dadri NCR 400kV line
Alwar 400kV	0.96	385.35	-612.48	0.5	Base Case
Hindaun 400kV	0.96	387.79	-888.76	0.8	Hindaun Chhabra 400kV line

It is evident from the QV analysis curves that there is sufficient reactive power margin available at the bus from the point of voltage collapse. The voltage profile & margin can be further improved by strategically providing reactive power support that is capable varying with renewable generation/line loading at the suitable buses. This will be further studied with jointly with concerned STUs, Grid India, CEA and other stakeholders and further planning shall be included in next rolling plan.

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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 NR & exports to ER during high RE scenarios whereas it exports power to NR & SR during evening peak and night off peak load.

5.1 Power Supply Scenario as on Jan'25

As on Jan'25, total Installed Capacity (IC) of Western Region was about 156GW which constitute capacity from fossil sources (56% share) & balance (44% share) from non-fossil sources comprising of nuclear, renewable generation capacity including hydro and the peak demand met was about 80.6 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 of Jan'25

(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	1.0	0.8	30.3	32.1	57.3	25.6
MP	16.0	0.3	16.3	0.5	3.2	8.1	11.8	28.1	19.2
Maharashtra	25.4	3.5	28.9	1.1	3.3	17.9	22.3	51.3	26.5
Chhattisgarh	12.2	0.0	12.2	0.1	0.2	1.7	2.1	14.3	6.3
UT of DD & DNH	0.6	0.1	0.7	0.0	0.0	0.1	0.1	0.8	1.4
Goa	0.5	0.1	0.6	0.0	0.0	0.1	0.1	0.7	0.8
Central unallocated	2.8	0.2	3.0	0.4	0.0	0.0	0.4	3.5	--
WR	**76.1**	**10.8**	**86.9**	**3.2**	**7.6**	**58.2**	**69.0**	**155.8**	**80.6**

Source: CEA Monthly Report

5.2 Envisaged Power Supply Scenario by 2029-30

As per the 20th EPS, Western Region demand for 2029-30 timeframe is expected to increase to about 107 GW. The Installed capacity of Western Region is expected to be about 267GW. The state wise bifurcation of the same is given at **Table 5-2.**

Table 5-2: WR Installed Capacity and Peak Demand (2029-30)

(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	29.0	29.3	0.2	40.2	34
MP	6.9	0.0	6.9	0.0	3.1	4.2	7.3	0.0	14.2	25.6
Maharashtra	19.5	1.2	20.7	0.0	2.5	10.7	13.3	0.4	34.4	42
Chhattisgarh	1.6	0.0	1.6	0.0	0.1	0.2	0.4	0.0	1.9	8.8
DD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
DNH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Goa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Central	22.2	3.3	25.5	3.2	0.0	104.5	107.8	4.6	137.9	--
IPP	35.5	2.8	38.2	0.0	0.0	0.0	0.0	0.0	38.2	--
WR	**93.4**	**10.1**	**103.6**	**3.2**	**6.1**	**148.7**	**158.0**	**5.3**	**266.8**	**107**

There is growth of around 26.5GW in the peak demand of Western Region from present timeframe to 2029-30. The state wise growth in demand for 2029-30 from present timeframe 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***
	2024-25 (Till Jan'2025)	**2029-30**		
Gujarat	25588	33964	8376	5.8%
MP	19183	25596	6413	5.9%
Maharashtra	26543	42042	15499	9.6%
Chhattisgarh	6347	8805	2458	6.8%
UT of DD & DNH	1390	2095	705	8.6%
Goa	803	1043	240	5.4%
WR	**80585**	**107050**	**26465**	**5.8%**

From the above data it is observed that the CAGR growth of peak demand is maximum for Maharashtra (9.6%) and minimum for Goa (5.4%). The CAGR of demand of WR is about 5.8% which is less than the National Average of 6 %.

In addition to above, bulk power demand of about 21000MW proposed to be directly connected to ISTS has also been considered from various upcoming green hydrogen/ green ammonia identified by MNRE & various other bulk consumers/distribution licensees who have been granted GNA under GNA Regulations, 2022.

5.3 Load Generation Balance for 2029-30 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 2029-30 timeframe. 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%	77%
2-Aug Peak Load	70%	80%	0%	75%	60%	50%	80%
3-Aug Night Off Peak	40%	80%	0%	65%	40%	50%	55%
4-Jun Solar Max	40%	80%	85%	55%	-100%	0%	84%
5-Jun Peak Load	70%	80%	0%	75%	50%	50%	81%
6-Jun Night Off Peak	40%	80%	0%	65%	1%	50%	79%
7-Feb Solar Max	20%	80%	90%	10%	-100%	0%	90%
8-Feb Peak Load	40%	80%	0%	20%	100%	50%	86%
9-Feb Night Off Peak	20%	80%	0%	20%	40%	30%	67%

The despatch from thermal generations have been done considering merit order despatch. Based on the simulation study, import / export of WR and the inter-regional flows through various corridors is summarised in **Table 5-5:**

Table 5-5: IR flows & Surplus/Deficit of WR

(All Fig in MW)

IR Flows	Import / Export of Western Region								
Scenario No / Corridors	Aug'29 Timeframe			Jun'29 Timeframe			Feb'30 Timeframe		
	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	-8458	16808	14006	3439	23449	10847	-26126	5074	-1552

IR Flows	Import / Export of Western Region								
Scenario No / Corridors	Aug'29 Timeframe			Jun'29 Timeframe			Feb'30 Timeframe		
	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-WR	-18833	-9743	-8860	-20129	-9065	-7267	-15021	1540	-3368
WR-SR	-5258	-13678	-5319	-15922	-14365	-7892	4321	-391	10150
Western Region	5117	12872	17547	7646	18148	10222	-6784	3143	11965

Out of these nine scenarios, Scenario-7 and Scenario-5 corresponds to two extreme cases with import / export requirement of Western Region i.e. Maximum import (6.7 GW) and maximum export (18.1 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 2029-30 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 Feb'24/Mar'24 to Jan'25

Various transmission systems have been planned and deliberated for implementation in the Consultation Meetings for Evolving Transmission Schemes in Western Region (CMETS-WR) and joint study meetings held from Feb'24/Mar'24 to Jan'25. 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	Timeframe	Quantum (MW)	Type of Scheme*	Tentative cost (in Crs.)
Gujarat					
1.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part B (B1 to B3)	2026-27	0	RE	718
2.	Transmission scheme for providing connectivity to REGS at Bhuj PS	2026-27	600	RE	71.24
3.	Augmentation of transformation capacity at 765/400kV Lakadia S/s (WRSS XXI(A) Transco Ltd) in Gujarat – Part B	2026-27	2500	RE	636
4.	Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd) - Amendment	2025-26	1200	SS	60.5
5.	Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS)	2026-27	500	RE	172

Sl. No.	Name of Scheme	Timeframe	Quantum (MW)	Type of Scheme*	Tentative cost (in Crs.)
6.	Transmission system to provide redundant power supply to Dholera area	2025-26		SS	110
7.	Bays at Vataman S/s for Vataman – Saurashtra 765kV D/c line	2027-28	0	SS	70.96
8.	220kV line bays at Vapi-II S/s for LILO of 220 KV Chikhli – Vapi 220kV S/c line at Vapi-II	2026-27	0	SS	12
9.	Transmission System for evacuation of RE power from Raghanesda area of Gujarat – 3 GW under Phase-I	2027-28	3500	RE	2102
10.	Transmission System for evacuation of Green Hydrogen/Ammonia potential in Kandla area of Gujarat (Phase-I: 3 GW)	2027-28	3000	GH	2775
11.	Transmission System for supply of power to Green Hydrogen/Green Ammonia manufacturing potential in Mundra area of Gujarat under Phase-I: Part:B1	2027-28	3000	GH	2817
12.	Transmission System for supply of power to Green Hydrogen/Green Ammonia manufacturing potential in Mundra area of Gujarat under Phase-I: Part:B2	2028-29	7500	GH	6405
13.	Transmission System for Offshore Wind Zone Phase-1 (500 MW VGF off the coast of Gujarat for Subzone B3)	2028-29	500	RE	6900
14.	Transmission system for Evacuation of Power from RE Projects in Jam Khambhaliya REZ -Phase II	2027-28	4500	RE	4000
15.	Installation of Synchronous Condensors at Jam Khambhaliya-II	2027-28	0	SS	400
16.	Transmission system for Evacuation of Power from RE Projects in Jamnagar REZ in Gujarat-Phase I	2027-28	1000	RE	150
17.	Transmission System for Evacuation of Power from potential renewable energy zone in Bhuj-II (Addl. 1.5GW), Khavda Ph-VI (5.5GW) & Lakadia-II (7.5GW)	2027-28	14500	RE	16000
18.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area (Phase-VII)	2029-30	6000	RE	25000
19.	Implementation of 2 nos. 220kV bays at Vapi-II S/s (MUML) for drawl of power by GETCO	2026-27	0	SS	21.46
Maharashtra					
1.	Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune)	2027-28	1500	RE	1663

Sl. No.	Name of Scheme	Timeframe	Quantum (MW)	Type of Scheme*	Tentative cost (in Crs.)
2.	Transmission system for Evacuation of Power from RE Projects in Solapur SEZ in Maharashtra-Phase II (2000MW) and Network Expansion scheme to enable drawal of power from Solapur PS	2027-28	2000	RE	1653
Madhya Pradesh					
1.	Network Expansion Scheme in Vindhyachal complex of Madhya Pradesh	2027-28	1600	Conv	5
2.	Transmission System for enabling RE interconnection at Mandsaur S/s	2029-30		RE	17.28
3.	Transmission System for enabling RE interconnection at Neemuch S/s	2025-26		RE	5.57
4.	Transmission system for Evacuation of Power from RE Projects in Neemuch (1000 MW) SEZ in Madhya Pradesh-Phase II	2027-28	1000	RE	2240
5.	Transmission system for Evacuation of Power from RE Projects in Rajgarh (1500 MW) SEZ in Madhya Pradesh-Phase III	2027-28	1500	RE	1079
6.	Transmission System for evacuation of power from Mahan Energen Limited Generating Station in Madhya Pradesh	2027-28	1200	Conv	558
7.	Augmentation of transformation capacity & Implementation of line bays at Mandsaur S/s for RE Interconnection	2027-28	2500	SS	319
8.	Network expansion at 765/400/220/132kV Kurawar S/s for drawal of power by MPPTCL	2026-27	0	SS	56.06
9.	Implementation of 2 nos. 400kV line bays at Mandsaur S/s for Interconnection of 3x504MW PSP of Greenko MP01 IREP Pvt. Ltd.	2026-27	0	SS	30.46
10.	Transmission system for Evacuation of Power from RE Projects in Morena SEZ in Madhya Pradesh-Phase I	2027-28	2500	RE	1693
Chhattisgarh					
1.	Transmission System for evacuation of power from Vedanta's Thermal Power Station (1200MW) in Sakti, Chhattisgarh	2025-26	1200	Conv	3.61
2.	400kV line bays at Champa for Interconnection of NTPC LARA STPP STAGE-II (1600MW) Project	2027-28	1600	Conv	18.57
3.	Scheme to control high voltages at Champa PS (on Bus Section-A, where Lara-I project is connected)	2025-26		SS	79.28
	Total	-	**64,900**	**-**	**77,842**

**RE – Renewable Energy; SS- System Strengthening; GH – Green Hydrogen; Conv – Conventional generators.*

The schemes are detailed in the following sections.

5.4.1 Gujarat

2. <u>Augmentation of transformation capacity at KPS1 (GIS) & KPS2 (GIS) & KPS3 (GIS) (Khavda Phase-V Part-B1, B2 & B3 Scheme)</u>

<u>KPS1 Augmentation:</u>

KPS1 (GIS) S/s with 3x1500MVA 765/400kV ICTs on Sec-I is already commissioned by M/s Adani Transmission Limited. Augmentation of transformation capacity by 1x1500MVA 765/400kV ICT (4th) on Sec-I is also being implemented by M/s ATL under RTM under Khavda Ph-IV Part-E1 scheme. Further, Sec-II of KPS1 is being established by M/s Megha Engineering & Infrastructures Limited with SCOD of Jan-25 with 4x1500MVA 765/400kV ICTs.

Further, applications for Connectivity for an additional 810MW were received from M/s Adani Green Energy Ltd. Augmentation of transformation capacity is required to enable the injection of 810MW power at KPS1 maintaining N-1 criteria compliance. The scheme was discussed and approved in the 21st NCT meeting held on 06.08.2024 for implementation under TBCB route.

<u>KPS2 Augmentation:</u>

KPS2 S/s with 4x1500MVA, 765/400kV ICTs (2x1500 MVA on Sec-I & 2x1500 MVA on Sec-II) is under implementation by POWERGRID. 4x1500 MVA (2x1500 MVA on Sec-I & 2x1500 MVA on Sec-II) Addl. ICTs are also being implemented by POWERGRID (under TBCB) under Khavda Ph-IV Part-E2 scheme.

However, to enable the onward dispersal of power from KPS2 maintaining the N-1 criteria compliance, augmentation of transformation capacity by 1x1500MVA, 765/400kV ICT(9th) is proposed. The scheme was discussed and approved in the 21st NCT meeting held on 06.08.2024 for implementation under TBCB route.

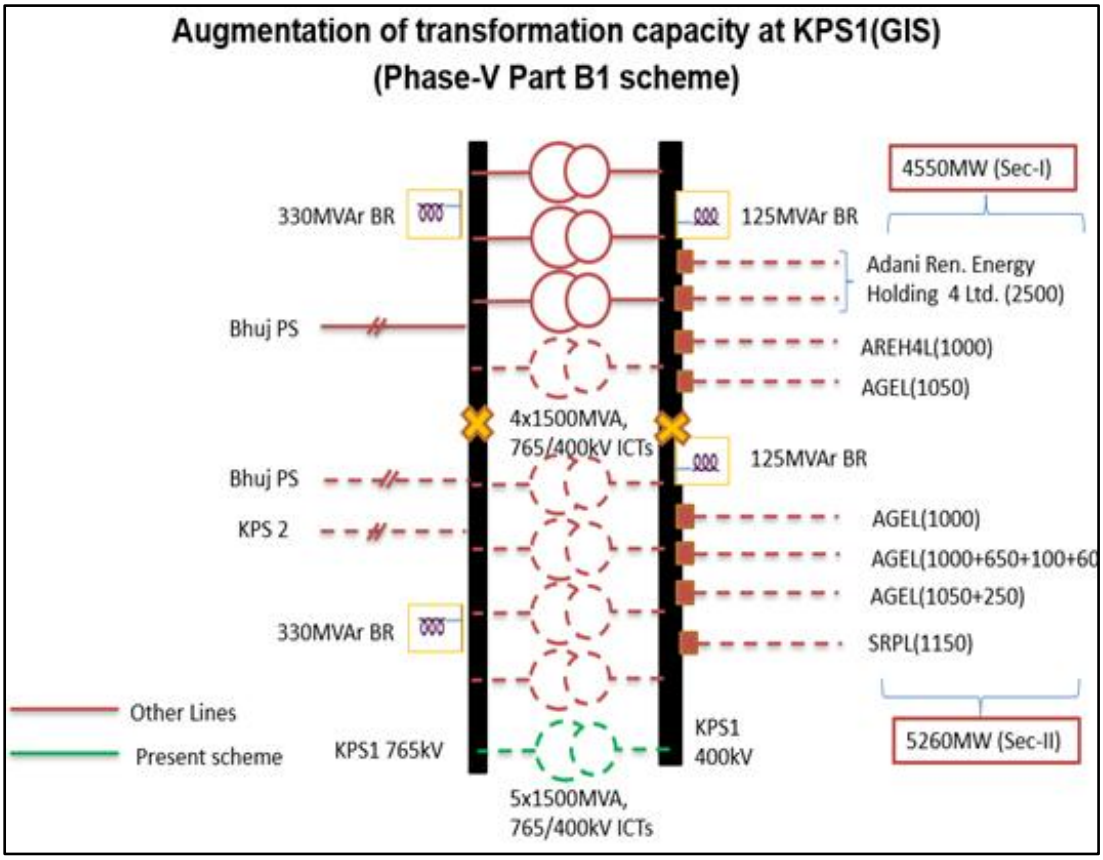
The detailed scope of work for the above schemes is tabulated as below:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	**<u>Khavda Ph-V Part-B1</u>** Augmentation of transformation capacity at KPS1(GIS) by 1x1500 MVA, 765/400 kV ICT on Bus section-II (9th)	• 1500 MVA, 765/400 kV ICT – 1 Nos. • 765kV ICT bay – 1 Nos. on Bus section-II • 400 kV ICT bay – 1 Nos. (+1 Nos. (with Sw.LR bay provision) for Dia. Completion in GIS) on Bus section-II
2.	**<u>Khavda Ph-V Part-B2</u>**	• 1500 MVA, 765/400 kV ICT – 1 Nos.

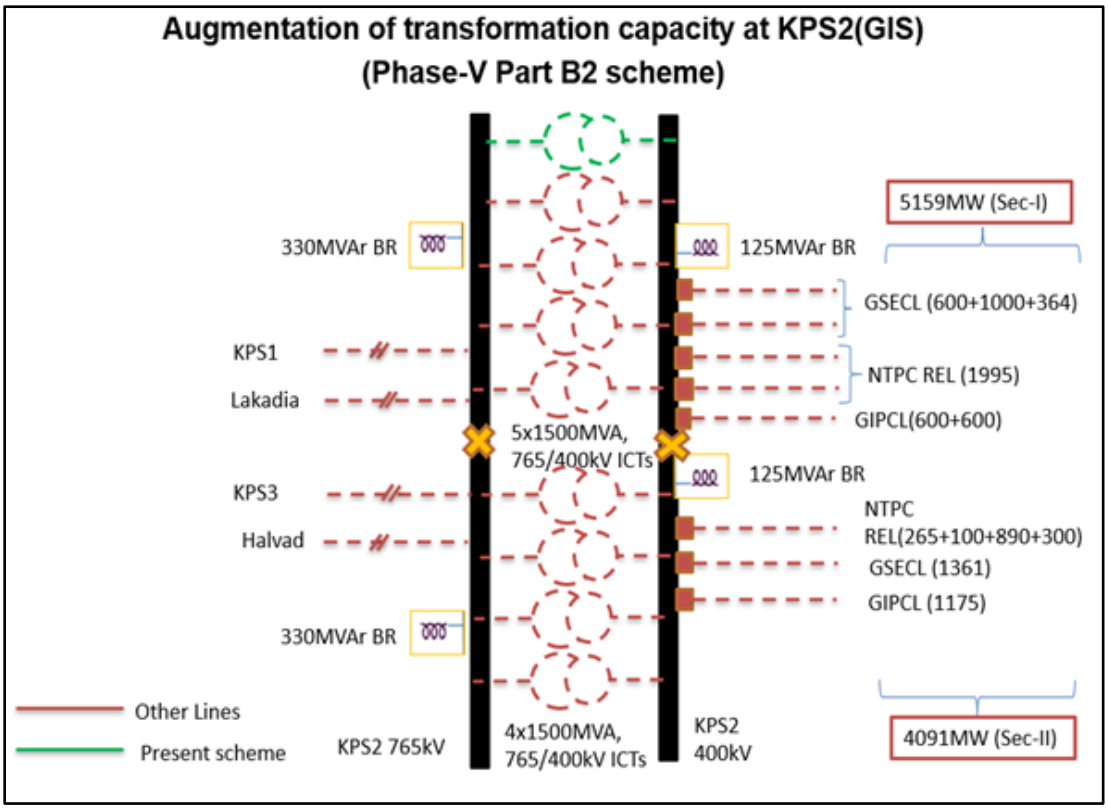
Sl. No.	Scope of the Transmission Scheme	Capacity /km
	Augmentation of transformation capacity at KPS2(GIS) by 1x1500 MVA, 765/400 kV ICT on Bus section-I (9th)	• 765 kV ICT bay – 1 Nos. (+1 Nos. (with Sw.LR bay provision) for Dia. Completion in GIS) on Bus section-I • 400 kV ICT bay – 1 Nos. (+1 Nos. (with Sw.LR bay provision) for Dia. Completion in GIS) on Bus section-I

Implementation timeframe: 24 months from the date of award to implementing agency i.e. 18.02.2027

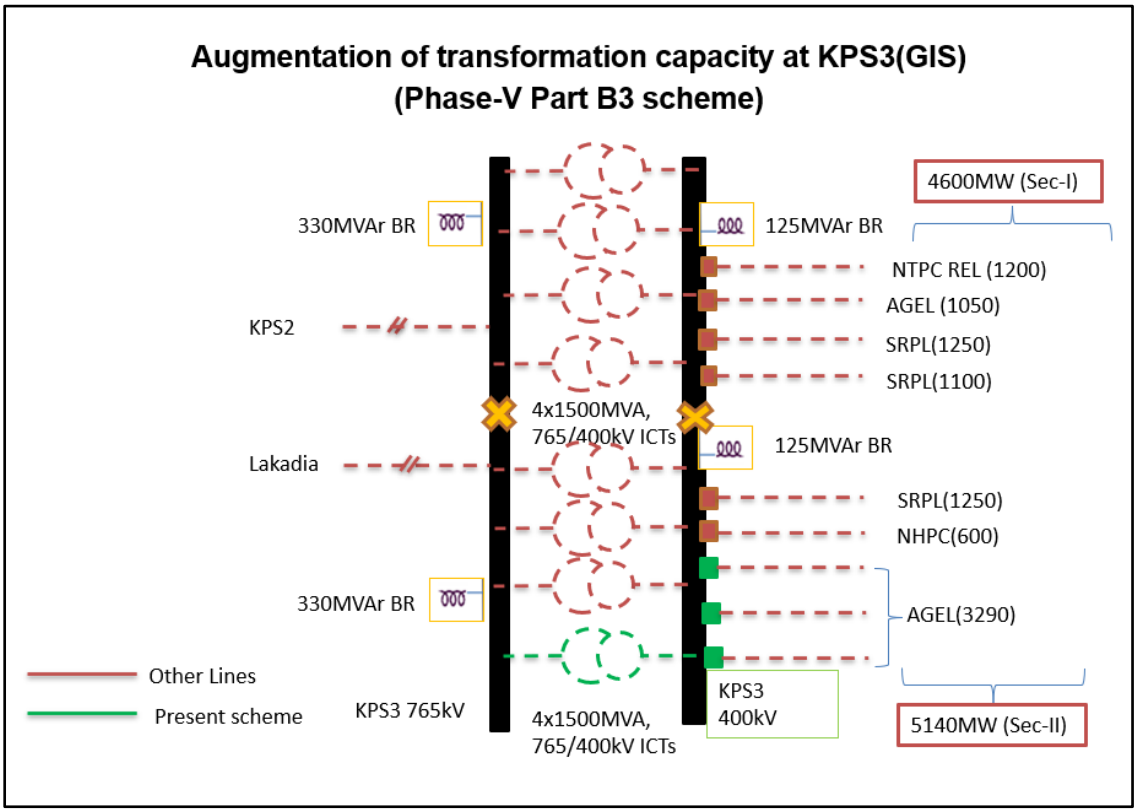
Estimated cost: ₹ 466 Cr.



(a)



(b)



(c)

Figure 5-1: KPS1 (a), KPS2 (b) & KPS3 (c) substations with the ICT augmentations

KPS3 Augmentation:

KPS3 S/s with 3x1500MVA, 765/400kV ICTs on Sec-I is under implementation by POWERGRID. Augmentation of transformation capacity by 1x1500MVA, 765/400kV ICT on Sec-I was also awarded to POWERGRID under RTM and is currently under implementation. Scheme for augmentation by 3x1500MVA, 765/400kV ICTs on Sec-II of KPS3 is under bidding under Khavda Ph-IV Part-A scheme.

Connectivity for 4600MW on Sec-I and 1850MW on Sec-II was granted at KPS3 against applications received so far. Further, applications for additional Connectivity for 3290MW (270MW on Sec-I & 3020MW on Sec-II) were received. Augmentation of transformation capacity by 1x1500MVA, 765/400kV ICT (8th) is required to enable the injection of additional 3290MW power from KPS3 considering the margins to be sufficient on commissioning of HVDC. The scheme was discussed and agreed for in the 31st CMETS-WR meeting held on 03.08.2024. The subject transmission scheme was also discussed and approved by the NCT during the 24th NCT meeting held on 23.10.2024 wherein the committee approved implementation of the subject transmission scheme by KIVAPTL under RTM.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	Khavda Phase-V Part B3	
1.	Augmentation of transformation capacity at KPS3(GIS) by 1x1500MVA, 765/400 kV ICT on Bus section-II (8th)	• 765/400kV ICT – 1 • 765kV ICT bay – 1 on Bus section-II* • 400kV ICT bay – 1 on Bus section-II*
2.	3 nos. 400kV line bays on KPS3 400kV Bus Section-II for RE interconnection	• 400kV line bays – 3 nos.

**Bay(s) as may be required for completion of diameter (GIS) in one-and-half breaker scheme, shall also be executed by the TSP. Further, TSP of KPS3 shall provide space to carry out above augmentation works.*

Implementation timeframe: 24 months from the date of award to implementing agency i.e. 25.11.2026

Estimated Cost: ₹ 252 Cr.

3. Transmission scheme for providing connectivity to REGS at Bhuj PS

1) Augmentation of transformation capacity at 400/220kV Bhuj PS in Gujarat by 1x500 MVA, 400/220kV ICT (10th)
2) Implementation of 220kV line bays at Bhuj PS for Interconnection of 600MW REGS

765/400/220kV Bhuj PS is an existing substation of POWERGRID with 4x1500MVA, 765/400kV ICTs & 8x500MVA 400/220kV ICTs. 9th 400/220kV ICT is being implemented by POWERGRID with schedule of 01/07/2025

600MW REGS of Indianoil NTPC Green Energy Pvt Ltd. (INGEPL) (Appl. No. 2200000634) has been granted connectivity at Bhuj PS with start date of connectivity from 30.06.2026 subject to commissioning of Common System, which involves Bhuj ICT-9 as well as Khavda Ph-II (UC), Ph-III (UC) and Ph-IV (Under Tendering) schemes. Khavda Ph-IV scheme is presently under tendering and is expected to be awarded by Sep/Oct-24 with SCOD of Sep/Oct-26.

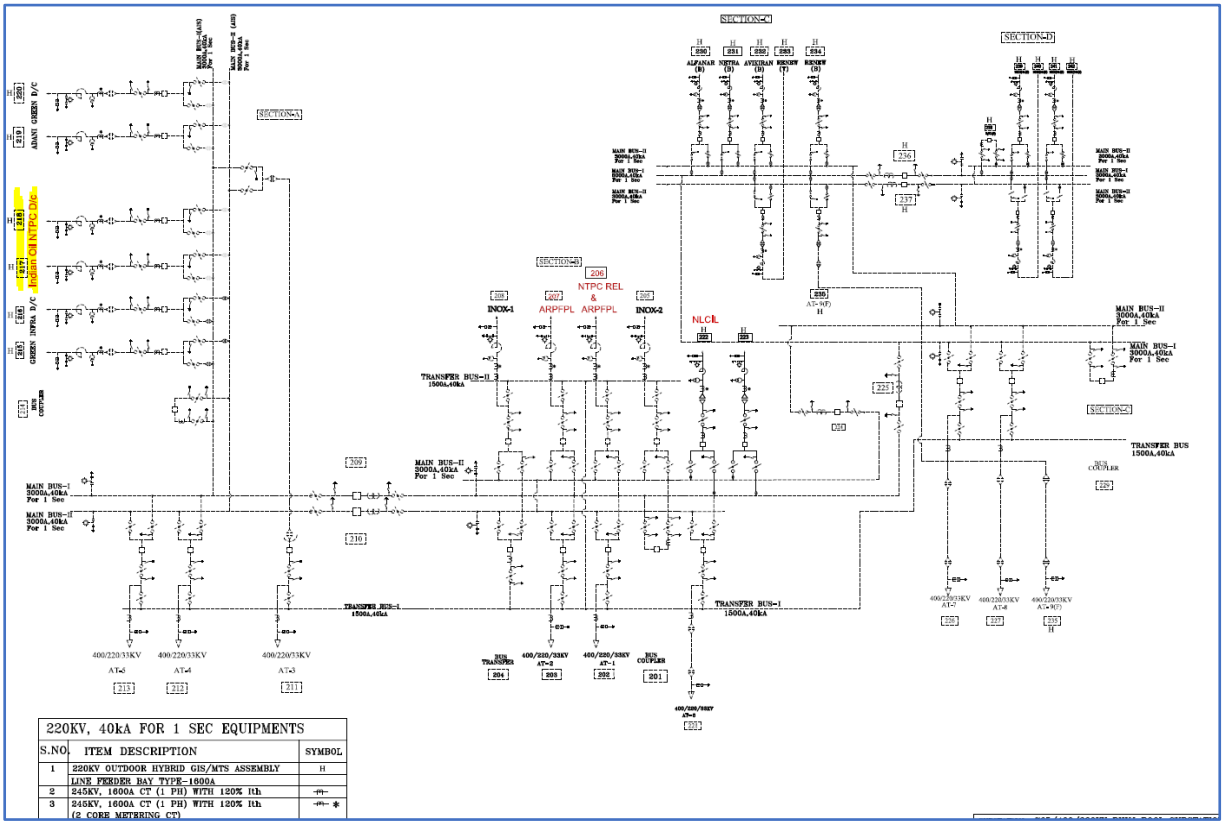
The present scheme involves 2 nos. 220kV line bays at Bhuj PS for Interconnection of 600MW REGS of Indianoil NTPC Green Energy Pvt. Ltd. (INGEPL) (Appl. No. 2200000634). The Scheme comprises Augmentation of 400/220 kV,1x500 MVA (10th) ICT at Bhuj PS. The proposal was deliberated in the 30th CMETS-WR meeting held on 02.07.2024. Subsequently augmentation with 1x500MVA, 400/220kV ICT (10th) at Bhuj PS along with associated transformer bays was agreed in 30th CMETS-WR meeting held on 02.07.2024.

CTU vide OM dated 20.01.2025 has approved the subject scheme with following scope of works for implementation under RTM to Power Grid Corporation of India Ltd, with implementation timeline of 21 months based on confirmation from INGEPL.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe	Total Estimated Cost
A. Augmentation of transformation capacity at 400/220kV Bhuj PS in Gujarat by 1x500 MVA, 400/220kV ICT (10th)				
1.	Augmentation of transformation capacity at 400/220kV Bhuj PS in Gujarat by 1x500 MVA, 400/220kV ICT (10^{th}) along with associated transformer bays	• 500 MVA, 400/220 kV ICT- 1 no. • 220 kV ICT bay (Hybrid GIS)- 1 no. • 220kV GIB Duct (1ph) – 1200m (3x400m) (approx.) • 220kV Air Bushing for connecting GIS to AIS – 3 nos. • Shifting of existing Bus Reactor from 415 bay to 413 bay – 1 no. • 400 kV Reactor Bay no. 413 (in existing diameter) (AIS) - 1 no.	21 months from the date of issuance of OM by CTUIL *(refer note a)*	₹ 58.54 Crs.
B. Implementation of 220kV line bays at Bhuj PS for Interconnection of 600MW REGS				

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe	Total Estimated Cost
2.	Implementation of 2 nos. 220kV line bays at Bhuj PS for Interconnection of 600MW REGS of Indianoil NTPC Green Energy Pvt. Ltd. (INGEPL) (Appl. No. 2200000634)	• 220kV Bays (Hybrid/MTS) – 2 Nos.	21 months from the date of issuance of CTUIL OM	₹ 12.7 Crs.
			Total Estimated Cost:	**₹ 71.24 Crs.**



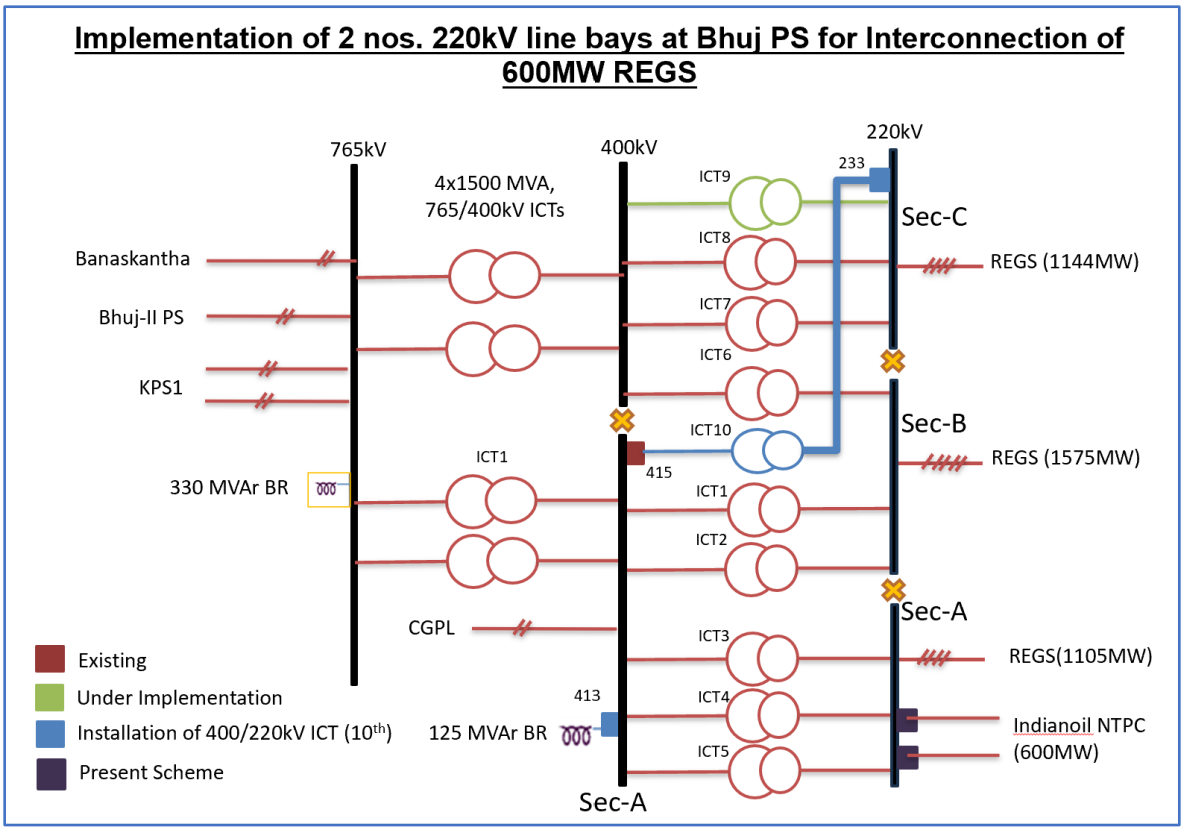


Figure 5-2: ICT augmentation & bay implementation at Bhuj PS

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

765/400kV Lakadia S/s is an existing and augmentation of transformation capacity by 2x500MVA 400/220kV ICTs are under implementation. Further, in view of the 2GW potential at Lakadia revived by MNRE vide letter dated 14.02.2024 & MoP letter dated 16.02.2024 and to enable the grant of Connectivity to the applicants in that area, the subject augmentation scheme is proposed.

The scheme was earlier discussed in parts (Part-B & Part-C) in the 17th & 18th NCT meetings wherein, considering the rapid pace of applications being received at Lakadia PS, it was decided to install all remaining ICTs and 220kV bays at Lakadia PS in one go so as to minimize multiple implementation timelines. Hence, the scheme was again deliberated and approved under TBCB in the 20th NCT meeting held on 25.06.2024 with implementation timeframe as mentioned below.

Detailed scope of work:

Sr. No.	Scope of the Transmission Scheme	SCOD in months from Effective Date
1.	Installation of 2x500 MVA, 400/220 kV ICTs (3rd & 4th) at Lakadia PS along with associated ICT bays • 400/220 kV, 1x500 MVA ICT - 2 Nos.	18 months from date of allocation to implementing agency (14.08.2026)

Sr. No.	Scope of the Transmission Scheme	SCOD in months from Effective Date
	• 400 kV ICT bay- 2 Nos. • 220 kV ICT bay - 2 Nos. (220 kV bus section-I)	
2.	Implementation of 220 kV line bay at Lakadia PS for TEQ Green Power XVII Private Limited (TGPXVIIPL: 300 MW) • 220 kV line bay - 1 no. (220 kV bus section-I)	18 months from date of allocation to implementing agency (14.08.2026)
3.	Implementation of 220 kV line bay at Lakadia PS for Arcelor Mittal Nippon Steel India Limited (AMNSIL: 350 MW) • 220 kV line bay - 1 no. (220 kV bus section-I)	18 months from date of allocation to implementing agency (14.08.2026)
4.	Implementation of 220 kV line bay at Lakadia PS for Renew Solar (Shakti Eight) Private Limited (RS(S8) PL: 200 MW) • 220 kV line bay - 1 no. (220 kV bus section-I)	30.09.2026 (as per start date requested by applicant)
5.	Creation of New 220 kV Bus Section-II at Lakadia PS along with 220 kV Sectionaliser arrangement between 220 kV Bus sec-I & Sec-II • 220 kV Bus Sectionaliser - 1 set • BC-1 No. • TBC-1 No	18 months from date of allocation to implementing agency (14.08.2026)
6.	Augmentation of transformation capacity at Lakadia PS by 4x500 MVA, 400/220 kV ICTs (5th 6th, 7th & 8th) terminated on new 220 kV Bus Section-II	
6a	2x500MVA ICTs (5th & 6th) • 500 MVA, 400/220 kV ICTs: 2 No. • 400 kV ICT bays: 2 Nos. • 220 kV ICT bays: 2 No. (New Bus Section-II)	18 months from date of allocation to implementing agency (14.08.2026)
6b	1x500MVA ICT (7th) • 500 MVA, 400/220 kV ICT: 1 No. • 400 kV ICT bay: 1 No. • 220 kV ICT bays: 1 No. (New Bus Section-II)	31.12.2026
6c	1x500MVA ICT (8th) • 500 MVA, 400/220 kV ICT: 1 No. • 400 kV ICT bay: 1 No. • 220 kV ICT bays: 1 No. (New Bus Section-II)	30.06.2027
7.	Implementation of 220 kV line bay at Lakadia PS for Juniper Green Energy Private Limited (JGEPL) (Appl. No. 2200000376: 300 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	30.06.2027 (as per start date requested by applicant)
8.	Implementation of 220 kV line bay at Lakadia PS for TEQ Green Power XVI Pvt. Ltd. (TGPXVIPL) (Appl. No. 2200000398: 76 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	30.09.2026 (as per start date requested by applicant)

Sr. No.	Scope of the Transmission Scheme	SCOD in months from Effective Date
9.	Implementation of 220 kV line bay at Lakadia PS for Ganeko Solar Pvt. Ltd. (GSPL) (Appl. No. 2200000458: 290 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	31.12.2026 (as per start date requested by applicant)
10.	Implementation of 220 kV line bay at Lakadia PS for Juniper Green Energy Private Limited (JGEPL) (Appl. No. 2200000500: 150 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	31.03.2027 (as per start date requested by applicant)
11.	Implementation of 220 kV line bay at Lakadia PS for Serentica Renewables India Private Limited (SRIPL) (Appl. No. 2200000610: 200 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	30.06.2026*
12.	Implementation of 220 kV line bay at Lakadia PS for RDS Solar Park Private Limited (RDSSPPL) (Appl. No. 2200000639: 350 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	30.06.2026*
13.	Implementation of 220 kV line bay at Lakadia PS for Percentum Renewables Private Limited (PRPL) (Appl. No. 2200000673: 148 MW) • 220 kV line bay - 1 No. (New Bus Section-II)	30.06.2026*
14.	Installation of 1x330 MVAr 765 kV Bus Reactor (2nd) along-with associated bay • 330 MVAr, 765 kV Bus Reactor: 1 No. • 765 kV BR bay: 1 No.	18 months from date of allocation to implementing agency (14.08.2026)
15.	Augmentation of transformation capacity at Lakadia PS by 1x1500 MVA, 765/400 kV ICTs (3rd) • 1500 MVA, 765/400 kV ICT: 1 No. • 400 kV ICT bay: 1 No. • 765 kV ICT bay: 1 No.	18 months from date of allocation to implementing agency (14.08.2026)

**Subject to minimum schedule of 18 months from the date of allocation to implementing agency i.e. 14.08.2026*

Estimated Cost: ₹ 636 Crs.

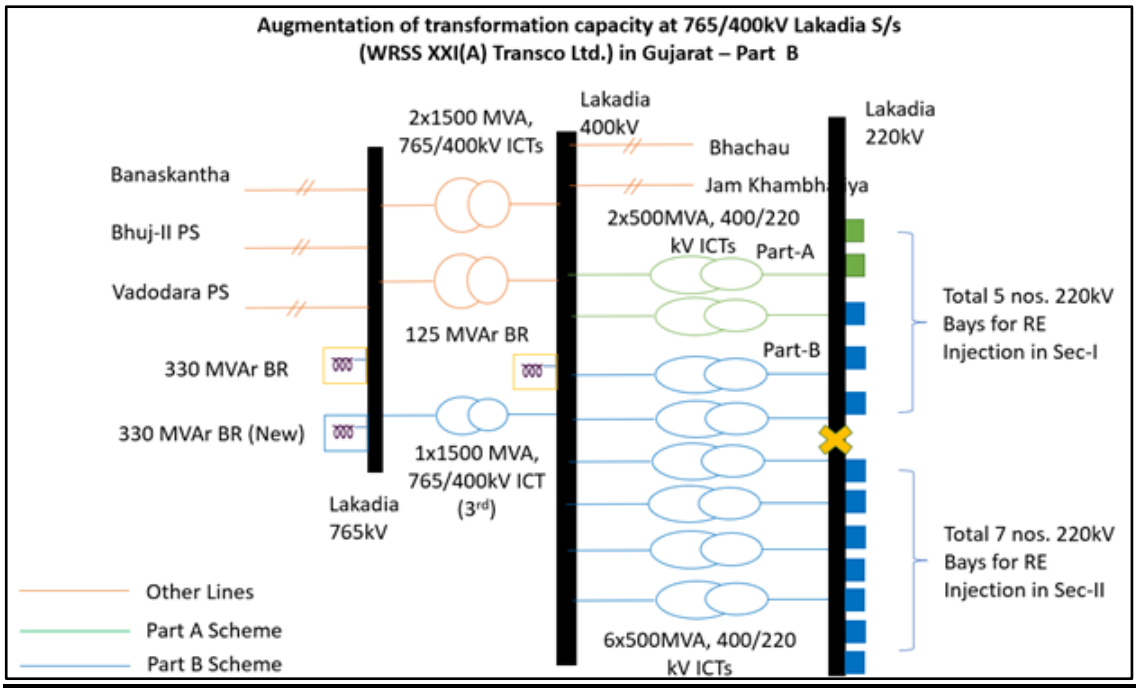


Figure 5-3: Augmentation of transformation capacity at Lakadia

5. Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd) - Amendment

In the 18th meeting of CTU Committee on Transmission Projects (CCTP) held on 21.05.2024, CCTP approved the implementation of transmission scheme "**Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd)'** under RTM through Power Grid Corporation of India Ltd.

Subsequently, POWERGRID vide email dated 22/08/2022 & 18/09/2024 has proposed utilizing existing 400kV Bay [Bay No. 401] implemented under **"Transmission System associated with DGEN (1200 MW) of Torrent Power Ltd."** for the termination of 400/220kV, 1x500MVA ICT (3rd) at Vadodara S/s under the scheme "Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd)". This aforesaid proposal is aligned with the CERC order dated 16/02/2023 in Petition No. 365/TT/2018, wherein, it was directed to explore the utilization of the 2nd 400kV line bay at Vadodara S/s for system requirement in future.

Considering the above, the proposal of utilization of existing 400kV bay for termination of 400/220kV, 1x500MVA ICT (3rd) was agreed in the 32nd CMETS WR held on 24/09/2024. In view of the above, the subject scheme was amended vide CTU OM dated 14/06/2024 in relation to implementation of ***"Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd)"***

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe.
1.	Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd)	• 400/220kV, 1x500MVA ICT – 1 No. • 220kV ICT bay GIS) – 1 No. • 220 kV GIS Bus duct (m) – 450m. approx.	31.03.2026
2.	2 nos. 220kV bays at Vadodara S/s (for Vadodara (PG) – Waghodia D/c line)	• 220kV line bays (GIS): 2 Nos. • 220kV GIS Bus duct (m) – 300m. approx.	
		Total Estimated Cost:	**₹ 60.5 Crs.**

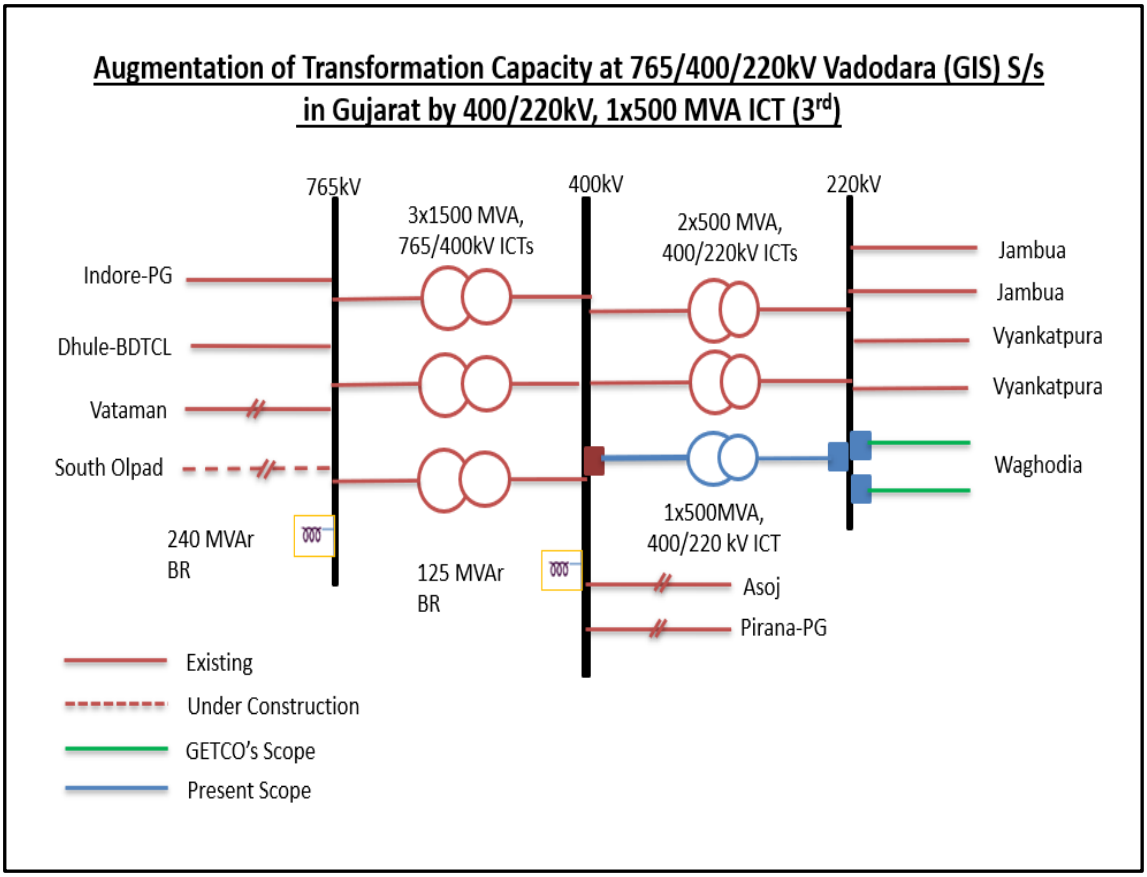


Figure 5-4: Augmentation of transformation capacity at Vadodara GIS

6. Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS)

400/220kV Banaskantha PS is an existing S/s with transformation capacity of 2x500MVA, 400/220kV ICTs, planned to enable injection of RE power from the 700MW GPCL's

Radhanesda Solar Power Park. M/s Sprng Power Earth Pvt. Ltd. was granted Connectivity for injection of 250MW RE power.

Subsequently, applications were received for additional 300MW Connectivity at Banaskantha PS. To enable the injection of additional 300MW RE power maintaining N-1 criterion compliance, the subject scheme was proposed. The scheme was deliberated and approved under TBCB in the 21st NCT meeting held on 06.08.2024 with implementation timeframe of 24 months from the date of SPV transfer.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS) by 2x500 MVA 400/220 kV ICTs (3rd & 4th)	• 500 MVA, 400/220 kV ICTs: 2 Nos. • 400 kV ICT bays: 2 Nos. (+ 2 Nos. for dia completion with provision of Switchable LR) • 220 kV ICT bays: 2 Nos.

Implementation timeframe: 24 months from the date of SPV transfer i.e. 24.03.2025

Estimated Cost: ₹ 172 Crs.

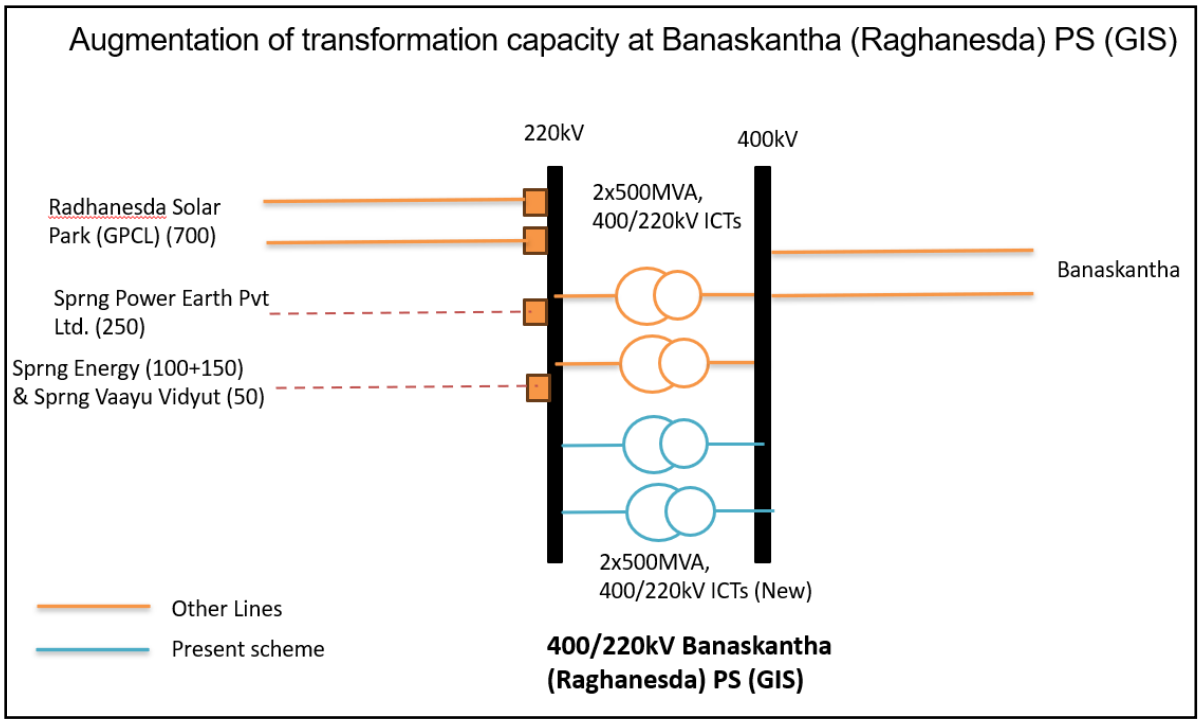


Figure 5-5: Aaugmentation of transformation capacity at Vadodara GIS

7. Transmission system to provide redundant power supply to Dholera area

In order to provide power supply to the semiconductor manufacturing industries in Dholera SIR area of Gujarat, GETCO has already established 220/33kV Dholera S/s along with Panchham – Dholera 400kV D/c line which is presently charged at 220kV level. However, in view of a redundant 2nd source of power, GETCO vide letter dated 22.07.2024, has proposed ISTS connectivity from Vataman substation, for drawal of 150-200MW at new proposed Dholera-2 S/s of GETCO in Jan-26 timeframe.

765kV Vataman Switching Substation is under implementation with SCOD of Dec'25. Subsequently, implementation of 2x1500MVA 765/400kV ICTs at Vataman S/s was approved in the 20th NCT meeting to enable evacuation of power from offshore wind projects in Gujarat in matching timeframe with offshore wind (Mar'29).

The interconnection of Vataman S/s (ISTS) with 220kV Dholera-2 S/s proposed by GETCO would require preponement of 2x1500MVA 765/400kV ICTs (agreed for offshore wind projects), from Mar-29 to an earlier timeframe as well as Installation of 2x500MVA 400/220kV ICTs and 2 nos. 220kV line bays at Vataman S/s. In this regard, the subject scheme was agreed for with the following scope of work in the 31st CMETS-WR held on 02.08.2024. The scheme was deliberated and approved under RTM mode in the 22nd NCT meeting held on 23.08.2024 with implementation timeframe as mentioned below:

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
A. Transmission System for Offshore Wind (required to be preponed)		
1.	Creation of 400kV switchyard along with Installation of 2x1500 MVA, 765/400 kV ICTs at Vataman (AIS) with 2x125 MVAr (420 kV) Bus Reactors	• 765/400kV, 1500 MVA, ICTs – 2 nos. (7x500MVA incl. spare unit) • 765kV ICT bays – 2 nos. • 400kV ICT bays – 2 nos. • 2x125 MVAR, 420kV Bus Reactor – 1 no. • 400kV Bus Reactor Bay – 2 no.
B. Additional Transmission System Proposed for redundant power supply to Dholera area		
2.	Creation of 220kV switchyard along with Installation of 2x500 MVA, 400/220 kV ICTs at Vataman (AIS)	• 400/220kV, 500 MVA, ICTs – 2 nos. • 400kV ICT bays – 2 nos. • 220kV ICT bays – 2 nos.
3.	2 Nos. 220kV line bays for Vataman – Dholera-2(GETCO) 220kV D/c line	• 220kV line bays – 2 nos.

Note: *GETCO shall implement Vataman – Dholera-2(GETCO) 220kV D/c line in matching timeframe*

Implementation timeframe: 18 months from award to implementing agency i.e. 02.03.2026

Estimated Cost: ₹ 110 Crs.

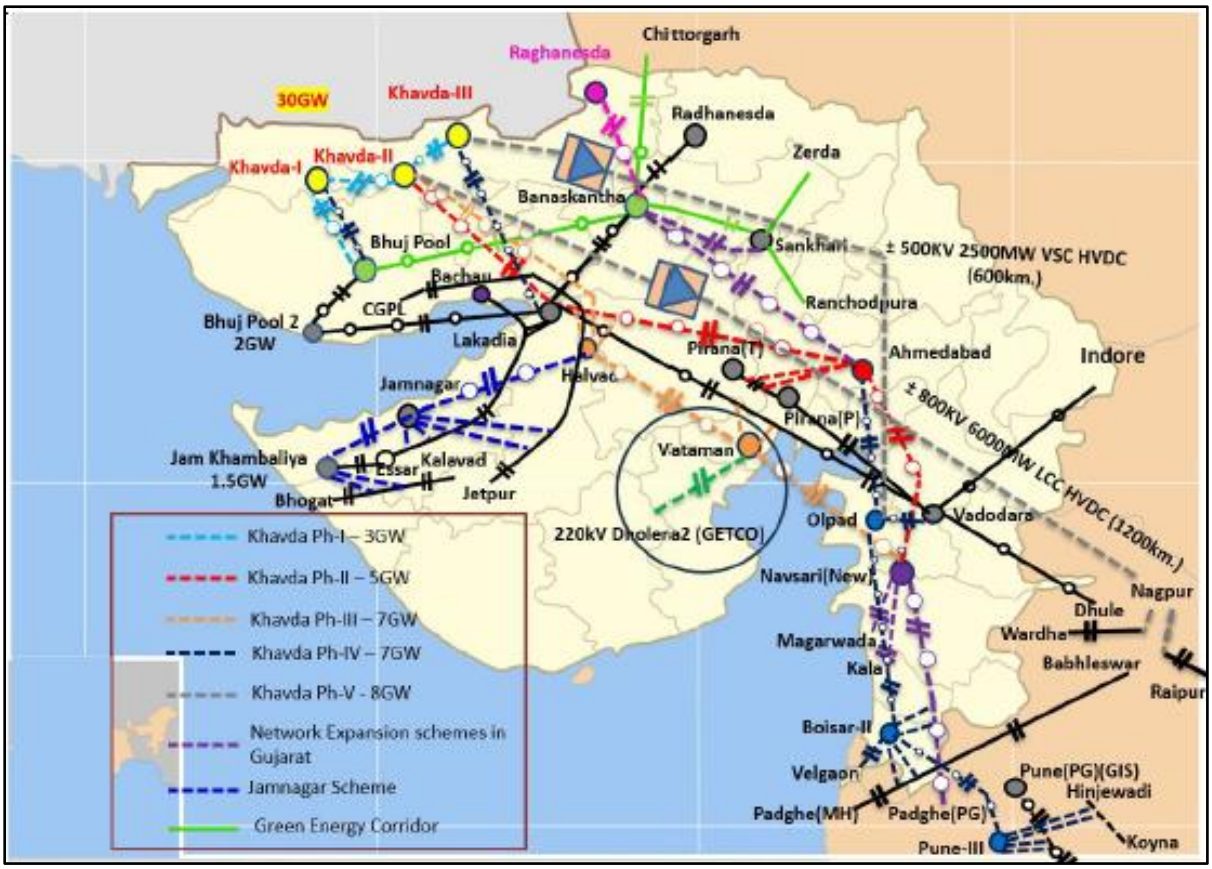


Figure 5-6: Tr. system to provide redundant power supply to Dholera area of Gujarat

8. Bays at Vataman S/s for Vataman – Saurashtra 765kV D/c line

Establishment of 2x1500MVA, 765/400kV Saurashtra S/s (near Rajkot), 765 kV D/C Vataman (ISTS) – Saurashtra line (with bays at both ends) (along with other transmission elements) is being taken up by GETCO for implementation. In this regard, GETCO vide letter dated 30.05.2024, has requested for implementation of 2 nos. 765kV bays at Vataman (ISTS) S/s for Saurashtra – Vataman 765kV D/c line (expected by Mar'27) under ISTS to ensure smooth execution of work. The request from GETCO was agreed for in the 30th CMETS-WR meeting held on 02.07.2024. CTU vide OM dated 13.09.2024 has awarded the scheme "**Implementation of 02 no. of 765 kV line bays at Vataman S/s under ISTS for termination of Saurashtra- Vataman 765 kV D/C line of InSTS**" for implementation to M/s Vataman Transmission Ltd. (a subsidiary of POWERGRID) through RTM.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	2 No. 765kV bays at Vataman S/s (of Vataman Tr. Limited) for Vataman – Saurashtra 765kV D/c line of GETCO	765kV line bay – 2 No.

Implementation timeframe: 31.03.2027

Estimated Cost: ₹71 Cr.

9. <u>220kV line bays at Vapi-II S/s for LILO of 220 KV Chikhli – Vapi 220kV S/c line at Vapi-II</u>

Establishment of Vapi-II with 2x500MVA, 400/220kV ICTs & 4 nos. 220kV bays (for GETCO) is already being implemented under ISTS by Sterlite Grid 4 Ltd. Subsequently, Transmission scheme for implementation of LILO of Kakrapar-Vapi 220kV D/c (ISTS) line & LILO of 220 KV Chikhli – Vapi 220kV S/c line at Vapi-II S/s was taken up by GETCO requiring 2 additional bays at Vapi-II S/s.

In this regard, GETCO, vide letter dated 30.05.2024, has requested for implementing the above two bays (in addition to the 4 bays granted earlier) under ISTS.

Subsequent to the deliberations regarding the implementation timeframe, the subject scheme was agreed for implementation under ISTS in the 31st CMETS-WR held on 02.08.2024. CTU vide OM dated 20.01.2025 has approved the subject scheme with following scope of works for implementation under RTM to Mumbai Urja Marg Ltd. [erstwhile Vapi-II North Lakhimpur Transmission Ltd (a subsidiary of Sterlite Grid 4 Ltd.)], with implementation timeline of 21 months.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	2 nos. 220kV line bays at Vapi-II S/s for LILO of 220 KV Chikhli – Vapi 220kV S/c line at Vapi-II	220kV line bays – 2 Nos. (GIS)

***Note**: GETCO shall match LILO of 220 KV Chikhli – Vapi 220kV S/c line at Vapi-II with the timeframe of commissioning of 220kV bays under ISTS.*

Implementation timeframe: 21 months from award to implementing agency i.e. 20.10.2026.

Estimated Cost: ₹ 12Crs.

10. <u>Network Expansion in Gujarat for RE interconnection at Raghanesda PS</u>

Govt. of India has set a target for establishing 500 GW capacity from non-fossil energy sources by 2030. In this direction, various RE Potential zones have been identified and declared in Gujarat. Raghanesda area of Gujarat is one among the identified zones with a RE potential of more than 5GW.

Further, in order to accommodate cumulative capacity of 650 MW at 220 kV level of Raghanesda PS (out of the 3500 MW which can be evacuated on Ph-I system) as well as additional capacity for about 500 MW (beyond 3000 MW), augmentation of Transformation Capacity at Raghanesda PS by 1x1500 MVA, 765/400 kV ICT (4th) is required. Accordingly, transmission scheme **"Network Expansion in Gujarat for RE interconnection at Raghanesda PS"** which includes Installation of 1x1500 MVA, 765/400 kV ICT (4th) at Raghanesda PS (Sec-I), Creation of 220 kV switchyard (Bus Sec-I) at Raghanesda PS (GIS) along with installation of 2x500 MVA, 400/220 kV ICTs, and 2 Nos. 220 kV line bay (GIS) (on 220 kV Bus Sec-I) was deliberated & agreed in 26th NCT meeting held on 06.01.2025.

The subject scheme was deliberated & agreed in 32nd CMETS-WR meeting held on 24.09.2024 & 34th CMETS-WR meeting held on 16.12.2024. The above two schemes were deliberated in 26th NCT meeting held on 06.01.2025, wherein, it was recommended that the above augmentation scheme may be added to the transmission scheme under bidding viz. "Transmission System for evacuation of RE power from Raghanesda area of Gujarat– 3 GW under Phase-I" with modified implementation timeframe.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity
1.	Establishment 4x1500 MVA, 765/400kV Substation near Raghanesda (GIS) with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor **Future Scope (Space for)**: ➢ 765/400 kV ICT along with bays- 4 Nos. (on Sec-II) ➢ 765 kV line bays along with switchable line reactors – 8 Nos. (4 Nos. on Sec-I & 4 Nos. on Sec-II) ➢ 765 kV Bus Reactor along with bay: 2 Nos. (on Sec-II) ➢ 765 kV Sectionaliser: 1 -set ➢ 400 kV line bays along with switchable line reactors– 12 Nos. *(4 Nos. on Sec-I & 8 Nos. on Sec-II)*	• 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 – 2 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. • 400 kV Reactor bay- 2 Nos.

Sl. No.	Scope of the Transmission Scheme	Capacity
	➢ 400/220 kV ICT along with bays - 6 Nos. (2 Nos. on Sec-I & 4 Nos. on Sec-II) (in addn. to 2 Nos. 400/220 ICTs on Sec-I in present scope) ➢ 400 kV Bus Reactor along with bays: 2 Nos. (Sec-II) ➢ 400 kV Sectionalization bay: 1- set ➢ 220 kV line bays: 10 Nos. (4 Nos. on Sec-I & 6 Nos. on Sec-II) (in addn. to 2 Nos. 220kV bays on Sec-I in present scope) ➢ 220 kV Sectionalization bay: 1 set ➢ 220 kV BC: 1 No. (for Sec-II) ➢ Establishment of 6000 MW, ± 800 kV Raghanesda (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard & all associated equipment (incl. filters)/bus extension, etc.	• 400 kV line bays - 4 Nos. (for interconnection of RE Projects)
2.	Raghanesda (GIS) – Banaskantha (PG) 765 kV D/c line	Route length: 95 Km
3.	2 Nos. 765 kV line bays at Banaskantha (PG) S/s	765 kV line bays – 2 Nos.
4.	Creation of 220kV switchyard (Bus Sec-I) at Raghanesda PS (GIS) along with installation of 2x500MVA, 400/220 kV ICTs	500MVA, 400/220kV ICT – 2 No. 400kV ICT bay – 2 Nos. 220kV ICT bay – 2 Nos. 220kV BC – 1 No.
5.	1 no. 220kV line bay (GIS) (on 220kV Bus Sec-I) for interconnection of Solar project of Azure Power Sixty Three Pvt. Ltd. (2200001107) (300MW)	220kV line bay–1 no.
6.	1 no. 220kV line bay (GIS) (on 220kV Bus Sec-I) for interconnection of Solar project of Sunsure Solarpark RJ One Pvt. Ltd. (2200001018) (350MW)	220kV line bay–1 no.

Implementation timeframe: Sl. 1 to 3: 27 months, sl. 4 & 5: 30.09.2027 (subject to minimum 27 months) & Sl. 6: 31.03.2028

Estimated Cost: ₹ 2102 Crs.

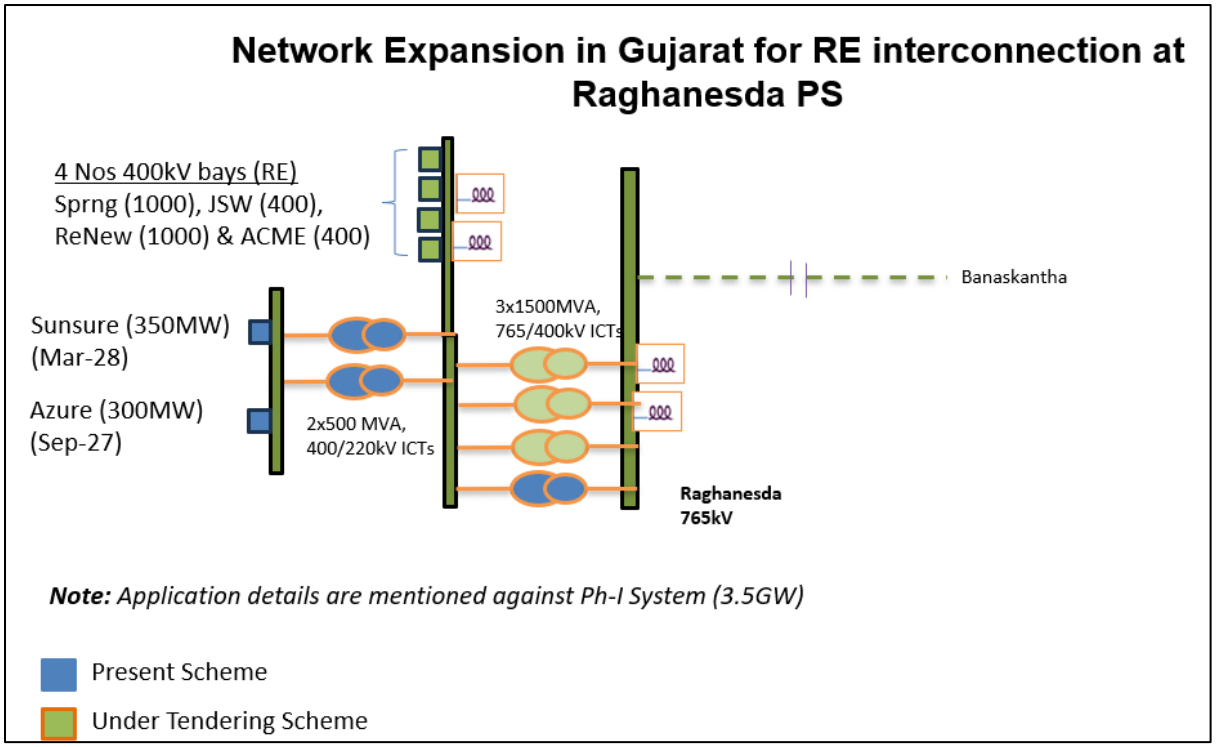


Figure 5-7: Network expansion at Raghanesda PS

11. Transmission System for evacuation of Green Hydrogen/Ammonia potential in Kandla area of Gujarat (Phase-I: 3 GW)

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.

During the further round of discussions in the meetings held by Hon'ble MNRE & CEA, regarding the capacity, different locations, tentative timelines and power demand etc., it was concluded that, there is a power drawal requirement of 2.2GW by 2027-28 progressively increasing up to 6GW by 2030 in the Kandla area of Gujarat.

In view of the envisaged network requirements by the year 2027-28, the subject scheme is proposed to cater to the power drawal requirement of up to 3GW under Phase-I with implementation timeframe of 24 months (by the year 2027-28).

The scheme was discussed in 49th WRPC meeting held on 03.05.2024 and in the 21st NCT meeting held on 06.08.2024 wherein it was recommended for implementation under TBCB route with the following scope of work.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity/line length km
1.	Establishment of 3X1500 MVA 765/400 kV Kandla (GIS) with 2X330 MVAR 765 kV bus reactor and 2X125 MVAR 420 kV bus reactor. **Future Scope (**Space for**)**: • 765/400 kV ICT along with bays-3 Nos. (on Sec-II) • 765 kV line bays along with switchable line reactors – 2 Nos. (on Sec-I) & 6 Nos. (on Sec-II) • 765 kV Bus Reactor along with bay: 2 Nos. (on Sec-II) • 765 kV Sectionaliser: 1 -set • 400 kV line bays along with switchable line reactors– 14 Nos. (6 on Sec-I & 8 on Sec-II) • 400/220 kV ICT along with bays-6 Nos. (3 Nos. each on Sec-I & Sec-II) • 400 kV Bus Reactor along with bays: 2 Nos. (Sec-II) • 400 kV Sectionalization bay: 1-set • 220 kV line bays: 12 Nos. (6 nos. each on Sec-I & Sec-II) • 220 kV Sectionalization bay: 1set • 220 kV BC: 2 Nos. • STATCOM (±400 MVAR) along with 2x125 MVAr MSC & 1x125 MVAr MSR and associated bays-2Nos. (1 on 400kV Sec-I and 1 on 400 kV Sec-II)	• 765/400 kV, 1500 MVA ICT-3 • 765 kV ICT bays- 3 • 400 kV ICT bays- 3 • 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 • 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 – Kandla(GIS) 765kV D/c line	140 km
3.	2 Nos. of 765kV line bays at Halvad for termination of Halvad – Kandla 765kV D/c line	• 765 kV line bays– 2 Nos. (for Halvad end)
4.	240 MVAr switchable line reactors on each ckt at Kandla (GIS) end of Halvad – Kandla 765kV 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. • 80 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 Nos.
5.	±400 MVAr STATCOM along with 2x125 MVAr MSC & 1x125 MVAr MSR at Kandla(GIS) 400 kV Bus section-I	• ±400 MVAr STATCOM along with 2x125 MVAr MSC & 1x125 MVAr MSR • 400 kV bay – 1 Nos.

Note:

- As per initial discussions with Deen Dayal Port Authority w.r.t. land allocation done to various Green Hydrogen/Ammonia developers in Kandla area, Kandla S/s is proposed to be located near Bhimasar area and line length of Kandla-Halvad line has been considered accordingly. However, exact location of the substation is to be finalized by the surveying agency in consultation with Deen Dayal Port Authority and other stakeholders.
- TSP of Halvad S/s shall provide space for scope at Sl. 3 above.

Implementation timeframe: 24 months from the date of SPV transfer.

Estimated Cost: ₹ 2775 Crs.

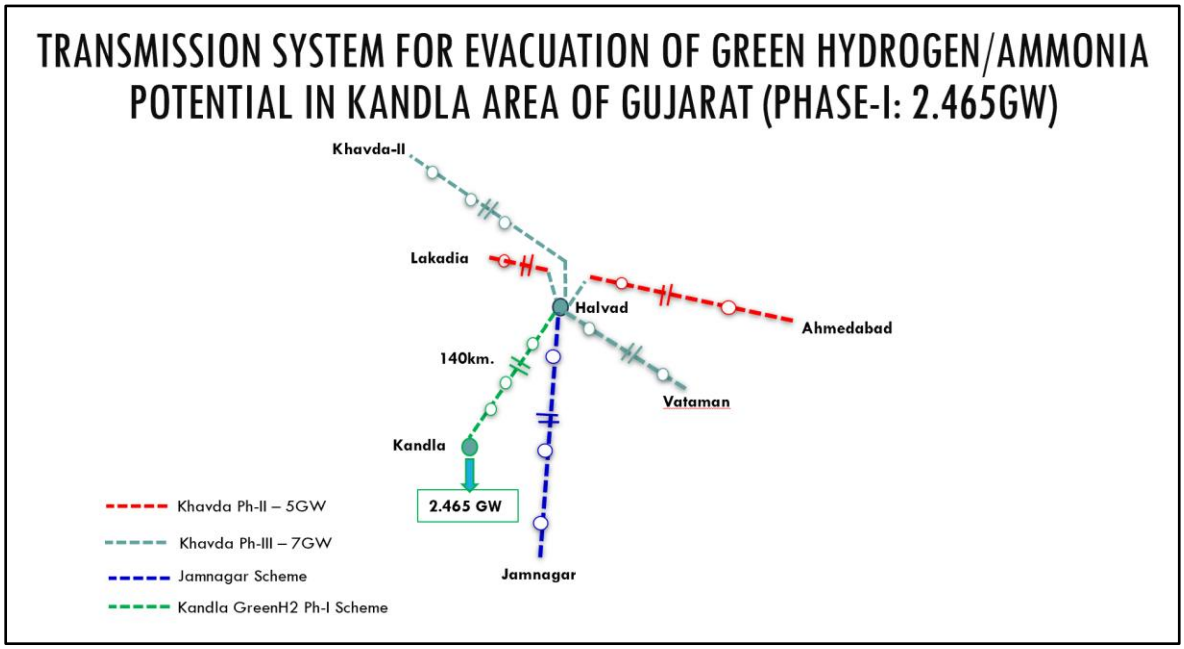


Figure 5-8: Green Hydrogen/Ammonia 3 GW scheme in Kandla area of Gujarat

12. Transmission System for supply of power to Green Hydrogen/Green Ammonia manufacturing potential in Mundra area of Gujarat under Phase-I

During the meetings held by Hon'ble MNRE & CEA, it was concluded that, there is a power drawal requirement of 6GW by 2027-28 progressively increasing up to 22GW by 2030 in the Mundra area of Gujarat.

765/400kV Navinal (Mundra) (GIS) was planned with 4x1500MVA, 765/400kV ICTs through LILO of Bhuj-II – Lakadia 765 kV D/c line at Navinal (Mundra) (GIS) S/s for meeting the demand of bulk consumers (3000MW) and for meeting the demand of Green Hydrogen/Ammonia manufacturers (1500MW) under Phase-I Part-A. This scheme is currently under bidding.

Further, in view of the envisaged network requirement by the year 2027-28, the subject scheme is proposed in two parts to cater to the power drawal requirement of up to 10.5GW under Phase-I with scope of work as follows.

Transmission System for evacuation of Green Hydrogen/Ammonia potential in Mundra area of Gujarat under Phase-I: Part B1 scheme (6GW at Navinal S/s):

- Augmentation of Transformation capacity at 765/400 kV Navinal (Mundra) S/s (GIS) by 2x1500 MVA ICTs (New Bus Section-II)
- Navinal(Mundra) (GIS) – Bhuj 765kV D/c line (70km.)
- ±400MVAr STATCOM at Navinal(Mundra) (GIS) 400kV Bus section-I
- ±400MVAr STATCOM at Navinal(Mundra) (GIS) 400kV Bus section-II

Transmission System for evacuation of Green Hydrogen/Ammonia potential in Mundra area of Gujarat under Phase-I: Part B2 scheme (3.5GW at Navinal-II S/s):

- Establishment of 6x1500 MVA, 765/400 kV Navinal-II (Mundra) S/s (GIS) with 2x330 MVAR, 765 kV & 2x125MVAr, 420 kV bus reactors (In 2 bus sections)
- LILO of KPS3 (GIS) – Lakadia 765kV D/c line at Navinal-II (Mundra) (GIS) S/s
- Navinal-II (Mundra) (GIS) – Bhuj-II (GIS) 765kV D/c line
- ±400MVAr STATCOM at Navinal-II (Mundra) (GIS) 400kV Bus section-I
- ±400MVAr STATCOM at Navinal-II (Mundra) (GIS) 400kV Bus section-II

The scheme was discussed in 49th WRPC meeting held on 03.05.2024 and in the 21st NCT meeting held on 06.08.2024 wherein it was decided that the scheme may again be examined jointly by CEA, CTUIL and Grid India.

Accordingly, considering the space availability for adequate reactive power compensation & drawal of huge load (more than 10GW) from a single substation (Navinal) from resiliency point of view, the scope of work was modified in a subsequent meeting held on 14.08.2024. Subsequently, in 22nd NCT meeting held on 23.08.2024, NCT recommended Transmission system for supply of power to Green Hydrogen/Ammonia manufacturing potential in Mundra area of Gujarat under Phase-I: Part B1 scheme (3 GW at Navinal S/s)" as mentioned below:

Detailed scope of work:

Transmission System for evacuation of Green Hydrogen/Ammonia potential in Mundra area of Gujarat under Phase-I: Part B1 scheme (3GW at Navinal S/s)

- Augmentation of Transformation capacity at 765/400 kV Navinal(Mundra) S/s (GIS) by 2x1500 MVA ICTs (New Bus Section-II)
- Navinal(Mundra) (GIS) – Bhuj 765kV D/c line (70km.)
- ±300MVAr STATCOM along with MSC (2x125 MVAr) & MSR (1x125 MVAr) at Navinal (Mundra) (GIS) 400kV Bus section-I
- ±300MVAr STATCOM along with MSC (2x125 MVAr) & MSR (1x125 MVAr) at Navinal (Mundra) (GIS) 400kV Bus section-II

Estimated Cost: ₹ 2817 Crs.

Implementation timeframe: 36 Months from date of allocation to implementing agency

In 22nd NCT meeting, it was decided that initial applications for drawal of power at Navinal from Green Hydrogen/Ammonia manufacturers would be accommodated at Navinal-I S/s (cumulative upto 4.5 GW). Therefore, Part B2 scheme scheme (details given below) may be deferred at present and would be taken up for deliberation subsequently based on receipt of applications from Green Hydrogen/Ammonia manufacturers at Navinal-I S/s.

Transmission System for evacuation of Green Hydrogen/Ammonia potential in Mundra area of Gujarat under Phase-I: Part B2 scheme (7.5GW at Navinal-II S/s)

- Establishment of 6x1500 MVA, 765/400 kV Navinal-II (Mundra) S/s (GIS) with 2x330 MVAR, 765 kV & 2x125MVAr, 420 kV bus reactors (In 2 bus sections)
- LILO of KPS3 (GIS) – Lakadia 765kV D/c line at Navinal-II (Mundra) (GIS) S/s
- Navinal-II (Mundra) (GIS) – Bhuj-II (GIS) 765kV D/c line
- ±2x300MVAr STATCOMs at Navinal-II (Mundra) (GIS) 400kV Bus section-I
- ±2x300MVAr STATCOMs at Navinal-II (Mundra) (GIS) 400kV Bus section-II

Estimated Cost: ₹ 6405 Crs.

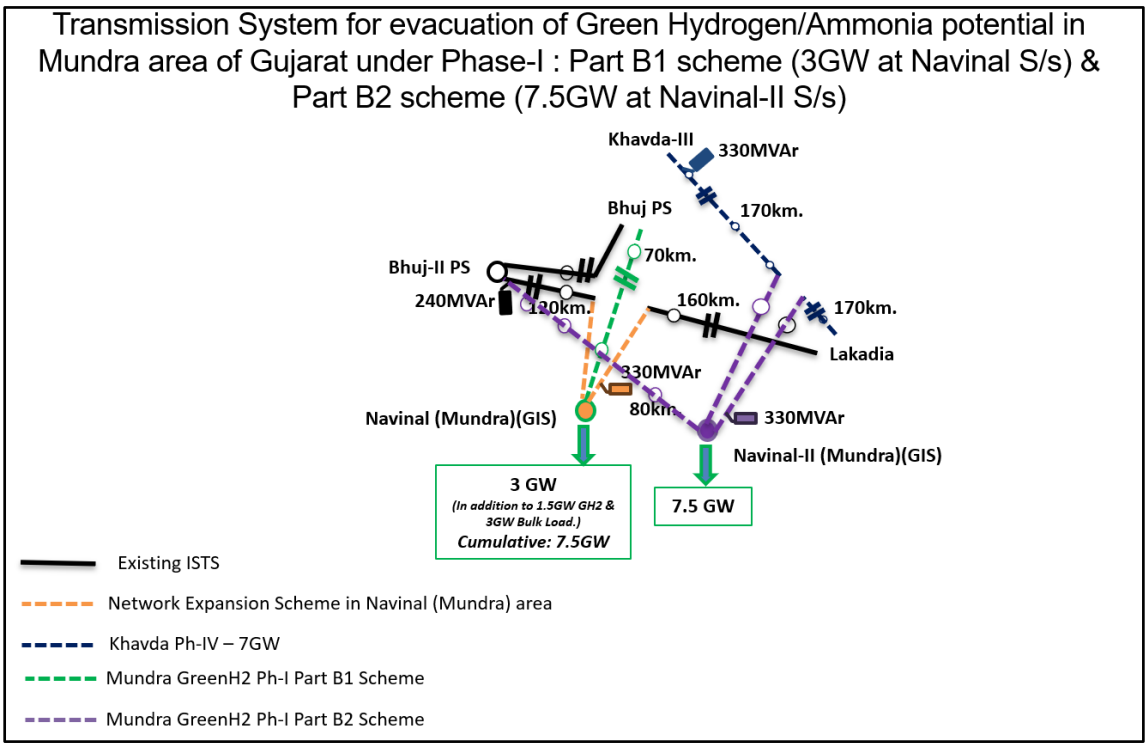


Figure 5-9: Tr. System for Mundra area of Gujarat under Phase-I & II

13. Transmission System for Offshore Wind Zone Phase-1 (500 MW VGF off the coast of Gujarat for Subzone B3)

MNRE has identified about 30 GW Offshore wind potential each off 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 wherein 2 GW transmission capacity (1 GW each off the coast of Gujarat and Tamil Nadu) will be developed in Phase-I and further 4 GW each off the coast of Gujarat and Tamil Nadu shall be developed subsequently.

In this regard, following broad decisions were taken in the meeting held on 22.12.2023, regarding tentative timelines for the offshore wind energy projects:

- 500 MW VGF project off-Gujarat coast to be commissioned by March 2028. Tender for the project to be published by March 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.
- 4 GW non-VGF project off-Tamil Nadu coast to be commissioned in FY 2029- 30. Tender for the projects to be published on 01.02.2024.
- Non-VGF project off-Gujarat coast will be tendered based on the response for the Tamil Nadu non-VGF project

The scheme was discussed and agreed upon in the WRPC meeting held on 27.03.2024. Further, in a meeting held on 14.06.2024 under the chairmanship of Hon'ble MoP & MNRE, it was decided that the subject project may be awarded to POWERGRID for implementation under RTM.

As per the press release dated 19.06.2024 from PIB, the Union Cabinet have approved the Viability Gap Funding (VGF) scheme for offshore wind energy projects for installation and commissioning of 1 GW of offshore wind energy projects. The scheme was deliberated and approved in the 20th NCT meeting held on 25.06.2024 for implementation by POWERGRID under RTM mode. The subject scheme was awarded to POWERGRID vide CTU letter dated 20.08.2024. The detailed scope of work is given below.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
A. Transmission System onwards Onshore Pooling Station		
1.	Establishment of 2x500 MVA, 400/220 kV Mahuva Onshore Pooling Station (GIS) (Mahuva PS) alongwith 1x125 MVAR, 420 kV bus reactor (with space provision for upgradation to 765 kV level to cater to future	• 400/220kV, 500 MVA, ICTs – 2 nos. • 400kV ICT bays – 2 nos. • 220kV ICT bays – 2 nos. • 1x125 MVAR, 420kV Bus Reactor – 1 no. • 400kV Bus Reactor bay – 1 no.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
A. Transmission System onwards Onshore Pooling Station		
	Offshore Wind Projects adjacent to B3, B4, B5 pockets in future) **Future Space Provisions:** • 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. • 400/220 kV ICT along with bays -8 Nos. • 400 kV Bus Reactor along with bays: 3 Nos. • 400 kV Sectionalization bay: 1- set • 220 kV line bays: 16 Nos. • 220 kV Sectionalization bay: 1 set • 220 kV BC and TBC: 1 No. • STATCOM (±300 MVAR) alongwith associated bay at 220 kV - 3 Nos. • 220kV Bus Reactor along with bays: 7 Nos. • VSR (420kV, 1x125 MVAR Variable Bus Shunt Reactor with OLTC with control range between 50 – 125 MVAr for each VSR) alongwith associated bay at 400 kV – 3 Nos.	• 400kV line bays – 2 nos. (for termination of Mahuva Onshore PS (GIS) – Vataman 400 kV D/c line) • 220kV line bays – 2 nos. (for termination of B3-OSS-1 – Mahuva Onshore PS 220 kV 2xS/c (3 core) cables) • 220 kV Bus Coupler (BC) Bay – 1 no.
2.	Creation of 400kV switchyard along with Installation of 2x1500 MVA, 765/400 kV ICTs at Vataman (AIS) with 2x125 MVAr (420 kV) Bus Reactors	• 765/400kV, 1500 MVA, ICTs – 2 nos. (7x500MVA incl. spare unit) • 765kV ICT bays – 2 nos. • 400kV ICT bays – 2 nos. • 2x125 MVAR, 420kV Bus Reactor – 1 no. • 400kV Bus Reactor bay – 2 no.
3.	2 nos. 400kV bays at Vataman for termination of Mahuva Onshore PS (GIS) – Vataman 400 kV D/c line	• 400kV line bays – 2 nos.
4.	Mahuva Onshore PS (GIS) – Vataman 400 kV D/c line (Quad ACSR/AAAC/AL59 moose equivalent) with 63MVAr & 50 MVAr, 420 kV switchable line reactors on each ckt at Mahuva & Vataman ends respectively.	Line length: 190 km 420 kV, 63 MVAr switchable line reactors at Mahuva S/s end– 2 Nos. Switching equipment for 420 kV, 63 MVAr switchable line reactors at Mahuva S/s end – 2 no 420 kV, 50 MVAr switchable line reactors at Vataman S/s end– 2 Nos. Switching equipment for 420 kV, 50 MVAr switchable line reactors at Vataman S/s end – 2 no

Sl. No.	Scope of the Transmission Scheme	Capacity /km
A. Transmission System onwards Onshore Pooling Station		
5.	± 300 MVAr STATCOM at 220 kV level of Mahuva PS (GIS) with 1 No. of 220 kV bay	• ± 300 MVAr STATCOM – 1 No. • 220 kV bay – 1 no.
6.	420 kV, 1x125 MVAR Variable Bus Shunt Reactor with OLTC (control range between 50 – 125 MVAr for VSR) with 1 No. of 400 kV bay	• 1x125 MVAR, 420kV Variable Bus Shunt Reactor with OLTC – 1 no. • 400kV Bus Reactor bay – 1 no.
7.	245 kV, 3x50 MVAr Bus Reactors at 220 kV level of Mahuva PS (GIS)	• 50 MVAR, 245kV Bus Reactor– 3 no. • 220kV Bus Reactor bay – 3 no.
B. Transmission System for integration of Offshore Wind Farms with Onshore PS		
	Offshore Substation-1 {500 MW VGF}	
1.	Establishment of 2x315 MVA, 220/66 kV Gujarat Offshore B3 Sub-Station Station-1 (B3-OSS-1) with 66 kV line bays – 10 Nos. for RE Interconnection	• 220/66kV, 315 MVA, ICTs – 2 nos. • 220kV ICT bays – 2 nos. • 66kV ICT bays – 2 nos. • 220kV line bays – 2 nos. (at B3-OSS-1 for termination of B3-OSS-1 – Mahuva Onshore PS (GIS) 220 kV two nos. (3 core) cables) • 66kV line bays – 10 nos.
2.	B3-OSS-1 – Mahuva Onshore PS (GIS) 220 kV two nos. (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 300 MVA/ckt at nominal voltage) with 1x50 MVAr switchable line reactors at B3-OSS-1 end on each cable	• Cable length ~45 km • 220 kV, 50MVAr switchable line reactors at OSS-1 end – 2 nos. • Switching equipment for 220 kV, 50 MVAr switchable line reactors at OSS-1 end – 2 nos.

Note:

- TSP of Vataman S/s (Vataman Transmission Ltd.) shall provide space for augmentation works at Vataman S/s
- 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 (SCOD).
- Distances indicated above are tentative and may change based on actual survey.

Implementation Timeframe: Mar-2029 except Vataman S/s 765/400kV ICT aug. by Mar'26

Estimated Cost: About ₹ 6900 Crs. {Onshore Portion: 2200, Offshore Portion: 4700}

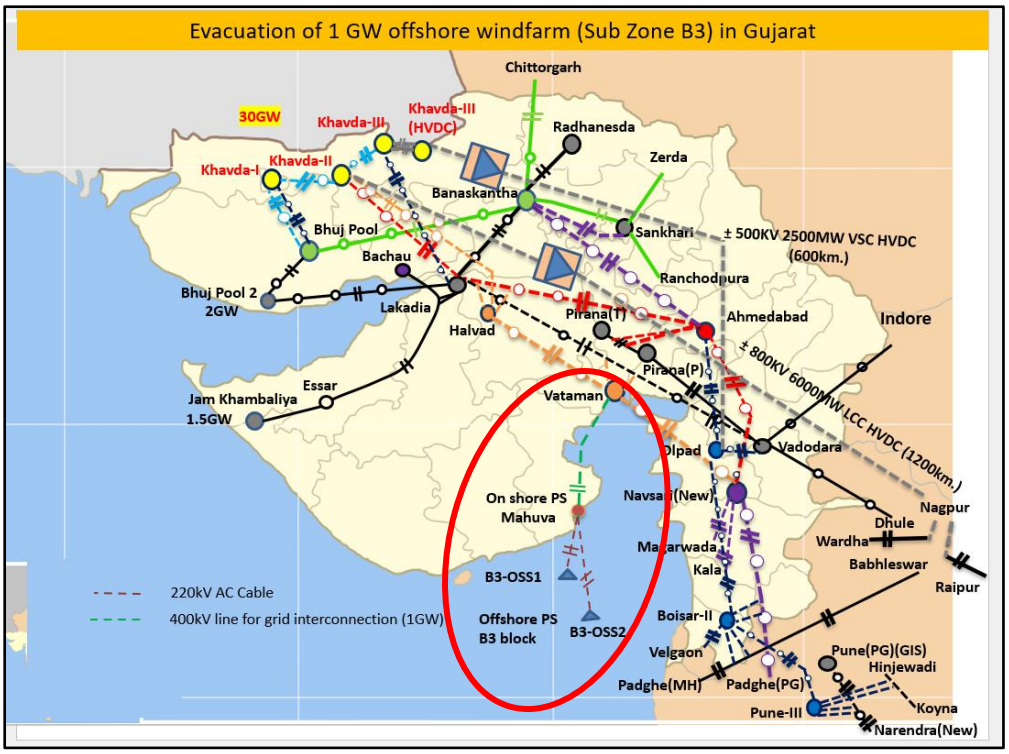


Figure 5-10: Tr. System for Offshore Wind Zone Phase-1 (500 MW)

14. Transmission system for Evacuation of Power from RE Projects in Jam Khambhaliya REZ -Phase II (4500MW)

Government of India has set a target for establishing 500GW non fossil generation capacity by 2030, out of which 1.5GW REZ potential was identified at Jam Khambhaliya (Gujarat) for which 400/220kV Jam Khambhaliya PS was set-up in that area. However, applications for about 6.15GW have been received in Jam Khambhaliya area till Sep-24 out of which about 4GW have been accommodated at Jam Khambhaliya PS (3GW at 220kV & 1GW at 400kV) and for balance 2.15GW (received in Kalyanpur & Bhanvad areas), **a new substation is required to be planned in Jam Khambhaliya area.**

In this respect, it may be noted that MNRE has declared 3.5GW potential in Jam Khambhaliya PS, 0.5GW potential at Porbandar & 3GW potential in Jamnagar vide letter dated 19.07.2024. Against 1.5GW potential already declared in Jam Khambhaliya area, applications for 3GW have been granted. Hence, considering receipt of applications in the area, there is immediate requirement of planning transmission system for balance 2GW potential in Jam Khambhaliya area and 0.5GW potential in Porbandar area.

The scheme with following scope was finalised in joint study meeting was convened by CEA amongst CEA, CTU, GRID-INDIA, GETCO & MSETCL on 18.11.2024 wherein the initially, to cater to 4.5GW RE projects in the Dwarka coast, Jam Khambhaliya as well as Porbandar areas ***(considering 1.5GW at 400kV level and 3GW at 220kV level).***

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment 4x1500 MVA, 765/400 kV & 7x500MVA, 400/220kV Substation near Kalyanpur (GIS) with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor **Future provision (space for):** ➢ 765/400 kV, 1500MVA ICT along with bays- 2 Nos. (on Sec-II) ➢ 765 kV line bays along with switchable line reactors – 8 Nos. (4 Nos. on Sec-I & 4 Nos. on Sec-II) ➢ 765 kV, 330MVAr Bus Reactor along with bay: 2 Nos. (1 on Sec-I & 1 on Sec-II) ➢ 400 kV line bays along with switchable line reactors– 12 Nos. *(4 Nos. on Sec-I & 8 Nos. on Sec-II)* ➢ 400/220 kV, 500MVA ICT along with bays - 3 Nos. (1 on Sec-I & 2 on Sec-II) ➢ 420 kV, 125MVAr Bus Reactor along with bays: 2 Nos. (1 on Sec-I & 1 on Sec-II) ➢ 220 kV line bays: 2 No. on Sec-I & 6 Nos. on Section-II ➢ Establishment of 6000 MW, ± 800 kV Jam Khambhaliya-II (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard & all associated equipment (incl. filters)/bus extension, etc. (2x1500MW Poles on each 400kV bus section) ➢ 300MVA Synchronous Condensor-2 Nos. ➢ 400kV Syncon Bays-2 No. (1 on Sec-I & 1 on Sec-II) ➢ ±400MVAr STATCOM with 400kV bay – 2 No. (1 on Sec-I & 1 on Sec-II)	• 765/400 kV, 1500 MVA ICT – 4 Nos. (13x500 MVA single phase units including one spare ICT Unit) (3 on Sec-I & 1 on Sec-II) • 400/220kV, 500MVA ICT – 7 Nos. (4 on Sec-I & 3 on Sec-II) • 765 kV ICT bays – 4 Nos. • 400 kV ICT bays – 11 Nos. • 220kV ICT bays – 7 Nos. • 765 kV Line bays – 4 Nos. (2 on Sec-I & 2 on Sec-II) • 765 kV Sectionaliser bay: 1 -set • 400 kV Sectionalization bay: 1-set • 220 kV Sectionalization bay: 1 set • 1x330 MVAr, 765 kV bus reactor- 2 Nos. (7x110 MVAR single phase Reactors including one spare Unit for bus /line reactors) (1 on Sec-I & 1 on Sec-II) • 765 kV Bus reactor bay – 2 Nos. • 125 MVAr, 420 kV reactor- 2 Nos. (1 on Sec-I & 1 on Sec-II) • 400 kV Reactor bay- 2 Nos. • 220kV BC Bay-2 No. • 400 kV line bays – 2 No. (for interconnection of RE Projects at Sec-I) • 220kV line bays – 10 Nos. (for interconnection of RE Projects, 7 on Sec-I & 3 on Sec-II)
2.	Kalyanpur (GIS) – Jamnagar (GIS) 765 kV D/c line	95 km
3.	2 Nos. 765 kV line bays at Jamnagar (GIS) S/s	765 kV line bays – 2 Nos. (GIS)
4.	Kalyanpur (GIS) – Saurashtra (near Rajkot) (GETCO) 765 kV D/c line	180-190 km
5.	330MVAr Switchable line reactors on each circuit at Kalyanpur (GIS) end of Kalyanpur (GIS) –	• 330 MVAr, 765 kV switchable line reactor- 2 Nos.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	Saurashtra (near Rajkot) (GETCO) 765 kV D/c line (with NGR bypass arrangement)	• Switching equipment for 765 kV line reactor- 2 Nos.
6.	2 Nos. 765 kV line bays at Saurashtra (near Rajkot) (GETCO) S/s	• 765 kV line bays – 2 Nos.

The above scheme was also deliberated & agreed in 34th WR-CMETS held on 16.12.2024 & 17.12.2024 with Implementation Timeframe of 24 months. The scheme shall be taken up for approval in ensuing WRPC & NCT meetings.

15. Installation of Synchronous Condensors at Jam Khambhaliya-II

From system studies, it was observed that SCR at Jam Khambhaliya-II (400kV: 1500MW & 220kV: 3000MW RE) is on lower side (400kV: 21500MVA & 220kV: 14400MVA), that too after considering IBR contribution and it would be a **good candidate location for Synchronous condensor**. Without Syncon, SCR at 220kV bus would be about 4.8 & at 400kV about 4.78. With 2 Nos. Synchronous Condensors (+300/-150MVAr), the SCR at 220kV bus would be about 5.1 & at 400kV about 5.36.

Hence, 2 Nos. (+300/-150MVAr each) Synchronous Condensors can be kept on each 400kV bus section of Jam Khambhaliya-II.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Installation of Synchronous Condensor (+300/-150MVAr) at Jam Khambhaliya-II (400kV Bus Section-I). Minimum SC contribution at PCC from Syncon & Minimum H shall be defined in RfP document.	• Synchronous Condensor- 1 No. • 400kV Bay-1 No. (Sec-I)
2.	Installation of Synchronous Condensor (+300/-150MVAr) at Jam Khambhaliya-II (400kV Bus Section-II) Minimum SC contribution at PCC from Syncon & Minimum H shall be defined in RfP document.	• Synchronous Condensor- 1 No. • 400kV Bay-1 No. (Sec-II)

The above scheme was also deliberated & agreed in 34th WR-CMETS held on 16.12.2024 & 17.12.2024 with Implementation Timeframe of 24 months. The scheme shall be taken up for approval in ensuing WRPC & NCT meetings.

16. Transmission system for Evacuation of Power from RE Projects in Jamnagar REZ in Gujarat-Phase I (1000MW)

Government of India has set a target for establishing 500GW non fossil generation capacity by 2030, out of which 1GW REZ potential was identified at Jamnagar (Gujarat). Jamnagar S/s is already under implementation, 3x500MVA, 400/220kV ICTs are being planned at

Jamnagar S/s to cater to upto 1GW RE capacity in Jamnagar area in Phase-I. For the balance potential at Jamnagar, GETCO has informed that they are planning transmission system in the area. Kalyanpur S/s is proposed to be interconnected with Jamnagar as well as Saurashtra(GETCO) substations for onward dispersal of power.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Creation of 220kV switchyard along with Installation of 3x500MVA, 400/220kV ICTs at Jamnagar (GIS) S/s	• Creation of 220kV Bus Section-I • 220kV BC Bay – 1 No. • 400/220 kV, 500 MVA ICT – 3 Nos. (on 400kV & 220kV Sec-I) • 400 kV ICT bays – 3 Nos. • 220kV ICT bays – 3 Nos.
2.	4 nos. 220kV line bays for RE interconnection	• 220kV line bays – 4 nos.

The above scheme was also deliberated & agreed in 34th WR-CMETS held on 16.12.2024 & 17.12.2024 with Implementation Timeframe of 21 months. The scheme shall be taken up for approval in ensuing WRPC & NCT meetings.

17. Transmission System for Evacuation of Power from potential renewable energy zone in Bhuj-II (Addl. 1.5GW), Khavda Ph-VI (5.5GW) & Lakadia-II (7.5GW)

For planning the transmission system for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-VI, either one of the following two interconnections was found essential to relieve overloading on the under implementation KPS3 – KPS2 765kV D/c line considering additional injection from KPS4/KPS5: KPS4 - KPS2 765kV D/c line: This shall entail requirement of North – South line corridor for about 100m in addition to the 300m. corridor being used for KPS2-KPS3 765kV D/c, KPS3-Lakadia 765kV D/c & NTPC REL-KPS3 400kV S/c line. KPS4 – KPS1 765kV D/c line: This shall entail requirement of a new 100m. line corridor towards west of KPS4 and then South towards KPS1 S/s.

In Joint Study Meeting amongst CEA, CTU, GRID-INDIA, GETCO, GPCL & TPL held on 23.02.2024, it was deliberated that evacuation from KPS4 S/s would not be possible without either of the above proposed line corridors. The same also leads to utilization of available capacity in already planned corridors (including KPS2 HVDC corridor) for evacuation of power from KPS4/KPS5. Hence, the requirement of either of the above proposed line corridors is indispensable from power flow point of view.

In a meeting amongst CEA, CTU, GPCL, NTPC REL, Adani Power, POWERGRID & AESL on 21.06.2024, it was decided that corridor for KPS4 - KPS2 765kV D/c line would be made available by POWERGRID through re-alignment of KPS2 – KPS3 765kV D/c line by POWERGRID.

The matter was also discussed in a meeting under the chairmanship of Secretary (Power), MOP on 01.07.2024 to review the transmission projects for evacuating power from Gujarat & Rajasthan wherein it was decided that realignment of 765 kV D/c KPS-ll to KPS-lll transmission line is to be done by POWERGRID at the earliest for accommodating 4th transmission line in that corridor.

Against 2GW potential which was declared very recently by MNRE (on 14.02.2024) at Lakadia, about 10.7GW applications for connectivity in Lakadia area have been received till Sep'24 out of which 3.5GW applications have been accommodated at Lakadia PS & no further margins are left for further RE evacuation at Lakadia PS.

Status of Transmission system for enabling evacuation of 3.5GW RE at Lakadia is given below:

2x500MVA, 400/220kV ICTs (1st & 2nd) at Lakadia PS for evacuation of 1GW power is under implementation under RTM mode by WRSS XXI(A) Transco Ltd. (subsidiary of Adani) with scheduled commissioning date as 16.08.2025 (30.06.2025 on best effort basis)

6x500MVA, 400/220kV ICTs (3rd to 8th) at Lakadia PS alongwith 1x1500 MVA, 765/400 kV ICTs (3rd) for evacuation of 2.5GW power has been recommended to MOP in 20th NCT meeting held on 25.06.2024 for implementation through TBCB route with commissioning schedule of 18 months from the date of allocation to implementing agency.

Detailed scope of work:

Common Transmission System for evacuation of 5.5GW RE power from Khavda area (Phase-VI), 1.5GW Addl. RE power from Bhuj-II and 7.5GW RE power from Lakadia area (Phase-II)

Part-A

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of transformation capacity at Bhuj-II PS by 1x1500MVA ICT (5th) with 2 nos. 400kV kV bays for RE interconnection at Bhuj-II PS (GIS)	• 765/400 kV, 1500 MVA ICT – 1 No. • 765 kV ICT bays – 1 No. (GIS) • 400 kV ICT bays – 1 No. (GIS) • 400 kV line bays - 2 Nos. (for interconnection of RE Projects)
2.	**Establishment of 765/400 kV, 6x1500MVA & 10x500MVA, 400/220kV Lakadia-II (Near Chitrod)** with 2x330 MVAR 765kV bus reactor and 2x125 MVAR 400kV bus reactor. *[765kV, 400kV & 220kV levels to be established in two sections with Sectionaliser arrangement. The 400kV & 220kV*	• 765/400 kV, 1500 MVA ICT – 6 Nos. (19x500 MVA single phase units including one spare ICT Unit) • 400/220 kV ICTs - 10 Nos. (5 on Sec-I & 5 on Sec-II) • 765 kV ICT bays – 6 Nos.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	Sectionaliser shall be kept normally open and may be closed under contingency condition. The 765kV Sectionaliser shall be kept normally closed. (3x1500MVA 765/400kV ICTs, 5x500MVA 400/220kV ICTs, 1x330MVA 765kV BR & 1x125MVAr 420kV BR shall be on Sec-I & 3x1500MVA 765/400kV ICTs, 5x500MVA 400/220kV ICTs, 1x330MVA 765kV BR & 1x125MVAr 420kV BR shall be on Sec-II)] **Future provision (space for):** ➢ 765 kV line bays along with switchable line reactors – 6 Nos. (2 Nos. on Sec-I & 4 Nos. on Sec-II) ➢ 765 kV Bus Reactor along with bay: 2 Nos. (1 on Sec-I & 1 on Sec-II) ➢ 400 kV line bays along with switchable line reactors– 7 Nos. *(3 on Sec-I & 4 on Sec-II)* ➢ 420 kV, 125MVAr Bus Reactor along with bays: 2 Nos. (1 on Sec-I & 1 on Sec-II) ➢ 220 kV line bays: 2 No. on Sec-I & 1 No. on Section-II ➢ Establishment of 6000 MW, ± 800 kV Lakadia-II (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard & all associated equipment (incl. filters)/bus extension, etc. (2x1500MW poles on each 400kV section) ➢ Synchronous Condensor (+300/-150MVAr) along with 400kV bay – 2 Nos. (1 on Sec-I & 1 on Sec-II)	• 400 kV ICT bays – 16 Nos. • 220kV ICT bays – 10 Nos. • 765 kV Line bays – 8 Nos. (4 Nos. on Sec-I (KPS5 & Halvad D/c lines) & 4 Nos. on Sec-II (KPS5 & Kandla D/c lines)) • 1x330 MVAr, 765 kV bus reactor- 2 Nos. (7x110 MVAR single phase Reactors including one spare Unit for bus /line reactor) (1 on Sec-I & 1 on Sec-II) • 765 kV Bus reactor bay – 2 Nos. • 765 kV Sectionaliser bay: 1 -set • 400 kV Sectionaliser bay: 1- set • 220 kV Sectionaliser bay: 1- set • 220kV BC & TBC – 1 No. each • 125 MVAr, 420 kV reactor- 2 Nos. (1 on Sec-I & 1 on Sec-II) • 400 kV Reactor bay- 2 Nos. • 400 kV line bays - 3 Nos. (2 nos. on Section-I & 1 No. on Sec-II for interconnection of RE Projects) • 220 kV line bays - 15 Nos. (7 nos. on Sec-I & 8 nos. on Sec-II for interconnection of RE Projects)
3.	**KPS5 – Lakadia-II 765kV 2xD/c line** (160km.)	160 km (640 ckm)
4.	4 Nos. 765 kV line bays at KPS5 (GIS) S/s for **KPS5 – Lakadia-II 765kV 2xD/c line**	765 kV line bays – 4 Nos. (GIS) (2 Nos. on Sec-I & 2 Nos. on Sec-II)
5.	765kV, 330MVAr Switchable line reactors on each circuit at Lakadia-II end of KPS5 – Lakadia-II 765kV 2xD/c line	• 330 MVAr, 765 kV switchable line reactor- 4 Nos. • Switching equipment for 765 kV line reactor- 4 Nos. • 110MVAr spare single phase reactor at Lakadia-II S/s is already provided above and same shall be used for subject Sw LR.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
6.	LILO of Halvad – Kandla 765kV D/c line at Lakadia-II	LILO route length ~10km. (40ckm)
4.	±400 MVAr STATCOM on each 400kV Bus section of Lakadia-II	±400 MVAr STATCOM – 2 Nos. 400kV bays – 2 Nos. (1 on each 400kV Section)

Note:

1. Bay(s) required for completion of diameter (GIS) in one-and-half breaker scheme shall also be executed by the TSP.
2. TSP of Bhuj-II PS S/s to provide space for scope of work at Sl. 1
3. TSP of KPS5 S/s to provide space for scope of work at Sl. 4

Part-B

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Lakadia-II – Ahmedabad 765kV D/c line (180km.)	180 km (360 ckm)
2.	2 Nos. 765 kV line bays at Lakadia-II S/s for Lakadia-II – Ahmedabad 765kV D/c line	765 kV line bays – 2 Nos. (AIS) (on Sec-I)
3.	2 Nos. 765 kV line bays at Ahmedabad S/s for Lakadia-II – Ahmedabad 765kV D/c line	765 kV line bays – 2 Nos. (AIS)
4.	765kV, 330MVAr Switchable line reactors on each circuit at Ahmedabad end of Lakadia-II – Ahmedabad 765kV D/c line	• 330 MVAr, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 110MVAr spare single phase reactor at Ahmedabad S/s is already available and same shall be used for subject Sw LR.
5.	**Lakadia-II – Vataman 765kV D/c line** (220km.)	220 km (440 ckm)
6.	2 Nos. 765 kV line bays at Lakadia-II S/s for **Lakadia-II – Vataman 765kV D/c line**	765 kV line bays – 2 Nos. (AIS) (on Sec-II)
7.	2 Nos. 765 kV line bays at Vataman S/s for **Lakadia-II – Vataman 765kV D/c line**	765 kV line bays – 2 Nos. (AIS)
8.	765kV, 240MVAr Switchable line reactors on each circuit at both ends of Lakadia-II – Vataman 765kV D/c line	• 240 MVAr, 765 kV switchable line reactor- 4 Nos. (2 for Lakadia-II end and 2 for Vataman end) • Switching equipment for 765 kV line reactor- 4 Nos (2 for Lakadia-II end and 2 for Vataman end) • 80MVAr spare single phase reactor at Lakadia-II for above 240MVAr Sw LR.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
		• 80MVAr spare single phase reactor at Vataman S/s is already available and same shall be used for subject Sw LR.

Note:

1. Bay(s) required for completion of diameter (GIS) in one-and-half breaker scheme shall also be executed by the TSP.
2. TSPs of Lakadia-II S/s, Ahmedabad S/s & Vataman S/s to provide space for above scope of work in their respective substations

Part-C

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of transformation capacity at **South Olpad** (GIS) **S/s** by 1x1500MVA, 765/400kV (3rd) ICT	• 765/400 kV, 1500 MVA ICT – 1 No. • 765 kV ICT bays – 1 No. (GIS) • 400 kV ICT bays – 1 No. (GIS)
2.	Vadodara(GIS) – Halvad 765kV D/c line to be terminated into Lakadia – Halvad 765kV D/c line (near Halvad S/s) so as to form **Lakadia – Vadodara(GIS) 765kV D/c line**	260 km (520 ckm) *(Length of complete Lakadia – Vadodara(GIS) 765kV D/c line after implementation of above line section between Vadodara and Halvad is expected to be around 350km.)*
3.	765kV line bays at Vadodara(GIS) end for termination of Lakadia – Vadodara 765kV D/c line (as per details above)	• 765kV line bays – 2 nos. (GIS)
4.	765kV, 330MVAr Switchable line reactors on each circuit at Vadodara(GIS) end of Lakadia – Vadodara(GIS) 765kV D/c line	• 330 MVAr, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 110MVAr spare single phase reactor at Vadodara S/s is already available and same shall be used for subject Sw LR.
5.	765kV, 330MVAr Switchable Mid-point reactors at bypass point near Halvad S/s on Lakadia – Vadodara(GIS) 765kV D/c line	• 330 MVAr, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 110MVAr spare single phase reactor at bypass point near Halvad S/s *Note: Additional land shall be required at bypass point near Halvad S/s for installing the subject Mid Point reactors.*
6.	**Establishment of 765/400 kV, 3x1500MVA & 400/220kV, 3x500MVA Nasik S/s (towards South of Nasik)** with 2x330 MVAR 765kV bus reactor and 2x125 MVAR 400kV bus reactor. **Future provision (space for):** ➢ 765/400 kV, 1500MVA ICT along with bays- 3 Nos. (on Sec-II)	• 765/400 kV, 1500 MVA ICT – 3 Nos. (10x500 MVA single phase units including one spare ICT Unit) • 400/220 kV ICTs - 3 Nos. • 765 kV ICT bays – 3 Nos. • 400 kV ICT bays –6 Nos. • 220kV ICT bays – 3 Nos. • 765 kV Line bays – 2 Nos. • 1x330 MVAr, 765 kV bus reactor- 2 Nos.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	➢ 765 kV line bays along with switchable line reactors – 10 Nos. (4 Nos. on Sec-I & 6 Nos. on Sec-II) ➢ 765 kV, 330MVAr Bus Reactor along with bay: 2 Nos. (on Sec-II) ➢ 765 kV Sectionaliser bay: 1 -set ➢ 400 kV Sectionaliser bay: 1- set ➢ 400/220 kV, 500MVA ICT along with bays - 7 Nos. (2 on Sec-I & 5 on Sec-II) ➢ 400 kV line bays along with switchable line reactors– 10 Nos. (4 on Sec-I & 6 on Sec-II) ➢ 420 kV, 125MVAr Bus Reactor along with bays: 2 Nos. (on Sec-II) ➢ 220 kV Sectionaliser bay: 1- set ➢ 220kV BC & TBC – 1 No. each ➢ 220 kV line bays: 2 No. on Sec-I & 8 Nos. on Section-II	(7x110 MVAR single phase Reactors including one spare Unit for bus /line reactor) • 765 kV Bus reactor bay – 2 Nos. • 220kV BC & TBC – 1 No. each • 125 MVAr, 420 kV reactor- 2 Nos. • 400 kV Reactor bay- 2 Nos. • 400 kV line bays - 2 Nos. • 220 kV line bays - 6 Nos. (for MSETCL 220kV lines: Adwadi 220kV D/c, Nasik GCR 220kV D/c & Nasik OCR 220kV D/c) *(Feedback of MSETCL awaited w.r.t. who will implement these bays)*- ***MSETCL feedback awaited (Mails sent on 27.12.2024 & 15.01.2025)***
7.	**Navsari (New) – Nasik 765kV D/c line** (190km.)	190 km (380 ckm)
8.	2 Nos. 765 kV line bays at Navsari (New) (GIS) S/s for **Navsari (New) – Nasik 765kV D/c line**	765 kV line bays – 2 Nos. (GIS)
9.	765kV, 330MVAr Switchable line reactors on each circuit at Nasik end of Navsari (New) – Nasik 765kV D/c line	• 330 MVAr, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 110MVAr spare single phase reactor at Nasik shall be utilized for above 330MVAr Sw LR.
10.	**Nasik – Pimpalgaon (MSETCL) 400kV D/c line** (Quad ACSR/AAAC/AL59 moose equivalent) (~50km.) *(Line to be routed from near Sinner TPP / Raymond i.e. from eastern side of Nasik).*	50km. (100ckm)
11.	2 Nos. 400 kV line bays at Pimpalgaon S/s for **Nasik – Pimpalgaon (MSETCL) 400kV D/c line** (Quad ACSR /AAAC/AL59 moose equivalent)	400 kV line bays – 2 Nos.

Note:

1. Bay(s) required for completion of diameter (GIS) in one-and-half breaker scheme shall also be executed by the TSP.
2. TSP of South Olpad S/s to provide space for above scope of work as Sl. 1
3. TSP of Vadodara(GIS) to provide space for above scope of work as Sl. 3 & 4
4. TSP of Navsari(New)(GIS) to provide space for above scope of work as Sl. 8
5. MSETCL to provide space for above scope of work as Sl. 11
6. MSETCL to implement 220kV downstream system from Nasik S/s in matching timeframe.

Part D

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	**Establishment of 765/400 kV, 2x1500MVA & 400/220kV, 3x500MVA Alephata S/s** with 2x330 MVAR 765kV bus reactor and 2x125 MVAR 400kV bus reactor. [Bus sectionalisers to be kept normally closed. May be opened based on Grid conditions] **Future provision (space for):** ➢ 765/400 kV, 1500MVA ICT along with bays- 4 Nos. (2 on Sec-I & 2 on Sec-II) ➢ 765 kV line bays along with switchable line reactors – 6 Nos. (2 Nos. on Sec-I & 4 Nos. on Sec-II) ➢ 765 kV, 330MVAr Bus Reactor along with bay: 2 Nos. (1 on Sec-I & 1 on Sec-II) ➢ 400/220 kV, 500MVA ICT along with bays - 7 Nos. (2 on Sec-I & 5 on Sec-II) ➢ 400 kV line bays along with switchable line reactors– 10 Nos. (4 on Sec-I & 6 on Sec-II) ➢ 420 kV, 125MVAr Bus Reactor along with bays: 2 Nos. (1 on Sec-I & 1 on Sec-II) ➢ 220 kV Sectionaliser bay: 1- set ➢ 220kV BC & TBC – 1 No. each ➢ 220 kV line bays: 4 No. on Sec-I & 8 Nos. on Section-II ➢ Establishment of 6000 MW, ± 800 kV Alephata (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard & all associated equipment (incl. filters)/bus extension, etc. (2x1500MW poles on each 400kV section)	• 765/400 kV, 1500 MVA ICT – 2 Nos. (7x500 MVA single phase units including one spare ICT Unit) (1 on Sec-I & 1 on Sec-II) • 400/220 kV ICTs - 3 Nos. (on Sec-I) • 765 kV ICT bays – 2 Nos. • 400 kV ICT bays –5 Nos. • 220kV ICT bays – 3 Nos. • 765 kV Line bays – 6 Nos. (4 on Sec-I: Nasik D/c, Pune (Shikrapur) & Padghe S/c & 2 on Sec-II: Pune (Shikrapur) & A'bad) • 1x330 MVAr, 765 kV bus reactor- 2 Nos. (7x110 MVAR single phase Reactors including one spare Unit for bus /line reactor) (1 on Sec-I & 1 on Sec-II) • 765 kV Bus reactor bay – 2 Nos. • 220kV BC & TBC – 1 No. each • 125 MVAr, 420 kV reactor- 2 Nos. (1 on Sec-I & 1 on Sec-II) • 400 kV Reactor bay- 2 Nos. • 400 kV line bays - 2 Nos. (on Sec-I) • 220 kV line bays - 4 Nos. (for MSETCL 220kV lines: Alephata(M) 220kV D/c & Bridgestone 220kV D/c) • 765 kV Sectionaliser bay: 1 -set • 400 kV Sectionaliser bay: 1- set
2.	**Alephata – Lonikand-I 400kV D/c line** (Quad ACSR/AAAC/AL59 moose equivalent) (~80km.)	80 km (160 ckm)
3.	2 Nos. 400 kV line bays at Lonikand-I (MSETCL) S/s for **Alephata – Lonikand-I 400kV D/c line**	400 kV line bays – 2 Nos.
4.	**LILO of A'bad – Pune (GIS)(Shikrapur) 765kV line and Padghe (GIS) – Pune (GIS) 765kV line at Alephata S/s** (LILO route length ~ 20km.)	LILO route length – 20 km. (80ckm)
5.	**Nasik – Alephata 765kV D/c line** (~100km.)	100 km (200 ckm)

Sl. No.	Scope of the Transmission Scheme	Capacity /km
6.	**2 Nos. 765kV bays at Nasik for Nasik – Alephata 765kV D/c line**	765 kV Line bays – 2 Nos.

Note:

1. TSP of Nasik S/s to provide space for above scope of work as Sl. 6
2. MSETCL to provide space for above scope of work as Sl. 3
3. MSETCL to implement 220kV downstream system from Alephata S/s in matching timeframe.

240MVAr line reactor at Pune (GIS) end of Pune (GIS) – A'bad 765kV line is already switchable. Since length of the line will reduce after the LILO at Alephata (Pune (GIS) – Alephata), NGR Bypassing along with Inter tripping scheme would need to be implemented to avoid parallel resonance phenomena due to overcompensation on the short line. NGR bypassing also helps in utilization of Sw LR as Bus Reactor when line is out of service. As confirmed by POWERGRID vide e-mail dated 02.12.2024, NGR bypass arrangement in 240MVAr line reactor at Pune (GIS) end of 765kV Pune (GIS) – A'bad line is **available**. Hence, only Inter tripping scheme to trip Sw LR along with main line breaker would need to be enabled after implementation of LILO. After the LILO, Alephata – A'bad line length is expected to be ~190-200km, Alephata – Padghe: ~140km. & Alephata – Pune (GIS): ~70km.

Alephata – Pune(West) 765kV D/c line has been proposed by MSETCL it its master plan for 2030. Same may be implemented by MSETCL along with associated bays at both ends as per requirement. Line shall be terminated at 400kV Sec-II of Alephata S/s.

18. Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area (Phase-VII: 6GW)

The scheme ensures system reliability in transferring such a large quantum of power over long distances (from North Gujarat to load centres in South Maharashtra) through HVDC system (for balance 6GW – Phase-VII).

After deliberations, the following transmission system has been agreed in the final joint study meeting convened by CEA amongst CEA, CTU, GRID-INDIA, GETCO & MSETCL on 18.11.2024 followed by discussions with MSETCL on 22.11.2024.

Detailed scope of work:

Common Transmission System for evacuation of 6GW RE power from Khavda area (Phase-VII: 6GW)

Alternative-1: LCC HVDC Configuration

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment of 6000 MW (2 nos. 3000MW	• 6000 MW, ± 800 kV Lakadia-II (HVDC)

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	Bipole configuration), ± 800 kV Lakadia-II (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard* *(2x1500MW Poles would be on 400kV Sec-I & 2x1500MW Poles would be on 400kV Sec-II)*	[LCC] terminal station • 400kV bus sectionaliser -2 nos. (1 Set) at Lakadia II (HVDC) station
2.	Establishment of 6000 MW (2 nos. 3000MW Bipole configuration), ± 800 kV Alephata (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard*	• 6000 MW, ± 800 kV Alephata (HVDC) [LCC] terminal station • 400kV bus sectionaliser -2 nos. (1 Set) at Alephata (HVDC) station
3.	±800 kV HVDC Bipole line (Hexa lapwing) between Lakadia-II (HVDC) and Alephata (HVDC) (800 km) (with Dedicated Metallic Return) (capable to evacuate 6000 MW with overload as specified)	• Route length: ~800 km.
4.	Installation of additional 3x1500 MVA, 765/400 kV ICTs at Alephata–S/s along with associated interconnections with HVDC Switchyard*. 2x1500 MVA ICTs on Sec-I & 1x1500MVA ICT on Sec-II. The 400kV bus sectionalisers shall be normally closed and may be opened based on Grid requirement.	○ 765/400 kV, 1500 MVA ICT-3 ○ 765 kV ICT bays- 3 Nos. (2 on Sec-I & 1 on Sec-II) ○ 400 kV ICT bays- 3 Nos. (2 on Sec-I & 1 on Sec-II)

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

Note-:

1. TSP of Lakadia-II S/s to provide space for above scope of work
2. HVDC System will be designed considering 100% power reversal capability.

Alternative-2: VSC HVDC Configuration

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment of 6000 MW (2 nos. 3000MW Bipole configuration) ± *600 kV* Lakadia-II (HVDC) *VSC* terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard* *(2x1500MW Poles would be on 400kV Sec-I & 2x1500MW Poles would be on 400kV Sec-II)*	• 6000 MW, ± 600 kV Lakadia-II (HVDC) VSC terminal station • 400kV bus sectionaliser -2 nos. (1 Set) at Lakadia II (HVDC) station
2.	Establishment of 6000 MW (2 nos. 3000MW Bipole configuration), ± 600 kV Alephata (HVDC) *VSC* terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard*	• 6000 MW, ± 600 kV Alephata (HVDC) VSC terminal station • 400kV bus sectionaliser -2 nos. (1 Set) at Alephata (HVDC) station
3.	± 600 kV HVDC Bipole line (Quad Lapwing on same tower) between Lakadia-II (HVDC)	Route length: ~800 km.

	and Alephata (HVDC) (800 km) (with Dedicated Metallic Return) (capable to evacuate 6000 MW (with overload as specified)	
4.	Installation of additional 3x1500 MVA, 765/400 kV ICTs at Alephata–S/s along with associated interconnections with HVDC Switchyard*. 2x1500 MVA ICTs on Sec-I & 1x1500MVA ICT on Sec-II. The 400kV bus sectionalisers shall be normally closed and may be opened based on Grid requirement.	• 765/400 kV, 1500 MVA ICT-3 • 765 kV ICT bays- 3 Nos. (2 on Sec-I & 1 on Sec-II) • 400 kV ICT bays- 3 Nos. (2 on Sec-I & 1 on Sec-II)

Note:

1. TSP of Lakadia-II S/s to provide space for above scope of work
2. HVDC System will be designed considering 100% power reversal capability.
3. VSC should be able to operate in STATCOM mode at 50% of rated capacity (under 0 power order). At other power levels, it should be able to provide minimum reactive power per pole of 33% of rated capacity.

Alternative-3: Technology Agnostic HVDC System

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment of 6000 MW (2 nos. 3000MW Bipole configuration) Lakadia-II (HVDC) *[± 800 kV LCC OR ± 600 kV VSC*] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard* *(2x1500MW Poles would be on 400kV Sec-I & 2x1500MW Poles would be on 400kV Sec-II)*	• 6000 MW, [± 800 kV LCC OR ± 600 kV VSC] Lakadia-II (HVDC) terminal station • 400kV bus sectionaliser -2 nos. (1 Set) at Lakadia II (HVDC) station
2.	Establishment of 6000 MW (2 nos. 3000MW Bipole configuration), ± 800 kV Alephata (HVDC) *[± 800 kV LCC OR ± 600 kV VSC*] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard*	• 6000 MW, [± 800 kV LCC OR ± 600 kV VSC] Alephata (HVDC) terminal station • 400kV bus sectionaliser -2 nos. (1 Set) at Alephata (HVDC) station
3.	±800 kV (in case of LCC, with (Hexa lapwing)) OR ± 600 kV (in case of VSC with Quad Lapwing on same tower) HVDC Bipole line between Lakadia-II (HVDC) and Alephata (HVDC) (800 km) (with Dedicated Metallic Return) (capable to evacuate 6000 MW (with overload as specified)	Route length: ~800 km.
4.	Installation of additional 3x1500 MVA, 765/400 kV ICTs at Alephata–S/s along with associated interconnections with HVDC Switchyard*. 2x1500 MVA ICTs on Sec-I & 1x1500MVA ICT on Sec-II. The 400kV bus sectionalisers shall be normally closed and may be opened based on Grid requirement.	• 765/400 kV, 1500 MVA ICT-3 • 765 kV ICT bays- 3 Nos. (2 on Sec-I & 1 on Sec-II) • 400 kV ICT bays- 3 Nos. (2 on Sec-I & 1 on Sec-II)

Note:

1. TSP of Lakadia-II S/s to provide space for above scope of work
2. HVDC System will be designed considering 100% power reversal capability.
3. In case VSC is chosen, VSC should be able to operate in STATCOM mode at 50% of rated capacity (under 0 power order). At other power levels, it should be able to provide minimum reactive power per pole of 33% of rated capacity.

Implementation Timeframe: 48 months (Bipole-1: 3000MW) and 54 months (Bipole-2: 3000MW)

The above schemes were also deliberated & agreed in 34th WR-CMETS held on 16.12.2024 & 17.12.2024 with Implementation Timeframe of 24 months. The scheme shall be taken up for approval in ensuing WRPC & NCT meetings.



Figure 5-11: Tr. system for 26GW RE Expansion in Gujarat

19. Implementation of 2 nos. 220kV bays at Vapi-II S/s (MUML) for drawl of power by GETCO

400/220kV Vapi-II is an existing substation of Mumbai Urja Marg Ltd. [erstwhile Vapi-II North Lakhimpur Transmission Ltd (a subsidiary of Sterlite Grid 4 Ltd.)] with a transformation capacity of 2x500MVA, 400/220kV ICTs Vapi-II is connected through LILO of KAPP - Vapi 400kV D/c lines. At 220kV level, Vapi-II is also connected to Sayali S/s through a 220kV D/c line. Further, 4 nos. 220kV line bays are already implemented under ISTS for drawl of power by GETCO. GETCO had originally planned the following 220kV outlets from Vapi-II (GIS) S/s for which the above 4 nos. 220kV bays were already under ISTS as part of the S/s

In the 31st CMETS-WR held on 02/09/2024, GETCO informed that the bays may be implemented in a minimum timeframe of 21 months (considering GIS) and GETCO shall match their 220kV line with the time-line of 220kV bays.

In the 32nd CMETS-WR held on 24/09/2024, it was agreed that a new 220kV GIS hall shall be constructed separate from existing GIS hall suitable for 8 nos. 220kV Bays (including maintenance space). Any kind of dismantling/rework required for the subject scope of works shall be under the scope of the new TSP. CTU vide OM dated dated 20.01.2025 has approved implementation of subject scheme under RTM mode by Mumbai Urja Marg Ltd. [erstwhile Vapi-II North Lakhimpur Transmission Ltd (a subsidiary of Sterlite Grid 4 Ltd.)].

Detailed scope of work:

Sl. No.	***Scope of the Transmission Scheme***	***Item Description***	***Implementation Timeframe***
1.	2 nos. 220kV bays at Vapi-II S/s (MUML) for LILO of Chikhli – Vapi 220kV S/c line at Vapi-II S/s	• 220kV line bays – 2 Nos. (GIS) • 245kV GIS Bus Duct (1ph) – 240 meters approx. • 220kV SF6 GIS to AIS Bushing – 6 nos. • New 220kV GIS Building for accommodating 8 Nos. 220kV Bays & associated development works – 600 Sqm. • EOT crane for GIS Building- 1 no.	21 months from the date of issuance of OM by CTUIL
		Total Estimated Cost:	**₹ 21.46 Crs.**

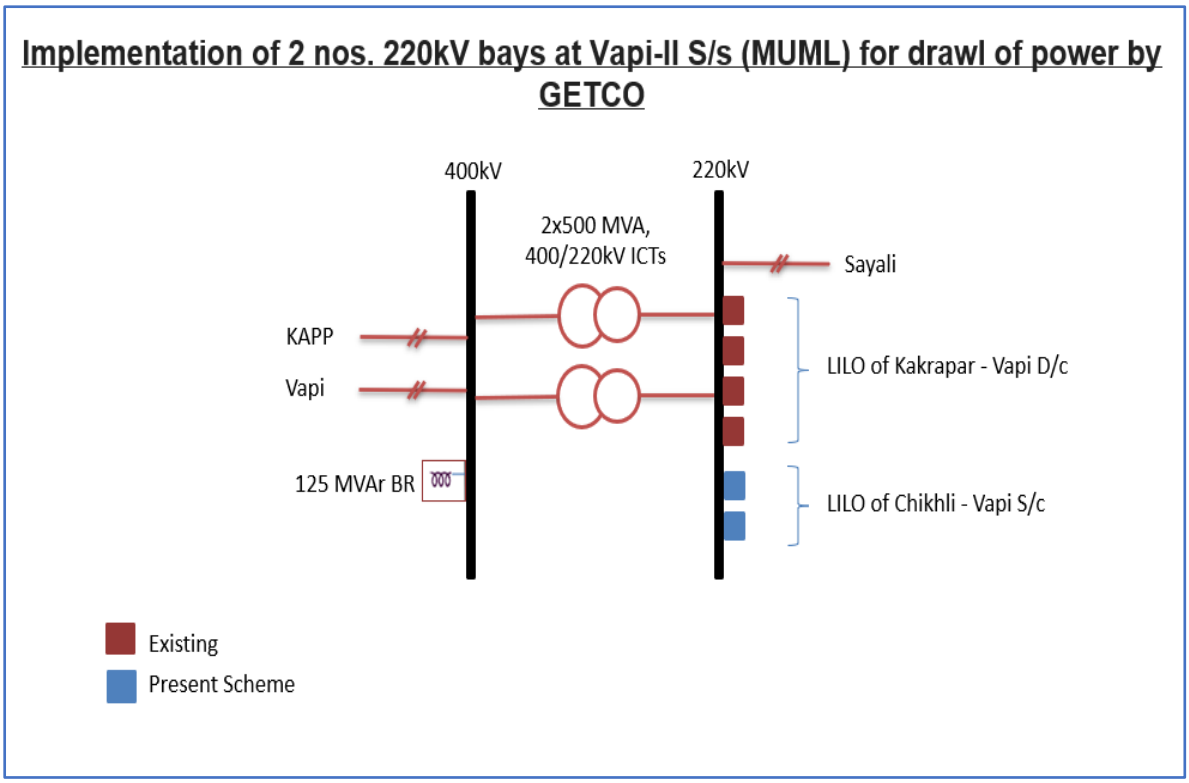


Figure 5-12: Implementation of 220kV Bay at Vapi-II S/s

5.4.2 Maharashtra

(i) <u>Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune)</u>

Hon'ble MoP, GOI has identified a potential of more than 10GW Pumped Storage Plants (PSPs) in the area between Boisar, Nashik & Pune. In this regard, application for Connectivity has been received from M/s Tata Power Company for Bhivpuri PSP of 1150MW with estimated commissioning date as 01.01.2028. M/s TPC is also planning PSP at Shirwata with 1980MW capacity.

Considering the huge PSP potential in the area, which are likely to tie up power for pumping mode from RE generation projects located far away, it was proposed to establish a 765/400 kV substation near South Kalamb. Further, considering huge demand of Mumbai area, space for HVDC terminal is proposed to be kept for future use.

Subsequently, applications for drawal of 1400MW power were received from Data Centre Loads in Mumbai area with start date of 01.01.2027. The applications are under process and Connectivity is being proposed at South Kalamb S/s to address the requirement of drawal of such huge quantum of power. The scheme was discussed and approved under TBCB in the 20th NCT meeting held on 25.06.2024 with Implementation Timeframe of 24 months or 01.01.2027 (i.e., start date of GNA of DC loads), whichever is later. The detailed scope of work is given below:

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment 2x1500 MVA, 765/400 kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor. **<u>Future provision (space for):</u>** ▪ 765/400 kV ICT along with bays- 10 Nos. (2 Nos. on Sec-I, 4 Nos. in Sec-II & 4 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: 4 Nos. (2 Nos. on Sec-II & 2 No. on Sec-III) ▪ 765 kV Sectionaliser: 2 -sets ▪ 400 kV line bays along with switchable line reactors– 20 Nos. *(6 Nos. on Sec-I, 6 Nos. on Sec-II & 8 Nos. on Sec-III)* ▪ 400/220 kV ICT along with bays -4 Nos. (on 400 kV Sec-III: 2 Nos. on 220 kV Sec-I & 2 Nos. on 220 kV Sec-II) ▪ 400 kV Bus Reactor along with bays: 4 Nos. (2 Nos. on Sec-II & 2 No. on Sec-III) ▪ 400 kV Sectionalization bay: 2- set ▪ 220 kV line bays: 8 Nos. (4 Nos. on Sec-I & 4 Nos. on Sec-II) ▪ 220 kV Sectionalization bay: 1 set ▪ 220 kV BC and TBC: 2 Nos. ▪ Establishment of 6000 MW, ± 800 kV South Kalamb (HVDC) [LCC] terminal station (4x1500 MW) along with associated interconnections with 400 kV HVAC Switchyard (2x1500 MW on 400 kV Sec-I & 2x1500 MW on 400 kV Sec-II) & all associated equipment (incl. filters)/bus extension, etc.	• 765/400 kV, 1500 MVA ICT – 2 Nos. (7x500 MVA single phase units including one spare ICT Unit) • 765 kV ICT bays – 2 Nos. • 400 kV ICT bays – 2 Nos. • 765 kV Line bays – 4 Nos. • 330 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. • 400 kV Reactor bay- 2 Nos. • 400 kV line bays - 2 Nos. (for interconnection of PSP)
2.	LILO of Pune-III – Boisar-II 765 kV D/c line at South Kalamb S/s with associated bays at South Kalamb S/s	• LILO Route length: 40 km (160 ckm.) • The Pune-III – Boisar-II 765 kV D/c line is of Hexa Zebra configuration and LILO shall be of similar conductor configuration
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. • Spare Reactor (1-ph, 1x80 MVAr)

Sl. No.	Scope of the Transmission Scheme	Capacity /km
		unit at 765/400 kV South Kalamb S/s

Implementation Timeframe: 24 months from the date of SPV transfer (or) 01.01.2027 whichever is earlier.

Estimated Cost: ₹ 1663 Crs.

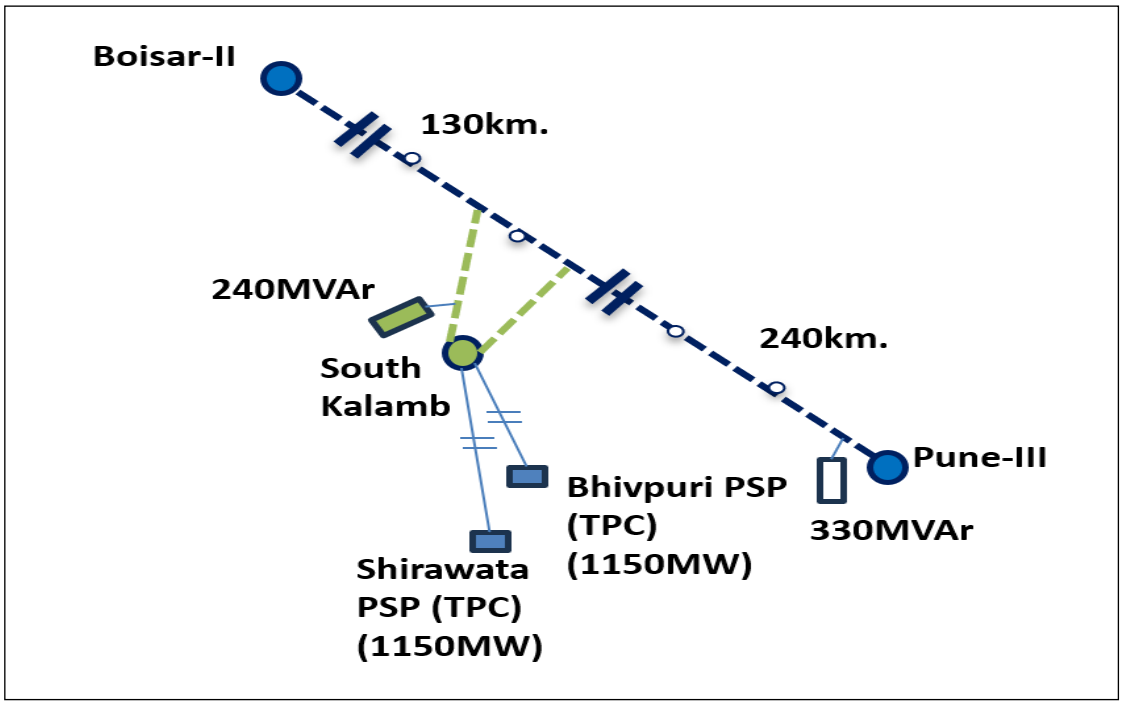


Figure 5-13: Tr. Scheme for interconnection of PSPs in Maharashtra.

Subsequently, data centre applications have been withdrawn by the applicant & accordingly implementation schedule of the scheme has been revised to 01.01.2028.

(ii) <u>Transmission system for Evacuation of Power from RE Projects in Solapur SEZ in Maharashtra-Phase II (2000MW) and Network Expansion scheme to enable drawal of power from Solapur PS</u>

With Solapur STPP as well as SEZ in Solapur area, loading on 220kV Solapur (PG)-Bale D/c line is seen on higher side. The matter was deliberated in a joint study meeting with MSETCL and flow of about 260MW was observed under N-1 contingency condition. It was deliberated that from Bale, power is flowing towards Osmanabad and then to Barshi, Paranda and Jeur. Further, there are low voltage issues in Jeur and adjoining areas. Hence additional outlets were planned from Solapur PS in consultation with MSETCL, along with Installation of 2x500MVA, 400/220kV ICTs (5th & 6th) at Solapur PS.

The subject scheme comprises of Installation of 2x500MVA, 400/220kV ICTs (5th & 6th) at Solapur PS (terminated on 4000kV bus section-1 and on segregated 220kV bus (2nd), other than the one where RE injection is planned) with space provision for ICT 7th (on 400kV Sec-1 and 220kV Sec-2 to be planned in future as per requirement) along with 6 Nos. 220kV line bays on 220kV Sec-2 at Solapur PS for 220kV downstream lines of MSETCL. This shall enable reliable dispersal of power from Solapur PS to Barshi, Paranda and Jeur areas of Maharashtra.

The scheme with following scope of works was deliberated & agreed in following meetings:

- 34th CMETS-WR meeting held on 16.12.2024 & 17.12.2024
- 51st WRPC meeting held on 11.01.2025

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***
Network Expansion scheme to enable drawal of power from Solapur PS		
1.	Installation of 2x500MVA, 400/220kV ICTs (5th & 6th) at Solapur PS (terminated on 400kV bus section-1 and on segregated 220kV bus (2nd), other than the one where RE injection is planned) *(with space kept for ICT 7th on 400kV Sec-1 and 220kV Sec-2 to be planned in future as per requirement)* Bus Sectionaliser between 220kV Sec-1, Sec-2 & Sec-3 (proposed for additional RE injection) shall be kept normally open and may be closed under contingency conditions.	• 400/220kV, 500MVA ICTs – 2 Nos. • 400kV ICT bays – 2 Nos. (Sec-1) • 220kV ICT bays – 2 Nos. (Sec-2) • 220 kV Sectionalization bay: 1 set • 220kV BC Bay-1 No. • 220kV TBC Bay-1 No.
2.	6 Nos. 220kV line bays on 220kV Sec-2 at Solapur PS for 220kV downstream lines of MSETCL	• 220kV line bays – 6 Nos. (Sec-2)
	Note: MSETCL shall implement the below lines in matching timeframe: • LILO of Bale – Osmanabad 220kV S/c line at Solapur PS • LLO of Osmanabad – Barshi 220kV S/c line at Solapur PS • Additional 2 nos. 220kV bays at Solapur PS shall be utilized by MSETCL for which feedback is awaited from MSETCL regarding details of line to be LILOed at Solapur PS	
Transmission system for Evacuation of Power from RE Projects in Solapur SEZ in Maharashtra-Phase II (2000MW)		
3.	Creation of New 400kV Bus Section-2 and 220kV Bus Section-3 with 400kV and 220kV Bus Sectionalizers at Solapur PS along with 3 nos. 220kV line bays on new Bus Section-3 & 1 no. 400kV bay for RE Interconnection	• 400 kV Sectionalization bay: 1- set • 220 kV Sectionalization bay: 1 set • 220kV BC Bay-1 No. • 220kV TBC Bay-1 No. • 400 kV line bays – 1 No. (for interconnection of RE Projects at Sec-2) • 220kV line bays – 3 Nos. (for interconnection of RE Projects at Sec-3)
4.	400/220 kV, 3x500 MVA ICT augmentation (8th ,9th & 10th) at Solapur PS on New 400kV	• 400/220kV, 500MVA ICTs – 3 Nos. • 400kV ICT bays – 3 Nos. (Sec-2)

Sl. No.	*Scope of the Transmission Scheme*	*Capacity /km*
	Bus Section-2 and 220kV Bus Section-3	• 220kV ICT bays – 3 Nos. (Sec-3)
5.	Solapur PS (Sec-II) – Jejuri (MSETCL) 400 kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent)	240 km
6.	400kV line bays at Solapur PS (Sec-2) as well as Jejuri (MSETCL) for Solapur PS (Sec-II) – Jejuri (MSETCL) 400 kV D/c line	• 400kV Bays (AIS) – 2 Nos. at Solapur PS (Sec-2) end • 400kV Bays (GIS) – 2 Nos. at Jejuri end
7.	63MVAr, 420kV Switchable line reactors on each circuit at both ends of Solapur PS (Sec-2) – Jejuri (MSETCL) 400 kV D/c line (with NGR bypass arrangement)	• 63 MVAr, 420 kV switchable line reactor- 4 Nos. (2 at Solapur PS end and 2 at Jejuri end) • Switching equipment for 420 kV line reactor- 4 Nos. (2 at Solapur PS end and 2 at Jejuri end)
8.	Jejuri (M) – Pune-III 400 kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) (~20km.)	20km.
9.	400kV line bays at Pune-III as well as Jejuri (MSETCL) for Jejuri (M) – Pune-III 400 kV D/c line	• 400kV Bays (GIS) – 2 Nos. at Pune-III end • 400kV Bays (GIS) – 2 Nos. at Jejuri end
Note: • MSETCL shall implement Jejuri (M) – Hinjewadi (M) 400kV D/c line in matching timeframe • The interim LILO of 400 kV Lonikand - Karad at Jejuri(M) will be reinstated by MSETCL, after commissioning of 400 kV Jejuri - Hinjewadi D/C line by MSETCL. • MSETCL has suggested that Scope at Sl. 5 & 8 may be implemented by constructing Solapur PS – Pune-III D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) and then LILOing the line at Jejuri through M/C towers in view of severe ROW issues near Jejuri. TSP may note the same for ease of implementation of the subject scope.		

Implementation Timeframe: 24 months from the date of SPV transfer or allocation

Estimated Cost: ₹ 1653 Crs.

The scheme was also discussed in 27th NCT meeting held on 06.02.2025, wherein, it was decided that the subject scheme shall be taken up after feedback from MNRE/SECI w.r.t. additional potential in Solapur area by which time CTU shall reconcile with STU to see that planning is not being done for the same generation capacity in Solapur area.

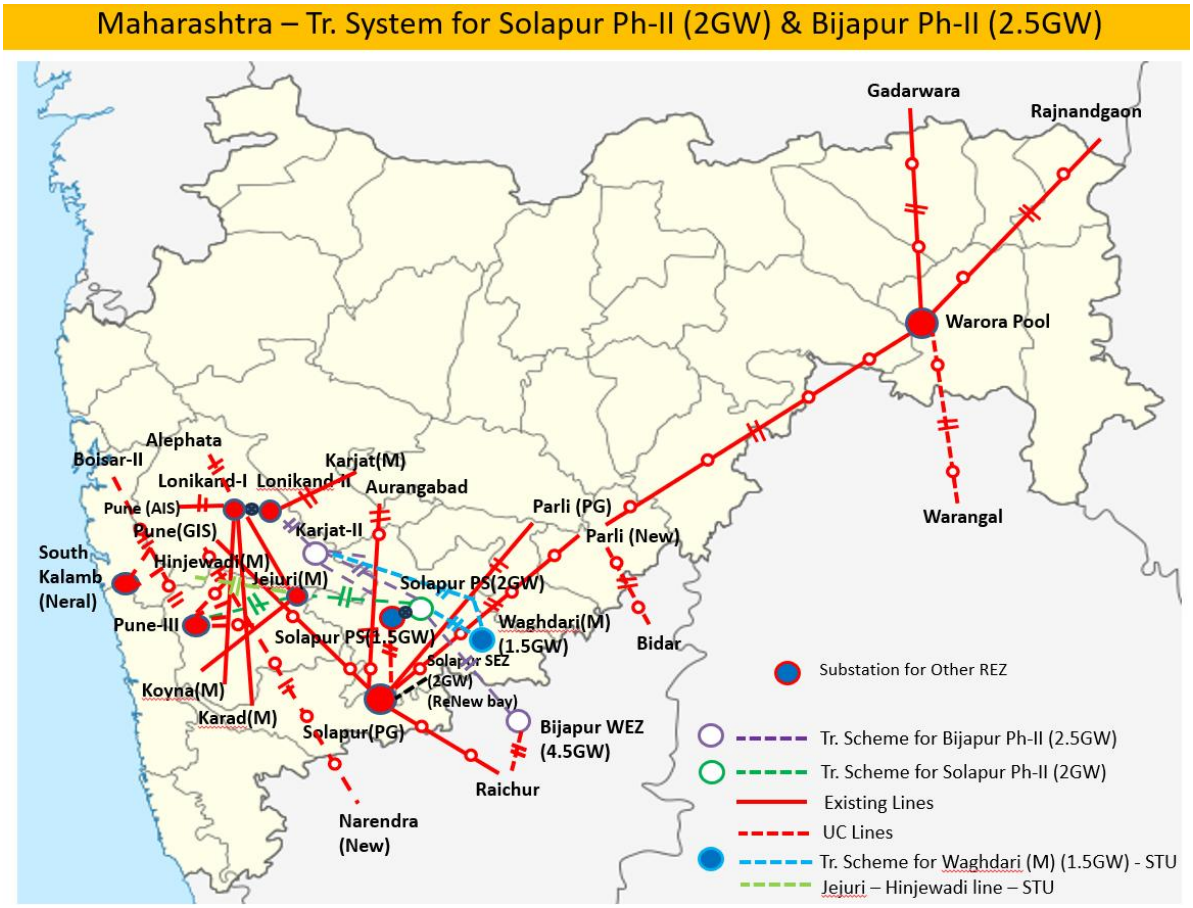


Figure 5-14: Tr. system for Solapur (Ph-II) scheme in Maharashtra

5.4.3 Madhya Pradesh

(i) <u>Network Expansion Scheme in Vindhyachal complex of Madhya Pradesh</u>

Connectivity application (No. 2200000400) by NTPC Ltd (1600 MW) was received in the month of Dec'23. After several round of deliberations, the transmission scheme for grant of connectivity under GNA to NTPC Ltd. for Singrauli-III 2x800MW units was finalised in 30th Consultation Meeting for Evolving Transmission Schemes in Western Region held on 02.07.2024 as per details given below:

Dedicated Transmission System for Connectivity

- *Shifting of existing Vindhyachal V – Vindhyachal IV 400kV D/c (twin) line to Singrauli-III so as to form Vindhyachal V – Singrauli III 400kV D/c (twin) line. (Under scope of NTPC Ltd.)*
- *Installation of 1x125MVAr, 420kV Bus Reactor at Singrauli III 400kV Bus (Under scope of NTPC Ltd.)*
- *Vindhyachal IV – Vindhyachal PS 400kV 2nd D/c (quad) line (of CWRTL) shall be disconnected at Vindhyachal-IV and shall be shifted to Singrauli-III to form Singrauli III – Vindhyachal PS 400kV D/C (Quad) line. (Under scope of NTPC Ltd.)*
- *Singrauli III – Vindhyachal PS 400kV S/c (Quad) line (on S/c tower) (with minimum capacity of 2100MVA per ckt at nominal voltage). (Under scope of NTPC Ltd.) along with associated bay at Singrauli-III end. The line will be terminated in a 400kV bay at Vindhyachal PS which would be made available after bypassing works at Vindhyachal PS as mentioned under Common Transmission System Augmentation for grant of GNA*

  ***Note:** Vindhyachal III – Vindhyachal V may be kept normally open and may be closed under contingency conditions based on feedback from GRID-INDIA.*

Common Transmission System Augmentation for grant of GNA: Under ISTS

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Vindhyachal IV – Vindhyachal PS 400kV 1st D/c (quad) line (of POWERGRID) and Vindhyachal PS – Sasan 400kV D/c (twin) line (of POWERGRID) to be bypassed at Vindhyachal PS and interconnected with each other at outskirts of Vindhyachal PS (Under scope of ISTS) so as to form Vindhyachal IV (2x500MW) – Sasan 400kV D/c line.	NA

Note:

1. *This line will be exclusively used for 2x500MW Vindhyachal-IV evacuation.*
2. *With this arrangement, 4 nos. 400kV bays shall become available at Vindhyachal PS. Out of the same, 1 no. shall be utilized for termination of Singrauli III – Vindhyachal PS 400kV S/c (Quad) line of NTPC and balance 3 nos. bays may be utilized as per requirement in future.*

Implementation Timeframe: *01.03.2028 (as per start date of connectivity requested by NTPC for Singrauli-III expansion project, for which above transmission system is*

required as Common Transmission System Augmentation for grant of connectivity under GNA)

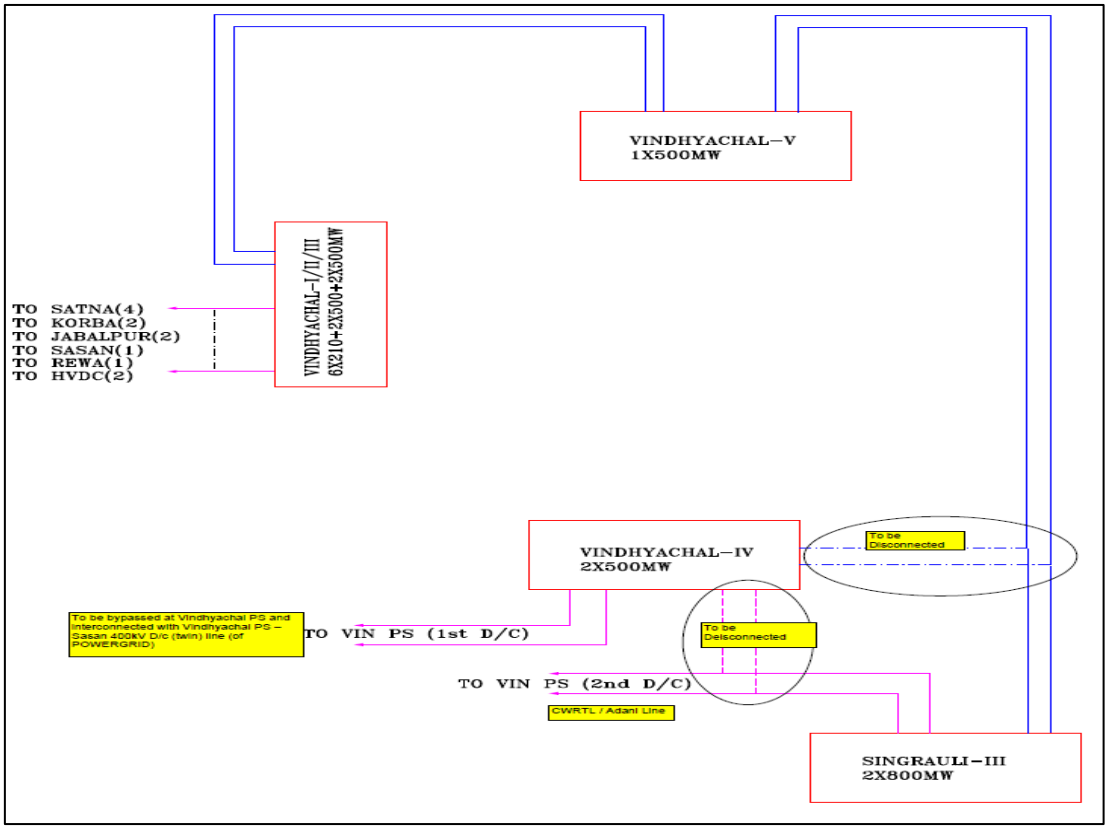


Figure 5-15: Network Expansion Scheme in Vindhyachal Complex

(ii) Transmission System for enabling RE interconnection at Mandsaur S/s

765/400/220kV Mandsaur PS was planned with 3x1500MVA, 765/400kV & 5x500MVA, 400/220kV ICTs to enable evacuation of power from 2 GW Wind Potential. The scheme is currently under implementation by Mandsaur Transmission Limited (subsidiary of POWERGRID). M/s Sprng Green Energy 2 Pvt. Ltd. (SGE2PL) has applied for Connectivity at Mandsaur S/s vide application no. 2200000824 for 600MW RE power injection from 31.12.2029. The subject scheme is planned to enable the Connectivity of M/s INGEPL.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	1 No. 400kV bay at Mandsaur S/s for RE Interconnection (Sprng Green Energy 2 Pvt. Ltd. (SGE2PL) (2200000824) for 600MW)	400kV line bay – 1 No.

Implementation Timeframe: 31.12.2029 as per start date of connectivity under GNA requested by applicant.

Estimated Cost: ₹ 17.28 Crs.

(a) Transmission System for enabling RE interconnection at Neemuch S/s

2x500MVA, 400/220kV Neemuch S/s is an existing S/s of POWERGRID, which was planned to enable RE evacuation of up to 1GW in Neemuch area of MP., 2 nos. of 220kV bays were also implemented as a part of the pooling station were allotted to RUMSL's Solar Park in Neemuch.

Subsequently, an application (No. 2200000709) for Connectivity for 300MW was received from M/s ACME Cleantech Solutions Pvt. Ltd. The subject scheme was planned to enable the injection of power from ACSPL's 300MW Solar Park. CTU vide OM dated 05.09.2024 has awarded the scheme to POWERGRID Neemuch Transmission System Ltd. (a subsidiary of Power Grid Corporation of India Ltd.) with Implementation Timeframe of 31.01.2026.

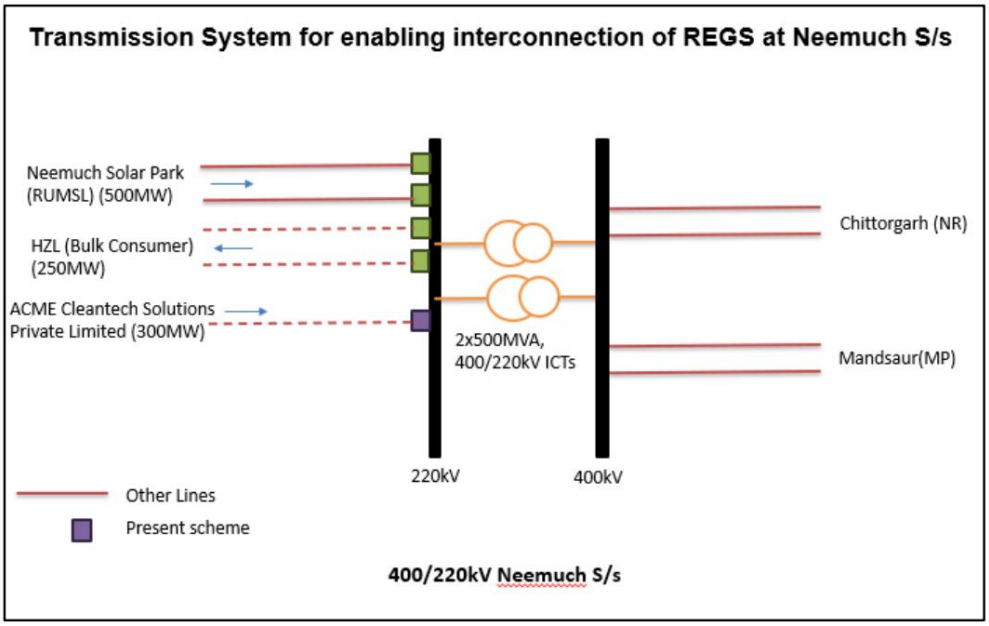


Figure 5-16: Tr. System for enabling RE interconnection at Neemuch PS

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	1 No. 220kV bay at Neemuch S/s for RE Interconnection (ACME Cleantech Solutions Private Limited (2200000709) for 300MW)	220kV line bay – 1 No.

Implementation Timeframe: 18 months or 31.01.2026 (as per start date requested by applicant), whichever is later

Estimated Cost: ₹ 5.57 Crs.

(iii) Transmission system for Evacuation of Power from RE Projects in Neemuch (1000 MW) SEZ in Madhya Pradesh-Phase II

The Government of India has set a target for establishing 500GW non-fossil generation capacity by 2030, out of which 1GW SEZ has been identified at Neemuch for which 2x500MVA, 400/220kV Neemuch PS is already commissioned by POWERGRID.

In view of applications received for cumulative capacity of 1770MW at Neemuch PS till Jun-24, it was found prudent to expand the substation to its full capacity so as to accommodate applications being received beyond 1GW at Pachora PS. Accordingly, the present scheme is planned which shall enable evacuation of additional 1000MW power from RE projects in Neemuch SEZ (i.e. 1000 MW beyond 1000MW) in Madhya Pradesh. The scheme was agreed in the 31st CMTS-WR held on 02.08.2024 and is currently under approval. The detailed scope of work is given below.

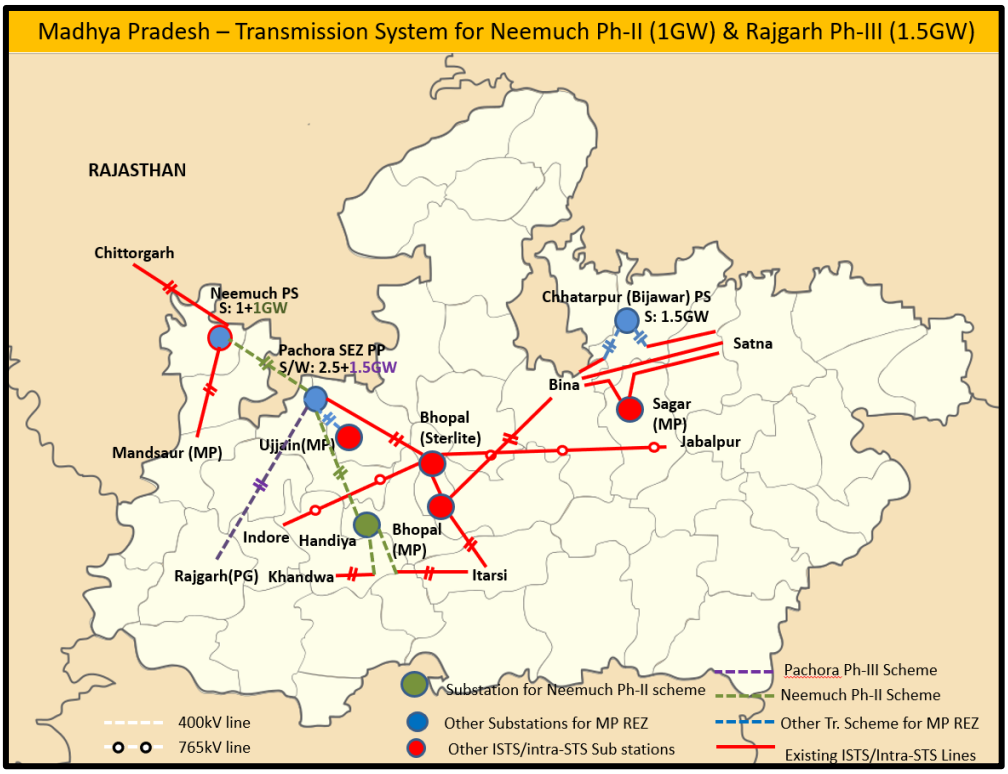


Figure 5-17: Tr. system for Evacuation of Power from RE Projects in Madhya Pradesh

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity
1.	Creation of New 220kV Bus Section-II at Neemuch PS with Augmentation of transformation capacity by 3x500MVA, 400/220kV ICTs (3rd, 4th & 5th) at Neemuch S/s along with associated bays.	• 500MVA 400/220kV ICT – 3 No. • 400kV ICT bay – 3 No. • 220kV ICT bay – 3 No. (on Sec-II)

Sl. No.	Scope of the Transmission Scheme	Capacity
		• 220kV Bus Sectionaliser bays – 1 set • 220kV BC & TBC – 1 No. each
2.	4 Nos. 220kV Line bays at Neemuch PS for RE interconnection	220kV Bays – 4 Nos. on Sec-II
3.	Neemuch PS – Pachora PS 400kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) along with 50MVAr Sw LR on each ckt at both ends	• Line length: 190km. • 400kV bays: 4 nos. (2 at Neemuch PS & 2 at Pachora PS) • 420kV, Sw LRs: 4 nos. (2 at Neemuch PS & 2 at Pachora PS) • Switching equipment for 400 kV line reactor – 4 Nos. (2 at Neemuch PS & 2 at Pachora PS)
4.	Establishment of 2x500MVA, 400/220kV S/s at Handiya with 2x125MVAr 420kV Bus Reactors **Future provision (space for):** • 400 kV line bays along with switchable line reactors– 6 Nos. (Sec-II) • 400/220 kV ICT along with bays - 4 Nos. (1 No. on Sec-I & 3 Nos. on Sec-II) • 400 kV Bus Reactor along with bays: 2 Nos. (Sec-II) • 220 kV line bays: 8 No. (on Sec-II) • 400 kV Sectionalization bay: 1 set • 220 kV Sectionalization bay: 1 set • 220 kV TBC & BC: 1 No.	• 400/220kV ICTs: 2 Nos. • 400kV ICT Bays: 2 Nos. • 220kV ICT Bays: 2 Nos. • 400kV Line bays: 6 Nos. • 220 kV line bays for MPPTCL – 8 Nos. • 125 MVAr, 420 kV Bus reactor – 2 Nos • 400 kV Bus reactor bay: 2 Nos. • 220 kV TBC bay – 1 no. • 220 kV BC bay – 1 no.
5.	Pachora PS – Handiya 400kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) along with associated bays at Pachora PS end and 50MVAr Sw LR on each ckt at both ends	• Line length: 190km. • 400kV bays: 2 nos. (at Pachora PS) • 420kV, Sw LRs: 4 nos. (2 at Handiya & 2 at Pachora PS) • Switching equipment for 400 kV line reactor – 4 Nos. (2 at Handiya & 2 at Pachora PS)
6.	LILO of Khandwa (PG) – Itarsi (PG) 400kV D/c (Twin Moose) line at Handiya S/s	• LILO route length: 22 km (88 ckm) • The Khandwa (PG) – Itarsi (PG) 400kV D/c line is of Twin Moose configuration and LILO shall be of similar conductor configuration
7.	Installation of 1x125 MVAR, 420 kV bus reactor (2nd) at Neemuch PS	• 125 MVAr, 420 kV Bus reactor – 1 No.

Sl. No.	Scope of the Transmission Scheme	Capacity
		• 400 kV Bus reactor bay: 1 No.

Note: *TSP of Neemuch & Pachora PS shall provide space for above scope of work*
Implementation Timeframe: 24 months from the date of SPV transfer.

Estimated Cost: ₹ 2240 Crs.

(iv) <u>Transmission system for Evacuation of Power from RE Projects in Rajgarh (1500 MW) SEZ in Madhya Pradesh-Phase III</u>

The Government of India has set a target for establishing 500GW non-fossil generation capacity by 2030, out of which 2.5GW REZ potential has been identified at Rajgarh (MP). Transmission schemes for evacuation of the identified 2.5GW RE power were planned in two phases as detailed below.

I. Phase-I (1.5GW) involves establishment of Pachora PS with 3x500 MVA 400/220kV ICTs and Pachora PS – Bhopal 400kV D/c line which was implemented by M/s G R Infraprojects Ltd.
II. Phase-II (1GW) involves ICT augmentation (4th, 5th & 6th) Pachora PS along with Pachora PS – Ujjan (MPPTCL) 400kV D/c line which is presently under implementation by M/s G R Infraprojects Ltd. with SCOD of 14.02.2026.

However, in view of applications received for cumulative capacity of 3813MW at Pachora PS till Jun-24, it is prudent to expand the substation to its full capacity so as to accommodate applications being received beyond 2.5GW at Pachora PS.

Accordingly, the present scheme is planned which shall enable evacuation of additional 1500MW power from RE projects in Rajgarh SEZ (i.e. 1500 MW beyond 2500MW) in Madhya Pradesh. The scheme was agreed in the 31st CMTS-WR held on 02.08.2024 and is currently under approval. The detailed scope of work is given below.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity
1.	Creation of New 220kV Bus Section (3rd) with 220kV Bus Sectionaliser and 400/220kV, 3x500MVA ICT augmentation (7th, 8th & 9th) at Pachora PS terminated on 220kV Bus Section (3rd)	• 500MVA 400/220kV ICT – 3 No. • 400kV ICT bay – 3 No. • 220kV ICT bay – 3 No. (on Sec-III) • 220kV Bus Sectionaliser bays – 1 set • 220kV BC & TBC – 1 No. each
2.	4 nos. 220kV line bays for RE Interconnection on Bus Section (3rd)	• 4 Nos. on Sec-III

Sl. No.	Scope of the Transmission Scheme	Capacity
3.	Pachora PS – Rajgarh (PG) 400 kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) along with associated bays at both ends (180km.) and 50MVAr Sw LR on each ckt at both ends	• Line length: 180km. • 400kV bays: 4 nos. (2 at Rajgarh (PG) & 2 at Pachora PS) • 420kV, Sw LRs: 4 nos. (2 at Rajgarh (PG) & 2 at Pachora PS) • Switching equipment for 400 kV line reactor – 4 Nos. (2 at Rajgarh (PG) & 2 at Pachora PS)
4.	Installation of 1x125 MVAR, 420 kV bus reactor at Pachora PS (400kV Bus Section-II)	• 125 MVAr, 420 kV Bus reactor – 1 No. • 400 kV Bus reactor bay: 1 No.

Note: *TSP of Rajgarh (PG) & Pachora PS shall provide space for above scope of work*

Implementation Timeframe: 24 months from the date of SPV transfer.

Estimated Cost: ₹ 1079 Crs.

In 26th NCT meeting held on 06.01.2025, it was recommended for clubbing of both the transmission schemes "Transmission system for Evacuation of Power from RE Projects (1500 MW) in Rajgarh SEZ in Madhya Pradesh-Phase III" and "Transmission system for Evacuation of Power from RE Projects (1000 MW) in Neemuch SEZ in Madhya Pradesh- Phase II".

(v) <u>Transmission System for evacuation of power from Mahan Energen Limited Generating Station in Madhya Pradesh</u>

2x600MW Thermal Power Station of M/s Mahan Energen Limited (MEL) located in Singrauli, Madhya Pradesh is already connected with ISTS. M/s MEL was granted Connectivity for 1100MW under the CERC Connectivity/ LTA Regulations, 2009 and power was being evacuated through implementation of SPS. Subsequently, M/s MEL has applied for Connectivity for remaining 100MW vide application no. 2200000224.

To evacuate the total 1200MW capacity of power reliably without SPS, the "Transmission System for evacuation of power from Mahan Energen Limited Generating Station in Madhya Pradesh" is proposed with the scope of work as detailed below. The scheme was deliberated and agreed in the WRPC meeting held on 27.03.2024 with an Implementation Timeframe of 30 months. Subsequently, the scheme was approved in the 20th NCT meeting held on 25.06.2024 and was recommended for implementation under TBCB.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Mahan (existing bus) – Rewa PS (PG) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	Route Length: ~110 km.
2.	2 Nos. 400 kV bays at Rewa PS (PG) for termination of Mahan (existing bus) – Rewa PS (PG) 400 kV D/c line (Quad ACSR/AAAC/AL59 moose equivalent) line	400 kV bays: 2 Nos.

Note:

- 2 Nos. 400 kV 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.

Implementation Timeframe: 30 months from the date of SPV transfer.

Estimated Cost: ₹ 558 Crs. (Approx.)

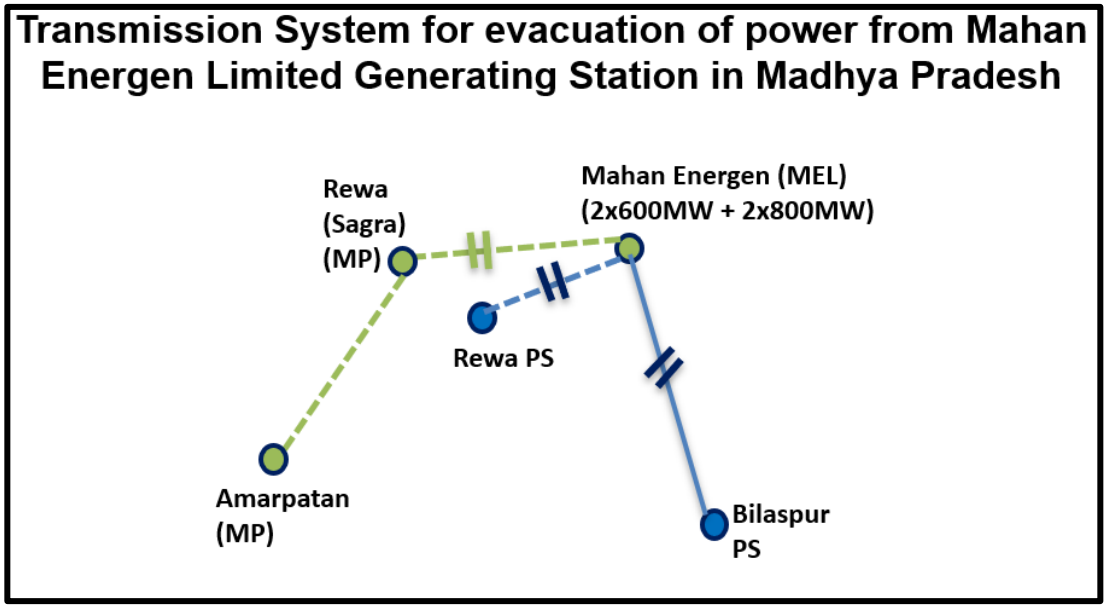


Figure 5-18: Scheme for 1200MW Mahan TPS &1600MW Mahan extension plant

(vi) Augmentation of transformation capacity & Implementation of line bays at Mandsaur S/s for RE Interconnection

The Government of India has set a target for establishing 500GW non fossil generation capacity by 2030, out of which 2GW REZ potential has been identified in Neemuch / Mandsaur area.

For evacuation of this 2GW capacity from Neemuch / Mandsaur region in MP, establishment of 765/400kV Mandsaur S/s along with 3x1500MVA 765/400kV ICTs & 5x500MVA, 400/220kV ICTs along with Mandsaur – Indore 765kV D/c line is already under implementation with SCOD of Aug'26 and Mandsaur – Kurawar 765kV D/c line is under implementation with SCOD of Oct'26. For Evacuation of Power from Sirohi PS (2 GW) & Merta-II PS (2GW) in Rajasthan, Mandsaur PS – Khandwa (New) 765 kV

D/c line was also planned, which is under tendering stage. Based on load flow studies, the same has also been linked with RE projects beyond 2GW received at Mandsaur PS.

Till Oct-24, applications for about 4.5GW have been received at Mandsaur PS (2998MW at 220kV level and 1500MW (600: Sprng & 900 NTPC REL) at 400kV level. To accommodate the same, Augmentation of transformation capacity is required at Mandsaur PS by 2x500MVA 400/220kV ICTs, 1x1500MVA, 765/400kV ICT (4^{th}) along with 400kV & 220kV line bays for RE interconnection. The scheme was deliberated & agreed in 33rd CMETS-WR meeting held on 29.10.2024 & 34th CMETS-WR meeting held on 16.12.2024 & 17.12.2024.

The subject Transmission system was also deliberated and recommended to be implemented under TBCB route in the 26th NCT meeting held on 06.01.2025 with scope & Implementation Timeframe as mentioned below:

Detailed scope of the scheme is given below:

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
1	Creation of New 400kV & 765kV Bus Section-II through Sectionaliser arrangement	765 kV Sectionalization bay: 1- set (so that Sirohi & Khandwa (New) 765kV D/c lines, currently under tendering, are terminated on New 765kV Bus Section-II) 400 kV Sectionalization bay: 1- set
2	Augmentation of Transformation capacity by 1x1500MVA, 765/400kV ICT (4^{th}) (Terminated at 400kV & 765kV Bus Section-II)	765/400 kV, 1500 MVA ICT – 1 No. 765kV ICT bay - 1 No. on Sec-II 400kV ICT bay - 1 No. on Sec-II
3	Augmentation of Transformation capacity by 1x500MVA, 400/220kV ICT (6^{th}) (Terminated on 400kV Bus Section-I & 220kV Bus Section-II)	1x500MVA, 400/220kV ICT – 1 No. 400kV ICT bay - 1 No. on Sec-I 220kV ICT bay - 1 No. on Sec-II
4	1 no. 220kV line bay (on 220kV Bus Sec-II) at Mandsaur PS for interconnection of Solar project of Waaree Renewable Technologies Ltd. (WRTL) (2200001192) (300MW)	220kV line bay – 1 No. on Sec-II
5	1 no. 400kV line bay at Mandsaur PS (on 400kV Bus Sec-II) for interconnection of Solar project of NTPC Renewable Energy Ltd. (NTPCREL) (2200001301) (300MW)	400kV line bay – 1 No. on Sec-II
6	Augmentation of Transformation capacity by 1x500MVA, 400/220kV ICT (7th) (Terminated on 400kV Bus Section-II & 220kV Bus Section-III) at Mandsaur PS	1x500MVA, 400/220kV ICT – 1 No. 400kV ICT bay - 1 No. on Sec-II 220kV ICT bay - 1 No. on Sec-III

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
7	Creation of New 220kV Bus Section-3 with Sectionaliser arrangement at Mandsaur PS	220 kV Sectionalization bay: 1- set 220kV BC & TBC – 1 No.
8	1 no. 220kV line bay at Mandsaur PS (220kV New Bus Section-3) for interconnection of wind project of JSP Green Pvt. Ltd. (JSPGPL) (2200001356) (350MW)	220kV line bay – 1 No. on Sec-III
9	1 no. 220kV line bay at Mandsaur PS (220kV New Bus Section-3) for interconnection of Hybrid project of TEQ Green Power XXII Pvt. Ltd. (TGP XXII PL) (2200001431) (250MW)	220kV line bay – 1 No. on Sec-III
Note: *TSP of Mandsaur PS shall provide requisite space for above scope of work (free of cost)*		

Implementation Timeframe:

- Scope at Sl. 1, 2, 3, 4 & 6: Matching with SCOD of Mandsaur – Khandwa 765kV D/c line being implemented under Transmission system for Common Evacuation of Power from Sirohi PS (2 GW) & Merta-II PS (2GW), which is currently under tendering stage subject to minimum schedule of 18 months.
- Scope at Sl. 5: 31.03.2027 or Matching with SCOD of Mandsaur – Khandwa 765kV D/c line, whichever is later subject to minimum schedule of 18 months
- Scope at Sl. 7 & 8: 15.06.2027 or Matching with SCOD of Mandsaur – Khandwa 765kV D/c line, whichever is later (subject to minimum schedule of 18 months)
- Scope at Sl. 9: 30.03.2028

Estimated Cost: ₹ 319 Crs.

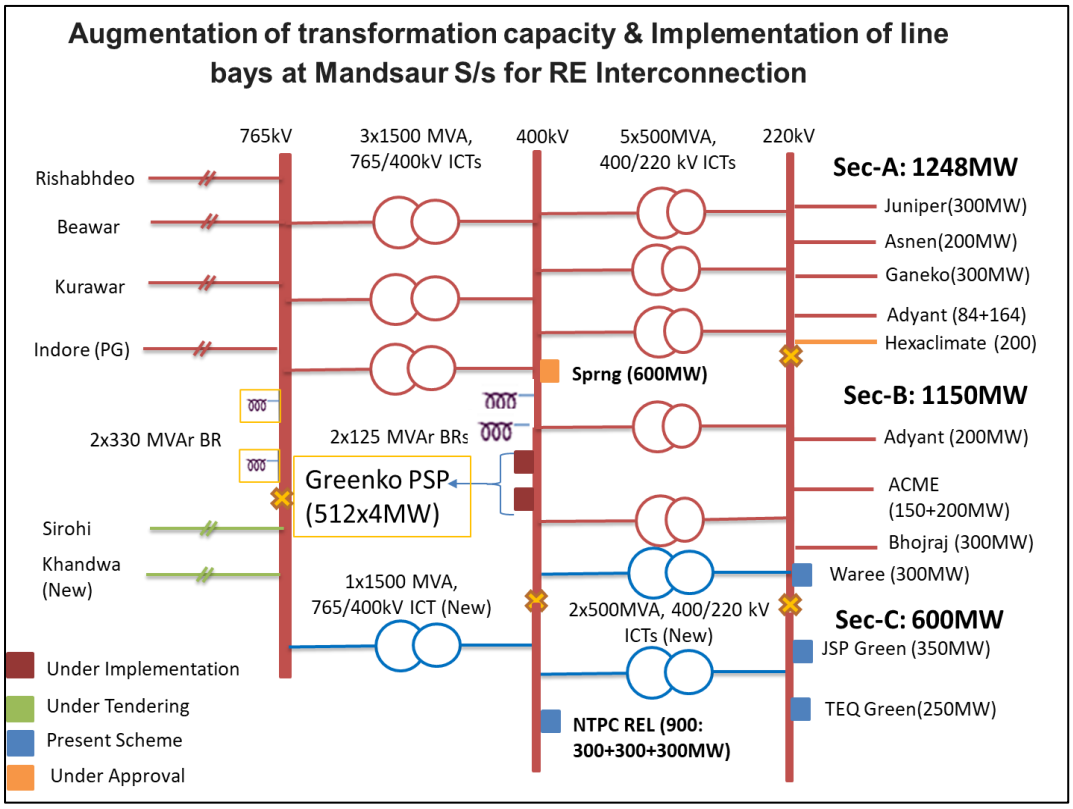


Figure 5-19: Augmentation at Mandsaur PS

(vii) <u>Network expansion at 765/400/220/132kV Kurawar S/s for drawal of power by MPPTCL</u>

765/400/220/132kV Kurawar PS is under implementation by Rajasthan IV H1 Power Transmission Ltd. (a subsidiary of Power Grid Corporation of India Ltd.) as part of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-H1) (Bikaner Complex)" with a total transformation capacity of 2x1500MVA, 765/400kV & 2x500MVA, 400/220kV & 3x200MVA, 220/132kV ICTs with implementation schedule as 15.10.2026.

The scheme was deliberated and agreed for in the 13th CMETS-WR held on 08/12/2022, 27th CMETS-WR held on 01/04/2024 & 32nd CMETS-WR held on 24/09/2024.

In the above meeting, it was agreed that timeframe of the implementation of the above ISTS bay works shall be 15.10.2026 i.e. matching with SCOD of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-H1) (Bikaner Complex)". MPPTCL agreed for implementation of corresponding 220kV & 132kV feeders in matching timeframe of the above ISTS bays.

Detailed scope of the scheme is given below:

Sl. No.	Scope of the Transmission Scheme	Item Description
1.	4 nos. 220kV line bays at Kurawar S/s (for LILO of both ckts of Bhopal – Shujalpur 220kV D/c line at Kurawar S/s being implemented by MPPTCL)	• 220kV line bays – 4 Nos.
2.	9 nos. 132kV line bays at Kurawar S/s for various 132kV lines planned by MPPTCL.	• 132kV line bays – 9 Nos.

Note:

a. The Implementation Timeframe of the subject transmission scheme shall be matched with the SCOD of Kurawar S/s being implemented under "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-H1) (Bikaner Complex)" project.

b. MPPTCL shall ensure that the implementation of 220kV & 132kV feeders in matching timeframe of the above ISTS bays.

c. *TSP of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-H1) (Bikaner Complex)" shall provide space for above scope of work at Kurawar S/s.*

CTU vide OM dated 20.01.2025 has approved the above scope of works for implementation under RTM mode through Rajasthan IV H1 Power Transmission Ltd. (a subsidiary of Power Grid Corporation of India Ltd.)

Implementation Timeframe: 15/10/2026 i.e., matching with SCOD of "Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2: 5.5 GW) (Jaisalmer/Barmer Complex): Part H1"

Estimated Cost: ₹ 56.06 Crs.

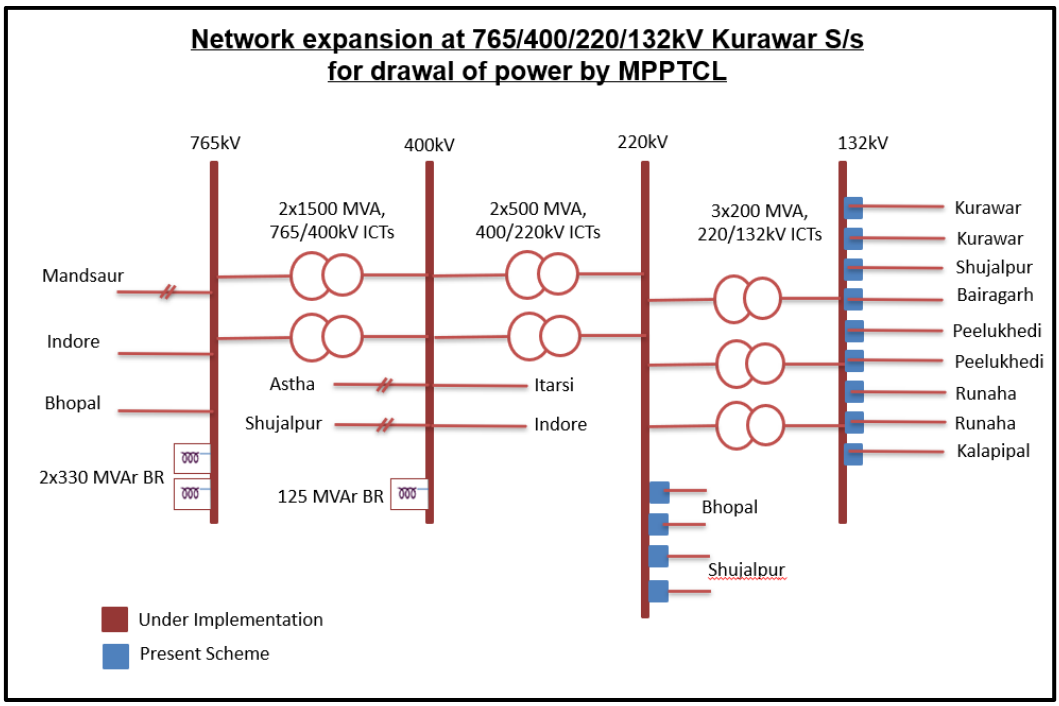


Figure 5-20: Transmission scheme for Network expansion at Kurawar S/s

(viii) <u>Implementation of 2 nos. 400kV line bays at Mandsaur S/s for Interconnection of 3x504MW PSP of Greenko MP01 IREP Pvt. Ltd.</u>

3x1500MVA 765/400kV and 5x500MVA, 400/220kV Mandsaur Pooling Station is under implementation under "Transmission System for Evacuation of Power from Rajasthan REZ Ph-IV (Part-2: 5.5GW) (Jaisalmer/Barmer Complex): Part C" by **Rajasthan IV C Power Transmission Ltd. (a subsidiary of Power Grid Corporation of India Ltd.)** with Implementation Timeframe of 24 months from the date of SPV transfer i.e. 19.08.2026.

In the 1st sitting of 21st CMETS-WR held on 29.08.2023, Greenko MP01 was agreed to be granted Connectivity for its 3x504MW PSP [(appl. no. 2200000089-504MW; 2200000090- 504MW & 2200000091-504MW)] at Mandsaur S/s through 400kV D/c line (quad ACSR/AAAC/AL59 moose equivalent) line with the availability of Common Transmission system Augmentation which inter-alia includes Establishment of 3x1500MVA, 765/400kV Mandsaur PS.

The scheme with following scope of works was discussed and agreed in the 2nd sitting of 21st CMETS-WR held on 29.08.2023.

Detailed scope of the scheme is given below:

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe.
1.	Implementation of 2 nos. 400kV line bays at Mandsaur S/s for Interconnection of 3x504MW PSP of Greenko MP01 IREP Pvt. Ltd. through Greenko MP01 – Mandsaur PS 400kV D/c (quad ACSR/AAAC/AL59 moose equivalent) line	• 400kV line bays (including associated tie bay): 2 Nos.	19.08.2026 *(as per start date of Greenko MP01 IREP Pvt. Ltd./ matching with the commissioning schedule of Mandsaur S/s)*
Total Estimated Cost:			**₹ 30.46 Crs.**

CTU vide OM dated 23.10.2024 has approved the above scope of works for implementation under RTM through **Rajasthan IV C Power Transmission Ltd.** (a subsidiary of Power Grid Corporation of India Ltd.).

Implementation Timeframe: 19.08.2026 (as per start date of Greenko MP01 IREP Pvt. Ltd./ matching with the commissioning schedule of Mandsaur S/s)

Estimated Cost: ₹ 30.46 Crs.

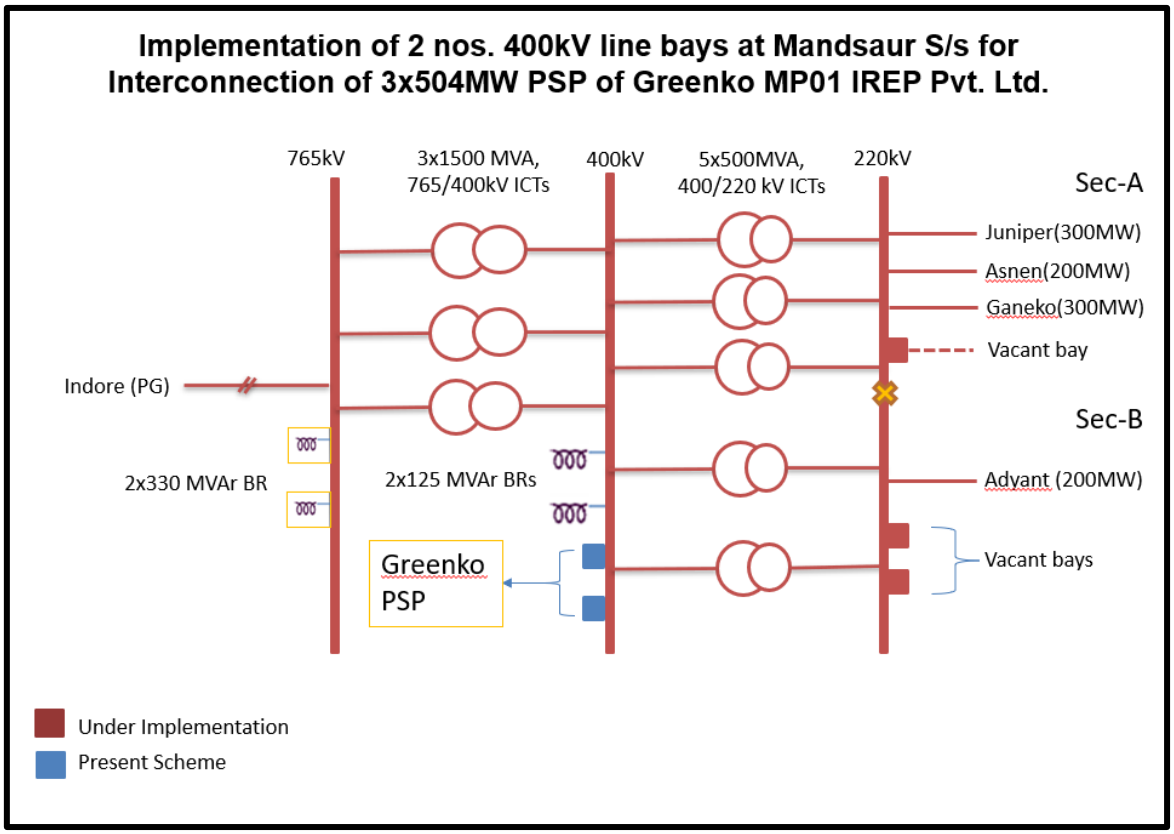


Figure 5-21: Implementation of 400kV line bay at Mandsaur S/s

(ix) <u>Transmission system for Evacuation of Power from RE Projects in Morena SEZ in Madhya Pradesh-Phase I (2500MW)</u>

The Government of India has set a target for establishing 500GW non fossil generation capacity by 2030, out of which 3.9GW REZ potential has been identified at Morena (MP) in following two phases:

1. Phase-I (2.5GW) by Dec-27
2. Phase-II (1.4GW) by Dec-30

The Phase-I of the scheme was discussed in a meeting held amongst CEA, CTU, GRID-INDIA, MPPTCL & RUMSL on 16.07.2024 and in the 31st CMETS-WR meeting held on 02.08.2024 wherein RUMSL informed the following:

1. Morena Solar Park (600MW) (with BESS) will connect to STU network and the timeline is July 2027
2. Morena Solar Park (1400MW) (without BESS) will connect to ISTS network and timelines are before June-2027.

Regarding location of ISTS substation, RUMSL informed that it may be located south of Sabalgarh area. Subsequently, MPPTCL submitted proposal for establishment of 400/220kV Sabalgarh (New) S/s planned for strengthening the intra-state transmission

network in and around the Sabalgarh and Sheopur areas and requested for ISTS in-feed for feeding power to 400/220kV Sabalgarh (New) S/s.

Since both the proposals were for development of ISTS in Sabalgarh area only, it was decided in the 32nd CMETS-WR meeting to setup a 765/400kV Morena PS near South of Sabalgarh through Morena PS – Karera (near Datia) 765 kV D/c line, which shall be used for evacuation of power from Morena SEZ (2.5GW in Ph-I) as well as for feeding power to 400/220kV Sabalgarh (New) S/s of MPPTCL [through 400kV D/c (Quad Moose / High Capacity) line].

The scheme was discussed and agreed in following meetings:

- Meeting held amongst CEA, CTU, GRID-INDIA, MPPTCL & RUMSL on 16.07.2024
- 31st CMETS-WR meeting held on 02.08.24
- 32nd CMETS-WR meeting held on 24.09.2024
- 51st WRPC meeting held on 11.01.2025

Details of the scheme are given below:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1	Establishment of 3x1500 MVA, 765/400 kV & 2x500MVA, 400/220kV Morena PS (South of Sabalgarh) with 2x330 MVAR 765 kV bus reactor and 2x125 MVAR 420 kV bus reactor. **Future provisions:** Space for ➢ 765/400 kV, 1500MVA ICT along with bays- 3 Nos. (on Sec-II) ➢ 765 kV line bays along with switchable line reactors– 6 Nos. (2nos. on Sec-I & 4 Nos. on Sec-II) ➢ 765 kV, 330MVAr Bus Reactor along with bay: 2 Nos. (on Sec-II) ➢ 765 kV Sectionaliser: 1 set ➢ 400 kV line bays along with switchable line reactors– 9 Nos. (3 on Sec-I & 6 on Sec-II) ➢ 400/220 kV, 500MVA ICT along with bays-8 Nos. (3 on Sec-I & 5 on Sec-II) ➢ 400 kV, 125MVAr Bus Reactor along with bays: 2 Nos. (Sec-II) ➢ 400 kV Sectionalization bay: 1-set ➢ 220 kV line bays: 12 Nos. (4 nos. on Sec-I & 8 nos. on Sec-II) ➢ 220 kV Sectionalization bay: 1set	➢ 765/400 kV, 1500 MVA ICT-3 Nos. ➢ 400/220kV, 500MVA ICT – 2 Nos. ➢ 765 kV ICT bays- 3 Nos. • 400 kV ICT bays- 5 Nos. • 220kV ICT bays – 2 Nos. • 330 MVAR 765 kV bus reactor-2 Nos. • 125 MVAR 420 kV bus reactor-2 Nos. • 765kV reactor bay- 2 Nos. • 765 kV line bay- 2 Nos. *(for termination of Morena PS (South of Sabalgarh) – Karera (near Datia) 765 kV D/c line)* • 400kV line bays- 5 Nos. *(2 no. for termination of Morena PS - Sabalgarh (New) (MPPTCL) 400kV D/c line (Quad Moose / High Capacity) line; 2 nos. for interconnection of Greenko PSP & 1 no for RE interconnection)* • 400 kV reactor bay- 2 Nos.

	➢ 220 kV TBC: 1 No. ➢ 220kV BC: 1 No. ➢ 2 Nos. STATCOM (±400 MVAR) along with 2x125 MVAr MSC & 1x125 MVAr MSR and associated bays- 2Nos. (1 on 400kV Sec-I and 1 on 400 kV Sec-II)	• 220 kV TBC – 1 No. • 220 kV BC – 1 No. • 220 kV line bays – 4 Nos. (*for RE Interconnection*) • 500MVA, 765/400 kV 1-Ph Spare ICT-1 No. • 110 MVAR, 765 kV, 1-ph reactor (spare unit for bus reactor)-1 No.
2.	Morena PS (South of Sabalgarh) – Karera (near Datia) 765 kV D/c line	90 km (approx.)
3.	2 Nos. of 765kV line bays at Karera (near Datia) for termination of Morena PS (South of Sabalgarh) – Karera (near Datia) 765 kV D/c line	765 kV line bays– 2 Nos.
4.	Augmentation of 400/220kV transformation capacity at 765/400/220kV Karera (near Datia) S/s (Sec-I) by 1x500MVA ICT (3rd)	• 400/220 kV, 500 MVA ICT-1 No. • 400 kV ICT bay- 1 No. • 220 kV ICT bay- 1 No.
***Note**:* *a. M/s Apraava Energy Pvt. Ltd. (AEPL) shall provide space for above scope of work at Karera S/s.* *b. Location of the substation shall be finalised near South of Sabalgarh in consultation with CEA, RUMSL and other stakeholders.* *c. MPPTCL shall ensure development of 400/220kV Sabalgarh (New) S/s and Morena PS - Sabalgarh (New) (MPPTCL) 400kV D/c line (Quad Moose / High Capacity) line in matching timeframe of above scheme.*		

The scheme was also discussed in 27th NCT meeting held on 06.02.2025, wherein, it was deliberated & agreed that since the Karera – Morena PS 765kV D/c line may pass through forest area or its buffer zone, a time-line of 27 months may be considered for the scheme. It was noted that RUMSL may be targeting an early schedule of Jun-27 and Greenko's 880MW Baran PSP has indicated a schedule of Oct-26. However, considering topology of the area, RUMSL / Greenko would have to match with the commissioning of transmission system (27 months) which cannot be compressed to 24 months considering forest area.

Implementation Timeframe: 27 months from the date of SPV transfer or allocation

Estimated Cost: ₹ 1693 Crs.

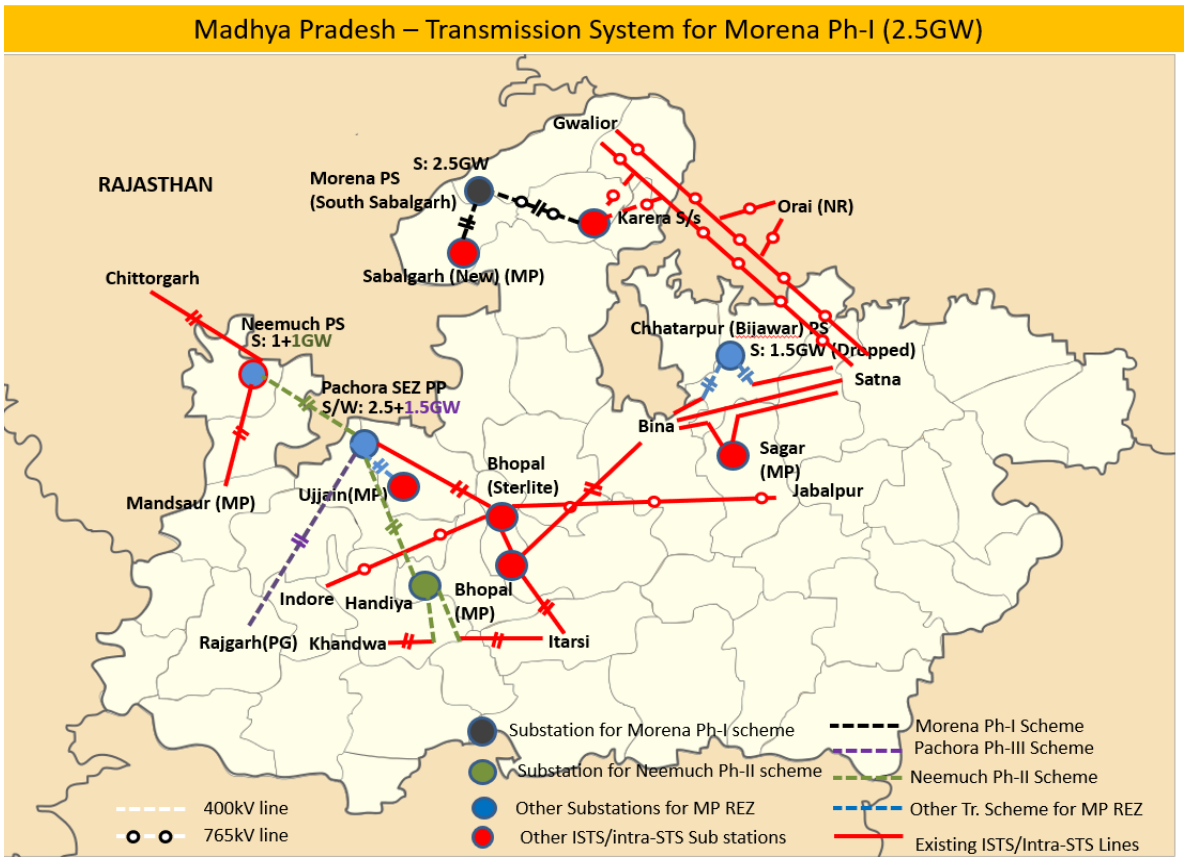


Figure 5-22: Transmission system for Morena (2.5GW) at Madhya Pradesh

5.4.4 Chhattisgarh

(i) <u>Transmission System for evacuation of power from Vedanta's Thermal Power Station (1200MW) in Sakti, Chhattisgarh</u>

M/s Vedanta applied for Connectivity for 1200MW at Raigarh (Kotra) S/s for Athena 2x600MW Power Project. However, there is no margin for injection left at Raigarh (Kotra) Substation for injection of power as any injection at Raigarh (Kotra) S/s leads to N-1 non-compliance of 765/400kV ICTs [especially under Raigarh-Pugalur HVDC reverse power flow scenario (3000MW reversal)] and there are severe fault level issues at the substation.

In view of the same, connectivity has been agreed at Raigarh (PG) S/s. However, as there is no space left at Raigarh(PG) S/s for 2 nos. 400kV bays, it was agreed that Vedanta shall connect to Raigarh(PG) S/s by interconnecting the already existing 400kV D/c line upto Raigarh(Kotra) with Raigarh (Kotra) – Raigarh (PG) 400kV D/c line (which is presently kept normally open to control fault level at Raigarh (Kotra) & Raigarh(PG) substations).

Considering that the 400kV bays at Raigarh (PG) are rated at 2000A (i.e. 1385MVA), they shall be sufficient to cater to 1200MW capacity of Vedanta's Athena project, without the need for upgradation. However, since Raigarh (Kotra) – Raigarh (PG) 400kV D/c line is twin moose line, a portion of it which would be utilized by M/s Vedanta would

need to be reconductored to meet the evacuation requirement of 1200MW capacity (matching with capacity of Vedanta's Athena project). Based on feedback from M/s Vedanta regarding the feasibility of implementation, the scheme was planned with the following scope of work. CTU vide OM dated 01.10.2024 has approved the above scope of works for implementation under RTM through Power Grid Corporation of India Ltd.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Reconductoring of a portion of Raigarh (Kotra) – Raigarh (PG) 400kV D/c line [i.e. from Raigarh(PG) to Termination point near Raigarh(PG) at which Vedanta's 400kV D/c line is being terminated into Raigarh (Kotra) – Raigarh (PG) 400kV D/c line so as to form Vedanta – Raigarh(PG) 400kV D/c line]* with twin HTLS conductor (with minimum capacity of 1200MW per ckt at nominal voltage (~1.3km.))	1.3km. reconductoring
2.	Associated jumpering arrangement at termination point so as to establish Vedanta – Raigarh(PG) 400kV D/c line (with minimum capacity of 1200MW per ckt at nominal voltage)	-

Note: *POWERGRID vide e-mail dated 01.07.2024 has informed that the permanent arrangement for connecting Vedanta's D/c line with POWERGRID's Raigarh (PG) – Raigarh (Kotra) D/c line requires one new DD tower with Auxiliary cross arm in place of 14/0 and new QD tower with auxiliary X arm in POWERGRID line, in place of tower No 5 with a span length of about 500 meters, considering the completion of reconductoring work between tower No 5 to Raigarh Gantry (actual length may vary at the time of survey).*

Implementation Timeframe: 6 months from award to implementing agency i.e 01.04.2025

Estimated Cost: ₹ 3.61 Crs.

(ii) <u>400kV line bays at Champa for Interconnection of NTPC LARA STPP STAGE-II (1600MW) Project</u>

6x1500MVA, 765/400kV Champa PS is an existing substation of POWERGRID with 3x1500MVA, 765/400kV ICTs on each bus section.

Lara stage-I STPP (2x800 MW) of NTPC was granted connectivity through Lara STPP I – Raigarh (Kotra) PS 400kV D/c line and Long Term Access (LTA) through Lara STPP I – Champa PS (Section-I) 400kV D/c (quad) line for transfer of 1500MW power from the Lara-I project to various beneficiaries in WR. The entire 1500MW quantum has now been converted into deemed GNA. KSK 3x600MW units are connected at Champa PS on the 400kV Bus Section-II.

Application for Connectivity for 1600MW was received from NTPC for LARA STPP STAGE-II Project (2x800MW) which was allowed for injection of power from the

400kV Bus Section-II of Champa PS (where KSK 3x600MW Units are connected). The present scheme involves 2 nos. 400kV bays at Champa PS (Bus Section B, with KSK 3x600MW Units) for termination of 400kV D/c (Quad) line from Lara STPP St-II generation switchyard to Champa PS. CTU vide OM dated 13.09.2024 has approved the above scope of works for implementation under RTM through Power Grid Corporation of India Ltd.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	2 nos. 400kV bays at Champa PS (Bus Section A, with KSK 3x600MW Units) for termination of Lara STPP St-II Generation Switchyard – Champa 400kV D/c (Quad) line	400kV line bays: 2 Nos. (on Bus Section A, with KSK 3x600MW Units)

Implementation Timeframe: 01.05.2027 (as per start date of connectivity requested by NTPC Ltd.)

Estimated Cost: ₹ 18.57 Crs.

(iii) <u>Scheme to control high voltages at Champa PS (on Bus Section-A, where Lara-I project is connected)</u>

6x1500MVA, 765/400kV Champa PS is an existing substation of POWERGRID with 3x1500MVA, 765/400kV ICTs on each bus section. During the deliberations made in the 29th CMETS-WR held on 03.06.2024, GRID-INDIA has put forth the observation of high voltages on the bus section-I of both 765kV & 400kV buses of Champa PS after bus sectionalisation due to inadequate shunt reactive power compensation.

As a result of this, Champa-Kurukshetra HVDC bipole-I is also being blocked for controlling the voltages during off-peak hours. Hence there is a requirement of sufficient reactive power compensation at Champa PS on Section-I of 765kV & 400kV buses (where Lara-I is connected) for reliable operation of Champa-Kurukshetra HVDC bipoles. CTU vide OM dated 13.09.2024 has approved the above scope of works for implementation under RTM through Power Grid Corporation of India Ltd.

Detailed scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity
1.	• Installation of 1x240MVAr, 765kV Bus Reactor & 1x125MVAr, 420kV Bus Reactor at Champa PS *(On Bus section-A where Lara-I project is connected)*	• 1x240MVAr, 765kV Bus Reactor – 1 No. • 765kV BR bay – 1 No. • 1x125MVAr, 420kV Bus Reactor – 1 No. • 400kV BR bay – 1 No.

***Note**: TSP of Champa PS shall provide space for above work.*

Implementation Timeframe: 18 months from issue of OM i.e. 13.03.2026

Estimated Cost: ₹79.28 Crs.

5.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in section 5.3, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are expected to be commissioned in 2029-30 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 file was prepared for 2029-30 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. All bus voltages are within limit from their nominal value.

5.5.3 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:

e) Transmission Lines

List of 765kV ISTS lines loaded around 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

(All Fig in MW)

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under n-1	Rating	% Loading
1	Dharamjaigarh-Ranchi (New) 765kV one line	Dharamjaigarh-Ranchi (New) 765kV other line	1,4	ISTS	3321	4649	3500	133
2	Vindhyachal Pool – Varanasi 765kV one line	Vindhyachal Pool – Varanasi 765kV 765kV oher line	4	ISTS	2288	3396	3500	97

Due to high generation in WR & NR during high RE period and low generation in ER, high power is flowing on Tamnar – Dharamjaigarh-Ranchi-Mednipur 765kV D/c corridor. Suitable network augmentation in the form of Tamnar-Jamshedpur 765kV D/c

line alongwith establishment of Jamshedpur S/s is being planned in consultation with respective STUs. High loadings on Vindhyachal Pool – Varanasi 765kV D/c line is observed on account of high demand near Varanasi area coupled with pumping operation of PSPs proposed to be connected at Varanasi S/s. However, loading under N-1 contingency is well within thermal limit considering the short length of the line.

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

(All Fig in MW)

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	% Loading	Rating
1	Sipat-Kunkuri 400kV D/c line one ckt	Sipat-Kunkuri 400kV D/c line other ckt	4	ISTS/STU	768	1073	102	1050
2	Dhamtari-Jagdalpur 400kV D/c line one ckt	Dhamtari-Jagdalpur 400kV D/c line other ckt	7	STU	730	998	116	857
3	Khandwa-Chegaon 400kV line one ckt	Indore 765/400kV 1500MVA ICT	5	STU	805	895	104	857
4	A'bad – I – A'bad – II 400kV D/c line one ckt	A'bad – I – A'bad – II 400kV D/c line other ckt	4	STU	467	882	103	857

Due to high generation in WR & NR during high RE period and low generation in ER, high power is flowing on Sipat-Kunkuri-Ranchi 400kV D/c corridor. Suitable network augmentation in the form of Tamnar-Jamshedpur 765kV D/c line alongwith establishment of Jamshedpur S/s is being planned in consultation with respective STUs which will reduce the loading on this line. High loadings on Dhamtari-Jagdalpur 400kV D/c line is on account of High RE & low self generation of Chhattisgarh.

A'bad-I and A'bad-II substations are interconnected through very short lines and the to resolve overloading alongwith high short circuit issues at the above subsations, MSETCL has planned Jalna S/s through LILO of A'bad-II - A'bad-III 400kV D/c line.

f) Transformers

List of ISTS 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

(All Fig in MW)

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, 3X500MVA Hazira ICTs	1 to 9	ISTS	347	529	106	500

In Gujarat, high loading of ICTs at Hazira is observed due to load growth in Hazira complex & also to meet the reactive power demand of these loads. Towards the same, AMNS has planned Hazira-II S/s in this area to cater to increased demand in this area.

In addition to above, Kallam 400/220kV, 4x500MVA ICTs are N-1 non compliant as the above 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. Further, mostly wind generators are proposed to be connected at Kallam PS which has around 70 to 75% diversity factor.

Further under N-1 contingency, high loading of more than 90% ICT rating is observed on 400/220kV ICTs at Raipur in Chhattisgarh, 765/400kV ICTs at Lakadiya in Gujarat due to high RE under ISTS in Kutch/Khavda complex & 765/400kV ICTs at Satna in MP due to high loading in Satna area. In this respect, 4th 500MVA, 400/220kV ICT at Raipur is already being planned to relieve the overloading. Further, suitable system augmentation at Lakadiya & Satna would be finalised after discussions with concerned stakeholders.

Raigarh Kotra 765/400kV ICTs has already been expanded to its full capacity to enable reversal in power from Raigarh-Pugalur HVDC to 3000MW. Further, Raigarh (Kotra)-II S/s alongwith interconnections with ER & within WR is also being planned which will also enable evacuation of power from upcoming thermal generation projects in this complex. Further, it will also relieve overloadings on Raigarh (Tamnar) – D'jaigarh (Sec-B) 765kV D/c line as well as Sipat – Ranchi 400kV D/c line.

List of Generation/STU ICTs loaded beyond MVA rating under N-1 contingency are summarized below at **Table 5-10:**

Table 5-10: Generator & STU ICTs not meeting N-1 Criteria in WR

(All Fig in MW)

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, 2X315 MVA Mundra APL ICTs	2,3,5,6	APL	350	477	151	315

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Base Case Flow	Maximum Loading under N-1 of ICT	% Loading	Rating
2	400/220kV, 2X315 MVA Jindal ICTs	1,2,4,5,7 & 8	JPL	177	359	114	315
3	400/220kV, 3X315 MVA Bhilai ICTs	1,4 & 7	CSPTCL	275	329	105	315

From above, it is observed that ICT loadings i.r.o 1 no. of substation in Gujarat and 2 nos. in Chhattisgarh are not complying with N-1 criteria in 2029-30 timeframe. Further under N-1 contingency, high loading of more than 90% ICT rating is observed on 400/220kV ICTs at Charanka, Halvad, Zerda, Sugen in Gujarat, 400/220kV ICT at Korba West & 400/132kV ICT at Kirnapur in Chhattisgarh, 400/220kV ICT at Lonikand-II & 765/400kV ICT at Aurangabad-III in Maharashtra.

Therefore, 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.

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 analysis, it emerged that there as 10 nos. of 765kV substations and 34 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 shown below:

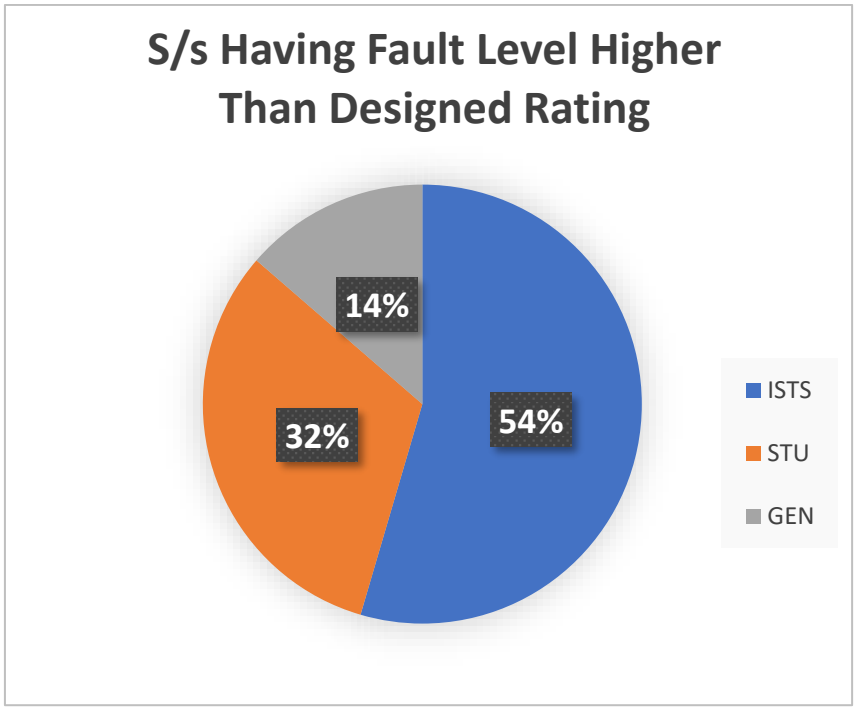


Figure 5-23: Chart representing S/s having fault level higher than designed value

Details of the ISTS buses exceeding design fault level by more than 5% are tabulated below at **Table 5-11:**

Table 5-11: 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	All	47	40
2	765kV Vataman	All	53	50
3	765kV Banaskantha	1,4,6,7,8,9	47	40
4	765kV Gwalior	1,2,3,5,6,7,8,9	44	40
5	765kV Bina	All	45	40
6	765kV Jabalpur Pool	2,3,5,6,7,8,9	58	50
7	765kV Wardha	All	51	40
8	765kV Aurangabad PG	All	46	40
9	765kV Pune GIS	1,4,7	44	40
10	765kV Padghe GIS	All	47	40
11	400kV Bilaspur-Pool	All	48	40
12	400kV Bachau	All	46	40
13	400kV Vadodara	All	54	50

Sl. No.	Substation Name	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
14	400kV Banaskantha	1,4,6,7,8,9	56	50
15	400kV Jabalpur	3,5,6,7,8,9	45	40
16	400kV Khandwa	7,8,9	43	40
17	400kV Bina PG	1,2,3,5,6,7,8,9	44	40
18	400kV Bhadrawati	5,6,7,8,9	44	40
19	400kV Boisar	All	50	40
20	400kV Pune AIS	All	53	40
21	400kV Aurangabad PG	All	61	50
22	400kV Pune GIS	All	58	50
23	400kV Padghe GIS	All	53	50
24	400kV Navi Mumbai	3,6,7,9	43	40

From the above, it can be seen that 24 nos. of buses i.e. 400kV & 765kV violates the design fault level by more than 5%. In this regard, MSETCL has planned Jalna S/s through LILO of A'bad-II - A'bad-III 400kV D/c line which will reduce the SC levels at Aurangabad complex. For other substations, 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 5-12:**

Table 5-12: 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	44	40
2	400kV Choraniya	Gujarat	All	44	40
3	400kV Ranchodpura	Gujarat	1,4,6,7,8,9	43	40
4	400kV Sankhari	Gujarat	1,4,5,6,7,8,9	44	40
5	400kV Bina	MP	1,2,3,5,6,7,8,9	44	40
6	400kV Nagda	MP	All	45	40
7	400kV Lonikand I	Maharashtra	All	53	40
8	400kV Parli-Girwal	Maharashtra	All	48	40
9	400kV Bableshwar	Maharashtra	All	48	40

Sl. No.	Substation Name	State	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
10	400kV Padghe	Maharashtra	All	44	40
11	400kV Aurangabad-II	Maharashtra	All	56	40
12	400kV Aurangabad-III	Maharashtra	All	53	40
13	400kV Vikhroli	Maharashtra	3,6,9	45	40
14	400kV Nasik	Maharashtra	All	50	40

Following Generator buses exceeding the substation design fault level by more than 5% under different scenarios are mentioned at Table 5-13 below:

Table 5-13: Generator Buses Exceeding Designed Fault Level in WR

Sl. No.	Substation Name	State	Scenario No.	Highest Fault level (kA)	Designed Rating (kA)
1.	400kV Jindal Ext	Chhattisgarh	2,3,5,6,7,8,9	45	40
2.	400kV Gandhar	Gujarat	All	50	40
3.	400kV Mundra APL	Gujarat	8,9	43	40
4.	400kV CGPL	Gujarat	All	48	40
5.	400kV TAPS	Maharashtra	All	48	40
6.	400kV Chandrapur Ext	Maharashtra	2,3,5,6,7,8,9	47	40

With respect to high fault levels at C'pur-I/C'pur-II/A'bad-I/A'bad-II/A'bad-III, high fault levels are seen at the above MSETCL substations primarily because of very short lines between C'pur-I & C'pur-II and between A'bad-I, A'bad-II & A'bad-III and presence of generators in close proximity. In this regard, MSETCL has planned Jalna S/s through LILO of A'bad-II - A'bad-III 400kV D/c line which will reduce the SC levels at Aurangabad complex.

STUs shall check ratings of breakers at above substations and possibility of upgradation of equipments from 40kA to 50kA (in earlier cases, several old equipments were already found to be rated to 50kA). Otherwise, STUs may explore possibility of reducing fault levels at above substations through suitable splitting / bypassing arrangement with or without series bus / line reactors.

Further, w.r.t. Sankhari high fault level, GETCO has informed that the existing equipment's are having rating of STC is 40kA for 3 seconds. The equipment thermal withstand capacity calculation is as below:

- Existing Equipment: STC 40 KA 3 Sec: $I^2t = 4800$

- Revised STC: STC 63 KA 1 Sec: $I^2t = 3969$

From above, I^2t for 3-sec duration as per existing equipment rating is much higher than STC with 1-sec rating equipment's. With the advanced numerical relays, most of all faults are cleared within 1 second time for which our existing equipment's stand safe against even higher fault level. In this context, equipment's rating at 400kV Sankhari substation are having rating of 40kA for 3 seconds which can withstand upto 63kA for 1 second.

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'25

As on Jan, 2025 total Installed Capacity (IC) of Southern Region was about 134 GW and the peak demand was about 65 GW. Southern Region has touched the maximum export of about 9 GW and maximum import of about 22 GW. The state-wise breakup of installed capacity and peak demand is summarised at **Table 6-1**.

Table 6-1: SR Installed Capacity and Peak Demand as on Jan'25

(All Fig in GW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total		
Andhra Pradesh	12.3	3.8	16.1	0.1	1.7	9.6	11.4	27.5	13.7
Telangana	11.7	0.8	12.5	0.1	2.5	5.3	7.9	20.4	15.6
Karnataka	10.5	0.0	10.5	0.7	3.6	19.3	23.7	34.1	17.7
Kerala	2.7	0.5	3.3	0.4	1.9	1.7	4.0	7.2	5.6
Tamil Nadu	15	1.0	16.0	1.4	2.2	22.2	25.8	41.8	20.8
NLC and Lakshadweep	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Pudducherry	0.3	0.0	0.3	0.1	0.0	0.1	0.1	0.4	0.5
Central unallocated	2.1	0.0	2.1	0.5	0.0	0.0	0.5	2.6	0.0
SR	**54.6**	**6.3**	**60.8**	**3.3**	**11.9**	**58.1**	**73.3**	**134.1**	**67.0**

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 134 GW is 73.3 GW i.e. 54.7% of total IC. This share would further increase in envisaged scenario of 2029-30 timeframe.

6.2 Envisaged Power Supply Scenario by 2029-30

As per the 20th EPS, Southern Region demand for 2029-30 timeframe is expected to increase to about 97 GW. As per the inputs received from various stakeholders, total installed capacity of Southern Region for 2029-30 is expected to be about 229 GW. The state wise bifurcation of installed capacity and peak demand is summarized at **Table 6-2.**

Table 6-2: SR Installed Capacity and peak demand (2029-30)

(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	0.0	2.9	8.4	11.3	1.4	19.9	22.1
Telangana	9.2	0.0	9.2	0.0	2.5	2.8	5.2	0	14.5	24.2
Karnataka	7.7	0.4	8.1	0.0	4.3	33.4	37.7	0.0	45.8	20.3
Kerala	0.0	0.4	0.4	0.0	2.4	0.5	2.8	0.0	3.2	6.4
Tamil Nadu	10.5	0.6	11.0	0.0	1.9	25.4	27.4	1.9	40.3	25.8
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	5.8	0.0	0.0	5.8	0.0	21.1	
IPP	4.8	0.0	4.8	0.0	0.0	91.4	91.4	5.1	101.3	
SR	**54.5**	**1.5**	**56.0**	**5.8**	**14.0**	**161.8**	**181.6**	**8.3**	**246**	**97.4**

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 54.7% to 72%.

Compound annual growth rate in peak demand of Southern Region from present timeframe to 2029-30 is around 8.5 %. The state wise peak demand growth is given at Table 6-3.

Table 6-3: Increase in Peak Demand of Various States of SR

(All Fig in MW)

Peak Demand (MW)				
State	**Present**	**2029-30**	**Difference**	**% CAGR**
Andhra Pradesh	12027	22091	10064	12.9%
Telangana	15205	24215	9010	9.8%
Karnataka	17709	20254	2545	2.7%
Kerala	4505	6431	1926	7.4%
Tamil Nadu	17036	25764	8728	8.6%
Puducherry	424	624	200	8.0%
SR	**64861**	**97440**	**32579**	**8.5%**

6.3 Load Generation Balance for 2029-30 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 Southern Region Load Generation Balance (LGB) for 2029-30 timeframe. 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 dispatch factors as mentioned at **Table 6-4** 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%	0%	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 6-5.**

Table 6-5: Surplus/ Deficit of Southern Region

All Fig in (MW)

State / UTs	Import / Export of Southern Region								
Scenario No / Corridors	Aug'28 Timeframe			Jun'28 Timeframe			Feb'29 Timeframe		
	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-SR	-367	-896	-670	-2376	-567	383	2227	2655	3216
WR-SR	-5258	-13678	-5319	-15922	-14365	-7892	4321	-391	10150
Southern Region	5625	14574	5989	18298	14932	7509	-6548	-2264	-13366

Out of these nine scenarios, Scenario-4 and Scenario-9 corresponds to two extreme cases with respect to export/import i.e. highest export (18 GW) and highest import (13 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 18 GW and deficit to the extent of about 13 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 22 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 Feb/Mar'24 to Feb'25

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Southern Region (CMETS-SR) from Feb/Mar 2024 to Feb 2025. Brief of all such deliberated transmission schemes are tabulated at **Table 6-5**.

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

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Type of scheme	Quantum (MW)	Tentative Cost (in Cr.)
Inter-regional					
1.	Inter-Regional Strengthening between SR Grid and ER Grid	2027-28	SS	-	2710
2.	Inter-Regional Strengthening between SR Grid and WR Grid	2027-28	SS	-	1007
Karnataka					
1.	Transmission system for integration of additional RE capacity in Davanagere and Bellary REZ	2027-28	RE	4000	1128
2.	Transmission system for proposed Green Hydrogen / Green Ammonia projects in Mangalore area	2027-28	GH	2250	2982
3.	Transmission System for integration of additional RE capacity at Tumkur-II REZ	2027-28	RE	3000	1194
4.	Augmentation of transformation capacity by 3x500 MVA, 400/220kV ICTs (6th - 8th) and 1x1500 MVA,765/400kV ICT (4th) at Bidar PS	2027-28	RE	1500	288

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Type of scheme	Quantum (MW)	Tentative Cost (in Cr.)
5.	Augmentation of transformation capacity by 2x500 MVA (9th & 10th), 400/220kV ICTs at Tumkur (Pavagada) 400/220kV Pooling Station in Karnataka	2027-28	RE	1500	251
6.	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Bidadi S/s in Karnataka	2026-27	SS	-	56
7.	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s in Karnataka	2026-27	SS	-	52
8.	Implementation of 3 nos. of 220kV line bays at Tumkur (Pavagada) PS for providing Connectivity to various RE generation projects	2026-27	RE	-	16.32
9.	Augmentation of transformation capacity by 2x500 MVA, 400/220kV ICTs (9th & 10th) & 1x1500 MVA, 765/400kV ICT (5th) and implementation of line bays at Bidar PS for providing Connectivity to various RE generation projects	2027-28	RE	1500	251
Andhra Pradesh					
1.	Transmission Scheme for integration of Kurnool-IV Phase-I (4.5 GW)	2026-27	RE	4500	5550
2.	Transmission Scheme for integration of Anantapur-II Phase-I REZ (4.5 GW)	2026-27	RE	4500	4679
3.	Transmission Scheme for integration of Kurnool-IV Phase-II (3 GW)	2027-28	RE	3000	3235
4.	Transmission Scheme for integration of Anantapur-II Phase-II REZ (3 GW)	2027-28	RE	3000	3339
5.	Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects	2025-26	RE	-	46
6.	Additional system strengthening at Kurnool-III	2027-28	RE	4500	2886
7.	Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area (Phase-I)	2027-28	GH	3000	1618
8.	Conversion of 80 MVAr FLR to SLR on Vijayawada – Nellore 400kV D/c line (Line-2) at Nellore as per 44th SRPC and 42nd TCC	2025-26	SS	-	3.5
9.	Augmentation of transformation capacity with 400/220kV, 1x500 MVA ICT (4th) at Nagarjunasagar 400/220kV substation	2027-28	SS	-	50
Tamil Nadu					
1.	Transmission system for 5 GW Off Shore wind farms in Tamil Nadu Ph-I (0.5 GW)	2029-30	RE	500	6269
2.	Transmission system for proposed Green Hydrogen / Green Ammonia projects in Tuticorin area	2027-28	GH	3000	3098
3.	Implementation of 1 nos. of 230kV line bay at Karur 400/230kV PS for integration of RE generation project (M/s Nannai Solar Park Private Ltd.)	2025-26	RE	-	6
4.	Augmentation / replacement of existing 400/230kV, 315 MVA ICT-2 with 1x500 MVA ICT at Udumalpet 400/230kV S/s	2026-27	SS	-	31
5.	Augmentation of 1x500 MVA, 400/230 kV ICT (7th) at Tuticorin-II GIS in Tamil Nadu	2026-27	RE	500	101.5
Kerala					
1.	Augmentation of transformation capacity at various ISTS substations in Kerala	2026-27	SS	-	96

**RE – Renewable Energy; SS- System Strengthening; GH – Green Hydrogen;*

Details of the schemes are reproduced below state-wise:

6.4.1 Inter-regional

(i) Inter-Regional links between NEW-Grid & SR-Grid

As per the mandate in the 50th SRPC meeting held on 16.03.2024, Joint Studies were conducted from 2 - 4th May, 2024 at Hyderabad for identification of Inter-Regional links between NEW-Grid & SR-Grid and ISTS network strengthening in SR to facilitate import of additional power for meeting demand by 2029-30 timeframe. The proposals agreed during the Joint Study meeting were submitted to SRPC which were deliberated in the 52nd SRPC meeting held on 03.08.2024 wherein it was decided that the shortest link(s) may be implemented at the earliest. Accordingly, it was agreed 765 kV Parli New (WR) - Bidar D/c link and 765 kV Angul (ER) - Srikakulam 2nd D/c link may be taken-up.

Transmission schemes were discussed in the 34th CMETS-SR held on 24.09.2024 wherein after detailed deliberations, following transmission schemes were agreed and it was decided that same shall be submitted to SRPC for views.

Scheme-1 : Inter-Regional Strengthening between SR Grid and ER Grid

- Angul – Srikakulam 765 kV D/c line (about 275 km)

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Angul – Srikakulam 765 kV 2nd D/c line (about 275 km) with 240 MVAR SLR at both ends on both circuits	~ 275 km • 765kV line bays – 2 nos. GIS (at Srikakulam) • 765kV line bays – 2 nos. AIS (at Angul) • 765 kV, 240 MVAr SLR at Srikakulam – 2 nos. (6x80 MVAr switchable units) • 765 kV, 240 MVAr SLR at Angul – 2 nos. (6x80 MVAr switchable units)
2.	1x330 MVAR, 765kV bus reactor (3rd) at Angul Substation	• 765kV bus reactor – 1 no. (3x110 MVAr switchable units) • 765kV bus reactor bay – 1 no.

Implementation Timeframe: 24 months

Estimated Cost: ₹2580 Crs.

Scheme-2 : Inter-Regional Strengthening between SR Grid and WR Grid

- Parli New – Bidar 765kV D/c line (about 120 km)

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1	Parli New – Bidar 765kV D/c line (about 120 km) with 240 MVAR SLR at Bidar end on both circuits	~ 120 km • 765kV line bays – 2 nos. (at Bidar PS) • 765kV line bays – 2 nos. (at Parli New) • 765 kV, 240 MVAr SLR at Bidar PS – 2 nos. (6x80 MVAr switchable units) (*1x80 MVAr spare switchable unit at Bidar PS is already under implementation and same may be used as spare)

Implementation Timeframe: 24months

Estimated Cost: ₹1007 Crs.

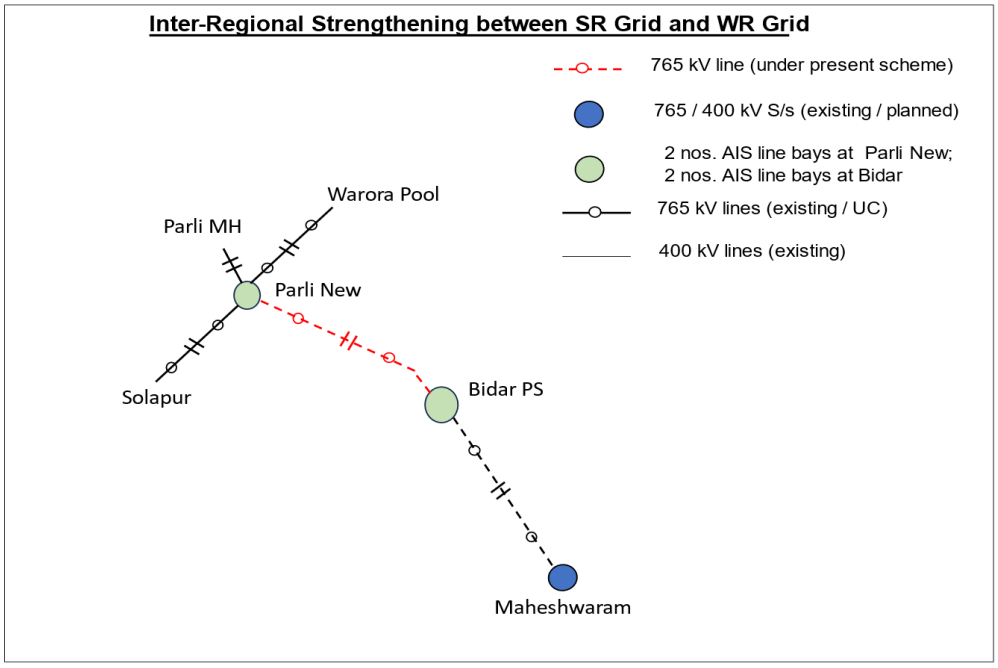


Figure 6-1 : Inter-Regional Strengthening between SR Grid and WR Grid

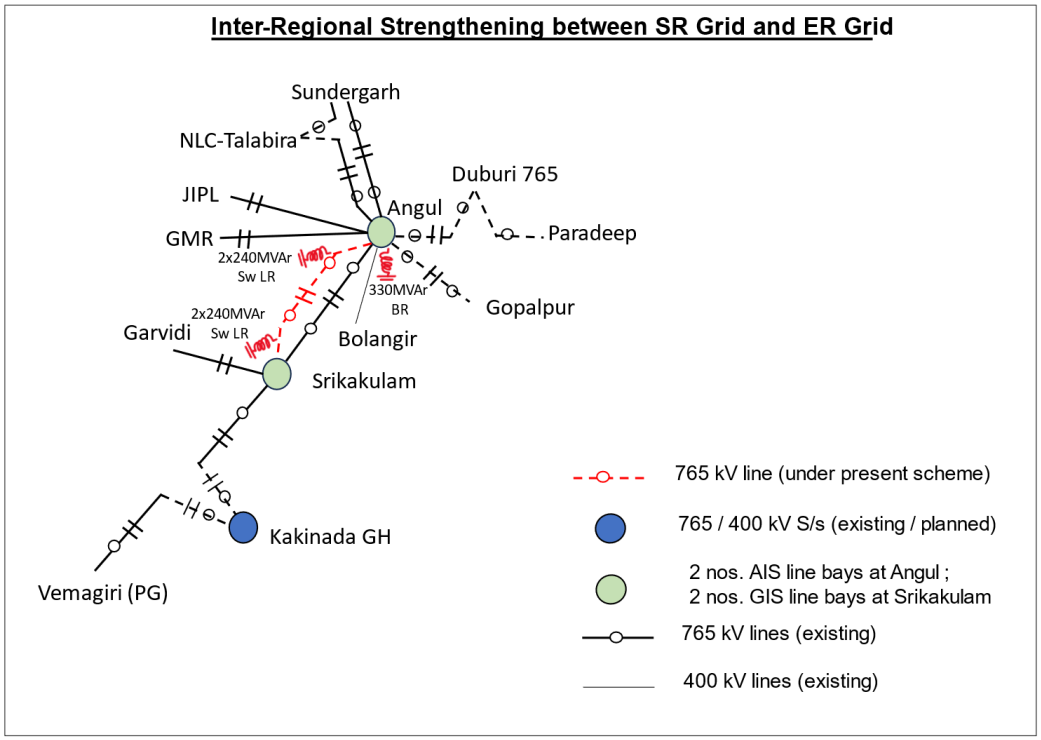


Figure 6-2 : Inter-Regional Strengthening between SR Grid and ER Grid

The above schemes have been forwarded to SRPC views on 16.01.2025 and 17.01.2025 respectively. The schemes were also agreed in the special SRPC meeting held on 04.02.2025. The schemes shall be taken-up in upcoming NCT.

6.4.2 Karnataka

(i) <u>Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s in Karnataka</u>

Presently, 2x500 MVA, 400/220kV are existing at Yelahanka GIS. KPTCL vide letter dated 28.03.2024 has communicated that residential load of about 250 MW is coming up at Dr. Shivaram Karanath BDA layout near Ganigarahalli in Bengaluru. KPTCL is proposing to establish a new 220kV substation in that area by interconnecting with Yelahanka 400/220kV GIS S/s through 1200sqmm UG cable for meeting the demand. Keeping in view of the upcoming 250 MW load, KPTCL opined that additional 1x500 MVA, 400/220kV ICT (3rd) at Yelahanka GIS is required considering the N-1 contingency criteria. Accordingly, they had requested for augmentation of 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s. Accordingly, augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s was discussed and agreed in the 32nd CMETS-SR held on 28.06.2024. Transmission scheme is under implementation by PGCIL and is expected by Jul'26. Schematic is given at **Figure 6-3**

Details of the scheme are as follows :

Sl. No.	Scope of the Transmission Scheme	Item Description
1.	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s	• 1x500 MVA, 400/220 kV ICT • 400kV ICT bay- 1 No. (GIS) • 220kV ICT bay- 1 No. • 400kV GIS Bus duct (1 Ph.) – ~100 meters

Estimated Cost: ₹52 Crs.

Implementation Timeframe: 21 months from the date of issue of OM by CTUIL

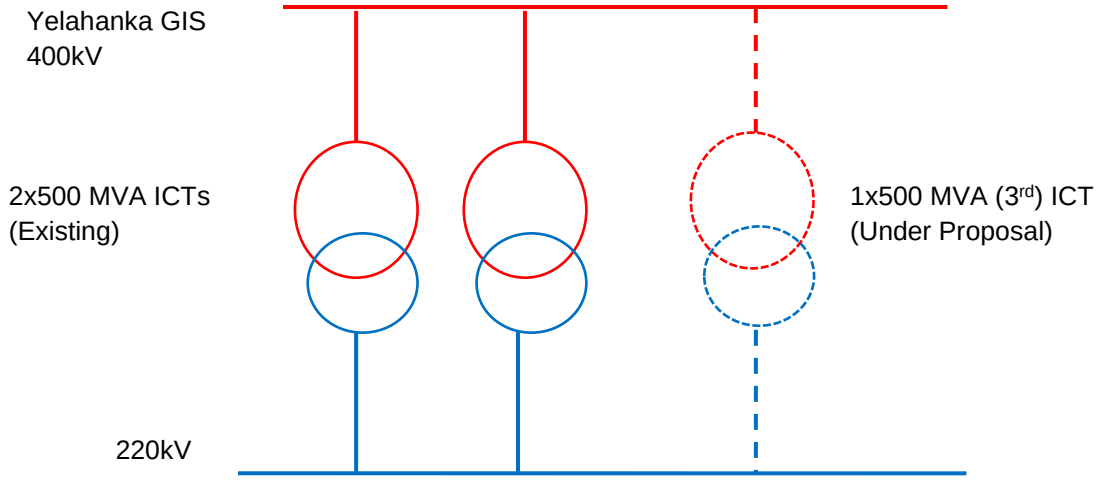


Figure 6-3 : Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s in Karnataka

(ii) <u>Augmentation of transformation capacity by 2x500 MVA (9th & 10th), 400/220kV ICTs at Tumkur (Pavagada) 400/220kV Pooling Station in Karnataka and Implementation of 1 nos. of 220kV line bay at Tumkur (Pavagada) 400/220kV PS for providing Connectivity to RE generation project</u>

Presently, Tumkur (Pavagada) PS is under operation with 6x500 MVA, 400/220kV ICTs and 2x500 MVA (7th & 8th), 400/220kV ICTs at Tumkur (Pavagada) are under implementation and expected by Aug'25. The Connectivity of 3350 MW has been granted to RE projects at Tumkur (Pavagada) PS.

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 with start date as 30.06.2026. The same was also agreed in the 28th CMETS-SR held on 29.02.2024. Further, M/s KSPDCL has submitted application for enhancement of Connectivity for 300 MW at Tumkur (Pavagada) PS (from under operation 2050 MW solar project to 2350 MW) as Renewable Power Park

Developer which was discussed in the 26th CMETS-SR held on 29.12.2023. During the meeting, it was decided that due to non-availability of margins for grant of additional connectivity at Tumkur (Pavagada) PS, the connectivity has been granted at Tumkur-II PS.

In 26th CMETS-SR, KSPDCL mentioned that they have taken initiatives towards acquisition of land for augmentation of Tumkur (Pavagada) PS and requested for grant of connectivity for 300 MW at Tumkur (Pavagada PS) instead of Tumkur-II PS. CTU informed that at present, for grant of connectivity, there is no margin in existing Tumkur (Pavagada) PS. After getting confirmation towards land acquisition and possibility of Tumkur (Pavagada) PS augmentation, the same shall be considered for grant of connectivity. KSPDCL vide letter dated 31.05.2024 informed that they have initiated few actions subsequent to the 26th CMETS-SR meeting viz. identification of land required for proposed expansion and fixation of land rate by Deputy Commissioner, consent from the farmers to sell the land etc.

Accordingly, as land is available for expansion of the pooling station and for optimal utilization of the transmission system, augmentation of transformation capacity by 2x500 MVA (9th & 10th), 400/220kV ICTs at Tumkur (Pavagada) 400/220kV Pooling Station in Karnataka was discussed and agreed in the 32nd CMETS-SR held on 28.06.2024. The scheme was discussed and agreed for implementation under RTM route with implementation schedule of 21 months in the 21st NCT held on 06.08.2024. Transmission scheme is under implementation by PGCIL and is expected by May'26. Schematic is given at **Figure 6-4** .The details of the scheme is as below:

Sl. No.	***Scope of the Transmission Scheme***	***Capacity /km***	***Schedule***
1	Augmentation of transformation capacity by 2x500 MVA (9^{th} & 10^{th}), 400/220kV ICTs at Tumkur (Pavagada) 400/220kV Pooling Station	• 2x500 MVA, 400/220kV ICTs • 400kV ICT bay – 2 Nos. • 220kV ICT bay – 2 Nos.	21 months
2	Additional land of about 100 m (width) x 540 m (length) on right side of the Tumkur (Pavagada) PS for expansion of Tumkur (Pavagada) PS with 2 nos. of additional 500 MVA ICTs & 220 kV line bays	The total land of about 13 Acres 22 Guntas is required for the proposed expansion and land rate has been fixed by the Deputy Commissioner at Rs. 2.62 Cr. (Rs. 19.35 L per Acre) as communicated by KSPDCL vide letter dated 31.05.2024	
3	Implementation of 1 nos. of 220kV line bay at Tumkur(Pavagada) 400/220kV PS for providing Connectivity to RE generation project	1 no. 220kV line bay at Tumkur(Pavagada) 400/220kV PS for termination of dedicated line of M/s TEQ Green Power XVIII Pvt. Ltd.	30.06.26

Estimated Cost: ₹118 Crs.

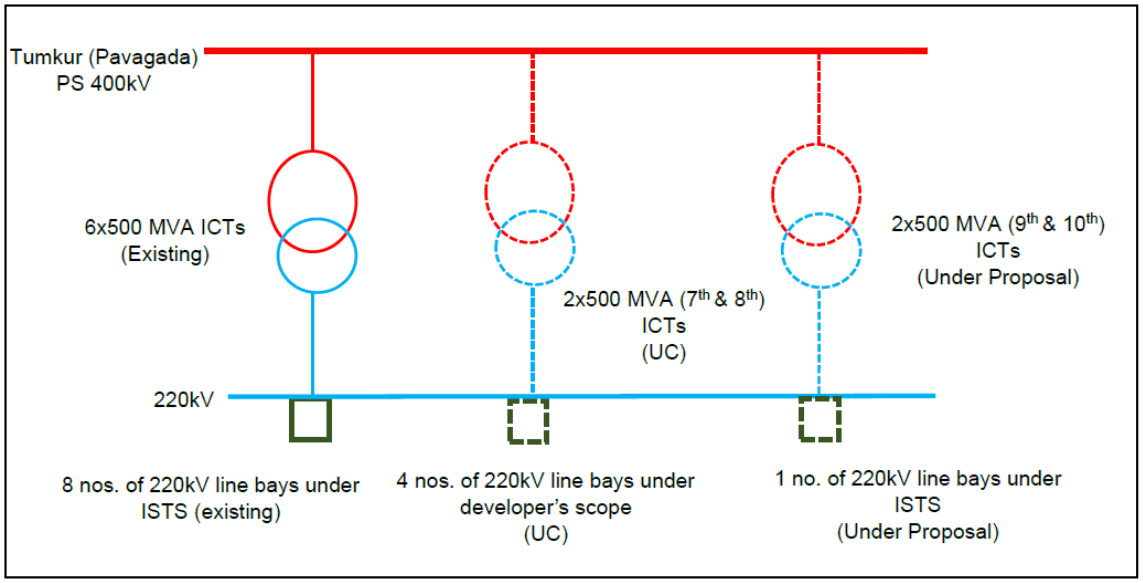


Figure 6-4: Augmentation of transformation capacity by 2x500 MVA (9th & 10th), 400/220kV ICTs at Tumkur (Pavagada) 400/220kV Pooling Station in Karnataka and Implementation of 1 nos. of 220kV line bay at Tumkur (Pavagada) 400/220kV PS

(iii) Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Bidadi S/s in Karnataka

During the 213th OCC meeting of SRPC held on 10.04.2024 requirement of additional ICT at Bidadi S/s due to continuous overloading / N-1 violation of existing ICTs was discussed. During the meeting it was opined that KPTCL have to plan / augment the downstream network to match the power evacuation. The matter was also deliberated during the 216th OCC meeting of SRPC held on 10.07.2024, wherein it was decided that matter may be taken up in the next CMETS-SR meeting for deliberations. Schematic is given at **Figure 6-5**

Accordingly, augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Bidadi S/s in Karnataka was discussed and agreed in the 33rd CMETS-SR held on 25.07.2024. Transmission scheme is under implementation by PGCIL and is expected by Jul'26. The details of the scheme is as below:

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe.
1.	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Bidadi 400/220kV GIS S/s	• 1x500 MVA, 400/220 kV ICT • 400kV ICT bay- 1 No. (GIS) • 220kV ICT bay- 1 No. • 220kV single Phase GIS Bus duct – ~ 120 meters • 400kV single Phase GIS Bus duct – ~ 80 meters • 220kV GIS hall to be extended for installation of 220kV GIS bay	21 months from the date of issue of OM by CTUIL

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe.
		module under present scope.	

Total Estimated Cost: ₹56 Crs.

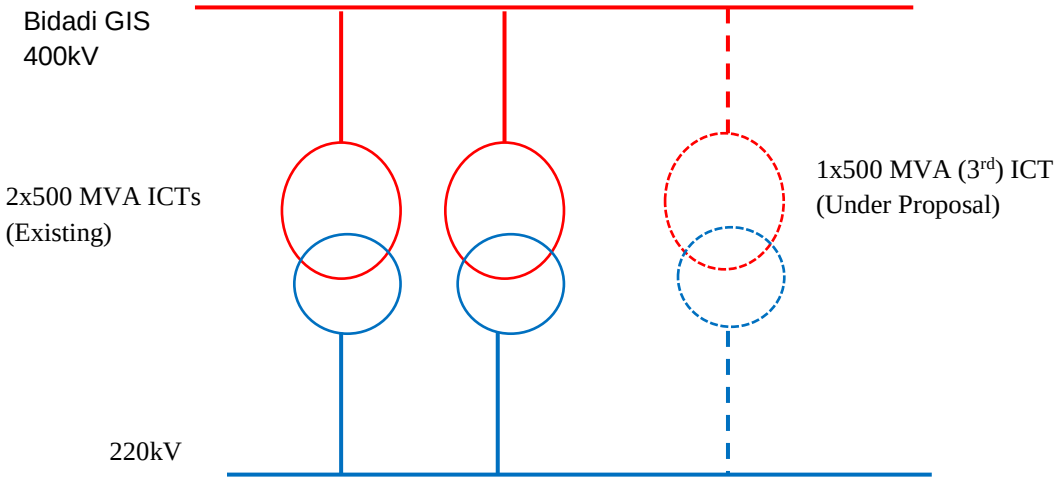


Figure 6-5 : Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Bidadi S/s in Karnataka

(iv) <u>Augmentation of transformation capacity by 3x500 MVA, 400/220kV ICTs (6th - 8th) and 1x1500 MVA,765/400kV ICT (4th) at Bidar PS</u>

CTU informed that Bidar PS is being established with 3x1500 MVA, 765/400kV and 5x500 MVA, 400/220 kV ICTs as part of 'Transmission Scheme for Solar Energy Zone in Bidar (2500 MW), Karnataka'. The transmission scheme is under implementation and expected by 09.02.2026. Total Connectivity already granted / agreed for grant at Bidar PS is 2500 MW. Therefore, in 32nd CMETS-SR, held on 28.06.2024, CTU informed that for grant of Connectivity, augmentation of 1x500 MVA, 400/220 kV (6th) ICT is required and same was agreed. Subsequently, applications for additional connectivity corresponding to 600 MW capacity has been received upto June 2024. Therefore, total connectivity granted / agreed for grant / under consideration shall be 3100 MW. Accordingly, for grant of connectivity (considering N-1 contingency criteria) total 8x500 MVA, 400/220kV and 4x1500 765/400kV ICTs shall be required at Bidar PS.

Accordingly, augmentation of transformation capacity by 3x500 MVA, 400/220 kV ICTs (6th – 8th) and 1x1500 765/400kV ICT (4th) at Bidar PS in Karnataka was discussed and agreed in the 33rd CMETS-SR held on 25.07.2024. Transmission scheme was agreed in the 22nd NCT held on 23.08.2024. Transmission scheme is under implementation under TBCB route by PGCIL and is expected by Feb'26. Schematic is given at Figure 6-6

The details of the scheme is as below:

Package	Scope of the Transmission Scheme	Capacity /km	Schedule	Est. Cost (crs.)
A	Augmentation of transformation capacity of 1x1500 MVA (4th), 765/400kV ICT at Bidar PS	• 1x1500 MVA, 765/400kV ICT • 765kV ICT bay – 1 No. • 400kV ICT bay – 1 No.	24 months	276
	Augmentation of transformation capacity by 3x500 MVA, 400/220kV ICTs (6th – 8 th) at Bidar PS	• 3x500 MVA, 400/220kV ICTs • 400kV ICT bay – 3 Nos. • 220kV ICT bay – 3 Nos		
B	1 no. of 220kV line bay at Bidar PS for termination of dedicated transmission lines of M/s Quest Hybren Pvt. Ltd	• 220kV line bay – 1 No..	30.06.27	12
	1 no. of 220kV line bay at Bidar PS for termination of dedicated transmission lines of M/s Pulse Hybren Pvt. Ltd	• 220kV line bay – 1 No.		

Estimated Cost: ₹288 Crs.

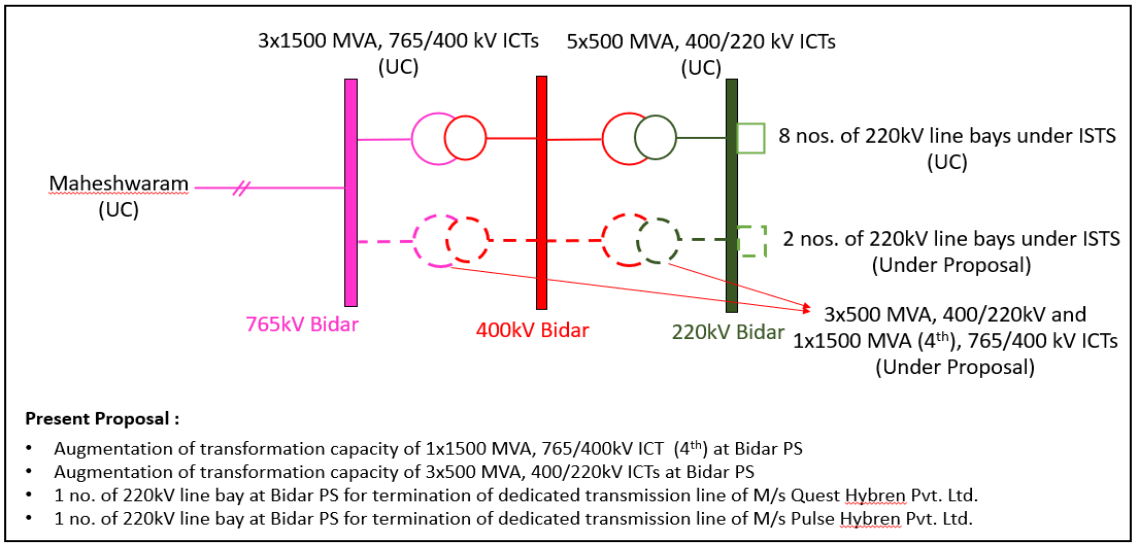


Figure 6-6 : Augmentation of transformation capacity by 3x500 MVA, 400/220kV ICTs (6th - 8th) and 1x1500 MVA,765/400kV ICT (4th) at Bidar PS

(v) Transmission system strengthening at Davanagere and Bellary for integration of additional RE generation beyond identified potential

Following transmission system was agreed and in under implementation for integration of Davanagere / Chitradurga and Bellary REZ:

Transmission system for integration of Davanagere/ Chitradurga REZ

- Establishment of 765/400kV 4x1500 MVA, 400/220kV 4x500 MVA Pooling Station near Davanagere / Chitradurga, Karnataka

- Augmentation of transformation capacity by 4x500 MVA, 400/220 kV ICTs (5th - 8th) at Davangere PS
- LILO of Narendra New – Madhugiri 765kV D/c line at Davanagere / Chitradurga 765/400kV PS (~40 km)
- Upgradation of Narendra New – Madhugiri 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level
- Upgradation of Madhugiri {Tumkur(Vasantnarsapura)} to its rated voltage of 765kV level along with 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors

Transmission system for integration of Bellary REZ

- Establishment of 4x500 MVA, 400/220kV Pooling Station near Bellary area
- Bellary PS – Davanagere / Chitradurga 400kV (Quad ACSR moose) D/c line

As per the CEA 500 GW report, potential of 17 GW was identified and accordingly based on the potential, transmission system was identified for grant of connectivity to various RE developers at potential RE zones. However, it is observed that a large number of application have been received which are over and above the potential declared by SECI/MNRE in these RE zones. Moreover, application for BESS capacity as per the report has not been received. Details of the potential, evacuation capacity planned and connectivity applications received at various RE Polling station in Karnataka are as follows:

District	Potential (GW)		Total (GW)	Dispatch (90% S + 55% W)	BESS	Evacuation capacity to be planned (GW)	Connectivity applications received (GW)	Connectivity capacity beyond potential (GW)
	Wind	Solar						
Koppal-II	2	2	4	2.9	1	2	3.9	
Gadag-II	2	2	4	2.9	1	2	5.1	1.1
Davanagere	2	2	4	2.9	1	2	3.6	
Bellary		1.5	1.5	1.35		1.5	4.9	3.4
Bijapur	2		2	1.1		2	6	4
Tumkur		1.5	1.5	1.35		1.5	4.9	3.4
Total	**8**	**9**	**17**	**12.5**	**3**	**11**	**28.5**	**12**

From the above, it may be seen that applications for 8.5 GW has been received against the declared potential of 5.5 GW in Davangere/Bellary complex. In view of the above, considering the large quantum of application received at Davangere/Bellary complex, beyond identified Potential, transmission system augmentation is required for grant of connectivity to applications at Davangere/ Bellary. Further, under process applications at Davangere/Bellary PS were discussed in the 35th SR CMETS held on 29.10.02024 wherein it was decided that applications of 4000 MW shall be considered for grant of connectivity at Davangere PS and 3500 MW at Bellary PS. Further, additional

transmission system required for integration of additional capacity at Davangere/ Bellary PS shall be discussed in the Joint study meeting.

Accordingly, Joint Study meeting was conducted from 21st to 23rd Nov, 2024 at SRPC, Bengaluru. After detailed deliberations, following transmission system was agreed for integration of additional RE capacity in Davangere and Bellary REZ :

Transmission system for integration of additional RE capacity in Davanagere and Bellary REZ

- Augmentation of Davanagere / Chitradurga PS by 765/400kV, 2x1500 MVA ICTs and 400/220kV, 1x500 MVA ICT (additional 400/220kV, 4x500 MVA ICTs already approved in CMETS-SR)
- Augmentation of Bellary PS by 400/220kV, 4x500 MVA ICTs
- Bellary – Davanagare 2nd 400kV (Quad) D/c line

Accordingly, above transmission system was discussed in the 36th CMETS-SR held on 19.12.2024 wherein after detailed deliberations, Transmission system for integration of additional RE capacity in Davanagere and Bellary REZ was approved. The schemes were agreed in the special SRPC meeting held on 04.02.2025.

The transmission scheme was discussed in the 28th NCT meeting held on 06.03.2025 wherein it was decided that Transmission system for integration of additional RE capacity in Davanagere may be approved with 24 months implementation schedule and the Transmission system for integration of additional RE capacity in Bellary may be put-on hold. Schematic is given at **Figure 6-7**

Details of transmission scheme "Transmission system for integration of additional RE capacity in Davanagere" are as follows :

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1	Augmentation of transformation capacity by 4x500 MVA, 400/ 220 kV ICTs (5th – 8th) at Davanagere PS	• · 400/ 220 kV, 500 MVA, ICTs – 4 Nos. • · 400 kV ICT bays – 4 Nos. • · 220 kV ICT bays – 4 Nos.
2	Augmentation of Davanagere / Chitradurga PS by 765/400 kV, 2x1500 MVA ICTs	• 765/400 kV, 1500 MVA, ICTs – 2 Nos. • 765 kV ICT bays – 2 Nos. • 400 kV ICT bays – 2 Nos. • 400 kV Bus Sectionalizer: 1 set • 220 kV Bus Sectionalizer : 1 set • 220 kV Bus Coupler (BC) Bay – 2 No. • 220 kV Transfer Bus Coupler (TBC) Bay – 2 No.
3	2 Nos. of 220 kV line bays at Davanagere / Chitradurga PS for termination of dedicated transmission lines of RE generation projects.	• 220 kV line bays – 2 Nos.

Estimated Cost: ₹379 Crs.

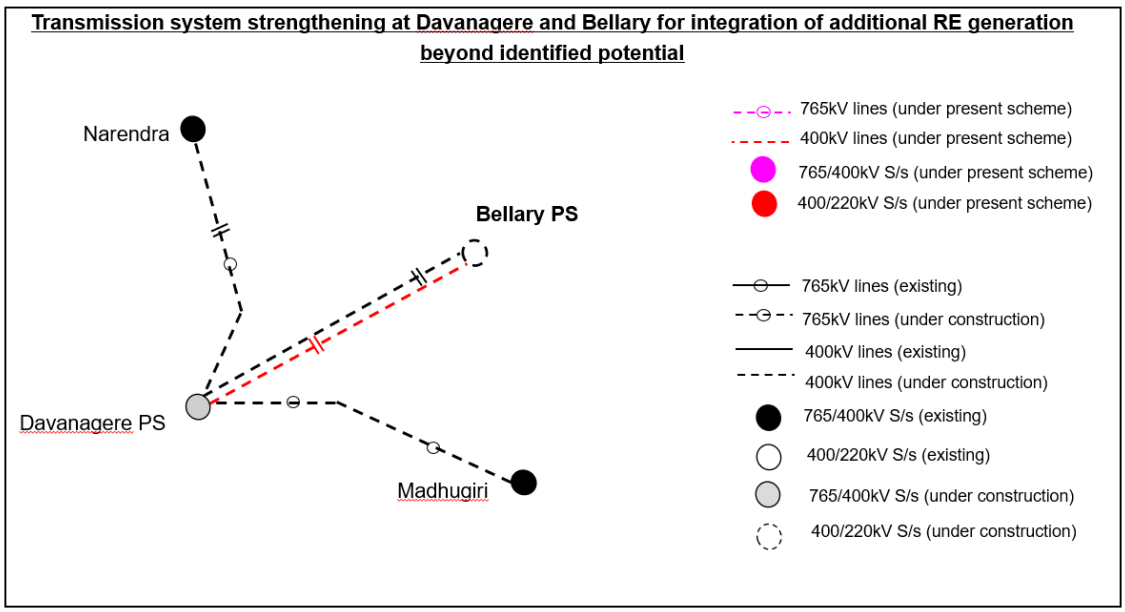


Figure 6-7 : Transmission system for integration of additional RE capacity in Davanagere and Bellary REZ

(vi) Transmission system for proposed Green Hydrogen / Green Ammonia projects in Mangalore area

During the Joint Study meeting held from 21st to 23rd Nov, 2024 at SRPC, Bengaluru, following transmission system was identified for supply of power to Green Hydrogen / Green Ammonia projects in Mangalore area. Same was discussed in the 36th CMETS meeting held on 19.12.2024 wherein it was decided that scheme may also be approved and may be taken-up for implementation under ISTS only upon receipt of GNA applications from Green Hydrogen / Green Ammonia developers. The above schemes has been forwarded to SRPC views on 28.01.2025. The schemes were agreed in the special SRPC meeting held on 04.02.2025. Subsequently, transmission system was discussed in the 28th NCT meeting held on 06.03.2025 wherein NCT noted the proposal but decided to take it up for further discussions based on the GNA applications/visibility. Schematic is given at **Figure 6-8**

Details of transmission scheme are as follows:

Transmission system for proposed Green Hydrogen / Green Ammonia projects in Mangalore area

- Establishment of 3x1500 MVA, 765/400kV GH S/s near Mangalore with space provision for establishment of 220kV switchyard
- Davanagare – Mangalore GH 765kV D/c line

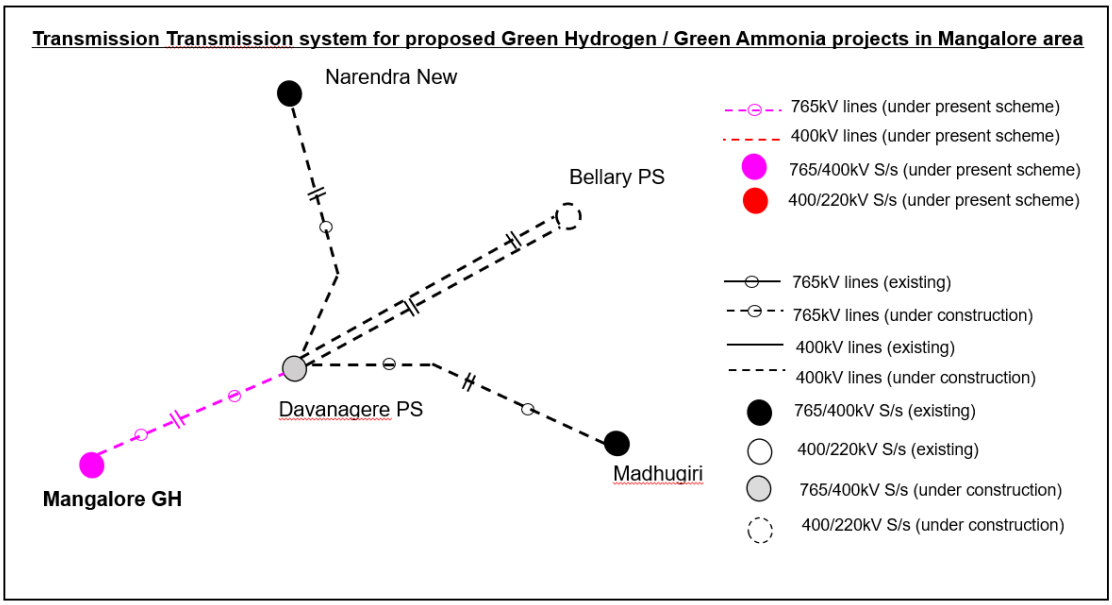


Figure 6-8 : Transmission system for proposed Green Hydrogen / Green Ammonia projects in Mangalore area

(vii) Transmission System for integration of additional RE capacity at Tumkur-II REZ

Transmission System for integration of Tumkur-II REZ is under implementation with SCOD as 03.09.2026. Details of the transmission system is as below:

- Establishment of 400/220 kV 4x500 MVA Pooling Station near Tumkur, Karnataka
- Tumkur-II – Tumkur (Pavagada) 400 kV (Quad ACSR moose) D/c line.

Connectivity of 2400 MW has already been granted / agreed for grant at Tumkur-II PS. However, in the reallocation meeting held on 22.10.2024 at CTUIL office, regarding shifting of connectivity from Tumkur-II PS to Tumkur PS, applicants have agreed to shift the connectivity corresponding to 800 MW from Tumkur-II PS to Tumkur PS. As power is being evacuated from Tumkur-II PS through Tumkur-II PS – Tumkur (Pavagada) PS 400 kV D/c (quad) line. Therefore, under N-1 contingency conditions, maximum power corresponding to 2000 MW can be evacuated. In view of above, margin for 400 MW is available at Tumkur-II PS for grant of connectivity. Further, in addition to above after augmentation of 2x500 MVA, 400/220 kV (9th - 10th) ICTs at Tumkur (Pavagada) PS and shifting of connectivity corresponding to 800 MW from Tumkur-II to Tumkur (Pavagada) PS, margins corresponding to 350 MW is available at Tumkur (Pavagada) PS.

In view of above, 700 MW of applications may be considered for grant of connectivity at Tumkur (Pavagada) PS / Tumkur-II PS. Further, for grant of connectivity to balance applications, additional system strengthening scheme beyond Tumkur-II PS is required. Transmission system for integration of additional RE capacity at Tumkur-II REZ was discussed in the Joint Study meeting conducted from 21st to 23rd Nov, 2024 at SRPC, Bengaluru.

Transmission system evolved in the Joint Studies was discussed in the 36th CMETS-SR held on 19.12.2024 wherein after detailed deliberations, following transmission system for integration of additional RE capacity at Tumkur-II was agreed:

Transmission System for integration of additional RE capacity at Tumkur-II REZ

- Augmentation of Tumkur-II PS by 400/220 kV, 6x500 MVA ICTs
- Tumkur-II – Madhugiri 400kV (Quad) D/c line (~100 km)
- + 300 MVAR STATCOM with switching arrangement of under implementation 2x125 MVAr bus reactors.

The scheme was agreed in the special SRPC meeting held on 04.02.2025. The transmission scheme was discussed in the 28th NCT meeting held on 06.03.2025 wherein it was decided that Transmission system for integration of additional RE capacity in Davanagere may be approved with 24 months implementation schedule and the Transmission system for integration of additional RE capacity in Bellary may be put-on hold. Schematic is given at **Figure 6-9.**

Details of transmission scheme are as follows:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1	Augmentation of Tumkur-II PS by 400/220 kV, 6x500 MVA ICTs (5th to 10th)	400/220kV, 500 MVA, ICTs – 6 nos. 400kV ICT bays – 6 nos. 220kV ICT bays – 6 nos. 220kV Bus Sectionalizer: 2 set 220 kV Bus Coupler (BC) Bay – 2 nos. 220 kV Transfer Bus Coupler (TBC) Bay – 2 nos.
2	Tumkur-II – Madhugiri 400kV (Quad) D/c line	~100 km 400kV line bays – 2 nos. (at Tumkur-II PS) 400kV line bays – 2 nos. (at Madhugiri)
3	± 300 MVAR STATCOM at Tumkur-II PS with switching arrangement of under implementation 2x125 MVAr bus reactors.	400 kV bay – 1 no

Estimated Cost: ₹1194 Crs.

Implementation Timeframe: 24 months

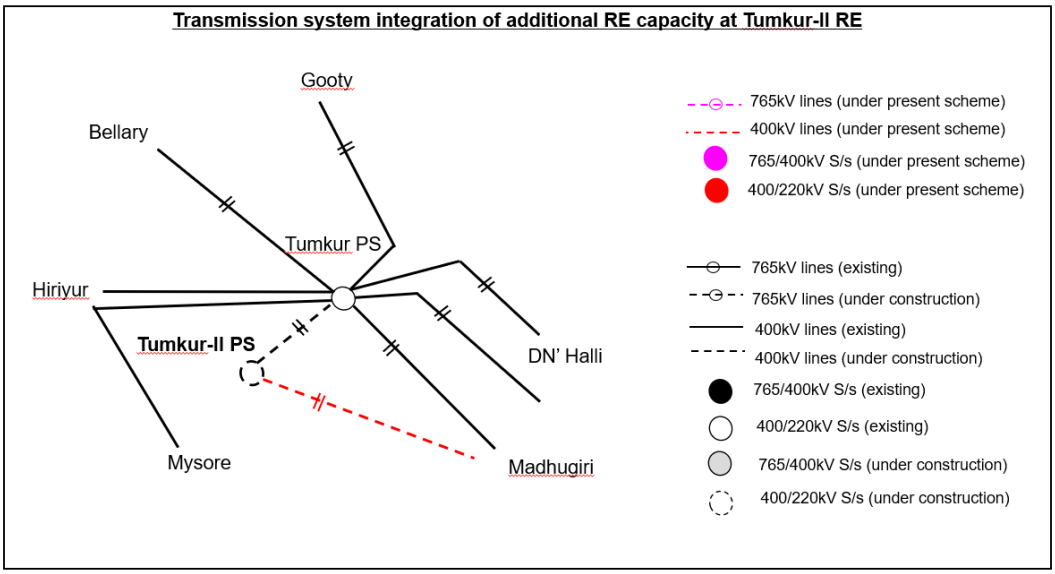


Figure 6-9: Transmission System for integration of additional RE capacity at Tumkur-II REZ

6.4.3 Andhra Pradesh

(i) <u>Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects</u>

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 has been granted at Ananthapuram to various RE generation projects. 12 nos. of 220kV line bays are already 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 bay at Ananthapuram PS under ISTS. The scheme was deliberated and agreed in the 28th CMETS-SR held on 29.02.2024. Schematic is given at Figure 6-10

Transmission scheme is under implementation and expected by Mar'26.

The details are as below:

Sl. No.	Description of Transmission Element	Scope of work	Schedule
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
2	1 no. of 400kV line bay at Ananthapuaram PS for Connectivity to M/s ABC Cleantech Pvt. Ltd.	400kV line bays – 1 Nos.	31.03.26

Estimated Cost: ₹46 Crs.

400kV bays at Ananthapuram for integration of RE generation projects

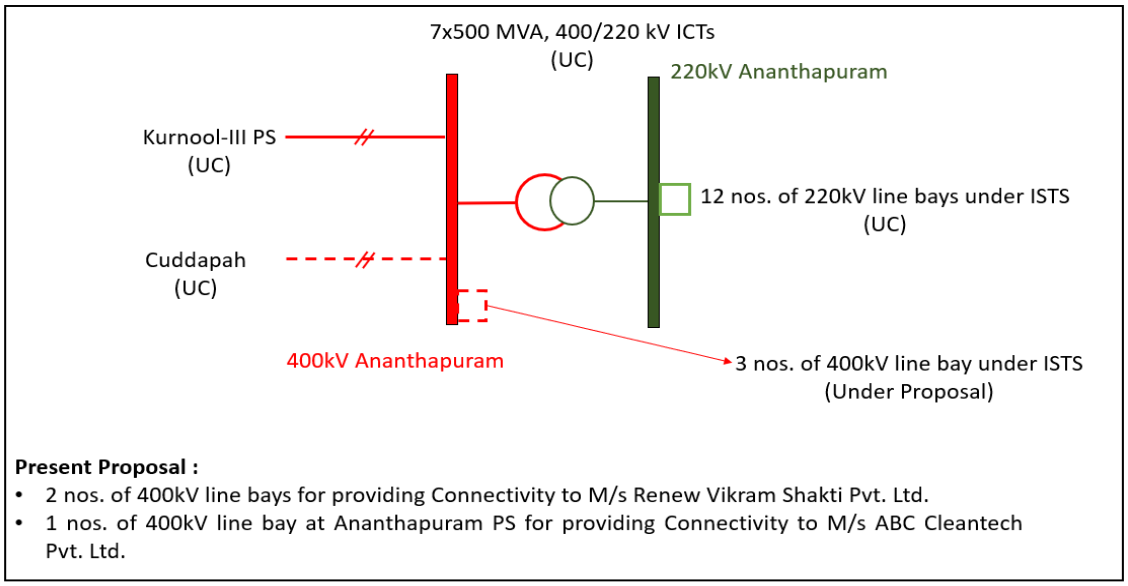


Figure 6-10 : Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects

Above transmission scheme viz., Implementation of 3 nos. of 400kV line bays at Ananthapuram PS for integration of RE generation projects has been allocated to POWERGRID under RTM vide CTU letter dated 22.03.2024.

(ii) <u>Transmission system strengthening at Kurnool-III PS for integration of additional RE generation projects</u>

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 became 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. CTU also received additional connectivity applications for 1650 MW (PSP: 1250 MW & Solar: 400 MW) at Kurnool-III PS 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).

Accordingly, the following transmission system was deliberated in the 28th CMETS-SR held on 29.02.2024 and 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 (about 260 km) with 240 MVAr switchable line reactors at both ends

CTU also received additional connectivity application for 260 MW at Kurnool-III PS in the month of Feb'24. Connectivity corresponding to 7740 MW have been granted / agreed for grant at Kurnool-III PS. However, for evacuation of additional power from Kurnool-III REZ and Ananthapuram REZ, 1x1500 MVA, 765/400 kV ICT (7th) is also required. Accordingly, augmentation of 1x1500 MVA 765/400kV ICT (7th) at Kurnool-III PS was proposed in the 29th CMETS-SR held on 28.03.2024. With this, the total connectivity quantum granted / agreed for grant at Kurnool-III PS shall be about of 8000 MW (2650 MW at 220kV level & 5350 MW at 400kV level).

The Connectivity have been granted for 600 MW to M/s Adani Renewable Energy Forty Two Ltd. for its PSP generation project at 400kV level with 2 nos. of 400kV line bays (under ISTS scope) for termination of its dedicated transmission line in the 23rd CMETS-SR held on 29.09.2023. Similarly, Connectivity have been granted for 3500 MW (800 MW & 3x900 MW) to M/s Indosol Solar Pvt. Ltd. for its Solar Power Park at 400kV level with 4 nos. of 400kV line bays (under ISTS scope) for termination of its dedicated transmission lines in the 26th CMETS-SR held on 29.12.2023. Similarly, Connectivity have been agreed for grant for 1250 MW to M/s Adani Renewable Energy Fifty One Ltd. for its PSP generation project at 400kV level with 2 nos. of 400kV line bays (under ISTS scope) for termination of its dedicated transmission lines in the 28th CMETS-SR held on 29.02.2024. Accordingly, total 8 nos. of 400kV line bays are required to developed under ISTS for termination of dedicated transmission lines from the above generation projects.

The scheme was deliberated in the 51st SRPC meeting held on 15.05.2024. SRPC vide letter dated 22.05.2024 has forwarded the views of Southern Region constituents. The scheme was discussed and agreed for implementation through TBCB route in the 20th NCT held on 25.06.2024. Transmission scheme under implementation and expected by Mar'27. Schematic is given at **Figure 6-11**

Details of transmission scheme are as follows:

Package	Scope of the Transmission Scheme	Capacity /km	Schedule	Est. Cost (₹ Crs.)
A	Augmentation of transformation capacity of 3x1500 MVA, 765/400kV ICTs at Kurnool-III PS	• 3x1500 MVA, 765/400kV ICT • 765kV ICT bay – 3 Nos. • 400kV ICT bay – 3 Nos. • 400kV Bus Sectionaliser – 1 Set	24 months	2650
	Kurnool-III PS – Chilakaluripeta 765 kV D/c line with 240 MVAr switchable line reactors at both ends	~ 260 km • 765kV line bays – 2 nos. (at Kurnool-III PS) • 765kV line bays – 2 nos. (at Chilakaluripeta) • 765 kV, 240 MVAr SLR at Kurnool-III PS – 2 nos. (6x80 MVAr units) • 765 kV, 240 MVAr SLR at Chilakaluripeta – 2 nos. (6x80 MVAr units)		
B	2 nos. of 400kV line bays at Kurnool-III PS for termination of dedicated transmission line of M/s Adani Renewable Energy Forty Two Ltd.	• 400kV line bays – 2 Nos.	30.06.26	110
	4 nos. of 400kV line bay at Kurnool-III PS for termination of dedicated transmission lines of M/s Indosol Solar Pvt. Ltd.	• 400kV line bays – 1 Nos.	24 months	
		• 400kV line bays – 1 Nos.	24 months	
		• 400kV line bays – 2 Nos.	31.03.27	
	2 nos. of 400kV line bays at Kurnool-III PS for termination of dedicated transmission line of M/s Adani Renewable Energy Fifty One Ltd.	• 400kV line bays – 2 Nos.	31.12.27	
C	Augmentation of 1x1500 MVA 765/400kV ICT (7^{th}) at Kurnool-III PS	• 1x1500 MVA, 765/400kV ICT • 765kV ICT bay – 1 Nos. • 400kV ICT bay – 1 Nos.	24 months	126

Estimated Cost : ₹2886 Crs.

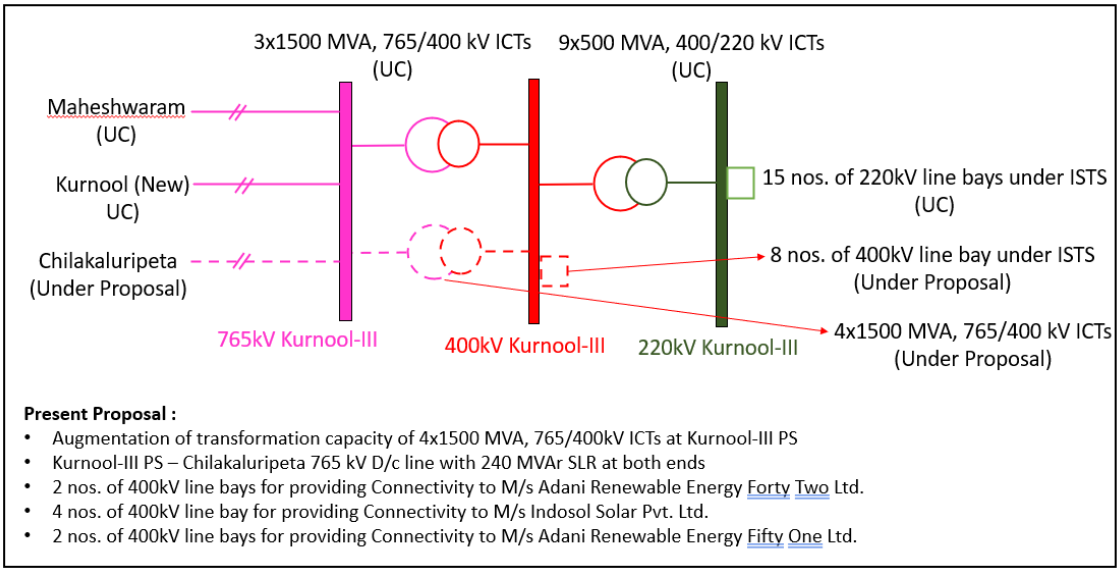


Figure 6-11 : Transmission system strengthening at Kurnool-III PS for integration of additional RE generation projects

(iii) Conversion of 80 MVAr FLR to SLR on Vijayawada – Nellore 400kV D/c line (Line-2) at Nellore as per 44th SRPC and 42nd TCC

POWERGRID vide letter dated 04.10.2023 informed that replacement of 50 MVAr line reactor at Nellore end on Vijayawada – Nellore 400kV D/c line (Line-2) with 80 MVAr under AddCap was approved in the 44th SRPC meeting held on 04.11.2022. Further, it was decided that line reactors would be made switchable for use of bus reactors wherever technically feasible / space available. Accordingly, POWERGRID requested that conversion of 80 MVAr fixed line reactor at Nellore end on Vijayawada – Nellore 400kV D/c line (Line-2) to switchable line reactor along with NGR and its bypassing scheme in the CMETS-SR meeting.

Accordingly, conversion of 80 MVAr fixed line reactor at Nellore end on Vijayawada – Nellore 400kV D/c line (Line-2) to switchable line reactor along with NGR and its bypassing scheme was agreed in the 32nd CMETS-SR held on 28.06.2024.

Scheme is under implementation and expected by Oct'26.

(iv) Augmentation of transformation capacity with 400/220kV, 1x500 MVA ICT (4th) at Nagarjunasagar 400/220kV substation

The proposal for augmentation of transformation capacity with 400/220kV, 1x500 MVA ICT (4th) at Nagarjunasagar 400/220kV substation was agreed in the Joint Study meeting of SR constituents held from 2nd to 4th May, 2024 at Hyderabad. During the Joint Study meeting, it was agreed that a joint site visit with participation from CTU, SRPC, POWERGRID, APTRANSCO and TGTRANSCO may be planned to explore the space availability for 220kV ICT bay at APTRANSCO switchyard along with interconnection with POWERGRID switchyard. Accordingly, for assessing space availability for 220kV

ICT bay at Nagarjunasagar, a joint site visit was held on 24th June, 2024 comprising officials from CEA, SRPC, POWERGRID, APTRANSCO and TGTRANSCO.

During the Joint study visit 2 options were identified and could not be finalized. After detailed deliberations, it was decided that the matter may be put up to the higher forum for further deliberations and finalization.

The proposal was deliberated in the 33rd CMETS-SR held on 25.07.2024 and 31.07.2024 and after detailed deliberations, the augmentation of 1x500 MVA ICT (4th) at Nagarjunasagar was agreed. However, options for implementation of the ICT shall be finalized in the meeting with CEA. Subsequently, the proposal was also deliberated and agreed in the meeting held on 17.09.2024 at CEA regarding finalization of options and implementation modalities. Same shall be taken-up in CCTP meeting for further approval. Schematic is given at **Figure 6-12**

Details are as follows:

Sl. No.	Description of Transmission Element	Scope of work (Type of Substation / Conductor capacity / km / no. of bays etc.)	Time schedule (in months)
1	Augmentation of transformation capacity with 400/220kV, 1x500 MVA ICT (4th) at Nagarjunasagar 400/220kV substation	• 1x500 MVA, 400/220kV ICT • Shifting of existing 125 MVAr, 420 kV Bus Reactor to new Bay No. 409 from existing Bay No. 404. • Installation of 4th ICT in existing bay No. 404 forming 404 (4th ICT) - 405 (tie) - 406 (Kadapa-II line) • Interconnection between POWERGRID 400/220 kV switchyard and APTRANSCO 220 kV switchyard • Extension of 220 kV Bus Bar of APTRANSCO for accommodation of 3 Nos. 220 kV Bays (1 No. for 4th ICT and provision for future 2 Nos. line bays) by shifting the Dead-end tower of 400 kV N'Sagar-Kadapa D/c line by approximately 86 meters towards AP2-DD+0 • Implementation of one number of new 220 kV bay at APTRANSCO switchyard for 4th ICT. • Dismantling of existing dead-end tower of 400 kV N'sagar-Kadapa D/c Line and installation of new dead-end tower alongwith associated stringing & civil works.	24 months

Estimated Cost : ₹ 50 Crs.

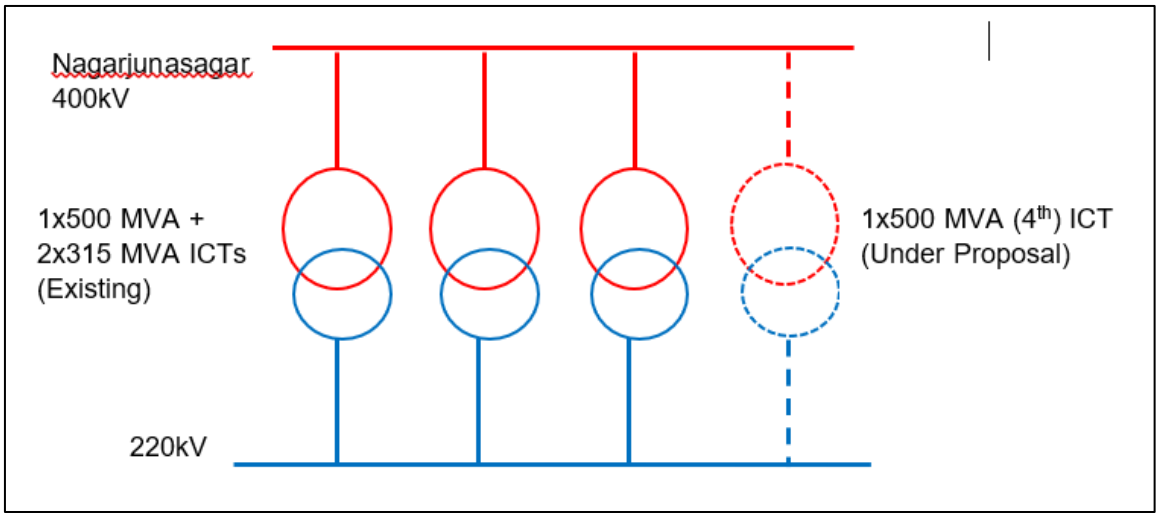


Figure 6-12 : Augmentation of transformation capacity with 400/220kV, 1x500 MVA ICT (4th) at Nagarjunasagar 400/220kV substation

(v) Transmission System for integration of Kurnool-IV REZ (Ph-I) in Andhra Pradesh

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 86 GW RE Potential in the State of Andhra Pradesh, Telangana, Karnataka and Tamil Nadu (Offshore) in Southern Region. Out of the identified (86 GW) RE Potential in Southern Region, 51 GW has been identified in the State of Andhra Pradesh (Ananthapur– 20 GW, Kurnool – 23 GW & Kadapa – 8 GW).

A comprehensive transmission system for integration of 51 GW RE Potential in Andhra Pradesh have 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. The details of district wise potential is as below.

District	Potential (GW)		Total (GW)	Maximum Dispatch (GW)	BESS (GW)	Evacuation System (GW)
	Wind	Solar				
Anantapur	10	10	20	15	5	10
Kurnool	8	15	23	18	6	12
Kadapa	0	8	8	8	3	5
Total	**18**	**33**	**51**	**41**	**14**	**27**

Presently, Connectivity of about 7740 MW (2390 MW at 220kV level & 5350 MW at 400kV level) has been granted / agreed for grant at Kurnool-III PS. Similarly, Connectivity of about 3765 MW (1055 MW at 220kV level & 2710 MW at 400kV level) has been granted / agreed for grant at Ananthapuram PS. Keeping above in view, it is prudent to take up the implementation of Kurnool-IV PS and Anantapur-II PS for integration of RE generation projects in Kurnool and Anantapur areas. The above transmission schemes were deliberated in the 28th CMETS-SR held on 29.02.2024 wherein it was decided that a physical joint study may be carried out for finalization of the transmission system for Kurnool-IV and Ananthapuram-II.

Accordingly, Joint Study meeting of Southern Region Constituents was held from 2nd to 4th May, 2024 at Hyderabad wherein following transmission system was finalized for integration of RE generation projects at Kurnool-IV in Andhra Pradesh.

Transmission System for Integration of Kurnool-IV (Near Aspiri) REZ (for 7.5 GW) Phase-I (4.5 GW)

- Establishment of 4x1500 MVA, 765/400 & 4x500 MVA, 400/220 kV Kurnool-IV Pooling Station near Kurnool, Andhra Pradesh along with 2x330 MVAr (765 kV) bus reactors at Kurnool-IV PS (1.5 GW injection at 220 kV level and 3 GW injection at 400 kV level)
- + 300 MVAR STATCOM at Kurnool-IV, 2x125 MVAr MSR
- Kurnool-IV – Bidar 765kV D/c line (about 330 kms) with 330 MVAR SLR at both end on both circuits
- Kurnool-IV – Kurnool-III PS 765 kV D/c line (about 150 kms) with 240 MVAR SLR at Kurnool-IV end on both circuits
- Augmentation of 1x1500 MVA, 765/400 kV ICT at C'Peta

Phase-II (3 GW)

- Augmentation of 2x1500 MVA, 765/400 & 6x500 MVA, 400/220 kV Kurnool-IV Pooling Station (2 GW injection at 220 kV level and 2 GW injection at 400 kV level)
- Establishment of 3x1500 MVA, 765/400 kV Veltoor-II Station with 2x330 MVAr (765 kV) bus reactors
- LILO of Kurnool-IV – Bidar 765kV D/c line at Veltoor-II (about 60 kms)
- Veltoor-II – Veltoor TS 400 kV D/c (quad) line (about 60 kms)
- Veltoor-II – Udandpur 400 kV D/c (quad) line (about 30 kms)
- LILO of Vijayawada-Nellore 400 kV D/c line at C'Peta (about 20 kms)

The above transmission schemes were deliberated in the 32nd CMETS-SR held on 28.06.2024 wherein it was agreed that initially Kurnool-IV Phase-I may be taken up for implementation and Kurnool-IV Phase-II may be reviewed as per the observations of the SR constituents. It was also agreed that LILO of Vijayawada-Nellore 400 kV D/c line at C'Peta (about 20 kms) may be considered in Phase-I.

The above transmission scheme has approved in the 23rd NCT meeting held on 02.09.2024 and is under bidding. Schematic is given at **Figure 6-13**

The detailed scheme is as below:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment of 4x1500 MVA, 765/400 & 4x500 MVA, 400/220 kV Kurnool-IV Pooling Station near Kurnool, Andhra Pradesh along with 2x330 MVAr (765 kV) bus reactors at Kurnool-IV PS with provision of two (2) sections of 4500 MVA each at 400kV 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 – 14 nos. • 400kV ICT bays – 14 nos. • 220kV ICT bays – 14 nos. • 765kV line bays – 8 nos. (with provision for SLR) • 400kV line bays – 12 nos. (with provision for SLR) • 220kV line bays – 20 nos. • 220kV Bus Sectionalizer : 2 sets • 220 kV Bus Coupler (BC) Bay – 2 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 2 nos. • 400kV Bus Sectionalizer : 1 set	• 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. • 400kV ICT bays – 4 nos. • 220kV ICT bays – 4 nos. • 765kV line bays – 4 nos. (at Kurnool-IV PS for termination of Kurnool-IV – Bidar and Kurnool-IV – Kurnool-III 765kV D/c lines) • 765 kV, 330 MVAr Bus Reactor – 2 nos. • 765 kV Bus Reactor bays – 2 nos. • 220kV line bays – 6 nos. • 220kV Bus Sectionalizer : 1 set • 220 kV Bus Coupler (BC) Bay – 2 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 2 nos.
2.	Kurnool-IV – Bidar 765kV D/c line (about 330 kms) with 330 MVAR SLR (convertible) at both ends on both circuits	~ 330 km • 765kV line bays – 2 nos. (at Bidar PS) • 765 kV, 330 MVAr SLR at Kurnool-IV PS – 2 nos. (7x110 MVAr inc. 1 switchable spare unit for both bus reactor and line reactor) • 765 kV, 330 MVAr SLR at Bidar PS – 2 nos. (7x110 MVAr inc. 1 switchable spare unit)
3.	Kurnool-IV – Kurnool-III PS 765 kV D/c line (about 150 kms) with 240 MVAR SLR (convertible) at Kurnool-IV end on both circuits	~ 150 km • 765kV line bays – 2 nos. (at Kurnool-III PS) • 765 kV, 240 MVAr SLR at Kurnool-IV PS – 2 nos. (7x80 MVAr inc. 1 switchable spare unit)
4.	± 300 MVAR STATCOM at Kurnool-IV PS along with 2x125 MVAr MSR	• 400 kV bay – 1 no.
5.	Augmentation of 1x1500 MVA, 765/400 kV ICT (3rd) at C'Peta	• 765/400kV, 1500 MVA, ICT – 1 no. • 765kV ICT bays – 1 no. • 400kV ICT bays – 1 no.
6.	LILO of Vijayawada-Nellore 400 kV D/c line at C'Peta (about 20 kms)	~ 20 km • 400kV line bays – 4 nos. (at C'Peta for termination of LILO

Sl. No.	Scope of the Transmission Scheme	Capacity /km
		of Vijayawada-Nellore 400 kV D/c line at C'Peta)

Estimated Cost: ₹ 5550Crs.

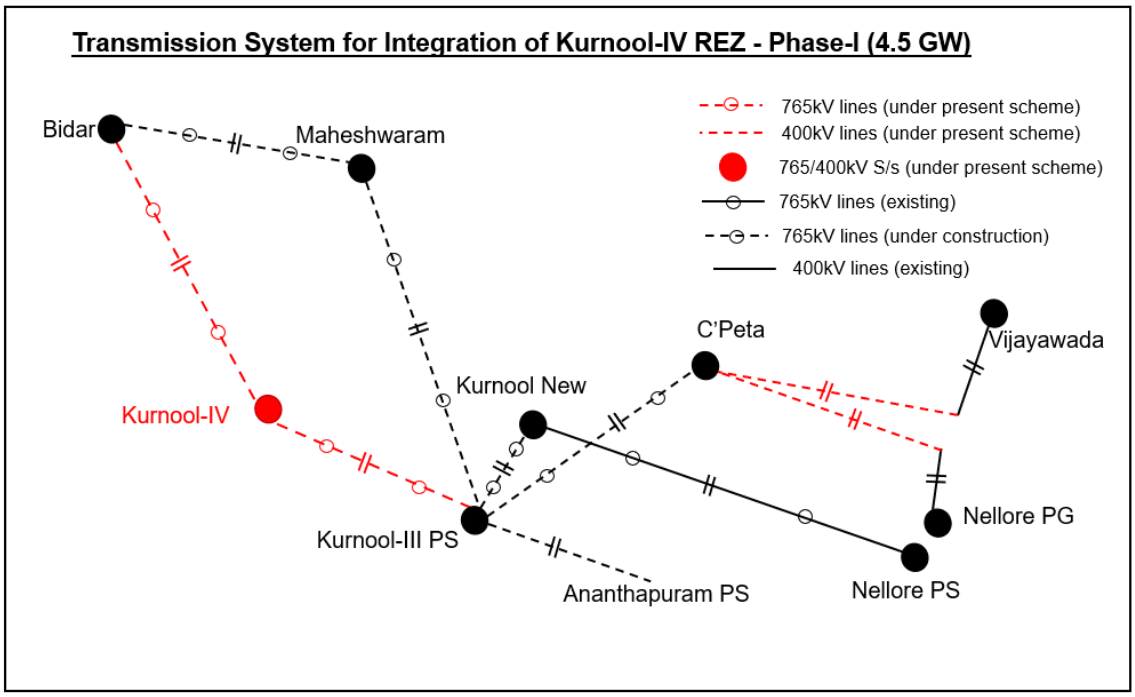


Figure 6-13 : Transmission System for Integration of Kurnool-IV REZ -Phase-I (for 4.5 GW)

(vi) Transmission System for integration of Anantapur-II REZ (Ph-I) in Andhra Pradesh

As per the Joint Study meeting of Southern Region Constituents held from 2nd to 4th May, 2024 at Hyderabad, following transmission system was finalized for integration of RE generation projects at Anantapur-I in Andhra Pradesh

Phase-I (4.5 GW)

- Establishment of 4x1500 MVA, 765/400 kV & 4x500 MVA, 400/220 kV Anantapur-II Pooling Station near Kurnool, Andhra Pradesh along with 2x330 MVAr (765 kV) bus reactors at Anantapur-II PS (1.5 GW injection at 220 kV level and 2.5 GW injection at 400 kV level)
- + 300 MVAR STATCOM at Ananthpur-II, 2x125 MVAr MSR
- Anantapur-II – Davangere 765kV D/c line (about 150km) with 240 MVAR SLR at Anatpur-II end on both circuits
- Anantapur-II – Cuddapah 765kV D/c line (about 200km) with 330 MVAR SLR at Anatpur-II end on both circuits

Phase-II (3.5 GW)

- Augmentation of 2x1500 MVA, 765/400 & 6x500 MVA, 400/220 kV Kurnool-IV Pooling Station (2.5 GW injection at 220 kV level and 2 GW injection at 400 kV level)
- Establishment of 3x1500 MVA, 765/400 kV CN'Halli Station along with 2x330 MVAr (765 kV) bus reactors
- Anantapur-II – CN'Halli 765kV D/c line (about 180km) with 330 MVAR SLR at Anatpur-II end on both circuits
- CN'Halli - CN'Halli (KPTCL) 400 kV (quad) D/c line (about 10km)

The above transmission schemes were deliberated in the 32nd CMETS-SR held on 28.06.2024 wherein it was agreed that initially Ananthapuram-II Phase-I may be taken up for implementation and Ananthapuram-II Phase-II may be reviewed as per the observations of the SR constituents. The above transmission scheme has approved in the 22nd NCT meeting held on 23.08.2024 and is under bidding. Schematic is given at **Figure 6-14**

The detailed scheme is as below:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment of 4x1500 MVA, 765/400 & 6x500 MVA, 400/220 kV Ananthapuram-II Pooling Station near Kurnool, Andhra Pradesh along with 2x330 MVAr (765 kV) bus reactors at Ananthapuram-II PS with provision of two (2) sections of 4500 MVA each at 400kV 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 – 12 nos. • 400kV ICT bays – 12 nos. • 220kV ICT bays – 12 nos. • 765kV line bays – 8 nos. (with provision for SLR) • 400kV line bays – 12 nos. (with provision for SLR) • 220kV line bays – 20 nos. • 220kV Bus Sectionalizer : 2 sets • 220 kV Bus Coupler (BC) Bay – 2 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 2 nos. • 400kV Bus Sectionalizer : 1 set	• 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 – 6 nos. • 400kV ICT bays – 6 nos. • 220kV ICT bays – 6 nos. • 765kV line bays – 4 nos. (at Ananthapuram-II PS for termination of Ananthapuram-II – Davanagere and Ananthapuram-II – Cuddapah 765kV D/c lines) • 765 kV, 330 MVAr Bus Reactor – 2 nos. • 765 kV Bus Reactor bays – 2 nos. • 220kV line bays – 6 nos. • 220kV Bus Sectionalizer : 1 set • 220 kV Bus Coupler (BC) Bay – 2 no. • 220 kV Transfer Bus Coupler (TBC) Bay – 2 no.
2.	Ananthapuram-II – Davangere 765kV D/c line (about 150km) with 240 MVAR SLR	~ 150 km

	(convertible) at Ananthapuram-II end on both circuits	• 765 kV line bays – 2 nos. (at Davanagere PS) • 765 kV, 240 MVAr SLR at Ananthapuram-II PS – 2 nos. (7x80 MVAr inc. 1 switchable spare unit)
3.	Ananthapuram-II – Cuddapah 765kV D/c line (about 200km) with 330 MVAR SLR (convertible) at Ananthapuram-II end on both circuits	~ 200 km • 765 kV line terminal equipments – 2 nos. (at Cuddapah) • 765 kV, 330 MVAr SLR at Ananthapuram-II PS – 2 nos. (7x110 MVAr inc. 1 switchable spare unit for both bus reactor and line reactor)
4.	±300 MVAR STATCOM at Ananthapuram-II PS along with 2x125 MVAr MSR	• 400 kV bay – 1 no.

Estimated Cost : ₹4679 Crs.

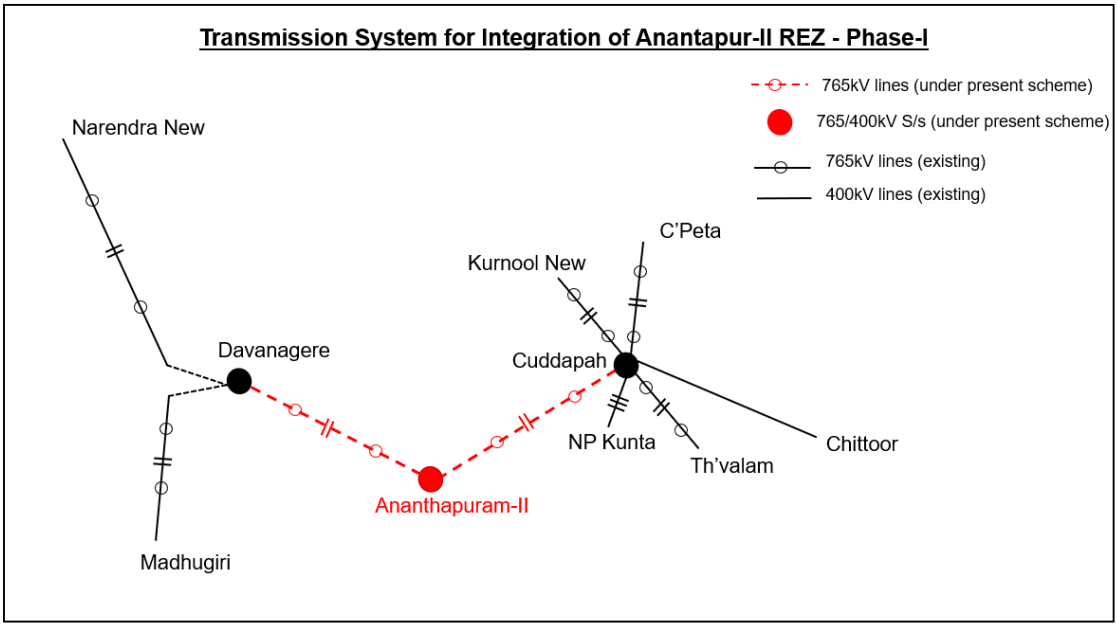


Figure 6-14 : Transmission System for integration of Anantapur-II REZ (Ph-I)

(vii) Transmission System for proposed Green Hydrogen / Green Ammonia projects in Kakinada area, Andhra Pradesh

Govt. of India has set a CTU 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.

Subsequently, CEA convened a meeting 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	4645
by 2030	6015

CTU has already received application from M/s AM Green Ammonia (India) Pvt. Ltd. seeking GNA-RE for 700 MW as Bulk Consumer in Kakinada area. The application is under discussion for grant of GNA in CMETS meeting. Further 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. Further, application has also been received from M/s AM Green Ammonia (India) Pvt. Ltd. for additional 1300 MW in the month of July 2024, seeking GNA-RE for additional 1300 MW as Bulk Consumer for Green Hydrogen loads in Kakinada area.

In view of the upcoming Green Hydrogen / Green Ammonia plants / industries, planning of transmission system has been done for delivery of power to Green Hydrogen / Ammonia manufacturing projects at Kakinada in Andhra Pradesh. Upon discussions between CTU and CEA, following transmission system identified for supply of power to Green Hydrogen / Ammonia projects at Kakinada was deliberated in the 33rd CMETS-SR held on 25.07.2024. Schematic is given at

Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area

Phase-I : 3000 MW

- Establishment of Kakinada 765/400 kV, 3x1500 MVA substation
- LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada substation

***Note*:** *Angul – Srikakulam 765 kV 2nd D/c line shall be required which is to be taken up for enhancement of TTC/ATC*

Phase-II: Cumulative 6000 MW

- Augmentation by 3x1500 MVA, 765/400 kV ICTs at Kakinada substation
- Establishment of Khammam-II 765/400 kV, 3x1500 MVA substation

- Warangal – Khammam-II 765 kV D/c line
- Khammam-II – Vemagiri 765 kV D/c line
- Khammam-II – Khammam (existing) 400 kV D/c (quad) line
- Vemagiri – Kakinada 765 kV 2nd D/c line

During the meeting, CTU informed that the proposed Phase-I Transmission system for Green Hydrogen / Green Ammonia projects in Kakinada area shall be required for immediate integration and supply of power to these projects irrespective of other transmission system strengthening including HVDC system. Further, CTU has already received applications from Green Hydrogen / Green Ammonia projects for 2000 MW which is to be disposed of in time bound manner in accordance with the CERC GNA Regulations, 2022. Accordingly, Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area, Andhra Pradesh (Phase-I) may be put up for formal approval and the balance Phase-II transmission system and HVDC proposal may be submitted to SRPC for further deliberations alongwith the inter-regional links studied during the Joint Study meeting.

After detailed deliberations, the proposal for "Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area, Andhra Pradesh (Phase-I)" was discussed and agreed in the 33rd CMETS-SR held on 25.07.2024. Transmission scheme was approved in the 25th NCT meeting held on 28.11.2024 and is under bidding. Schematic is given at Figure 6-15

Details of scheme are as follows:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
3.	Establishment of Kakinada 765/400 kV, 3x1500 MVA substation (GIS) alongwith 240 MVAr bus reactor **Future Space Provisions:** • 765/400 kV, 1500 MVA, ICTs – 3 Nos. • 765 kV ICT bays – 3 Nos. • 400 kV ICT bays – 3 Nos. • 765 kV line bays – 8 Nos. (with provision for SLR) • 400 kV line bays – 12 Nos. (with provision for SLR) • 400 kV Bus Sectionalizer : 1 set	• 3x1500 MVA, 765/400 kV ICT (10x500 MVA including 1 spare unit) • 765 kV ICT bay – 3 Nos. (GIS) • 400 kV ICT bay – 3 Nos. (GIS) • 765 kV line bays – 4 Nos. (GIS) (at Kakinada for termination of LILO of Srikakulam – Vemagiri 765 kV D/c line) • 765 kV, 240 MVAr Bus Reactor -1 Nos. (4x80 MVAr inc. 1 switchable spare unit for both bus reactor and line reactor) • 765 kV Bus Reactor bays – 1 No. (GIS)
4.	LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada substation (~20 km) {with 240 MVAr SLR at Kakinada GH end on Srikakulam – Kakinada section (~334 km)}	~ 20 km • 765 kV, 240 MVAr SLR at Kakinada– 2 Nos. (6x80 MVAr switchable units)
5.	• ± 300 MVAr STATCOM with 2x125 MVAr MSC at Kakinada 765/400 kV GIS S/s with control switching arrangement for proposed 1x240 MVAr bus reactor	• 400 kV bay – 1 No. (GIS) *

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	• Space provision for 2nd ± 300 MVAr STATCOM with 2x125 MVAr MSC at Kakinada 765/400 kV S/s	

Estimated Cost : ₹1618 Crs.

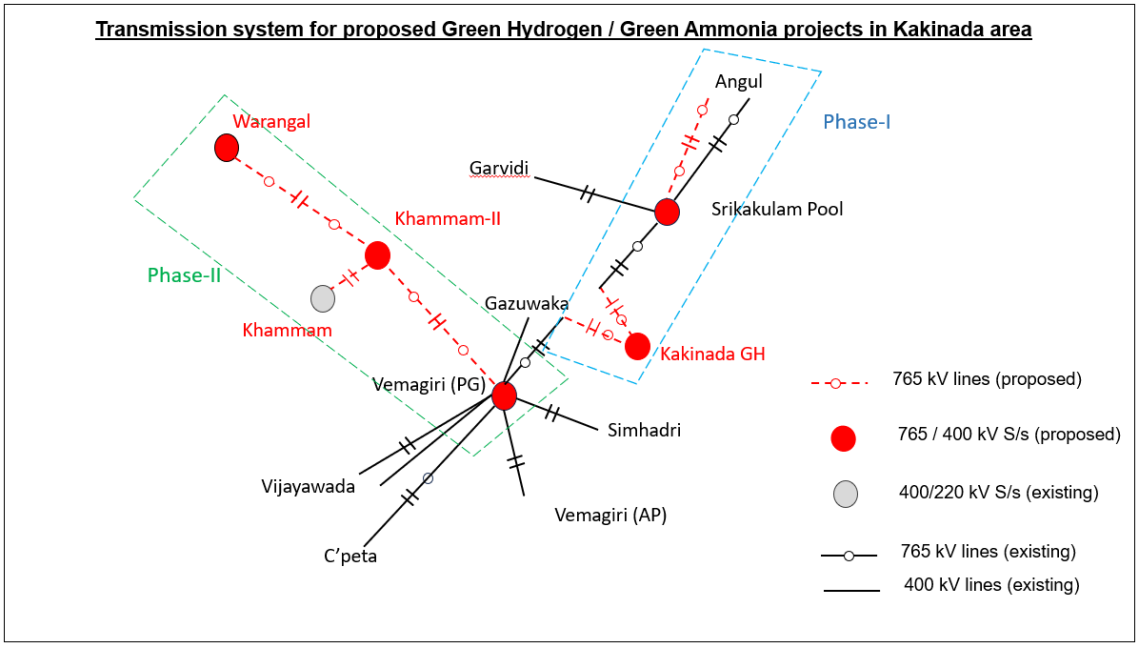


Figure 6-15 : Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area

(viii) Transmission System for integration of Kurnool-IV REZ (Ph-II) and Ananthapuram-II REZ (Ph-II)

Transmission system for Kurnool-IV and Ananthapuram-II was evolved in the physical Joint Study meeting of Southern Region Constituents held from 2nd to 4th May, 2024 at Hyderabad:

Transmission System for Integration of Kurnool-IV (Near Aspiri) REZ (for 7.5 GW)

Phase-I (4.5 GW)

Establishment of 4x1500 MVA, 765/400 & 4x500 MVA, 400/220 kV Kurnool-IV Pooling Station near Kurnool, Andhra Pradesh along with 2x330 MVAr (765 kV) bus reactors at Kurnool-IV PS (1.5 GW injection at 220 kV level and 3 GW injection at 400 kV level)

- ± 300 MVAR STATCOM at Kurnool-IV, 2x125 MVAr MSR
- Kurnool-IV – Bidar 765kV D/c line (about 330 kms) with 330 MVAR SLR at both end on both circuits

- Kurnool-IV – Kurnool-III PS 765 kV D/c line (about 150 kms) with 240 MVAR SLR at Kurnool-IV end on both circuits
- Augmentation of 1x1500 MVA, 765/400 kV ICT at C'Peta

Phase-II (3 GW)

- Augmentation of 2x1500 MVA, 765/400 & 6x500 MVA, 400/220 kV Kurnool-IV Pooling Station (2 GW injection at 220 kV level and 2 GW injection at 400 kV level)
- Establishment of 3x1500 MVA, 765/400 kV Veltoor-II Station with 2x330 MVAr (765 kV) bus reactors
- LILO of Kurnool-IV – Bidar 765kV D/c line at Veltoor-II (about 60 kms)
- Veltoor-II – Veltoor TS 400 kV D/c (quad) line (about 60 kms)
- Veltoor-II – Udandpur 400 kV D/c (quad) line (about 30 kms)
- LILO of Vijayawada-Nellore 400 kV D/c line at C'Peta (about 20 kms)

Further, following transmission system evolved for integration of Anantapur-II REZ-

Transmission System for Integration of Anantapur-II REZ - Phase-I (4.5 GW)

- Establishment of 4x1500 MVA, 765/400 kV & 4x500 MVA, 400/220 kV Anantapur-II Pooling Station near Kurnool, Andhra Pradesh along with 2x330 MVAr (765 kV) bus reactors at Anantapur-II PS (1.5 GW injection at 220 kV level and 2.5 GW injection at 400 kV level)
- ± 300 MVAR STATCOM at Ananthpur-II, 2x125 MVAr MSR .
- Anantapur-II – Davangere 765kV D/c line (about 150km) with 240 MVAR SLR (convertible) at Anantapur-II end on both circuits .
- Anantapur-II – Cuddapah 765kV D/c line (about 200km) with 330 MVAR SLR (convertible) at Anantapur-II end on both circuits Presently, Connectivity of about 2100 MW at 220kV level has been granted / agreed for grant at Kurnool-IV PS. Further, Connectivity of Connectivity of about 3760 MW (2760 MW at 220kV level & 1000 MW at 400kV level) has been granted / agreed for grant at Anantapur-II PS.

Transmission System for Anantapur-II REZ - Phase-II (3 GW)

- Augmentation of Anantapur-II PS by 765/400kV, 2x1500 MVA and 400/220 kV, 4x500 MVA ICTs
- Establishment of 3x1500 MVA, 765/400 kV Halli Mysore Station along with 1x240 MVAr (765 kV) bus reactor with space provision for establishment of 220 kV switchyard
- Anantapur-II – Halli Mysore 765kV D/c line (about 260 km) with 240 MVAR SLR at Anantapur-II end on both circuits
- LILO of Mysore – Waynad 400 kV D/c line at Halli Mysore(~25 km)
- Halli Mysore – Hassan 400 kV D/c (Quad) line (~50 km)

"Transmission System for Integration of Kurnool-IV REZ (Ph-I)" and "Transmission System for Integration of Anantapur-II REZ (Ph-I)" were discussed and agreed in principally in the 52nd SRPC meeting held on 03.08.2024. The National Committee on Transmission in its 22nd meeting held on 23.08.2024 recommended the implementation of transmission schemes "Transmission System for Integration of Anantapur-II REZ - Phase-I" through TBCB route and has identified the PFC Consulting Limited as BPC for bidding of the transmission scheme. The scheme "Transmission System for Integration of Kurnool-IV REZ - Phase-I" was discussed in the 23rd NCT meeting held on 02.09.2024 wherein NCT recommended Transmission System for Integration of Kurnool-IV (Ph-I) under TBCB route with RECPDCL as BPC.

Presently, Connectivity of about 2100 MW at 220kV level has been granted / agreed for grant at Kurnool-IV PS. Further, Connectivity of Connectivity of about 3760 MW (2760 MW at 220kV level & 1000 MW at 400kV level) has been granted / agreed for grant at Anantapur-II PS. Accordingly, Transmission System for Integration of Kurnool-IV REZ - Phase-II and Anantapur -II REZ-Ph-II are required to be taken-up for implementation for grant of connectivity at Kurnool-IV and Anantapur-II as per the CERC Regulations.

In view of the above, Transmission System for Integration of Kurnool-IV REZ - Phase-II and Transmission System for Integration of Anantapur-II REZ - Phase-II is required to be taken-up for implementation. Transmission System for Integration of Kurnool-IV REZ - Phase-II and Anantapur-II REZ - Phase-II was discussed in the Joint Study meeting conducted from 21st to 23rd Nov, 2024 at SRPC, Bengaluru (minutes of the meeting are enclosed at Enclosure-A). After detailed deliberations, following transmission system was agreed for integration of Kurnool-IV REZ - Phase-II . Schematic is given at Figure 6-17

Transmission System for Kurnool-IV REZ - Phase-II (3 GW)

- Augmentation of Kurnool-IV PS by 765/400kV, 2x1500 MVA and 400/220 kV, 6x500 MVA ICTs
- Establishment of 4x1500 MVA, 765/400 kV Shadnagar Station with 2x330 MVAr (765 kV) bus reactors with space provision for establishment of 220 kV switchyard
- LILO of Kurnool-IV – Bidar 765kV D/c line at Shadnagar (about 50 kms)
- Shadnagar – Shadnagar (TGTRANSCO) 400 kV quad D/c line (about 50 kms) {TGTRANSCO to upgrade Shadnagar (TGTRANSCO) to 400 kV in matching timeframe}
- Shadnagar – Kethiredipally (TGTRANSCO) 400 kV quad D/c line (about 60 kms)

Schematic is given at **Figure 6-16**

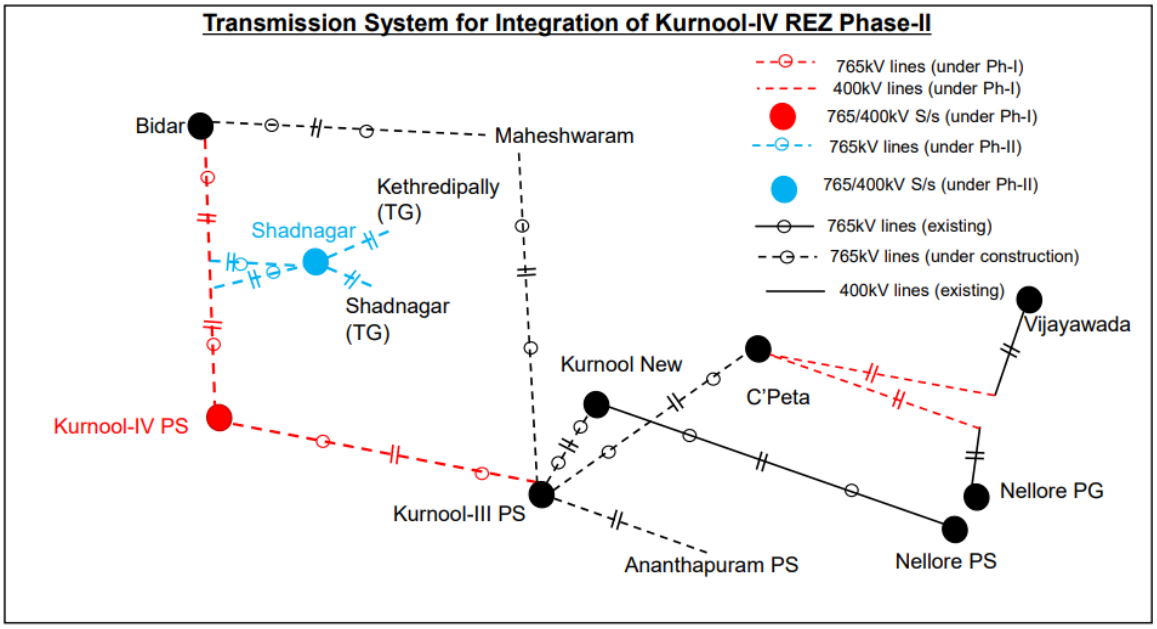


Figure 6-16 : Transmission System for Kurnool-IV REZ - Phase-II

It was also decided that Transmission System for Anantapur-II REZ - Phase-II (3 GW) shall be discussed subsequently based on the observations received from KPTCL.

Accordingly, Joint Study meeting was again conducted on 09.01.2025 for finalization of the transmission system wherein based on the confirmation of KPTCL that CN'Halli 765/400 kV substation may be taken-up under ISTS, following transmission system was agreed for integration of Ananthapuram-II REZ - Phase-II (3 GW) :

Phase-II (3 GW)

- Augmentation of 2x1500 MVA, 765/400 & 4x500 MVA, 400/220 kV Ananthapuram-II PS
- Establishment of 3x1500 MVA, 765/400 kV CN'Halli Station along with 2x330 MVAr (765 kV) bus reactors
- Ananthapuram-II – CN'Halli 765kV D/c line (about 180km) with 330 MVAR SLR at Ananthapuram-II end on both circuits
- LILO of one circuit of Talaguppa-Neelmangala 400 kV D/c line at CN'Halli
- LILO of Hassan-Talaguppa-Neelmangala 400 kV line at CN'Halli through:
  i) LILO at CN'Halli of already LILOed section of one circuit of Talaguppa - Neelmangala 400 kV line at Hassan (25 KM) or
  ii) LILO of another circuit of Talaguppa-Neelmangala 400 kV D/c line at CN'Halli (25 KM) and extension of LILOed section of one circuit of Talaguppa - Neelmangala 400 kV line at Hassan to CN'Halli to make Hassan - CN'Halli 400kV D/c line (25 KM)

In addition to the above, following connectivity for CN'Halli Substation was finalized under KPTCL scope:

- Jagalur - CN'Halli 400 kV (Quad) D/c line
- Kadakola - CN'Halli 400 kV (Quad) D/c line

The scheme was agreed in the special SRPC meeting held on 04.02.2025. The transmission schemes were discussed and approved in the 28th NCT meeting held on 06.03.2025.

Details of scheme are as under:

Transmission System for Kurnool-IV REZ - Phase-II (3 GW)

Sl. No.	Scope of the Transmission Scheme	Capacity /km	Schedule
1.	Augmentation of Kurnool-IV PS by 400/220 kV, 4x500 MVA ICTs	• 400/220kV, 500 MVA, ICTs – 4 nos. • 400kV ICT bays – 4 nos. • 400kV Bus Sectionalizer: 1 set • 220kV ICT bays – 4 nos. • 220kV Bus Sectionalizer: 1 set • 220 kV Bus Coupler (BC) Bay – 1 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 1 no.	24 months
2.	220kV line bays at Kurnool-IV PS for termination of dedicated transmission lines of RE generation projects	• 220kV line bays – 5 nos.	24 months
3.	400kV line bays at Kurnool-IV PS for termination of dedicated transmission lines of RE generation projects	• 400kV line bays – 1 no.	24 months
4.	Augmentation of Kurnool-IV PS by 765/400kV, 2x1500 MVA and 400/220 kV, 6x500 MVA ICTs	• 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. • 220kV Bus Sectionalizer: 1 set • 220 kV Bus Coupler (BC) Bay – 1 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 1 no.	30 months
5.	220kV line bays at Kurnool-IV PS for termination of dedicated transmission lines of RE generation projects	• 220kV line bays – 8 nos.	30 months

Sl. No.	Scope of the Transmission Scheme	Capacity /km	Schedule
6.	400kV line bays at Kurnool-IV PS for termination of dedicated transmission lines of RE generation projects	• 400kV line bays – 1 no.	30 months
7.	Establishment of 4x1500 MVA, 765/400 kV Shadnagar Station with 2x330 MVAr (765 kV) bus reactors with space provision for establishment of 220 kV switchyard **Future Space Provisions:** • 765/400kV, 1500 MVA, ICTs – 2 nos. • 765kV ICT bays – 2 nos. • 400kV ICT bays – 2 nos. • 765kV line bays – 8 nos. (with provision for SLR) • 400kV line bays – 8 nos. (with provision for SLR) • 400kV Bus Sectionalizer: 1 set **Future Space Provisions for 220kV switchyard:** • 400/220kV, 500 MVA, ICTs – 10 nos. • 400kV ICT bays – 10 nos. • 220kV ICT bays – 10 nos. • 220kV line bays – 16 nos. • 220kV Bus Sectionalizer: 3 set • 220 kV Bus Coupler (BC) Bay – 4 no. • 220 kV Transfer Bus Coupler (TBC) Bay – 4 no.	• 765/400kV, 1500 MVA, ICTs – 4 nos. (13x500 MVA incl. 1 spare unit) • 765kV ICT bay – 4 nos. • 400kV ICT bay – 4 nos. • 765kV line bays – 4 nos. (at Shadnagar for termination of LILO of Kurnool-IV – Bidar 765kV D/c line) • 765 kV, 330 MVAr Bus Reactors – 2 nos. (7x110 MVAr inc. 1 switchable spare unit) • 765 kV Bus Reactor bays – 2 nos. • 400kV line bays – 4 nos. (at Shadnagar for termination of Shadnagar – Shadnagar (TGTRANSCO) and Shadnagar – Kethiredipally (TGTRANSCO) 400 kV quad D/c lines)	30 months
8.	LILO of Kurnool-IV – Bidar 765kV D/c line at Shadnagar (about 50 kms)	~ 50 km	30 months
9.	Shadnagar – Shadnagar (TGTRANSCO) 400 kV quad D/c line (about 50 kms) {TGTRANSCO to upgrade Shadnagar (TGTRANSCO) to 400 kV in matching timeframe}	~ 50 km 400kV line bays – 2 nos. (at Shadnagar (TGTRANSCO))	30 months
10	Shadnagar – Kethiredipally (TGTRANSCO) 400 kV quad D/c line (about 60 kms)	~ 60 km 400kV line bays – 2 nos. (at Kethiredipally (TGTRANSCO))	30 months

Estimated Cost: ₹3235 Crs.

Implementation Timeframe: Progressively from 24 Months to 30 months

Transmission System for integration of Ananthapuram-II REZ - Phase-II (3 GW)

Sl. No.	Scope of the Transmission Scheme	Capacity /km	Schedule
1.	Augmentation of Ananthapuram-II PS by 400/220 kV, 1x500 MVA ICTs	• 400/220kV, 500 MVA, ICTs – 1 nos. • 400kV ICT bays – 1 nos. • 400kV Bus Sectionalizer: 1 set • 220kV ICT bays – 1 nos. • 220kV Bus Sectionalizer: 1 set • 220 kV Bus Coupler (BC) Bay – 1 no. • 220 kV Transfer Bus Coupler (TBC) Bay – 1 no.	24 months
2.	220kV line bays at Ananthapuram-II PS for termination of dedicated transmission lines of RE generation projects	• 220kV line bays – 2 nos.	24 months
3.	400kV line bays at Ananthapuram-II PS for termination of dedicated transmission line of RE generation projects	• 400kV line bays – 3 nos.	24 months
4.	Augmentation of Ananthapuram-II PS by 765/400kV, 2x1500 MVA and 400/220 kV, 6x500 MVA ICTs	• 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. • 220kV Bus Sectionalizer: 1 set • 220 kV Bus Coupler (BC) Bay – 1 nos. • 220 kV Transfer Bus Coupler (TBC) Bay – 1 no.	30 months
5.	220kV line bays at Ananthapuram-II PS for termination of dedicated transmission lines of RE generation projects	• 220kV line bays – 10 nos.	30 months
6.	Establishment of 3x1500 MVA, 765/400 kV CN'Halli Station with 2x330 MVAr (765 kV) bus reactors **Future Space Provisions:** • 765/400kV, 1500 MVA, ICTs – 3 nos. • 765kV ICT bays – 3 nos. • 400kV ICT bays – 3 nos. • 765kV line bays – 6 nos. (with provision for SLR)	• 765/400kV, 1500 MVA, ICTs – 3 nos. (10x500 MVA incl. 1 spare unit) • 765kV ICT bay – 3 nos. • 400kV ICT bay – 3 nos. • 765kV line bays – 2 nos. (at CN'Halli for termination of CN'Halli – Ananthapuram-II PS 765kV D/c line) • 765 kV, 330 MVAr Bus Reactors – 2 nos. (7x110 MVAr inc. 1 switchable spare unit) • 765 kV Bus Reactor bays – 2 nos. • 400kV line bays – 6 nos.	30 months

Sl. No.	Scope of the Transmission Scheme	Capacity /km	Schedule
	• 400kV line bays – 12 nos. (with provision for SLR) • 400kV Bus Sectionalizer : 1 set		
7.	Ananthapuram-II PS – CN'Halli 765kV D/c line with (about 180km) with 330 MVAR SLR at Ananthapuramam-II end on both circuits	~ 180 km • 765kV line bays – 2 nos. (at Ananthapuramam-II PS end) • 765 kV, 330 MVAr SLR at Ananthapuram-II – 2 nos. (6x110 MVAr switchable units)	30 months
8.	LILO of one circuit of Talaguppa-Neelmangala 400 kV D/c line at CN'Halli (25 KM)	~ 25 km	30 months
9.	i) LILO at CN'Halli of already LILOed section of one circuit of Talaguppa - Neelmangala 400 kV line at Hassan (25 KM) or ii) LILO of another circuit of Talaguppa-Neelmangala 400 kV D/c line at CN'Halli (25 KM) and extension of LILOed section of one circuit of Talaguppa - Neelmangala 400 kV line at Hassan to CN'Halli to make Hassan - CN'Halli 400kV D/c line (25 KM)	~ 25 km & ~ 25 km	30 months

Estimated Cost: ₹3339 Cr

Implementation Timeframe: Progressively from 24 Months to 30 months

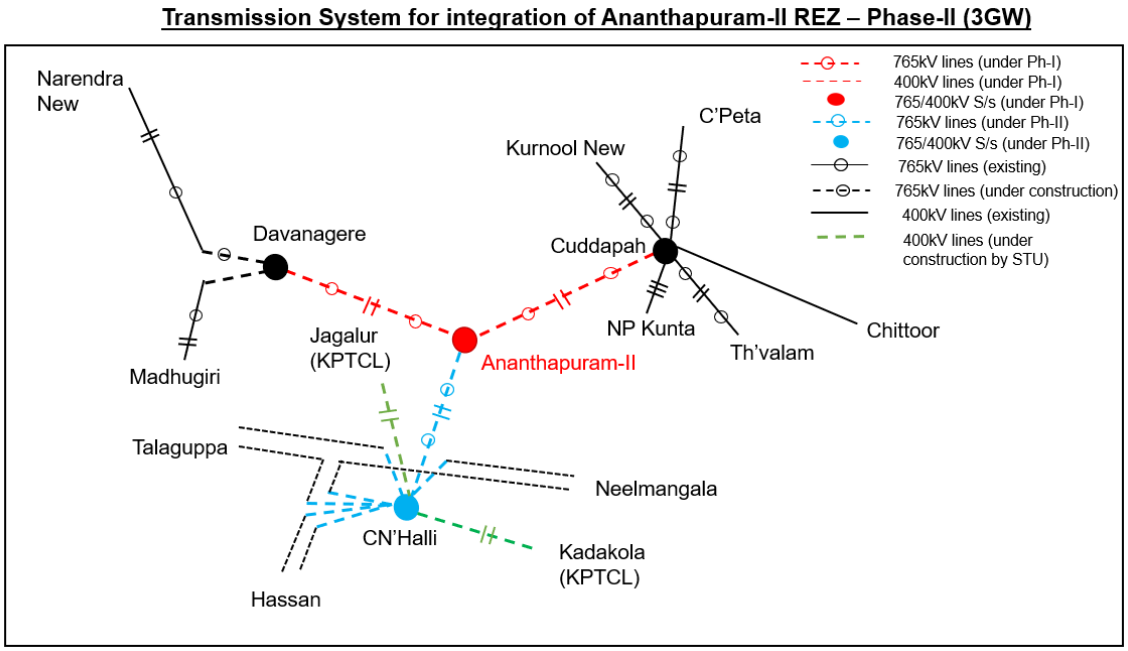


Figure 6-17 : Transmission System for integration of Ananthapuram-II REZ - Phase-II (3 GW)

6.4.4 Kerala

(i) <u>Augmentation of transformation capacity at various ISTS substations in Kerala</u>

During the Joint Study meeting conducted from 21st to 23rd Nov, 2024 at SRPC, Bengaluru, SRLDC presented the constraints being observed in the SR grid during real time operation. SRLDC requested SR constituents for timely implementation of the under construction / approved ICTs at various STU substations for smooth operation of the grid. STUs are requested to update the status of the augmentation of ICTs at various STU substations.

It was also informed that KSEB vide letter dated 25.10.2024 (Copy of letter enclosed at Enclosure-B) has communicated that the unrestricted peak demand of Kerala system touched 6000 MW and restricted demand was 5797 MW on 03.05.2024. SRDC has observed high loading on the ICTs at Kozhikode and Thrissur HVDC during the peak demand season of 2023-24. Based on the above operational feedback of SRLDC, KSEB has carried out system studies and it was observed that ICTs at various ISTS and STU substations are heavily loaded and not meeting the N-1 contingency criteria. In order to mitigate the high loading issues and enhance the ATC of Kerala system, ICT augmentation at following substations are proposed by KSEB.

Accordingly, based on the Joint Studies following ICT augmentations were agreed in the 36th CMETS-SR held on 19.12.2024:

- Augmentation of additional 400/220kV, 1x500 MVA ICT (4th) at Kozhikode.
- Augmentation of additional 400/220kV, 1x500 MVA ICT (4th) at Trivandrum

The proposal for augmentation of additional 400/220kV, 1x500 MVA ICT (3rd) at Thrissur HVDC will be discussed in the next CMETS-SR meeting based on the inputs from POWERGRID / outcome of joint site visit. Schematic is given at Figure 6-18 & **Figure 6-19**

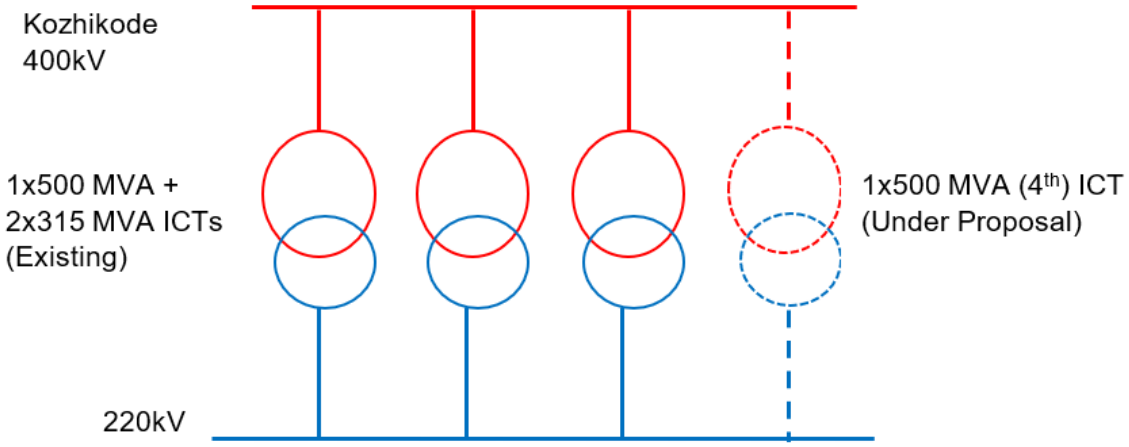


Figure 6-18 : Augmentation of additional 400/220kV, 1x500 MVA ICT (4th) at Kozhikode

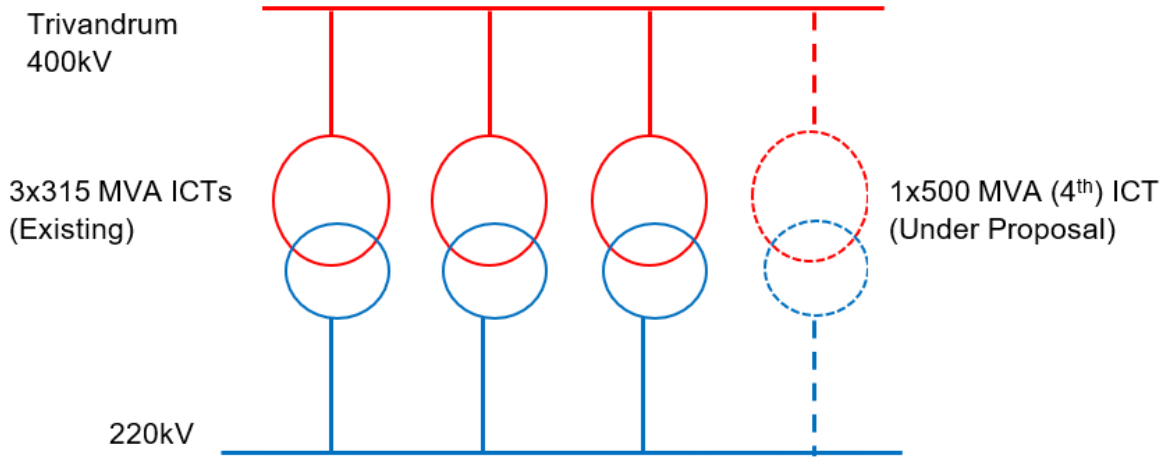


Figure 6-19 : Augmentation of additional 400/220kV, 1x500 MVA ICT (4th) at Trivandrum

Estimated Cost: ₹96 Crs.

6.4.5 Tamil Nadu

(i) <u>Transmission System for 1 GW Offshore wind farm (Phase-I) in Tamil Nadu</u>

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.

The transmission system for the 1 GW Offshore wind generation in Tamil Nadu was deliberated during the 28th CMETS meeting held on 29.02.2024 and was forwarded to SRPC for views on 05.03.2024 and same was deliberated in the 50th SRPC meeting held on 16.03.2024. SRPC vide letter dated 18.04.2024 has forwarded the views of Southern Region constituents.

The transmission system was discussed in the 20th NCT meeting held on 25.06.2024. During the 20th NCT meeting, based on the inputs from MNRE, it was decided that initially transmission system for 500 MW VGF offshore wind generation project may be taken up for implementation. The details of the transmission system is as below:

A. Transmission System onwards Onshore Pooling Station

- Establishment of 2x500 MVA, 400/230 kV Onshore Pooling Station near Avaraikulam, Tirunelveli District in Tamil Nadu with provision of expansion upto 5 GW.
- Avaraikulam Onshore PS – Tuticorin PS 400 kV D/c quad line (approx. 100 km)
- ± 300 MVAr STATCOM along with 2x125 MVAr MSR

The details are as below:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
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: • 400/230 kV, 500 MVA, ICTs – 9 Nos.	• 400/230 kV, 500 MVA, ICTs – 3 Nos. • 400 kV ICT bays – 3 Nos. • 220 kV ICT bays – 3 Nos. • 400 kV line bays – 2 Nos. (at Avaraikulam Onshore PS for

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	• 400 kV ICT bays – 9 Nos. • 230 kV ICT bays – 9 Nos. • 400 kV line bays – 12 Nos. (with provision for SLR) • 230 kV line bays – 16 Nos. • 230 kV Bus Sectionalizer : 3 sets • 230 kV Bus Coupler (BC) Bay – 3 Nos. • 230 kV Transfer Bus Coupler (TBC) Bay – 3 Nos: 1 set	termination of Avaraikulam Onshore PS – Tuticorin PS line) • 230 kV 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 400 kV line bays - 2 (at Tuticorin PS)
3	± 300 MVAr STATCOM along with 2x125 MVAr MSR	400 kV bay – 1 No.

Estimated Cost: ₹ 1123 Crs.

B. Transmission System for integration of Offshore Wind Farms with Onshore PS Offshore Substation-1 {500 MW VGF} :

- Establishment of 2x315 MVA, 230/66kV Off-Shore Substation-1 with 10 nos. of 66kV line bays for RE integration
- 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. Schematic is given at Figure 6-20

The details are as below:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	Offshore Substation-1 {500 MW VGF}	
1	• Establishment of 2x315 MVA, 230/66 kV Off-Shore Substation- 1 No. with 10 Nos. of 66 kV line bays for RE integration	• 230/66 kV, 315 MVA, ICTs – 2 Nos. • 230 kV ICT bays – 2 Nos. • 66 kV ICT bays – 2 Nos. • 230 kV line bays – 2 Nos. (at OffShore Substation-1 for termination of Offshore substation 1 (OSS-1) – Avaraikulam Onshore PS line) • 66 kV line bays – 10 Nos
A	**Transmission System Onwards Onshore Pooling Station**	
2	• Offshore substation 1 (OSS-1) – Avaraikulam Onshore PS 2 Nos. 230 kV (atleast 300 MVA capacity) Submarine cables (~35 - 40 km) with 2x50 MVAr switchable line reactors at OSS-1 end	• Cable length ~35 - 40 km • 230 kV, 50 MVAr 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. • 230 kV ICT bays – 2 Nos. • 66kV ICT bays – 2 Nos. • 230 kV line bays – 2 Nos. (at OffShore Substation-2 for termination of Offshore substation 2 (OSS-2) – Avaraikulam Onshore PS line) • 66 kV line bays – 10 Nos.
2	Offshore substation 2 (OSS-2) – Avaraikulam Onshore PS 2 Nos. 230 kV (atleast 300 MVA capacity) Submarine cables (~35 - 40 km) with 2x50 MVAr switchable line reactors at OSS-2 end	• Cable length ~35 - 40 km • 230 kV, 50 MVAr switchable line reactors at OSS-2 end – 2 Nos.

Estimated Cost: ₹ 5146 Crs

Total Estimated Cost: ₹ 6269 Crs

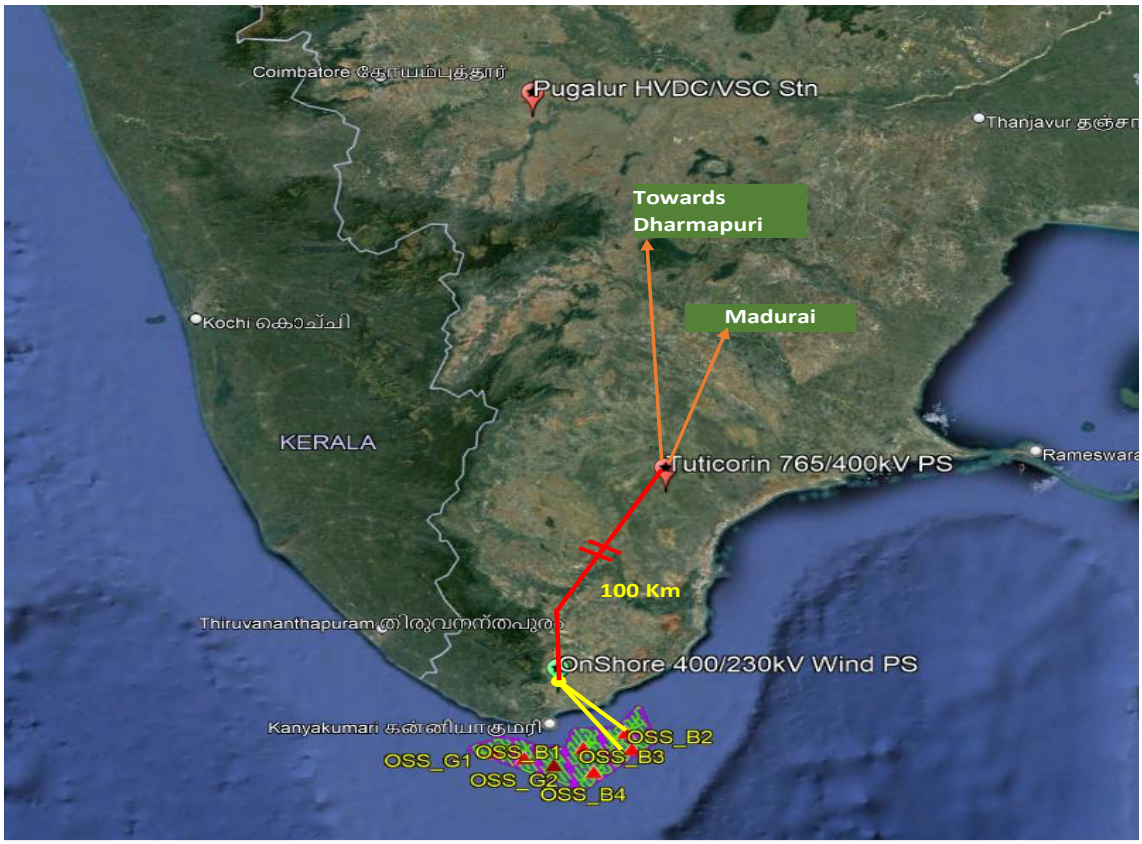


Figure 6-20 : Transmission System for integration of Offshore Wind Farms with Onshore PS

(ii) Implementation of 1 nos. of 230kV line bay at Karur 400/230kV PS for integration of RE generation project (M/s Nannai Solar Park Private Ltd.)

Presently, Karur 400/230kV PS is under operation with 2x500 MVA, 400/230kV ICTs and 2x500 MVA, 400/230kV ICTs (3rd & 4th) are under implementation and expected commissioning schedule is 11.09.2025. During the 30th CMETS-SR held on 30.04.2024, Connectivity of 93 MW has been agreed for grant to M/s Nannai Solar Park Private Ltd. at 230kV level with 1 nos. of 230kV line bay. The applicant has requested for implementation of 230kV bay at Karur PS under ISTS and same was agreed. Schematic is given at Figure 6-21. The details are as below:

Sl. No.	Description of Transmission Element	Scope of work	Schedule
1	1 no. 230kV line bay at Karur 400/230kV PS for termination of dedicated line of M/s Nannai Solar Park Private Ltd.	230kV line bays – 1 Nos.	30.09.25

Estimated Cost : ₹ 6Crs.

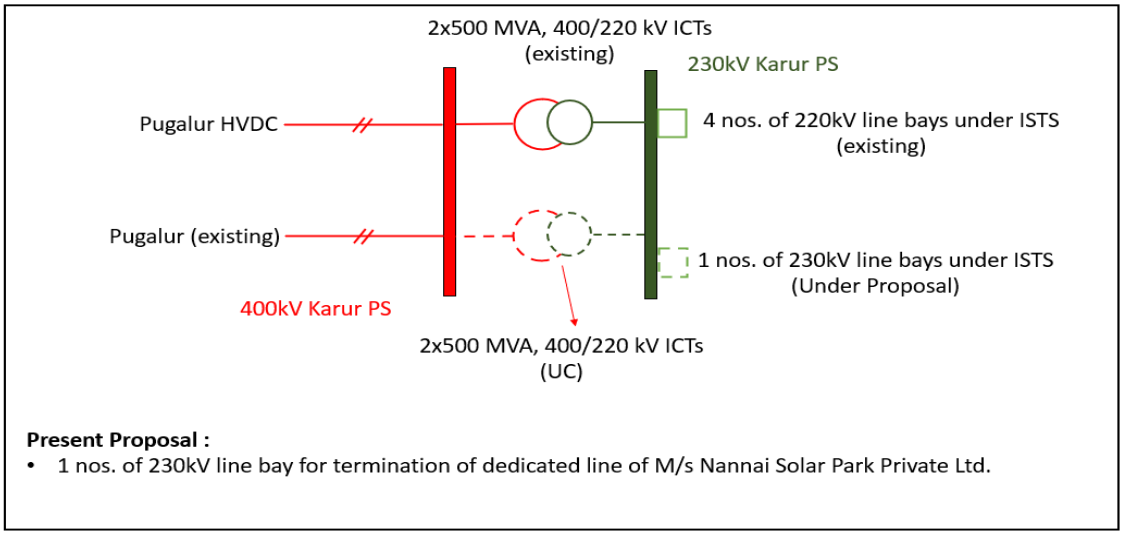


Figure 6-21: Implementation of 1 nos. of 230kV line bay at Karur 400/230kV PS for integration of RE

(iii) Transmission system for proposed Green Hydrogen / Green Ammonia projects in Tuticorin area.

A meeting was held on 19.10.2023 chaired by Hon'ble Minister of Power and NRE with Green Hydrogen stakeholders/association, wherein it was decided that developers shall share the details of year-wise planned Green Ammonia / Green Methanol capacities and corresponding drawl capacities desired at different locations. It was also decided 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.

Subsequently, CEA convened a meeting with Green Hydrogen / Green Ammonia manufacturers to access the year wise electricity demand for proper planning of transmission system. In Tuticorin area, about 7000 MW demand has been envisaged for the Green Hydrogen / Green Ammonia projects. In view of the upcoming Green Hydrogen / Green Ammonia projects, transmission system has been identified for delivery of power to the potential Green Hydrogen / Green Ammonia projects. After discussion, CEA & CTU identified following transmission system for supply of power at Tuticorin to potential Green Hydrogen / Green Ammonia projects:

Proposed Transmission network:

- Establishment of Tuticorin (GH) 765/400 kV, 3x1500 MVA S/s with 1x240 MVAR Bus Reactor.
- Tuticorin Pool – Tuticorin (GH) 765 kV D/c line.
- Upgradation of 765 kV Tuticorin Pool (presently charged at 400 kV) to its rated voltage at 765 kV.
- Upgradation of 765 kV Dharmapuri (presently charged at 400 kV) to its rated voltage at 765 kV.
- Upgradation of Tuticorin Pool – Dharmapuri 765 kV line (presently charged at 400 kV) to its rated voltage at 765 kV.
- Upgradation of Dharmapuri – Madhugiri 765 kV line (presently charged at 400 kV) to its rated voltage at 765 kV

In the meanwhile, application under GNA Regulations has been received from M/s AM Green Ammonia (India) Pvt. Ltd. in Feb, 2024 seeking grant of GNA-RE as Bulk Consumer for 1660 MW. M/s AM Green Ammonia (India) Pvt. Ltd. has indicated that they are in the process of developing Green Ammonia Plant in phased manner. The total drawl requirement for the entire Green Ammonia Tuticorin project capacity shall be 2260 MW. The application was discussed in the 31st CMETS-SR, held on 30.05.2024 wherein it was decided that GNA-RE may be granted to M/s AM Green Ammonia (India) Pvt. Ltd. at Tuticorin for production of Green Hydrogen / Green Ammonia through following transmission scheme:

- Establishment of 3x1500 MVA, 765/400 kV Tuticorin (GH) project with 1x240 MVAR bus Reactor.
- Tuticorin Pool – Tuticorin (GH) 765 kV D/c line.
- Upgradation of 765 kV Tuticorin Pool (presently charged at 400 kV) to its rated voltage at 765 kV along with 3x1500 MVA, 765/400 kV ICTs and 1x330 MVAr bus Reactor.
- Upgradation of 765 kV Dharmapuri (presently charged at 400 kV) to its rated voltage at 765 kV along with 3x1500 MVA, 765/400 kV ICTs and 1x330 MVAr bus Reactor.

- Upgradation of Tuticorin Pool – Dharmapuri 765 kV line (presently charged at 400 kV) to its rated voltage at 765 kV alongwith 1x330 MVAr Switchable Line Reactor at both end of each circuit.
- Upgradation of Dharmapuri – Madhugiri 765 kV line (presently charged at 400 kV) to its rated voltage at 765 kV alongwith 1x330 MVAr Switchable Line Reactor at Dharmapuri end of each circuit

The transmission scheme was discussed and agreed in principally in the 52nd SRPC meeting held on 03.08.2024. Subsequently, same was approved in the 22nd NCT meeting held on 23.08.2024. Schematic is given at Figure 6-22

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Establishment of 3x1500 MVA, 765/400 kV Tuticorin (GH) S/s with 1x240 MVAR bus Reactor **Future Space Provisions:** • 765/400kV, 1500 MVA, ICTs – 3 nos. • 765kV ICT bays – 3 nos. • 400kV ICT bays – 3 nos. • 765kV line bays – 6 nos. (with provision for SLR) • 400kV line bays – 16 nos. (with provision for SLR) • 400kV Bus Sectionalizer : 1 set	• 765/400kV, 1500 MVA, ICTs – 3 nos. (10x500 MVA incl. 1 spare unit) • 765kV ICT bays – 3 nos. • 400kV ICT bays – 3 nos. • 765kV line bays – 2 nos. (at Tuticorin (GH) S/s for termination of Tuticorin (GH) – Tuticorin PS 765kV D/c line) • 765 kV, 240 MVAr Bus Reactor – 1 nos. (4x80 MVAr inc. 1 switchable spare unit) • 765 kV Bus Reactor bays – 1 nos.
2.	Tuticorin PS – Tuticorin (GH) 765 kV D/c line	~ 50 km • 765kV line bays – 2 nos. (at Tuticorin PS)
3.	Upgradation of Tuticorin PS - Dharmapuri (Salem New) 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	• 765kV line bays Tuticorin PS – 2 nos. • 765 kV, 330 MVAr SLR at Tuticorin PS – 2 nos. (7x110 MVAr inc. 1 spare unit for both bus reactor and line reactor) • 765kV line bays at Dharmapuri (Salem New) – 2 nos. • 765 kV, 330 MVAr SLR at Dharmapuri (Salem New) – 2 nos. (7x110 MVAr inc. 1 spare unit for both bus reactor and line reactor)
4.	Transmission line for change of termination from 400kV switchyard to 765kV switchyard for Tuticorin PS – Dharmapuri (Salem New) 765kV D/c line at Tuticorin PS & Dharmapuri (Salem New)	Approx. 1-2 kms at each end
5.	Upgradation of Tuticorin PS to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 1x330 MVAr, 765kV bus reactors **Future Space Provisions:** • 765/400kV, 1500 MVA, ICTs – 1 no. • 765kV ICT bays – 1 no.	• 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 – 1 nos. • 765 kV Bus Reactor bays – 1 nos.

Sl. No.	Scope of the Transmission Scheme	Capacity /km
	• 400kV ICT bays – 1 no. • 765kV line bays – 6 nos. (with provision for SLR)	
6.	Upgradation of Dharmapuri (Salem New) to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 1x330 MVAr, 765kV bus reactor **Future Space Provisions:** • 765/400kV, 1500 MVA, ICTs – 1 no. • 765kV ICT bays – 1 no. • 400kV ICT bays – 1 no. • 765kV line bays – 6 nos. (with provision for SLR)	• 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 – 1 nos.765 kV Bus Reactor bays – 1 nos.
7.	400 kV line reactors on Tuticorin PS - Dharmapuri (Salem New) 765kV D/c line shall be utilized as bus reactors at respective 400kV substations based on availability of bays.	
8.	Upgradation of Dharmapuri (Salem New) – Madhugiri 765kV 2xS/c lines (presently charged at 400 kV) to its rated voltage at 765 kV with 1x330 MVAr switchable Line Reactor on Dharmapuri (Salem New) end of each circuit	• 765kV line bays at Dharmapuri (Salem New) – 2 nos. • 765 kV, 330 MVAr SLR at Dharmapuri (Salem New) – 2 nos. (6x110 MVAr switchable units) • 765kV line bays at Madhugiri – 2 nos.
9.	Transmission line for change of termination from 400kV switchyard to 765kV switchyard for Dharmapuri (Salem New) – Madhugiri 765kV 2xS/c line at Dharmapuri (Salem New) & Madhugiri	Approx. 1-2 kms at each end
10.	400 kV line reactors on Dharmapuri (Salem New) – Madhugiri 765 kV 2xS/c lines shall be utilized as bus reactors at respective 400kV substations based on availability of bays.	

Estimated Cost: ₹ 3098Crs.

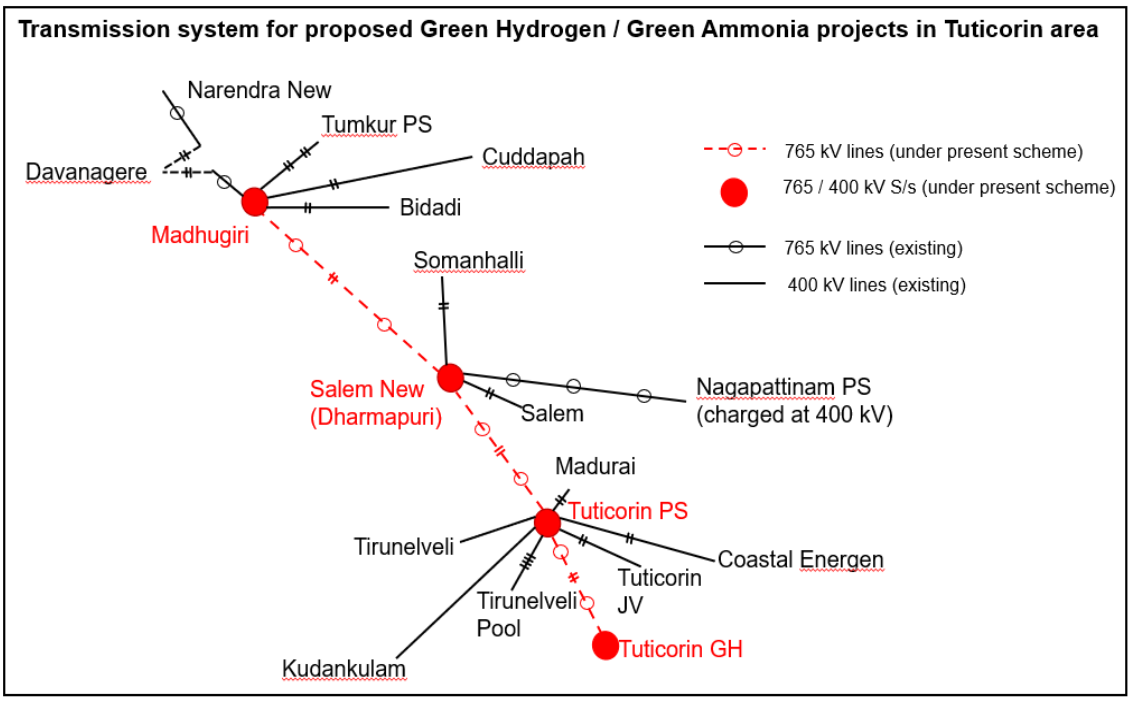


Figure 6-22 : Transmission system for proposed Green Hydrogen / Green Ammonia projects in Tuticorin area

(iv) <u>Dynamic compensation at proposed Kakinada GH and Tuticorin GH substations for integration of Green Hydrogen / Green Ammonia project</u>

Transmission system for proposed Green Hydrogen / Green Ammonia projects in Tuticorin area was agreed for implementation through TBCB route in the 22nd NCT meeting held on 23.08.2024 and the transmission scheme is under bidding stage. This transmission scheme involves establishment of 3x1500 MVA, 765/400 kV Tuticorin (GH) S/s.

The transmission scheme involves establishment of 3x1500 MVA, 765/400 kV Kakinada GH S/s. After detailed deliberations, the requirement of dynamic reactive compensation at proposed Kakinada GH and Tuticorin GH Substations for integration of Green Hydrogen / Green Ammonia projects was agreed by the SR constituents. Details of dynamic reactive compensation is as below:

<u>Dynamic compensation at proposed Tuticorin GH for integration of Green Hydrogen / Green Ammonia projects</u>

- <u>+</u> 300 MVAr STATCOM with 2x125 MVAr MSC at Tuticorin 765/400kV GH S/s with control switching arrangement for proposed 1x240 MVAr bus reactor
- Space provision for 2nd <u>+</u> 300 MVAr STATCOM with 2x125 MVAr MSC at Tuticorin 765/400kV GH S/s

<u>Dynamic compensation at proposed Kakinada GH for integration of Green Hydrogen / Green Ammonia projects</u>

- ± 300 MVAr STATCOM with 2x125 MVAr MSC at Kakinada 765/400kV GH S/s with control switching arrangement for proposed 1x240 MVAr bus reactor
- Space provision for 2nd ± 300 MVAr STATCOM with 2x125 MVAr MSC at Kakinada 765/400kV GH S/s

"Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area. Andhra Pradesh (Phase-I)" was discussed in the 25th NCT meeting held on 28.11.2024 wherein NCT recommended Transmission System under TBCB route with PFCCL as BPC. Details of the transmission schemes are as under:

Transmission system for proposed Green Hydrogen / Green Ammonia projects in Kakinada area (Phase-I: 3000 MW)

- Establishment of Kakinada 765/400 kV, 3x1500 MVA substation with 240 MVAr bus reactor.
- LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada substation with 240 MVAr SLR at Kakinada end on Srikakulam – Kakinada section
- ± 300 MVAr STATCOM with 2x125 MVAr MSC at Kakinada 765/400 kV GIS S/s with control switching arrangement for proposed 1x240 MVAr bus reactor
- Space provision for 2nd ± 300 MVAr STATCOM with 2x125 MVAr MSC at Kakinada 765/400 kV S/s

Further, Modification in the scope of the scheme "Transmission system for proposed Green Hydrogen/ Green Ammonia projects in Tuticorin area" was also agreed in the NCT meeting wherein Dynamic compensation at proposed Tuticorin GH for integration of Green Hydrogen / Green Ammonia projects was also agreed.

(v) Augmentation of transformation capacity at Udumalpet 400/230kV S/s

Presently Udumalpet substation is under operation with 3x315 MVA, 400/230kV ICTs. During the 220th OCC meeting of SRPC held on 12.11.2024, POWERGRID SR-II informed that the existing ICTs at Udumalpet are continuously loaded most of the time to their full load and not meeting the N-1 contingency criteria (Copy of MoM enclosed at Enclosure-F). It was informed that Dissolved Gas Analysis (DGA) violations have been detected in ICT-2 at Udumalpet substation which has been operational since January 25, 1992, indicating a potential issue with the transformer. Accordingly, POWERGRID proposed that the ICT-2 at Udumalpet Substation shall be considered for augmentation due to the increasing fault gases.

During the above OCC meeting SRLDC informed that N-1 variation has been observed during pump mode operation at Kadamparai and high demand season as well. It is also informed that during the January to March 2024 period, the N-1 violation occurred 8% to 26 % of the time, and the loading reached up to 270-280 MVA per ICT. In April 2024, the violation occurred 22% of the time. This clearly indicates the need for an additional ICT to address the issue. The commissioning of this additional ICT is necessary to

resolve these concerns. Edayarpalayam is also supposed to be commissioned, but it has been delayed. According to recent meetings / TN information, it is expected to be completed by the year 2026-27. Considering all these factors, there is definitely a need for the additional ICT, and its augmentation is required.

After detailed deliberations in the 36th CMETS-SR held on 19.12.2024, augmentation / replacement of existing 400/230kV, 315 MVA ICT-2 with 1x500 MVA ICT at Udumalpet 400/230kV S/s was agreed. It was also agreed that the shutdown time of the ICT may be optimised and the replacement works may be carried out during the off peak demand period. It was also agreed that the requirement of 4th 500 MVA ICT at Udumalpet shall be studied separately based on the inputs from TANTRANSCO regarding space availability at Udumalpet 230kV switchyard. Schematic is given at **Figure 6-23**.

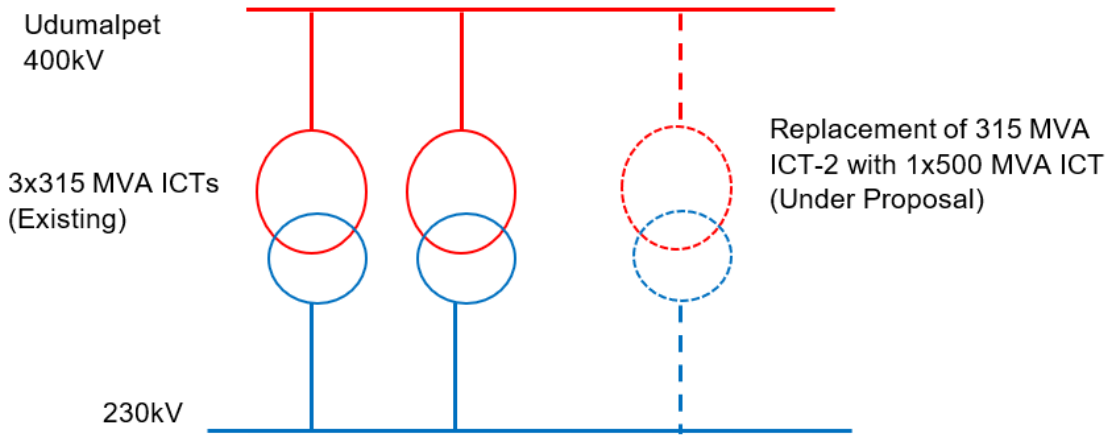


Figure 6-23: Augmentation of transformation capacity at Udumalpet 400/230kV S/s

Estimated Cost: ₹ 31 Crs.

(vi) <u>Augmentation of 1x500 MVA, 400/230 kV ICT (7th) at Tuticorin-II GIS in Tamil Nadu</u>

Tuticorin-II GIS PS was implemented by POWERGRID as part of Green Energy Corridor with 2x500 MVA, 400/230 kV transformation capacity. Subsequently, 3x500 MVA, 400/230 kV ICTs (3rd, 4th & 5th) have been implemented & under operation. Further, 1x500 MVA, 400/230 kV ICT (6th) is under implementation and expected by December 2025. Presently, Connectivity of about 2500 MW has been granted / agreed for grant at Tuticorin-II GIS PS and the pooling station was closed as no margins were available for further grant of connectivity.

Subsequently, additional Connectivity for 130 MW has been received from M/s NCL Industries Ltd. in the month of Aug'24. The connectivity application was discussed in the 36th CMETS-SR held on 19.12.2024 wherein it was agreed to grant connectivity to M/s NCL Industries Ltd. with 7th ICT at Tuticorin-II GIS PS. The applicant has

requested for implementation of 230kV line bay under ISTS for termination of dedicated transmission line.

Accordingly, the augmentation of transformation capacity by 1x500 MVA, 400/230kV ICT (7th) at Tuticorin-II GIS PS is proposed for implementation. Schematic is given at **Figure 6-24.**

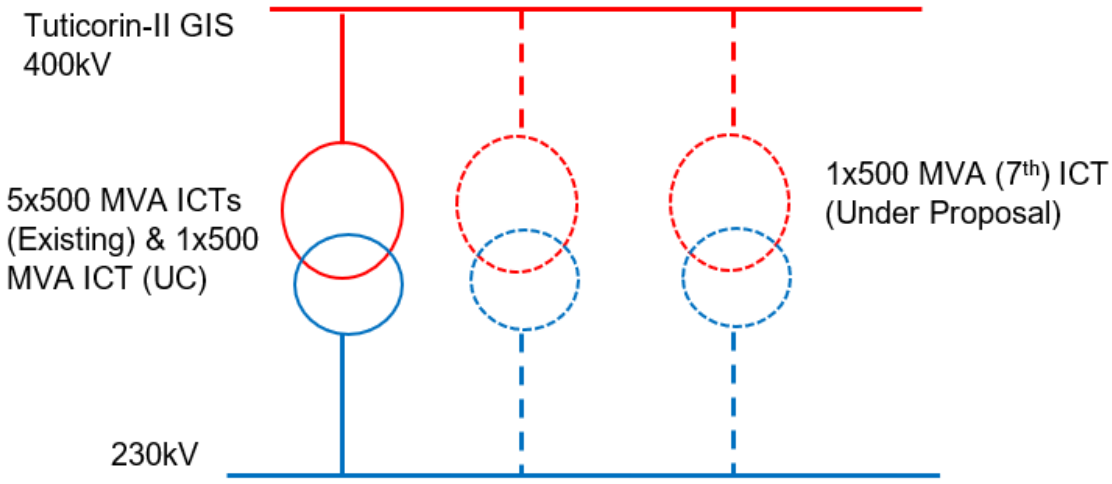


Figure 6-24: Augmentation of 1x500 MVA, 400/230 kV ICT (7th) at Tuticorin-II GIS in Tamil Nadu

Estimated Cost: ₹ 101.5 Crs.

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 2029-30 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. Tranmisison system for integration of above capacity in ISTS is being planned phase-wise depending on the receipt of applications. Accordingly, transmission system planned / approved till date in ISTS along with the corresponding RE capacities has been considered in the system studies. Further, as per the deliberations held with STUs, additional generation capacities in STU along with the planned STU transmission system has been considered in the studies.

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 2029-30 timeframe, 3 nos. of 765kV and 20 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 at **Table 6-6**.

Table 6-6: Transmission Lines Loading in the Base Cases

(All Fig in MVA)

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating
1.	Nagarjuna Sagar – Cuddapah 400 kV S/C line	1,4	ISTS	1017	948
2.	Vijayawada-VIJTP-IV 400 kV S/C line	7	ISTS	647	874
3.	Vijayawada- C'Peta 400 kV D/C line	4	ISTS	629	852
4.	Cuddapah – Chittoor 400 kV S/C line	1	ISTS	707	852
5.	Cuddapah – Nagarjuna Sagar 400 kV S/C line	1,4	ISTS	1079	948
6.	Gooty – Kurnool 400 kV S/C line	1,4	ISTS	803	850
7.	Gooty – Tumkur SP 400 kV D/C line	4	ISTS	1008	1100
8.	Kurnool – Srisailam LB 400 kV S/C line	1,4,7	AP	1374	850
9.	Kurnool – Maheshwaram 400 kV S/C line	4	ISTS	648	850
10.	Vemagiri (AP) – Kakinada SEZ 400kV D/C line	4	AP	627	874
11.	Hyderabad – Maheshwaram 400 kV S/C line	1,4	ISTS	1575	2100
12.	Veltoor – Raichur 400 kV S/C line	1,4	ISTS	2262	2186
13.	Raichur - Munirabad 400 kV S/C line	4	ISTS	600	852
14.	Raichur – Bellary TPP	2,4,5	KPTCL	643	852
15.	Hoody – Devanhalli 400 kV D/C line	1,4,7	KPTCL	771	852
16.	Neelmangala – Yelahanka 400 kV S/C line	7	ISTS & STU (KPTCL)	613	852
17.	Kolar – SP Budur 400 kV S/C line	1,4	ISTS	642	852
18.	Pugalur New – Karur PS 400 kV D/C line	1,4	ISTS	1900	2186

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating
19.	Manali -North Chennai 400 kV S/C line	All	TN	1369	1093
20.	Manali -Manjpkcpint 400 kV S/C line	3,6,9	TN	653	857
21.	Cuddapah – Anantapur-II 765 kV D/C line	1,4	ISTS	2910	3500
22.	Kakinada – Vemagiri 765 kV D/C line	4	ISTS	2657	3500
23.	Vemagiri – C'Peta 765 kV D/C line	1,4	ISTS	2900	3500

b) Transformers

In the base case file prepared for 2029-30 timeframe, transformers at 4 nos. of 765/400kV & 11 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 at **Table 6-7**.

Table 6-7: 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 2x500 MVA, 2x315 MVA Uravakonda ICTs	2,5	APTRANSCO	355 223	500 315
2.	400/220kV, 3x315 MVA Nagarjuna Sagar ICT	7	ISTS	224	315
3.	400/220kV, 3x315 MVA Talaricheruvu ICTs	4,7	APTRANSCO	256	315
4.	400/220kV, 2x315MVA , 2x250 MVA Ramagundam ICTs	7,8,9	ISTS	335 241	315 250
5.	400/220kV, 4x500 MVA Shadnagar ICTs	1,4,7	TGTRANSCO	459	500
6.	400/220kV, 2x315MVA, 1x 500MVA Raichur ICTs	4	KPTCL	294 460	315 500
7.	400/220kV, 3x315MVA Talaguppa ICTs	4	KPTCL	239	315
8.	400/220kV, 2x500 MVA Kudgi ICTs	4	ISTS	359	500
9.	400/220kV, 2x500 MVA Gulbarga ICTs	2,3,5,6	KPTCL	423	500
10.	400/230kV, 3x315MVA , 1x 500MVA Hosur ICTs	1,4,7	ISTS	253 403	315 500
11.	400/220kV, 2x315 MVA, 3x200 MVA Kanarpatti ICTs	1,4,7	TANTRANSCO	342	315
12.	765/400kV, 3x1500 MVA C'Peta ICTs	1	ISTS	1091	1500
13.	765/400kV, 4x1500 MVA Shadnagar ICTs	1,4	ISTS	1185	1500
14.	765/400kV, 2x1500 MVA Warangal ICTs	1	ISTS	1097	1500
15.	765/400kV, 4x1500 MVA Nizamabad ICTs	1	ISTS	1066	1500

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 thermal rating under N-1 contingency are summarized at **Table 6-8.**

Table 6-8: 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.	Nagarjuna Sagar - Cuddapah 400 kV S/C line	Nagarjuna Sagar - Cuddapah 400 kV one ckt	1	ISTS	1109	1290	948	136
Remark: *High RE injection at Cuddapah from nearby RE zones and operation of Hydro units at Nagarjuna Sagar in pump mode is causing the overloading. Suitable strengthening shall be identified in consultation with SR constituents.*								
2.	Gooty- Tumkur SP 400 kV D/c line	Gooty- Tumkur SP 400 kV one ckt	4	ISTS	1028	1294	1100	118
Remark: *High RE injection at Tumkur from ISTS as well STU network is causing the overloading. Shall be studied further after finalisation of KPTCL Intra-State proposals for RE integration.*								
3.	Cuddapah – Ananatapur-II 765 kV D/c line	Cuddapah – Ananatapur-II 765 kV one ckt	1,4	ISTS	2947	4273	3500	122
Remark: *Power from Davanagere & Ananthapuram-II is getting pooled at Cuddapah and causing overloading of Cuddapah – Ananthapuram-II 765kV D/c line. Additional transmission system shall be planned upon materialization of generation as per the requirement.*								
4.	Kakinada – Vemagiri 765 kV D/c line	Kakinada – Vemagiri 765 kV one ckt	1,4,7	ISTS	2664	5075	3500	145
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.*								
5.	Vemagiri – C'Peta 765 kV D/C line	Vemagiri – C'Peta 765 kV one ckt	4	ISTS	2962	4007	3500	115
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.*								

Sl.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
6.	Dichpally – Nizamabad 400 kV D/c line	Dichpally – Nizamabad 400 kV one ckt	1	ISTS	1227	2380	2186	109
Remark: *High loading being observed in high RE scenarios as the despatch from Thermal generation at Ramagundam is not considered in the scenario.*								
7.	Veltoor - Raichur 400 kV S/c line	Kurnool New - Raichur New 765kV S/c	1,4	ISTS	2375	2494	2186	114
Remark: *High Loading is on account of LI loads at Yedula, Vattem, Narlapur etc. Suitable strengthening shall be identified in consultation with SR constituents if required.*								
8.	Pugalur new – Karur PS 400kV D/c line	Pugalur new – Karur PS 400kV one ckt	1,4	ISTS	1910	3242	2186	148
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 NEW – Karur 400kV D/c line. Strengthening of Pugalur New-Karur and Karur- Pugalur 400kV system is being planned as a part of RE integration at Karur / system strengthening for enhancing reverse power flow on RPT to 6000 MW.*								

Further, STU lines loaded beyond thermal rating under N-1 contingency are summarized at **Table 6-9.**

Table 6-9: 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.	Kurnool – Srisailam LB 400kV S/c line	Veltoor - Raichur 400 kV S/c line	1,4	AP	1374	1481	1045	142
2.	Hoodi – Davanahalli 400kV D/c line	Hoodi – Davanahalli 400kV one ckt	1,4,7	KPTCL	774	1332	852	156
3.	Manali – North Chennai 400 kV S/c line	North Chennai – Ariyalur 765kV one ckt	All	TN	1377	1603	1093	147

Suitable system strengthening may be planned by STU based on operational feedback and system studies.

b) Transformers

ISTS ICTs loaded beyond rated MVA rating under N-1 contingency are summarized at **Table 6-10**.

Table 6-10: 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.	400/220kV, 1x250 MVA Ramagundam ICTs	8	ISTS	266	309	250	124
2.	400/132kV, 1x200 MVA Ramagundam ICTs	8	ISTS	204	222	200	111
3.	765/400kV, 4x1500 MVA Shadnagar ICTs	1	ISTS	1210	1529	1500	102
4.	765/400kV, 2x1500 MVA Warangal New ICTs	1, 4	ISTS	1101	1742	1500	116
5.	400/230kV, 3x315 MVA Hosur ICTs	1, 4,7	ISTS	256	339	315	107
6.	400/220 kV, 2x500 MVA Kudgi ICTs	4	ISTS	394	592	500	118

Requirement of additional transformation augmentation wherever necessary would be planned subsequently in coordination with respective STUs.

STU ICTs loaded beyond 100% of MVA rating under N-1 contingency are summarized at **Table 6-11**.

Table 6-11: 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.	400/220kV, 3x315 MVA Talaricheruvu ICTs	1,4,7	AP	262	394	315	125
2.	400/220 kV, 4x500 MVA Shadnagar ICTs	1, 4	TG	461	552	500	110
3.	400/220kV, 2x315 MVA Raichur ICTs	1, 4	KPTCL	292	435	500	138
4.	400/220kV, 1x500 MVA Raichur ICTs	1	KPTCL	463	585	500	117
5.	400/220kV, 2x500 MVA Gulbarga ICTs	2,3,5,6,8	KPTCL	433	674	500	134
6.	400/220kV, 2x200 MVA Salem ICTs	1, 7	TN	188	235	200	117
7.	765/400 kV, 2x1500 MVA Virudhnagar ICTs	4	TN	907	1516	1500	101
8.	400/110 kV, 3x100 MVA Rasipalayam ICTs	2,3,4,5,6	TN	97	131	100	131
9.	400/110 kV, 3x200 MVA Edayarapalayam ICTs	7	TN	176	211	200	105
10.	400/230 kV, 1x315 MVA Kamudhi ICTs	1	TN	209	414	315	131
11.	400/230 kV, 2x200 MVA Kamudhi ICTs	1,4,7	TN	278	558	200	278

12.	400/110 kV, 3x200 MVA Thenampatti ICTs	1,4,7	TN	171	338	200	169

From above, it is observed that 1 nos. of ICT in AP, 1 nos. of ICT in Telanagana, 2 nos. of ICT in Karnataka and 7 nos. of ICTs 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 at **Table 6-12.**

Table 6-12: 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	57	40
2.	400kV Kurnool-III	ISTS	All	70	63
3.	765kV Maheshwaram	ISTS	All	52	40
4.	400kV Kurnool New*	ISTS	All	64	50
5.	400kV CPeta	ISTS	All	53	50
6.	400kV Somanhally	ISTS	All	47	40
7.	400kV Tirunelveli	ISTS	All	56	40
8.	400kV Udumalpet	ISTS	All	58	40
9.	400kV Pugalur	ISTS	All	47	40
10.	400kV Bidadi	ISTS	All	48	40
11.	400kV Madhugiri	ISTS	All	64	50
12.	400kV Raichur New	ISTS	2,8	49	40
13.	400kV Narendra (new)	ISTS	8,9	57	50
14.	400kV Neyveli TS-II	ISTS	7,8,9	47	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 at **Table 6-13**.

Table 6-13: 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	59	40
2.	400kV Vijayawada	AP	All	50	40
3.	400kV Dichipally	TSTRANSCO	All	49	40
4.	400kV Gajwel	TSTRANSCO	7,8	45	40
5.	400kV Neelamangala	KPTCL	All	54	40
6.	400kV Devanahalli	KPTCL	8,9	45	40
7.	400kV Chennai Ext.	TNTRANSCO	8,9	45	40
8.	400kV Arasur	TNTRANSCO	All	46	40
9.	400kV Almathi	TNTRANSCO	8,9	46	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'25

As on Jan'2025, total Installed Capacity (IC) of Eastern Region was about 36.1 GW and the peak demand met was about 31.4GW. 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'25

(All Fig in MW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES* (MNRE)	Total		
Bihar	7283	-	7283	-	73	528	601	7884	7852
DVC	3037	-	3037	-	192	-	192	3229	3605
Jharkhand	2607	-	2607	-	177	224	401	3008	2292
Odisha	5351	-	5351	-	2179	796	2975	8327	6905
Sikkim	77	-	77	-	643	63	706	783	134
West Bengal	8683	80	8763	-	1414	757	2171	10934	12640
Central unallocated	1836	-	1836	-	86	-	86	1922	64
ER	**28874**	**80**	**28954**	**-**	**4764**	**2369**	**7132**	**36087**	**31,399**

Source: CEA monthly report

7.2 Envisaged Power Supply Scenario by 2029-30

As per the 20th EPS, Eastern Region demand for 2029-30 timeframe is expected to increase to about 45.8 GW. As per the inputs received from various stakeholders, total installed capacity

of Eastern Region for 2029-30 is expected to be about 71.3GW. 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 (2029-30)

(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	13360
DVC	1300	-	1300	-	143	1415	1558	-	2858	5176
Jharkhand	2820	-	2820	-	130	0	130	-	2950	4597
Odisha	3350	-	3350	-	2193	403	2596	600	6546	9107
Sikkim	0	-	0	-	14	0	14	0	14	214
West Bengal	7100	-	7100	-	574	0	574	900	8574	15507
Central	29449	-	29449	-	5819	0	5819	0	35268	-
IPP	4850	-	4850	-	5252	0	5252	0	10102	-
ER	**50909**		**50909**		**14170**	**2518**	**16688**	**1500**	**69097**	**45,752**

There is a growth in peak demand of Eastern Region from present timeframe (2024-25) to 2029-30 with a CAGR of 7.8%. 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	2024-25	2029-30	Increase in demand	CAGR
Bihar	7852	13360	5508	11.2%
DVC	3605	5176	1571	7.5%
Jharkhand	2292	4597	2305	14.9%
Odisha	6905	9107	2202	5.7%
Sikkim	134	214	80	9.8%
West Bengal	12640	15507	2867	4.2%
Andaman	64	72	8	2.4%
ER	**31,399**	**45,752**	**14,353**	**7.8%**

From the above data, it is observed that the CAGR growth of peak demand is maximum for Jharkhand (14.9%) and minimum for West Bengal (4.2%). The CAGR of demand of ER is about 7.8% which is more than the National Average of 6%. In addition to above, bulk power demand of about 6280MW has been considered at various upcoming green hydrogen/ green ammonia, bulk consumers/distribution licensees directly connected to ISTS in the following areas: Paradeep: 3000MW, Gopalpur: 3000MW, Vedanta: 180MW and Maithon:100MW.

The hydro generations of Bhutan (about 4500MW) and Nepal (3200MW) and demand of Bangladesh (1000MW) have been considered in 2029-30 timeframe as a part of Eastern Region for study purpose.

7.3 Load Generation Balance for 2029-30 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 2029-30

timeframe. 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%	81%
2-Aug Peak Load	90%	0%	60%	86%
3-Aug Night Off Peak	70%	0%	40%	71%
4-Jun Solar Max	70%	85%	-100%	91%
5-Jun Peak Load	90%	0%	50%	97%
6-Jun Night Off Peak	70%	0%	0%	77%
7-Feb Solar Max	30%	90%	-100%	64%
8-Feb Peak Load	60%	0%	100%	68%
9-Feb Night Off Peak	30%	0%	40%	47%

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'29 Timeframe			Jun'29 Timeframe			Feb'30 Timeframe		
	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	-8866	2212	2727	-6760	5875	6049	-9080	5639	1632
ER-WR	-18833	-8383	-8860	-20610	-9065	-7267	-15021	1540	-3368
ER-SR	-367	-696	-670	-2212	-567	383	2227	2655	3216
ER-NER	-1712	-1166	-1245	-2746	-2404	-1798	-1528	-517	-315
ER- Cross border	-3049	-4182	-3715	-3050	-4196	-3742	-760	-2433	-1016
Eastern Region (net)	-32827	-12215	-11763	-35378	-10357	-6375	-24162	6884	149

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 (35.4GW) and export (6.9GW). 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 2029-30 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 Feb/Mar'24 to Jan'25

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Eastern Region (CMETS-ER) from Feb/Mar'24 to Jan'25. 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, Odisha & West Bengal			
1.	ERES-43 – Reconductoring (Farakka, Kahalgaon, Talcher & Meramunduli)	01-03-26	310.28
Bihar & West Bengal			
1.	ERES-44 – Re-conductoring Chukha Transmission System (CTS)	30-09-26	385.77
West Bengal			
1.	ERGS-IV – LILO at OMIPL Station	31-01-27	38.4
Jharkhand			
1.	ERGS-III – Line Shifting at Koderma Thermal Power Station (DVC)	01-02-28	Awaited
Odisha			
1.	ERES-42 – 3rd ICT at Pandiabili	30-09-26	45.58
2.	Paradeep – Andaman – Nicobar HVDC link	2031-32	37981

7.4.1 Odisha

(i) <u>ERES-42 – 3rd ICT at Pandiabili</u>

Presently, 400/220kV Pandiabili (POWERGRID) S/s is having the transformation capacity of 2x500MVA. The maximum loading has crossed 500MW. Further, with upcoming Pratapsan – Cuttack 220kV line and Pandiabili (POWERGRID) – Samangara 220kV line, the existing transformers would breach the N-1 criteria. Accordingly, there is requirement of new 1x500MVA, 400/220kV (3rd) ICT at Pandiabili (POWERGRID) S/s.

Presently, 1 no. 400kV spare GIS bay is being implemented at Pandiabilli GIS S/s (under approved ERBS-I scheme) with completion schedule of 30-09-2024. The said spare bay is planned to be used for installation of 3rd ICT. The same timeline viz. 30-09-2024 is planned for augmentation of transformation capacity at Pandiabili S/s so as to match availability of ICT and associate bay. For installation of 3rd ICT, there is requirement of GIB duct of 250m (1-Ph) and 100m (1-Ph) at 400kV and 220kV levels respectively.

This scheme has been agreed in the 31st CMETS-ER held on 30-05-2024. Details of the scheme is tabulated below at **Table 7-7**. Schematic is also given at **Figure 7-1**.

Table 7-7: Scope of works of ERES-42

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Installation of new 1x500MVA, 400/220kV (3rd) ICT at Pandiabili (POWERGRID) S/s along with associated bay at 220kV level [using the bay no. 413 at 400kV level, which is already under implementation under ERBS-I scheme].	• 500MVA, 400/220kV ICT: 1 no. • 220kV GIS ICT bay: 1 no. • 400kV GIS duct: 250m approx.(1-Ph) • 220kV GIS duct: 100m approx.(1-Ph)
Note: *POWERGRID is inter alia implementing a full diameter (413-414-415) under ERBS-I scheme for termination of one circuit of Talcher-III – Pandiabili (POWERGRID) 400kV D/c line in bay no. 415. The other bay of the diameter viz. 413 is planned to be used for termination of the 3rd 400/220kV ICT.*		

Implementation Timeframe: 30-09-2026

Estimated Cost: ₹45.58 Cr.

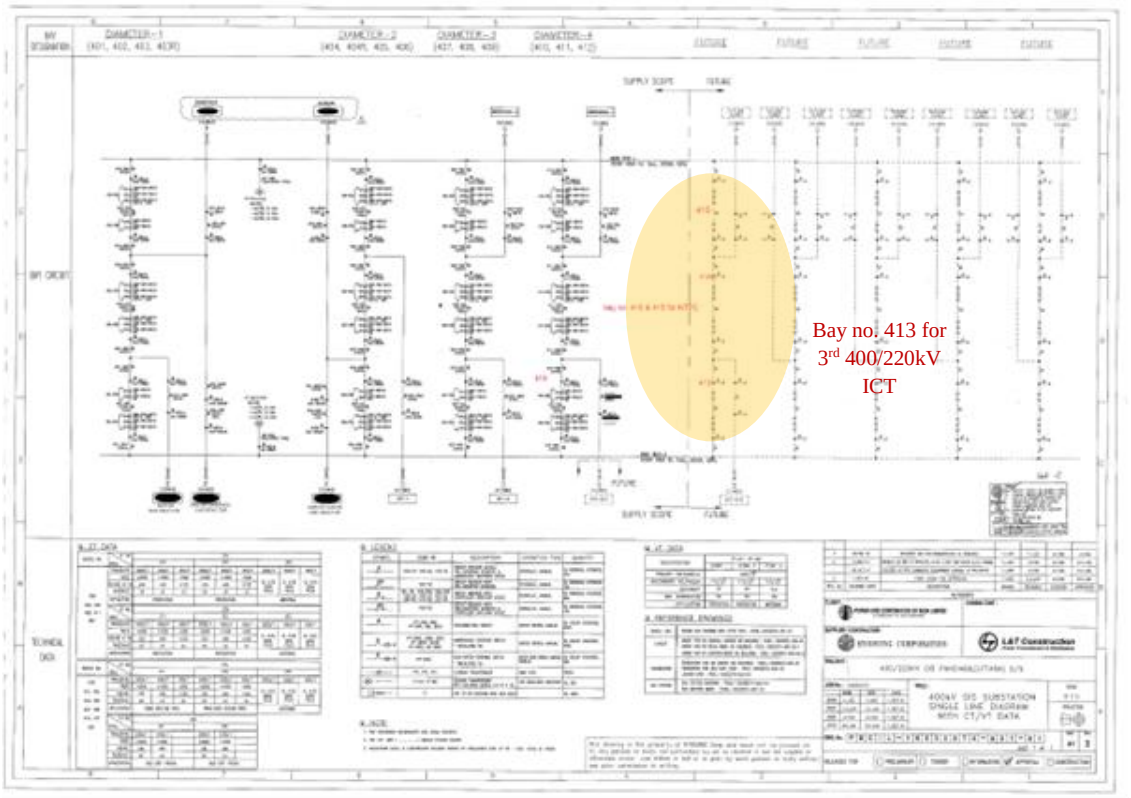


Figure 7-1: Schematic of ERES-42

(ii) Paradeep – Andaman – Nicobar HVDC link

The peak demand of North, Middle and South Andaman is expected to increase to about 79 MW by 2029-30. Presently, there is dependency on diesel generators to large extent. Keeping in view the long-term power requirement of Andaman & Nicobar Islands (ANI);

to supply clean and reliable power towards greening the island initiative; reduce dependency on diesel generators; reduce greenhouse gas emissions; and improve reliability, security and quality of power supply, a HVDC link from mainland to ANI through undersea cable has been envisaged. In this regard, feasibility of ±320kV, 500MW HVDC Bipole Paradeep – Andaman interconnection (about 1150 km) with 250MW HVDC terminals at both ends in first phase is explored. It is also estimated that a new bulk power demand is expected in greater Nicobar area. Accordingly, this link can be extended to greater Nicobar Island. Various alternatives regarding the Paradeep – Andaman – Greater Nicobar were deliberated and a configuration comprising of three 250 MW VSC Symmetrical Monopole HVDC Terminals one each at Paradeep, Andaman Islands and Greater Nicobar Islands and 500 MW HVDC cable from Paradeep to Andaman and 250 MW HVDC Cable from Andaman Islands to Greater Nicobar Islands was decided from techno-economical point of view.

Considering the present and future demand expected at Andaman Islands and Greater Nicobar Islands, ±320 kV, 250 MW Multi-Terminal Symmetrical Monopole HVDC link with 250 MW terminals each at Paradeep (Odisha), Andaman Islands and Greater Nicobar Islands is technically feasible. The cable from Paradeep to Andaman Islands shall have 500 MW rating and the one from Andaman to Greater Nicobar shall be rated for 250 MW. Space shall be kept at Paradeep HVDC station for upgradation of terminal by 250 MW when total demand towards the A&N Islands exceeds 250 MW. A schematic is given below.

The scheme was discussed and agreed in the 24th CMETS-ER held on 31-10-2023 & in the 20th NCT held on 25-06-2024 considering the views of RPC and 26th NCT held on 06-01-2025. Details of the scheme are given below. Schematic is also given at **Figure 7-2**

Scope of Works:

(i) **Transmission Line**

a) 400 kV D/c (Twin Moose) Paradeep 765/400 kV GIS S/S - Paradeep HVDC Station line: 12km
b) (b) Paradeep HVDC Station – Andaman Island: 320 kV, 500 MW HVDC Undersea Cable: 1150 km
c) Andaman Island – Nicobar Island 320kV, 250 MW HVDC Undersea Cable: 550 km

Remarks: *66 kV lines at Andaman and Nicobar side not considered and expected to be under Andaman & Nicobar Electricity Department Scope.*

(ii) **Substation**

a) Establishment of new HVDC station at Paradeep, Orissa
   - ±320kV, 250MW VSC based Symmetric Monopole HVDC terminal at Paradeep, Orissa

- Power will be injected at 400kV AC bus through VSC converter transformers
  - 400 kV line bays (AIS): 2 nos. for termination of Paradeep HVDC Station – Paradeep 765/400 kV GIS Substation (400 kV D/c Twin Moose) line
  - 400 k VSC bays: 2 Nos. for evacuation through VSC Pole

b) Extension at Paradeep 765/400 kV GIS Substation S/S
- 2 Nos. 400 kV line bays (GIS) at Paradeep 765/400 kV GIS Substation S/S for termination Paradeep HVDC Station – Paradeep 765/400 kV GIS Substation 400 kV D/c (Twin Moose) line

c) Establishment of new HVDC station at Andaman Island
- ±320kV, 250MW VSC based Symmetric Monopole HVDC terminal at Andaman Island
- Power will be drawn at 66kV AC bus through VSC interface transformers
  - 12 nos. 66kV GIS line bays for termination of outgoing 66kV feeder
  - 1 No.66kV GIS (3000 A) VSC Bay for evacuation from VSC System

d) Establishment of new HVDC station at Nicobar Island
- - ±320 kV, 250 MW VSC based Symmetric Monopole HVDC terminal at Nicobar Island
- - Power will be drawn at 66 kV AC bus through VSC interface transformers
  - 12 Nos. 66kV GIS line bays for termination of outgoing 66kV feeder
  - 1 No. 66kV GIS (3000 A) VSC Bay for evacuation from VSC System

Implementation Timeframe: 5 years from the date of allocation

Estimated Cost: ₹37,981Cr.

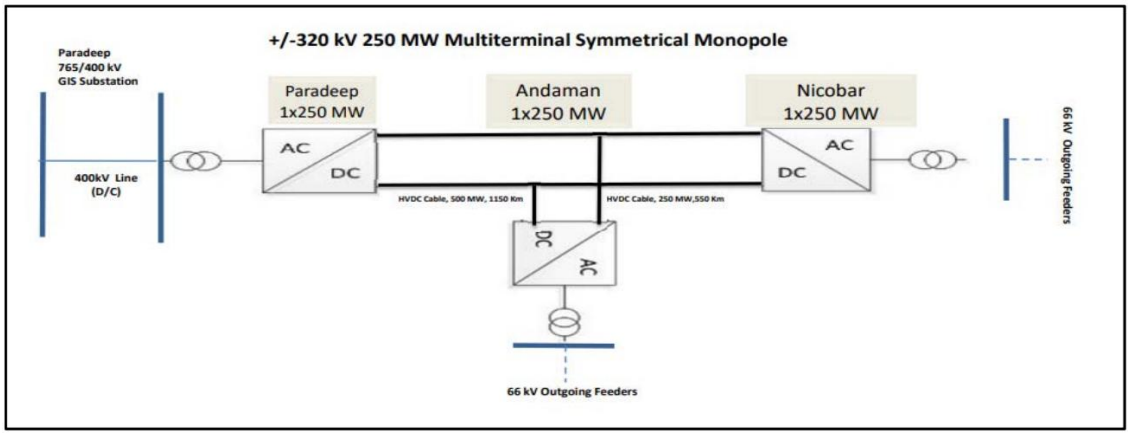


Figure 7-2: Schematic for Paradeep – Andaman – Nicobar HVDC link

7.4.2 West Bengal

(i) ERGS-IV – LILO at OMIPL Station

OMIPL had applied for ISTS Connectivity of 270MW & 180MW for its generation in Paschim Medinipur district of West Bengal with start date of connectivity as 31-03-2025 & 13-12-2025 respectively. Thus, the total generation capacity of the complex becomes 450MW. The application for 270MW quantum was discussed the 36th Consultation Meeting for Evolving Transmission Schemes in Eastern Region (CMETS-ER) meeting held on 29-10-2024. After receipt of new application for 180MW quantum, both applications were together discussed in 37th and 38th CMETS-ER held on 29-11-2024 and 27-12-2024 respectively, wherein study results were presented for two alternatives. Studies have been carried out for 2024-25 timeframe as well as 2028-29 timeframe in the peak solar scenario for 450MW injection from OMIPL generation for the following alternatives:

Alt-1: 400kV D/c DTL from OMIPL to Medinipur (POWERGRID) S/s

Alt-2: LILO of both circuits of Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c at OMIPL generation switchyard.

Further study was carried out with LILO of one circuit of Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c at OMIPL generation switchyard and loading was observed within permissible limit. After detailed deliberations, it was decided in the 38th CMETS-ER that connectivity of M/s OMIPL has been granted with LILO of one circuit of Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c at OMIPL generation switchyard. Accordingly, it was agreed that for termination of LILO of ISTS line at M/s OMIPL switchyard 2 no. 400kV line bays in same diameter shall be provided by M/s OMIPL. M/s OMIPL agreed to the same.

Based on discussion, final scope of works under **Eastern Region Generation Scheme-IV** (**ERGS-IV**) was agreed in the 38th CMETS-ER held on 27-12-2024. Details of the scheme is tabulated below at **Table 7-8**. Schematic is also given at **Figure 7-3**

Table 7-8: Scope of works of ERGS-IV

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	LILO of one circuit of Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c ISTS line at OMIPL generation switchyard under ISTS	• About 9km
Note: *M/s OMIPL shall provide 2 no. of 400kV furnished line bays in same diameter at their generation switchyard for termination of LILO of one circuit of Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c ISTS line at their generation switchyard in matching timeframe of the ISTS scheme namely ERGS-IV for M/s OMIPL.*		

Implementation Timeframe: 18 months from date of allocation

Estimated Cost: ₹38.4Cr.

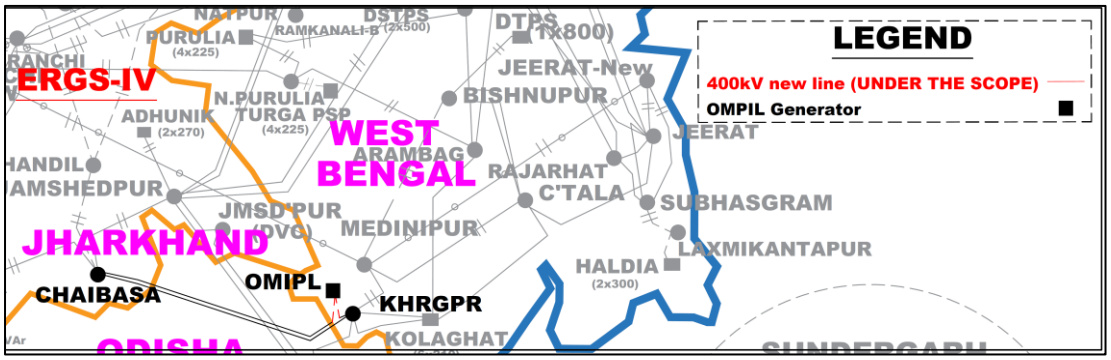


Figure 7-3: Schematic of ERGS-IV

7.4.3 Jharkhand

(i) <u>ERGS-III – Line Shifting at Koderma Thermal Power Station (DVC)</u>

DVC had applied ISTS connectivity for 1100MW and intra-state connectivity for 500MW for its upcoming generation of 1600MW (2x800MW) at Koderma Thermal Power Station, Jharkhand for its 2nd Phase (KTPS-II). Alternatives for providing Connectivity to this generation project at nearby ISTS substations were explored. Considering future generation project system studies were carried out for 2028-29 timeframe for providing ISTS Connectivity to KTPS-II and planning of evacuation system for upcoming intra-state generations in DVC and discussed in the joint study meeting among ER stakeholders on 26-08-2024.

As decided in the special meeting held on 04-10-2024 & 35th Consultation Meeting for Evolving Transmission Schemes in Eastern Region (CMETS-ER) held on 30-09-2024, ISTS Connectivity of 1100MW was provided to DVC for it KTPS-II through shifting of one circuit each of existing Biharsharif – Koderma Ph-I 400kV D/c (Quad) line and Gaya – Koderma Ph-I 400kV D/c (Quad) line from Koderma Ph-I to Koderma Ph-II switchyard so as to form Biharsharif – Koderma Ph-II 400kV S/c (Quad) line and Gaya – Koderma Ph-II 400kV S/c (Quad) line shall be implemented in ISTS as ATS under the Eastern Region Generation Scheme-III (ERGS-III). Details of the scheme is tabulated below at **Table 7-9**.

Table 7-9: Scope of works of ERGS-III

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Shifting of one circuit each of existing Biharsharif – Koderma Ph-I 400kV D/c (Quad) line and Gaya – Koderma Ph-I 400kV D/c (Quad) line from Koderma Ph-I to Koderma Ph-II switchyard so as to form Biharsharif – Koderma Ph-II 400kV S/c (Quad) line and Gaya – Koderma Ph-II 400kV S/c (Quad) line	About 10km
Note:		

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
	• *DVC shall provide 2 nos. 400kV furnished bays at Koderma Ph-II generation switchyard either through shifting of existing line bays equipment or through establishment of new bays for the termination of the one circuit each of Koderma-Gaya & Koderma-Biharsharif lines.* • *DVC and ISTS licensee shall coordinate for above line shifting works.* • *ISTS licensee shall also take care of completion of communication link upon line shifting.* • *The scrap value of the tower members, ACSR conductor, auxiliaries etc. of dismantled assets shall be deducted by the ISTS licensee as per prevailing scrap value to arrive at the final cost of the project. As the scrap value of dismantled assets is already being adjusted against the project cost of this new scheme, tariff of the original Biharsharif – Koderma Ph-I and Biharsharif – Gaya Ph-I 400kV D/c (Quad) lines of POWERGRID shall remain unaffected.* • *DVC shall not implement any arrangement such that KTPS Ph-I and KTPS Ph-II gets connected at 400kV level by any means*	

Implementation Timeframe: 01-02-2028

Estimated Cost: Awaited

Schematic: under finalisation

7.4.4 Bihar, Odisha & West Bengal

(i) ERES-43 – Reconductoring (Farakka, Kahalgaon, Talcher & Meramunduli)

ER predominantly has thermal generations. During the peak solar hours in neighbouring regions of ER, backing down of thermal generations takes place in ER. Under such scenario, constraints are being observed on Kahalgaon (NTPC) – Farakka (NTPC) 400kV D/c line and Talcher (NTPC) – Meramundali (OPTCL) 400kV D/c line (one circuit LILOed at Angul and subsequently bypassed) under N-1.

The Kahalgaon – Farakka 400kV D/c line with thermal rating of 850MVA/ckt. During the peak solar hours loading of 400kV Kahalgaon – Farakka D/c remains above the N-1 security limit. During the backing down of generators of both ends the power flow through this line is above 650MW per circuit.

On the other side Due to frequent outage of HVDC Talcher – Kolar on forced outages/ tripping/ maintenance activities during the peak solar hours constraints in 400 kV Talcher – Meramundali lines. One circuit of Talcher – Meramundali 400kV D/c line was LILOed at Angul in the HCPTC-I project which was subsequently bypassed from Angul switchyard. Due to different length of both circuit uneven power flows through in both circuits. The power flow on the long line is about 300MW and shorter line is about 500MW. On many occasions, to facilitate any planned shutdown in the complex (N-1), generation back down at Talcher I & II, which are cheap pit-head plants, is required to be done to limit the power flow in the Talcher – Meramundali lines.

In view of above, to eliminate these constraints reconductoring of 400kV Kahalgaon – Farakka D/c line & 400 kV Talcher – Meramundali lines with HTLS conductor of 1228A ampacity was discussed and agreed in the 31st CMETS-ER held on 30-05-2024. The scheme was also agreed in the 2nd NCT meeting held on 23rd Aug 2024. Reconductoring of these lines with upgradation of associated 400kV bay equipments at both ends of lines are being taken up under this scheme. As urgent requirement of the scheme and that the line lengths are less, the timeframe of the scheme may be considered as 18 months with best effort basis schedule as 15 months. Details of the scheme is tabulated below at **Table 7-10**. Schematic is also given at **Figure 7-4.**

Table 7-10: Scope of works of ERES-43

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Reconductoring of Kahalgaon (NTPC) – Farakka (NTPC) 400kV D/c (Twin Moose) line with Twin HTLS conductor (with ampacity of single HTLS as 1228A)	190ckm
2.	Reconductoring of Talcher (NTPC) – Meramundali (OPTCL) 400kV D/c (Twin Moose) line (one circuit via Angul and bypassed at Angul) with Twin HTLS conductor (with ampacity of single HTLS as 1228A)	140ckm
3.	Upgradation of associated 400kV bay equipment at Kahalgaon (NTPC)	Associated bay equipment with line capacity 3150A (as per standard equipment rating).
4.	Upgradation of associated 400kV bay equipment at Farakka (NTPC)	Associated bay equipment with line capacity 3150A (as per standard equipment rating).
5.	Upgradation of associated 400kV bay equipment at Talcher (NTPC)	Associated bay equipment with line capacity 3150A (as per standard equipment rating).
6.	Upgradation of associated 400kV bay equipment at Meramundali (OPTCL)	Associated bay equipment with line capacity 3150A (as per standard equipment rating).
Note: *a) NTPC and OPTCL to provide unconditional access to the ISTS licensee for upgradation of identified bay equipment at their respective substation / generation switchyard. The equipment released after replacement shall be handed over to NTPC and OPTCL on as is where is basis by the ISTS licensee.* *b) NTPC has already awarded R&M works for diameter 19-20-21 and 22-23-24 for some bay equipments at Farakka switchyard. Further, at Kahalgaon switchyard, R&M for some equipments of diameter 31-32-33 has also been awarded. ISTS licensee needs to coordinate with NTPC for replacement of balance equipments at Farakka and*		

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
	Kahalgaon switchyards as identified from Annexure-VII and Annexure-VIII (comprising of SLD and bay equipment details) respectively of the minutes of the 31st CMETS-ER.	
c)	*ISTS licensee needs to coordinate with NTPC and OPTCL for replacement of equipments at Talcher switchyard and Meramundali S/s respectively as identified from Annexure-V and Annexure-VI respectively (comprising of SLD and bay equipment details) of the minutes of the 31st CMETS-ER.*	

Implementation Timeframe: 18 months from allocation (15 months on best efforts basis) i.e. 01-03-2026

Estimated Cost: ₹310.28 Crs.



Figure 7-4: Schematic of ERES-43

7.4.5 Bihar & West Bengal

(i) <u>ERES-44 – Re-conductoring Chukha Transmission System (CTS)</u>

A transmission network consisting of several transmission lines and substations was built for importing power from Chukha Hydro Electric Plant in Bhutan. The network is called Chukha Transmission System (CTS). POWERGRID vide letter dated 22-03-2024 informed that the transmission system is more than 35 years old and considering the increase in conductor snapping, the matter was deliberated in 209th and 210th OCC and 51st ERPC meetings. Thereafter, in a special meeting at ERPC on 05-02-2024, POWERGRID was advised to approach CTU to ascertain the requirement of reconductoring of various 220kV lines. Accordingly, system studies were performed and the matter was deliberated in the 31st meeting of CMETS-ER held on 30-05-2024

wherein reconductoring of entire 220kV D/c corridor from Alipurduar to Malda [viz. Alipurduar (POWERGRID) – Falakata (WBSETCL) – Birpara (POWERGRID) – Binaguri (POWERGRID) – Siliguri (POWERGRID) – Kishanganj (POWERGRID) – Dalkhola (POWERGRID) – Gazole (WBSETCL) – Malda (POWERGRID)] in Indian grid was proposed to be reconductored with HTLS conductor. Reconductoring of Birpara – Chukha HEP/Malbase 220kV lines was also agreed for reconductoring.

As the system involved cross border links also, CTUIL had requested CEA for clarification regarding approval and implementation of reconductoring works.

A meeting was convened by CEA under the chairpersonship of Member (Power System) on 27-08-2024, wherein it was inter alia decided to reconductor the whole 220kV corridor viz. Alipurduar (POWERGRID) – Falakata (WBSETCL) – Birpara (POWERGRID) – Binaguri (POWERGRID) – Siliguri (POWERGRID) – Kishanganj (POWERGRID) – Dalkhola (POWERGRID) – Gazole (WBSETCL) – Malda (POWERGRID), comprising of ISTS and intra-state sections (WBSETCL) owned. CTUIL was inter alia directed to bring an agenda in the NCT meeting for reconductoring of ISTS transmission lines as new ISTS strengthening project after deliberation in appropriate forum based on cost estimate.

It was also decided that detailed proposal for reconductoring of Birpara – Chukha HEP/Malbase 220kV cross border lines shall be submitted by CTUIL to Designated Authority, CEA for further taking up with Bhutan.

This scheme has been agreed in the 34th CMETS-ER held on 29-08-2024 and 24th NCT Meeting held on 23-10-2024. Details of the scheme is tabulated below at **Table 7-11**. Schematic is also given at **Figure 7-5.**

Table 7-11: Scope of works of ERES-44

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
1.	Reconductoring of ISTS portion of Alipurduar (POWERGRID) – Falakata (WBSETCL) 220kV D/c line with HTLS conductor of ampacity 1250A	54ckm
2.	Reconductoring of ISTS portion of Falakata (WBSETCL) – Birpara (POWERGRID) 220kV D/c line with HTLS conductor of ampacity 1250A	54ckm
3.	Reconductoring of Birpara (POWERGRID) – Binaguri (POWERGRID) 220kV D/c line with HTLS conductor of ampacity 1250A	160ckm
4.	Reconductoring of Binaguri (POWERGRID) – Siliguri (POWERGRID) 220kV D/c line with HTLS conductor of ampacity 1250A	12ckm

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
5.	Reconductoring of Siliguri (POWERGRID) – Kishanganj (POWERGRID) 220kV D/c line with HTLS conductor of ampacity 1250A	216ckm
6.	Reconductoring of Kishanganj (POWERGRID) – Dalkhola (POWERGRID) 220kV D/c line with HTLS conductor of ampacity 1250A	62ckm
7.	Reconductoring of ISTS portion of Dalkhola (POWERGRID) – Gazole (WBSETCL) 220kV D/c line with HTLS conductor of ampacity 1250A	195ckm
8.	Reconductoring of ISTS portion of Gazole (WBSETCL) – Malda (POWERGRID) 220kV D/c line with HTLS conductor of ampacity 1250A	33ckm
9.	Upgradation of associated 220kV bay equipment at Alipurduar (POWERGRID)	Replacement of Wave Traps of Alipurduar (POWERGRID) – Falakata (WBSETCL) 220kV D/c line commensurate with rating of HTLS.
10.	Upgradation of associated 220kV bay equipment at Birpara (POWERGRID)	Replacement of Wave Traps of Falakata (WBSETCL) – Birpara (POWERGRID) and Birpara (POWERGRID) – Binaguri (POWERGRID) 220kV D/c lines commensurate with rating of HTLS.
11.	Upgradation of associated 220kV bay equipment at Binaguri (POWERGRID)	Replacement of Wave Traps of Birpara (POWERGRID) – Binaguri (POWERGRID) and Binaguri (POWERGRID) – Siliguri (POWERGRID) 220kV D/c lines commensurate with rating of HTLS.
12.	Upgradation of associated 220kV bay equipment at Siliguri (POWERGRID)	Replacement of Wave Traps of Binaguri (POWERGRID) – Siliguri (POWERGRID) and Siliguri (POWERGRID) – Kishanganj (POWERGRID) 220kV D/c lines commensurate with rating of HTLS.

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
13.	Upgradation of associated 220kV bay equipment at Dalkhola (POWERGRID)	Replacement of Wave Traps of Kishanganj (POWERGRID) – Dalkhola (POWERGRID) and Dalkhola (POWERGRID) – Gazole (WBSETCL) 220kV D/c lines commensurate with rating of HTLS.
14.	Upgradation of associated 220kV bay equipment at Malda (POWERGRID)	Replacement of Wave Traps of Gazole (WBSETCL) – Malda (POWERGRID) 220kV D/c line commensurate with rating of HTLS.
15.	Installation of OPGW on Siliguri (POWERGRID) – Kishanganj (POWERGRID) 220kV D/c (HTLS) line	108km

Note:

a) *WBSETCL will reconductor their following lines sections under intra-state scheme matching with completion of ISTS scheme namely ERES-44:*

- *About 4km intra-state portion of Alipurduar (POWERGRID) – Falakata (WBSETCL) 220kV D/c line at Falakata end with HTLS conductor of ampacity 1250A along with necessary upgradation of associated 220kV bay equipment at Falakata (WBSETCL) end commensurate with rating of HTLS (1250A).*
- *About 4km intra-state portion of Birpara (POWERGRID) – Falakata (WBSETCL) 220kV D/c line at Falakata end with HTLS conductor of ampacity 1250A along with necessary upgradation of associated 220kV bay equipment at Falakata (WBSETCL) end commensurate with rating of HTLS (1250A).*
- *About 2km intra-state portion of Dalkhola (POWERGRID) – Gazole (WBSETCL) 220kV D/c line at Gazole end with HTLS conductor of ampacity 1250A along with necessary upgradation of associated 220kV bay equipment at Gazole (WBSETCL) end commensurate with rating of HTLS (1250A).*
- *About 2km intra-state portion of Gazole (WBSETCL) – Malda (POWERGRID) 220kV D/c line at Gazole end with HTLS conductor of ampacity 1250A along with necessary upgradation of associated 220kV bay equipment at Gazole (WBSETCL) end commensurate with rating of HTLS (1250A).*

b) *ISTS licensee and WBSETCL shall coordinate for reconductoring of their respective portion of the lines matching with completion schedule of this scheme.*

Implementation Timeframe: 30-09-2026

Estimated Cost: ₹385.77 Cr.

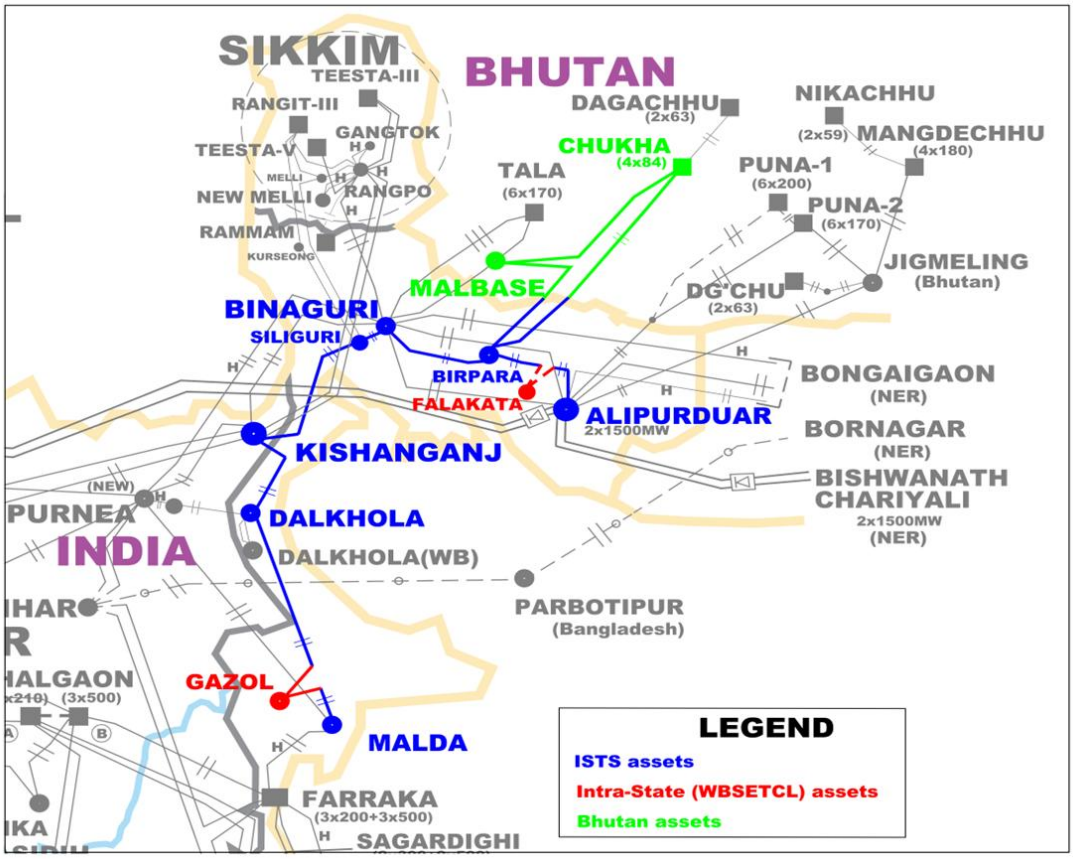


Figure 7-5: Schematic of ERES-44

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 2029-30 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 2029-30 timeframe, 7 nos. of 400 kV & 1 no. 765kV 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 7-12**

Table 7-12 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.	Rourkela – Chaibasa 400kV line-1	1,4	ISTS	1079	850	127%
2.	Duburi – Bhadrak 400kV line-1	4	ISTS+OPTCL	851	1093	78%

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating	% Loading
3.	Baripada - Kharagpur 400kV line-1	4	ISTS	794	850	93%
4.	Medinipur – Chanditala 400kV line-1	4	WBSETCL	775	1093	71%
5.	Purulia – New Purulia 400kV line-1	1, 4 & 7	WBSETCL	960	850	113%
6.	Ranchi – New Purulia 400kV line-1	1, 4 & 7	ISTS	1264	1093	116%
7.	Jamshedpur - Durgapur 400kV line-1	4	ISTS	668	850	79%
8.	Dharamjygarh – Ranchi 765kV line-1	1,4	ISTS	3370	3500	96%

b) Transformers

In the base case file prepared for 2029-30 timeframe, transformers at 12 nos. of 400/220kV substations are having loading more than 70% of the ICT rating. Scenarios where loading is more than 70% of rating and maximum loading hit by these transformers in the simulation studies are tabulated below at **Table 7-13**

Table 7-13 Transformer Loading in the Base Cases

(All Fig in MW)

Sl. No.	Name of ICT	Capacity (MVA)	Scenario No.	Owner	Maximum Loading per ICT (MW)	% Loading
1.	Bhadrak 400/220kV	2x315	2,5	OPTCL	238	76%
2.	Duburi 400/220kV	2x315 +1x500	4	OPTCL	2x312 +1x496	99%
3.	Mendhasal 400/220kV	3x315	5	OPTCL	227	72%
4.	Bolangir 400/220kV	2x315	5	OPTCL	246	78%
5.	Kolaghat 400/220kV	2x315	All except 9	WBPDCL	453	144%
6.	Chanditala 400/220kV	3x315	All except 9	WBSETCL	425	135%
7.	Kharagpur 400/220kV	3x315	All except 8,9	WBSETCL	348	110%
8.	BAPL 400/220kV	2x315	4	WBSETCL	224	71%
9.	Gokarna 400/220kV	3x315	1,4	WBSETCL	255	81%
10.	Jeerat 400/220kV	4x315	1,4,8	WBSETCL	295	94%
11.	Bidhannagar 400/220kV	3x315	1,4	WBSETCL	336	107%
12.	Arambag 400/220kV	4x315	5	WBSETCL	227	72%

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.

Voltage at Paradeep and Gopalpur is observed to be about near 0.95pu in high solar case. Suitable reactive compensation is under planning to mitigate this issue.

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 100% of thermal rating under N-1 contingency are summarized below at **Table 7-14.**

Table 7-14: 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.	Jeypore - Gazuwaka 400kV line-1	Jeypore - Gazuwaka 400kV line-2	1,4,7,8,9	ISTS	456	902	852	106%
2.	Rourkela – Chaibasa 400kV line-1	Rourkela – Chaibasa 400kV line-2	4	ISTS	1079	1491	1093	136%
3.	Ranchi – New Purulia 400kV line-1	Ranchi – New Purulia 400kV line-2	1, 4, 7	ISTS	965	1361	1093	124%
4.	Dharamjaigarh – Ranchi New 765kV line-1	Dharamjaigarh – Ranchi New 765kV line-2	1,4	ISTS	3324	4649	3500	133%

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. Further, the Gazuwaka HVDC has only feed from Jeypore – Gazuwaka 400kV D/c line which leads to overloading under N-1 contingency. Additional inter regional lines from WR to ER is under planning stage, which is expected to reduce the loading of these lines.

STU lines loaded beyond 100% of thermal rating under N-1 contingency are summarized below at **Table 7-15.**

Table 7-15: 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	979	2022	850 (Twin Moose)	238%

WBSETCL may initiate action to control the overloading of the line in 2029-30 timeframe.

b) Transformers

ISTS ICTs loaded beyond 100% of MVA rating under N-1 contingency are summarized below at **Table 7-16**

Table 7-16: 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, 1x1500MVA at Sasaram (in outage of Varanasi - Sasaram 400kV Line-1)	4	ISTS	1368	1521	1500	101%
2.	765/400kV, 2X1500 MVA ICTs at Jeerat-New	1	ISTS	1089	1804	1500	120%
3.	400/220kV, 2X315MVA ICTs at Daltonganj	7	ISTS	215	348	315	110%

Requirement of additional transformation augmentation wherever necessary would be planned subsequently in coordination in the CMETS-ER meeting and the same would be included in the subsequent Rolling Plan.

ICTs of STU(s) loaded beyond 100% of MVA rating under N-1 contingency are summarized below at **Table 7-17**

Table 7-17: 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	2,3,4,5,6	OPTCL	251	399	315	127%
2.	765/400kV, 2x1500MVA ICTs at Duburi-765	All except 8 & 9	OPTCL	1627	2362	1500	157%
3.	400/220kV, 2x500MVA ICTs at Meramundali-B	5 & 6	OPTCL	217	369	500	117%
4.	400/220kV, 2x315MVA ICTs at Lapanga	4,5,6,7	OPTCL	244	340	315	108%
5.	765/400kV, 2x1500MVA ICTs at Khuntuni	1&4	OPTCL	1207	1863	1500	124%
6.	400/220kV, 2x315MVA ICTs at Bhadrak	2,5	OPTCL	247	347	315	110%
7.	400/220kV, 5x315MVA ICTs at Jeerat	4	WBSETCL	301	342	315	108%
8.	400/220kV, 2x315MVA ICTs at Kolaghat TPS	All except 9	WBPDCL	395	581	315	184%
9.	400/220kV, 3x315MVA ICTs at Chanditala	All	WBSETCL	428	523	315	166%
10.	400/220kV, 3x315MVA ICTs at Kharagpur	All except 8 & 9	WBSETCL	352	487	315	155%
11.	400/220kV, 3x315MVA ICTs at Gokoarna	4	WBSETCL	266	319	315	101%
12.	400/132kV, 2x315MVA ICTs at New Laxmikantpur	4	WBSETCL	229	335	315	106%
13.	400/220kV, 3x315MVA ICTs at Bidhannagar	1,4	WBSETCL	343	434	315	138%
14.	400/220kV, 2x315MVA ICTs at BAPL	1,4,5	WBSETCL	233	348	315	111%
15.	400/220kV, 2x315+1x500MVA ICTs at Bokaro TPS (in outage of 500MVA ICT)	8	DVC	214	321	315	102%

From above, it is observed that 6 nos. of S/s of OPTCL and 8 nos. of S/s of WBSETCL/ WBPDCL and 1 nos. of S/s of DVC are not complying N-1 criteria in 2029-30 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 2029-30 timeframe.

7.5.3 Short Circuit Analysis

Short circuit level was calculated for all 765kV 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 no. of 400kV ISTS S/s, 1 no. of 400kV ISGS S/s, 1 no. of 400kV CPP generation and 1 no. 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 7-18.**

Table 7-18: 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	2,5,6,8,9	44	40
2.	400kV Siliguri	ISTS	2,5,6,8,9	41	40
3.	400kV Vedanta	CPP	All	53	50
4.	400kV Patratu	JUSNL	2,5,6,8,9	42	40

The fault level control measures for Farakka have been implemented. The maximum fault level at Farakka, Siliguri, Patratu & Vedanta have marginally crossed its design limits. Detailed studies are being carried out for these stations 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'25

As on Jan'25, total Installed Capacity (IC) of North Eastern Region was 5508MW and the peak demand met was 3914MW. 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'25

(All Fig in MW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES (MNRE)	Total		
Assam	875	742	1616	-	522	225	747	2363	2687
Arunachal Pradesh	37	47	84	-	545	155	700	784	198
Meghalaya	52	110	161	-	417	73	490	652	408
Tripura	56	487	543	-	68	37	106	649	386
Manipur	83	82	165	-	87	19	106	271	269
Nagaland	32	74	106	-	66	36	102	208	188
Mizoram	31	60	92	-	98	76	174	265	168
Central unallocated	113	64	176	-	140	0	140	316	0
NER	**1279**	**1666**	**2943**		**1943**	**621**	**2565**	**5508**	**3914**

Source: CEA monthly report

8.2 Envisaged Power Supply Scenario by 2029-30

As per the 20th EPS, North Eastern Region demand for 2029-30 timeframe is expected to increase to 5835MW. As per the inputs received from various stakeholders, total installed capacity of North Eastern Region for 2029-30 is expected to be 10723MW. 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 (2029-30)

(All Fig in MW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Arunachal Pradesh	0	0	0	-	24	100	124	-	124	259
Assam	0	741	741	-	893	1269	2162	-	2903	3683
Manipur	0	0	0	-	120	0	120	-	120	404
Meghalaya	0	0	0	-	626	0	626	-	626	546
Mizoram	0	0	0	-	32	0	32	-	32	289
Nagaland	0	0	0	-	48	0	48	-	48	221
Tripura	0	237	237	-	0	0	0	-	237	645
Central	750	1254	2004	-	3630	1000	4630	-	6634	-
NER	**750**	**2232**	**2982**	**-**	**5372**	**2369**	**7741**	**-**	**10723**	**5835**

There is a massive growth in peak demand of North Eastern Region from present timeframe 2024-25 to 2029-30 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	2024-25	2029-30	Increase in demand	CAGR
Assam	2687	3683	996	6.5%
Arunachal Pradesh	198	259	61	5.5%
Meghalaya	408	546	138	6.0%
Tripura	386	645	259	10.8%
Manipur	269	404	135	8.5%
Nagaland	188	221	33	3.3%
Mizoram	168	289	121	11.5%
NER	**3914**	**5835**	**1921**	**8.3%**

From the above data it is observed that the CAGR growth of peak demand is maximum for Mizoram (11.5%) and minimum for Nagaland (3.3%). The CAGR of demand of NER is about 8.3% which is more than the National Average of 6%. 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 2029-30 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 2029-30 timeframe. 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%	75%	0%	71%
2-Aug Peak Load	90%	0%	50%	89%
3-Aug Night Off Peak	70%	0%	50%	68%
4-Jun Solar Max	70%	85%	0%	56%
5-Jun Peak Load	90%	0%	50%	66%
6-Jun Night Off Peak	70%	0%	50%	58%
7-Feb Solar Max	30%	90%	0%	59%
8-Feb Peak Load	60%	0%	50%	72%
9-Feb Night Off Peak	30%	0%	30%	38%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import / export of NER and the inter-regional flow 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'29 Timeframe			Jun'29 Timeframe			Feb'30 Timeframe		
	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	1712	1166	1245	2746	2404	1798	1528	517	315
NER-NR	0	0	0	0	0	0	-1000	0	0
NER-Cross Border	343	304	317	344	317	324	406	315	356
North Eastern Region (net)	2055	1470	1562	3090	2721	2122	934	832	671

From the above, it is observed that for 2029-30 timeframe, NER is exporting power in all 9 scenarios. Out of these nine scenarios, Scenario-4 and Scenario-9 corresponds to two extreme cases with export requirement of North Eastern Region i.e. Maximum export (3090MW) and minimum export (671MW) scenarios respectively.

Considering the above LGB for nine scenarios, load flow cases were prepared for 2029-30 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 Feb/Mar'24 to Jan'25

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of North Eastern Region (CMETS-NER) from Feb/Mar'24 to Jan'25. 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.)
Arunachal Pradesh			
1.	NERES-XXIII (Reconductoring of Pasighat – Roing – Tezu – Namsai Corridor)	14-12-2026	73.47
Assam			
1.	NERES-XXVI (Bus Reactor at Balipara)	14-12-2025	35.79
2.	NERES-XXVIII (VSR at Misa)	14-03-2026	52.71
Nagaland			
3.	NERES-XXVII (Reconductoring Diampur, Kohima)	14-09-2025	0.3
Assam & Arunachal Pradesh			
1.	NERES-XXIX (Part-A: Namsai ICT & Part-B**:** Biswanath Chariali Reactor)	23-04-2026	48.69 (16.3+32.39)
2.	NERES-XXX (Reconductoring)	2027-28	41

8.4.1 Arunachal Pradesh

(i) NERES-XXIII (Reconductoring of Pasighat – Roing – Tezu – Namsai Corridor)

Pasighat (Arunachal Pradesh) – Roing (POWERGRID) – Tezu (POWERGRID) – Namsai (POWERGRID) 132kV S/c on D/c corridor is owned by POWERGRID. Pasighat (Arunachal Pradesh) S/s is of DoP, Arunachal Pradesh and Roing, Tezu & Namsai substations are of POWERGRID.

DoP, Arunachal Pradesh informed that additional industrial demand of about 100MW (1st - 35MW and 2nd - 65MW) is expected at Niglok (Arunachal Pradesh) S/s. Niglok (Arunachal Pradesh) is connected to Napit/New Pasighat and Likbali substations of DoP, Arunachal Pradesh. POWERGRID, NERLDC and DoP, Arunachal Pradesh had mentioned that owing to hilly and difficult terrain conditions in Arunachal Pradesh, 2nd circuit stringing of Roing – Tezu – Namsai 132kV S/c on D/c line also needs to be taken up for reliable power supply in the area. Moreover, various new HEPs are coming up in Arunachal Pradesh in these areas which require construction power as well. Thus, keeping in view upcoming industrial demand, regular demand growth in eastern Arunachal Pradesh, and to improve reliability of 132kV system (predominantly S/c), it was agreed to take up 2nd circuit stringing of various intra-state [Gerukamukh – Likabali – Niglok – Pasighat (New)] and ISTS lines [Pasighat (Arunachal Pradesh) – Roing (POWERGRID) – Tezu (POWERGRID) – Namsai (POWERGRID)].

The ISTS portion of the scope under subject scheme was finalized after detailed consultation in the 29th CMETS-NER held on 28-03-2024. Details of the scheme is tabulated below at **Table 8-7**. Schematic is also given at **Figure 8-1**

Table 8-7: Scope of works of NERES-XXIII

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Stringing of 2nd circuit of Pasighat (Arunachal Pradesh) – Roing (POWERGRID) 132kV S/c on D/c line with ACSR Panther conductor commensurate with rating and maximum operating temperature of 1st circuit	103km
2.	Stringing of 2nd circuit of Roing (POWERGRID) – Tezu (POWERGRID) 132kV S/c on D/c line with ACSR Panther conductor commensurate with rating and maximum operating temperature of 1st circuit	73km
3.	Stringing of 2nd circuit of Tezu (POWERGRID) – Namsai (POWERGRID) 132kV S/c on D/c line with ACSR Panther conductor commensurate with rating and maximum operating temperature of 1st circuit	95.24km
4.	Extension at Pasighat (DoP, Arunachal Pradesh)@: 1 no. 132kV AIS line bay for termination of 2nd circuit of Pasighat (Arunachal Pradesh) – Roing (POWERGRID) 132kV D/c line	132kV AIS line bay: 1 no.
5.	Extension at Roing (POWERGRID) S/s: 2 no. 132kV AIS line bay for termination of 2nd circuit of Pasighat (Arunachal Pradesh) – Roing (POWERGRID) 132kV D/c line and 2nd circuit of Roing (POWERGRID) – Tezu (POWERGRID) 132kV D/c line	132kV AIS line bay: 2 no.
6.	Extension at Tezu (POWERGRID) S/s: 2 no. 132kV AIS line bay for termination of 2nd circuit of Roing (POWERGRID) – Tezu (POWERGRID) 132kV D/c line and 2nd circuit of Tezu (POWERGRID) – Namsai (POWERGRID) 132kV D/c line	132kV AIS line bay: 2 no.
7.	Extension at Namsai (POWERGRID) S/s: 1 no. 132kV AIS line bay for termination of 2nd circuit of Tezu (POWERGRID) – Namsai (POWERGRID) 132kV D/c line	132kV AIS line bay: 1 no.

Implementation Timeframe: 14-12-2026

Estimated Cost: ₹73.47 Crs.

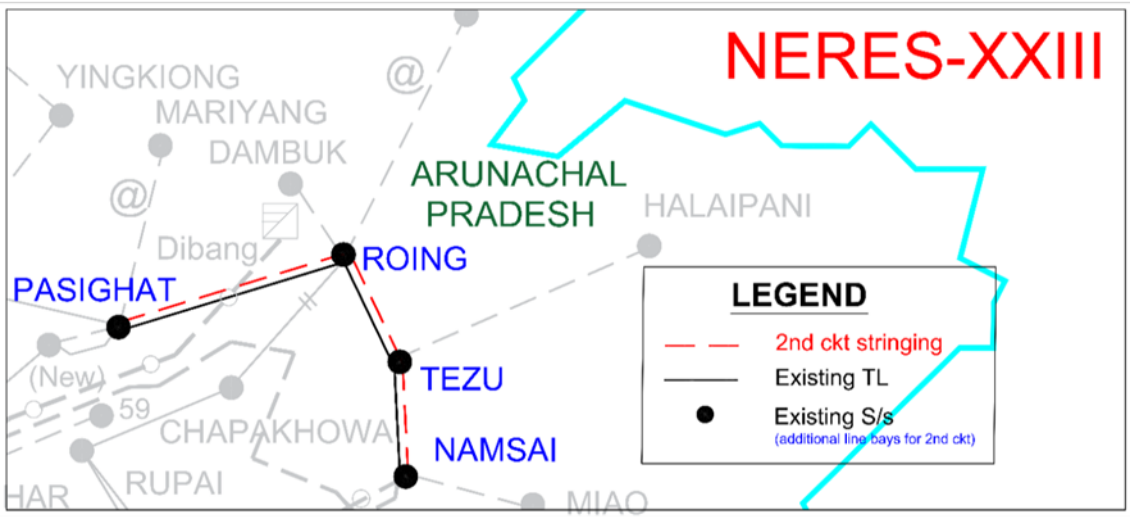


Figure 8-1: Schematic of NERES-XXIII

8.4.2 Assam

(i) <u>NERES-XXVI (Bus Reactor at Balipara)</u>

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. Details of the scheme is tabulated below at **Table 8-8**. Schematic is also given at **Figure 8-2**

Table 8-8: Scope of works of NERES-XXVI

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Decommissioning of existing 420kV, 50MVAr (bus reactor-1) and installation of new 420kV, 125MVAr bus reactor in its place along with replacement of associated main and tie bay equipment at Balipara (POWERGRID) S/s	• 420kV, 1x125MVAr Bus Reactor: 1 no. • Replacement of 400kV main & tie bay equipment of bus reactor diameter

Implementation Timeframe: 14-12-2025

Estimated Cost: ₹35.79 Crs.

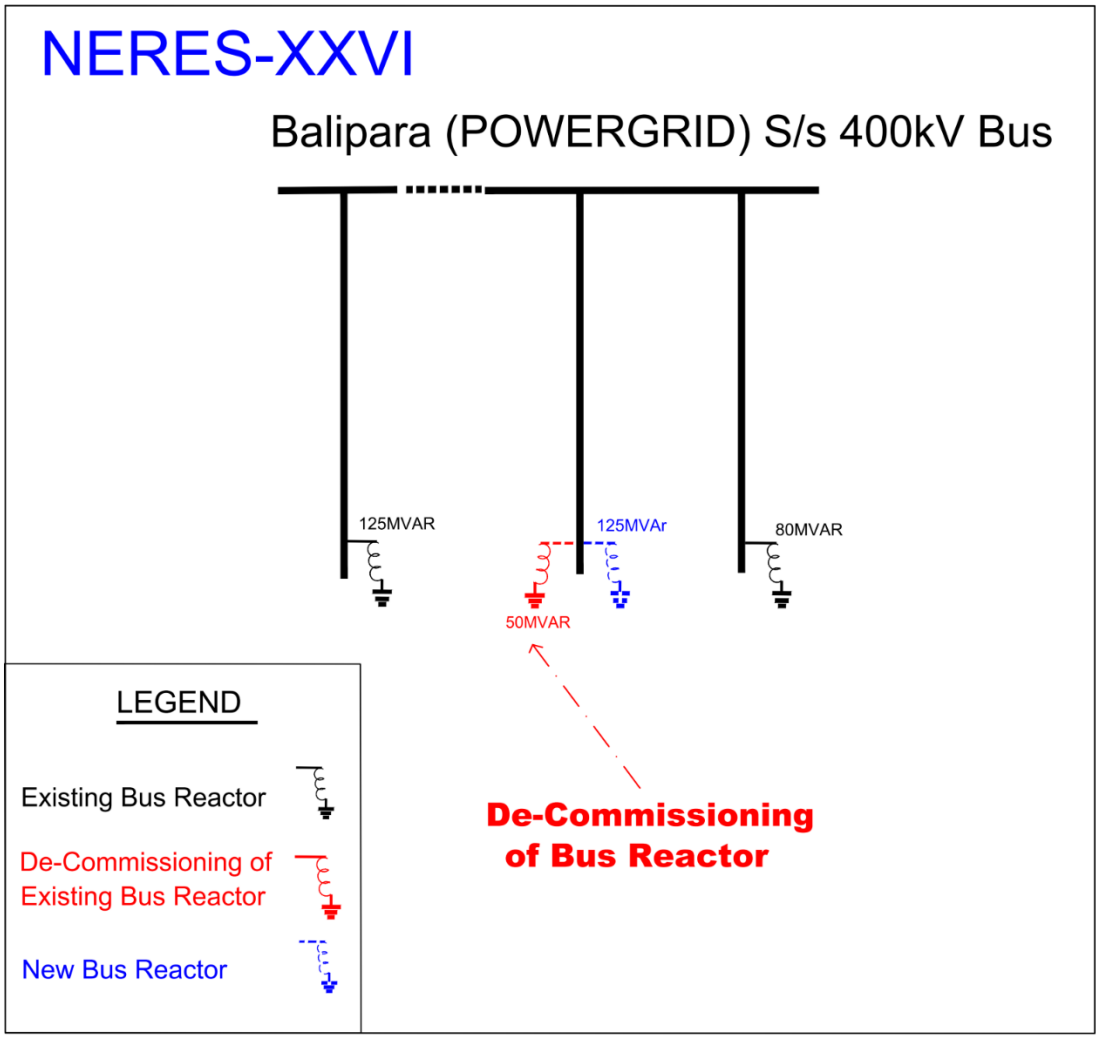


Figure 8-2: Schematic of NERES-XXVI

(ii) <u>NERES-XXVIII (VSR at Misa)</u>

Presently, 1x50MVAr + 1x80MVAr, 420kV Bus reactors are installed at Misa (POWERGRID) 400/220kV S/s. Additionally, 36kV, 4x25MVAr bus reactors are also installed in tertiary of 400/220/33kV ICT at Misa (POWERGRID) S/s.

These tertiary reactors are almost 24 to 28 years old and as informed by POWERGRID, there is no support from OEM. Due to ageing, the conditions of these tertiary reactors have deteriorated, and heavy oil leakages are frequently reported even after gasket replacements. In recent time, it is observed that even with the 4x25MVAr tertiary bus reactors, maximum voltage at 400kV bus is in the range of 415kV to 418kV and 25% of time it is above nominal voltage level. After decommissioning of tertiary reactors, the voltage at Misa S/s will increase further. Accordingly, it was suggested that with decommissioning of tertiary reactors, additional bus reactor may be planned at Misa S/s.

Accordingly, decommissioning of existing 36kV, 4x25MVAr bus reactors installed in tertiary of 400/220/33kV ICT(s) at Misa S/s and installation of new 420kV, 1x125MVAr bus reactors with associated GIS bay at Misa (POWERGRID) S/s was discussed and agreed in the 29th CMETS-NER held on 28-03-2024. In view of space constraint, bay for bus reactor is planned in GIS with double bus scheme with two circuit breakers.

Details of the scheme is tabulated below at **Table 8-9.** Schematic is also given at **Figure 8-3:**

Table 8-9: Scope of works of NERES-XXVIII

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Installation of new 420 kV, 1x125 MVAr bus reactor along with associated GIS bay at Misa (POWERGRID) S/s	• 420 kV, 1x125 MVAr Bus Reactor: 1 No. • 400 kV GIS bus reactor bay: 1 No. [@with two circuit breakers] • 400kV GIB: 1000m (approximate)
Note: *a) @In view of space constraints for GIS extension and space constraint towards usage of other bay of one and half breaker scheme, bus reactor is planned to be installed in double bus scheme with two circuit breakers.* *b) As discussed in the 31st CMETS-NER, POWERGRID shall claim the cost of installation of a new 420kV, 1x125 MVAr bus reactor along with associated GIS bay at Misa (POWERGRID) S/s under this scheme. The difference in cost between a new 420kV, 1x125MVAr bus reactor and a new 420kV, 1x125MVAr VSR shall be booked by POWERGRID under its R&D Budget head as informed by POWERGRID.* *c) The project cost has been estimated considering 420 kV, 1x125 MVAr Bus Reactor along with associated GIS bay and GIB. However, as intimated by POWERGRID, implementation of the VSR shall incur additional cost of about 8.5 Cr. approx. (incl. GST).*		

Implementation Timeframe: 14-03-2026

Estimated Cost: ₹ 52.71Crs.

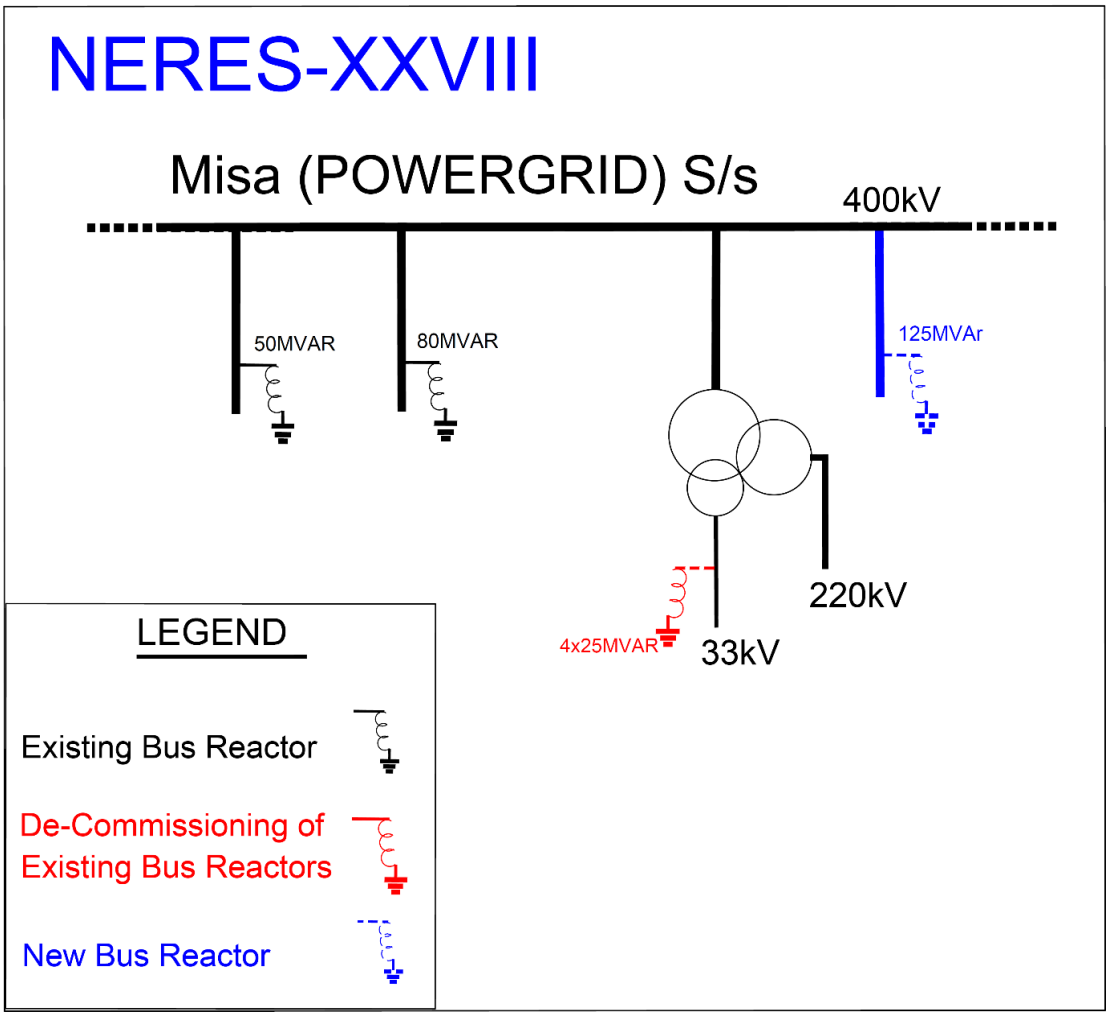


Figure 8-3: Schematic of NERES-XXVIII

8.4.3 Nagaland

(i) <u>NERES-XXVII (Reconductoring Diampur, Kohima)</u>

Dimapur (DoP, Nagaland) – Kohima (DoP, Nagaland) 132kV S/c line of DoP, Nagaland was LILOed by POWERGRID under ISTS at Dimapur (POWERGRID) S/s, resulting in formation of Dimapur (POWERGRID) – Dimapur (Nagaland) ckt-2 and Dimapur (POWERGRID) – Kohima (DoP, Nagaland) 132kV S/c lines, which became partly owned by DoP, Nagaland and partly owned by POWERGRID.

The conductor of Dimapur (DoP, Nagaland) – Dimapur (POWERGRID) and Dimapur (POWERGRID) – Kohima (DoP, Nagaland) 132kV lines are very old (commissioned around 1970) and their thermal rating is of the order of 40MVA only (degraded). Upon outages of Kohima (DoP, Nagaland) – Karong (MSPCL) & Doyang – Wokha 132kV S/c lines, high loadings are observed in Nagaland intra-state system. Dimapur (DoP, Nagaland) is fed radially from ISTS substation through two single circuit lines and if one circuit of Dimapur (POWERGRID) – Dimapur (DoP, Nagaland) is out, the other circuit would also trip on overloading. The demand at Dimapur is expected to reach 130MW in next 2 years and for reliable power supply reconductoring of Dimapur (POWERGRID)

– Dimapur (Nagaland) ckt-1 & ckt-2 is required. Ckt-1 is owned by DoP, Nagaland and ckt-2 is jointly owned by DoP, Nagaland and POWERGRID.

In view of the above, to strengthen the power supply situation in major cities of Nagaland viz. Kohima and Dimapur, reconductoring of Dimapur (POWERGRID) – Dimapur (Nagaland) ckt-1 & ckt-2 and Dimapur (POWERGRID) – Kohima (DoP, Nagaland) 132kV S/c lines with HTLS conductor of 800A ampacity was discussed and agreed in the 29th CMETS-NER held on 28-03-2024. Reconductoring of ISTS portion of these lines are being taken up under this scheme. DoP, Nagaland shall reconductor their portion of lines in matching timeframe. Details of the scheme is tabulated below at **Table 8-10.** Schematic is also given at **Figure 8-4.**

Table 8-10: Scope of works for NERES-XXVII

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Reconductoring of ISTS portion of Dimapur (POWERGRID) – Dimapur (DoP, Nagaland) 132kV (ckt-2) ACSR Panther S/c line with Single HTLS conductor of 800A	0.335km
2.	Reconductoring of ISTS portion of Dimapur (POWERGRID) – Kohima (DoP, Nagaland) 132kV ACSR Panther S/c line with Single HTLS conductor of 800A	0.335km

Implementation Timeframe: 14-09-2025

Estimated Cost: ₹0.3 Cr.

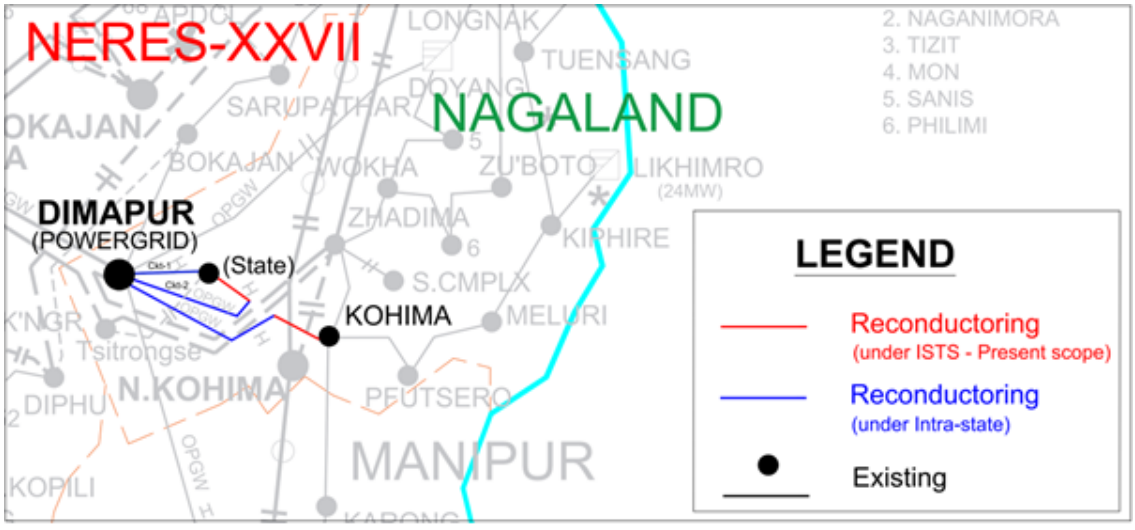


Figure 8-4: Schematic of NERES-XXVII

8.4.4 Assam & Arunachal Pradesh

(i) <u>NERES-XXIX (Part-A:Namsai ICT & Part-B: Biswanath Chariali Reactor)</u>

Part-A: Namsai ICT

132/33kV Namsai S/s is owned by POWERGRID. At present there are 2x15MVA ICT at this substation. DoP Arunachal Pradesh mentioned that presently the total load at Namsai area is about 13MW out of which 9MW is met through Namsai (POWERGRID) S/s and 4MW is met through Rupai – Namsai 33kV old line. The load at Namsai is expected to reach to about 17MW by Mar 2027. Rupai – Namsai 33kV line was implemented long back to supply power to Namsai area when 132kV was not available. Now, Namsai is one of the fastest growing load centres in Arunachal Pradesh due to improvement in road and other infrastructures. Accordingly, for reliable and power supply 4MW load is also fed from ISTS S/s and the old 33kV line is made to be defunct. Thus, there shall be drawl requirement of about 17MW in next few years at Namsai (POWERGRID) S/s, which would not be N-1 compliant. Further, as per CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV & above Voltage Class)" published in April 2021, the minimum standard rating of 132/33kV, 3-phase ICT is of 31.5MVA. Presently there are two different rating of 132/33kV ICTs in NER viz. 1-phase 5MVA and 3-phase 50MVA. To meet the contingency requirement in case of failure of ICT, spare 50MVA ICT is also available in the region and presently kept at Nirjuli S/s. Accordingly, a new 1x50MVA ICT was proposed and agreed in 33rd CMETS-NER held on 26-07-2024.

Part-B: Biswanath Chariali Reactor

During winter season, monopole operation in reverse direction of Agra to BNC HVDC link is being carried out with metallic return mode through the conductor of the other pole. Therefore, voltage on metallic return conductor has been negligible which results of theft of line materials like spacer, corona ring etc. Theft of hundreds of spacer-dampers has been experienced in the past which leads to damage of conductor fittings and accessories and chance of conductor snapping increases. Accordingly, a solution was proposed to operate in Bipole mode during reverse power flow (Agra to BNC) during winter season.

Presently at BNC there are 4 no. of 63MVAr switchable line reactor connected in BNC – Lower Subansiri 400kV 2xD/c line which are being used as Bus Reactor as generation is not commissioned. After studies it was observed that, During charging of 1st circuit of Biswanath Chariali (POWERGRID) – Lower Subansiri 2xD/c line (along with 63MVAr switchable line reactor at BNC end), about 3.5kV voltage rise is observed at BNC end and upon charging of all four circuits from BNC to LS, total about 14-15kV rise is observed at BNC end. Subsequently, upon charging of 1x80MVAr Bus reactor at Lower Subansiri end, voltage drop by about 4kV at BNC end and with 2x80MVAr Bus reactor voltage drop by about 8kV at BNC end was observed. Further, with new 1x125MVAr Bus reactor at BNC, the voltage drop is observed to be about 6kV at BNC end. So overall voltage at BNC end comes back to its original voltage level with additional 125MVAr bus reactor. According due to operational requirements an additional 1x125MVAr, 420kV bus reactor at BNC (POWERGRID) S/s was agreed in the 31st CMETS-NER

held on 29-05-2024. Details of the scheme is tabulated below at **Table 8-11.** Schematics are also given at **Figure 8-5 & Figure 8-6.**

Table 8-11: Scope of works of NERES-XXIX

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
Part-A		
1.	Installation of new 1x50MVA, 132/33kV (3rd) ICT at Namsai (POWERGRID) S/s along with associated bays.	• 50MVA, 132/33kV ICT: 1 no. • 132kV ICT bays: 1 no. • 33kV ICT bays: 1 no.
Part-B		
1.	Installation of new 420kV, 125MVAr Bus Reactor at Biswanath Chariali (POWERGRID) S/s along with associated bays.	• 420kV, 125MVAr Bus Reactor: 1 no. • 400kV reactor bay (including associated tie bay): 1 no.

Implementation Timeframe: Part-A: 23-04-2026 & **Part-B**: 23-04-2026

Expected Cost: ₹16.3 Crs. (**Part-A**) & ₹32.39 Crs. (**Part-B**)

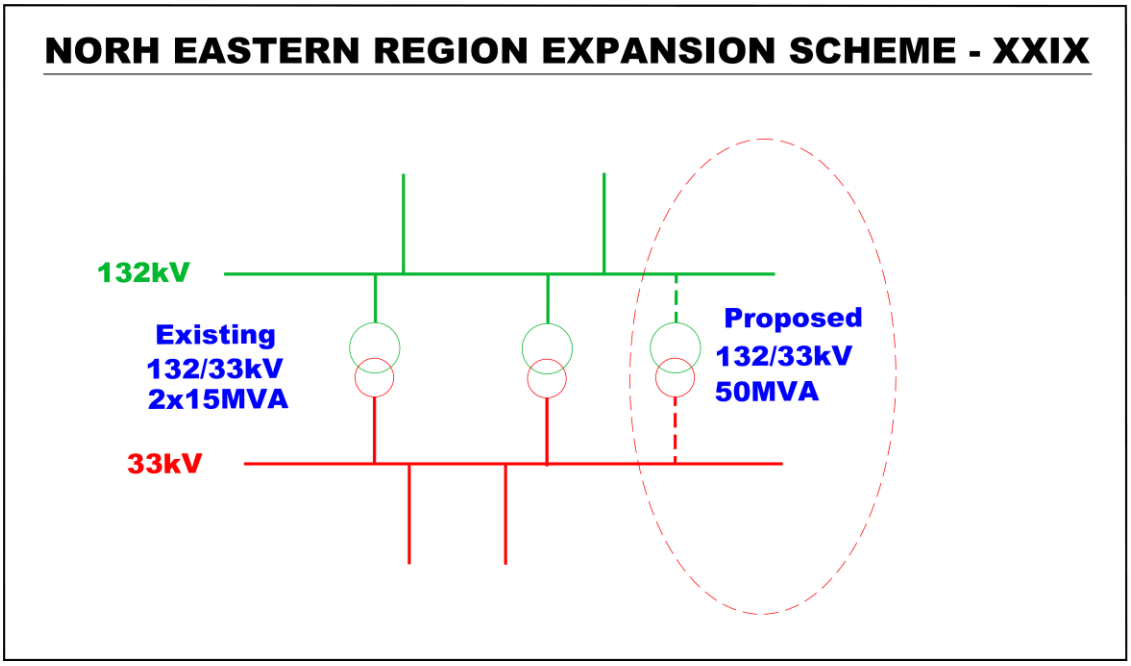


Figure 8-5: Schematic of NERES-XXIX (Part-A)

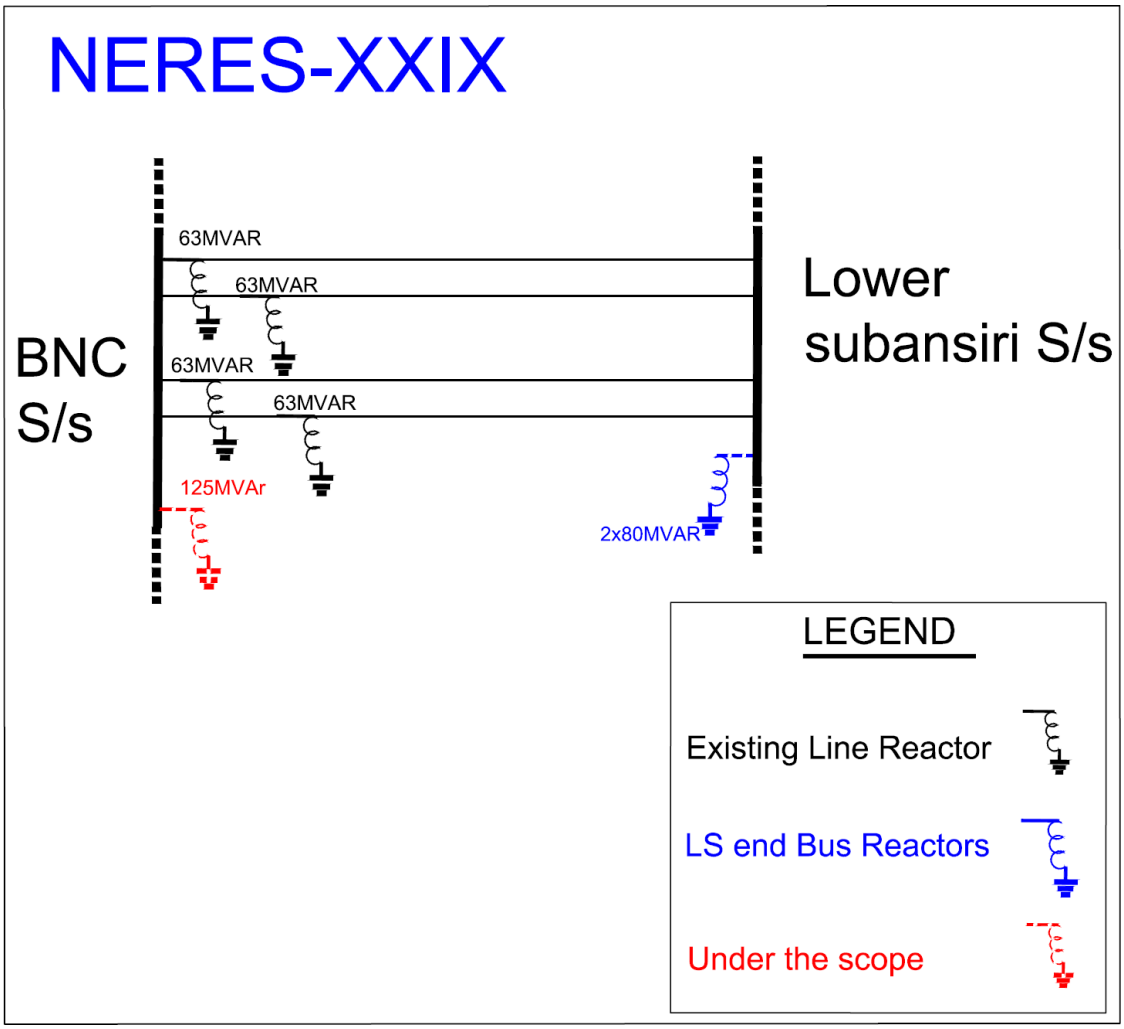


Figure 8-6: Schematic NERES-XXIX (Part-B)

(ii) <u>NERES-XXX (Reconductoring)</u>

During the system studies carried out for the future timeframe including the study done for the NER 2032 Report, it was observed that following ISTS lines in NER are getting critically loaded:

- Balipara (POWERGRID) – Misa (POWERGRID) 400kV D/c line
- Balipara (POWERGRID) – Sonabil (POWERGRID) 220kV D/c line
- Silchar (POWERGRID) – Srikona (AEGCL) 132kV D/c line
- Badarpur (POWERGRID) – Karimganj (AEGCL) 132kV S/c line
- Karimganj (AEGCL) – Kumarghat (POWERGRID) 132kV S/c line
- Ranganadi (NEEPCO) – Ziro (POWERGRID) 132kv S/c line

In view of critical loading observed on the above lines, it was proposed to be reconductored with HTLS conductors. The terminal bays of the above lines are owned by POWERGRID, AEGCL and NEEPCO. Further studies were carried out in 2028-29 and 2031-32 timeframe using file of CEA's NER 2032 Report on High & Low Hydro

conditions. As per study results it was observed that in 2028-29 timeframe, there is heavy loading on Silchar-Srikona 132kV D/c line under N-1 contingency and Ranganadi-Ziro 132kV S/c line under base case itself. Accordingly, these two lines should be considered for reconductoring on an immediate basis. Loading in Badarpur (POWERGRID) – Karimganj (AEGCL) 132kV S/c and Karimganj (AEGCL) – Kumarghat (POWERGRID) 132kV S/c line are well permissible limit in 2028-29 timeframe therefore reconductoring of these lines will be taken up later.

For Balipara-Sonabil 220kV D/c line, NERLDC is planning to implement a SPS for both circuits due to limiting constraints and this line is the limiting constraint in the ATC of Assam. Thus, reconductoring of both circuits of Balipara-Sonabil 220kV D/c line also agreed for immediate reconductoring.

New line viz. BNC (POWERGRID) – Khumtai (AEGCL) 400kV D/c line will be commissioned on May 2026 (as per recorded in 38th CMETS-NER), therefore in view of all stakeholders, it was decided that reconductoring of Balipara (POWERGRID) – Misa (POWERGRID) 400kV D/c line may be considered after completion of the new upcoming BNC (POWERGRID) – Khumtai (AEGCL) 400kV D/c line.

Situation in NER, reconductoring of Balipara (POWERGRID) – Sonabil (POWERGRID) 220kV ckt-I & ckt-II with HTLS conductor of 1050A ampacity, Silchar (POWERGRID) – Srikona (AEGCL) 132kV D/c line and Ranganadi (NEEPCO) – Ziro (POWERGRID) 132kV S/c with HTLS conductor of 900A ampacity was discussed and agreed in the 36th CMETS-NER held on 28-10-2024. Reconductoring of ISTS portion of these lines are being taken up under this scheme. AEGCL shall reconductor their portion of lines in matching timeframe. Details of the scheme is tabulated below at Table 8-12**.** Schematics are also given at Figure 8-7**.**

Table 8-12: Scope of works of NERES-XXX

Sl. No.	Scope of the Transmission Scheme	Capacity/km
1.	Reconductoring of ISTS portion of Balipara (POWERGRID) – Sonabil (POWERGRID) ckt-I 220kV line owned by POWERGRID with HTLS conductor of ampacity 1050A (at nominal voltage level)	8.623
2.	Reconductoring of ISTS portion of Balipara (POWERGRID) – Sonabil (POWERGRID) ckt-II 220kV line owned by POWERGRID with HTLS conductor of ampacity 1050A (at nominal voltage level)	9.205
3.	Reconductoring of Silchar (POWERGRID) – Srikona (AEGCL) 132kV D/c line owned by POWERGRID with HTLS conductor of ampacity 900A (at nominal voltage level)	1.119
4.	Reconductoring of Ranganadi (NEEPCO) – Ziro (POWERGRID) 132kV S/c line owned by POWERGRID with HTLS conductor of ampacity 900A (at nominal voltage level)	44.52

Sl. No.	Scope of the Transmission Scheme	Capacity/km
5.	Replacement of existing CT at Ziro (POWERGRID) end in Ranganadi (NEEPCO) – Ziro (POWERGRID) 132kV S/c line with rating commensurate with ampacity (900A) of HTLS conductor	CT: 1 no.

Implementation Timeframe: 24 months

Estimated Cost: Awaited

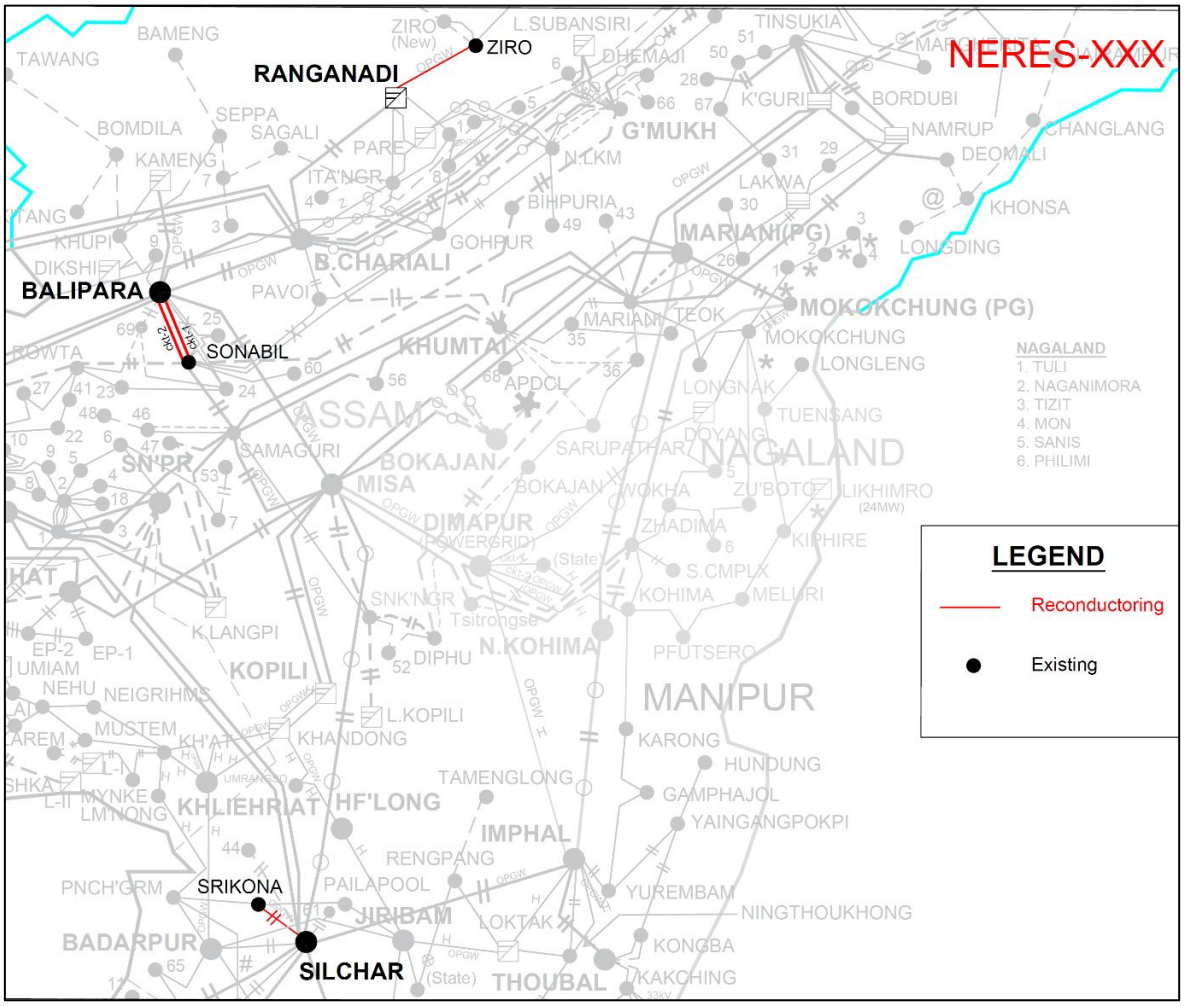


Figure 8-7: Schematic of NERES-XXX

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 2029-30 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 2029-30 timeframe, 7 nos. of 132 kV intra-state lines of Assam, Arunachal Pradesh & Nagaland and 2 nos. of 220kV intra-state lines of Assam 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 8-13.

Table 8-13 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.	LRPP Lakhwa – LTPS-Lakwa 132kV S/c line	2,5	AEGCL	60	84	71%
2.	Bilasipara – Khudigaon 132kV S/c line	1,4,7	AEGCL	71	84	85%
3.	Sonapur – Narengi 132kV S/c line	2	AEGCL	60	84	71%
4.	Sonabil – Hailakandi 132kV S/c line	1,4,7	AEGCL	72	84	85%
5.	Gerukamukh – Likhabali 132kV D/c line	All Scenarios	DoP, Arunachal Pradesh	81	84	97%
6.	Likhabali – Niglok 132kV D/c line	All Scenarios except 5 & 9	DoP, Arunachal Pradesh	66	84	79%
7.	Lower Tezu – Khipire 132kV S/c line	1,2,3,4,5,6	DoP, Nagaland	76	84	90%
8.	Jamuguri – Khumtai 220kV S/c line	4,7	AEGCL	204	250	82%
9.	Danguapra – Rangia New 220kV S/c line	4,7	AEGCL	204	250	82%

b) Transformers

In the base case file prepared for 2029-30 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 and Maximum & Minimum voltage of each bus were identified from the bus voltages in these scenarios. It has been observed that there is no under voltage buses less than 0.92pu for 132kV, 0.90pu for 220kV & 0.95pu for 400kV & above buses in line with CEA's Manual Planning Criteria 2023. Similarly, no overvoltage is observed beyond 1.11pu for 220kV & 1.05pu for 400kV & above buses. However, list of substations where overvoltage above 1.1pu for 132kV is observed is given at Table 8-14.

Table 8-14 List of substations with Voltage greater than 1.1pu in North Eastern Region

Sl. No.	Bus Name	Voltage level (kV)	Owner	V_{max} (pu)	Scenario
1.	Hnahthial	132	P & E Department, Mizoram	1.11	9
2.	Lunglei-khaw	132	P & E Department, Mizoram	1.12	9
3.	S. Bungtlang	132	P & E Department, Mizoram	1.13	9
4.	Champhai	132	P & E Department, Mizoram	1.11	9
5.	Ngopa	132	P & E Department, Mizoram	1.12	9
6.	Lungsen	132	P & E Department, Mizoram	1.12	9
7.	Saiha	132	P & E Department, Mizoram	1.13	9
8.	Lawngtlai	132	P & E Department, Mizoram	1.13	9
9.	Kawmzawl	132	P & E Department, Mizoram	1.11	9
10.	Vankal	132	P & E Department, Mizoram	1.11	9
11.	Serchip-bukp	132	P & E Department, Mizoram	1.11	9
12.	Chawngte	132	P & E Department, Mizoram	1.13	9
13.	Saitul	132	P & E Department, Mizoram	1.10	9
14.	E Lungdar	132	P & E Department, Mizoram	1.11	9
15.	Khawzawl	132	P & E Department, Mizoram	1.11	9
16.	S Khawbung	132	P & E Department, Mizoram	1.11	9

From the above, 16 nos. of 132kV substations owned by P & E Department, Mizoram are violating the nominal voltage limits as defined under CEA's Planning Criteria 2023. P & E Department, Mizoram may take necessary action.

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 100% of thermal rating under N-1 contingency are summarized below at **Table 8-15**.

Table 8-15: 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.	Gogaumkh – Gerukamukh 132kV line-1	Gogaumkh – Gerukamukh 132kV line-2	1,2	ISTS	94	165	160	103%
2.	Gerukamukh - Likabali 132kV line-1	Gerukamukh - Likabali 132kV line-2	All Scenarios	DoP, Arunachal Pradesh	86	142	84	169%
3.	Likabali - Niglok 132kV line-1	Likabali - Niglok 132kV line-2	All Scenarios	DoP, Arunachal Pradesh	70	110	84	131%
4.	Pfutsero - Kohima 132kV line-1	Tuesang – Khipire 132kV line-1	2,5	DoP, Nagaland	45	91	84	108%
5.	Pfutsero - Meluri 132kV line-1	Tuesang – Khipire 132kV line-1	5	DoP, Nagaland	48	93	84	111%
6.	Tuesang - Mokokchung 132kV line-1	Meluri – Khipire 132kV line-1	5	DoP, Nagaland	41	94	84	112%
7.	Tuesang – Khipire 132kV line-1	Meluri – Khipire 132kV line-1	3,4,5,6	DoP, Nagaland	47	100	84	119%
8.	Meluri – Khipire 132kV line-1	Tuesang – Khipire 132kV line-1	3,4,5,6	DoP, Nagaland	54	99	84	118%

From the above, it can be seen that 1 nos. ISTS line, 2 line of DoP Arunachal Pradesh, 3 lines of DoP Nagaland are violating the N-1 contingency. Respective STU / entities may initiate actions to mitigate the overloading on their respective lines. The ISTS line is marginally crossing the limit under N-1 contingency. Suitable strengthening, if required would be taken up in forthcoming Rolling plan.

b) Transformers

From the analysis, it is observed that no ICTs at 400kV & 220kV level is loaded beyond 100% 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.

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

- 2651MW 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 (6x200MW) and balance units of Punatsangchu-II (4 units out of 6x170MW) generation by 2026-27, the power transfer capacity would increase to about 4531MW.

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

- 1600MW can be transferred from India to Nepal through following links in radial mode of operation:
  - *About 600MW through 132kV & below radial lines*
  - *About 1000MW 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 Mar 2025 – 800MW
  - Gorakhpur (India) – New Butwal (Nepal) 400kV D/c (Quad) line: Expected by May 2026 – 1000MW
  - Nanpara (India) - Kohlapur (Nepal) 132kV D/c line: Expected by Dec 2025 – 100MW

(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
- Chameliya (Nepal) – Jauljivi (lndia) 220kV D/c (Twin Moose) link – 300MW

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 timeframe and through under construction interconnections is summarized below in Table 9-1:

Table 9-1: Cross-border power transfer capacity by 2029-30

(All fig in MW)

Country	Existing	Under Construction (By 2027-28)	Planned (by 2029-30)	Total
India-Bangladesh	1160	0	1000	2160
India-Bhutan	2651	1880	0	4531
India-Myanmar	3	0	504	507
India-Nepal	1600	1900	3300	6800
India-Sri Lanka	0	0	500	500
Total	**5414**	**3780**	**5304**	**14498**

A schematic of the existing, under-construction and proposed cross-border interconnections is given in Figure 9-1 below:

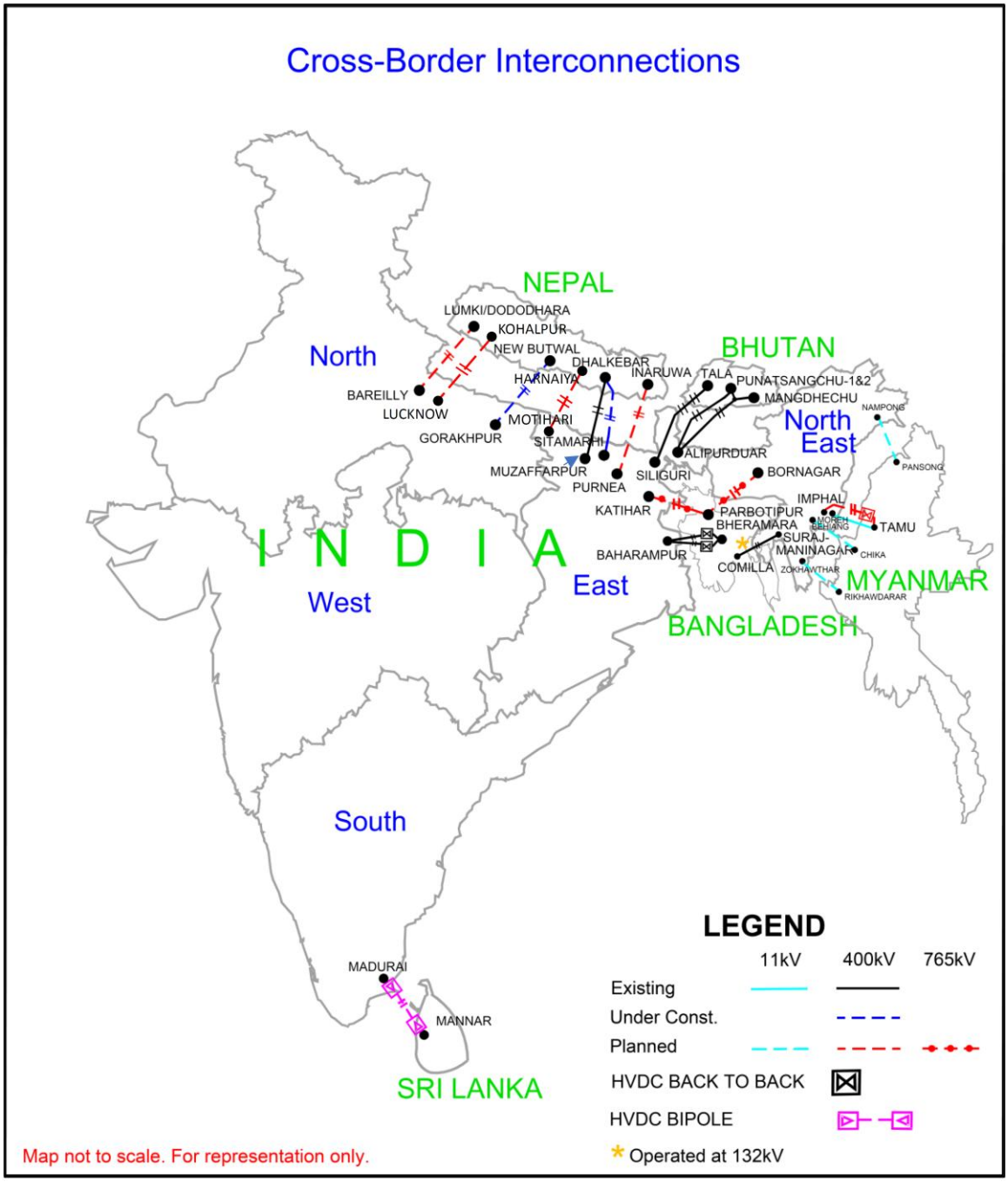


Figure 9-1: Cross-Border interconnections

Chapter 10: Transient Stability Analysis: Specific cases

Transient stability analysis determines the electrical power system ability to maintain synchronism after a large disturbance. The study period of interest w.r.t transient stability is usually limited to 3 to 5 seconds following clearance; however, it may be extended to about 10 seconds for a very large systems with dominant inter area model of oscillations. The system behaviour during such window can be analysed using numerical simulations. During transient stability case, the resulting system response involves significant changes in machine rotor angles and is influenced by non-linear power angle relationship. Further, the response depends on both the initial operating state of the system and the severity of the fault. The objective of transient stability study is to ensure that the system is capable to sustain the severe fault, maintain stability and return to stable condition. Classically, the transient stability analysis involves monitoring of synchronous machine rotor angles to check whether they are able to maintain synchronism. However, in the RE dominant pockets, the system behaviour is predominantly governed by Inverter Based Resources (IBR) control actions. Therefore, ability of the RE generators to stay connected to the grid following disturbances and other grid requirements of LVRT & HVRT compliances are critical to ensure stable operation.

In addition to the above, concentration of large quantum of RE in few pockets can lead to several challenges as it is highly intermittent in nature & can impact grid stability and operation. The challenges with high RE penetration broadly include the following:

Reduced System Inertia: Traditional synchronous generators provide inertia that helps in dampen frequency fluctuations. Replacing these with inverter-based RES diminishes this inertial support, potentially leading to increased frequency deviations and affecting transient stability.

Voltage Control Dynamics: IBRs have different voltage control mechanisms i.e Closed loop voltage control, Fixed PF mode & Fixed reactive power mode to control exchange of reactive power at POI. Also, there is a significant amount communication delays & polling rates involved w.r.t PPC & IBR. This divergence can influence voltage stability during transient events, necessitating careful coordination to ensure system reliability.

Voltage Fault Ride-Through Capabilities: RES must be capable of withstanding faults without disconnecting from the grid. Ensuring that these systems can ride through faults without tripping is essential for maintaining stability during and after disturbances.

Hence, transient stability analysis becomes important to understand the behaviour of the grid subject to disturbance/fault & identify potential issues w.r.t. voltage stability, power flow, and system dynamics. Based on the analysis, suitable measures for improving the stability such as planning of synchronous condensers, storage devices, reactive compensation devices etc. may be planned. This will ensure that the transition to renewable energy supports a stable and reliable power supply.

Further, RE Generators seeking to connect to the grid are mandated to comply with various

requirements of CEA Technical Standards for Connectivity to the Grid, 2007 (incl. amendments thereof), which includes LVRT, HVRT, power quality, reactive capability, frequency response, ramping capability etc.

In this chapter, transient stability analysis has been carried out for critical RE pockets of Gujarat and Rajasthan.

10.1 Transient stability studies in Khavda RE complex in Gujarat

Gujarat has been emerged as a leader in India's renewable energy sector, significantly contributing to the nation's clean energy goals & towards meeting Govt. of India target of 500 GW capacity from non-fossil energy sources by 2030. As of March 2025, the state's renewable energy capacity stands at approximately 33GW accounting for about 15% of India's total installed renewable capacity.

In this direction, Govt. of India had announced an ambitious project for development of 30 GW Khavda RE park in Gujarat. The transmission system for complete 30GW capacity envisaged in the Khavda RE Park has already been planned based on confirmation from GPCL and the same is under various stage of implementation as summarised below:

(i) Phase-I (3GW): Commissioned.
(ii) Phase-II (5GW): Under Implementation and expected by Mar-25 (SCOD).
(iii) Phase-III (7GW): Under Implementation and expected by Dec-25 (SCOD).
(iv) Phase-IV (7GW): Under Implementation and expected progressively by Nov-26(SCOD).
(v) Phase-V (8GW): Part A (6GW) is Under Implementation and expected by Nov-28 (LCC Bipole-1) / May-29 (LCC Bipole-2) (SCOD). Part C (2.5GW) is Under Tendering and expected by Apr-29 (VSC).

Three nos. pooling stations (KPS1, KPS2 & KPS3) have been planned for evacuation of 30GW RE capacity envisaged in the Khavda area. Further, based on confirmation from GPCL, Phase-VI scheme including KPS4 and KPS5 S/s is being planned for catering to evacuation of 11.5GW additional capacity in Khavda area which would result in cumulative capacity of 41.45GW in Khavda area. Out of this, transmission scheme for evacuation of upto 22GW power from various generators proposed to be connected at Khavda has been planned through AC system, wherein, power is evacuated to the load centers (South Gujarat/Mumbai/Pune area) through long transmission lines.

Study Considerations:

(i) Timeframe: 2026-27

(ii) Khavda Phase-I to IV transmission scheme & associated generation projects proposed to be connected at KPS1, KPS2 and KPS3 have been considered, wherein, more than 90% of the generation is solar in nature.

(iii) Detailed modelling of RE generators including 33kV collector system upto 690/800V

generation voltage alongwith dedicated lines has been considered, topology of the same is given in Figure-2.

(iv) Benchmarked generic RMS models submitted by entities w.r.t KPS1 have been considered in the subject study. Whereas Generic models as available in PSS/E standard library have been considered for balance RE plants in the subject study which are not benchmarked. Such WECC based generic models have been tuned so as to emulate the desired response.

(v) KPS1, KPS2 & KPS3 alongwith its associated transmission lines have been modelled & equivalent synchronous machines as per the Thevenin impedance & power flow for buses beyond Khavda has been considered.

(vi) WECC Generic STATCOM model i.e SVSMO3T2 as available in PSS/E standard library have been considered for modelling the STATCOMs at KPS1 & KPS3. Generic tuned parameters of such model have been incorporated to get the requisite response.

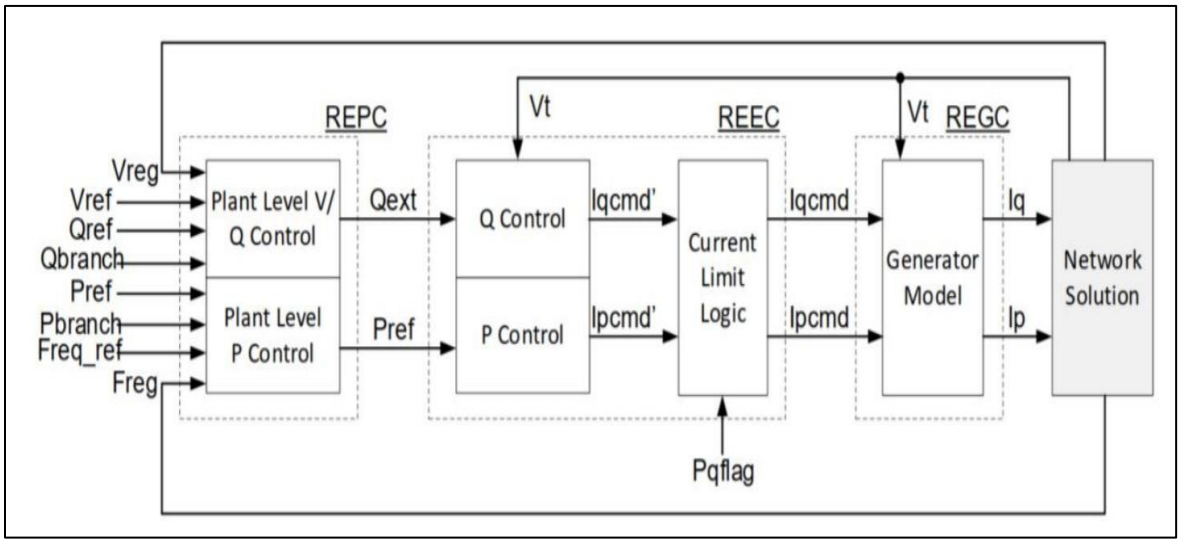
(vii) STATCOMs (ST) have been considered at ISTS level as per the following ratings:

Sr. No.	Name of PS	Capacity (dynamic portion)
1	KPS1 (Sec-I)	±300MVAr
2	KPS1 (Sec-II)	±300MVAr
3	KPS3 (Sec-I)	±300MVAr
4	KPS3 (Sec-II)	±300MVAr

(viii) Breakup of RE Generation at Khavda considered in the study is as below:

Sr. No.	Name of PS	RE Capacity at POI (MW)
1	KPS1 (Sec-I)	2250
2	KPS1 (Sec-II)	3750
3	KPS2 (Sec-I)	3750
4	KPS2 (Sec-II)	2600
5	KPS3 (Sec-I)	3200
6	KPS3 (Sec-II)	3200
Total		**18750**

(ix) Block diagram/ connections of Electrical control, Generator control, Power plant control w.r.t Solar plants modelling has been considered as per following, also, the hybrid PPC (HPLNTDU) has been considered as per the requirement.



(x) In addition to the above PSS/E generic models, pitch control, aerodynamic control and torque control has also been considered for modelling of Wind Generation in PDT model. Master (HPLNTDU) – Slave PPC (REAXDU) concept have been considered w.r.t benchmarked models submitted by entity(ies) at Khavda.

(xi) Inertial Based Fast Frequency Response Model as available in PSS/E standard library i.e WTGIBFFRA has been considered w.r.t some of the Wind models, however since the scope of subject is to analyse RE behaviour during LVRT conditions, therefore, such model have been kept disabled.

Study cases: Three cases have been studies as per the following details:

(i) Case:1- LVRT case at 400kV KPS1 (Sec-I) bus.
(ii) Case:2- LVRT case at 400kV KPS2 (Sec-I) bus.
(iii) Case:3- LVRT case at 400kV KPS3 (Sec-II) bus.

Case-1: In this case, a three-phase fault corresponding to 0.15pu Voltage at KPS1 (Sec-1) is simulated in PSS/E V36 which was subsequently cleared after 300ms, topology of the same is given in Figure-1. During such LVRT condition, RE models are selected to operate in a reactive current priority mode whereas the active current is constrained during fault condition. During the subject fault condition, the reactive power (and current) of each plant is monitored to check whether the plants are providing reactive current support during depressed voltage condition. Also, the active power recovery post fault clearance scenario is monitored to check that atleast 90% of the pre-fault active is recovered within one second of fault clearance.

The mechanically switched capacitor and reactor banks have not been considered during the study, as the RE plants alone are able to maintain the POI voltage close to unity (within dead band). Due to the above, the MSC/MSR slow reset logic and MSS coordinated switching has been kept disabled. The output (reactive power and current) of STATCOMs at KPS1 & KPS3 are also monitored to check their performance during such low voltage condition. The respective plots of voltage, active power, reactive power and STATCOMs output during the case-1 are shown in subsequent **Figure 10-3** to **Figure 10-23**.

Based on the simulation results, it is inferred that with the considered transmission system, RE plants are able to ride through the low voltage conditions for 0.15pu (300ms) at KPS1 (Sec-1) and they are able to provide the reactive power (current) support to help the Grid in maintaining stability. RE plants are able to recover their pre-fault active power well within 1 sec of fault clearance. Spikes in reactive power have been observed during the fault clearance period which results in voltage spikes. These spikes in reactive power are known to be a numerical convergence issue. Also, the HVRT activation level of subject RE plants are coordinated such that plant should not enter in HVRT mode after fault clearance due to presence of large reactive during fault clearance zone. Since, the reactive power in a system is a function of corresponding voltage, accordingly, the reactive power output from STATCOMs near fault locations are observed to be less that rated capacity i.e ±300MVAr, however they are able to provide rated reactive current during such fault condition.

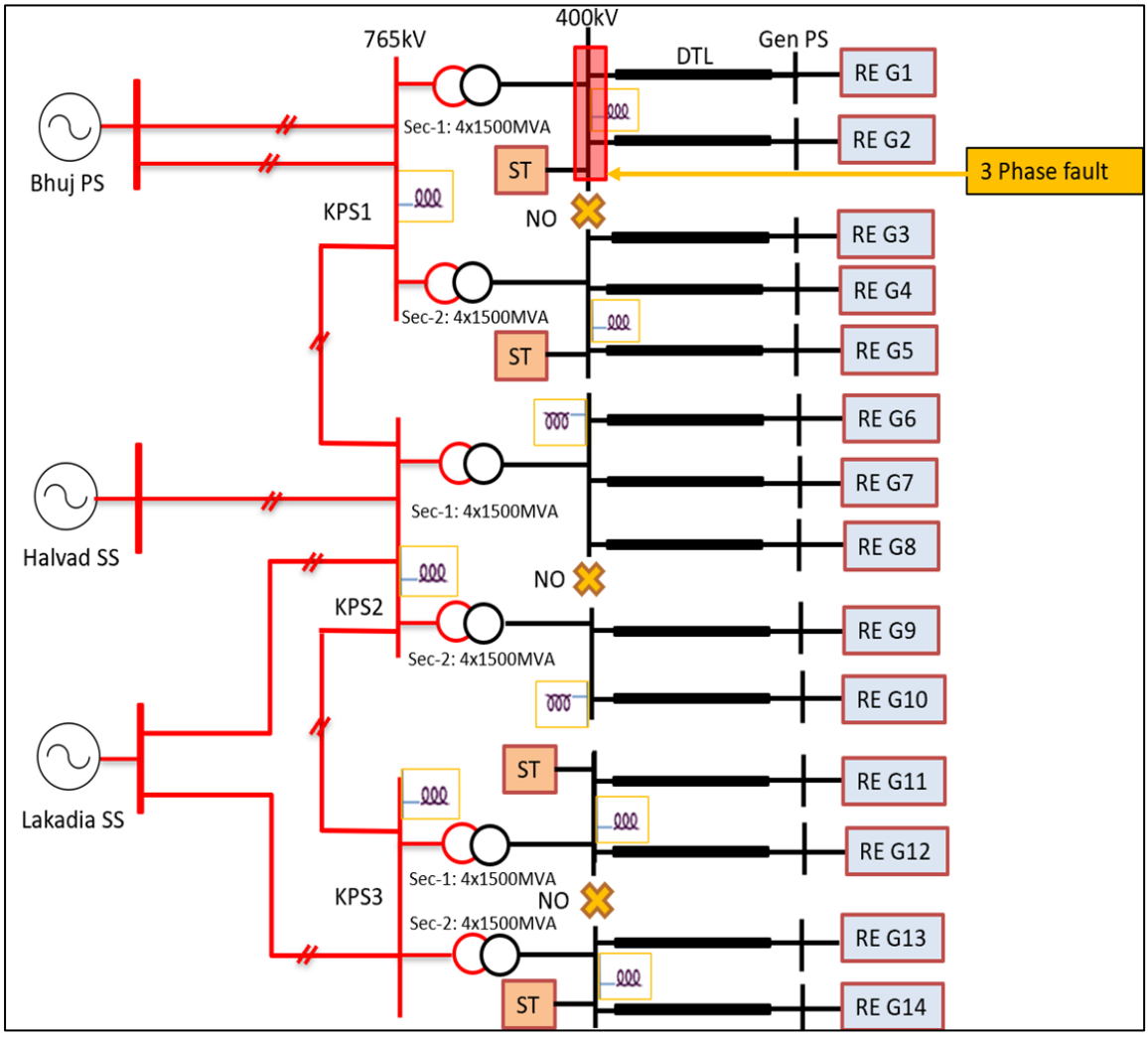


Figure 10-1 Network topology considered during Case-1

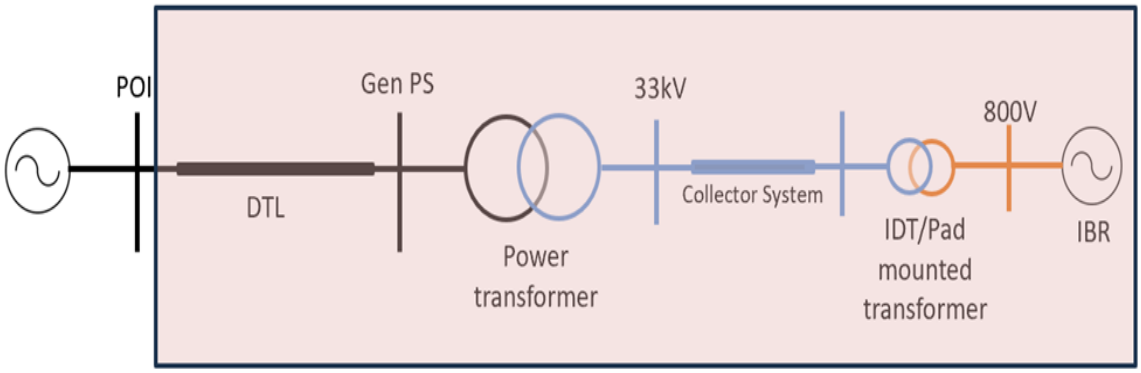


Figure 10-2 Topology considered for RE park modelling in the studies

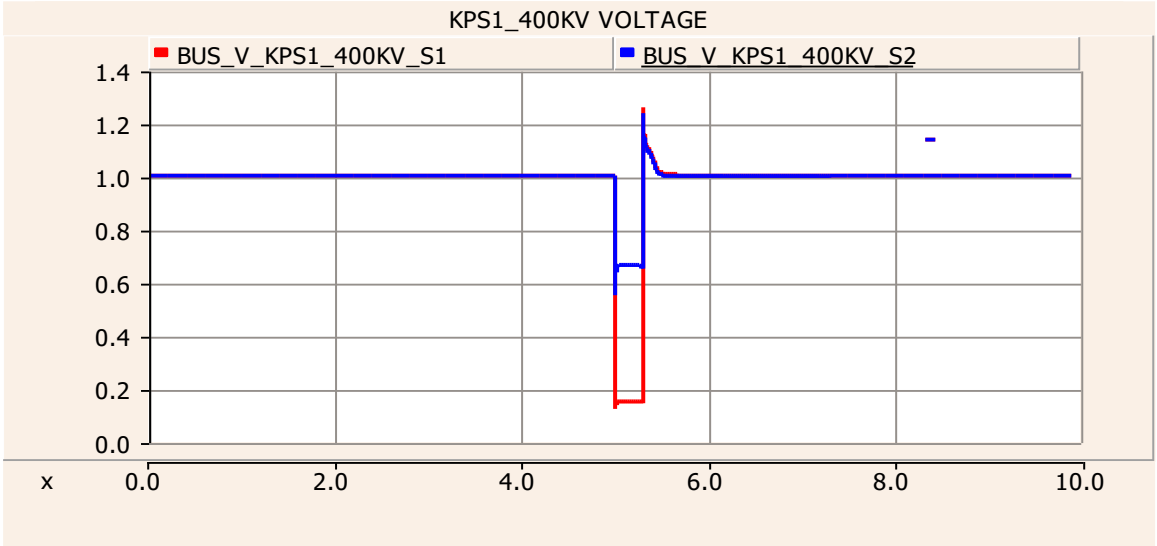


Figure 10-3 Voltages (pu) at KPS1 (Sec-I & II) at 400kV level during Case-1

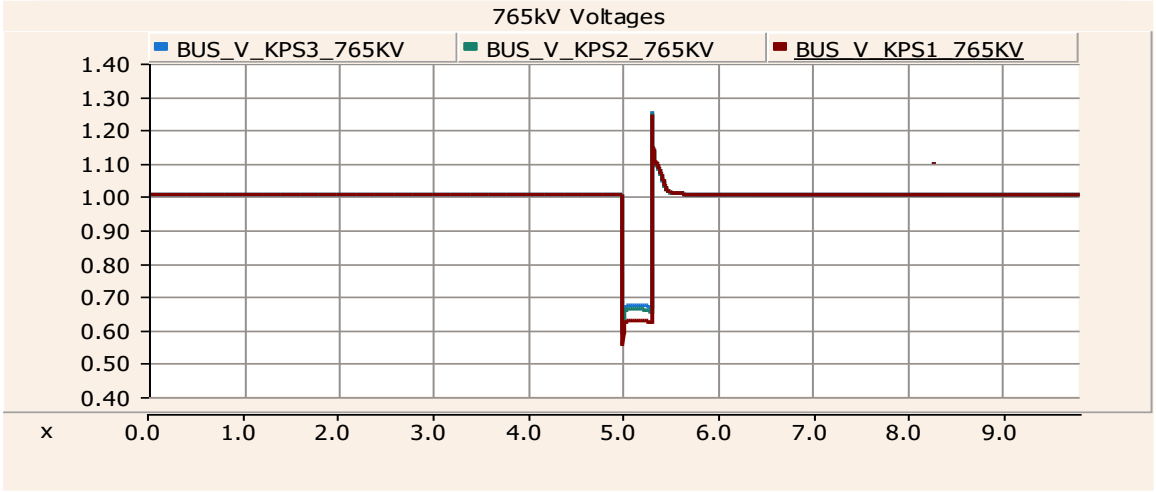


Figure 10-4 765kV Voltages at KPS1, KPS2 & KPS3 during Case-1

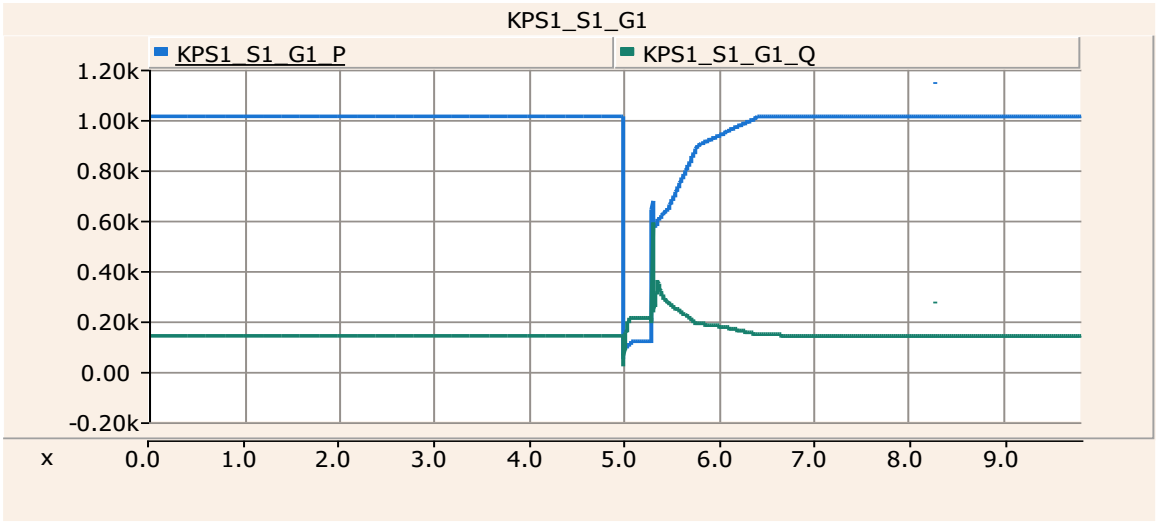


Figure 10-5 RE G1 Active and Reactive from during Case-1

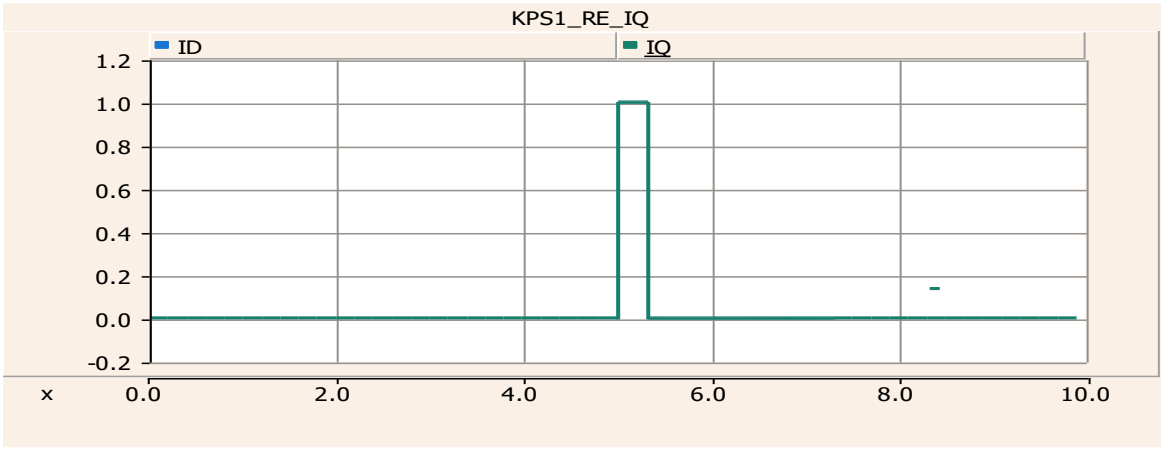


Figure 10-6 RE G1 Reactive current (pu) during Case-1

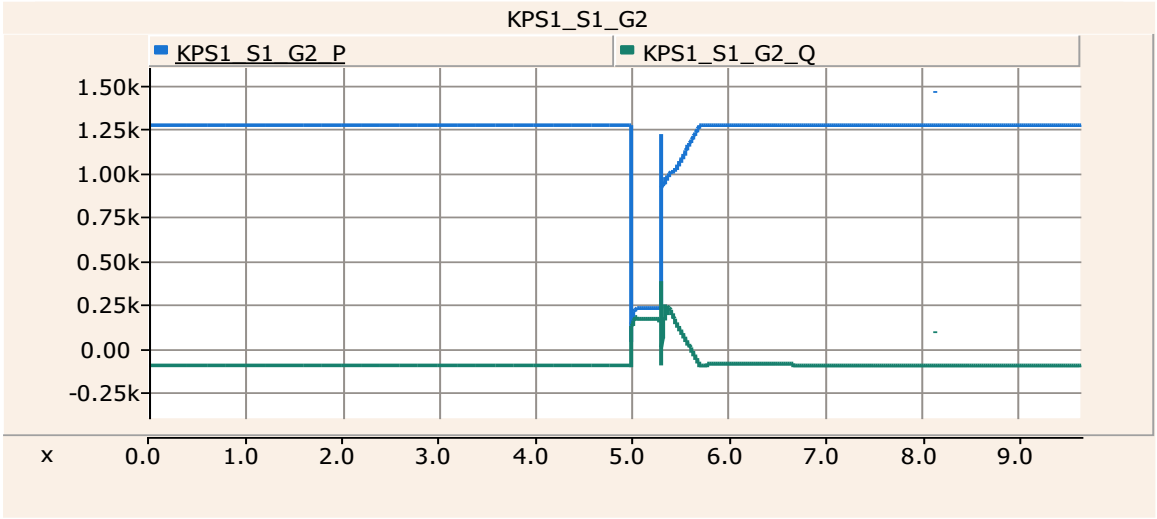


Figure 10-7 RE G2 Active and Reactive from during Case-1

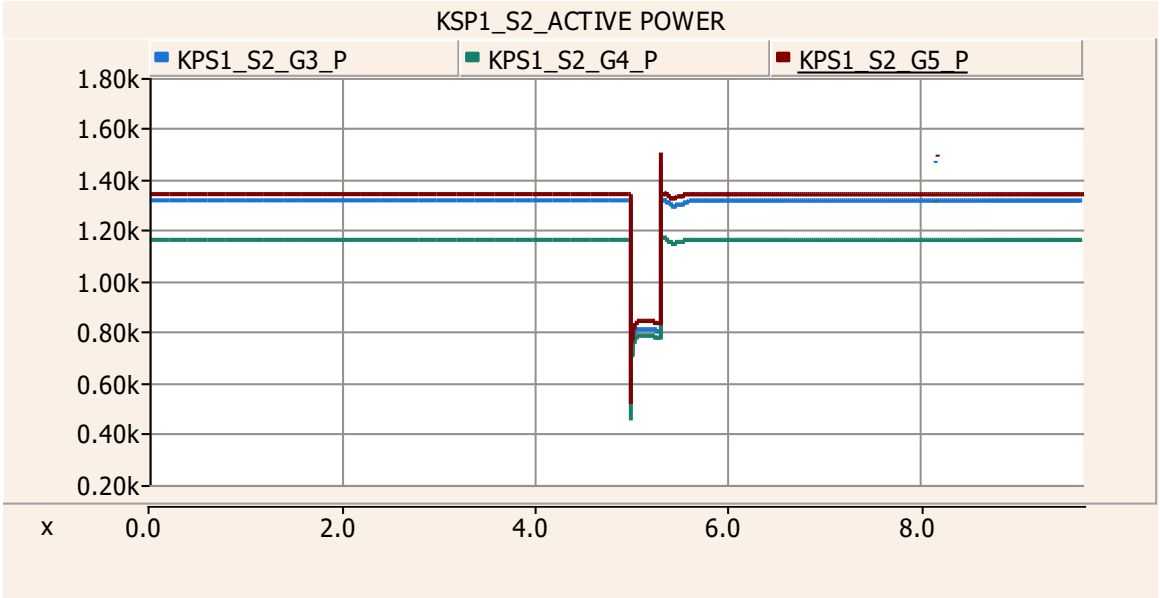


Figure 10-8 RE G3, G4 & G5 Active power during Case-1

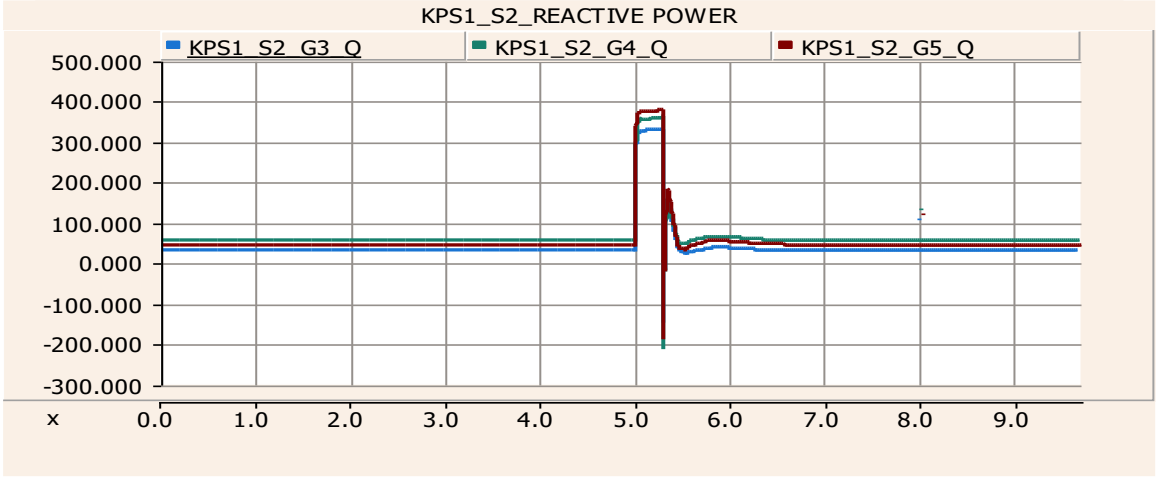


Figure 10-9 RE G3, G4 & G5 Reactive power during Case-1

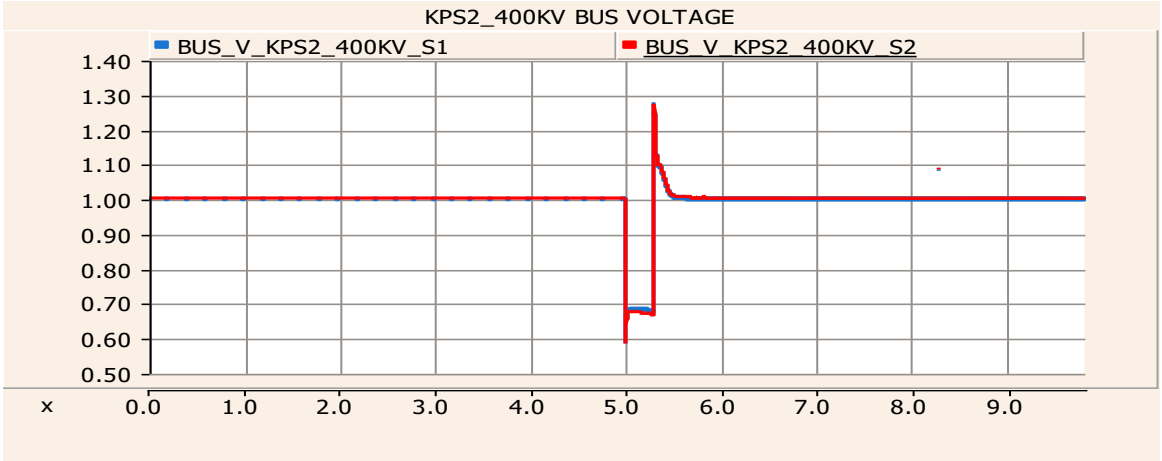


Figure 10-10 KPS2 400KV bus voltage (pu) during Case-1

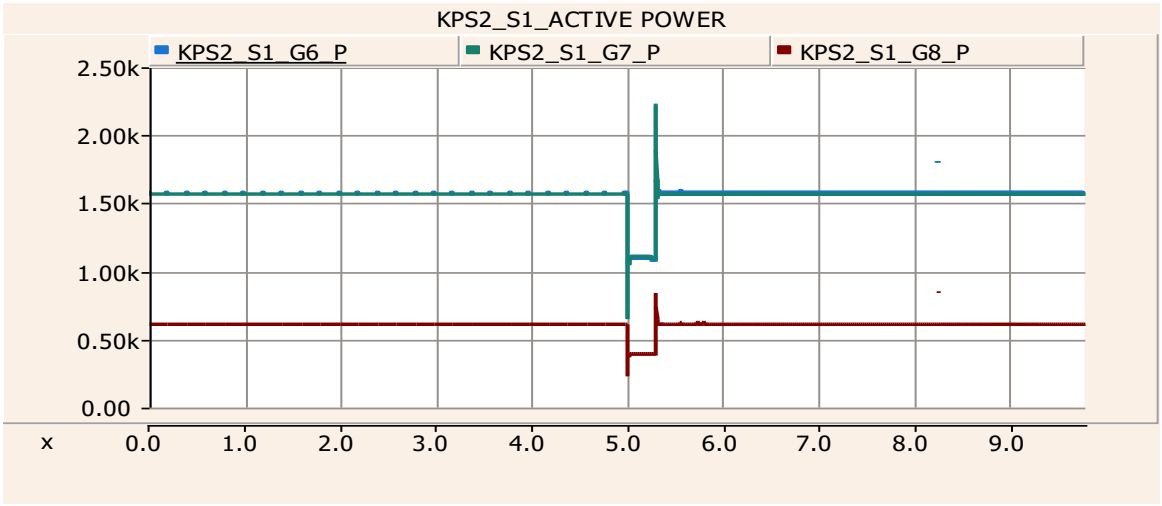


Figure 10-11 RE G6, G7 & G8 Active power during Case-1

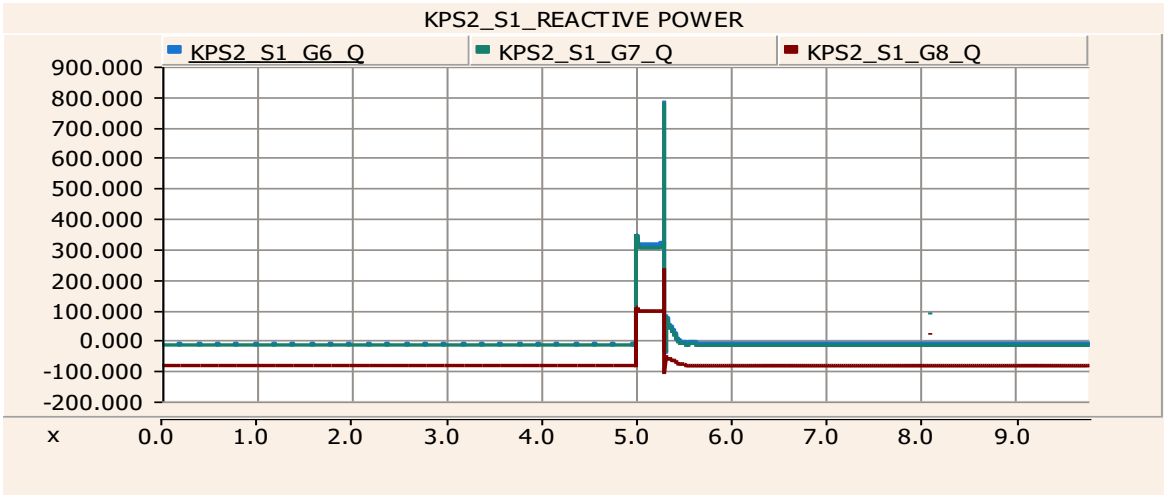


Figure 10-12 RE G6, G7 & G8 Reactive power during Case-1

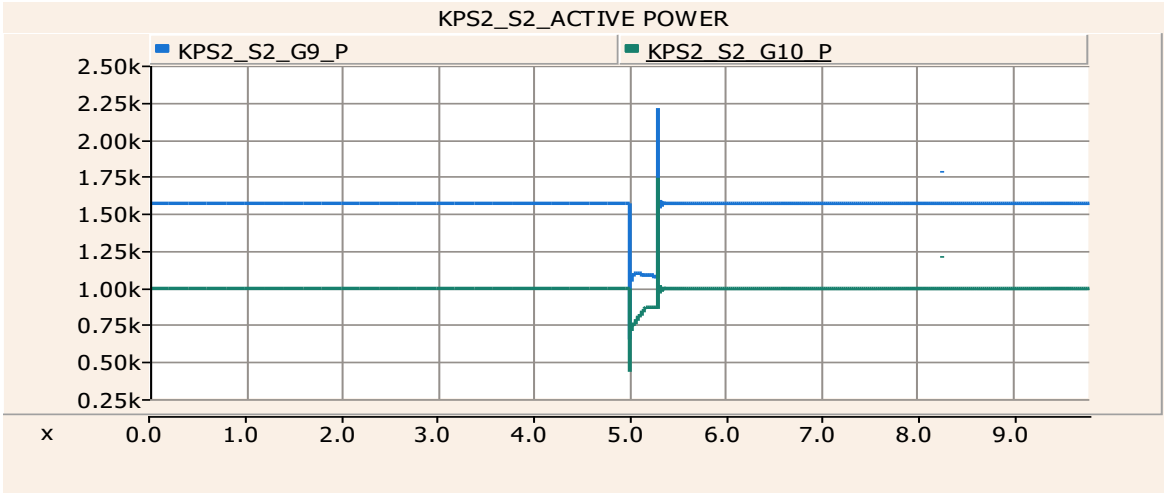


Figure 10-13 RE G9 & G10 Active power during Case-1

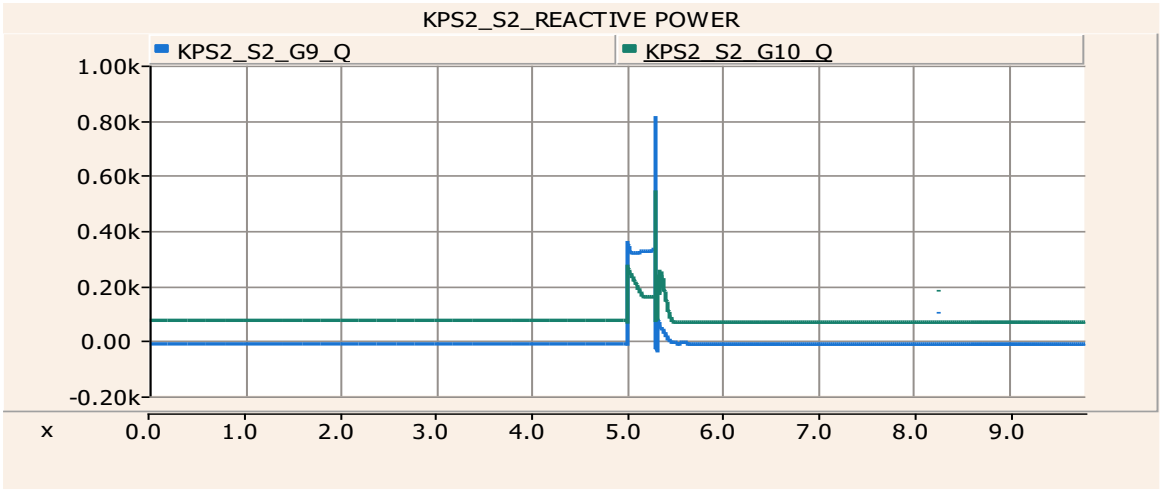


Figure 10-14 RE G9 & G10 Reactive power during Case-1

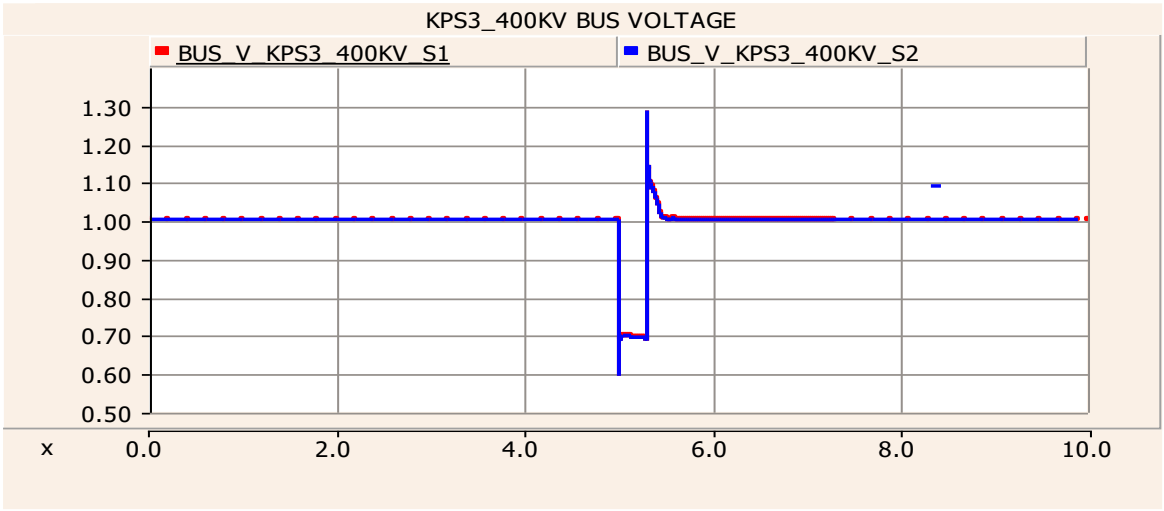


Figure 10-15 KPS3 400KV bus voltage (pu) during Case-1

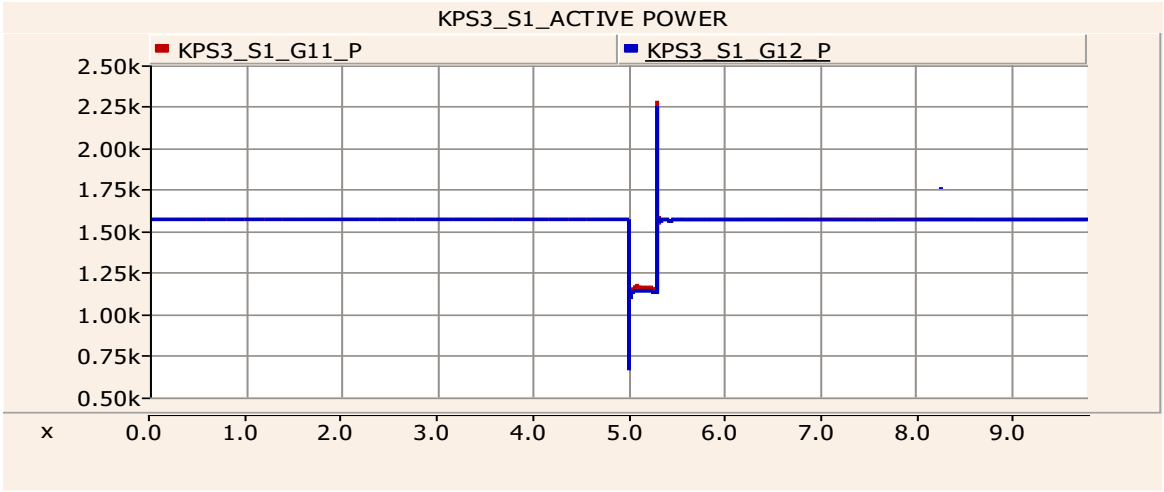


Figure 10-16 RE G11 & G12 Active power during Case-1

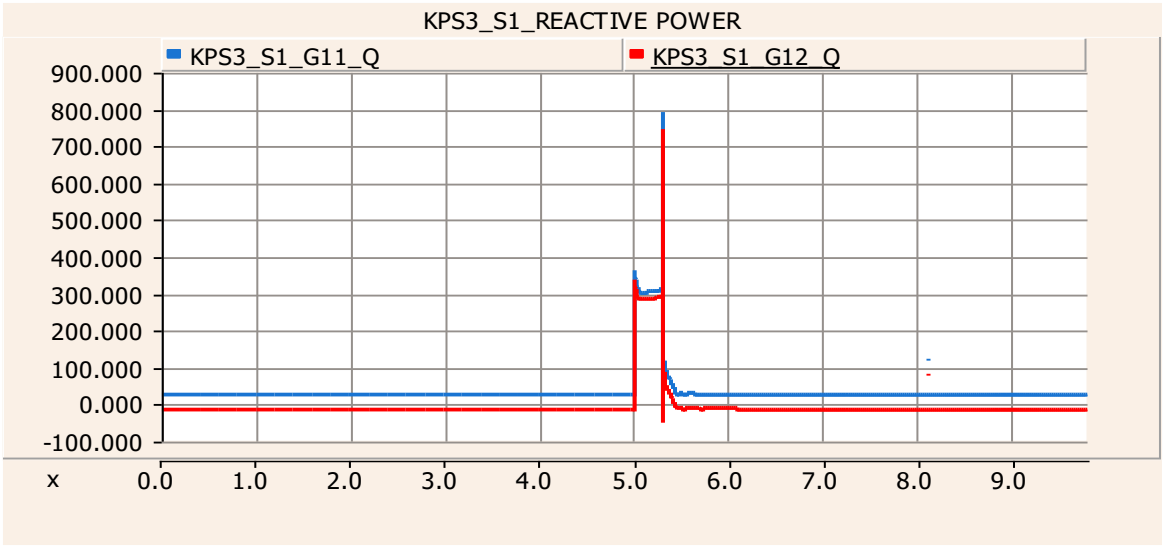


Figure 10-17 RE G11 & G12 Reactive power during Case-1

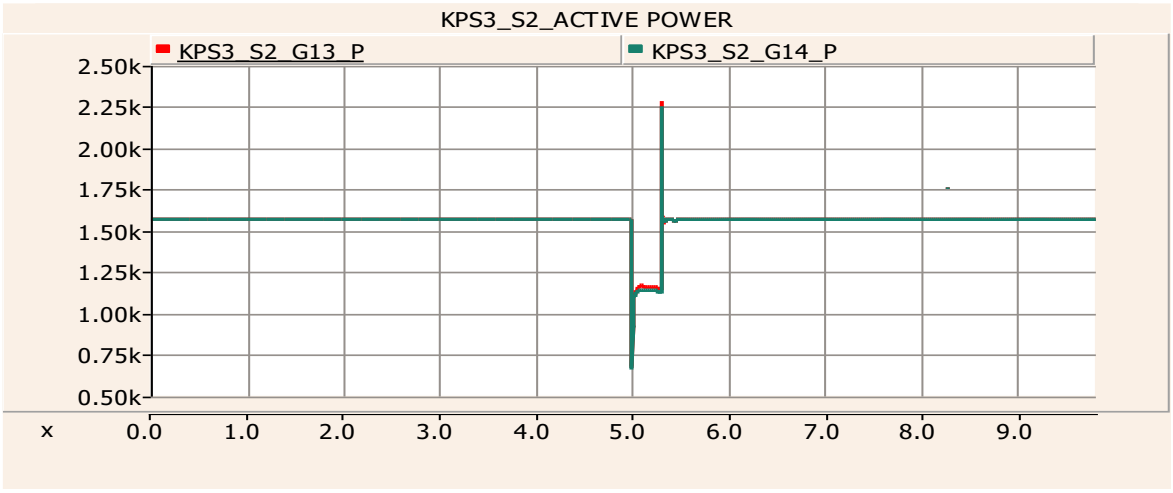


Figure 10-18 RE G13 & G14 Active power during Case-1

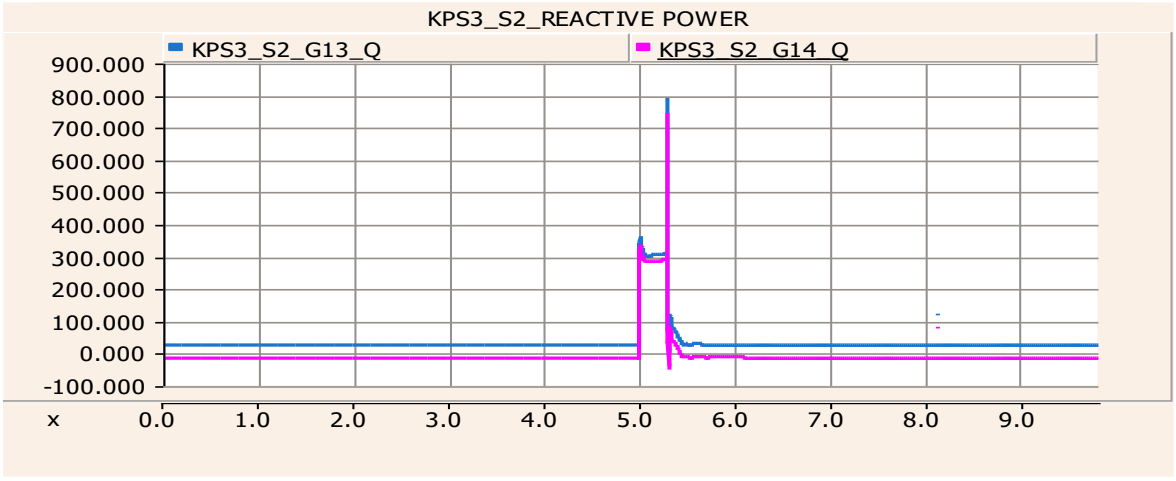


Figure 10-19 RE G13 & G14 Reactive power during Case-1

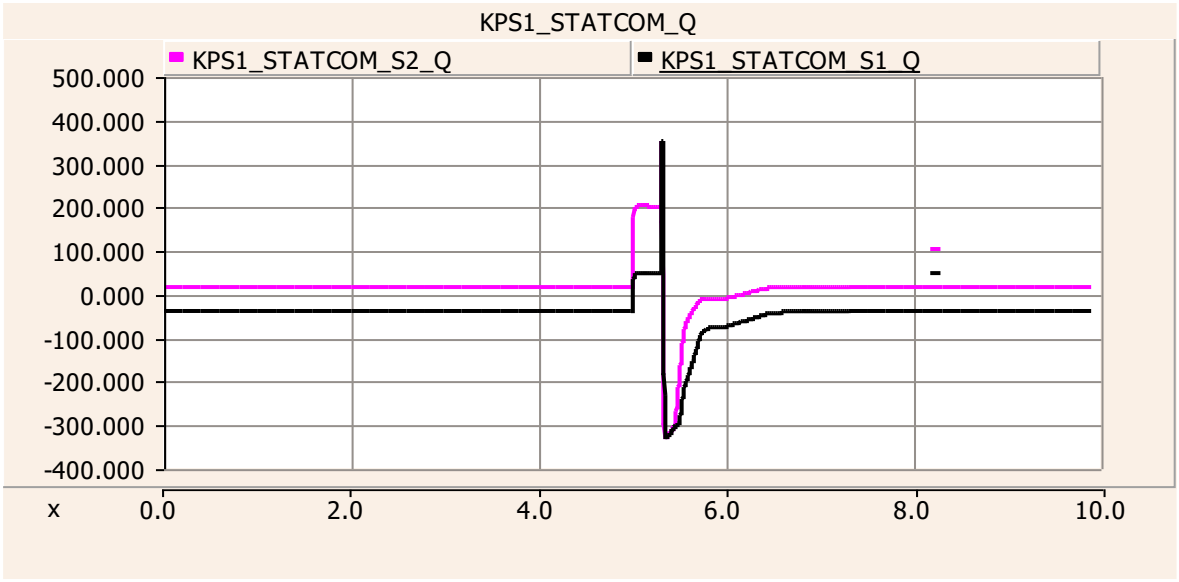


Figure 10-20 KPS1 STATCOMs output during Case-1

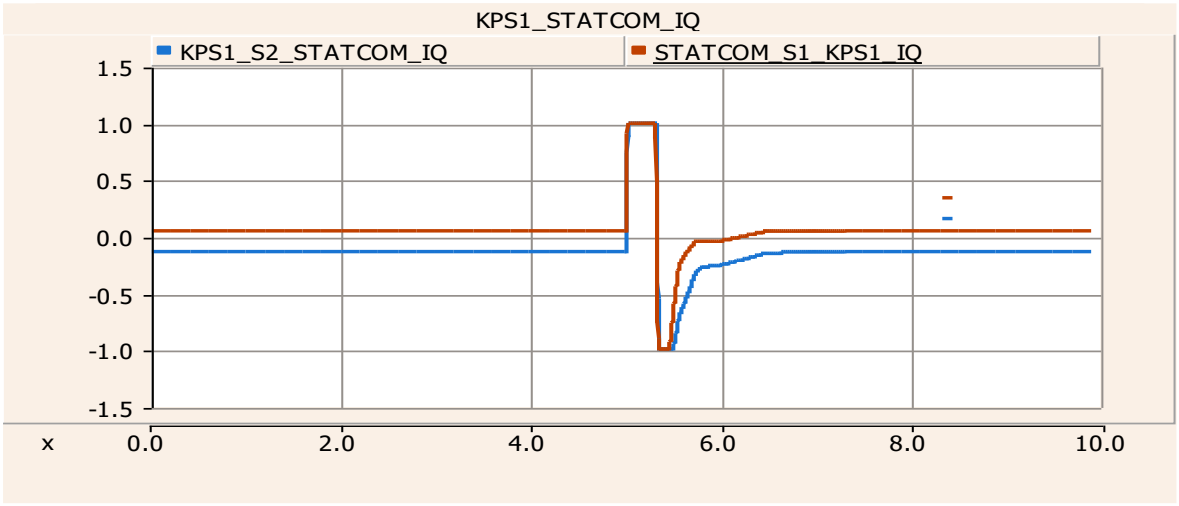


Figure 10-21 KPS1 STATCOMs reactive current during Case-1

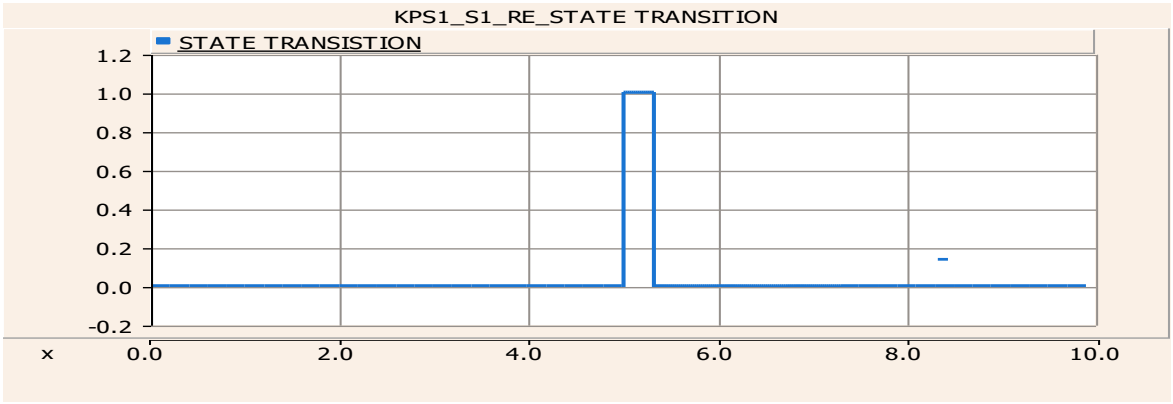


Figure 10-22 State transition of RE G1 during case-1

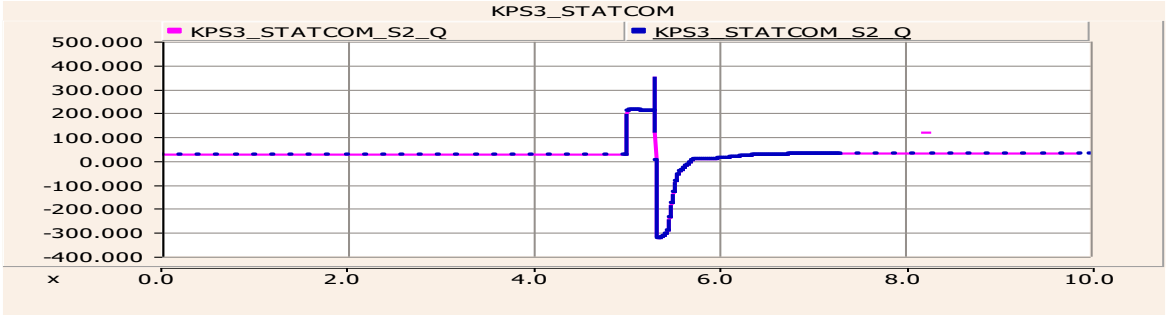


Figure 10-23 KPS3 STATCOMs output during Case-1

Case-2: In the case 2, a three-phase fault corresponding to 0.15pu Voltage at KPS2 (Sec-1) is simulated in PSS/E V36 which were cleared after 300ms, topology of the same is given in **Figure 10-2**. The respective plots of voltage, active power, reactive power and STATCOMs output during the case-2 are shown in subsequent **Figure 10-25** to **Figure 10-37.**

Based on the simulation results, it is inferred that RE plants are able to ride through conditions and they are able to provide the reactive power (current) support to help in maintaining stability. RE plants are able to recover their pre fault active power well within 1 sec of fault clearance. As observed in Case-1, similar spikes in reactive power have been observed during the fault clearance period which results in voltage spikes. These spikes in reactive power are known to be a numerical convergence issue. STATCOMs are also able to provide 1.0 pu reactive current during the fault condition in this case also.

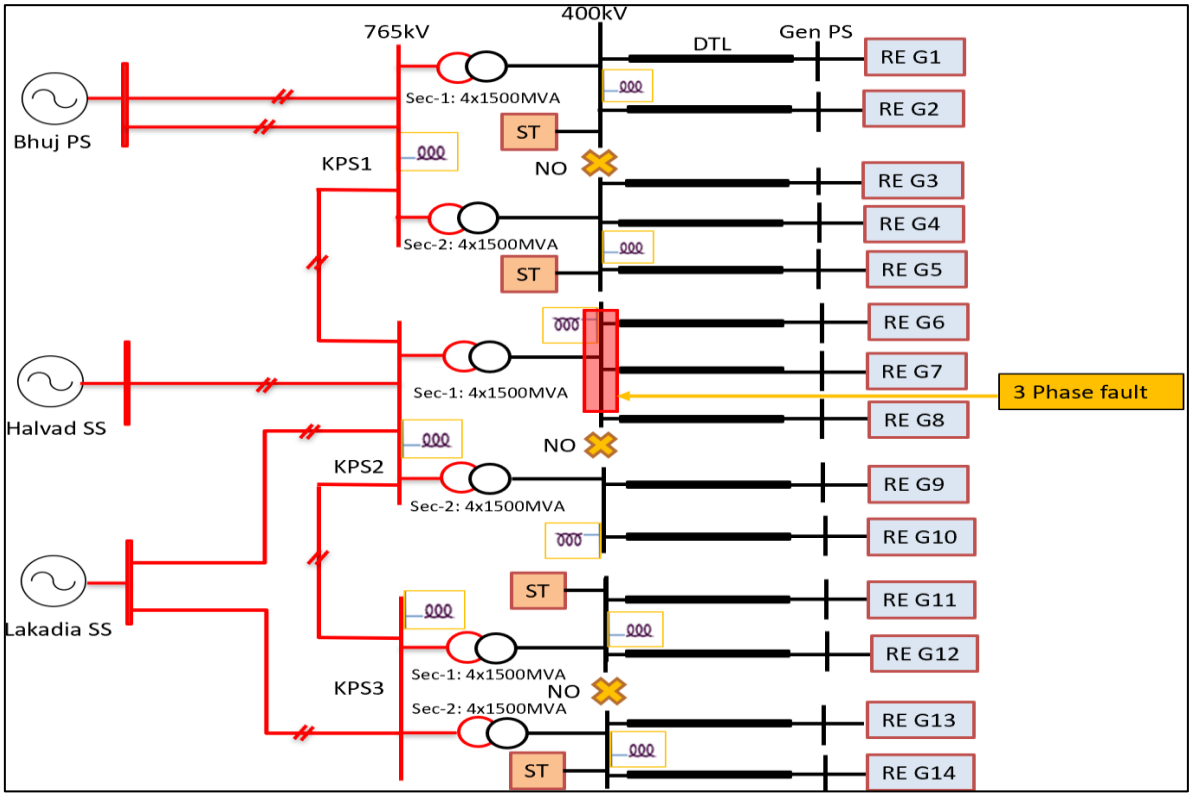


Figure 10-24 Network topology considered during Case-2

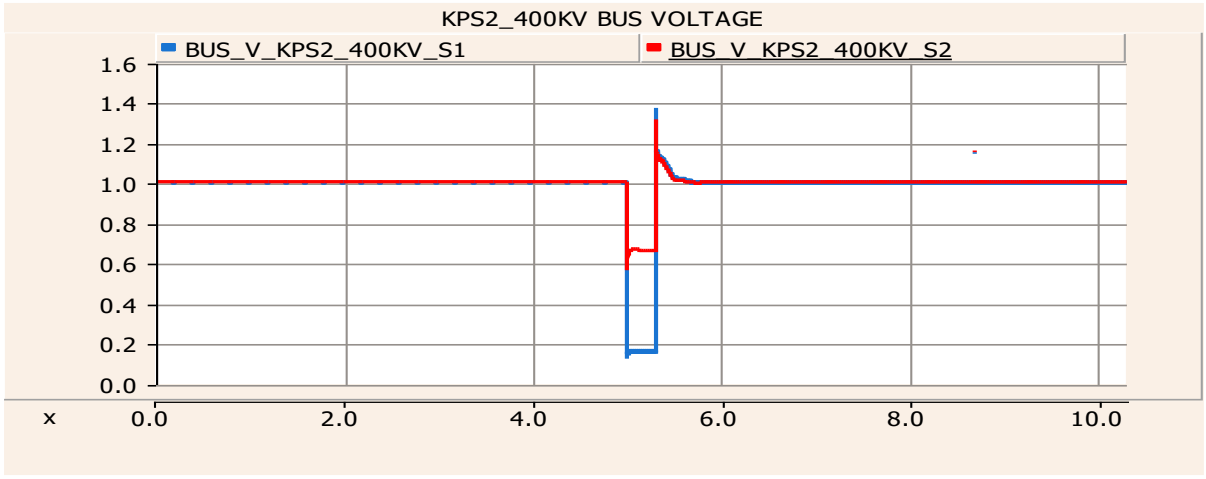


Figure 10-25 KPS2 400kV Voltage (pu) during case-2

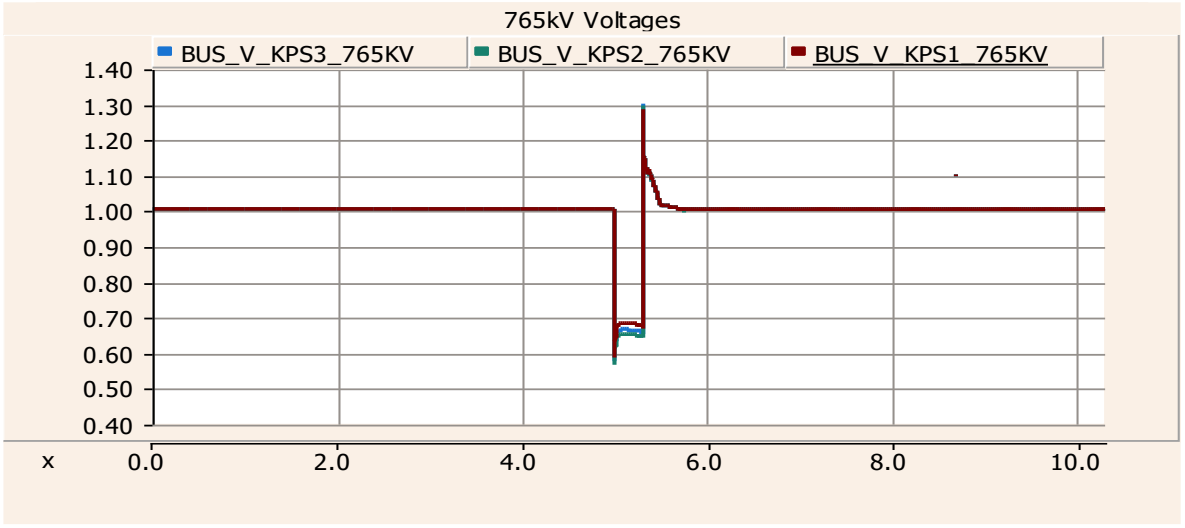


Figure 10-26 765kV bus voltage at KPS1, KPS2 & KPS3 (pu) during case-2

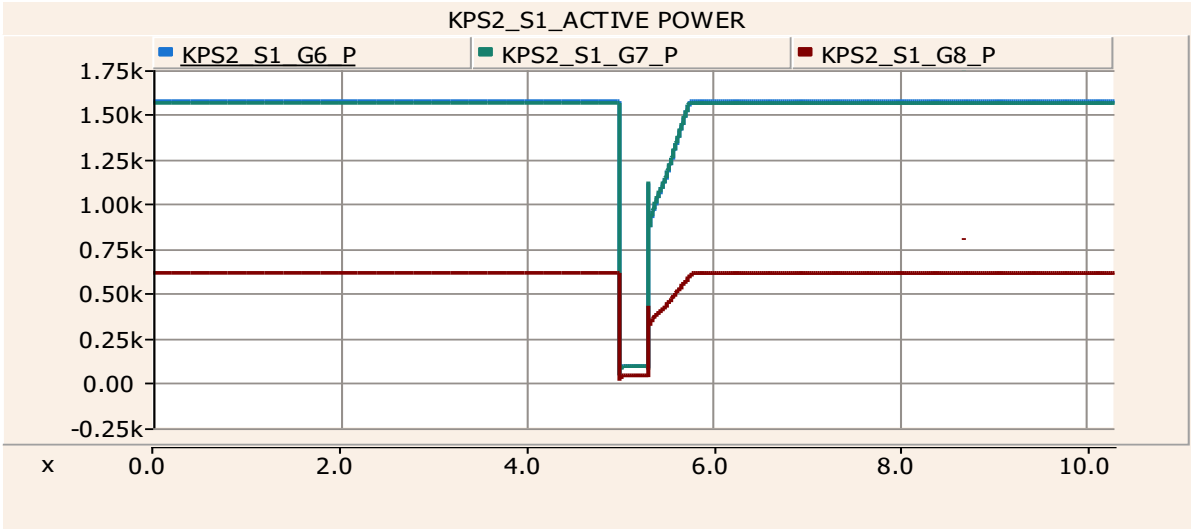


Figure 10-27 KPS2 (Sec-1) active power during Case-2

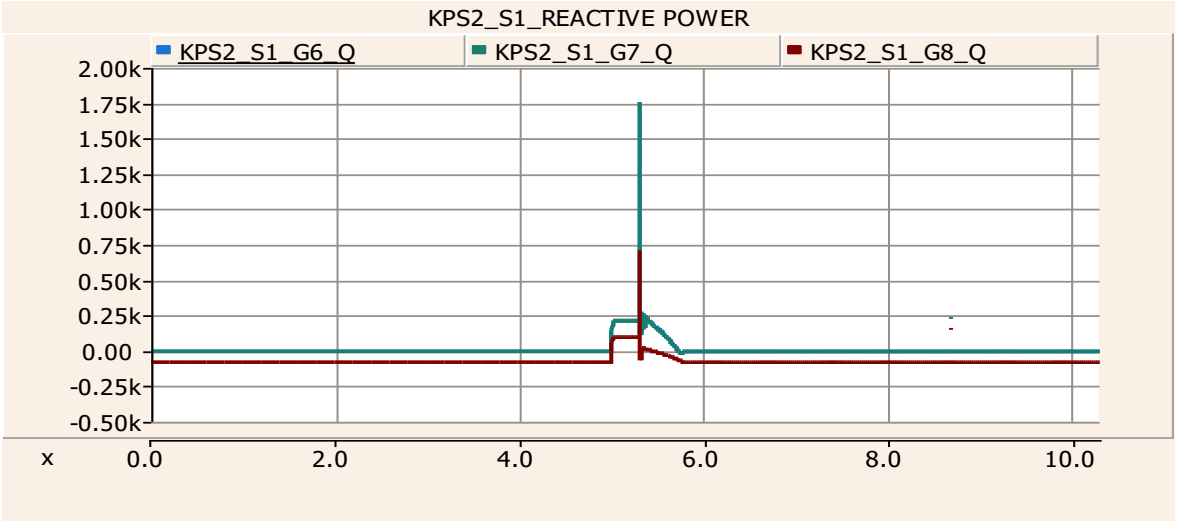


Figure 10-28 KPS2 (Sec-1) reactive power during Case-2

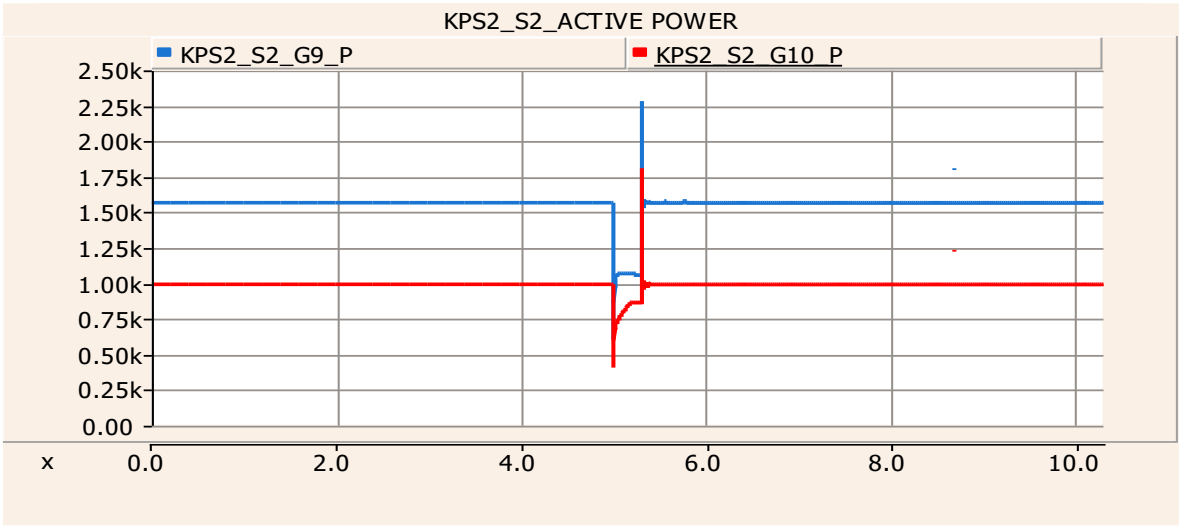


Figure 10-29 KPS2 (Sec-2) active power during Case-2

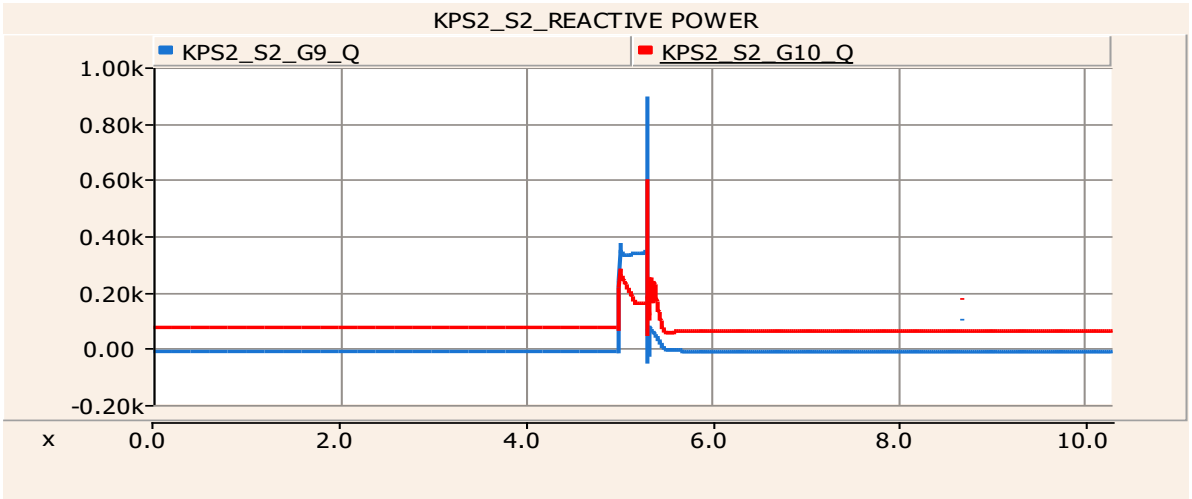


Figure 10-30 KPS2 (Sec-2) reactive power during Case-2

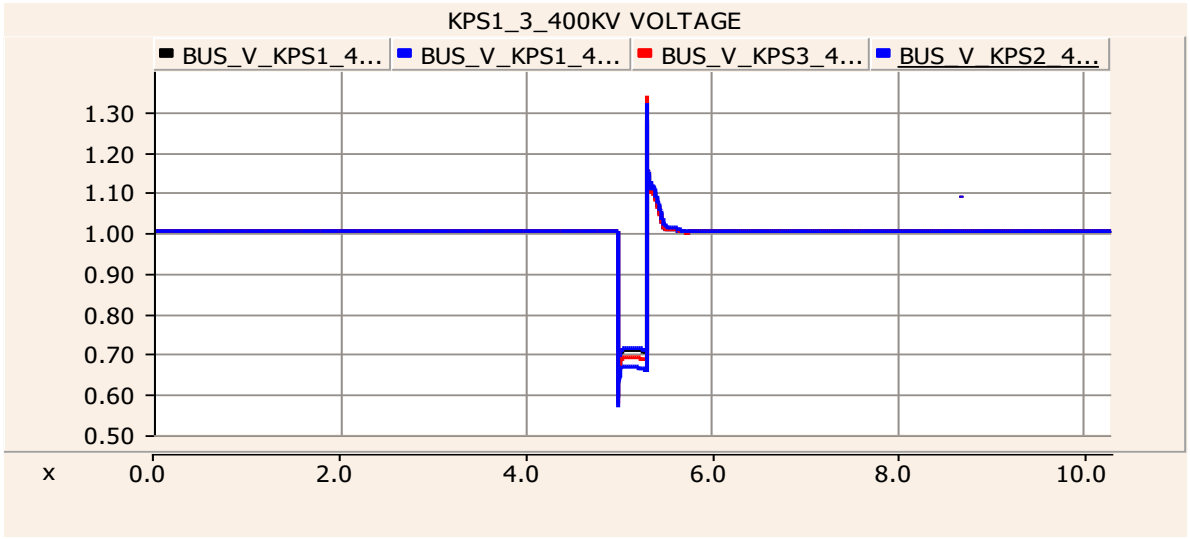


Figure 10-31 400kV bus voltage at KPS1 & KPS3 during case-2

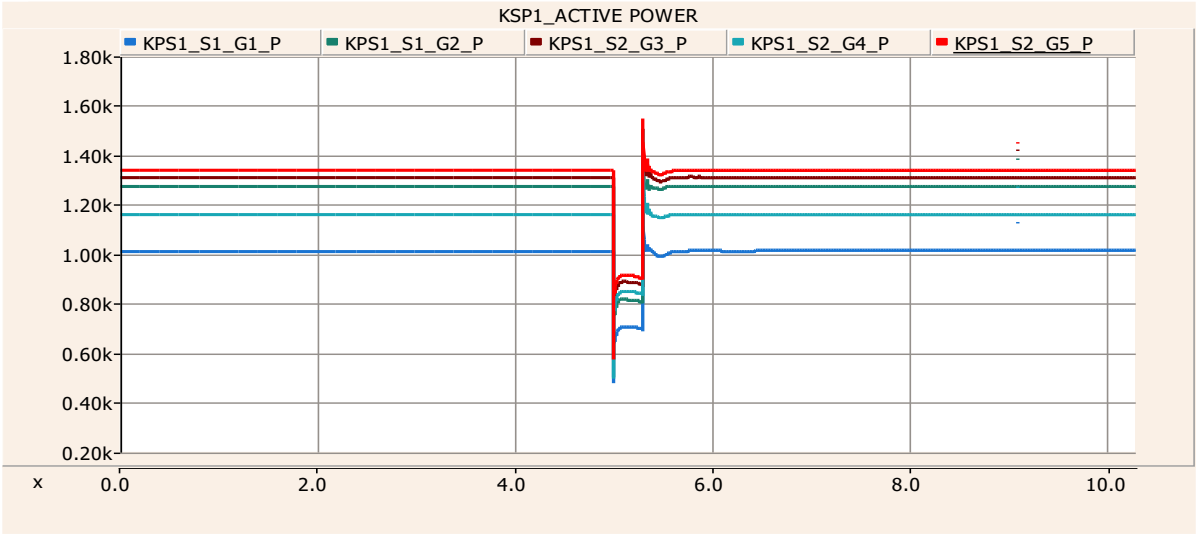


Figure 10-32 KPS1(Sec-1 & 2) active power during Case-2

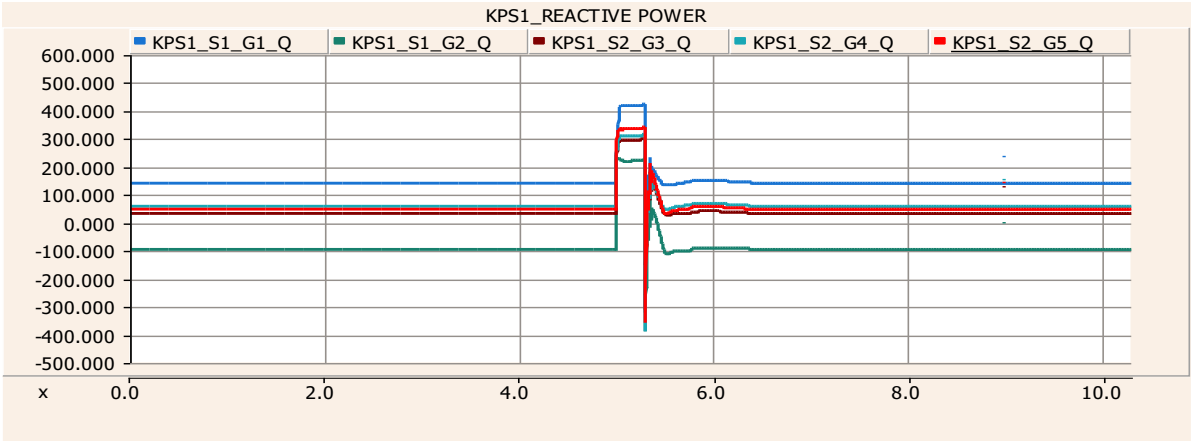


Figure 10-33 KPS1(Sec-1 & 2) reactive power during Case-2

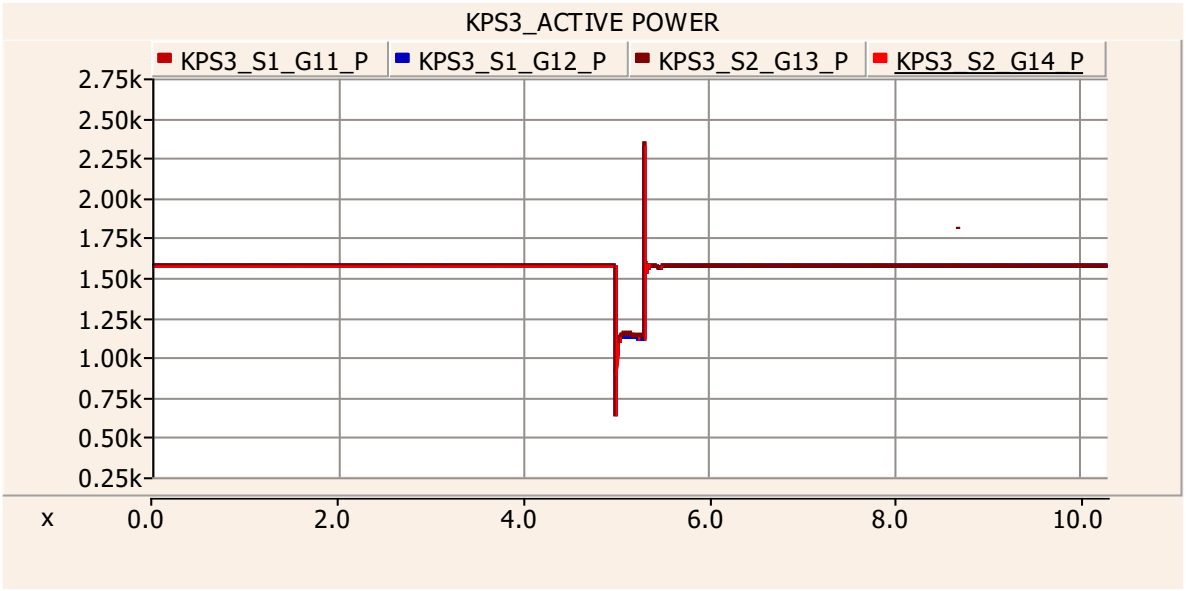


Figure 10-34 KPS3(Sec-1 & 2) active power during Case-2

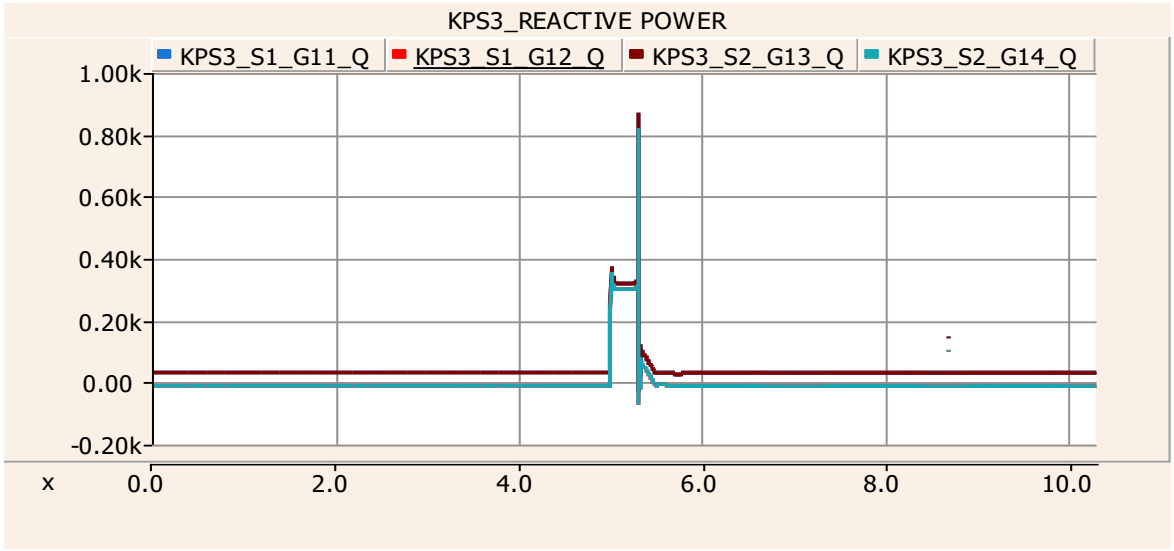


Figure 10-35 KPS3(Sec-1 & 2) reactive power during Case-2

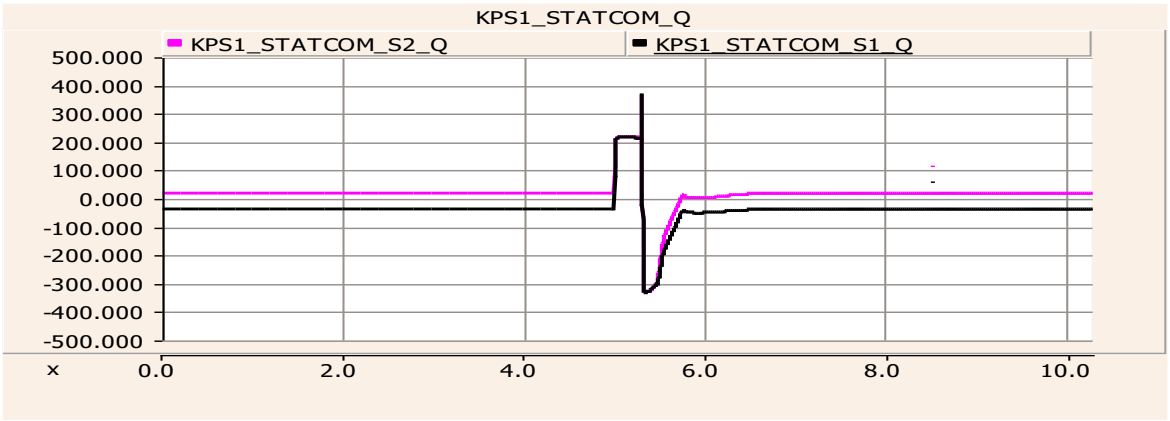


Figure 10-36 KPS1 (Sec-1&2) STATCOMs output during Case-2

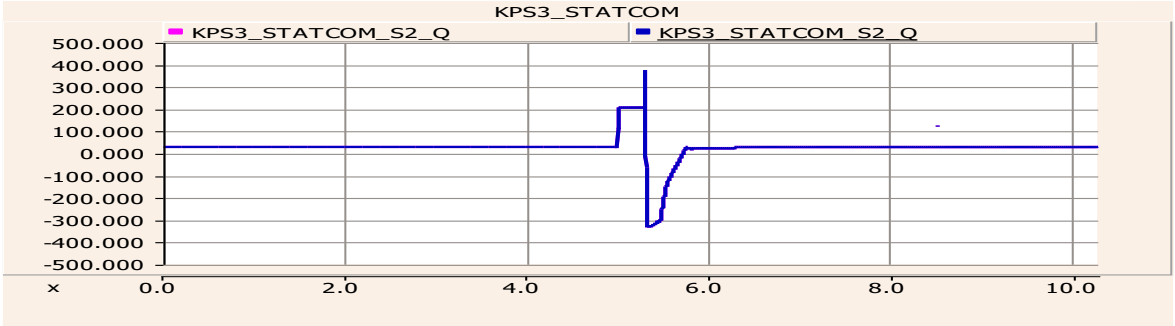


Figure 10-37 KPS3 (Sec-1&2) STATCOMs output during Case-2

Case-3: In the case 3, a three-phase fault corresponding to 0.15pu Voltage at KPS3 (Sec-2) is simulated in PSS/E V36 which were cleared after 300ms, topology of the same is given in **Figure 10-3**. The respective plots of voltage, active power, reactive power and STATCOMs output during the case-3 is shown in subsequent **Figure 10-39** to **Figure 10-50.**

Based on the simulation results, it is inferred that RE plants are able to ride through conditions and they are able to provide the reactive power (current) support to help in maintaining stability. RE plants are able to recover their pre fault active power well within 1 sec of fault clearance. As observed in Case-1 & 2, similar spikes in reactive power have been observed during the fault clearance period which results in voltage spikes. These spikes in reactive power are known to be a numerical convergence issue. STATCOMs are also able to provide 1.0 pu reactive current during the fault condition.

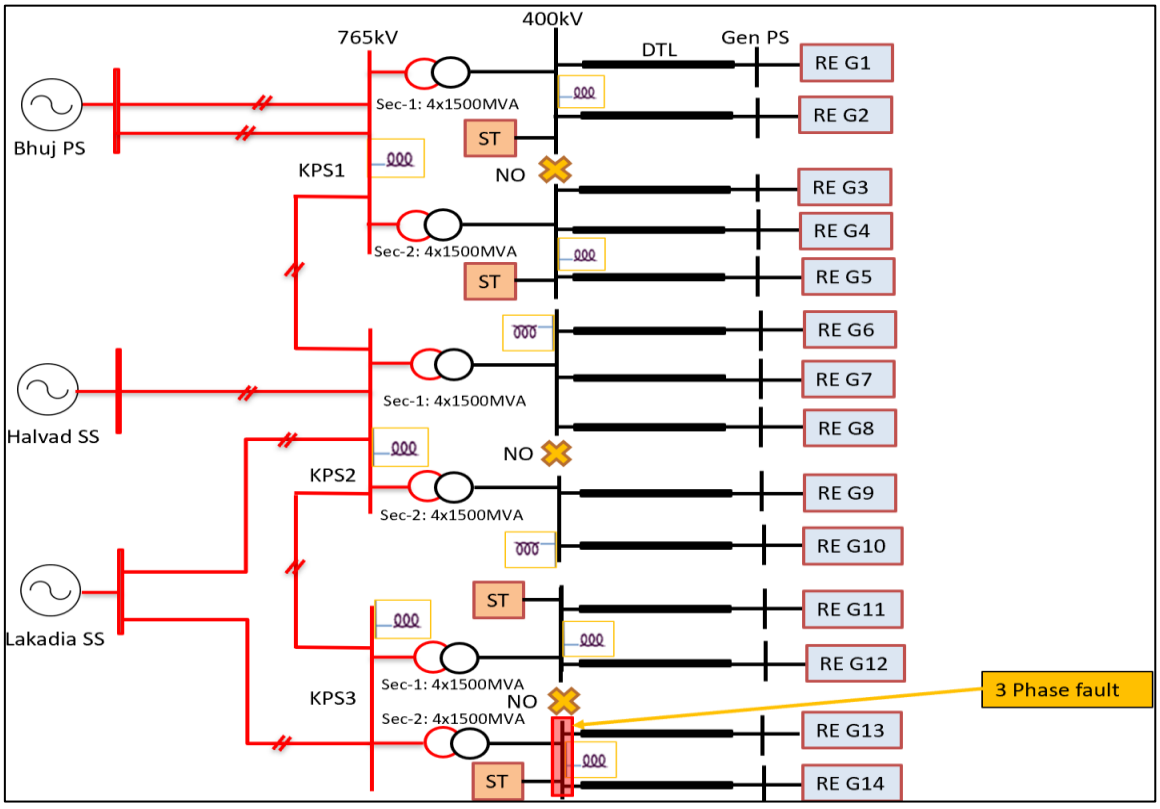


Figure 10-38 Network topology considered during Case-3

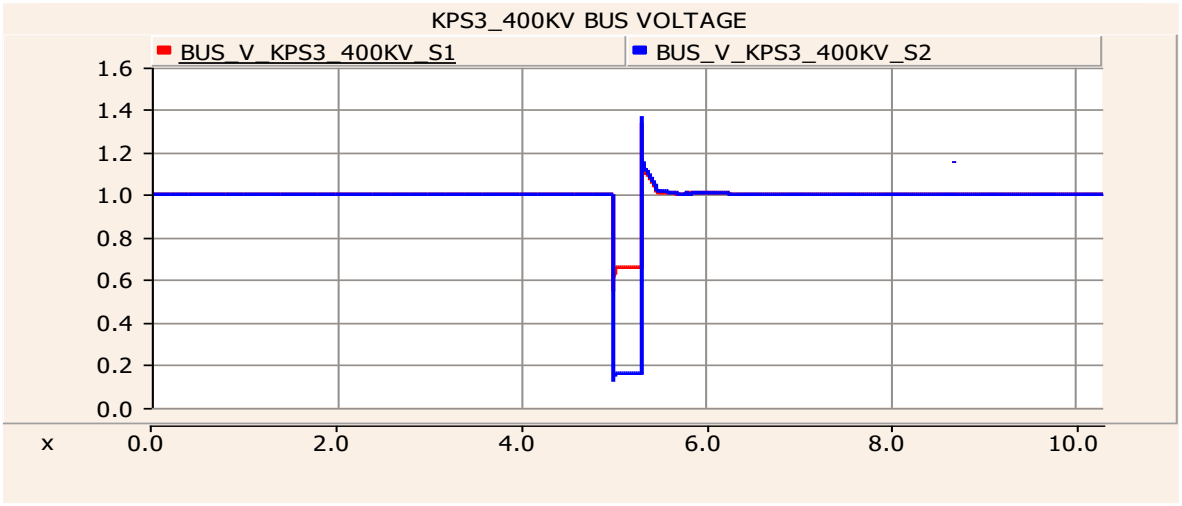


Figure 10-39 KPS3 (Sec 1 & 2) 400kV bus voltage (pu) during Case-3

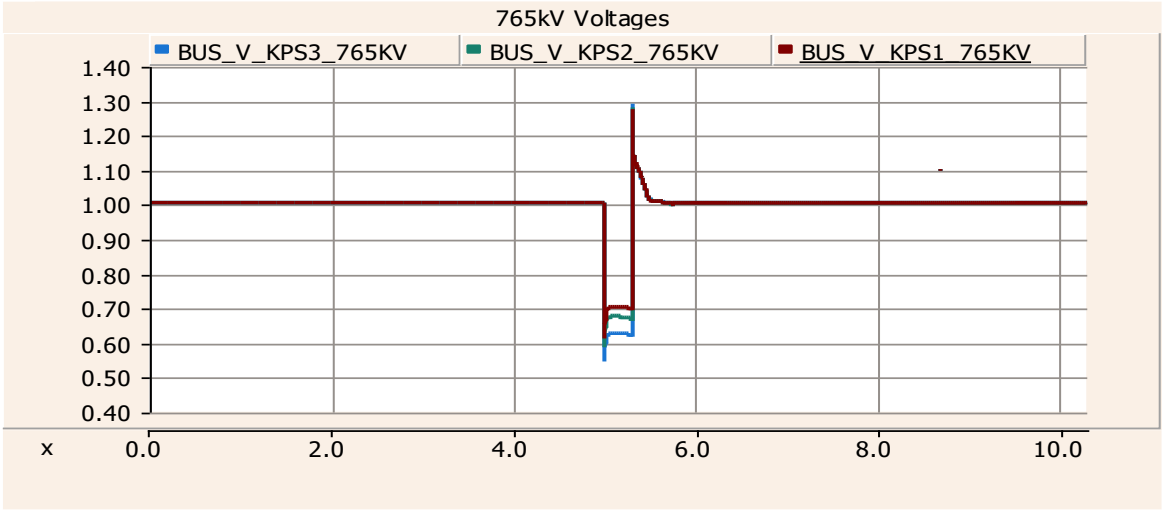


Figure 10-40 765kV bus voltage at KPS1, KPS2 & KPS3 (pu) during Case-3

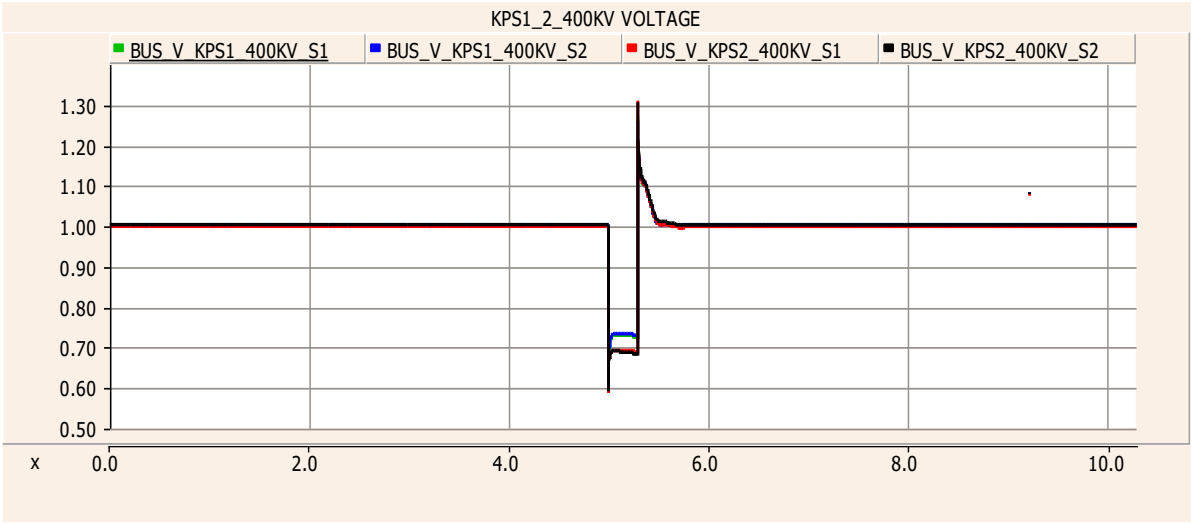


Figure 10-41 KPS1 (Sec-1 & 2) 400kV bus voltage (pu) during Case-3

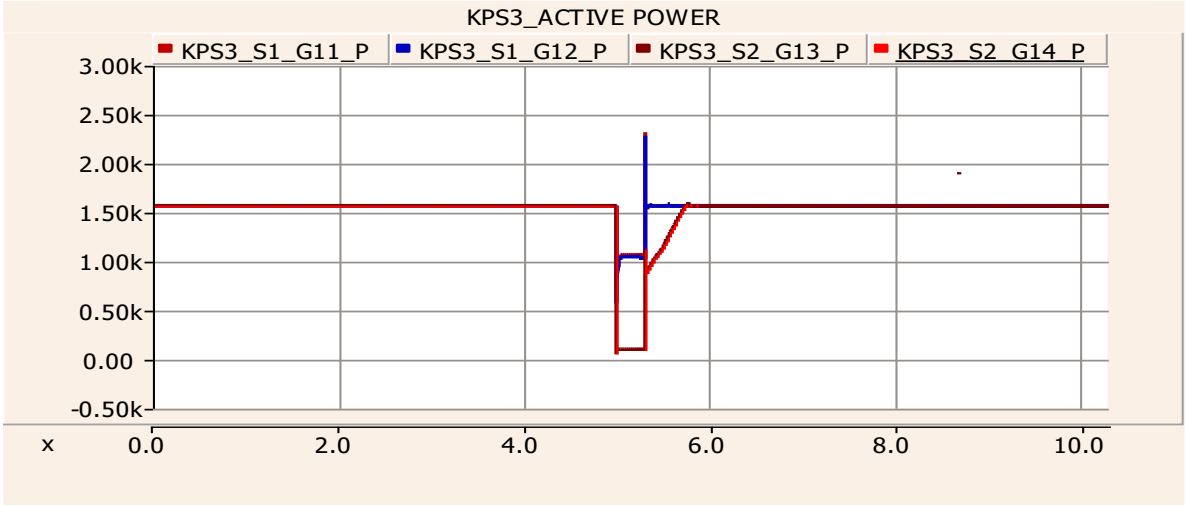


Figure 10-42 Active Power at KPS3 (Sec-1 & 2) during Case-3

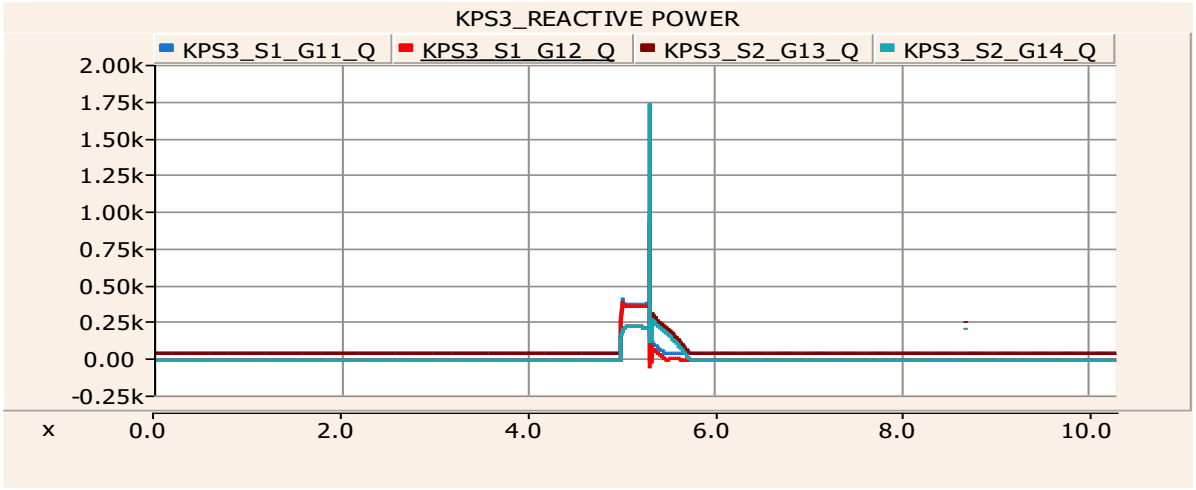


Figure 10-43 Reactive Power at KPS3 (Sec-1 & 2) during Case-3

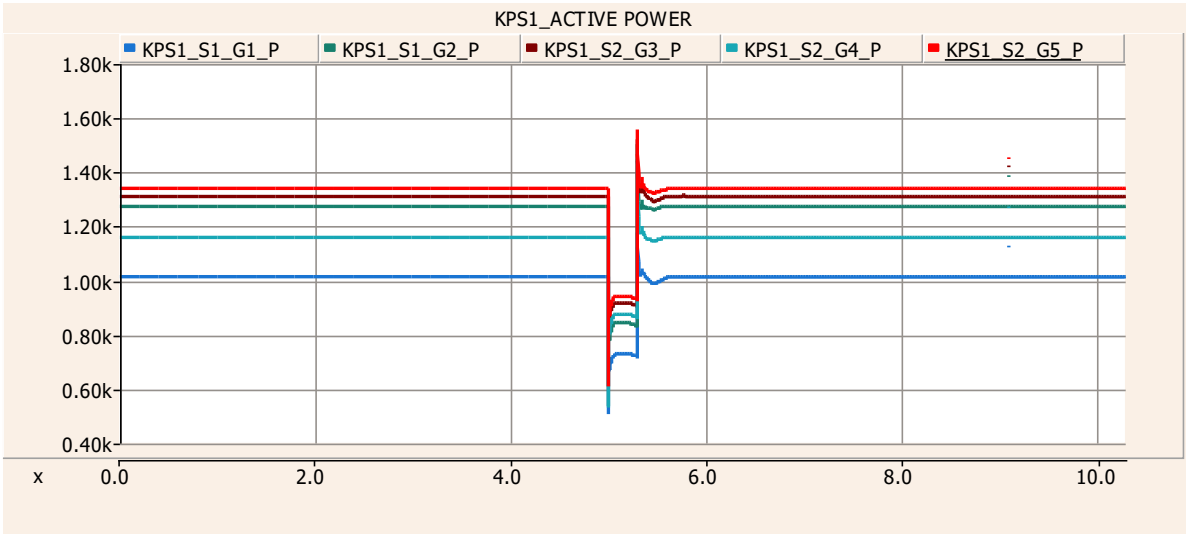


Figure 10-44 Active Power at KPS1 (Sec-1 & 2) during case-3

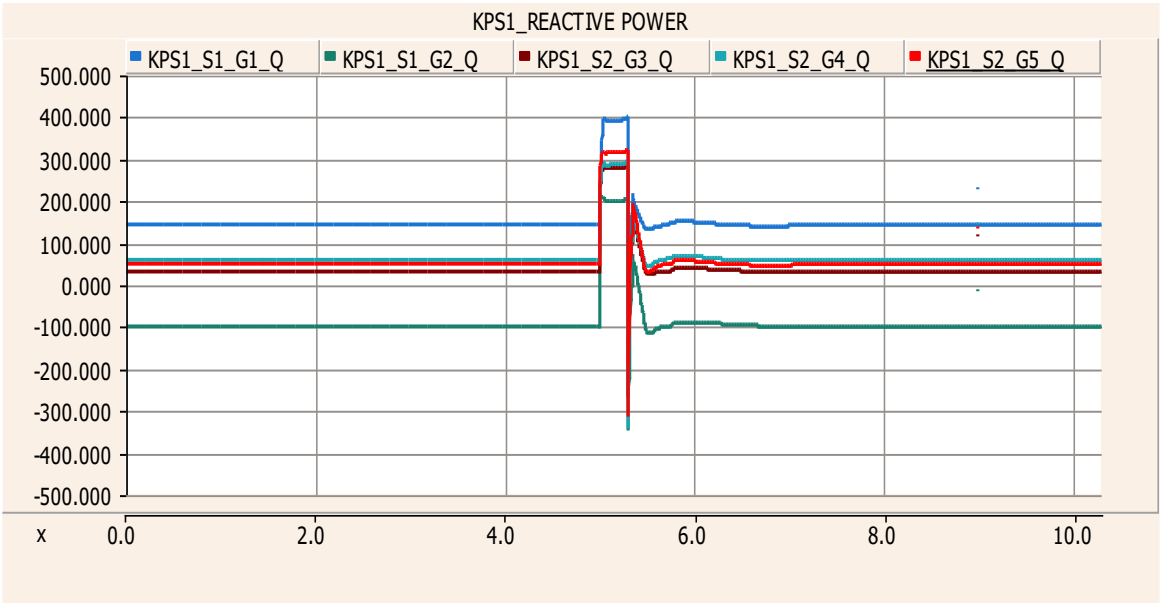


Figure 10-45 Reactive Power at KPS1 (Sec-1 & 2) during case-3

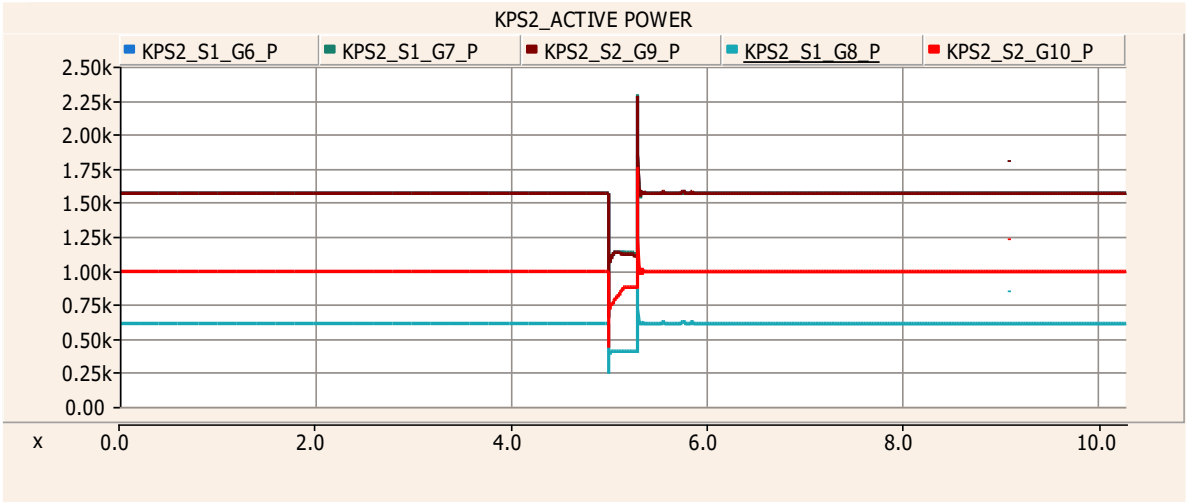


Figure 10-46 Active Power at KPS2 (Sec-1 & 2) during case-3

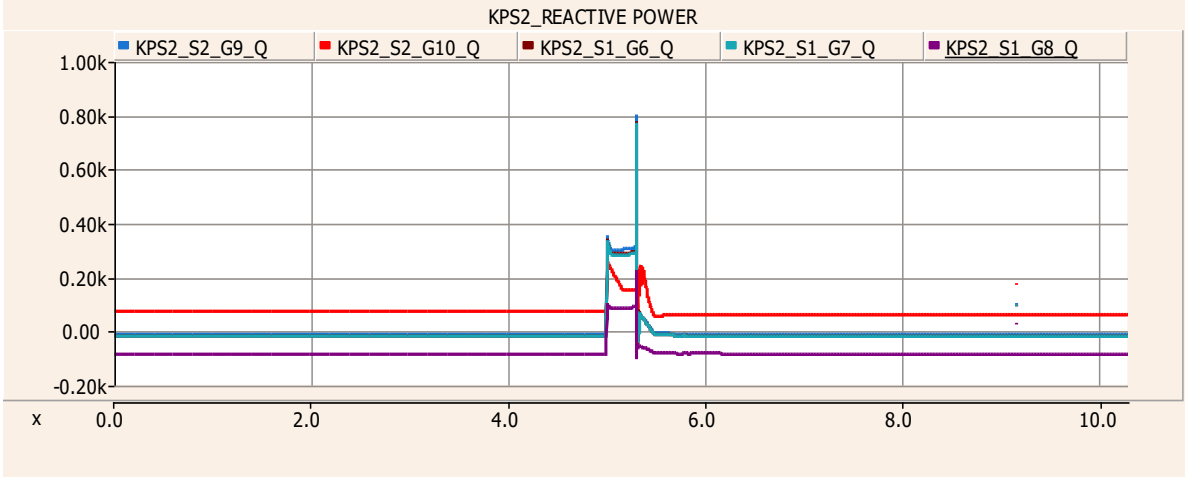


Figure 10-47 Reactive Power at KPS2 (Sec-1 & 2) during case-3

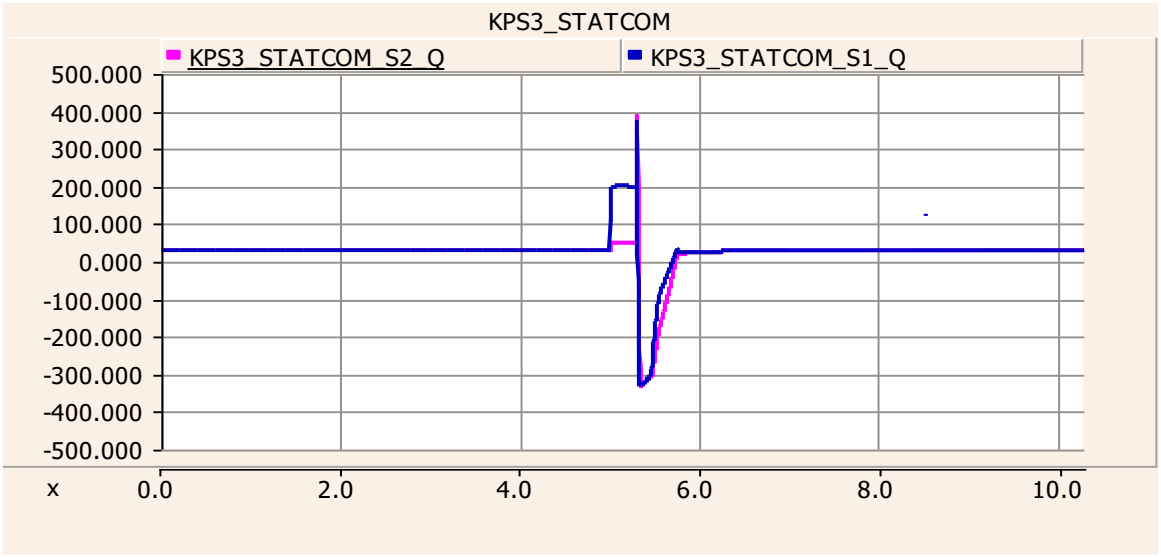


Figure 10-48 KPS3 (Sec-1 & 2) STATCOM output (MVAr) during Case-3

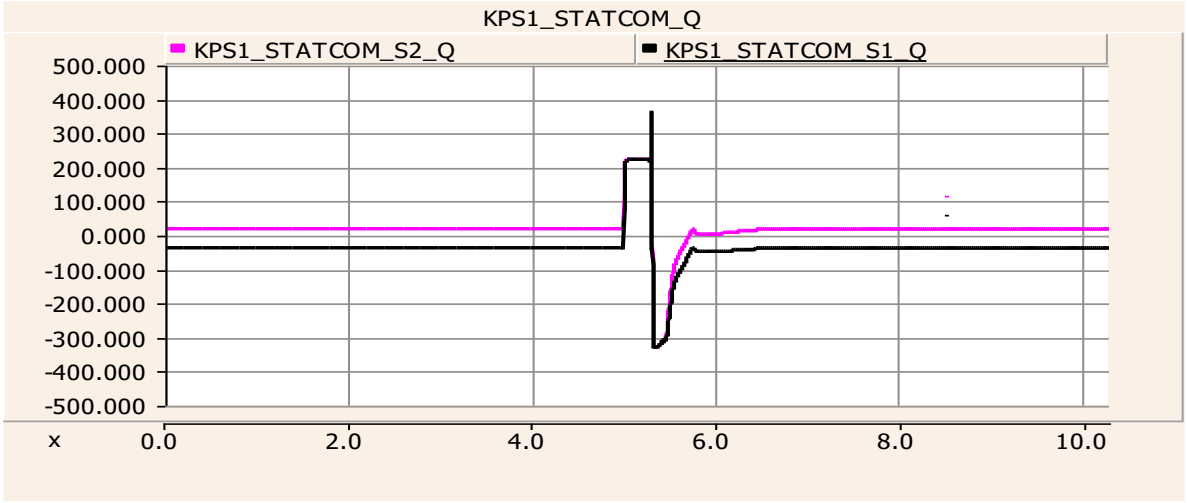


Figure 10-49 KPS1 (Sec-1 & 2) STATCOM output (MVAr) during Case-3

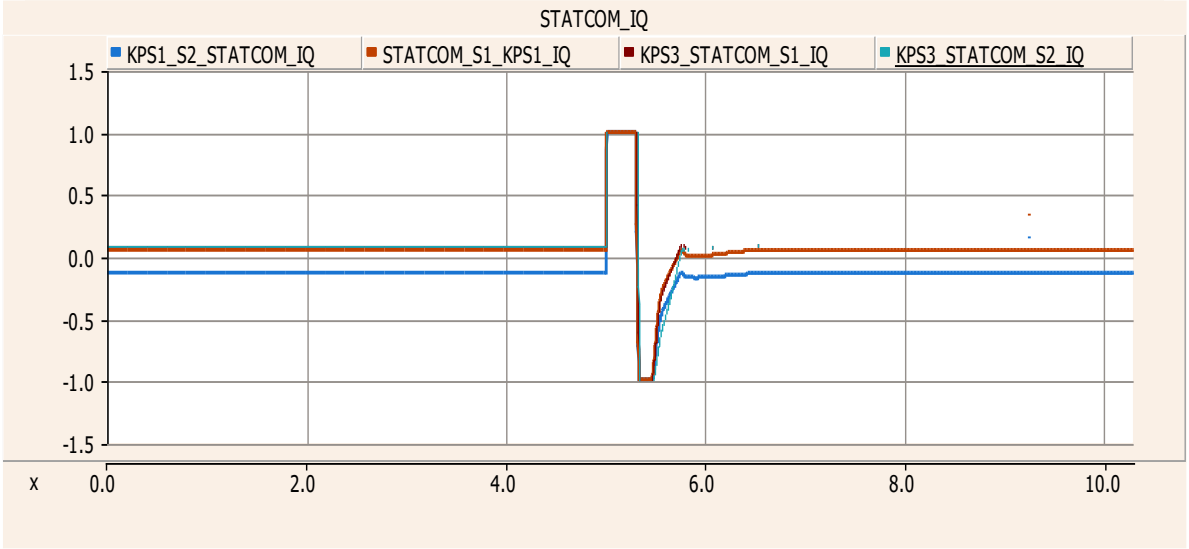


Figure 10-50 KPS (1&3) STATCOMs reactive current during Case-3

Conclusion:

(i) The study results shown above w.r.t Case-1, 2 & 3 depicts LVRT compliance of RE plants as mandated in the CEA Technical Standards for Connectivity to Grid. RE plants are able to provide reactive support during the fault condition further RE plants are able to fully recover the pre fault active power well within 1second period. However, the RE quantum considered in the subject is less than the planned quantum in Khavda complex, therefore study encompassing the total quantum will be taken up subsequently. Also, the subject study demonstrates RE plant behaviour during one of the LVRT case considering voltage dip of 0.15pu at POI, the study can be extended to cover other topics including HVRT, Frequency response, LVRT at 0.85pu voltage.

(ii) Further, LCC and VSC HVDC based systems & synchronous condensers have been planned in Khavda complex which would further enhance the stability, power flow controllability, inertia & system dynamics.

(iii) Also, the subject study has been carried out on PDT Model (Phasor Domain Transient), which could not capture the asymmetrical behaviour and well as high frequency phenomena of IBRs, therefore the EMT studies will also be undertaken at a wide area level.

10.2 Transient Stability Studies for Rajasthan:

The installation of renewable energy in Rajasthan is progressing at a rapid pace, thanks to its expansive barren land, abundant solar irradiation, and consistent wind patterns. The state has seen substantial growth in solar & wind plants installations, making it a major contributor to India's renewable energy capacity addition. As of 2025, Rajasthan's total Renewable energy capacity has surpassed 29 GW, accounting for over 64% of its installed power capacity.

The transmission system for 67 GW capacity envisaged in the Rajasthan has already been planned based on renewable energy potential & connectivity application received and the same is under various stage of implementation as summarised below:

(i) UMSPP Scheme (3 GW): Commissioned
(ii) Phase-I (8.9 GW): Commissioned
(iii) Phase-II (8.1 GW): Partly Commissioned
(iv) Phase-III (20 GW): Under Implementation
(v) Phase-IV-Part-I (7.7 GW): Under Implementation
(vi) Phase-IV-Part-2 (5.5 GW): Under Implementation
(vii) Phase-IV-Part-3 (6 GW): Under Implementation
(viii) Phase-IV-Part-4 (3.5 GW): Under Implementation
(ix) Phase-V-Part-I (4 GW): Under Implementation

Further, dynamic compensation devices, Static Synchronous Compensators (STATCOM), Static VAR compensators (SVCs) & Synchronous Condensers are commissioned & planned

in the state of Rajasthan at various locations in Rajasthan to enhance transient stability as below:

Table 10-1: Dynamic Compensation in Rajasthan

Sr. No.	Name of PS	Device	Capacity (Dynamic portion)
1	Bhadla-II	STATCOM	2x±300MVAr (Commissioned)
2	Fatehgarh-II	STATCOM	2x±300MVAr (Commissioned)
3	Bikaner-II	STATCOM	±300MVAr (Commissioned)
4	Kankroli	SVC	(+) 400 / (-) 300MVAr - Commissioned
5	Barmer-I	STATCOM	2x±300MVAr
6	Fatehgarh-III	STATCOM	2x±300MVAr
7	Ramgarh	STATCOM	2x±300MVAr
8	Bikaner-IV	STATCOM	2x±300MVAr
10	Fatehgarh-II	Synchronous Condenser	2x(+300/-200 MVAr)
11	Barmer-II	Synchronous Condenser	2x(+300/-150 MVAR)

It may be noted that majority of renewable energy power is being pooled at five locations in Western Rajasthan as described below:

a) Bhadla (5 Polling Stations)
b) Fatehgarh (4 Pooling Stations)
c) Barmer (3 Pooling Stations)
d) Bikaner (5 Pooling Stations)
e) Ramgarh (2 Polling Stations)

Concentration of such large quantum of RE in a single pocket can lead to several challenges as it is highly intermittent in nature & can impact grid stability and operation. To assess the transient stability with consideration of RE generation in Rajasthan, a transient stability study has been carried out.

Study Considerations:

To understand the behaviour of the grid subject to disturbance scenarios for Rajasthan, an equivalent network file is created to conduct these studies for Rajasthan so that grid behaviour can be assessed during disturbances. This file represents the electromechanical characteristics of the grid and is used to simulate various scenarios, helping to predict how the grid will behave under disturbances in the 2026-27 timeframe.

Scenario

Transient stability simulation has been carried out by creating disturbance in the network by creating 3-Ph Fault close to Bhadla 765kV bus on one circuit of Bhadla-III – Sikar-II 765kV D/c line and subsequent outage of one circuit of Bhadla-III – Sikar-II 765kV D/c line in 100ms.

Bus voltage at Bhadla-III, Sikar-II, Power Flow on Circuit-2 of Bhadla-III - Sikar 765kV D/c line, Voltage Angles at Bhadla-III & Sikar-II and Frequency at Bhadla-III & Sikar-II have been plotted.

Simulation Results

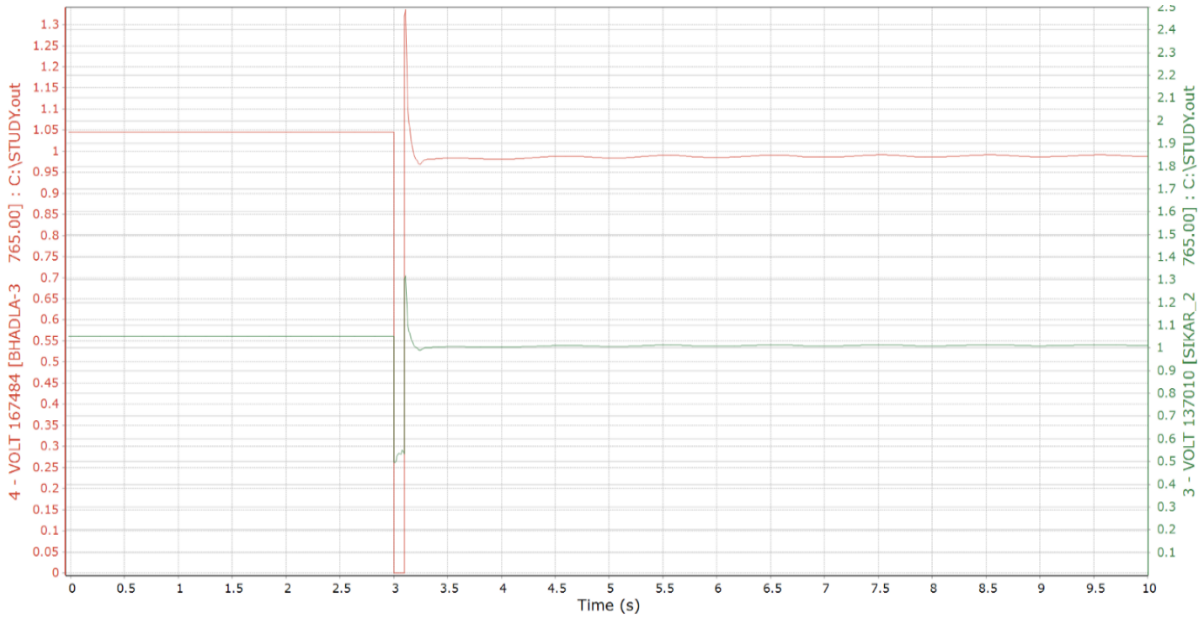


Figure 10-51: Voltages at Bhadla-II & Sikar-II 765kV Bus

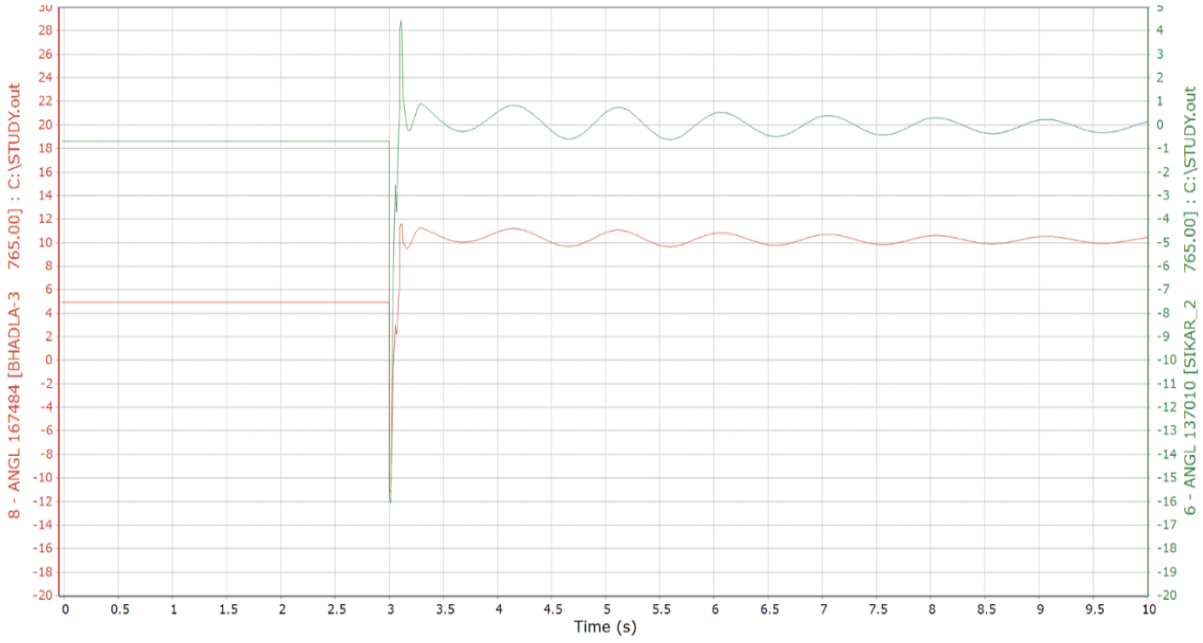


Figure 10-52: Voltage Angles at Bhadla-III & Sikar-II 765kV Buses

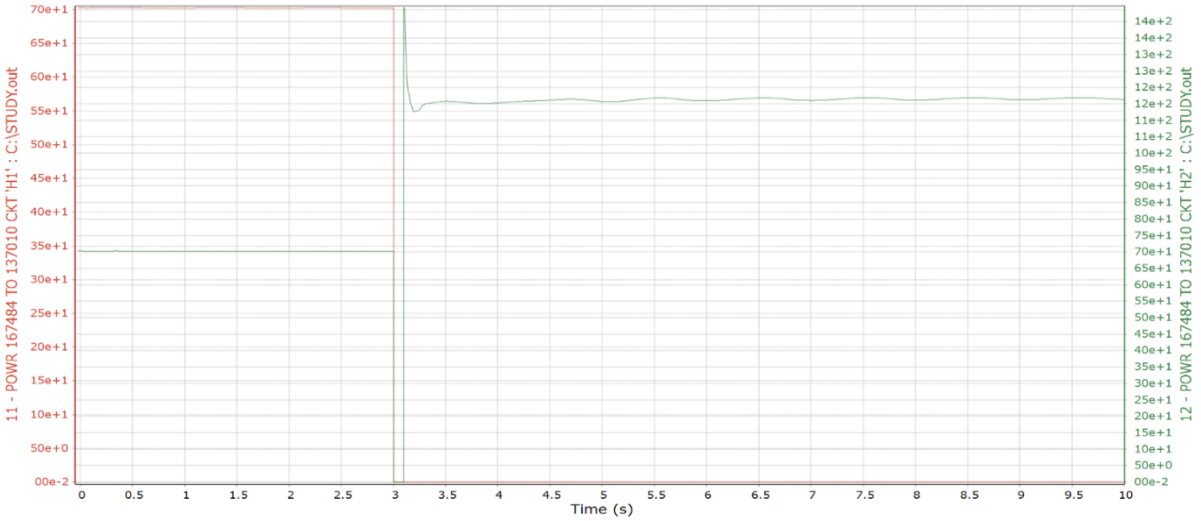


Figure 10-53: Active Power Flow on CKT I & II of Bhadla-III – Sikar-II 765kV D/c line

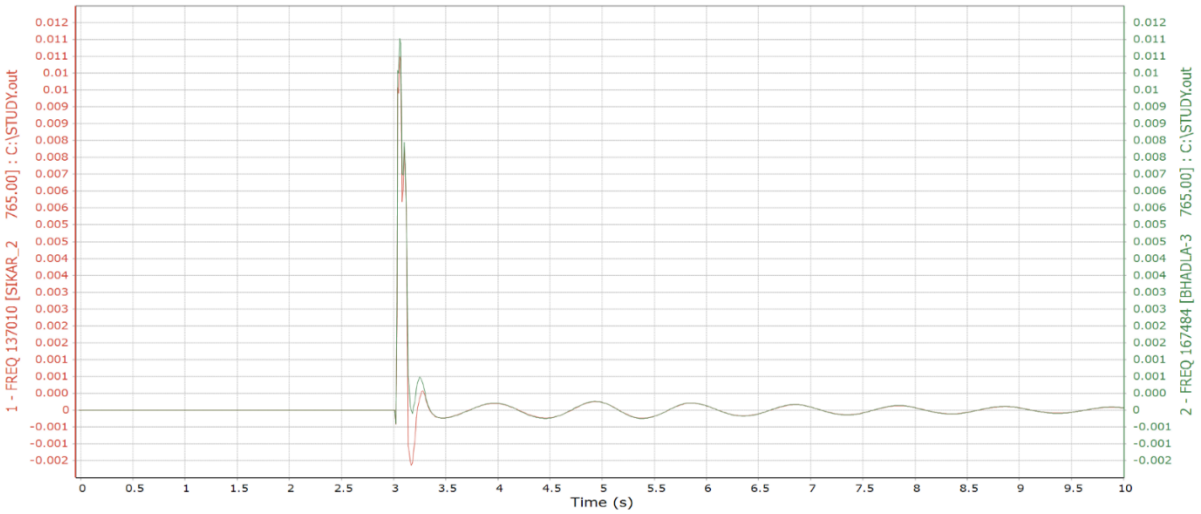


Figure 10-54: Frequency Deviation from 50Hz for Bhadla-III & Sikar-II 765kV buses

It is observed from the above plots that voltage at Bhadla-III and Sikar-II bus was recovered in about 0.5 seconds, which is satisfactory. It is also observed that oscillations are also damping out in about 9-10 seconds. Transient stability studies shall be studied for future time frames with increased generation in next rolling plan.

Chapter 11: Conclusion

The installed capacity of generation in Indian grid is expected to increase to about 783 GW including ESS(20 GW) by 2029-30 from 466 GW as on Jan'25. It will witness an increase in contribution of non-fossil fuel-based energy sources from 47% to 65%, whereas contribution of fossil fuel-based energy source will see a decline from 53% to 35% 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 being established in Northern, Western, and Southern regions and are further going to expand by 2029-30 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. 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 396 GW and 197 GW after accounting an additional demand of about 39 GW including Green Hydrogen/Ammonia as direct drawl from ISTS has been considered while working out the LGBs for 2029-30 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 2029-30. As of now, the portion of energy served as compared to total requirement is about 12%. However, this will not be the case of future when a large quantum of RE will integrate with grid.

Brief of transmission systems evolved for each region are as below:

Northern Region (NR)

The total installed generation capacity of NR as on Jan'25 is about 134.5 GW which constitute capacity from fossil sources (49% share) & balance from Non-fossil sources in which (50%) 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 2029-30 timeframe is expected to increase to about 117 GW. As per the inputs received from various stakeholders, total installed capacity of NR for 2029-30 is expected to be about 207 GW.

Various transmission schemes i..e. Transmission system strengthening to facilitate evacuation of power from Bhadla/Bikaner complex, Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-4: 3.5 GW), Transmission system for evacuation of power from Rajasthan REZ Ph-V (Part-1 :4 GW) [Sirohi/Nagaur] Complex, Transmission System for Inter-regional (NR-WR) Transmission System strengthening to relieve the loading of 765kV Vindhyachal-Varanasi D/c line, Transmission system scheme for Ratle HEP (850MW) & Kiru HEP (624 MW), Transmission system for evacuation of power from Pumped Storage Projects in Sonbhadra District, Uttar Pradesh, Transmission system for evacuation of power from Luhri Stage-I HEP and augmentation of transformation capacity at various stations of Northern Region has been planned in the Consultation Meeting for Evolution of Transmission System in Northern Region (CMETS-NR) from Mar'24 to Feb'25 for implementation. In this Rolling Plan, 28 nos. of transmission schemes of about 4,847 ckm of transmission lines and 33,000 MVA of transformation capacity has been formulated at an estimated cost of Rs. 26,023 Cr.

During the system studies for 2029-30 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 27,872 ckm of transmission lines and transformation capacity of 1,91,620 MVA at estimated cost of Rs 1,55,279 Cr. is expected to be added in the grid.

Western Region (WR)

The total installed generation capacity of WR as on Jan'25 is about 156GW which constitute capacity from fossil sources (56% share) & balance (44% 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 2029-30 timeframe is expected to increase to about 107 GW. In addition to above, the demand of about 21 GW corresponding to green hydrogen/ green ammonia, bulk consumer / distribution licensees is expected to be added to the grid by 2029-30. As per the inputs received from various stakeholders, total installed capacity of Western Region for 2029-30 is expected to be about 267 GW.

Various transmission schemes from Feb'24/Mar'24 to Jan'25 have been evolved such as Transmission System for Evacuation of power from various potential renewable energy zone in Khavda area of Gujarat under Phase-VI & VII (11.5GW), Lakadia-II (7.5GW), Jam Khambhaliya-II (4.5GW), Jamnagar (1GW), Transmission System for Offshore Wind Zone (500MW) Phase-1, Morena (2.5GW), Augmentation at Bhuj-I PS, Raghanesda, Lakadia PS, Rajgarh, Neemuch, Mandsaur, Network Expansion scheme in Western Region to cater to Pumped storage potential near Talegaon (Pune) and is expected to play a major role in fulfilling India's vision of generating 500 GW of non-fossil generation capacity by 2030. Additionally, transmission system to cater to the power requirement of the upcoming Green Hydrogen and Green Ammonia manufacturing hubs in Western Region by 2029-30 (3GW at Navinal (Mundra) and 3GW 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, 34 nos. of transmission schemes of about 8510 ckm of transmission lines and transformation capacity of 1,08,630 MVA have been formulated at an estimated cost of Rs.77,842 Cr which will cater to evacuation/drawl of 64,900 MW power from various RE/Conventional/GH in WR. 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 for smooth, reliable and secure grid operation to facilitate supply of quality power to stakeholders/consumers.

Thus, cumulatively by 2029-30, transmission schemes comprising of 19,865 ckm of transmission lines and transformation capacity of 2,25,230 MVA at an estimated cost of Rs 1,69,489 Cr. is expected to be added in the WR ISTS grid.

Southern Region (SR)

The total generation installed capacity of SR as on Jan'25 is 134 GW which comprises of 45 % from fossil fuel sources & 55% from Non-fossil sources. Further, Non-fossil fuel comprises of 52% contribution from renewable generation which also including hydro and 3% from nuclear sources.

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.

It is observed that Southern Region demand is growing at a rapid pace of more than 10% on annual basis and similar growth in demand is expected in future as well. Southern Region demand is expected to increase to about 97 GW by 2029-30. To meet such growing demand, Southern Region is continuously adding generation capacity predominantly from renewable energy sources/nuclear. Further, thermal based generation projects to meet the peak demand are also envisaged. As per the inputs received from various stakeholders, total installed capacity of Southern Region for 2029-30 is expected to be about 246 GW.

To facilitate integration and evacuation of power within and outside the Southern Grid, transmission system is being identified in consultation with stakeholders through regularly held Consultation Meeting for Evolution of Transmission System (CMETS). Various transmission systems have been identified through Consultation Meeting for Evolution of Transmission System in SR (CMETS-SR) from Feb/Mar'24 to Feb'25 for implementation. These schemes are under various stages of implementation/ approval.

Transmission system for integration of RE of about 32 GW in Kurnool, Ananthapur, Bidar, Davanagere, Bellary, Tumkur and Tuticorin area have been identified during this period. The proposed scheme shall facilitate in integration and evacuation of RE of Karnataka, Andhra Pradesh and Tamil Nadu which are under various stages of approval. Transmission System for prioritized 0.5 GW Offshore wind farms in Tamil Nadu have been evolved as a major step towards development of Off shore wind in India. Further, transmission system for 6 GW has been evolved for facilitating integration of Green hydrogen/ Green ammonia based bulk consumers in Kakinada & Tuticorin area. Further, 2 nos. of additional 765 kV Inter-regional links between SR and WR/ER have been identified to facilitate import of power from NEW Grid during peak load conditions and export of surplus power during high RE scenario. In addition to the above schemes for RE based generation and GH projects, system strengthening of ISTS transmission system in the form of ICT augmentations at Bidadi, Yelahanka, N'Sagar, Udumalpet, Kozhikode and Trivandrum have been identified for addressing constraints and reliable supply of power.

In this Rolling Plan, 26 nos. of transmission schemes of about 5,360 ckm of transmission lines and transformation capacity of 86,130 MVA have been formulated at an estimated cost of Rs. 40,811 Cr. These schemes are under various stages of implementation/ approval. Further, the identification of network expansion is a continuous process and being undertaken for smooth, reliable and secure grid operation to facilitate supply of quality power to stakeholders/consumers.

In addition to the existing ISTS network in Southern Region, 9,314 ckm of transmission lines and transformation capacity of 1,59,630 MVA at estimated cost of Rs 61,698 Cr. is expected to be added in the SR ISTS grid by 2029-30.

Eastern Region (ER)

The total installed generation capacity of ER as on Jan'25 is about 36GW which constitute capacity from fossil sources (80% share) & balance (20% 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 2029-30 timeframe is expected to increase to about 45.8 GW. In addition to above, the demand of about 6.3GW corresponding to bulk consumer / distribution licencees is expected to added to the grid by 2029-30. As per the inputs received from various stakeholders, total installed capacity of Eastern Region for 2029-30 is expected to be about 69 GW (including 3.2GW in Nepal and 4.5GW in Bhutan), which constitute capacity from fossil sources (74% share) & balance (26% share) from Non-fossil sources.

Various transmission schemes such as establishment of HVDC station each at Paradeep (Odisha) & Andaman & Nicobar Islands including HVDC under sea cable link, ICT Augmentation at Pandiabili (POWERGRID) S/s, LILO of one ckt of existing Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c line at Odisha Metallurgical Industries Private Limited (OMIPL) for grant of ISTS Connectivity to M/s OMIPL, Shifting of existing lines at Koderma generation switchyard for grant of new Connectivity to DVC for its Koderma Phase-II generation & Reconductoring of various 400kV lines viz. Farakka – Kahalgaon and Talcher – Meramunduli 400kV D/c lines & 220kV lines viz. Alipurduar (POWERGRID) – Falakata (WBSETCL) – Birpara (POWERGRID) – Binaguri (POWERGRID) – Siliguri (POWERGRID) – Kishanganj (POWERGRID) – Dalkhola (POWERGRID) – Gazole (WBSETCL) – Malda (POWERGRID), comprising of ISTS and intra-state sections (WBSETCL) owned have been evolved in the Consultation Meeting for Evolution of Transmission System in Eastern Region (CMETS-ER) from Feb/Mar'24 to Feb'25. In this Rolling Plan, 6 nos. of transmission schemes of about 3,452 ckm of transmission lines and 500 MVA of transformation capacity and Paradeep – Andaman – Nicobar ±320kV, 250MW VSC based HVDC link have been formulated at an estimated cost of Rs. 38,773 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 2029-30, transmission schemes comprising of 4,805 ckm of transmission lines and transformation capacity of 8,050 MVA at estimated cost of Rs 45,925 Cr. is expected to be added in the grid.

North Eastern Region (NER)

The total installed generation capacity of NER as on Jan'25 is about 5.5GW which constitute capacity from fossil sources (53% share) & balance (47% 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 2029-30 timeframe is expected to increase to about 5.8 GW. As per the inputs received from various stakeholders, total installed capacity of Northern Eastern Region for 2029-30 is expected to be about 10.7 GW, which constitute capacity from fossil sources (28% share) & balance (72% share) from Non-fossil sources.

Various transmission schemes i.e. Stringing of 2nd circuit of Pasighat – Roing – Tezu – Namsai 132kV corridor, Reconductoring of (a) Balipara – Sonabil 220kV D/c line, (b) Silchar – Srikona 132kV S/c line and (c) Ranganadi – Ziro 132kV S/c line, installation of 50MVA ICT at Namsai, 125MVAR Variable Shunt Reactor (VSR) at Misa, 125MVAR bus reactor at Balipara and Biswanath Chariali have been approved in the Consultation Meeting for Evolution of Transmission System in North Eastern Region (CMETS-NER) from Feb/Mar'24 to Feb'25. In this Rolling Plan, 7 nos. of transmission schemes of about 335 ckm of transmission lines, augmentation of 50MVA of transformation capacity and reconductoring of 65 ckm of transmission lines have been formulated at an estimated cost of Rs. 252 Cr. These schemes have either been approved or are under various stages of approval.

Thus, cumulatively by 2029-30, transmission schemes comprising of 2,280 ckm of transmission lines and transformation capacity of 1,770 MVA at estimated cost of Rs 5,308 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 5414MW (2651MW: Bhutan, 1160MW: Bangladesh, 1600MW: 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 3780MW resulting in total of about 9194MW (4531MW: Bhutan, 1160MW: Bangladesh, 3500MW: Nepal and 3MW: Myanmar).

Annexures

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Annex-1.1

Data Collection

For initiating Rolling plan associated activities for upcoming cycle i.e., Oct'24 to Mar'25 for 2029-30 timeframe, a letter dated 03.10.2024 from CTU was sent to all the concerned stakeholders 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	No Inputs received
WR	Inputs received from Gujarat, Maharashtra, MP & Chhattisgarh
SR	Inputs received from AP, Telangana, Kerela & Puducherry
ER	Inputs received WB, Odisha & DVC
NER	Inputs received from all States

Further the updated list of nominations of nodal officers received from various stakeholders along with nodal officers of CTUIL for association in preparation of Rolling plan report are as under:

Sr. No	**State/Organisation**	**Name (Sh./Smt.)**	**Designation**
NR			
1.	CTUIL	VMS Prakash Yerubandi	DGM
2.	CTUIL	Ankita Singh	Chief Manager
3.	Rajasthan/RVPN	Sanjay Mathur	SE
4.	Rajasthan/RVPN	Om Prakash Mahela	Executive Engineer (PP&D)
5.	Haryana/HVPN	Sanjay Verma	SE (Planning)
6.	Haryana/HVPN	Deepak Sarit	XEN (SS)
7.	Punjab/PSTCL	Vivek Khanna	Dy CE
8.	Punjab/PSTCL	Nitin Kumar	Sr. XEN (Planning)
9.	Uttar Pardesh/UPPTCL	Satyendra Kumar	SE (Planning)
10.	Uttrakhand/PTCUL	Lalit Kumar	SE
11.	Uttrakhand/PTCUL	Ashok Kumar	Executive Engineer
12.	Himachal Pardesh/HPPTCL	Suresh Sharma	DGM (Planning)
13.	Himachal Pardesh/HPPTCL	Harmanjeet Singh	AE
14.	J&K/JKPTCL	Ehtisham Andrabi	Assistant EE
15.	J&K/JKPTCL	K. K. Thappa	SE
16.	Delhi/DTL	Dinesh	Manager (Planning)
WR			
1.	CTUIL	Shashank Shekhar	Manager
2.	CTUIL	Aditya Ranjan	Engineer Trainee
3.	Gujarat/GETCO	K. J. Bhuva	Additional Chief Engineer(R&C)
4.	Gujarat /GETCO	S. M. Soni	Superintending Engineer
5.	Gujarat/GETCO	Dipak H. Patel	Dy. Engineer
6.	Madhya Pradesh	Sanjay Kulshreshtha	Chief Engineer (Planning & Design)

Sr. No	State/Organisation	Name (Sh./Smt.)	Designation
	/MPPTCL		
7.	Madhya Pradesh /MPPTCL	M.M.Dhoke	Supreintending Engineer
8.	Chhattisgarh /CSPTCL	Manoj Verma	Executive Engineer O/o ED (Planning & Project)
9.	Chhattisgarh /CSPTCL	C.K.S. Thakur	Executive Engineer O/o CE (C&RA)
10.	Maharashtra/MSETCL	Mr. Amit Naik	Superintending Engineer, STU
11.	Maharashtra/MSETCL	Vinay Khedekar	ADEE, STU
SR			
1.	CTUIL	Ankush Patel	Ch. Manager
2.	CTUIL	Venkatesh Gorli	Ch. Manager
3.	Andhra Pradesh	L. Pardha Sarathi	DEE4/SS1
4.	Andhra Pradesh	CH Laxmi Kantaiah	DEE3/SS2
5	Karnataka	N.Pradeep Kumar	Executive Engineer (PSS-1)
6.	Karnataka	Divya Prabha	Asst. Executive Engineer (Elec)
8.	Tamil Nadu	L. Porchelvi	Asst. Executive Engineer
9.	Tamil Nadu	J. Kalaiselvi	Asst. Executive Engineer
10.	Telangana	P Srinivasu	ADE
11.	Telangana	P. Saritha Kumari	ADE
12.	KSEB	Amritha Sasi	AEE (PSE)
12.	KSEB	P. Saritha Kumari	AEE (PSE)
13.	Puducherry	T.A. Arun	EE
ER			
1.	CTUIL	Anupam Kumar	Manager
2.	CTUIL	Abhilash Thakur	Asst. Manager
3.	ERPC	N. S. Mondal	MS, ERPC
4.	ERPC	P.P. Jena	EE
5.	ERPC	Agniva Chatterjee	Asst Director
6.	Bihar	Sunil Agrwal	Director (Projects)
7.	Bihar	Kumar Prasant	CE (P&E), BSPTCL
8.	Bihar	Pervez Alam	CE (STU), BSPTCL
9.	Bihar	Rakesh Kumar	ESE(P&E), BSPTCL
10.	Bihar	Abhishek Kumar	EEE(P&E), BSPTCL
11.	Jharkhand	Manoj Karmali	Director (Project)
12.	Jharkhand	Ajit Kumar Bhagat	Sr Mgr (C&M)
13.	Jharkhand	Atilesh Gautam	Sr Mgr (STU)
14.	Jharkhand	Shailesh	DGM SLDC
15.	Jharkhand	Rishi Nandan	GM comm
16.	West Bengal	Debashis Chaki	Chief Engineer
17.	West Bengal	Ranjan Das	Addl. CE
18.	Odisha	S.K.Panigrahi	CGM (CP)
19.	Odisha	A.K. Banerjee	DGM (CP)

Sr. No	State/Organisation	Name (Sh./Smt.)	Designation
20.	Sikkim	Sunil Rai	Chief Engineer (Transmission)
21.	Sikkim	Ashish Lamichaney	AE (EHV)
22.	Sikkim	Sonam Wongchuk Lepcha	AE (SLDC)
23.	DVC	Jayanta Dutta	Sr. GM, Engineering
24.	DVC	Sushil Kumar	Senior Manager(E), SPM
25.	DVC	Amiyaranjan Swain	Manager(E), SPM
26.	DVC	Preetosh Ghosh	Dy. Manager(E), SLDC
27.	ERLDC	Shyamal Konar	GM
28.	ERLDC	Bilash Achari	DGM
NER			
1.	CTUIL	Anupam Kumar	Manager
2.	CTUIL	Abhilash Thakur	Asst. Manager
3.	NERPC	K.B.Jagtap	Member Secretary
4.	NERPC	S.M. Aimol	Director
5.	NERPC	Abhijit Agrawal	DD
6.	NERPC	Vikash Shankar	AD
7.	NERLDC	Amaresh Mallick	CGM(I/C)
8.	NERLDC	S C De	Sr. GM (SO-II)
9.	NERLDC	Biswajit Sahu	Sr. GM (MO)
10.	NERLDC	Palash Jyoti Borah	Manager, NERLDC
11.	NERLDC	Sachin Singh	Deputy Manager, NERLDC
12.	Assam	Debasish Choudhury	DGM(Operation), SLDC
13.	Assam	Tridip Borah	AGM(T), AEGCL
14.	Assam	Neelkamal Sarma	DM (P&D), AEGCL
15.	Assam	Dipmoni Nath	AM (T), AEGCL
16.	Arunachal Pradesh	T. K. Tara	S.E.(Trans.)
17.	Arunachal Pradesh	Moli Kamki	Assistant Engineer (Electrical)
18.	Meghalaya	J. Hynniewta	C.E.(Trans)
19.	Meghalaya	H.F.Shangpliang	A.C.E.(Trans.)
20.	Meghalaya	W.Wanrieh	A.C.E.(P&D)
21.	Meghalaya	T.Gidon	S.E.(SLDC)
22.	Meghalaya	D J Lyngdoh	SLDC Meghalaya
23.	Nagaland	A. Jakhalu	S.E.(Trans.)
24.	Nagaland	Nitovi Wotsa	S.E.(SLDC)
25.	Nagaland	Asangba Tikhir	E.E.(Trans)
26.	Manipur	Pangambam Yaiphaba	DGM (Trans Planning)
27.	Manipur	J.H. Malsawma	S.E.(Planning)
28.	Manipur	Lalruatkima	E.E.(SLDC)
29.	Tripura	Ranjan Debbarman	GM(Trans.) TPTL
30.	Tripura	Nirupam Guha	AGM

Sr. No	**State/Organisation**	**Name (Sh./Smt.)**	**Designation**
31.	Tripura	Anil Debbarma	DGM(SLDC)
Others			
1	CTUIL	Chinmay Sharma	Chief Manger
2	CTUIL	Malla Mahendranath	Chief Manager

Annex-3.1

Load Generation Balance (LGB)

Monsoon (Aug'29)

Installed Capacity

Region	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas	Total	EPS Peak Demand	App. Peak Demand	ISTS Demand	GH Load
NR	11880	41744	0	53624	3020	25269	109067	0	6401	1360	4636	3583	206959	116745	104842	0	0
WR	22200	35760	35452	93412	3240	6078	88773	0	59914	0	5256	10139	266812	107050	96136	11960	9250
SR	15270	34448	4780	54498	5820	13985	81332	0	61796	2119	8345	1512	229406	97440	87506	0	8250
ER	29449	16671	4850	50970	0	14026	2518	0	0	0	1500	0	69014	45752	41087	3933	5568
NER	750	0	0	750	0	5372	2369	0	0	0	0	2232	10723	5835	5240	0	0
	79549	**128622**	**45082**	**253253**	**12080**	**64730**	**284059**	**0**	**128111**	**3479**	**19737**	**17465**	**782913**	**334811**	334811	15893	23068
		253253				**480378**								372822		**373772**	

Scenario 1 : Solar Max Aug 2029

g factor	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other	ESS	Gas		National DF	al DF
NR	18%	6%	0%	-12%	80%	70%	75%	0%	50%	0%	-100%	0%		76%	78%
WR	19%	3%	14%	6%	80%	40%	75%	0%	50%	0%	-100%	0%		75%	77%
SR	3%	0%	11%	24%	80%	40%	75%	0%	50%	0%	-100%	0%		82%	84%
ER	10%	5%	27%	16%	80%	70%	75%	0%	0%	0%	-100%	0%		79%	81%
NER	40%	0%	0%	23%	80%	70%	75%	0%	0%	0%	-100%	0%		69%	71%
	12%	3%	15%	8%										86%	288132

Availability	Central	State	IPP	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	2100	2617	0	-6431	2416	17688	81800	0	3201	96921	-4636	0	105186	88270	16916	109822	88270	0
WR	4136	900	5080	5329	2592	2431	66580	0	29957	98495	-5256	0	106419	101160	5259	111675	79950	21210
SR	501	0	528	13317	4656	5594	60999	0	30898	78327	-8345	0	94831	87955	6876	103176	79705	8250
ER	2904	825	1304	8388	0	9818	1889	0	0	38781	-1500	0	15239	45669	-30430	16739	36168	9501
NER	300	0	0	172	0	3761	1777	0	0	3867	0	0	5837	4039	1798	5837	4039	0
Total	**9941**	**4341**	**6912**	**20775**	**9664**	**39292**	**213044**	**0**	**64056**	**316391**	**-19737**	**0**	**327513**	**327093**	**419**	**347250**	**288132**	**38961**
		21194				**316391**								296876				
20%	StateTh																	

Scenario 2 : Peakload Aug 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas	0	National DF	Regional DF
NR	62%	61%	0%	71%	80%	95%	0%	0%	70%	0%	60%	50%		78%	81%
WR	62%	39%	63%	40%	80%	70%	0%	0%	75%	0%	60%	50%		78%	80%
SR	11%	45%	30%	38%	80%	70%	0%	0%	75%	0%	60%	50%		70%	72%
ER	30%	50%	60%	45%	80%	90%	0%	0%	0%	0%	60%	50%		84%	86%
NER	40%	0%	0%	28%	80%	90%	0%	0%	0%	0%	60%	50%		87%	89%
	40%	49%	59%	48%										86%	287192

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	7377	25536	0	38272	2416	24005	0	0	4481	46339	2782	1791	68388	91600	-23212	68388	91600	0
WR	13824	13817	22172	37736	2592	4254	0	0	44936	47092	3154	5069	109817	95642	14175	109817	83682	11960
SR	1640	15669	1432	20694	4656	9789	0	0	46347	37449	5007	756	85296	68562	16734	85296	68562	0
ER	8918	8407	2934	22763	0	12623	0	0	0	18542	900	0	33782	42205	-8422	33782	38272	3933
NER	300	0	0	2111	0	4835	0	0	0	1849	0	1116	6251	5076	1175	6251	5076	0
Total	**32059**	**63429**	**26538**	**121576**	**9664**	**55508**	**0**	**0**	**95763**	**151271**	**11842**	**8732**	**303535**	**303085**	**450**	**303535**	**287192**	**15893**
		122026				**151271**								295225				
52%	StateTh																	

Scenario 3 : offpeakload Aug 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	62%	45%	0%	51%	80%	70%	0%	0%	60%	0%	40%	50%		61%	63%
WR	51%	20%	51%	23%	80%	40%	0%	0%	65%	0%	40%	50%		53%	55%
SR	7%	35%	30%	40%	80%	40%	0%	0%	65%	0%	40%	50%		62%	64%
ER	24%	36%	34%	39%	80%	70%	0%	0%	0%	0%	40%	50%		69%	71%
NER	40%	0%	0%	16%	80%	70%	0%	0%	0%	0%	40%	50%		66%	68%
	34%	34%	47%	36%										67%	224479

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus / Deficit	Net Availability	Net Demand	ISTS Demand
NR	7377	18646	0	27572	2416	17688	0	0	3841	37447	1854	1791	53614	71081	-17467	53614	71081	0
WR	11314	7114	18135	21318	2592	2431	0	0	38944	38056	2102	5069	87702	69137	18565	87702	57177	11960
SR	1010	11912	1432	21785	4656	5594	0	0	40167	30263	3338	756	68865	60798	8068	68865	60798	0
ER	7088	6074	1654	19915	0	9818	0	0	0	14984	600	0	25234	35499	-10265	25234	31566	3933
NER	300	0	0	1248	0	3761	0	0	0	1494	0	1116	5176	3858	1319	5176	3858	0
Total	**27089**	**43746**	**21221**	**91837**	**9664**	**39292**	**0**	**0**	**82952**	**122244**	**7895**	**8732**	**240591**	**240372**	**219**	**240591**	**224479**	**15893**
		92056				**122244**								231256				
48%	StateTh																	

Summer (Jun'29)

Installed Capacity

Region	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas	Total	EPS Peak Demand	App. Peak Demand	ISTS Demand	GH Load
NR	11880	41744	0	53624	3020	25269	109067	0	6401	1360	4636	3583	206959	116745	104842	0	0
WR	22200	35760	35452	93412	3240	6078	88773	0	59914	0	5256	10139	266812	107050	96136	11960	9250
SR	15270	34448	4780	54498	5820	13985	81332	0	61796	2119	8345	1512	229406	97440	87506	0	8250
ER	29449	16671	4850	50970	0	14026	2518	0	0	0	1500	0	69014	45752	41087	3933	5568
NER	750	0	0	750	0	5372	2369	0	0	0	0	2232	10723	5835	5240	0	0
	79549	128622	45082	253253	12080	64730	284059	0	128111	3479	19737	17465	782913	334811	334811	15893	23068
		253253				480378								372822		373772	

Scenario 4 : Solar Max Jun 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	18%	6%	0%	12%	80%	70%	85%	0%	50%	0%	-100%	0%		94%	97%
WR	19%	3%	13%	4%	80%	40%	85%	0%	50%	0%	-100%	0%		82%	84%
SR	0%	0%	0%	3%	80%	40%	85%	0%	50%	0%	-100%	0%		77%	79%
ER	13%	12%	27%	18%	80%	70%	85%	0%	0%	0%	-100%	0%		89%	91%
NER	40%	0%	0%	-137%	80%	70%	85%	0%	0%	0%	-100%	0%		55%	56%
	13%	4%	13%	8%										94%	316235

Availability	Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	2100	2572	0	6851	2416	17688	92707	0	3201	105623	-4636	0	116048	110054	5994	120684	110054	0
WR	4136	900	4598	3810	2592	2431	75457	0	29957	107338	-5256	0	114815	108484	6331	120071	87274	21210
SR	0	0	0	1719	4656	5594	69132	0	30898	85359	-8345	0	101935	83389	18545	110280	75139	8250
ER	3718	1976	1304	9317	0	9818	2140	0	0	42263	-1500	0	17456	50080	-32624	18956	40579	9501
NER	300	0	0	-1026	0	3761	2014	0	0	4214	0	0	6074	3188	2886	6074	3188	0
Total	10254	5448	5902	20472	9664	39292	241450	0	64056	344797	-19737	0	356328	355196	1132	376065	316235	38961
		21604				344797								324103				

25% StateTh

Scenario 5 : Peak Load Jun 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	64%	74%	0%	96%	80%	95%	0%	0%	70%	0%	50%	50%		89%	92%
WR	75%	43%	70%	42%	80%	70%	0%	0%	75%	0%	50%	50%		79%	81%
SR	13%	46%	44%	40%	80%	70%	0%	0%	75%	0%	50%	50%		70%	72%
ER	44%	59%	60%	55%	80%	90%	0%	0%	0%	0%	50%	50%		95%	97%
NER	40%	0%	0%	106%	80%	90%	0%	0%	0%	0%	50%	50%		64%	66%
	50%	56%	67%	56%										91%	304917

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	7616	30878	0	51372	2416	24005	0	0	4481	46339	2318	1791	73505	104237	-30731	73505	104237	0
WR	16704	15401	24993	39549	2592	4254	0	0	44936	47092	2628	5069	116577	96930	19647	116577	84970	11960
SR	2040	15903	2092	21560	4656	9789	0	0	46347	37449	4173	756	85756	68593	17162	85756	68593	0
ER	12972	9892	2934	27997	0	12623	0	0	0	18542	750	0	39171	47289	-8118	39171	43356	3933
NER	300	0	0	796	0	4835	0	0	0	1849	0	1116	6251	3761	2490	6251	3761	0
Total	39632	72073	30019	141274	9664	55508	0	0	95763	151271	9869	8732	321260	320810	450	321260	304917	15893
		141724				151271								312815				

51% StateTh

Scenario 6 : Off peak Load Jun 2029

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	63%	41%	0%	48%	80%	70%	0%	0%	60%	0%	1%	50%		58%	60%
WR	75%	43%	70%	52%	80%	40%	0%	0%	65%	0%	1%	50%		77%	79%
SR	8%	34%	44%	39%	80%	40%	0%	0%	65%	0%	1%	50%		59%	60%
ER	44%	40%	60%	45%	80%	70%	0%	0%	0%	0%	1%	50%		74%	77%
NER	40%	0%	0%	90%	80%	70%	0%	0%	0%	0%	1%	50%		56%	58%
	49%	40%	67%	47%										73%	244296

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	7433	17281	0	25798	2416	17688	0	0	3841	37447	46	1791	50496	67499	-17003	50496	67499	0
WR	16704	15376	24993	48581	2592	2431	0	0	38944	38056	53	5069	106162	94351	11811	106162	82391	11960
SR	1253	11751	2092	21383	4656	5594	0	0	40167	30263	83	756	66353	57142	9211	66353	57142	0
ER	12972	6714	2934	22911	0	9818	0	0	0	14984	15	0	32452	37910	-5457	32452	33977	3933
NER	300	0	0	678	0	3761	0	0	0	1494	0	1116	5176	3288	1889	5176	3288	0
Total	38661	51121	30019	119351	9664	39292	0	0	82952	122244	197	8732	260639	260189	450	260639	244296	15893
		119801				122244								251816				

43% StateTh

Winter (Feb'30)

Installed Capacity

Region	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas	Total	EPS Peak Demand	App. Peak Demand	ISTS Demand	GH Load
NR	11880	41744	0	53624	3020	25269	109067	0	6401	1360	4636	3583	206959	116745	104842	**0**	**0**
WR	22200	35760	35452	93412	3240	6078	88773	0	59914	0	5256	10139	266812	107050	96136	**11960**	**9250**
SR	15270	34448	4780	54498	5820	13985	81332	0	61796	2119	8345	1512	229406	97440	87506	**0**	**8250**
ER	29449	16671	4850	50970	0	14026	2518	0	0	0	1500	0	69014	45752	41087	**3933**	**5568**
NER	750	0	0	750	0	5372	2369	0	0	0	0	2232	10723	5835	5240	**0**	**0**
	79549	**128622**	**45082**	**253253**	**12080**	**64730**	**284059**	**0**	**128111**	**3479**	**19737**	**17465**	**782913**	**334811**	334811	15893	23068
		253253				**480378**								372822		**373772**	

Scenario 7 : Solar max Feb 2030

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	22%	10%	0%	-17%	80%	30%	90%	0%	10%	0%	-100%	0%		64%	66%
WR	33%	13%	31%	32%	80%	20%	90%	0%	10%	0%	-100%	0%		87%	90%
SR	25%	42%	40%	63%	80%	20%	90%	0%	0%	0%	-100%	0%		94%	97%
ER	24%	14%	27%	10%	80%	30%	90%	0%	0%	0%	-100%	0%		62%	64%
NER	40%	0%	0%	-11%	80%	30%	90%	0%	0%	0%	-100%	0%		57%	59%
	27%	20%	32%	24%										87%	291484

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	2628	4113	0	-9036	2416	7581	98160	0	640	85680	-4636	0	110902	74425	36477	115538	74425	0
WR	7424	4740	11108	30355	2592	1216	79896	0	5991	87072	-5256	0	107710	114762	-7052	112968	93552	21210
SR	3774	14472	1912	34529	4656	2797	73198	0	0	69242	-8345	0	92465	100083	-7618	100810	91833	8250
ER	6991	2396	1304	5052	0	4208	2266	0	0	34284	-1500	0	15665	37836	-22171	17165	28335	9501
NER	300	0	0	-79	0	1612	2132	0	0	3419	0	0	4044	3339	704	4044	3339	0
Total	**21117**	**25721**	**14324**	**60821**	**9664**	**17413**	**255653**	**0**	**6632**	**279697**	**-19737**	**0**	**330786**	**330445**	**341**	**350523**	**291484**	**38961**
		61163				**279697**								301436				
42%	StateTh																	

Scenario 8 : Peak Load Feb 2030

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	70%	63%	0%	84%	80%	60%	0%	0%	35%	0%	100%	50%		62%	64%
WR	79%	74%	95%	74%	80%	40%	0%	0%	20%	0%	100%	50%		83%	86%
SR	65%	69%	81%	77%	80%	40%	0%	0%	20%	0%	100%	50%		73%	75%
ER	70%	55%	79%	50%	80%	60%	0%	0%	0%	0%	100%	50%		66%	68%
NER	40%	0%	0%	295%	80%	60%	0%	0%	0%	0%	100%	50%		70%	72%
	72%	67%	92%	72%										80%	**267043**

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	State Demand	ISTS Demand
NR	8366	26126	0	45069	2416	15161	0	0	2240	18811	4636	1791	60736	72723	-11987	60736	72723	0
WR	17632	26489	33679	68800	2592	2431	0	0	11983	19117	5256	5069	105131	100834	4298	105131	88874	11960
SR	9972	23769	3881	42074	4656	5594	0	0	12359	15202	8345	756	69331	71034	-1702	69331	71034	0
ER	20624	9181	3828	25239	0	8416	0	0	0	7527	1500	0	43548	34266	9283	43548	30333	3933
NER	300	0	0	2214	0	3223	0	0	0	751	0	1116	4639	4080	559	4639	4080	0
Total	**56893**	**85564**	**41389**	**183396**	**9664**	**34825**	**0**	**0**	**26582**	**61408**	**19737**	**8732**	**283386**	**282936**	**450**	**283386**	**267043**	15893
		183846				**61408**								275448				
47%	StateTh																	

Scenario 9 : Off peak Load Feb 2030

Availability factor	Thermal Central	Thermal State	Thermal IPP	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	68%	34%	0%	40%	80%	30%	0%	0%	10%	0%	40%	30%		31%	32%
WR	75%	64%	88%	69%	80%	20%	0%	0%	20%	0%	40%	30%		65%	67%
SR	45%	65%	54%	76%	80%	20%	0%	0%	0%	0%	40%	30%		59%	61%
ER	49%	35%	74%	40%	80%	30%	0%	0%	0%	0%	40%	30%		46%	47%
NER	40%	0%	0%	149%	80%	30%	0%	0%	0%	0%	40%	30%		37%	38%
	58%	51%	83%	59%										55%	185526

Availability	Thermal Central	Thermal State	Thermal Private	Reqd Thermal	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total availability	Demand	Surplus /Deficit	Net Availability	Net Demand	ISTS Demand
NR	8037	14127	0	21414	2416	7581	0	0	640	9201	1854	1075	35730	35960	-230	35730	35960	0
WR	16704	23063	31239	64201	2592	1216	0	0	11983	9350	2102	3042	91940	81288	10652	91940	69328	11960
SR	6908	22336	2572	41376	4656	2797	0	0	0	7436	3338	454	43061	57259	-14198	43061	57259	0
ER	14304	5876	3570	20474	0	4208	0	0	0	3682	600	0	28558	24755	3803	28558	20822	3933
NER	300	0	0	1121	0	1612	0	0	0	367	0	669	2581	2158	423	2581	2158	0
Total	**46253**	**65402**	**37381**	**148585**	**9664**	**17413**	**0**	**0**	**12623**	**30036**	**7895**	**5239**	**201869**	**201419**	**450**	**201869**	**185526**	15893
		149035				**30036**								192837				
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
MODAK	BHANPURA-2	220	-57	-205	-251	-212	-201	-90	268	184	218	267
RAPS_C4	SHUJALPR-4	400	368	-109	-122	203	-217	-28	709	127	276	857
RAPS_C4	SHUJALPR-4	400	368	-109	-122	203	-217	-28	709	127	276	857
SAHUPU_N	PUSAULI BSPT	220	351	27	-110	274	-126	-236	315	-228	-66	267
RAIGR2	BUDHIPADAR	220	164	95	184	192	111	150	165	43	119	268
DHRAM_SPL	RANCHI-NEW	765	2642	1078	1162	3370	1279	1177	1258	-380	-41	3500
DHRAM_SPL	RANCHI-NEW	765	2624	1071	1154	3347	1271	1169	1250	-377	-41	3500
MAHAP220	DUMMY BUS	220	0	1310	0	0	1426	0	0	450	0	0
BALIMELA	UPPERSILERU	220	39	-9	67	-185	-10	125	-175	-40	-3	250

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	0	0	0	0	0	0	501	0	0
IR	AGRA	BISWANATH-CH	800	0	0	0	0	0	0	501	0	0
IR	ALIPURDUAR	AGRA	800	1002	2008	1504	2260	2512	1806	0	601	1002
IR	ALIPURDUAR	AGRA	800	1002	2008	1504	2260	2512	1806	0	601	1002
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
IR	BARMER-II HV	MURBAD400	800	3019	150	3019	3019	150	3019	3020	150	1002
IR	BARMER-II HV	MURBAD-SPT2	800	3019	150	3019	3019	150	3019	3020	150	1002
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	502	502	502
IR	BHADR4	CHANDRAPR-SR	70	0	0	0	0	0	0	502	502	502
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	BIKANER-V	BEGUNIA HV	800	0	0	0	0	0	0	0	0	0
IR	BIKANER-V	BEGUNIA HV	800	0	0	0	0	0	0	0	0	0
IR	BISWANATH-CH	ALIPURDUAR	800	300	300	300	1004	803	501	0	300	300
IR	BISWANATH-CH	ALIPURDUAR	800	300	300	300	1004	803	501	0	300	300
IR	CHAMPA SPLT	KURUKSHETR	800	500	500	1253	501	501	1253	501	501	1253
IR	CHAMPA_POOL	KURUKSHETR	800	500	500	1253	501	501	1253	501	501	1253
IR	CHANDRAPR-SR	BHADR4	70	502	502	502	502	502	502	0	0	0
IR	CHANDRAPR-SR	BHADR4	70	502	502	502	502	502	502	0	0	0
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
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702
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	0	0	0	0	0	0	428	428	428
IR	GAZUWAKA-ER	GAZU-SR	70	0	0	0	0	0	0	428	428	428
IR	GAZU-SR	GAZUWAKA-ER	70	428	301	301	428	301	301	0	0	0
IR	GAZU-SR	GAZUWAKA-ER	70	428	301	301	428	301	301	0	0	0
WEST	KHAVDA-II	NAGPUR-B	800	3018	0	0	3018	0	0	3018	0	0
WEST	KHAVDA-IIS	NAGPUR-A	800	3018	0	0	3018	0	0	3018	0	0
WEST	KUDUS	ARAY-220	320	1000	1000	1000	1000	1000	1000	1000	1000	1000
SOUTH	KURN HVDC	VIZAG HVDC	800	0	0	0	0	0	0	0	0	0
SOUTH	KURN HVDC	VIZAG HVDC	800	0	0	0	0	0	0	0	0	0
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	501	0	1003	501	0	1003	501
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	501	0	1003	501	0	1003	501
IR	PUGALUR-NEW	RAIGARH_POOL	800	2512	1505	1505	2512	1505	1505	0	0	0
IR	PUGALUR-NEW	KOTRA SPLT	800	2512	1505	1505	2512	1505	1505	0	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	0	0	0	1002	3018	3018
IR	KOTRA SPLT	PUGALUR-NEW	800	0	0	0	0	0	0	1002.0167	3017.8801	3017.8801
WEST	RAPAR4	ALEPHAT 400	800	3018	500.46	500.468	2714.1	500.489	None	3017.8801	500.48093	500.4726
WEST	RAPAR4	ALEPHAT-SPT	800	3018	500.46	None	2714.1	500.489	500.5	3017.8801	500.48093	None
NORTH	RIHAN-HV	DADR-HVD	500	753	753.46	753.456	753.456	753.456	753.46	753.45599	753.45599	753.45599
NORTH	RIHAN-HV	DADR-HVD	500	753	753.46	753.456	753.456	753.456	753.46	753.45599	753.45599	753.45599
EAST	SASARAM-ER	SASARAM-NR	70	251	250.61	250.606	250.606	250.606	250.61	250.6062	250.6062	250.6062

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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
NORTH	GNOIDAUP	ALIGARH	-2794	-603	-615	-4109	-1177	-494	-2346	-423	236	4363
IR	DHRAM_SPL	RANCHI-NEW	2642	1078	1162	3370	1279	1177	1258	-380	-41	3500
IR	DHRAM_SPL	RANCHI-NEW	2624	1071	1154	3347	1271	1169	1250	-377	-41	3500
WEST	VADODARA	VATAMAN	-969	-1384	-1068	-1309	-1469	-851	-273	-167	219	1250
WEST	VADODARA	VATAMAN	-969	-1384	-1068	-1309	-1469	-851	-273	-167	219	1250
WEST	AHMDABAD PG	HALVAD	-877	-1451	-950	-1157	-1515	-893	-434	-417	-68	1600
WEST	AHMDABAD PG	HALVAD	-877	-1451	-950	-1157	-1515	-893	-434	-417	-68	1600
WEST	LAKADIA-II	KANDLA	1296	0	763	1408	0	1176	1520	0	946	1250
WEST	LAKADIA-II	KHAVDA-V	-1497	-533	-378	-1749	-537	-433	-1887	-430	-189	1250
WEST	LAKADIA-II	KHAVDA-V	-1497	-533	-378	-1749	-537	-433	-1887	-430	-189	1250
WEST	JAMNAGAR7	BHANVAD	-662	-1015	-1060	-611	-1058	-1082	-39	-308	-438	1250
WEST	MUL 765	BHUJ-II PS-7	-1289	-1168	-1085	-1355	-1190	-1087	-1016	-694	-635	1250
WEST	BHUJ-II PS-7	MUL-II	988	865	1238	908	888	1314	525	229	736	1600
WEST	BHUJ-II PS-7	MUL-II	988	865	1238	908	888	1314	525	229	736	1600
WEST	KHAVDA-III	MUL-II	893	-216	511	1175	-230	397	1328	56	593	1250
WEST	KHAVDA-IV	KHAVDA-V	984	534	379	1163	538	434	1265	431	190	1250
WEST	BHOPAL_STER	KURAWAR-7	-2366	511	68	-2537	782	790	-1952	1343	966	3500
WEST	WARDHA	WASHIM	-1578	-127	-808	-1768	-114	-134	-501	758	632	2000
EAST	TALABIRA-NLC	TALABIRA ST	552	-253	36	794	-250	-69	419	-725	-499	0
SOUTH	CUDP800	ANANTPR2_7	-2525	-1260	-1224	-2910	-1237	-1107	-1619	-3	380	3500
SOUTH	CUDP800	ANANTPR2_7	-2525	-1260	-1224	-2910	-1237	-1107	-1619	-3	380	3500
SOUTH	KAKINADA PS	VEM-II80	-2069	-582	-621	-2657	-536	-250	-1851	-60	153	3500
SOUTH	KAKINADA PS	VEM-II80	-2069	-582	-621	-2657	-536	-250	-1851	-60	153	3500
SOUTH	VEM-II80	CPETA800	-2528	-802	-921	-2900	-784	-676	-2087	-75	95	3500
SOUTH	VEM-II80	CPETA800	-2528	-802	-921	-2900	-784	-676	-2087	-75	95	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
NORTH	PARBT-PO	HAMIRPUR	446	557	432	562	632	419	351	423	208	857
NORTH	RAJPURA4	BHIWANI	-458	173	193	-756	-46	172	-539	83	124	857
NORTH	MOGA SPLT4	FATEHABAD	-581	90	102	-897	-139	94	-805	-31	47	857
NORTH	MOGA SPLT4	BHIWANI-PG	-406	34	75	-691	-181	72	-533	-50	57	857
NORTH	MALERKOTLA4	KURUKSHETR	-468	-61	-131	-742	-252	-140	-591	-152	-174	857
NORTH	MALERKOTLA4	KAITHAL	-305	67	163	-610	-153	152	-461	-51	89	857
NORTH	BHIWANI	BHIWANI-PG	-535	-110	5	-898	-374	1	-526	-127	61	857
NORTH	BALLABSPLIT	BALLABHG	-227	651	321	-203	810	354	-312	661	275	1106
NORTH	BHIWANI SR	BAWANA-G	440	117	-9	647	209	-26	434	99	-59	857
NORTH	MERTA	HERAPU-4	505	53	16	602	66	3	557	32	-16	857
NORTH	MERTA	RATANGAR	479	71	46	656	174	26	385	-29	-109	857
NORTH	MERTA	JODH KANKANI	-674	-220	-73	-780	-160	-33	-698	-73	19	857
NORTH	MERTA	BEAWAR	-238	-522	-376	-502	-673	-276	10	-213	91	857
IR	RAPS_C4	SHUJALPR-4	368	-109	-122	203	-217	-28	709	127	276	857
IR	RAPS_C4	SHUJALPR-4	368	-109	-122	203	-217	-28	709	127	276	857
NORTH	BABAI	SIKAR	-440	97	87	-618	0	86	-422	127	136	874
NORTH	BASSI	KOTPUT	448	6	15	709	190	-24	205	-91	-176	874
NORTH	SIKAR	BIKANE-4	-651	39	51	-773	21	67	-722	46	65	874
NORTH	SIKAR	BIKANE-4	-651	39	51	-773	21	67	-722	46	65	874
NORTH	SURATG-4	BIKANR NEW S	-638	118	80	-774	95	68	-678	207	147	874
NORTH	SURATG-4	BIKANR NEW S	-638	118	80	-774	95	68	-678	207	147	874
NORTH	JAIPUR_PG	DAUSA	-137	-555	-338	-277	-633	-324	-36	-398	-122	874
NORTH	JAIPUR_PG	DAUSA	-137	-555	-338	-277	-633	-324	-36	-398	-122	874
NORTH	MEJA	ALLAHABA	218	663	353	170	557	131	365	251	86	874
NORTH	BAGPAT	MEERUT	-337	-119	-21	-628	-332	-19	-393	-164	37	857

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
NORTH	BAGPAT	MEERUT	-337	-119	-21	-628	-332	-19	-393	-164	37	857
NORTH	ORAI	GARAUTHA	-602	-72	-155	-910	-211	-161	-401	50	74	874
NORTH	ORAI	GARAUTHA	-602	-72	-155	-910	-211	-161	-401	50	74	874
NORTH	ORAI	GARAUTHA	390	180	244	718	347	226	106	52	-56	857
NORTH	ORAI	GARAUTHA	390	180	244	718	347	226	106	52	-56	857
NORTH	AGRAUP4	AGRA	-1111	-549	-602	-1781	-739	-602	-498	-57	-209	857
NORTH	BARELI4	BAREL-PG	-587	181	-27	-659	213	-16	-537	316	58	857
NORTH	BARELI4	BAREL-PG	-587	181	-27	-659	213	-16	-537	316	58	857
NORTH	NOIIDA-148	NOIDA-SEC123	497	255	309	720	356	281	504	212	137	857
NORTH	AGRANEW	AGRA	-580	-309	-330	-971	-418	-329	-214	-22	-116	857
NORTH	ALIGARH-PG	KHURJA TPS	568	114	235	781	178	204	498	157	81	857
NORTH	ALIGARH-PG	KHURJA TPS	568	114	235	781	178	204	498	157	81	857
NORTH	LUCK4-PG	LUCK74-P	-1031	49	-210	-1345	-22	-202	-869	240	15	1714
NORTH	LUCK4-PG	LUCK74-P	-1031	49	-210	-1345	-22	-202	-869	240	15	1714
NORTH	LUCK74-P	KANPRNEW	-685	-67	-183	-863	-130	-175	-567	102	-49	857
NORTH	LUCK74-P	KANPRNEW	-685	-67	-183	-863	-130	-175	-567	102	-49	857
NORTH	KHURJA TPS	ALIGARH	504	-92	-87	650	-81	-70	432	-17	-139	857
WEST	RAIPUR	WAR_FS1	-535	103	9	-630	134	181	-367	269	276	857
WEST	RAIPUR	WAR_FS2	-535	103	12	-630	134	181	-367	269	275	857
WEST	DHAMTARI	JAGADALPUR	503	163	252	514	178	255	732	262	393	857
WEST	DHAMTARI	JAGADALPUR	503	163	252	514	178	255	732	262	393	857
WEST	HADALA	KALAVAD	-137	-651	-377	-177	-667	-434	145	-89	88	857
WEST	HADALA	KALAVAD	-137	-651	-377	-177	-667	-434	145	-89	88	857
WEST	ZERDA	BANASKANTHA	48	-728	-341	-58	-744	-390	115	-361	126	857
WEST	CGPL	BACHAU	239	711	594	211	746	624	312	604	454	857
WEST	BACHAU	HALVAD NEW	363	1075	706	415	1060	770	412	555	166	1283
WEST	MUL	MUL-SPLT	500	-750	250	500	-750	250	500	-750	250	857

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	SATPURA	KORADI-I	279	-116	-146	163	-224	-146	625	-281	-198	857
WEST	KHANDWA-4	CHEGAON	32	738	366	72	805	631	132	243	68	857
WEST	WAR_FS1	WARDHA SPLT	-555	102	9	-659	133	179	-376	264	271	857
WEST	WAR_FS2	WARDHA SPLT	-555	102	12	-659	133	179	-376	264	270	857
WEST	LONIKANDII	KARJAT-II M	-228	-133	-69	-236	-129	-103	-290	-189	-144	0
WEST	LONIKANDII	KARJAT-II M	-228	-133	-69	-236	-129	-103	-290	-189	-144	0
WEST	WAGDARI 400	KARJAT-II M	425	218	52	488	224	50	470	120	249	0
WEST	WAGDARI 400	KARJAT-II M	425	218	52	488	224	50	470	120	249	0
EAST	ROURKELA	CHAIBASA	807	369	355	1079	430	353	237	-163	-43	1106
EAST	ROURKELA	CHAIBASA	807	369	355	1079	430	353	237	-163	-43	1106
EAST	DUBURI	BHADRAK-NEW	528	168	150	851	256	114	60	-275	-272	1093
EAST	BARIPADA	KHARAGPR-WB	407	-30	-1	794	52	67	-165	-285	-289	1093
EAST	TALCHER-III	TALCHR3-ST	-20	232	250	-171	-180	228	-99	-70	269	0
EAST	MEDINIPUR4	CHANDITALA_N	597	332	355	775	407	396	392	257	225	1093
EAST	MEDINIPUR4	CHANDITALA_N	597	332	355	775	407	396	392	257	225	1093
EAST	PPSP_NEW	PURULIAPS	648	5	54	960	61	179	727	-211	-5	850
EAST	PPSP_NEW	PURULIAPS	648	5	54	960	61	179	727	-211	-5	850
EAST	PPSP_NEW	RANCHI-NEW	-944	-361	-387	-1264	-418	-467	-847	-168	-209	1093
EAST	PPSP_NEW	RANCHI-NEW	-944	-361	-387	-1264	-418	-467	-847	-168	-209	1093
EAST	DURGAPUR-A	JAMSHEDPR-PG	-426	-114	-149	-668	-213	-207	-180	-100	-125	850
EAST	WARIA-400	WARIA ST	-46	-37	-146	-113	27	-91	-84	-270	-255	0
EAST	RAGHUNATH P2	RAGHU P2 ST	0	0	0	340	122	66	100	-168	-101	0
EAST	RANCHI	RNC-SIPT FSC	-536	-184	-258	-670	-215	-181	-269	142	-2	0
EAST	RANCHI	RNC-SIPT FSC	-536	-184	-258	-670	-215	-181	-269	142	-2	0
EAST	KODERMA P2	KODERMA 2 ST	346	439	367	360	414	336	283	387	236	0
SOUTH	NSAGAR	FSC-3	-665	-430	-437	-791	-440	-453	-439	-182	-96	948
SOUTH	NSAGAR	FSC-4	-854	-553	-562	-1015	-566	-583	-439	-232	-122	948

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	VIJW	VIJTP-IV	-350	-39	-43	-487	-37	-2	-647	-253	-221	874
SOUTH	VIJW	CPETA400	-594	-271	-305	-629	-275	-296	-423	-79	-44	852
SOUTH	VIJW	CPETA400	-594	-271	-305	-629	-275	-296	-423	-79	-44	852
SOUTH	CUDP	CHITOR	707	23	64	596	4	-11	557	-248	-260	852
SOUTH	CUDP	FSC-4	898	570	579	1079	583	602	225	235	123	948
SOUTH	GOOT	KURNOOL4	602	376	402	803	406	458	333	150	36	850
SOUTH	GOOT	TUMKUR SP	-717	-222	-142	-1008	-215	-179	-671	-16	92	1100
SOUTH	GOOT	TUMKUR SP	-717	-222	-142	-1008	-215	-179	-671	-16	92	1100
SOUTH	KURNOOL4	SSLBPH4	1216	492	573	1374	503	554	824	187	40	850
SOUTH	KURNOOL4	MAHESWRM	506	380	352	648	387	352	360	228	105	850
SOUTH	VEMAGIR4	KAKINADA SEZ	564	19	81	627	36	134	398	-268	-188	874
SOUTH	VEMAGIR4	KAKINADA SEZ	564	19	81	627	36	134	398	-268	-188	874
SOUTH	HYDERABAD	MAHESWRM	-1575	-845	-967	-1565	-848	-934	-1046	-358	-333	2100
SOUTH	VELTOOR	RAIC	-2101	-1195	-1407	-2262	-1206	-1347	-1440	-702	-509	2186
SOUTH	MNRB	RAIC	445	337	223	600	349	248	285	22	-150	852
SOUTH	RAIC	BELLARY TPP	-414	-642	-462	-611	-643	-500	-412	-270	-29	850
SOUTH	HOODI4	DHANLLI	-771	-182	-180	-752	-183	-116	-638	132	215	852
SOUTH	HOODI4	DHANLLI	-771	-182	-179	-752	-183	-116	-638	132	215	852
SOUTH	NELMANG4	YELAHNKA	-476	-102	-124	-498	-115	-117	-613	-211	-224	852
SOUTH	KOLAR	TIRUVLM-BYPA	607	20	50	642	10	24	497	-164	-183	852
SOUTH	SPBUDUR4	TIRUVLM-BYPA	-591	-19	-50	-625	-10	-23	-487	165	185	852
SOUTH	PUGALUR-NEW	KARUR II	-1798	-1187	-1164	-1900	-1195	-1187	-570	340	467	2186
SOUTH	PUGALUR-NEW	KARUR II	-1798	-1187	-1164	-1900	-1195	-1187	-570	340	467	2186
SOUTH	MANALI4	NORTH CHEN P	-1094	-1351	-1272	-913	-1369	-1253	-1145	-1187	-1101	1093
SOUTH	MANALI4	MANJPKCPINT	344	481	632	55	506	628	486	386	653	857

Note: Highlighted cell indicates Power flow > 70% of Thermal limit

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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	BHIWANI-PG	400	BHIWN-PG	765	-978	-112	25	-1505	-389	38	-922	-74	164	1500
NORTH	BHIWANI SR	400	BHIWN-PG	765	-715	-51	12	-987	-253	30	-636	38	189	1000
NORTH	SIWANI	400	SIWANI	765	-1101	-14	54	-1406	-132	60	-1298	-14	88	1500
NORTH	NARELA ISTS	400	NARELA ISTS	765	-1009	-179	-61	-1258	-252	-27	-973	-69	81	1500
NORTH	BIKANER-IV	400	BIKANER-IV	765	1111	14	-54	1425	132	-60	1313	14	-88	1500
NORTH	RAMG-I	400	RAMGARH-I	765	1092	0	0	1288	0	0	1327	0	0	1500
NORTH	BHADLA-2	400	BHADLA-2	765	1077	-80	-72	1245	-96	-71	1277	-68	-33	1500
NORTH	VARANASI	400	VARNASI8	765	-958	-32	-197	-1399	-159	-182	-533	134	50	1500
EAST	SASARAM-ER	400	SASARAM	765	-1153	-252	-260	-1336	-16	41	-796	329	-28	1500
EAST	DUBURI765_4	400	DUBURI_765	765	-1428	-1122	-1133	-1586	-1072	-969	-1191	-719	-684	1500
EAST	KHUNTUNI4	400	KHUNTUNI7	765	-1026	-767	-791	-1200	-655	-538	-827	-306	-264	1500
EAST	JEERAT-NEW	400	JEERAT7	765	-1083	-425	-557	-1390	-520	-612	-640	-506	-291	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	-189	-199	-180	-262	-254	-170	-187	-172	-88	315
NORTH	DEHAR	220	DEHAR	400	-171	-109	-67	-279	-185	-59	-218	-132	-47	315
NORTH	PATRAN42	220	PATRAN4	400	-372	-99	-32	-533	-203	-41	-398	-97	-13	500
NORTH	MALERKOTLA42	220	MALERKOTLA4	400	-306	-134	-83	-421	-204	-92	-285	-110	-52	500
NORTH	MOGA42	220	MOGA SPLT4	400	-332	-196	-110	-427	-245	-112	-300	-144	-46	500
NORTH	JALANDHAR42	220	JALANDHAR4	400	-343	-206	-118	-451	-251	-114	-321	-168	-58	500
NORTH	PATIALA42	220	PATIALA4	400	-338	-203	-123	-448	-265	-129	-289	-152	-58	500
NORTH	JINDPG	220	JINDPG	400	-386	-194	-179	-487	-239	-166	-377	-147	-71	500
NORTH	BAWANA	220	BAWANA	400	-194	-102	-45	-254	-121	-43	-173	-83	-22	315
NORTH	GOPAL PUR-II	220	GOPAL PUR	400	-316	-114	-36	-405	-149	-28	-299	-79	4	500
NORTH	GOPAL PUR1	220	GOPAL PUR	400	-318	-117	-36	-409	-154	-29	-302	-82	3	500
NORTH	DWARKA-II	220	DWARKA	400	-340	-221	-158	-417	-250	-149	-313	-177	-95	500
NORTH	BIKANER-IV	220	BIKANER-IV	400	362	0	0	427	0	0	440	0	0	500
NORTH	DEEDWANA-42	220	DEEDWANA	400	-238	-269	-188	-318	-311	-170	-208	-194	-63	315
NORTH	MERTA-42	220	MERTA	400	-150	-382	-266	-204	-438	-253	-123	-316	-136	315
NORTH	KANKR-PG	220	KANKROLI	400	-137	-257	-211	-203	-274	-172	-50	-161	-46	315
NORTH	HINDAU-4	220	HINDAU-4	400	-219	-340	-232	-289	-372	-223	-184	-281	-119	315
NORTH	RATANGAR	220	RATANGAR	400	-134	-269	-183	-176	-295	-167	-113	-214	-92	315
NORTH	HIRAPURA	220	HERAPU-4	400	-201	-300	-202	-270	-340	-189	-170	-230	-87	250
NORTH	CHITTOR-42	220	CHITTOR4	400	-242	-432	-319	-358	-443	-269	-180	-305	-89	315
NORTH	BIKANE-4	220	BIKANE-4	400	-10	-358	-242	-38	-381	-215	39	-245	-88	315
NORTH	SURATGARH-42	220	SURATG-4	400	-119	-369	-248	-158	-311	-182	-94	-210	-86	315
NORTH	CHABRA-2	220	CHABRA-4	400	-130	-331	-213	-160	-344	-194	-132	-292	-136	315
NORTH	BASSI	220	BASSI	400	-285	-384	-263	-371	-425	-243	-249	-290	-109	500
NORTH	BHADLA-S	220	BHADLA	400	399	-229	-177	441	-259	-169	469	-198	-99	500

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	BHILWA-4	220	BHILWA-4	400	-136	-374	-265	-214	-409	-234	-63	-270	-86	315
NORTH	JODHPU-4	220	JODH SURPURA	400	-56	-334	-247	-113	-391	-221	-10	-255	-100	315
NORTH	KALISIND	220	KALISI-4	400	-187	-380	-210	-197	-583	-323	-271	-596	-306	500
NORTH	AJMER42	220	AJMER	400	-186	-441	-310	-267	-484	-283	-128	-338	-128	315
NORTH	BHIWADI	220	BHIWADI	400	-224	-410	-286	-321	-458	-278	-174	-324	-160	315
NORTH	BABAI	220	BABAI	400	-133	-280	-189	-159	-302	-178	-123	-233	-113	315
NORTH	ALWAR-42	220	ALWAR	400	-169	-255	-170	-241	-292	-169	-123	-202	-88	315
NORTH	SIKAR-PG	220	SIKAR	400	-216	-383	-263	-279	-427	-250	-191	-296	-131	500
NORTH	BHADLA-PG	220	BHADLA PG	400	385	0	0	454	0	0	467	0	0	500
NORTH	FATEH-2	220	FATEHG-2	400	340	0	0	401	0	0	413	0	0	500
NORTH	FATEHG-3	220	FATEHG-3	400	356	0	0	419	0	0	432	0	0	500
NORTH	FATEHG-4	220	FATEHG-4	400	332	0	0	391	0	0	403	0	0	500
NORTH	BHADLA-3	220	BHADLA-3	400	461	0	0	544	0	0	560	0	0	500
NORTH	SIROHI	220	SIROHI	400	410	0	0	483	0	0	498	0	0	0
NORTH	BIKANER-2	220	BIKANER-II	400	332	0	0	392	0	0	404	0	0	500
NORTH	BHADLA-2	220	BHADLA-2	400	389	0	0	459	0	0	473	0	0	500
NORTH	BHAD-2 SPLT	220	BHADLA-2	400	388	0	0	457	0	0	471	0	0	500
NORTH	BIKANER-3	220	BIKANER-3	400	371	0	0	438	0	0	451	0	0	500
NORTH	BARMER-I	220	BARMER1_4	400	364	0	85	429	0	84	442	0	14	500
NORTH	BHINM-PG	220	BHINMAL	400	-200	-255	-170	-274	-291	-158	-213	-205	-76	315
NORTH	KOTA	220	KOTA	400	-264	-480	-333	-346	-480	-300	-240	-358	-156	315
NORTH	JAIPUR_PG	220	JAIPUR_PG	400	-251	-461	-318	-340	-514	-297	-196	-350	-142	500
NORTH	FATEH-SPL 2	220	FATEHG-2	400	337	0	0	398	0	0	410	0	0	500
NORTH	BHADLA3-SPL	220	BHADLA-3	400	369	0	0	435	0	0	448	0	0	500
NORTH	BAKNTPR2	220	BARELI4	400	-225	-125	-147	-280	-148	-137	-199	-78	-62	315
NORTH	KANPU-PG	220	KANPUR	400	-303	-52	-103	-386	-84	-105	-229	6	-14	315
NORTH	REWAROAD	220	REWA	400	-230	-231	-200	-269	-222	-157	-222	-144	-107	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	AGRA-PG	220	AGRA	400	-230	-223	-194	-339	-262	-195	-138	-140	-96	315
NORTH	RAIBRELY2	220	RAIBARELY4	400	-358	-137	-171	-482	-153	-151	-288	-70	-75	500
WEST	BHILAI	220	BHI4	400	-244	-197	-152	-250	-197	-201	-272	-235	-200	315
WEST	MUNDRA-APL	220	MUNDRA-APL	400	95	346	287	105	357	274	-64	70	36	315
WEST	JAM KHAMB PS	220	JAM KHAMB PS	400	289	421	388	291	438	397	59	112	120	500
WEST	HINDALCO	220	HINDALCO	400	-284	-154	-131	-317	-147	-290	-345	-122	-188	315
WEST	MAHAP220	220	MAHAPE40	400	-263	-590	-263	-263	-619	-263	-263	-375	-263	500
WEST	KALLAM	220	KALLAM	400	289	421	388	291	438	397	59	112	120	500
EAST	KTPS220	220	KOLAGHAT	400	-362	-356	-304	-453	-298	-265	-288	-295	-183	315
EAST	CHANDITALA_N	220	CHANDITALA_N	400	-365	-360	-302	-425	-388	-326	-304	-311	-167	315
EAST	KHARAGPR-WB	220	KHARAGPR-WB	400	-294	-273	-228	-348	-296	-243	-224	-206	-131	315
EAST	GOKARNA	220	GOKARNA	400	-222	-189	-152	-255	-213	-185	-190	-171	-58	315
EAST	JEERAT	220	JEERAT	400	-247	-188	-196	-295	-211	-220	-197	-226	-103	315
EAST	BIDHANNGR-WB	220	BIDHAN NGR	400	-280	-177	-153	-336	-208	-191	-204	-143	-66	315
SOUTH	TALARI_CRV 2	220	TALARICH	400	210	0	0	238	0	0	256	0	0	315
SOUTH	NTPC-RMGD	220	RAMGUNDM STP	400	-84	-99	-91	-85	-98	-88	-241	-335	-233	315
SOUTH	SHADNAGAR	220	SHADNGR_TG	400	-459	-273	-297	-452	-273	-283	-392	-210	-192	500
SOUTH	RAIC	220	RAIC	400	343	66	-10	460	67	6	211	25	-99	500
SOUTH	GLBRGA220	220	GULBRG	400	-293	-418	-359	-316	-423	-359	-259	-332	-212	500
SOUTH	HOSUR42	230	HOSUR4	400	-403	-83	-94	-389	-79	-69	-393	13	26	500
SOUTH	KANARP42	230	KANAPATT	400	315	196	176	341	196	176	342	178	158	315

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
NORTH	AMRITSAR4	400.00	0.99	0.99	1.00	1.00	0.97	1.00	1.05	1.00	1.01	1.05
NORTH	BEHMNJSINGH4	400.00	1.00	1.00	1.00	1.01	1.00	1.00	1.06	1.00	1.01	1.06
NORTH	GORAKHPU	400.00	0.98	1.02	1.03	1.00	1.01	1.03	1.00	1.02	1.06	1.06
NORTH	JAISALMR NEW	765.00	1.01	1.04	1.04	1.00	1.03	1.04	1.00	1.05	1.06	1.06
NORTH	JODH KANKANI	765.00	0.99	1.03	1.03	0.99	1.02	1.03	0.99	1.04	1.05	1.05
NORTH	MAKHU4	400.00	0.99	0.99	1.00	1.00	0.98	1.00	1.06	1.00	1.01	1.06
NORTH	MITAL(ENG)4	400.00	1.00	1.00	1.00	1.01	0.99	1.00	1.06	1.00	1.01	1.06
NORTH	MUKATSAR4	400.00	1.00	0.99	1.00	1.01	0.99	1.00	1.07	1.00	1.01	1.07
NORTH	NAKODAR4	400.00	1.00	0.99	1.00	1.00	0.99	1.00	1.05	1.00	1.01	1.05
NORTH	TALWNDISABO4	400.00	1.00	1.00	1.00	1.01	1.00	1.00	1.06	1.00	1.00	1.06
EAST	MOTIHARI	400.00	0.98	1.02	1.03	1.01	1.02	1.03	1.00	1.02	1.05	1.05
EAST	CHAPRA NEW	400.00	0.98	1.03	1.04	1.00	1.02	1.03	1.01	1.03	1.05	1.05
SOUTH	ANANTPR2_7	765.00	1.00	1.02	1.01	1.00	1.01	1.01	1.01	1.04	1.05	1.05
SOUTH	CHANDRAPR-SR	400.00	1.00	1.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.05
SOUTH	SHADNGR_765	765.00	1.00	1.05	1.03	1.00	1.04	1.04	1.02	1.05	1.06	1.06
SOUTH	MANGALORE GH	400.00	0.94	1.03	1.04	1.01	1.03	1.03	1.00	1.06	1.07	1.07
SOUTH	DAVANGERE PS	400.00	1.00	1.00	1.01	1.00	1.00	1.00	1.00	1.03	1.05	1.05
SOUTH	BIDAR PS SZ	765.00	1.01	1.05	1.04	1.01	1.04	1.04	1.03	1.05	1.06	1.06
SOUTH	MANGALORE GH	765.00	0.96	1.03	1.04	1.01	1.03	1.03	1.00	1.06	1.07	1.07
SOUTH	CNHALLI NEW	765	1.01	1.03	1.02	1.01	1.03	1.02	1.02	1.04	1.05	1.05
SOUTH	DAVANGERE PS	765.00	1.00	1.02	1.02	1.01	1.02	1.02	1.01	1.04	1.05	1.05
CROSS BORDER	BUTWAL	400.00	1.00	1.00	1.04	1.00	1.00	1.04	1.00	1.00	1.06	1.06

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
NORTH	MOGA4	400.00	0.99	1.01	1.00	0.93	1.01	1.01	0.97	1.01	1.02	0.93
NORTH	MOGA-PG	765.00	0.98	1.01	1.00	0.92	1.01	1.01	0.97	1.01	1.02	0.92
NORTH	KHEDAR	400.00	0.98	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95
NORTH	KIRORI	400.00	0.98	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95
NORTH	NUHIYANWALI	400.00	0.98	0.99	1.00	0.95	0.99	1.00	1.00	1.00	1.01	0.95
NORTH	FATEHABAD	400.00	0.98	0.99	1.00	0.94	0.99	1.00	0.99	1.00	1.01	0.94
NORTH	SIWANI	400.00	0.97	0.99	0.99	0.92	1.00	0.99	0.98	1.00	1.00	0.92
NORTH	BHIWN-PG	765.00	0.97	1.00	0.99	0.93	0.99	0.99	0.98	1.00	1.01	0.93
NORTH	SIWANI	765.00	0.98	1.00	0.99	0.92	1.00	0.99	0.98	1.00	1.00	0.92
NORTH	BAMNAULI4	400.00	0.97	0.99	1.00	0.94	0.98	1.00	0.99	1.00	1.02	0.94
NORTH	MUNDKA	400.00	0.97	1.00	1.00	0.95	0.99	1.00	0.99	1.00	1.01	0.95
NORTH	JHATIKALA-PG	400.00	0.97	1.00	1.00	0.94	0.99	1.00	0.99	1.00	1.01	0.94
NORTH	GOPAL PUR	400.00	0.98	0.99	1.00	0.95	0.99	1.00	0.99	1.00	1.01	0.95
NORTH	DWARKA	400.00	0.96	0.99	1.00	0.94	0.98	1.00	0.99	1.00	1.02	0.94
NORTH	NARELA ISTS	400.00	0.98	0.99	1.00	0.95	0.99	1.00	0.98	1.00	1.01	0.95
NORTH	JHATIKARASP	400.00	0.97	0.99	1.00	0.94	0.98	1.00	0.98	1.00	1.02	0.94
NORTH	NARELA ISTS	765.00	0.97	1.00	1.00	0.94	0.99	1.00	0.98	1.00	1.01	0.94
NORTH	JHATI-PG	765.00	0.97	1.00	1.00	0.93	0.99	1.00	0.97	1.00	1.01	0.93
NORTH	NEEMR (NEW)	400.00	0.98	1.00	0.99	0.95	1.00	0.99	0.99	1.00	1.01	0.95
NORTH	HERAPU-4	400.00	0.97	0.98	0.96	0.95	0.95	0.98	1.00	0.99	1.01	0.948518
NORTH	ALWAR	400.00	0.98	0.96	0.95	0.97	0.94	0.97	1.01	0.99	1.01	0.94
NORTH	RATANGAR	400.00	0.98	0.98	0.98	0.95	0.98	0.98	0.99	1.00	1.01	0.95

NORTH	HINDAU-4	400.00	0.98	0.96	0.95	0.97	0.93	0.97	1.02	0.99	1.01	0.93
NORTH	DEEDWANA	400.00	0.97	0.97	0.96	0.95	0.94	0.98	1.00	1.00	1.02	0.94
NORTH	SURATG-4	400.00	0.98	1.00	1.00	0.95	1.00	1.00	0.99	1.00	1.00	0.95
NORTH	SIKAR NEW	400.00	0.98	1.02	1.00	0.94	1.01	1.01	0.98	1.02	1.02	0.94
NORTH	KHETRI	400.00	0.98	1.01	0.99	0.95	1.01	1.00	0.98	1.01	1.02	0.95
NORTH	BIKANER-IV	765.00	0.99	1.00	0.98	0.95	1.00	0.99	0.99	1.00	1.00	0.95
NORTH	NEEMR (NEW)	765.00	0.98	1.01	0.99	0.94	1.00	1.00	0.98	1.01	1.02	0.94
NORTH	BIKANER-NW	765.00	0.98	1.02	1.00	0.95	1.01	1.01	0.97	1.02	1.02	0.95
NORTH	SIKAR NEW	765.00	0.98	1.02	1.01	0.93	1.01	1.01	0.97	1.02	1.03	0.93
NORTH	KHETRI	765.00	0.98	1.01	1.01	0.94	1.01	1.01	0.98	1.02	1.03	0.94
NORTH	MEERTFS1	765.00	0.98	1.00	1.00	0.95	1.00	1.00	0.98	1.01	1.01	0.95
NORTH	MEERTFS2	765.00	0.98	1.00	1.00	0.95	1.00	1.00	0.98	1.01	1.01	0.95
WEST	KUNKURI	400.00	0.97	1.01	1.01	0.94	1.01	1.01	1.01	1.01	1.02	0.94
EAST	SASARAM-NR	400.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95
EAST	JEY-BOL_FSC	400.00	0.94	0.94	0.92	0.94	0.95	0.93	0.94	0.94	0.91	0.91
EAST	DUBURI	400.00	0.97	0.97	0.98	0.94	0.96	0.97	0.99	1.00	0.99	0.94
EAST	PARADEEP	400.00	0.97	0.98	0.99	0.95	0.97	0.96	0.99	1.00	0.98	0.95
EAST	DUBURI765_4	400.00	0.97	0.97	0.98	0.94	0.96	0.97	0.99	0.99	0.99	0.94
EAST	PARADEEP4	400.00	0.97	0.98	0.99	0.95	0.97	0.97	0.99	1.00	0.98	0.95
EAST	BHADRAK-NEW	400.00	0.99	0.98	0.99	0.94	0.96	0.98	1.01	1.00	1.01	0.94
EAST	MEDINIPUR4	400.00	0.99	0.99	0.99	0.94	0.98	1.00	1.02	1.00	1.01	0.94
EAST	RAJARHAT	400.00	0.98	0.98	1.00	0.91	0.97	1.00	1.02	0.99	1.02	0.91
EAST	JEERAT	400.00	0.98	0.98	0.99	0.92	0.97	1.00	1.02	1.00	1.02	0.92
EAST	SUBHASGRAM	400.00	0.98	0.98	1.00	0.91	0.98	1.00	1.02	1.00	1.02	0.91
EAST	KOLAGHAT	400.00	0.96	0.97	0.98	0.92	0.96	0.99	1.01	0.99	1.02	0.92
EAST	HALDIA-TPS	400.00	0.99	1.00	1.00	0.91	0.99	1.00	1.01	1.00	1.00	0.91
EAST	CHANDITALA_N	400.00	0.97	0.97	0.98	0.92	0.97	0.99	1.01	0.99	1.01	0.92
EAST	KHARAGPR-WB	400.00	0.98	0.98	0.99	0.94	0.98	1.00	1.02	1.00	1.01	0.94

EAST	BAKRASWR	400.00	0.96	1.00	1.00	0.92	1.00	1.00	1.01	1.00	1.01	0.92
EAST	ARAMBAGH	400.00	0.96	0.97	0.99	0.92	0.97	0.99	1.02	0.99	1.02	0.92
EAST	NEW LAXMKTNP	400.00	0.99	0.98	1.00	0.91	0.97	1.00	1.02	1.00	1.02	0.91
EAST	JEERAT-NEW	400.00	0.98	0.98	0.99	0.92	0.98	1.00	1.02	1.00	1.02	0.92
EAST	BIDHAN NGR	400.00	0.97	0.99	0.99	0.94	0.99	0.99	1.01	0.99	1.00	0.94
EAST	DURGAPUR-A	400.00	0.97	0.99	0.99	0.95	0.99	0.99	1.01	1.00	1.00	0.95
EAST	BAPL_400	400.00	0.97	0.99	0.99	0.94	0.98	0.99	1.00	0.99	1.00	0.94
EAST	MEDINIPUR7	765.00	0.99	0.99	0.98	0.94	0.98	1.01	1.01	1.00	1.00	0.94
EAST	JEERAT7	765.00	0.99	0.98	0.98	0.93	0.98	1.01	1.01	1.00	1.01	0.93
EAST	ODISHA METAL	400.00	0.99	0.99	1.00	0.94	0.98	1.00	1.01	1.00	1.01	0.94
SOUTH	MANGALORE GH	400.00	0.94	1.03	1.04	1.01	1.03	1.03	1.00	1.06	1.07	0.94

Highlighted cell indicates Bus Voltage <0.95 P.U.

Annex-3.6

N-1 Contingency of 765 kV Transmission Lines

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
508082 KAKINADA PS 765.00 508092 VEM-II80 765.00 1	OPEN LINE FROM BUS 508082 [KAKINADA PS 765.00] TO BUS 508092 [VEM-II80 765.00] CKT 2	2079.34	4016.09	3500	113.19	SC 1
508082 KAKINADA PS 765.00 508092 VEM-II80 765.00 2	OPEN LINE FROM BUS 508082 [KAKINADA PS 765.00] TO BUS 508092 [VEM-II80 765.00] CKT 1	2079.34	4016.09	3500	113.19	SC 1
318998 DHRAM_SPL 765.00 478046 RANCHI-NEW 765.00 1	OPEN LINE FROM BUS 318998 [DHRAM_SPL 765.00] TO BUS 478046 [RANCHI-NEW 765.00] CKT 2	2603.89	3714.05	3500	103.90	SC 1
508007 CUDP800 765.00 508885 ANANTPR2_7 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508885 [ANANTPR2_7 765.00] CKT 2	2555.89	3710.77	3500	105.69	SC 1
508007 CUDP800 765.00 508885 ANANTPR2_7 765.00 2	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508885 [ANANTPR2_7 765.00] CKT 1	2555.89	3710.77	3500	105.69	SC 1
318998 DHRAM_SPL 765.00 478046 RANCHI-NEW 765.00 2	OPEN LINE FROM BUS 318998 [DHRAM_SPL 765.00] TO BUS 478046 [RANCHI-NEW 765.00] CKT 1	2586.44	3698.67	3500	103.49	SC 1
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	2567.31	3604.35	3500	101.67	SC 1
508092 VEM-II80 765.00 508099 CPETA800 765.00 2	OPEN LINE FROM BUS 508092 [VEM-II80 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	2567.31	3604.35	3500	101.67	SC 1
508082 KAKINADA PS 765.00 508092 VEM-II80 765.00 1	OPEN LINE FROM BUS 508082 [KAKINADA PS 765.00] TO BUS 508092 [VEM-II80 765.00] CKT 2	2664.82	5319.81	3500	145.02	SC 4
508082 KAKINADA PS 765.00 508092 VEM-II80 765.00 2	OPEN LINE FROM BUS 508082 [KAKINADA PS 765.00] TO BUS 508092 [VEM-II80 765.00] CKT 1	2664.82	5319.81	3500	145.02	SC 4
318998 DHRAM_SPL 765.00 478046 RANCHI-NEW 765.00 1	OPEN LINE FROM BUS 318998 [DHRAM_SPL 765.00] TO BUS 478046 [RANCHI-NEW 765.00] CKT 2	3324.1	4906.92	3500	132.84	SC 4
318998 DHRAM_SPL 765.00 478046 RANCHI-NEW 765.00 2	OPEN LINE FROM BUS 318998 [DHRAM_SPL 765.00] TO BUS 478046 [RANCHI-NEW 765.00] CKT 1	3301.61	4886.51	3500	132.33	SC 4
508007 CUDP800 765.00 508885 ANANTPR2_7 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508885 [ANANTPR2_7 765.00] CKT 2	2947.02	4289.23	3500	122.09	SC 4
508007 CUDP800 765.00 508885 ANANTPR2_7 765.00 2	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508885 [ANANTPR2_7 765.00] CKT 1	2947.02	4289.23	3500	122.09	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	2961.67	4263.45	3500	114.49	SC 4
508092 VEM-II80 765.00 508099 CPETA800 765.00 2	OPEN LINE FROM BUS 508092 [VEM-II80 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	2961.67	4263.45	3500	114.49	SC 4
508082 KAKINADA PS 765.00 508092 VEM-II80 765.00 1	OPEN LINE FROM BUS 508082 [KAKINADA PS 765.00] TO BUS 508092 [VEM-II80 765.00] CKT 2	1861.71	3530.03	3500	101.36	SC 7
508082 KAKINADA PS 765.00 508092 VEM-II80 765.00 2	OPEN LINE FROM BUS 508082 [KAKINADA PS 765.00] TO BUS 508092 [VEM-II80 765.00] CKT 1	1861.71	3530.03	3500	101.36	SC 7

N-1 Contingency of 400 kV Transmission Lines

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
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	773.76	1350.23	852	156.36	SC 1
524005 HOODI4 400.00 524025 DHANLLI 400.00 2	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 524025 [DHANLLI 400.00] CKT 1	773.63	1350.16	852	156.35	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	670.55	1337.3	850	156.77	SC 1
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 2	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 1	670.55	1337.3	850	156.77	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	1806.73	3065.51	2186	140.23	SC 1
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 2	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 1	1806.73	3065.51	2186	140.23	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	1096.83	2179.45	1714	124.20	SC 1
174438 LUCK4-PG 400.00 174451 LUCK74-P 400.00 2	OPEN LINE FROM BUS 174438 [LUCK4-PG 400.00] TO BUS 174451 [LUCK74-P 400.00] CKT 1	1096.83	2179.45	1714	124.20	SC 1
504013 KURNOOL4 400.00 514011 SSLBPH4 400.00 1	OPEN LINE FROM BUS 514023 [VELTOOR 400.00] TO BUS 524003 [RAIC 400.00] CKT 1	1216.32	1315.93	1045	125.80	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	964.9	1360.6	1093	124.48	SC 1
444074 PPSP_NEW 400.00 474047 RANCHI-NEW 400.00 2	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 474047 [RANCHI-NEW 400.00] CKT 1	964.9	1360.6	1093	124.48	SC 1
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	514.72	1056.35	874	120.86	SC 1
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	514.72	1056.35	874	120.86	SC 1
174058 ORAI 400.00 174964 GARAUTHA 400.00 1	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 174964 [GARAUTHA 400.00] CKT 2	606.05	977.79	857	113.91	SC 1
174058 ORAI 400.00 174964 GARAUTHA 400.00 2	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 174964 [GARAUTHA 400.00] CKT 1	606.05	977.79	857	113.91	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	1227.73	2418.28	2186	108.87	SC 1

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
514021 DICHPAL4 400.00 514061 NIZAMABAD 400.00 2	OPEN LINE FROM BUS 514021 [DICHPAL4 400.00] TO BUS 514061 [NIZAMABAD 400.00] CKT 1	1227.73	2418.28	2186	108.87	SC 1
504003 NSAGAR 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504003 [NSAGAR 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	905.89	1029.87	948	110.34	SC 1
504007 CUDP 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504003 [NSAGAR 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	905.89	1029.87	948	110.34	SC 1
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 1	1099.02	1170.93	1093	107.45	SC 1
514023 VELTOOR 400.00 524003 RAIC 400.00 1	OPEN LINE FROM BUS 508028 [KURL800 765.00] TO BUS 528003 [RAIC800 765.00] CKT 2	2198.27	2339.97	2186	105.21	SC 1
374898 MURBAD-SPT2 400.00 374899 MURBAD400 400.00 1	BLOCK TWOTERMDC "BARMR -MURBD"	829.67	2252.33	2186	103.03	SC 1
424004 JEYPORE 400.00 424053 JEYP GAZ F1 400.00 1	OPEN LINE FROM BUS 424054 [JEYP GAZ F2 400.00] TO BUS 424099 [GAZUWAKA-ER 400.00] CKT 2	416.23	821.9	850	100.15	SC 1
424004 JEYPORE 400.00 424054 JEYP GAZ F2 400.00 1	OPEN LINE FROM BUS 424053 [JEYP GAZ F1 400.00] TO BUS 424099 [GAZUWAKA-ER 400.00] CKT 3	416.23	821.9	850	100.15	SC 1
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 548008 [NORTH CHN PS765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 3	1351.05	1578.41	1093	145.05	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	668.28	1107.65	857	129.25	SC 2
174000 MEJA 400.00 174474 ALLAHABA 400.00 2	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 1	668.28	1107.65	857	129.25	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	939.91	1873.94	1714	109.33	SC 2
174927 GORAKHPU 400.00 644002 BUTWAL 400.00 2	OPEN LINE FROM BUS 174927 [GORAKHPU 400.00] TO BUS 644002 [BUTWAL 400.00] CKT 1	939.91	1873.94	1714	109.33	SC 2
354018 HADALA 400.00 354072 KALAVAD 400.00 1	OPEN LINE FROM BUS 354018 [HADALA 400.00] TO BUS 354072 [KALAVAD 400.00] CKT 2	661.39	935.18	857	109.26	SC 2
354018 HADALA 400.00 354072 KALAVAD 400.00 2	OPEN LINE FROM BUS 354018 [HADALA 400.00] TO BUS 354072 [KALAVAD 400.00] CKT 1	661.39	935.18	857	109.26	SC 2
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 548008 [NORTH CHN PS765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 3	1272.52	1469.31	1093	133.26	SC 3
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	512.77	1048.83	874	120.00	SC 3
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	512.77	1048.83	874	120.00	SC 3
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	978.9	2021.95	850	228.83	SC 4

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 2	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 1	978.9	2021.95	850	228.83	SC 4
174058 ORAI 400.00 174964 GARAUTHA 400.00 1	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 174964 [GARAUTHA 400.00] CKT 2	917	1480.63	857	172.39	SC 4
174058 ORAI 400.00 174964 GARAUTHA 400.00 2	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 174964 [GARAUTHA 400.00] CKT 1	917	1480.63	857	172.39	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	1391.94	2699.78	1714	157.79	SC 4
174438 LUCK4-PG 400.00 174451 LUCK74-P 400.00 2	OPEN LINE FROM BUS 174438 [LUCK4-PG 400.00] TO BUS 174451 [LUCK74-P 400.00] CKT 1	1391.94	2699.78	1714	157.79	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	756.57	1302.57	852	152.74	SC 4
524005 HOODI4 400.00 524025 DHANLLI 400.00 2	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 524025 [DHANLLI 400.00] CKT 1	756.44	1302.51	852	152.73	SC 4
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	1910.41	3241.96	2186	148.31	SC 4
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 2	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 1	1910.41	3241.96	2186	148.31	SC 4
504013 KURNOOL4 400.00 514011 SSLBPH4 400.00 1	OPEN LINE FROM BUS 514023 [VELTOOR 400.00] TO BUS 524003 [RAIC 400.00] CKT 1	1374.85	1484.48	1045	141.78	SC 4
424012 ROURKELA 400.00 474062 CHAIBASA 400.00 1	OPEN LINE FROM BUS 424012 [ROURKELA 400.00] TO BUS 474062 [CHAIBASA 400.00] CKT 2	1078.9	1490.73	1093	131.01	SC 4
424012 ROURKELA 400.00 474062 CHAIBASA 400.00 2	OPEN LINE FROM BUS 424012 [ROURKELA 400.00] TO BUS 474062 [CHAIBASA 400.00] CKT 1	1078.9	1490.73	1093	131.01	SC 4
504003 NSAGAR 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504003 [NSAGAR 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	1109.21	1240.57	948	136.08	SC 4
504007 CUDP 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504003 [NSAGAR 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	1109.21	1240.57	948	136.08	SC 4
314008 SIPAT4 400.00 314102 KUNKURI 400.00 1	OPEN LINE FROM BUS 314008 [SIPAT4 400.00] TO BUS 314102 [KUNKURI 400.00] CKT 2	768.65	1081.27	1050	102.19	SC 4
314008 SIPAT4 400.00 314102 KUNKURI 400.00 2	OPEN LINE FROM BUS 314008 [SIPAT4 400.00] TO BUS 314102 [KUNKURI 400.00] CKT 1	768.65	1081.27	1050	102.19	SC 4
444074 PPSP_NEW 400.00 474047 RANCHI-NEW 400.00 1	OPEN LINE FROM BUS 444421 [BIDHAN NGR 400.00] TO BUS 444425 [BAPL_400 400.00] CKT 1	1274.76	1349.44	1093	118.20	SC 4
444074 PPSP_NEW 400.00 474047 RANCHI-NEW 400.00 2	OPEN LINE FROM BUS 444421 [BIDHAN NGR 400.00] TO BUS 444425 [BAPL_400 400.00] CKT 1	1274.76	1349.44	1093	118.20	SC 4
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	513.4	1052.44	874	120.42	SC 4

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	513.4	1052.44	874	120.42	SC 4
504008 GOOT 400.00 524087 TUMKUR SP 400.00 1	OPEN LINE FROM BUS 504008 [GOOT 400.00] TO BUS 524087 [TUMKUR SP 400.00] CKT 2	1028.01	1294.81	1100	117.71	SC 4
504008 GOOT 400.00 524087 TUMKUR SP 400.00 2	OPEN LINE FROM BUS 504008 [GOOT 400.00] TO BUS 524087 [TUMKUR SP 400.00] CKT 1	1028.01	1294.81	1100	117.71	SC 4
514023 VELTOOR 400.00 524003 RAIC 400.00 1	OPEN LINE FROM BUS 504004 [MADIKERASWS4400.00] TO BUS 514023 [VELTOOR 400.00] CKT P1	2375	2568.59	2186	114.11	SC 4
164446 SIKAR 400.00 164456 BIKANE-4 400.00 1	OPEN LINE FROM BUS 164446 [SIKAR 400.00] TO BUS 164456 [BIKANE-4 400.00] CKT 2	792.48	990.88	857	110.07	SC 4
164446 SIKAR 400.00 164456 BIKANE-4 400.00 2	OPEN LINE FROM BUS 164446 [SIKAR 400.00] TO BUS 164456 [BIKANE-4 400.00] CKT 1	792.48	990.88	857	110.07	SC 4
144404 JHAJAR_N 400.00 144408 DHANONDA 400.00 1	OPEN LINE FROM BUS 144404 [JHAJAR_N 400.00] TO BUS 144408 [DHANONDA 400.00] CKT 2	555.6	983.21	857	110.00	SC 4
144404 JHAJAR_N 400.00 144408 DHANONDA 400.00 2	OPEN LINE FROM BUS 144404 [JHAJAR_N 400.00] TO BUS 144408 [DHANONDA 400.00] CKT 1	555.6	983.21	857	110.00	SC 4
154455 MUNDKA 400.00 154463 JHATIKALA-PG400.00 1	OPEN LINE FROM BUS 154455 [MUNDKA 400.00] TO BUS 154463 [JHATIKALA-PG400.00] CKT 2	1158.6	2243.17	1988	106.18	SC 4
154455 MUNDKA 400.00 154463 JHATIKALA-PG400.00 2	OPEN LINE FROM BUS 154455 [MUNDKA 400.00] TO BUS 154463 [JHATIKALA-PG400.00] CKT 1	1158.6	2243.17	1988	106.18	SC 4
504003 NSAGAR 400.00 504998 FSC-3 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	833.67	1045.64	948	112.46	SC 4
504007 CUDP 400.00 504998 FSC-3 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 3	416.83	1045.64	948	112.46	SC 4
504007 CUDP 400.00 504998 FSC-3 400.00 3	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	416.83	1045.64	948	112.46	SC 4
374898 MURBAD-SPT2 400.00 374899 MURBAD400 400.00 1	BLOCK TWOTERMDC "BARMR -MURBD"	1139.47	2371.72	2186	108.50	SC 4
174002 BAGPAT 400.00 174905 MEERUT 400.00 1	OPEN LINE FROM BUS 174002 [BAGPAT 400.00] TO BUS 174905 [MEERUT 400.00] CKT 2	641.73	916.04	857	104.14	SC 4
174002 BAGPAT 400.00 174905 MEERUT 400.00 2	OPEN LINE FROM BUS 174002 [BAGPAT 400.00] TO BUS 174905 [MEERUT 400.00] CKT 1	641.73	916.04	857	104.14	SC 4
374014 AURANGBD-I 400.00 374047 AURANGABD-II400.00 1	OPEN LINE FROM BUS 374014 [AURANGBD-I 400.00] TO BUS 374047 [AURANGABD-II400.00] CKT 2	467	860.06	857	102.91	SC 4
374014 AURANGBD-I 400.00 374047 AURANGABD-II400.00 2	OPEN LINE FROM BUS 374014 [AURANGBD-I 400.00] TO BUS 374047 [AURANGABD-II400.00] CKT 1	467	860.06	857	102.91	SC 4
424004 JEYPORE 400.00 424053 JEYP GAZ F1 400.00 1	OPEN LINE FROM BUS 424054 [JEYP GAZ F2 400.00] TO BUS 424099 [GAZUWAKA-ER 400.00] CKT 2	416.23	821.9	850	100.15	SC 4

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
424004 JEYPORE 400.00 424054 JEYP GAZ F2 400.00 1	OPEN LINE FROM BUS 424053 [JEYP GAZ F1 400.00] TO BUS 424099 [GAZUWAKA-ER 400.00] CKT 3	416.23	821.9	850	100.15	SC 4
374705 ALEPHAT 400 400.00 374795 ALEPHAT-SPT 400.00 1	BLOCK TWOTERMDC RAPAR-ALPHT2	1324.56	2119.13	2200	101.57	SC 4
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 548008 [NORTH CHN PS765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 3	1377.74	1602.11	1093	146.71	SC 5
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	511.89	1044.38	874	119.49	SC 5
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	511.89	1044.38	874	119.49	SC 5
354018 HADALA 400.00 354072 KALAVAD 400.00 1	OPEN LINE FROM BUS 354018 [HADALA 400.00] TO BUS 354072 [KALAVAD 400.00] CKT 2	676.21	957	857	111.75	SC 5
354018 HADALA 400.00 354072 KALAVAD 400.00 2	OPEN LINE FROM BUS 354018 [HADALA 400.00] TO BUS 354072 [KALAVAD 400.00] CKT 1	676.21	957	857	111.75	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	937.4	1876.53	1714	109.48	SC 5
174927 GORAKHPU 400.00 644002 BUTWAL 400.00 2	OPEN LINE FROM BUS 174927 [GORAKHPU 400.00] TO BUS 644002 [BUTWAL 400.00] CKT 1	937.4	1876.53	1714	109.48	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	562.45	932.09	857	108.76	SC 5
174000 MEJA 400.00 174474 ALLAHABA 400.00 2	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 1	562.45	932.09	857	108.76	SC 5
164473 JAIPUR_PG 400.00 164999 DAUSA 400.00 1	OPEN LINE FROM BUS 164473 [JAIPUR_PG 400.00] TO BUS 164999 [DAUSA 400.00] CKT 2	637.11	918.82	857	102.27	SC 5
164473 JAIPUR_PG 400.00 164999 DAUSA 400.00 2	OPEN LINE FROM BUS 164473 [JAIPUR_PG 400.00] TO BUS 164999 [DAUSA 400.00] CKT 1	637.11	918.82	857	102.27	SC 5
364011 KHANDWA-4 400.00 364029 CHEGAON 400.00 1	OPEN LINE FROM BUS 364023 [INDORE-74 400.00] TO BUS 368023 [INDORE-7 765.00] CKT 2	805.12	900.8	857	104.43	SC 5
374068 VIKROLI400 400.00 374592 MURBAD-SPT3 400.00 2	OPEN LINE FROM BUS 374217 [NAVI-MUM 400.00] TO BUS 374592 [MURBAD-SPT3 400.00] CKT 1	1024.34	1163.92	857	133.96	SC 6
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 548008 [NORTH CHN PS765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 3	1253.61	1472.65	1093	133.66	SC 6
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	511.83	1044.02	874	119.45	SC 6
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	511.83	1044.02	874	119.45	SC 6

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
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	727.33	1445.58	850	170.13	SC 7
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 2	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 1	727.33	1445.58	850	170.13	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	640.28	1115.98	852	129.36	SC 7
524005 HOODI4 400.00 524025 DHANLLI 400.00 2	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 524025 [DHANLLI 400.00] CKT 1	640.17	1115.93	852	129.36	SC 7
314050 DHAMTARI 400.00 314051 JAGADALPUR 400.00 1	OPEN LINE FROM BUS 314050 [DHAMTARI 400.00] TO BUS 314051 [JAGADALPUR 400.00] CKT 2	730.4	1019.93	857	116.53	SC 7
314050 DHAMTARI 400.00 314051 JAGADALPUR 400.00 2	OPEN LINE FROM BUS 314050 [DHAMTARI 400.00] TO BUS 314051 [JAGADALPUR 400.00] CKT 1	730.4	1019.93	857	116.53	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	1013.6	1977.86	1714	114.64	SC 7
174438 LUCK4-PG 400.00 174451 LUCK74-P 400.00 2	OPEN LINE FROM BUS 174438 [LUCK4-PG 400.00] TO BUS 174451 [LUCK74-P 400.00] CKT 1	1013.6	1977.86	1714	114.64	SC 7
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	497.06	998.26	874	114.22	SC 7
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	497.06	998.26	874	114.22	SC 7
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	864.62	1205.5	1093	110.29	SC 7
444074 PPSP_NEW 400.00 474047 RANCHI-NEW 400.00 2	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 474047 [RANCHI-NEW 400.00] CKT 1	864.62	1205.5	1093	110.29	SC 7
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544085 [TIRUVLM SE-C400.00] CKT 1	1149.06	1201.16	1093	110.06	SC 7
374898 MURBAD-SPT2 400.00 374899 MURBAD400 400.00 1	BLOCK TWOTERMDC "BARMR -MURBD"	1060.1	2392.33	2186	109.44	SC 7
424053 JEYP GAZ F1 400.00 424099 GAZUWAKA-ER 400.00 3	OPEN LINE FROM BUS 424054 [JEYP GAZ F2 400.00] TO BUS 424099 [GAZUWAKA-ER 400.00] CKT 2	437.31	906.09	850	102.27	SC 7
424054 JEYP GAZ F2 400.00 424099 GAZUWAKA-ER 400.00 2	OPEN LINE FROM BUS 424053 [JEYP GAZ F1 400.00] TO BUS 424099 [GAZUWAKA-ER 400.00] CKT 3	437.31	906.09	850	102.27	SC 7
424004 JEYPORE 400.00 424053 JEYP GAZ F1 400.00 1	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424054 [JEYP GAZ F2 400.00] CKT 1	443.14	895.86	850	105.26	SC 7

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
424004 JEYPORE 400.00 424054 JEYP GAZ F2 400.00 1	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424053 [JEYP GAZ F1 400.00] CKT 1	443.14	895.86	850	105.26	SC 7
374705 ALEPHAT 400 400.00 374795 ALEPHAT-SPT 400.00 1	BLOCK TWOTERMDC RAPAR-ALPHT2	1470.43	2307.55	2200	104.89	SC 7
164446 SIKAR 400.00 164456 BIKANE-4 400.00 1	OPEN LINE FROM BUS 164446 [SIKAR 400.00] TO BUS 164456 [BIKANE-4 400.00] CKT 2	740.05	885.42	857	102.86	SC 7
164446 SIKAR 400.00 164456 BIKANE-4 400.00 2	OPEN LINE FROM BUS 164446 [SIKAR 400.00] TO BUS 164456 [BIKANE-4 400.00] CKT 1	740.05	885.42	857	102.86	SC 7
164419 RAPS_C4 400.00 364021 SHUJALPR-4 400.00 2	OPEN LINE FROM BUS 164419 [RAPS_C4 400.00] TO BUS 364021 [SHUJALPR-4 400.00] CKT 1	709.56	880.25	857	102.71	SC 7
164419 RAPS_C4 400.00 364021 SHUJALPR-4 400.00 1	OPEN LINE FROM BUS 164419 [RAPS_C4 400.00] TO BUS 364021 [SHUJALPR-4 400.00] CKT 2	709.56	880.24	857	102.71	SC 7
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 548008 [NORTH CHN PS765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 3	1187.31	1459.93	1093	132.73	SC 8
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	497.05	1080.21	874	114.08	SC 8
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	497.05	1080.21	874	114.08	SC 8
174471 ROSA-TP2 400.00 174965 BADAUN 400.00 1	OPEN LINE FROM BUS 174471 [ROSA-TP2 400.00] TO BUS 174965 [BADAUN 400.00] CKT 2	570.27	936.05	857	109.91	SC 8
174471 ROSA-TP2 400.00 174965 BADAUN 400.00 2	OPEN LINE FROM BUS 174471 [ROSA-TP2 400.00] TO BUS 174965 [BADAUN 400.00] CKT 1	570.27	936.05	857	109.91	SC 8
424053 JEYP GAZ F1 400.00 424099 GAZUWAKA-ER 400.00 3	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424054 [JEYP GAZ F2 400.00] CKT 1	444.98	905.18	850	106.49	SC 8
424054 JEYP GAZ F2 400.00 424099 GAZUWAKA-ER 400.00 2	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424053 [JEYP GAZ F1 400.00] CKT 1	444.98	905.18	850	106.49	SC 8
424004 JEYPORE 400.00 424053 JEYP GAZ F1 400.00 1	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424054 [JEYP GAZ F2 400.00] CKT 1	455.78	901.62	850	106.60	SC 8
424004 JEYPORE 400.00 424054 JEYP GAZ F2 400.00 1	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424053 [JEYP GAZ F1 400.00] CKT 1	455.78	901.62	850	106.60	SC 8
544040 MANALI4 400.00 544130 NORTH CHEN P400.00 1	OPEN LINE FROM BUS 548008 [NORTH CHN PS765.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 3	1101.72	1390.52	1093	126.26	SC 9
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 1	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 2	497.05	1080.21	874	114.08	SC 9

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
514001 RAMGUNDM STP400.00 514009 CHANDRAPR-SR400.00 2	OPEN LINE FROM BUS 514001 [RAMGUNDM STP400.00] TO BUS 514009 [CHANDRAPR-SR400.00] CKT 1	497.05	1080.21	874	114.08	SC 9
544040 MANALI4 400.00 545005 MANJPKCPINT 400.00 1	BLOCK TWOTERMDC RAIGR-PUGLR2	654.98	971.46	857	112.54	SC 9
374068 VIKROLI400 400.00 374592 MURBAD-SPT3 400.00 2	BLOCK TWOTERMDC KUDUS-AAREY1	793.23	919	857	105.33	SC 9
424004 JEYPORE 400.00 424053 JEYP GAZ F1 400.00 1	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424054 [JEYP GAZ F2 400.00] CKT 1	451.83	900.52	850	106.52	SC 9
424053 JEYP GAZ F1 400.00 424099 GAZUWAKA-ER 400.00 3	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424054 [JEYP GAZ F2 400.00] CKT 1	438.55	900.52	850	104.42	SC 9
424004 JEYPORE 400.00 424054 JEYP GAZ F2 400.00 1	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424053 [JEYP GAZ F1 400.00] CKT 1	448.65	889.4	850	104.97	SC 9
424054 JEYP GAZ F2 400.00 424099 GAZUWAKA-ER 400.00 2	OPEN LINE FROM BUS 424004 [JEYPORE 400.00] TO BUS 424053 [JEYP GAZ F1 400.00] CKT 1	448.54	889.4	850	104.97	SC 9

Annex-3.7

N-1 Contingency of 765/400 kV Transformers

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
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	1442.87	2089.13	1500	139.28	SC 1
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 2	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 1	1442.87	2089.13	1500	139.28	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	1089.3	1804.13	1500	120.28	SC 1
444090 JEERAT-NEW 400.00 448008 JEERAT7 765.00 2	OPEN LINE FROM BUS 444090 [JEERAT-NEW 400.00] TO BUS 448008 [JEERAT7 765.00] CKT 1	1089.3	1804.13	1500	120.28	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	1100.92	1742.26	1500	116.15	SC 1
514078 WARANGAL NEW400.00 518079 WARANGAL NEW765.00 2	OPEN LINE FROM BUS 514078 [WARANGAL NEW400.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 1	1100.92	1742.26	1500	116.15	SC 1
424074 KHUNTUNI4 400.00 428272 KHUNTUNI7 765.00 1	OPEN LINE FROM BUS 424074 [KHUNTUNI4 400.00] TO BUS 428272 [KHUNTUNI7 765.00] CKT 2	1028.7	1586.64	1500	105.78	SC 1
424074 KHUNTUNI4 400.00 428272 KHUNTUNI7 765.00 2	OPEN LINE FROM BUS 424074 [KHUNTUNI4 400.00] TO BUS 428272 [KHUNTUNI7 765.00] CKT 1	1028.7	1586.64	1500	105.78	SC 1
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 1	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 2	1210.22	1528.28	1500	101.89	SC 1
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 2	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 1	1210.22	1528.28	1500	101.89	SC 1
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 3	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 1	1210.22	1528.28	1500	101.89	SC 1
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 4	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 1	1210.22	1528.28	1500	101.89	SC 1
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 1	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 2	1004.53	1516.03	1500	101.07	SC 1
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 2	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 1	1004.53	1516.03	1500	101.07	SC 1
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 3	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 1	1004.53	1516.03	1500	101.07	SC 1
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	1142.9	1658.08	1500	110.54	SC 2
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 2	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 1	1142.9	1658.08	1500	110.54	SC 2
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	1155.04	1676.95	1500	111.80	SC 3

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 2	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 1	1155.04	1676.95	1500	111.80	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	1626.52	2362.34	1500	157.49	SC 4
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 2	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 1	1626.52	2362.34	1500	157.49	SC 4
174479 VARANASI 400.00 177000 VARNASI8 765.00 1	OPEN LINE FROM BUS 174479 [VARANASI 400.00] TO BUS 177000 [VARNASI8 765.00] CKT 2	1416.9	2029.8	1500	135.32	SC 4
174479 VARANASI 400.00 177000 VARNASI8 765.00 2	OPEN LINE FROM BUS 174479 [VARANASI 400.00] TO BUS 177000 [VARNASI8 765.00] CKT 1	1416.9	2029.8	1500	135.32	SC 4
134423 MOGA4 400.00 137703 MOGA-PG 765.00 1	OPEN LINE FROM BUS 134423 [MOGA4 400.00] TO BUS 137703 [MOGA-PG 765.00] CKT 2	1148.89	1977.14	1500	131.81	SC 4
134423 MOGA4 400.00 137703 MOGA-PG 765.00 2	OPEN LINE FROM BUS 134423 [MOGA4 400.00] TO BUS 137703 [MOGA-PG 765.00] CKT 1	1148.89	1977.14	1500	131.81	SC 4
424074 KHUNTUNI4 400.00 428272 KHUNTUNI7 765.00 1	OPEN LINE FROM BUS 424074 [KHUNTUNI4 400.00] TO BUS 428272 [KHUNTUNI7 765.00] CKT 2	1206.96	1863.22	1500	124.21	SC 4
424074 KHUNTUNI4 400.00 428272 KHUNTUNI7 765.00 2	OPEN LINE FROM BUS 424074 [KHUNTUNI4 400.00] TO BUS 428272 [KHUNTUNI7 765.00] CKT 1	1206.96	1863.22	1500	124.21	SC 4
154501 NARELA ISTS 400.00 157001 NARELA ISTS 765.00 1	OPEN LINE FROM BUS 154501 [NARELA ISTS 400.00] TO BUS 157001 [NARELA ISTS 765.00] CKT 2	1268.77	1660.91	1500	110.73	SC 4
154501 NARELA ISTS 400.00 157001 NARELA ISTS 765.00 2	OPEN LINE FROM BUS 154501 [NARELA ISTS 400.00] TO BUS 157001 [NARELA ISTS 765.00] CKT 1	1268.77	1660.91	1500	110.73	SC 4
154501 NARELA ISTS 400.00 157001 NARELA ISTS 765.00 3	OPEN LINE FROM BUS 154501 [NARELA ISTS 400.00] TO BUS 157001 [NARELA ISTS 765.00] CKT 1	1268.77	1660.91	1500	110.73	SC 4
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	990.7	1570.41	1500	104.69	SC 4
514078 WARANGAL NEW400.00 518079 WARANGAL NEW765.00 2	OPEN LINE FROM BUS 514078 [WARANGAL NEW400.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 1	990.7	1570.41	1500	104.69	SC 4
414491 SASARAM-ER 400.00 418892 SASARAM 765.00 1	OPEN LINE FROM BUS 174479 [VARANASI 400.00] TO BUS 414491 [SASARAM-ER 400.00] CKT 1	1368.17	1521.75	1500	101.45	SC 4
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 1	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 2	1005.19	1518.49	1500	101.23	SC 4
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 2	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 1	1005.19	1518.49	1500	101.23	SC 4
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 3	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 1	1005.19	1518.49	1500	101.23	SC 4
544028 VIRUDHNAGAR 400.00 548999 VIRUDHNAGAR 765.00 1	OPEN LINE FROM BUS 544028 [VIRUDHNAGAR 400.00] TO BUS 548999 [VIRUDHNAGAR 765.00] CKT 2	907.86	1516.04	1500	101.07	SC 4
544028 VIRUDHNAGAR 400.00 548999 VIRUDHNAGAR 765.00 2	OPEN LINE FROM BUS 544028 [VIRUDHNAGAR 400.00] TO BUS 548999 [VIRUDHNAGAR 765.00] CKT 1	907.86	1516.04	1500	101.07	SC 4

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 1	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 2	1195.51	1509.54	1500	100.64	SC 4
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 2	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 1	1195.51	1509.54	1500	100.64	SC 4
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 3	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 1	1195.51	1509.54	1500	100.64	SC 4
514053 SHADNGR 400.00 518053 SHADNGR_765 765.00 4	OPEN LINE FROM BUS 514053 [SHADNGR 400.00] TO BUS 518053 [SHADNGR_765 765.00] CKT 1	1195.51	1509.54	1500	100.64	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	1106.6	1607.03	1500	107.14	SC 5
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 2	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 1	1106.6	1607.03	1500	107.14	SC 5
364025 VIN-POOL 400.00 368025 VIN-POOL 765.00 1	OPEN LINE FROM BUS 364025 [VIN-POOL 400.00] TO BUS 368025 [VIN-POOL 765.00] CKT 2	1001.18	1500.88	1500	100.06	SC 5
364025 VIN-POOL 400.00 368025 VIN-POOL 765.00 2	OPEN LINE FROM BUS 364025 [VIN-POOL 400.00] TO BUS 368025 [VIN-POOL 765.00] CKT 1	1001.18	1500.88	1500	100.06	SC 5
364025 VIN-POOL 400.00 368025 VIN-POOL 765.00 3	OPEN LINE FROM BUS 364025 [VIN-POOL 400.00] TO BUS 368025 [VIN-POOL 765.00] CKT 1	1001.18	1500.88	1500	100.06	SC 5
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	1196.04	1730.92	1500	115.39	SC 7
424024 DUBURI765_4 400.00 428024 DUBURI_765 765.00 2	OPEN LINE FROM BUS 424024 [DUBURI765_4 400.00] TO BUS 428024 [DUBURI_765 765.00] CKT 1	1196.04	1730.92	1500	115.39	SC 7
134423 MOGA4 400.00 137703 MOGA-PG 765.00 1	OPEN LINE FROM BUS 134423 [MOGA4 400.00] TO BUS 137703 [MOGA-PG 765.00] CKT 2	968.1	1663.4	1500	110.89	SC 7
134423 MOGA4 400.00 137703 MOGA-PG 765.00 2	OPEN LINE FROM BUS 134423 [MOGA4 400.00] TO BUS 137703 [MOGA-PG 765.00] CKT 1	968.1	1663.4	1500	110.89	SC 7
354159 KANDLA-SPLT 400.00 358148 KANDLA 765.00 3	OPEN LINE FROM BUS 354159 [KANDLA-SPLT 400.00] TO BUS 358148 [KANDLA 765.00] CKT 4	1026.33	1555.76	1500	103.72	SC 7
354159 KANDLA-SPLT 400.00 358148 KANDLA 765.00 4	OPEN LINE FROM BUS 354159 [KANDLA-SPLT 400.00] TO BUS 358148 [KANDLA 765.00] CKT 3	1026.33	1555.76	1500	103.72	SC 7
354159 KANDLA-SPLT 400.00 358148 KANDLA 765.00 1	OPEN LINE FROM BUS 354159 [KANDLA-SPLT 400.00] TO BUS 358148 [KANDLA 765.00] CKT 3	1026.33	1555.76	1500	103.72	SC 7
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 1	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 2	1004.22	1514.84	1500	100.99	SC 7
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 2	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 1	1004.22	1514.84	1500	100.99	SC 7
504082 KAKINADA 400400.00 508082 KAKINADA PS 765.00 3	OPEN LINE FROM BUS 504082 [KAKINADA 400400.00] TO BUS 508082 [KAKINADA PS 765.00] CKT 1	1004.22	1514.84	1500	100.99	SC 7
364025 VIN-POOL 400.00 368025 VIN-POOL 765.00 1	OPEN LINE FROM BUS 364025 [VIN-POOL 400.00] TO BUS 368025 [VIN-POOL 765.00] CKT 2	1079.36	1619.52	1500	107.97	SC 8

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
364025 VIN-POOL 400.00 368025 VIN-POOL 765.00 2	OPEN LINE FROM BUS 364025 [VIN-POOL 400.00] TO BUS 368025 [VIN-POOL 765.00] CKT 1	1079.36	1619.52	1500	107.97	SC 8
364025 VIN-POOL 400.00 368025 VIN-POOL 765.00 3	OPEN LINE FROM BUS 364025 [VIN-POOL 400.00] TO BUS 368025 [VIN-POOL 765.00] CKT 1	1079.36	1619.52	1500	107.97	SC 8
504093 NEL-POOL 400.00 508093 NELL-POL 765.00 1	OPEN LINE FROM BUS 504093 [NEL-POOL 400.00] TO BUS 508093 [NELL-POL 765.00] CKT 2	902.12	1507.11	1500	100.47	SC 8
504093 NEL-POOL 400.00 508093 NELL-POL 765.00 2	OPEN LINE FROM BUS 504093 [NEL-POOL 400.00] TO BUS 508093 [NELL-POL 765.00] CKT 1	902.12	1507.11	1500	100.47	SC 8

N-1 Contingency of 400/220 kV Transformers

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
544132 KAMUTHI4 400.00 541512 KAMUDHI41 110.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 541512 [KAMUDHI41 110.00] CKT 2	227.89	455.19	200	227.60	SC 1
544132 KAMUTHI4 400.00 541512 KAMUDHI41 110.00 2	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 541512 [KAMUDHI41 110.00] CKT 1	227.89	455.19	200	227.60	SC 1
544026 KANAPATT 400.00 542148 KANARP42 230.00 1	OPEN LINE FROM BUS 544026 [KANAPATT 400.00] TO BUS 542148 [KANARP42 230.00] CKT 2	318.55	638.16	315	202.59	SC 1
544026 KANAPATT 400.00 542148 KANARP42 230.00 2	OPEN LINE FROM BUS 544026 [KANAPATT 400.00] TO BUS 542148 [KANARP42 230.00] CKT 1	318.55	638.16	315	202.59	SC 1
374988 APTA 400.00 441633 NEW TOWN-AA3132.00 1	OPEN LINE FROM BUS 374989 [MAHAPE40 400.00] TO BUS 441612- 2 [SALTLAKE 132.00] CKT 1	947.32	1126.29	160	715.13	SC 2
374989 MAHAPE40 400.00 441612- 2 SALTLAKE 132.00 1	OPEN LINE FROM BUS 374988 [APTA 400.00] TO BUS 441633 [NEW TOWN-AA3132.00] CKT 1	590.8	846.06	160	537.61	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	540.72	702.36	1000000	0.07	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	465.35	651.98	315	206.98	SC 2
164416 AJMER 400.00 162329 AJMER42 220.00 2	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 1	465.35	651.98	315	206.98	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	489.97	634.08	315	201.30	SC 2
164420 KOTA 400.00 162919 KOTA 220.00 2	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 1	489.97	634.08	315	201.30	SC 2
174071 JALPURA 400.00 441587 CLC 132.00 1	OPEN LINE FROM BUS 174889 [ROBERTGANJ 400.00] TO BUS 174891 [AVAADA WATER400.00] CKT 1	454.79	520.94	160	316.15	SC 3
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	1781.22	2240.17	1000000	0.22	SC 4
544132 KAMUTHI4 400.00 541512 KAMUDHI41 110.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 541512 [KAMUDHI41 110.00] CKT 2	260.28	521.36	200	260.68	SC 4
544132 KAMUTHI4 400.00 541512 KAMUDHI41 110.00 2	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 541512 [KAMUDHI41 110.00] CKT 1	260.28	521.36	200	260.68	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	978.9	2021.95	850	228.83	SC 4
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 2	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 1	978.9	2021.95	850	228.83	SC 4
544026 KANAPATT 400.00 542148 KANARP42 230.00 1	OPEN LINE FROM BUS 544026 [KANAPATT 400.00] TO BUS 542148 [KANARP42 230.00] CKT 2	344.43	690.85	315	219.32	SC 4
544026 KANAPATT 400.00 542148 KANARP42 230.00 2	OPEN LINE FROM BUS 544026 [KANAPATT 400.00] TO BUS 542148 [KANARP42 230.00] CKT 1	344.43	690.85	315	219.32	SC 4
544027 KAYATHAR4 400.00 541305 KAYATR41 110.00 1	OPEN LINE FROM BUS 544027 [KAYATHAR4 400.00] TO BUS 541305 [KAYATR41 110.00] CKT 2	252.84	431.03	200	215.52	SC 4
544027 KAYATHAR4 400.00 541305 KAYATR41 110.00 2	OPEN LINE FROM BUS 544027 [KAYATHAR4 400.00] TO BUS 541305 [KAYATR41 110.00] CKT 1	252.84	431.03	200	215.52	SC 4
364999 HINDALCO 400.00 362139 HINDALCO 220.00 1	OPEN LINE FROM BUS 364999 [HINDALCO 400.00] TO BUS 362139 [HINDALCO 220.00] CKT 2	317.82	640.1	630	101.60	SC 4

Monitored Element	Contingency	Base Flow	Flow Under Contingency	Rate	% loading	Scenario
364999 HINDALCO 400.00 362139 HINDALCO 220.00 2	OPEN LINE FROM BUS 364999 [HINDALCO 400.00] TO BUS 362139 [HINDALCO 220.00] CKT 1	317.82	640.1	630	101.60	SC 4
374988 APTA 400.00 441633 NEW TOWN-AA3132.00 1	OPEN LINE FROM BUS 374989 [MAHAPE40 400.00] TO BUS 441612- 2 [SALTLAKE 132.00] CKT 1	1118.92	1343.13	160	845.26	SC 5
374989 MAHAPE40 400.00 441612- 2 SALTLAKE 132.00 1	OPEN LINE FROM BUS 374988 [APTA 400.00] TO BUS 441633 [NEW TOWN-AA3132.00] CKT 1	697.44	1008.76	160	635.55	SC 5
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	623.26	812.44	1000000	0.08	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	525.27	737.85	315	234.24	SC 5
164416 AJMER 400.00 162329 AJMER42 220.00 2	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 1	525.27	737.85	315	234.24	SC 5
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	468.78	661.2	1000000	0.07	SC 5
164400 MERTA 400.00 162200 MERTA-42 220.00 2	OPEN LINE FROM BUS 164400 [MERTA 400.00] TO BUS 162200 [MERTA-42 220.00] CKT 1	468.78	661.2	1000000	0.07	SC 5
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	497.96	644.67	315	204.66	SC 5
164420 KOTA 400.00 162919 KOTA 220.00 2	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 1	497.96	644.67	315	204.66	SC 5
174071 JALPURA 400.00 441587 CLC 132.00 1	OPEN LINE FROM BUS 174889 [ROBERTGANJ 400.00] TO BUS 174891 [AVAADA WATER400.00] CKT 1	366.28	426	160	261.56	SC 6
544132 KAMUTHI4 400.00 541512 KAMUDHI41 110.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 541512 [KAMUDHI41 110.00] CKT 2	278.17	557.29	200	278.65	SC 7
544132 KAMUTHI4 400.00 541512 KAMUDHI41 110.00 2	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 541512 [KAMUDHI41 110.00] CKT 1	278.17	557.29	200	278.65	SC 7
364999 HINDALCO 400.00 362139 HINDALCO 220.00 1	OPEN LINE FROM BUS 364999 [HINDALCO 400.00] TO BUS 362139 [HINDALCO 220.00] CKT 2	346.27	698.34	630	110.85	SC 7
364999 HINDALCO 400.00 362139 HINDALCO 220.00 2	OPEN LINE FROM BUS 364999 [HINDALCO 400.00] TO BUS 362139 [HINDALCO 220.00] CKT 1	346.27	698.34	630	110.85	SC 7
544026 KANAPATT 400.00 542148 KANARP42 230.00 1	OPEN LINE FROM BUS 544026 [KANAPATT 400.00] TO BUS 542148 [KANARP42 230.00] CKT 2	346.1	694.07	315	220.34	SC 7
544026 KANAPATT 400.00 542148 KANARP42 230.00 2	OPEN LINE FROM BUS 544026 [KANAPATT 400.00] TO BUS 542148 [KANARP42 230.00] CKT 1	346.1	694.07	315	220.34	SC 7
374988 APTA 400.00 441633 NEW TOWN-AA3132.00 1	OPEN LINE FROM BUS 374989 [MAHAPE40 400.00] TO BUS 441612- 2 [SALTLAKE 132.00] CKT 1	699.05	783.02	160	498.76	SC 8
374989 MAHAPE40 400.00 441612- 2 SALTLAKE 132.00 1	OPEN LINE FROM BUS 374988 [APTA 400.00] TO BUS 441633 [NEW TOWN-AA3132.00] CKT 1	298.37	489.57	160	312.33	SC 8
174071 JALPURA 400.00 441587 CLC 132.00 1	OPEN LINE FROM BUS 174889 [ROBERTGANJ 400.00] TO BUS 174891 [AVAADA WATER400.00] CKT 1	360.75	405.77	160	260.06	SC 9

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	JAIPUR 765.00	42	45	46	40	46	49	42	47	48	49	40	STU
NORTH	VARNASI8 765.00	38	43	44	38	43	44	41	43	44	44	40	ISTS
NORTH	GNOIDAUP 765.00	38	43	43	36	43	45	38	42	43	45	40	STU
NORTH	ALIGARH 765.00	43	50	48	40	50	49	43	49	48	50	40	ISTS
WEST	BLPSR WR 765.00	43	46	46	42	46	47	47	47	47	47	40	ISTS
WEST	BANASKANTHA 765.00	47	39	40	47	39	41	47	41	41	47	40	ISTS
WEST	GWALIOR 765.00	41	43	43	39	42	44	42	43	44	44	40	ISTS
WEST	BINA-PG-7 765.00	41	43	44	40	43	45	43	44	44	45	40	ISTS
WEST	JABALPR-POOL765.00	49	56	56	49	56	58	56	58	58	58	50	ISTS
WEST	GADARWARA 765.00	39	48	48	39	48	49	48	49	49	49	40	GEN
WEST	WARDHA 765.00	47	49	51	47	49	51	51	49	50	51	40	ISTS
WEST	AURANG-CHTPM765.00	45	44	46	44	43	46	46	44	45	46	40	ISTS
WEST	PADGHEGIS 765.00	45	46	44	45	46	45	46	47	43	47	40	ISTS
SOUTH	KURL800 765.00	54	54	55	52	54	55	57	56	56	57	40	ISTS
SOUTH	KURNOOL-III 765.00	48	45	45	47	45	45	50	46	46	50	40	ISTS
SOUTH	MAHESHWARAM 765.00	48	48	49	47	48	48	52	50	50	52	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	PATIALA4 400.00	42	46	46	41	46	46	43	46	46	46	40	ISTS
NORTH	JALANDHAR4 400.00	40	44	44	38	44	44	40	44	44	44	40	ISTS
NORTH	DAULATABAD4 400.00	42	50	50	39	50	51	43	50	50	51	40	STU
NORTH	JHAJAR_N 400.00	37	47	48	34	47	48	38	48	47	48	40	GEN
NORTH	KABULPUR 400.00	37	45	45	35	45	46	38	45	45	46	40	STU
NORTH	DHANONDA 400.00	47	57	57	44	57	58	48	57	57	58	40	STU
NORTH	PANCHKULA-PG400.00	45	48	48	44	48	49	46	48	49	49	40	ISTS
NORTH	JINDPG 400.00	39	46	46	36	46	47	40	46	46	47	40	ISTS
NORTH	ABDULLAP 400.00	48	53	53	47	53	53	49	53	53	53	40	ISTS
NORTH	BALLABHG 400.00	43	48	49	41	48	49	44	48	49	49	40	ISTS
NORTH	BAWANA-G 400.00	41	53	53	39	53	54	42	53	53	54	40	STU
NORTH	BAWANA 400.00	41	53	53	39	54	54	42	53	53	54	40	STU
NORTH	MANDOLA 400.00	39	44	45	37	44	45	39	44	45	45	40	ISTS
NORTH	MANDOLASP2 400.00	39	44	45	37	44	45	39	44	45	45	40	ISTS
NORTH	MANDOLASP3 400.00	39	44	45	37	44	45	39	44	45	45	40	ISTS
NORTH	GOPAL PUR 400.00	39	45	45	37	44	46	39	45	45	46	40	STU
NORTH	BHADLA 400.00	46	41	41	45	41	43	46	42	42	46	40	STU
NORTH	BASSI 400.00	47	50	51	45	50	53	48	52	52	53	40	ISTS
NORTH	NEEMR-PG 400.00	47	54	54	44	54	55	48	54	54	55	40	ISTS
NORTH	JAIPUR_RS 400.00	50	53	53	47	52	55	50	54	55	55	40	STU
NORTH	BIKANER-NW 400.00	58	47	47	56	47	48	57	47	48	58	50	ISTS
NORTH	FATEHG-3 400.00	59	39	45	58	39	47	58	40	45	59	50	ISTS
NORTH	BHIWADI 400.00	45	50	50	42	50	52	45	50	51	52	40	ISTS
NORTH	MEJA 400.00	41	48	48	41	48	49	42	42	43	49	40	GEN
NORTH	BARA 400.00	40	44	44	40	44	45	41	41	41	45	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
NORTH	GNOIDAUP 400.00	51	59	59	49	59	61	51	58	58	61	40	STU
NORTH	GAZIABAD 400.00	40	43	44	38	43	44	40	43	43	44	40	STU
NORTH	BARELI4 400.00	39	51	42	38	50	43	39	50	42	51	40	STU
NORTH	SIKANDERABAD400.00	38	43	43	36	43	44	38	41	42	44	40	STU
NORTH	AGRANEW 400.00	42	45	45	40	45	47	42	45	46	47	40	STU
NORTH	DADR-NCR 400.00	45	59	59	44	59	60	46	59	59	60	40	GEN
NORTH	GNOIDA4 400.00	49	58	59	47	58	60	49	58	58	60	40	STU
NORTH	LUCK4-PG 400.00	48	54	53	47	54	53	50	54	53	54	40	ISTS
NORTH	LUCK74-P 400.00	46	52	51	46	52	52	49	52	51	52	40	ISTS
NORTH	DADR-HVD 400.00	44	58	58	43	58	59	45	58	57	59	40	GEN
NORTH	ALLAHABA 400.00	46	50	50	45	50	51	46	47	48	51	40	ISTS
NORTH	BAL74-PG 400.00	41	47	47	43	47	47	45	48	48	48	40	ISTS
NORTH	SARNATH4 400.00	40	43	44	40	43	44	42	44	44	44	40	STU
NORTH	AGRA 400.00	51	56	56	49	56	60	52	56	57	60	40	STU
NORTH	TIKRI KHURD 400.00	37	47	47	35	47	47	38	47	47	47	40	STU
NORTH	BAREL-PG 400.00	51	78	56	49	78	57	51	77	56	78	50	ISTS
NORTH	ALIGARH-PG 400.00	39	74	44	37	74	44	39	73	44	74	40	STU
NORTH	BAREILY 400.00	50	79	55	49	79	56	51	78	56	79	50	ISTS
NORTH	MEERUT 400.00	59	65	66	57	65	67	59	65	65	67	40	ISTS
WEST	JINDAL_EX 400.00	34	44	44	40	44	45	44	45	45	45	40	GEN
WEST	BIL-POOL 400.00	42	48	48	42	48	48	48	48	48	48	40	ISTS
WEST	GANCS4 400.00	45	49	49	45	49	50	45	50	50	50	40	GEN
WEST	CGPL 400.00	48	46	46	48	46	46	48	47	47	48	40	GEN
WEST	BACHAU 400.00	46	43	43	46	44	43	46	45	44	46	40	ISTS
WEST	BANASKANTHA 400.00	56	50	50	55	50	51	55	54	53	56	50	ISTS
WEST	SANKHARI 400.00	44	40	40	44	41	42	44	44	43	44	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	BINA-4 400.00	41	43	44	40	43	44	44	44	44	44	40	STU
WEST	NAGDA-4 400.00	44	43	44	44	43	44	44	45	45	45	40	STU
WEST	JABALPUR-4 400.00	38	39	40	37	42	43	43	45	45	45	40	ISTS
WEST	BINA-PG-74 400.00	41	44	44	40	43	44	44	44	44	44	40	ISTS
WEST	KHARGAR 400.00	42	42	45	42	41	46	43	42	44	46	40	STU
WEST	LONIKAND I 400.00	52	48	48	52	48	48	53	48	47	53	40	STU
WEST	PARLI-GIRWAL400.00	47	45	45	46	44	45	48	45	45	48	40	STU
WEST	CHANDRAPUR I400.00	30	44	44	29	47	47	49	49	49	49	40	GEN
WEST	BHADR4 400.00	28	38	39	28	43	43	44	44	44	44	40	ISTS
WEST	BABLESWAR 400.00	47	43	43	48	42	43	48	43	43	48	40	STU
WEST	AURANGBD-I 400.00	56	50	50	55	49	50	57	51	51	57	40	STU
WEST	JEJ4 400.00	49	45	44	48	44	44	49	45	43	49	40	STU
WEST	TAPS4 400.00	47	47	47	48	46	47	48	47	46	48	40	GEN
WEST	BOISAR 400.00	50	49	49	50	49	49	50	49	48	50	40	ISTS
WEST	CHANDRPR-II 400.00	30	44	44	29	47	47	49	49	49	49	40	GEN
WEST	PUNE-PG-AIS 400.00	52	48	49	52	48	49	53	48	48	53	40	ISTS
WEST	AURANG-CHTPM400.00	60	56	56	59	55	56	61	56	56	61	50	ISTS
WEST	PUNE-PG-GIS 400.00	57	53	53	57	53	53	58	53	52	58	50	ISTS
WEST	AURANGABD-II400.00	54	49	49	54	48	48	56	50	50	56	40	STU
WEST	AURANGBD-III400.00	51	46	47	51	46	46	53	48	48	53	40	STU
WEST	CHNDPUR_SW 400.00	29	42	42	28	45	45	47	47	47	47	40	GEN
WEST	NASIK400 400.00	49	49	50	49	49	49	49	49	49	50	40	STU
EAST	FARAKKA 400.00	39	42	40	40	44	42	39	44	42	44	40	ISTS
SOUTH	KURNOOL4 400.00	57	58	58	56	58	58	58	59	59	59	40	STU
SOUTH	VIJ-AP 400.00	45	47	47	44	47	47	50	49	49	50	40	STU
SOUTH	KURL-NEW 400.00	61	63	63	60	63	63	62	64	64	64	50	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	KURNOOL-III 400.00	69	61	61	68	61	61	70	61	61	70	63	ISTS
SOUTH	DICHPAL4 400.00	45	47	47	44	47	47	49	48	48	49	40	STU
SOUTH	GAJWEL4 400.00	39	42	42	37	42	42	45	44	44	45	40	STU
SOUTH	SMNH 400.00	46	45	45	46	45	46	47	46	47	47	40	ISTS
SOUTH	NELMANG4 400.00	53	52	52	53	52	52	54	53	54	54	40	STU
SOUTH	NARDR-NW 400.00	49	45	46	48	45	46	49	56	57	57	50	ISTS
SOUTH	DHANLLI 400.00	44	43	43	44	43	43	45	44	44	45	40	STU
SOUTH	BIDADI 400.00	48	47	46	48	47	47	48	48	48	48	40	ISTS
SOUTH	MADHUGI4 400.00	63	58	58	62	58	58	64	60	61	64	50	ISTS
SOUTH	CHENN-EX 400.00	31	39	39	30	39	39	31	45	45	45	40	STU
SOUTH	NYVL TS 2 400.00	36	39	39	36	40	41	47	46	47	47	40	ISTS
SOUTH	UDMP 400.00	56	56	56	56	56	58	58	58	58	58	40	ISTS
SOUTH	PUGALUR4 400.00	46	45	45	46	45	47	47	46	46	47	40	ISTS
SOUTH	ARSUR4 400.00	44	45	44	44	45	46	45	45	45	46	40	STU
SOUTH	TIRUNEL4 400.00	54	52	52	54	52	53	56	55	56	56	40	ISTS
SOUTH	ALMATI4 400.00	35	42	42	35	42	42	36	46	46	46	40	ISTS

Highlighted cell indicates 400 kV Bus Fault Current > Design level

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Annex 3.9

ISTS Network Expansion Plan upto 2029-30

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.	2025-26	WR	LILO of one ckt. of KPS1- Bhuj PS 765 kV D/c line at KPS2	765	D/c	2		
2.	2025-26	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		
3.	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		
4.	2025-26	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
5.	2025-26	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
6.	2025-26	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
7.	2025-26	WR	KPS3- KPS2 765 kV D/c line - 20km	765	D/c	40		
8.	2025-26	WR	KPS2 (GIS) – Lakadia 765 kV D/C line with 330 MVAr switchable line reactors at KPS2 end - 159KM	765	D/c	320	330	
9.	2025-26	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
10.	2025-26	WR	Lakadia PS – Ahmedabad 765kV D/c line with 240 MVAR switchable line reactors on both ends (500ckm)	765	D/c	500	240	240
11.	2025-26	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		
12.	2025-26	WR	Banaskantha – Sankhari 400 kV 2nd D/c line	400	D/c	52	0	0
13.	2025-26	WR	Banaskantha – Ahmedabad 765 kV D/c line with 330MVAr, 765 kV Switchable	765	D/c	400	0	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
			line reactor on each ckt at Ahmedabad S/s end					
14.	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		
15.	2025-26	WR	LILO of Wardha - Warora Pool 400 kV D/c (Quad) line at Wardha SEZ PP - 85KM	400	2xD /c	340		
16.	2025-26	WR	Dholera PS – Vataman switching station 765 kV D/C line – 40 km.	765	D/c	80		
17.	2025-26	WR	LILO of Satna-Gwalior 765 kV S/c line at Karera	765	S/c	140	330	
18.	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		
19.	2025-26	WR	Pachora PS – Ujjain (MPPTCL) 400kV D/c line (Quad ACSR/AAAC/AL59 Moose equivalent)	400	D/c	120		
20.	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
21.	2025-26	WR	LILO of Lakadia – Ahmedabad 765 kV D/c line at Halvad (LILO length~50 km)	765	D/c	100		
22.	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
23.	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		
24.	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
25.	2025-26	WR	KPS3 – KPS2 765kV 2nd D/c line (20km.)	765	D/c	40		
26.	2025-26	WR	KPS1 – Bhuj 765kV 2nd D/c line (60km.)	765	D/c	120		
27.	2025-26	WR	KPS2 – Lakadia 765kV 2nd D/c line with 330 MVAR switchable line reactors at KPS2 end of KPS2 (GIS) – Lakadia 765 kV 2nd D/C line (with NGR bypass arrangement) (160km.)	765	D/c	320	330	
28.	2025-26	WR	Vadodara – Navsari(New) 765kV D/c line with 240 MVAR switchable line reactors at Vadodara(GIS) end of Vadodara(GIS) – Navsari(New)(GIS) 765 kV D/C line (with NGR bypass arrangement) (120km.)	765	D/c	240	240	
29.	2025-26	WR	KPS1 – Bhuj 765kV 2nd D/c line (60km.)	765	D/c	120		
30.	2025-26	WR	Navsari(New) – Boisar-II 765kV D/c line with 330 MVAR switchable line reactors at Navsari(New) end of Navsari(New) – Boisar-II 765kV D/c line (with NGR bypass arrangement) (175km.)	765	D/c	350	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
31.	2025-26	WR	LILO of Navsari(New) – Padghe(PG) 765kV D/c line at Boisar-II (LILO route length 25km.)	765	D/c	50		
32.	2025-26	WR	Boisar-II – Velgaon(MH) 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (10km.)	400	D/c	20		
33.	2025-26	WR	LILO of Babhaleswar – Padghe(M) 400kV D/c line at Bosar-II using twin HTLS conductor with minimum capacity of 1700MVA per ckt at nominal voltage (LILO route length 65km.) and with 80 MVAR switchable line reactors at Bosar-II end of Boisar-II – Babhaleswar 400kV D/c line (with NGR bypass arrangement)	400	D/c	130	80	
34.	2025-26	WR	Boisar-II – Pune-III 765kV D/c line (200km.) along with 330 MVAR switchable line reactors at Pune-III end of Boisar-II – Pune-III 765kV D/c line (with NGR bypass arrangement).	765	D/c	400		330
35.	2025-26	WR	LILO of Narendra(New) – Pune(GIS) 765kV D/c line at Pune-III (LILO route length 10km.) along with 330 MVAR switchable line reactors at Pune-III end of Narendra(New) – Pune-III(GIS) 765kV D/c line (with NGR bypass arrangement).	765	D/c	20		330
36.	2025-26	WR	LILO of Hinjewadi-Koyna 400kV line at Pune-III(GIS) S/s along with 80MVAr, 420kV switchable Line Reactors on each ckt at Pune-III(GIS) end of Pune-III(GIS) – Koyna 400kV line	400	D/c			80
37.	2025-26	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 along with Installation of 1x330 MVAr switchable line reactor on each ckt at Navinal end of Lakadia – Navinal 765 kV D/c line..	765	D/c	280	330	
38.	2025-26	WR	Dhule PS – Dhule (BDTCL) 400 kV D/c Line (Quad Moose) (60 km)	400	D/c	120		
39.	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 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	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
			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					
40.	2025-26	SR	Mangalore (Udupi PCL) – Kasargode 400kV (Quad) D/c line	400	D/c	231		
41.	2025-26	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
42.	2025-26	SR	Bidar PS – Maheshwaram (PG) 765kV D/C line along with 1x240 MVAr switchable Line Reactor on Bidar end of both ckts	765kV	D/c	320	240	0
43.	2025-26	SR	Ananthpuram PS - Kurnool-III PS 400 kV (High capacity equivalent to quad moose) D/c Line	400	D/c	200		
44.	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
45.	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	
46.	2025-26	SR	Gadag-II PS - Koppal-II PS 400kV (Quad Moose) D/c line	400kV	D/c	100		
47.	2025-26	SR	Koppal-II - Raichur 765kV D/c linw with 330 MVAr SLR at Koppal-II PS end	765kV	D/c	190	240	
48.	2025-26	SR	Reconductoring of raichur-Veltoor 400kV D/c line with HTLS Conductor	400kV	D/c	0	-	-
49.	2025-26	NR	LILO of one circuit of Kishenpur – Dulhasti 400kV D/c (Quad) line	400	D/c	20		
50.	2025-26	NR	Stringing of 2nd circuit of Kishenpur – Dulhasti 400kV D/c line (Kishtwar – Kishenpur Section)	400	D/c	130		
51.	2025-26	NR	LILO of both 400 kV D/c Amargarh - Samba line at 400/220 kV Siot S/s	400	D/c	30		
52.	2025-26	NR	Nange (GIS) Pooling Station – Koldam 400 kV D/c line (Triple snowbird)	400kV	D/c	80		
53.	2025-26	NR	LILO of one ckt of 400kV Koldam (NTPC) – Ropar (Triple snowbird) D/c line at Pooling Station near Bilaspur (GIS)	400kV	S/c	1		50
54.	2025-26	NR	LILO of both ckts of 400kV Bikaner (PG)-Bikaner-II D/c line at Bikaner-III PS	400kV	D/c	80		
55.	2025-26	NR	Bikaner-II PS – Bikaner-III PS 400 kV D/c line (Quad)	400kV	D/c	60		
56.	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		

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
57.	2025-26	NR	Neemrana-II -Kotputli 400 kV D/c line (Quad	400kV	D/c	140		
58.	2025-26	NR	Bikaner-III – Neemrana-II 765 kV 2xD/c line	765kV	D/c	1400	660	660
59.	2025-26	NR	Neemrana-II- Bareilly(PG) 765 kV D/c line	765kV	D/c	700	330	330
60.	2025-26	NR	Fatehgarh-IV (Section-2) PS – Bhinmal (PG) 400 kV D/c line (Twin HTLS)	400kV	D/c	400	50	50
61.	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	-
62.	2025-26	NR	Fatehgarh-III (Section-2) PS – Barmer-I PS 400 kV D/c line (Quad)	400kV	D/c	100	-	-
63.	2025-26	NR	Fatehgarh-IV (Section-2) PS – Sirohi PS 765 kV D/c line	765kV	D/c	480	240	240
64.	2025-26	NR	Barmer-I PS– Sirohi PS 765 kV D/c line	765kV	D/c	400	240	240
65.	2025-26	NR	Sirohi PS-Chittorgarh (PG) 400 kV D/c line	400kV	D/c	320	80	
66.	2025-26	NR	Sirohi PS- Rishabdeo/Salumbar 765 kV D/c line	765kV	D/c	340	330	
67.	2025-26	NR	Rishabdeo/Salumbar - Mandsaur PS 765 kV D/c line	765kV	D/c	320		330
68.	2025-26	NR	LILO of one circuit of 765 kV Chittorgarh-Banaskanta D/c line at Rishabdeo/Salumbar S/s	765kV	S/c	20		
69.	2025-26	NR	Beawar- Mandsaur PS 765 kV D/c line	765kV	D/c	520	240	240
70.	2025-26	NR	Generation switchyard of Shongtong HEP to Wangtoo (HPPTCL) 400 kV D/c [Quad] line	400kV	D/c	36	-	-
71.	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	-	-
72.	2025-26	NR	Wangtoo (HPPTCL) - Panchkula (PG) 400 kV D/c (Twin HTLS)	400kV	D/c	420	-	80
73.	2025-26	NR	765 kV Bhadla-III – Bikaner-III D/c line	765	D/c	300	240	
74.	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		
75.	2025-26	NR	400 kV Bareilly(765/400kV) – Bareilly(PG) D/c line (Quad) (2nd)	400	D/c	4		
76.	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	220	D/c	28		

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
			bay equipment upgradation at 220kV Hisar (PG) end					
77.	2025-26	NER	Kathalguri (NEEPCO) – Namsai (POWERGRID) 220kV D/c line	220	D/c	150		
78.	2025-26	NER	Gogamukh - Gerukamukh 132kV D/c line	132	D/c	40		
79.	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		
80.	2025-26	NER	LILO of both circuits of Misa - Mariani 400kV D/c line at Bokajan	400	D/c	20		100
81.	2025-26	ER	NKSTPP – Jharkhand Pool 400kV D/c (quad) line (50ckm)	400	D/c	50		
82.	2025-26	ER	NKSTPP – Gaya 400kV D/c (quad) line (185ckm)	400	D/c	185		
83.	2025-26	ER	Angul - Paradeep 765 kV D/c line	765kV	D/c	380	-	330
84.	2025-26	ER	Paradeep - Paradeep (OPTCL) 400kV D/c (Quad) line	400kV	D/c	20	-	330
85.	2025-26	ER	Malda - New Purnea 400kV D/c line	400	D/c	0	126	
86.	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		
87.	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
88.	2026-27	WR	LILO of one ckt. of Narendra (existing) – Narendra (New) 400kV D/c quad line at Xeldem -240ckm	400	D/c	187.35		
89.	2026-27	WR	Xeldem – Mapusa 400kV D/c (quad) line - 80ckm	400	D/c	109.6		
90.	2026-27	WR	Xeldem (existing) - Xeldem (new) 220kV D/c line	220	D/c	40		
91.	2026-27	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	
92.	2026-27	WR	Mandsaur – Kurawar 765kV D/c line (~235km.) with 240MVAr **switchable line reactors (SLRs) at both ends**	765	D/c	470	240	240
93.	2026-27	WR	LILO of Indore – Bhopal 765kV 765kV S/c line at Kurawar (LILO length 15km.)	765	S/c	30		
94.	2026-27	WR	Kurawar – Ashtha 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (65km.)	400	D/c	130		
95.	2026-27	WR	LILO of one circuit of Indore – Itarsi 400kV D/c line at Astha (LILO length 30km.)	400	D/c	60		
96.	2026-27	WR	Shujalpur – Kurawar 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (40km.)	400	D/c	80		

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
97.	2026-27	WR	±800 kV HVDC Bipole line between KPS2(HVDC) and Akola-III(HVDC) (1000km.) (with Dedicated Metallic Return) (capable to evacuate 8000MW with overload capacity as specified)	800	S/c	1000		
98.	2026-27	WR	LILO of Wardha – Aurangabad 765kV 2xD/c line at Akola-III (LILO route length 30km.)	765	D/c	120		330
99.	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
100.	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	
101.	2026-27	WR	Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line (50km.)	400	D/c	100		
102.	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	
103.	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		
104.	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	
105.	2026-27	WR	KPS3 (GIS) – Lakadia (AIS) 765 kV D/C line	765	D/c	370	330	0
106.	2026-27	WR	KPS1 (GIS)– Bhuj PS 765 kV 2nd D/C line	765	D/c	220	0	0
107.	2026-27	WR	Vadodara (GIS) –South Olpad (GIS) 765 kV D/C line	765	D/c	280	240	0
108.	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		
109.	2026-27	WR	Ahmedabad – South Olpad (GIS) 765 kV D/c line	765	D/c	500	240	240
110.	2026-27	WR	South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line	765	D/c	450	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
111.	2026-27	WR	LILO of Navsari (New) – Padghe (PG) 765 kV D/c line at Boisar-II	765	D/c	100	0	0
112.	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
113.	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
114.	2026-27	WR	Boisar-II – Pune-III 765 kV D/c line	765	D/c	400	330	0
115.	2026-27	WR	LILO of Narendra (New) – Pune (GIS) 765 kV D/c line at Pune-III	765	D/c	40	330	0
116.	2026-27	WR	LILO of Hinjewadi-Koyna 400 kV S/c line at Pune-III (GIS) S/s	400	S/c	80	80	0
117.	2026-27	WR	Mahan (existing bus) – Rewa PS (PG) 400kV D/c (quad) line	400	D/c	220		
118.	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	
119.	2026-27	SR	Tumkur-II PS - Tumkur (Pavagada) 400kV (QM equivalent) D/c line	400kV	D/c	200	-	-
120.	2026-27	SR	Bijapur PS - Koppal-II PS 400kV (QM equivalent) D/c line	400kV	D/c	200	-	-
121.	2026-27	SR	Kurnool-IV - Bidar PS 765kV D/c line with 240 MVAr SLR at both ends	765kV	D/c	660	330	330
122.	2026-27	SR	Anantapur-II - Cuddapah 765kV D/c line with 240 MVAr SLR at Anantapur-II PS	765kV	D/c	400	330	-
123.	2026-27	SR	Anantapur-II - Davangere 765kV D/c line	765kV	D/c	300	240	-
124.	2026-27	SR	KNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line	400kV	D/c	240	-	-
125.	2026-27	SR	Gadag-II PS - Koppal-II PS 400kV (Quad Moose) 2nd D/c line	400	D/c	90		
126.	2026-27	SR	Reconductoring of Somanahalli – Bidadi 400kV D/c line with HTLS conductor	400	D/c	17		
127.	2026-27	SR	Reconductoring of Maheshwaram(PG) – Hyderabad 400kV S/c line with HTLS conductor	400	D/c	56		
128.	2026-27	SR	Kurnool-IV - Kurnool-III PS 765kV D/c line	765	D/c	300	240	
129.	2026-27	SR	LILO of Vijaywada-Nellore 400 kV D/c line at C'Peta	400	D/c	80		

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
130.	2026-27	SR	LILO of Narendra New – Madhugiri 765kV D/c line at Davanagere / Chitradurga 765/400kV PS	765	D/c	80	480	660
131.	2026-27	NR	400kV Kishenpur Kishtwar D/c (2nd) (Quad)	400kV	D/c	260		
132.	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		
133.	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
134.	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
135.	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
136.	2026-27	NR	Siwani – Fatehabad (PG) 400 kV D/c line (Quad)	400	D/c	160	0	0
137.	2026-27	NR	Siwani – Jind (PG) 400 kV D/c line (Quad Moose)	400	D/c	220	0	0
138.	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
139.	2026-27	NR	Fatehgarh-IV PS (Sec-2) – Barmer-I PS 400kV D/c line (Quad)	400	D/c	90		
140.	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
141.	2026-27	NR	Merta-II – Beawar 400 kV D/c line (Quad) (~55 km)	400	D/c	110		
142.	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
143.	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
144.	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	
145.	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	

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
146.	2026-27	NR	400kV Ghiror-Firozabad (UPPTCL) D/c line (Quad)	400	D/c	100		
147.	2026-27	NR	400 kV Kishenpur-Samba D/c line (Quad) (2nd)	400	D/c	70		
148.	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				
149.	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				
150.	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				
151.	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		
152.	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				
153.	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				
154.	2026-27	NR	LILO of 400 kV Kishenpur- Dulhasti line (Twin Zebra) at Kishtwar S/s (one ckt already LILOed as part of Pakaldul transmission system)	400		20		
155.	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				
156.	2026-27	NR	400 kV Bareilly (765/400 kV) – Bareilly (PG) D/c line (Quad) (2nd)	400	D/c	8		
157.	2026-27	NR	Fatehgarh-IV PS (Sec-2) – Barmer-I PS 400kV D/c line (Quad)	400	D/c	90		
158.	2026-27	NR	Dausa - Ghiror 765 kV D/c line along with 330MVAr switchable line reactor at	765	D/c	610	240	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
			Ghiror end and 240 MVAr switchable line reactor at Dausa end for each circuit of Dausa - Ghiror 765 kV D/c line					
159.	2026-27	NR	LILO of both ckt of 765 kV Aligarh (PG) - Orai (PG) D/c line at Ghiror S/s along with 240 MVAr switchable line reactor for each circuit at Ghiror S/s end of 765 kV Ghiror - Orai (PG) D/c line	765	D/c	60	240 MVAr SLR for each circuit at Ghiror S/s end of 765 kV Ghiror - Orai (PG) D/c line	
160.	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 end of 765 kV Ghiror -Fatehpur (PG) line	765	S/c	60	240 MVAr switchable line reactor at Ghiror end of 765 kV Ghiror - Fatehpur (PG) line	
161.	2026-27	NR	400kV Ghiror-Firozabad (UPPTCL) D/c line (Quad)	400	D/c	100		
162.	2026-27	NR	Barmer-I PS – Merta-II 765 kV D/c line along with 330 MVAr 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
163.	2026-27	NR	Merta-II – Beawar 400 kV D/c line (Quad)	400	D/c	110		
164.	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 765kV D/c line line	765	D/c	500	240	240
165.	2026-27	NR	Sirohi – Mandsaur PS 765KV D/c line (~ 320kms) along with 240 MVAr switchable line reactor at Sirohi S/s end 330MVAr switchable line reactor at Mandsaur PS end for each circuit of Sirohi – Mandsaur PS 765KV D/c line	765	D/c	640	240	330
166.	2026-27	NR	Mandsaur PS – Khandwa (New) 765kV D/c line (~230km.) along with 240MVAr switchable line reactor for each circuit at each end of Mandsaur PS – Khandwa (New) 765kV D/c line	765	D/c	460	240	240
167.	2026-27	NR	LILO of 400 kV Kishenpur- Dulhasti line (Twin) at Kishtwar S/s along with associated bays at Kishtwar S/s	400	D/c	6		
168.	2026-27	NR	400 kV Kishenpur-Samba D/c line (Quad) (only one circuit is to be terminated at Kishenpur utilizing 1 no. of 400kV vacated line bay at Kishenur S/s (formed with bypassing of one ckt of 400kV Kishtwar – Kishenpur 400kV D/c line (Quad) at Kishenpur) while second circuit would be	400	D/c	72		

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
			connected to bypassed circuit of 400kV Kishtwar – Kishenpur line (Quad))					
169.	2026-27	NR	Bypassing of one ckt of 400kV Kishtwar – Kishenpur 400kV D/c 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)	400	D/c			
170.	2026-27	NR	400kV Samba- Jalandhar D/c line(Quad) (only one circuit is to be terminated at Jalandhar utilizing 1 no. of 400kV vacated line bay at Jalandhar S/s (formed with bypassing of 400kV Jalandhar – Nakodar line (Quad) at Jalandhar) while second circuit would be connected to bypassed circuit of Jalandhar –Nakodar 400kV line (Quad))	400	D/c	290		
171.	2026-27	NR	Bypassing both ckts of 400 kV Kishenpur – Samba D/c line (Twin) & 400 kV Samba – Jalandhar D/c line (Twin) at Samba and connecting them together to form 400 kV Kishenpur– Jalandhar D/c direct line (Twin) (4 Nos. of vacated 400 kV line bays at Samba S/s will be utilized for 400 kV Kishenpur-Samba D/c line (Quad) & 400 kV Samba- Jalandhar D/c line(Quad),	400	D/c	2		
172.	2026-27	NER	Stringing of 2nd circuit of Pasighat (Arunachal Pradesh) – Roing (POWERGRID) 132kV S/c on D/c line with ACSR Panther conductor commensurate with rating and maximum operating temperature of 1st circuit	132	S/c	103		0
173.	2026-27	NER	Stringing of 2nd circuit of Roing (POWERGRID) – Tezu (POWERGRID) 132kV S/c on D/c line with ACSR Panther conductor commensurate with rating and maximum operating temperature of 1st circuit	132	S/c	73		0
174.	2026-27	NER	Stringing of 2nd circuit of Tezu (POWERGRID) – Namsai (POWERGRID) 132kV S/c on D/c line with ACSR Panther conductor commensurate with rating and maximum operating temperature of 1st circuit	132	S/c	95.24		0
175.	2027-28	WR	Halvad – Kandla(GIS) 765kV D/c line	765	D/c	280		0
176.	2027-28	WR	Navinal(Mundra) (GIS) – Bhuj 765kV D/c line	765	D/c	140		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
177.	2027-28	WR	Navinal-II (Mundra) (GIS) – Bhuj-II (GIS) 765kV D/c line	765	D/c	160		0
178.	2027-28	WR	LILO of KPS3 (GIS) – Lakadia 765kV D/c line at Navinal-II (Mundra) (GIS) S/s	765	D/c	280		0
179.	2027-28	WR	LILO of Pune-III – Boisar-II 765 kV D/c line at South Kalamb S/s	765	D/c	160		240MV Ar LR at S' Kalamb end of Boisar-II - S' Kalamb line
180.	2027-28	WR	Neemuch PS – Pachora PS 400kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) along with 50MVAr Sw LR on each ckt at both ends	400	D/c	380	50	50
181.	2027-28	WR	Pachora PS – Handiya 400kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) along with associated bays at Pachora PS end and 50MVAr Sw LR on each ckt at both ends	400	D/c	380	50	50
182.	2027-28	WR	LILO of Khandwa (PG) – Itarsi (PG) 400kV D/c (Twin Moose) line at Handiya S/s	400	D/c	80		
183.	2027-28	WR	Pachora PS – Rajgarh(PG) 400 kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) along with associated bays at both ends (180km.) and 50MVAr Sw LR on each ckt at both ends	400	D/c	360	50	50
184.	2027-28	WR	Mahan (existing bus) – Rewa PS (PG) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	400	D/c	220		0
185.	2027-28	WR	Kalyanpur (GIS) – Jamnagar (GIS) 765 kV D/c line	765	D/c	190		
186.	2027-28	WR	Kalyanpur (GIS) – Saurashtra (near Rajkot) (GETCO) 765 kV D/c line	765	D/c	360-380	2X330	2X330
187.	2027-28	WR	KPS5 – Lakadia-II 765kV 2xD/c line & 765kV, 330MVAr Switchable line reactors on each circuit at Lakadia-II end of KPS5 – Lakadia-II 765kV 2xD/c line	765	D/c	640		4x330
188.	2027-28	WR	LILO of Halvad – Kandla 765kV D/c line at Lakadia-II	765	D/c	40		
189.	2027-28	WR	Lakadia-II – Ahmedabad 765kV D/c line & 765kV, 330MVAr Switchable line reactors on each circuit at Ahmedabad end of Lakadia-II – Ahmedabad 765kV D/c line	765	D/c	360		2x330
190.	2027-28	WR	Lakadia-II – Vataman 765kV D/c line & 765kV, 240MVAr Switchable line reactors on each circuit at both ends of Lakadia-II – Vataman 765kV D/c line	765	D/c	440		4x240
191.	2027-28	WR	Vadodara(GIS) – Halvad 765kV D/c line to be terminated into Lakadia – Vadodara(GIS) 765kV D/c line & 765kV, 330MVAr Switchable line reactors on each circuit at Vadodara(GIS) end of	765	D/c	520	2X330 (Mid point near	2x330

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
			Lakadia – Vadodara(GIS) 765kV D/c line . **Note:** 765kV, 330MVAr Switchable Mid-point reactors at bypass point near Halvad S/s on Lakadia – Vadodara(GIS) 765kV D/c line				Halvad S/s)	
192.	2027-28	WR	Navsari(New) – Nasik 765kV D/c line & 765kV, 330MVAr Switchable line reactors on each circuit at Nasik end of Navsari(New) – Nasik 765kV D/c line	765	D/c	380		2x330
193.	2027-28	WR	Nasik – Pimpalgaon (MSETCL) 400kV D/c line (Quad ACSR/AAAC/AL59 moose equivalent) (~50km.)	400	D/c	100		
194.	2027-28	WR	Alephata – Lonikand-I 400kV D/c line (Quad ACSR/AAAC/AL59 moose equivalent) (~80km.)	400	D/c	160		
195.	2027-28	WR	LILO of A'bad – Pune(GIS)(Shikrapur) 765kV line and Padghe(GIS) – Pune(GIS) 765kV line at Alephata S/s (LILO route length ~ 20km.)	765		80		
196.	2027-28	WR	Nasik – Alephata 765kV D/c line (~100km.)	765	D/c	200		
197.	2027-28	WR	Raghanesda (GIS) – Banaskantha (PG) 765 kV D/c line	765	D/c	190		
198.	2027-28	WR	Solapur PS (Sec-II) – Jejuri (MSETCL) 400 kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) & 63MVAr, 420kV Switchable line reactors on each circuit at both ends of Solapur PS (Sec-2) – Jejuri (MSETCL) 400 kV D/c line (with NGR bypass arrangement)	400	D/c	480	2x63	2x63
199.	2027-28	WR	Jejuri (M) – Pune-III 400 kV D/c line (Quad ACSR/ AAAC/ AL59 Moose equivalent) (~20km.)	400	D/c	40		
200.	2027-28	WR	Morena PS (South of Sabalgarh) – Karera (near Datia) 765 kV D/c line	765	D/c	180		
201.	2027-28	SR	Upgradation/charging of Tuticorin PS - Dharmapuri (Salem New) 765 kV D/c line (initially charged at 400 kV) to its rated voltage of 765 kV along with 1x330 MVAr switchable Line Reactor on both end of each circuit	765	D/c		330	330
202.	2027-28	SR	Upgradation/charging of Dharmapuri (Salem New) - Madhugiri (Tumkur) 765 kV 2xS/c line (initially charged at 400 kV) to its rated voltage of 765 kV along with 1x330 MVAr switchable Line Reactor on Dharampuri (Salem New) end of both ckts	765	2XS /c		330	
203.	2027-28	SR	Nizamabad-II PS - Nizamabad (PG) 765kV 2XD/c line	765kV	D/c	120	-	-
204.	2027-28	SR	Nizamabad-II PS - Warangal (New) 765kV D/c line with 330 MVAr SLR at Nizamabad-II PS	765kV	D/c	360	330	-
205.	2027-28	SR	Medak PS - Nizamabad-II 400kV (QM equivalent) D/c line	400kV	D/c	120	-	-
206.	2027-28	SR	Rangareddy PS - Nizamabad-II 400kV (QM equivalent) D/c line with 80 MVAr SLR at Rangareddy PS	400kV	D/c	310	80	-
207.	2027-28	SR	Bellary PS – Davanagere / Chitradurga 400kV (Quad ACSR moose) D/c line	400kV	D/c	200	-	-
208.	2027-28	SR	Karimnagar PS - Nizamabad-II 400kV (QM equivalent) D/c line	400kV	D/c	200	-	-

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
209.	2027-28	SR	Kurnool-IV - Kurnool-V PS 765kV D/c line	765kV	D/c	200		
210.	2027-28	SR	LILO of both circuits of Anantapur-II - Cuddapah 765kV D/c line at Kadapa-II PS	765kV	D/c	20	-	-
211.	2027-28	SR	LILO of Kurnool-IV – Bidar 765kV D/c line at Shadnagar	765	D/c	200		
212.	2027-28	SR	Shadnagar – Shadnagar (TGTRANSCO) 400 kV quad D/c line	400	D/c	100		
213.	2027-28	SR	Shadnagar – Kethredipally (TGTRANSCO) 400 kV quad D/c line	400	D/c	120		
214.	2027-28	SR	Kurnool-III PS – Chilakaluripeta 765 kV D/c line	765	D/c	520	240	240
215.	2027-28	SR	Kurnool-V PS – Chilakaluripeta 765 kV D/c line	765	D/c	420	330	
216.	2027-28	SR	Tuticorin PS - Tuticorin (GH)	765	D/c	100		
217.	2027-28	SR	LILO of Vemagiri – Srikakulam 765 kV D/c line at Kakinada GH substation with 240 MVAr SLR at Kakinada GH end on Srikakulam – Kakinada GH section	765	D/c	80	240	
218.	2027-28	SR	Anantapur-II – CN'Halli 765kV D/c line with 330 MVAR SLR at Anatpur-II end on both circuits	765	D/c	360	330	
219.	2027-28	SR	LILO of one circuit of Talaguppa-Neelmangala 400 kV D/c line at CN'Halli (25 KM)	400	D/c	50		
220.	2027-28	SR	Bellary – Davanagare 2nd 400kV (Quad) D/c line	400	D/c	160		
221.	2027-28	SR	Angul – Srikakulam 765 kV 2nd D/c line (about 275 km) with 240 MVAR SLR at both ends on both circuits	765	D/c	550	480	480
222.	2027-28	SR	Parli New – Bidar 765kV D/c line (about 120 km) with 240 MVAR SLR at Bidar end on both circuits	765	D/c	240	480	480
223.	2027-28	SR	Mangalore GH – Davanagare / Chitradurga 765 kV D/c line (~280 km) with 240 MVAr SLR at both ends on both circuits	765	D/c	560	480	480

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
224.	2027-28	SR	Tumkur-II – Madhugiri 400kV (Quad) D/c line	400	D/c	200		
225.	2027-28	SR	i) LILO at CN'Halli of already LILOed section of one circuit of Talaguppa - Neelmangala 400 kV line at Hassan (25 KM) or ii) LILO of another circuit of Talaguppa-Neelmangala 400 kV D/c line at CN'Halli (25 KM) and extension of LILOed section of one circuit of Talaguppa - Neelmangala 400 kV line at Hassan to CN'Halli to make Hassan - CN'Halli 400kV D/c line (25 KM)	400	D/c	100		
226.	2027-28	NR	LILO of both circuits of 765 kV VaranasiGaya 2xS/c line at Robertsganj PS along with 240 MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)	765	S/c	280	240 MVAr switchable line reactor at each ckt of Robertsganj PS end of 765 kV Robertsganj PS - Gaya 2xS/c line (after LILO)	
227.	2027-28	NR	Robertsganj PS – Prayagraj S/s 765 kV D/c line along with 330 MVAr line reactor at each circuit of Robertsganj end of Robertsganj PS – Prayagraj S/s 765 kV D/c line	765	D/c	370	3x110	
228.	2027-28	NR	LILO of 765 kV Fatehpur-Varanasi S/c line at Prayagraj	765	S/c	30	3x110	
229.	2027-28	NR	LILO of 765 kV Fatehpur-Sasaram S/c line at Prayagraj	765	S/c	28		
230.	2027-28	NR	765 kV Vindhyachal Pool - Prayagraj D/c line along with 330MVAr line reactor (switchable) at Prayagraj end on each ckt of 765 kV Vindhyachal Pool - Prayagraj D/c line	765	D/c	440		3x330

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
231.	2027-28	NR	Bypassing of both ckts of 765 kV Sasan – Vindhyachal Pool 2xS/c line at Vindhyachal Pool and connecting it with 765 kV Vindhyachal Pool - Prayagraj D/c line, thus forming 765 kV Sasan - Prayagraj D/c line	765	S/c	1		
232.	2027-28	NER	LILO of both circuits of existing Bongaigaon (POWERGRID) – Balipara (POWERGRID) 400kV D/c (Quad) line at Bornagar (ISTS)	400kV	D/c	4		126
233.	2027-28	NER	extension of Alipurduar (POWERGRID) – Bongaigaon (POWERGRID) 400kV D/c line for termination at Bornagar (ISTS) S/s	400	D/c	110		160
234.	2027-28	NER	Reconductoring of ISTS portion of Balipara (POWERGRID) – Sonabil (POWERGRID) ckt-I 220kV line owned by POWERGRID with HTLS conductor of ampacity 1050A (at nominal voltage level.	220	S/c	8.623		
235.	2027-28	NER	Reconductoring of ISTS portion of Balipara (POWERGRID) – Sonabil (POWERGRID) ckt-II 220kV line owned by POWERGRID with HTLS conductor of ampacity 1050A (at nominal voltage level)	220	S/c	9.205		
236.	2027-28	NER	Reconductoring of Silchar (POWERGRID) – Srikona (AEGCL) 132kV D/c line owned by POWERGRID with HTLS conductor of ampacity 900A (at nominal voltage level)	132	D/c	1.119		
237.	2027-28	NER	Reconductoring of Ranganadi (NEEPCO) – Ziro (POWERGRID) 132kV S/c line owned by POWERGRID with HTLS conductor of ampacity 900A (at nominal voltage level)	132	D/c	44.52		
238.	2027-28	ER	Angul - Gopalpur 765 kV D/c line	765kV	D/c	410	-	330
239.	2027-28	ER	Gopalpur - Gopalpur (OPTCL) 400kV D/c (Quad) line	400kV	D/c	40	-	330
240.	2027-28	ER	LILO of both circuits of Angul – Sundargarh (Jharsuguda) 765kV 2xS/c lines at NLC-Talabira generation switchyard	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
241.	2027-28	ER	Shifting of one circuit each of existing Biharsharif – Koderma Ph-I 400kV D/c (Quad) line and Gaya – Koderma Ph-I 400kV D/c (Quad) line from Koderma Ph-I to Koderma Ph-II switchyard so as to form Biharsharif – Koderma Ph-II 400kV S/c (Quad) line and Gaya – Koderma Ph-II 400kV S/c (Quad) line	400	D/c	10		0
242.	2027-28	ER	Angul - Gopalpur 765kV D/c line	765	D/c	205		0
243.	2027-28	ER	Gopalpur - Gopalpur (OPTCL) 400kV D/c (Quad) line	400	D/c	10		0
244.	2027-28	ER	LILO of one circuit of Chaibasa (POWERGRID) – Kharagpur (WBSETCL) 400kV D/c ISTS line at OMIPL generation switchyard	400	S/c	18		0
245.	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	
246.	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
247.	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	
248.	2028-29	WR	Mahuva Onshore PS (GIS) – Vataman 400 kV D/c line	400	D/c	380	2x63	2x50
249.	2028-29	WR	B3-OSS-1 – Mahuva Onshore PS (GIS) 220 kV two nos. (3 core) cables (45 km- under sea cable of about 35 km & under ground cable of about 10 km)	220	D/c	90		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
250.	2028-29	SR	Warangal – Khammam-II 765 kV D/c line	765	D/c	220		
251.	2028-29	SR	Khammam-II – Vemagiri 765 kV D/c line	765	D/c	430	330	
252.	2028-29	SR	Vemagiri – Kakinada 765 kV 2nd D/c line	765	D/c	100		
253.	2028-29	SR	Khammam-II – Khamman (exisiting) 400 kV D/c (quad) line	400	D/c	40		
254.	2028-29	NR	Bhadla-3 - Bhadla(HVDC) 400kV 2xD/c quad moose line(2km)	400	D/c	4		
255.	2028-29	NR	±800KV HVDC line (Hexa lapwing)(4x1500 MW) between Bhadla-3 & Fatehpur (950km) with DMR.	800(HV DC)	D/c	1900		
256.	2028-29	NR	LILO of both ckts of 765kV Varanasi – Kanpur (GIS) D/c at Fatehpur(30km)	765	D/c	60		
257.	2028-29	NR	400kV PS-1 - Pang D/c (quad moose) line	400	D/c	14		
258.	2028-29	NR	400kV PS-2 -Pang D/c (quad moose) line	400	D/c	54		
259.	2028-29	NR	400kV PS-3 -Pang D/c (quad moose) line	400	D/c	82		

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
260.	2028-29	NR	220kV Pang – Leh (Phyang) S/c line (Deer conductor) (S/c line on D/c tower)	220	S/c	158		
261.	2028-29	NR	Kaithal – Bahadurgarh (PG) 400 kV D/c Line (Twin HTLS)	400	D/c	340		
262.	2028-29	NR	Kaithal-Modipuram (Meerut) (UPPTCL) 765 kV D/c Line	400	D/c	420		240
263.	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		
264.	2029-30	WR	±800 kV HVDC Bipole line (Hexa lapwing) between KPS2 (HVDC) and Nagpur (HVDC) (1200 km)	±800		1200		
265.	2029-30	WR	LILO of Wardha – Raipur 765 kV one D/c line (out of 2xD/c lines) at Nagpur	765	D/c	120	240	0
266.	2029-30	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
267.	2029-30	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
268.	2029-30	WR	±800 kV (in case of LCC, with (Hexa lapwing)) OR ± 600 kV (in case of VSC with Quad Lapwing on same tower) HVDC Bipole line between Lakadia-II (HVDC) and Alephata (HVDC) (800 km) (with Dedicated Metallic Return) (capable to evacuate 6000 MW (with overload as specified)	800 or 600		1600		

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
269.	2029-30	SR	Avaraikulam Onshore PS – Tuticorin PS 400 kV D/c quad line	400	D/c	200	0	0
270.	2029-30	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	230	S/c	80	100	0
271.	2029-30	NER	Dibang - Gogamukh 400kV 2xD/c line	400kV	2xD /c	860	252	252
272.	2029-30	NER	Gogamukh- Lower Subansiri 400kV D/c line	400kV	D/c	350	160	
273.	2029-30	ER	Paradeep (HVDC) - Andaman HVDC interconnection (Undersea Cable)	320	Bip ole	2300		
274.	2029-30	ER	Andaman - Nicobar HVDC interconnection (Undersea Cable)	320	Bip ole	1100		
275.	2029-30	ER	Paradeep (HVDC) - Paradeep (ISTS) 400kV D/c line	400	D/c	24		
276.	2030-31	SR	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	230	S/c	80	100	0

2. Transformers

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
1.	2025-26	WR	Establishment of 765/400 kV, 4x1500MVA, KPS2 (GIS)	765/400	4	1500	6000
2.	2025-26	WR	Augmentation of Khavda PS1 by 765/400 kV transformation capacity * (max. upto 4x1500 MVA)	765/400	4	1500	6000
3.	2025-26	WR	Establishment of 3x500 MVA, 400/220 kV Pooling Station at Chhatarpur	400/220	3	500	1500
4.	2025-26	WR	Augmentation of transformation capacity at Padghe (GIS) 765/400 kV substation by 1x1500 MVA ICT	765/400	1	1500	1500
5.	2025-26	WR	Establishment of 765/400/220 kV Navsari (new) (South Gujarat) S/s (GIS)	765/400	2	1500	3000
6.	2025-26	WR	Establishment of 765/400/220 kV Navsari (new) (South Gujarat) S/s (GIS)	400/220	3	500	1500
7.	2025-26	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
8.	2025-26	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
9.	2025-26	WR	Establishment of 3x1500 MVA, 765/400 kV Ahmedabad S/s	765/400	3	1500	4500
10.	2025-26	WR	Augmentation of 765/400 kV Navsari (new) (South Gujarat) S/s (GIS)	765/400	1	1500	1500
11.	2025-26	WR	Augmentation of transformation capacity at Banaskantha 765/400 kV S/s by 1x1500 MVA ICT	765/400	1	1500	1500
12.	2025-26	WR	Additional 1x500MVA 400/220kV (9th) ICT, for injection from any additional RE project (other than 4000MW injection under SECI bids upto Tranche IV) in existing Bhuj PS with associated 400 kV	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)
			GIS bay and 220kV AIS bay.				
13.	2025-26	WR	Establishment of 400/220 kV, 3x500 MVA at Solapur PP (near Mohol)	400/220	3	500	1500
14.	2025-26	WR	Establishment of 400/220 kV, 5X500 MVA at Wardha SEZ PP	400/220	5	500	2500
15.	2025-26	WR	Establishment of 3x1500MVA, 765/400kV at Dholera PS	765/400	3	1500	4500
16.	2025-26	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
17.	2025-26	WR	Establishment of 765/400 kV, 2x1500 MVA	765/400	2	1500	3000
18.	2025-26	WR	Establishment of 400/220 kV, 2x500 MVA ICTs at Karera (near Datiya)	400/220	2	500	1000
19.	2025-26	WR	Establishment of 765/400 kV, 2x1500 MVA ICTs at Ishanagar (New)	765/400	2	1500	3000
20.	2025-26	WR	Establishment of 400/220 kV, 2x500 MVA ICTs at Ishanagar (New)	400/220	2	500	1000
21.	2025-26	WR	Installation of 1x500 MVA, 400/220 kV ICT (4th) along with associated ICT bays at Satna(PG)	400/220	1	500	500
22.	2025-26	WR	400/220 kV, 3x500 MVA ICT augmentation (4th 5th & 6th) at Pachora PS	400/220	3	500	1500
23.	2025-26	WR	Establishment of 3x1500MVA 765/400kV Transformers at Boisar-II (GIS) S/s	765/400	3	1500	4500
24.	2025-26	WR	Establishment of 2x500MVA 400/220kV transformers at Boisar-II (GIS) S/s	400/220	2	500	1000
25.	2025-26	WR	Establishment of 2x1500MVA 765/400kV transformers at Pune-III	765/400	2	1500	3000
26.	2025-26	WR	Establishment of 3x500MVA, 400/220kV transformers at PuneIII	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)
27.	2025-26	WR	Augmentation of transformation capacity at KPS1(GIS) by 1x1500MVA, 765/400kV ICT (8th)	765/400	1	1500	1500
28.	2025-26	WR	Augmentation of transformation capacity at KPS2(GIS) by 1x1500MVA, 765/400kV ICT (8th) on Bus section-II	765/400	1	1500	1500
29.	2025-26	WR	Augmentation of transformation capacity at KPS3(GIS) by 1x1500MVA, 765/400kV ICT (4th) on Bus section-I	765/400	1	1500	1500
30.	2025-26	WR	Establishment of 4x1500 MVA, 765/400 kV at Navinal (Mundra) S/s (GIS)	765/400	4	1500	6000
31.	2025-26	WR	Augmentation of transformation capacity at Pune (GIS) 765/400 kV substation by 1x1500 MVA ICT (3rd)	765/400	1	1500	1500
32.	2025-26	WR	Establishment of 4x500 MVA, 400/220kV ICTs in pooling station near Dhule, Maharashtara.	400/220	4	500	2000
33.	2025-26	WR	765/400 kV, 2x1500 MVA ICT augmentation (3rd & 4th on Bus SectionI) at KPS2	765/400	2	1500	3000
34.	2025-26	WR	765/400 kV, 1x1500 MVA ICT augmentation (3rd on Bus Section-II) at KPS2	765/400	1	1500	1500
35.	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
36.	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
37.	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
38.	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
39.	2025-26	WR	Augmentation of transformation capacity at Padghe (PG) (GIS) by 1x1500 MVA, 765/400 kV ICT (4th)	765/400	1	1500	1500
40.	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)				
41.	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
42.	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
43.	2025-26	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 2x500MVA, 400/220kV ICT (5th& 6th)	400/220	2	500	1000
44.	2025-26	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (3rd)	765/400	1	1500	1500
45.	2025-26	WR	Installation of 2x500MVA, 400/220kV ICT-1 at Lakadia PS along with 220kV switchyard and associated ICT bays	400/220	2	500	1000
46.	2025-26	WR	Augmentation of Transformation capacity at 400/220kV Rajgarh S/s by 1x500MVA ICT (4th) (terminated on the sectionalized 220kV bus) - 400/220kV, 1x500MVA	400/220	1	500	500
47.	2025-26	WR	Augmentation of Transformation capacity at Mandsaur PS by 1x1500MVA, 765/400kV ICT (4th) alongwith associated bays	765/400	1	1500	1500
48.	2025-26	WR	Augmentation of transformation capacity at at Jam Khambhaliya PS (GIS) by 2x500MVA, 400/220kV ICT (5th& 6th)	400/220	2	500	1000
49.	2025-26	WR	Augmentation of transformation capacity at Bhuj-I PS by 1x500MVA, 400/220kV ICT (9th)	400/220	1	500	500
50.	2025-26	WR	Augmentation of transformation capacity at Boisar (PG) S/s by 1x500MVA, 400/220kV ICT (5th)	400/220	1	500	500
51.	2025-26	WR	Augmentation of Transformation capacity at 400/220kV Rajgarh S/s by 1x500MVA ICT (3rd)	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)
			(terminated on the sectionalized 220kV bus)				
52.	2025-26	WR	Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS) by 1x500MVA 400/220kV ICT (3rd)	400/220	1	500	500
53.	2025-26	WR	Augmentation of transformation capacity at Bhuj-I PS by 1x500MVA, 400/220kV ICT (9th)	400/220	1	500	500
54.	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
55.	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
56.	2025-26	WR	Creation of 400kV switchyard along with Installation of 2x1500 MVA, 765/400 kV ICTs at Vataman (AIS) with 2x125 MVAr (420 kV) Bus Reactors	765/400	2	1500	3000
57.	2025-26	WR	Creation of 220kV switchyard along with Installation of 2x500 MVA, 400/220 kV ICTs at Vataman (AIS)	400/220	2	500	1000
58.	2025-26	WR	Augmentation of Transformation Capacity at 765/400/220kV Vadodara (GIS) S/s in Gujarat by 400/220kV, 1x500MVA ICT (3rd)	400/220	1	500	500
59.	2025-26	SR	Establishment of 2x500MVA, 400/220 kV GIS substation at Kasargode	400/220	2	500	1000
60.	2025-26	SR	Augmentation of 400/220 kV, 3x500 MVA Gadag Pooling Station	400/220	3	500	1500
61.	2025-26	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
62.	2025-26	SR	Establishment of 3x1500MVA (765/400kV) Bidar PS	765/400	3	1500	4500
63.	2025-26	SR	Establishment of 5x500MVA (400/220kV) Bidar PS	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)
64.	2025-26	SR	Establishment of 400/220 kV, 7x500 MVA, Ananthpuram pooling station at suitable location between Anantapur & Kurnool Distt	400/220	7	500	3500
65.	2025-26	SR	Establishment of 765/400kV , 2X1500 MVA transformer at Koppal-II	765/400	2	1500	3000
66.	2025-26	SR	Establishment of 400/220kV , 2X500 MVA transformer at Koppal-II	400/220	2	500	1000
67.	2025-26	SR	Establishment of 400/220kV , 2X500 MVA transformer at Gadag-II	400/220	2	500	1000
68.	2025-26	SR	Augmentation of transformation capacity at Koppal-II with 765/400kV , 2X1500 MVA transformers	765/400	2	1500	3000
69.	2025-26	SR	Augmentation of transformation capacity at Koppal-II with 400/220kV , 2X500 MVA transformers	400/220	2	500	1000
70.	2025-26	SR	Augmentation of transformation capacity at Maheshwaram by 1x1500 MVA, 765/400 kV ICT (3rd)	765/400	1	1500	1500
71.	2025-26	SR	Augmentation of 1x1500 MVA (3rd), 765/400kV transformation capacity at Kurnool New S/s	765/400	1	1500	1500
72.	2025-26	SR	Augmentation of 2x500 MVA, 400/220kV transformation capacity at Tumkur (Pavagada) PS	400/220	2	500	1000
73.	2025-26	SR	Augmentation of 1x500 MVA, 400/220kV ICT(6th) at Koppal PS	400/220	1	500	500
74.	2025-26	SR	Augmentation of 1x500 MVA, 400/220kV ICT(6th) at Gadag PS	400/220	1	500	500
75.	2025-26	SR	Augmentation of 1x500 MVA, 400/220kV ICT(3rd) at Hassan S/s	400/220	1	500	500
76.	2025-26	SR	Augmentation of 1x500 MVA, 400/230kV ICT (6th) at Tuticorin-II GIS	400/230	1	500	500
77.	2025-26	SR	Augmentation of 2x500 MVA, 400/230 kV transformation capacity (3rd & 4th ICTs) at Karur PS	400/230	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
78.	2025-26	SR	Augmentation of 1x500 MVA, 400/220 kV ICT (5th) at NP Kunta Pooling Station	400/220	1	500	500
79.	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
80.	2025-26	NR	Establishment of 2x315MVA, 400/220kV Siot(Rajouri) S/s with 1x125 MVAR (420 kV) bus reactors	400/220	2	315	630
81.	2025-26	NR	Establishment of 7x105 MVA, 400/220kV Nange GIS Pooling Station	400/220	2	315	630
82.	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
83.	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
84.	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
85.	2025-26	NR	Augmentation with 400/220 kV, 5x500 MVA^ ICT at Bikaner-II PS	400/220	5	500	2500
86.	2025-26	NR	Augmentation with 765/400 kV, 1x1500MVA ICT (4th) at Bikaner (PG)	765/400	1	1500	1500
87.	2025-26	NR	Augmentation by 400/220 kV, 1x500 MVA (3rd) ICT at Kotputli (PG)	400/220	1	500	500
88.	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
89.	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
90.	2025-26	NR	Establishment of 3x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Barmer-I Pooling Station	765/400	3	1500	4500
91.	2025-26	NR	Establishment of 3x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Barmer-I 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)
92.	2025-26	NR	Establishment of 2x1500 MVA, 765/400 kV Substation at suitable location near Sirohi PS	765/400	2	1500	3000
93.	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			
94.	2025-26	NR	Augmentation by 1x1500 MVA, 765/400 kV ICT at Fatehgarh-II PS (7th)	765/400	1	1500	1500
95.	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
96.	2025-26	NR	Augmentation of 400/220 kV, 1x500 MVA (4th) ICT at 400/220 kV Allahabad (PG) substation	400/220	1	500	500
97.	2025-26	NR	Augmentation of 400/220 kV, 1x500 MVA ICT at 400/220 kV Malerkotla substation	400/220	1	500	500
98.	2025-26	NR	Augmentation of Transformation capacity at 400/220kV Fatehgarh-III PS by 400/220kV 1x500MVA ICT (3rd)	400/220	1	500	500
99.	2025-26	NR	Augmentation of 400/220 kV, 1x500 MVA (4 th) ICT at 400/220kV Kankroli substation	400/220	1	500	500
100.	2025-26	NR	Augmentation with 1x1500 MVA, 765/400 kV ICT(3rd) at Bareilly (765/400kV) S/s	765/400	1	1500	1500
101.	2025-26	NR	Augmentation of 2x500 MVA (4th & 5th) 400/220 kV ICTs at Bhadla-III PS	400/220	2	500	1000
102.	2025-26	NR	Augmentation of 2x1500 MVA 765/400kV (3rd & 4th) ICTs at Bhadla-III PS	765/400	2	1500	3000
103.	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
104.	2025-26	NR	Augmentation of Transformation Capacity at 400/220 kV Bassi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th)	400/220	1	500	500
105.	2025-26	NR	Augmentation of Transformation Capacity at 400/220 kV Bhiwadi (PG) S/s in Rajasthan by 400/220 kV, 1x500 MVA ICT (4th)	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)
106.	2025-26	NR	Augmentation of Transformation Capacity at 400/220 kV Bikaner-II PS in Rajasthan by 400/220 kV, 1x500 MVA ICT (9th)	400/220	1	500	500
107.	2025-26	NR	Augmentation of 400/220kV, 1x500 MVA ICT (4th) to cater the N-1 contingency requirement at 765/400/220kV Bikaner PS	400/220	1	500	500
108.	2025-26	NR	Augmentation with 400/220 kV, 1x500 MVA Transformer (11th) at Fatehgarh-2 PS	400/220	1	500	500
109.	2025-26	NR	Augmentation of 400/220 kV ,1x500 MVA (4th) ICT at Hissar (PG) S/s along with transformer bays	400/220	1	500	500
110.	2025-26	NER	Upgradation of existing 132kV Namsai (POWERGRID) S/s to 220kV (with 220kV side as GIS)	220/132	2	160	320
111.	2025-26	NER	400/220kV, 2x500MVA ICTs at Gogamukh	400/220	2	500	1000
112.	2025-26	NER	220/132kV, 2x200MVA ICTs at Gogamukh	220/132	2	200	400
113.	2025-26	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
114.	2025-26	ER	Establishment of Paradeep 765/400kV, 2x1500MVA GIS substation	765/400	2	1500	3000
115.	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
116.	2025-26	ER	Augmentation of 1x500MVA (3rd) ICT at Rajarhat	400/220	1	500	500
117.	2026-27	WR	Establishment of 2x500MVA, 400/220kV substation at Xeldem	400/220	2	500	1000
118.	2026-27	WR	Installation of 3x1500MVA, 765/400kV at Mandasaur PS + 1 spare unit of 500MVA 765/400kV ICT	765/400	3	1500	4500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
119.	2026-27	WR	Installation of 5x500MVA, 400/220kV at Mandasaur PS	400/220	5	500	2500
120.	2026-27	WR	Establishment of 2x1500MVA 765/400kV ICTs at Kurawar	765/400	2	1500	3000
121.	2026-27	WR	Establishment of 2x500MVA 400/220kV ICTs at Kurawar	400/220	2	500	1000
122.	2026-27	WR	Establishment of 3x200MVA 220/132kV ICTs at Kurawar	200/132	3	200	600
123.	2026-27	WR	Establishment of 8x1500MVA, 765/400kV ICTs at Akola-III(HVDC)	765/400	8	1500	12000
124.	2026-27	WR	Augmentation of transformation capacity at KPS2(GIS) by 1x1500MVA, 765/400kV ICT (9th) on Bus section-I	765/400	1	1500	1500
125.	2026-27	WR	Augmentation of transformation capacity at KPS3(GIS) by 3x1500MVA, 765/400kV ICT (5th, 6th & 7th) on Bus section-II	765/400	3	1500	4500
126.	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
127.	2026-27	WR	Creation of 765 kV bus section-II at KPS3 (GIS), 765/400kV ICT, 3x1500MVA	765/400	3	1500	4500
128.	2026-27	WR	Establishment of 2x1500 MVA, 765/400 kV ICT GIS SS South Olpad	765/400	2	1500	3000
129.	2026-27	WR	Establishment of 2x500 MVA, 400/220 kV ICT GIS SS South Olpad	400/220	2	500	1000
130.	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
131.	2026-27	WR	Establishment of 2x500 MVA, 400/220 kV Boisar-II (GIS) S/s	400/220	2	500	1000
132.	2026-27	WR	Establishment of 2x1500 MVA, 765/400 kV Pune-III (GIS) S/s	765/400	2	1500	3000
133.	2026-27	WR	Establishment of 3x500 MVA, 400/220 kV Pune-III (GIS) S/s	400/220	3	500	1500
134.	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

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
135.	2026-27	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
136.	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
137.	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
138.	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
139.	2026-27	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
140.	2026-27	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (3rd)	765/400	1	1500	1500
141.	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
142.	2026-27	WR	Augmentation of transformation capacity at Bhuj-II PS (GIS) by 1x1500MVA, 765/400kV ICT (4th)	765/400	1	1500	1500
143.	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
144.	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
145.	2026-27	WR	Augmentation of transformation capacity at Lakadia PS by 1x1500MVA, 765/400kV ICT (3rd)	765/400	1	1500	1500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
146.	2026-27	WR	Augmentation of transformation capacity at KPS1 by 1x1500MVA, 765/400kV ICT (9th) on Bus Section II	765/399	1	1500	1500
147.	2026-27	WR	Augmentation of transformation capacity at KPS2 by 1x1500MVA, 765/400kV ICT (9th) on Bus Section I	765/400	1	1500	1500
148.	2026-27	WR	Augmentation of transformation capacity at KPS3 by 1x1500MVA, 765/400kV ICT (8th) on Bus Section II	765/400	1	1500	1500
149.	2026-27	WR	Establishment of 4x1500 MVA, 765/400 kV Navinal (Mundra) S/s (GIS)	765/400	4	1500	6000
150.	2026-27	WR	Augmentation of transformation capacity at Banaskantha (Raghanesda) PS (GIS) by 2x500 MVA 400/220 kV ICTs (3rd & 4th)	400/220	2	500	1000
151.	2026-27	WR	Augmentation of transformation capacity at 400/220kV Bhuj PS in Gujarat by 1x500 MVA, 400/220kV ICT (10th)	400/220	1	500	500
152.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA, 400/220kV 4x500 MVA Pooling Station near Davanagere / Chitradurga, Karnataka	765/400	4	1500	6000
153.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA, 400/220kV 4x500 MVA Pooling Station near Davanagere / Chitradurga, Karnataka	400/220	4	500	2000
154.	2026-27	SR	Upgradation of Madhugiri {Tumkur(Vasantnarsapura) } to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs	765/400	3	1500	4500
155.	2026-27	SR	Establishment of 400/220kV 4x500 MVA Tumkur-II Pooling Station	400/220	4	500	2000
156.	2026-27	SR	Establishment of 400/220kV 2x500 MVA Bijapur Pooling Station	400/220	2	500	1000
157.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	765/400	4	1500	6000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
158.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA Anantapur-II Pooling Station	765/400	4	1500	6000
159.	2026-27	SR	Establishment of 400/220kV 5x500 MVA Anantapur-II Pooling Station	400/220	6	500	3000
160.	2026-27	SR	Establishment of 765/400kV 4x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	400/220	4	500	2000
161.	2026-27	SR	Augmentation of 3x1500 MVA (5th, 6th & 7th), 765/400 kV ICTs at Koppal-II PS	765/400	3	1500	4500
162.	2026-27	SR	Augmentation of additional 5x500 MVA, 400/220kV ICTs (5th, 6th, 7th, 8th & 9th) at Koppal-II PS	400/220	5	500	2500
163.	2026-27	SR	Augmentation of additional 7x500 MVA, 400/220kV ICTs (3rd, 4th, 5th, 6th, 7th, 8th & 9th) at Gadag-II PS	400/220	7	500	3500
164.	2026-27	SR	Augmentation of transformation capacity at 765/400 kV C'Peta by 1X1500 MVA	765/400	1	1500	1500
165.	2026-27	SR	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Bidadi S/s in Karnataka	400/220	1	500	500
166.	2026-27	SR	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s in Karnataka	400/220	1	500	500
167.	2026-27	SR	Augmentation of additional 400/220kV, 1x500 MVA ICT (4th) at Kozhikode	400/220	1	500	500
168.	2026-27	SR	Augmentation of additional 400/220kV, 1x500 MVA ICT (4th) at Trivandrum	400/220	1	500	500
169.	2026-27	SR	Augmentation / replacement of existing 400/230kV, 315 MVA ICT-2 with 1x500 MVA ICT at Udumalpet 400/230kV S/s	400/220	1	500	500
170.	2026-27	SR	Augmentation of transformation capacity by 1x500 MVA, 400/230kV ICT (7th) at Tuticorin-II GIS PS in Tamil Nadu	400/220	1	500	500
171.	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)
172.	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
173.	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
174.	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
175.	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
176.	2026-27	NR	Augmentation with 765/400 kV, 2x1500 MVA Transformer (4th & 5th) at Barmer-I PS	765/400	2	1500	3000
177.	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
178.	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
179.	2026-27	NR	Augmentation with 1x1500 MVA, 765/400 kV ICT (3rd) at Bareilly (765/400 kV) S/s	765/400	1	1500	1500
180.	2026-27	NR	Augmentation with 400/220 kV, 3x500 MVA (6th ,7th & 8th) ICTs at Fatehgarh-IV PS(Sec-II)	400/220	3	500	1500
181.	2026-27	NR	Augmentation with 400/220 kV, 2x500 MVA (3rd & 4th) ICTs at Barmer-I PS	400/220	2	500	1000
182.	2026-27	NR	Augmentation with 765/400 kV, 2x1500 MVA Transformer (4th & 5th) at Barmer-I PS	765/400	2	1500	3000
183.	2026-27	NR	Augmentation of 5x500 MVA (5th to 9th), 400/220 kV ICTs at Barmer-I PS	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)
184.	2026-27	NR	Establishment of 765/400kV, 2x1500 MVA S/s at suitable location near Ghiror (Distt. Mainpuri) along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) bus reactor at Ghiror S/s (UP)	765/400	2	1500	3000
185.	2026-27	NR	Establishment of 765/400 kV, 2x1500 MVA S/s at suitable location near Merta (Merta-II Substation) along with 2x240 MVAr (765kV) & 2x125 MVAr (420kV) bus reactor at Merta-II S/s	765/400	2	1500	3000
186.	2026-27	NR	5x500MVA, 400/220kV ICTs at Sirohi S/s along with associated transformer bays	400/220	5	500	2500
187.	2026-27	NR	3x500MVA, 400/220kV ICTs at Merta-II S/s along with associated transformer bays	400/220	3	500	1500
188.	2026-27	NR	Augmentation of 400/220 kV, 1x500 MVA (10th) ICT at Bikaner-II PS along with associated transformer bays	400/220	1	500	500
189.	2026-27	NR	Augmentation of 400/220 kV, 1x500 MVA (6th) ICT at Bikaner-III PS along with associated transformer bays	400/220	1	500	500
190.	2026-27	NR	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (4th) at Bhadla-II PS (Section-1A) along with associated transformer bays	400/220	1	500	500
191.	2026-27	NR	Augmentation of Transformation capacity by 1x500MVA ,400/220kV ICT (6th) at Bhadla-II PS (Section-1) along with associated transformer bays	400/220	1	500	500
192.	2026-27	NR	Augmentation of 400/220 kV ,1x500 MVA (4th) ICT at Samba (PG) S/s along with associated transformer bays	400/220	1	500	500
193.	2026-27	NR	Augmentation of 400/220 kV ,1x500 MVA (3rd) ICT at 765/400/220kV Agra (PG) S/s along with associated transformer bays	400/220	1	500	500
194.	2026-27	NR	Augmentation of 400/220 kV ,1x500 MVA (5th) ICT at 400/220kV Mandola (PG) S/s along with associated transformer bays	400/220	1	500	500
195.	2026-27	NR	Augmentation of 400/220 kV, 1x500 MVA (3rd) ICT at 400/220kV Lucknow (PG) S/s along with associated transformer bays	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)
			(1 no. additional 400kV line bay is also being implemented for GIS diameter completion)				
196.	2026-27	NER	Installation of new 1x50MVA, 132/33kV (3rd) ICT at Namsai (POWERGRID) S/s along with associated bays.	132/33	1	50	50
197.	2026-27	ER	Installation of new 1x500MVA, 400/220kV (3rd) ICT at Pandiabili (POWERGRID) S/s along with associated bay at 220kV level [using the bay no. 413 at 400kV level, which is already under implementation under ERBS-I scheme].	400/220	1	500	500
198.	2027-28	WR	Establishment 3x1500 MVA, 765/400 kV Substation near Raghanesda (GIS) with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor	765/400	3	1500	4500
199.	2027-28	WR	Establishment of 3X1500 MVA 765/400 kV Kandla (GIS) with 2X330 MVAR 765 kV bus reactor and 2X125 MVAR 420 kV bus reactor	765/400	3	1500	4500
200.	2027-28	WR	Augmentation of Transformation capacity at 765/400 kV Navinal(Mundra) S/s (GIS) by 2x1500 MVA ICTs (New Bus Section-II)	765/400	2	1500	3000
201.	2027-28	WR	Establishment of 6x1500 MVA, 765/400 kV Navinal-II (Mundra) S/s (GIS) with 2x330 MVAR, 765 kV & 2x125MVAr, 420 kV bus reactors (In 2 bus sections)	765/400	6	1500	9000
202.	2027-28	WR	Establishment 2x1500 MVA, 765/400 kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor.	765/400	2	1500	3000
203.	2027-28	WR	Creation of New 220kV Bus Section-II at Neemuch PS with Augmentation of transformation capacity by 3x500MVA, 400/220kV ICTs (3rd, 4th & 5th) at Neemuch S/s along with associated bays.	400/220	3	500	1500
204.	2027-28	WR	Establishment of 2x500MVA, 400/220kV S/s at Handiya with	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)
			2x125MVAr 420kV Bus Reactors				
205.	2027-28	WR	Creation of New 220kV Bus Section (3rd) with 220kV Bus Sectionaliser and 400/220kV, 3x500MVA ICT augmentation (7th, 8th & 9th) at Pachora PS terminated on 220kV Bus Section (3rd)	400/220	3	500	1500
206.	2027-28	WR	Establishment 4x1500 MVA, 765/400 kV Substation near Kalyanpur (GIS) with 2x330 MVAR, 765 kV bus reactor	765/400	4	1500	6000
207.	2027-28	WR	Establishment 7x500 MVA, 400/220kV Substation near Kalyanpur (GIS) with 2x125 MVAR, 420 kV bus reactor	400/220	7	500	3500
208.	2027-28	WR	Creation of 220kV switchyard along with Installation of 3x500MVA, 400/220kV ICTs at Jamnagar (GIS) S/s	400/220	3	500	1500
209.	2027-28	WR	Augmentation of transformation capacity at Bhuj-II PS by 1x1500MVA ICT (5th)	765/400	1	1500	1500
210.	2027-28	WR	Establishment of 765/400 kV, 6x1500MVA Lakadia-II (Near Chitrod) with 2x330 MVAR 765kV bus reactor	765/400	6	1500	9000
211.	2027-28	WR	Establishment of 10x500MVA, 400/220kV Lakadia-II (Near Chitrod) with 2x125 MVAR 400kV bus reactor.	400/220	10	500	5000
212.	2027-28	WR	Augmentation of transformation capacity at South Olpad (GIS) S/s by 1x1500MVA, 765/400kV (3rd) ICT	765/400	1	1500	1500
213.	2027-28	WR	Establishment of 765/400 kV, 3x1500MVA Nasik S/s (towards South of Nasik) with 2x330 MVAR 765kV bus reactor	765/400	3	1500	4500
214.	2027-28	WR	Establishment of 400/220kV, 3x500MVA Nasik S/s (towards South of Nasik) with 2x125 MVAR 400kV bus reactor.	400/220	3	500	1500
215.	2027-28	WR	Establishment of 765/400 kV, 2x1500MVA Alephata S/s with 2x330 MVAR 765kV bus reactor	765/400	2	1500	3000
216.	2027-28	WR	Establishment of 400/220kV, 3x500MVA Alephata S/s 2x125 MVAR 400kV bus reactor	400/220	3	500	1500
217.	2027-28	WR	Establishment 4x1500 MVA, 765/400kV	765/400	4	1500	6000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
			Substation near Raghanesda (GIS) with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor				
218.	2027-28	WR	Creation of 220kV switchyard (Bus Sec-I) at Raghanesda PS (GIS) along with installation of 2x500MVA, 400/220 kV ICTs	400/220	2	500	1000
219.	2027-28	WR	Installation of 2x500MVA, 400/220kV ICTs (5th & 6th) at Solapur PS	400/220	2	500	1000
220.	2027-28	WR	400/220 kV, 3x500 MVA ICT augmentation (8th ,9th & 10th) at Solapur PS on New 400kV Bus Section-2 and 220kV Bus Section-3	400/220	3	500	1500
221.	2027-28	WR	Augmentation of Transformation capacity by 1x1500MVA, 765/400kV ICT (4th) (Terminated at 400kV & 765kV Bus Section-II)	765/400	1	1500	1500
222.	2027-28	WR	Augmentation of Transformation capacity by 1x500MVA, 400/220kV ICT (6th) (Terminated on 400kV Bus Section-I & 220kV Bus Section-II)	400/220	1	500	500
223.	2027-28	WR	Augmentation of Transformation capacity by 1x500MVA, 400/220kV ICT (7th) (Terminated on 400kV Bus Section-II & 220kV Bus Section-III) at Mandsaur PS	400/220	1	500	500
224.	2027-28	WR	Establishment of 3x1500 MVA, 765/400 kV Morena PS (South of Sabalgarh) with 2x330 MVAR 765 kV bus reactor	765/400	3	1500	4500
225.	2027-28	WR	Establishment of 2x500MVA, 400/220kV Morena PS (South of Sabalgarh) with 2x125 MVAR 420 kV bus reactor	400/220	2	500	1000
226.	2027-28	WR	Augmentation of 400/220kV transformation capacity at 765/400/220kV Karera (near Datia) S/s (Sec-I) by 1x500MVA ICT (3rd)	400/220	1	500	500
227.	2027-28	SR	Augmentation of 2x500 MVA, 400/230 kV at Karur PS	400/230	2	500	1000

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
228.	2027-28	SR	Upgradation of Tuticorin PS to its rated voltage of 765kV level alongwith 2x1500 MVA, 765/400kV ICTs and 1x330 MVAr Bus Reactor	765/400	3	1500	4500
229.	2027-28	SR	Upgradation of Dharmapuri (Salem New) to its rated voltage of 765kV level alongwith 2x1500 MVA, 765/400kV ICTs and 1x240 MVAr Bus Reactor	765/400	3	1500	4500
230.	2027-28	SR	Establishment of 3x1500 MVA, 765/400 kV Tuticorin (GH) S/s with 1x240 MVAR bus Reactor	765/400	3	1500	4500
231.	2027-28	SR	Establishment of 3x1500 MVA, 765/400 kV Kakinada (GH) S/s with 1x240 MVAR bus Reactor	765/400	3	1500	4500
232.	2027-28	SR	Establishment of 765/400kV 4x1500 MVA Pooling Station near Nizamabad (Nizamabad-II)	765/400	4	1500	6000
233.	2027-28	SR	Establishment of 400/220kV 2x500 MVA Pooling Station at Nizamabad-II	400/220	2	500	1000
234.	2027-28	SR	Establishment of 400/220kV 2x500 MVA Medak Pooling Station	400/220	2	500	1000
235.	2027-28	SR	Establishment of 400/220kV 2x500 MVA Rangareddy Pooling Station	400/220	2	500	1000
236.	2027-28	SR	Augmentation of transformation capacity at 765/400kV Nizamabad (PG) by 1X1500 MVA (4th) ICT	765/400	1	1500	1500
237.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Nizamabad-II by 1X500 MVA	400/220	1	500	500
238.	2027-28	SR	Augmentation of transformation capacity at 765/400 kV Nizamabad-II by 2X1500 MVA	765/400	2	1500	3000
239.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Medak by 1X500 MVA	400/220	1	500	500
240.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Rangareddy by 1X500 MVA	400/220	1	500	500
241.	2027-28	SR	Establishment of 400/220kV 3x500 MVA Karimnagar Pooling Station	400/220	3	500	1500
242.	2027-28	SR	Establishment of 400/220kV 4x500 MVA Bellary Pooling Station	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)
243.	2027-28	SR	Augmentation of 2x1500 MVA, 765/400 & 6x500 MVA, 400/220 kV Kurnool-IV Pooling Station	765/400	2	1500	3000
244.	2027-28	SR	Augmentation of 2x1500 MVA, 765/400 & 6x500 MVA, 400/220 kV Kurnool-IV Pooling Station	400/220	6	500	3000
245.	2027-28	SR	Augmentation of transformation capacity at 765/400kV Anantapur-II by 2X1500 MVA	765/400	2	1500	3000
246.	2027-28	SR	Augmentation of transformation capacity at 400/220kV Anantapur-II by 4X500 MVA	400/220	4	500	2000
247.	2027-28	SR	Establishment of 765/400kV 3x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	765/400	3	1500	4500
248.	2027-28	SR	Establishment of 765/400kV 3x1500 MVA,5x500 MVA Kurnool-IV Pooling Station	400/220	5	500	2500
249.	2027-28	SR	Establishment of 765/400kV 3x1500 MVA Kadapa-II Pooling Station	765/400	3	1500	4500
250.	2027-28	SR	Establishment of 400/220kV 4x500 MVA Kadapa-II Pooling Station	400/220	4	500	2000
251.	2027-28	SR	Augmentation of transformation capacity at 765/400/220kV Kurnool-III by 4X1500 MVA	765/400	4	1500	6000
252.	2027-28	SR	Establishment of 765/400kV 4x1500 MVA,5x500 MVA Kurnool-V	765/400	3	1500	4500
253.	2027-28	SR	Augmentation of transformation capacity at 765/400 kV Kurnool-V by 1X1500 MVA	765/400	1	1500	1500
254.	2027-28	SR	Establishment of 3x1500 MVA, 765/400 kV CN'Halli Station with 2x330 MVAr (765 kV) bus reactors	765/400	3	1500	4500
255.	2027-28	SR	Augmentation of transformation capacity by 3x500 MVA, 400/220 kV ICTs (6th – 8th) at Bidar PS	400/220	3	500	1500
256.	2027-28	SR	Augmentation of transformation capacity by 1x1500 765/400kV ICT (4th) at Bidar PS	765/400	1	1500	1500
257.	2027-28	SR	Augmentation of transformation capacity by 4x500 MVA, 400/220kV ICTs (5th – 8th) at Davanagere PS	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)
258.	2027-28	SR	Augmentation of transformation capacity by 1x500 MVA (3rd), 400/220kV ICT at Yelahanka 400/220kV GIS S/s in Karnataka	400/220	1	500	500
259.	2027-28	SR	Establishment of 4x1500 MVA, 765/400 kV Shadnagar Station with 2x330 MVAr (765 kV) bus reactors with space provision for establishment of 220 kV switchyard	765/400	4	1500	6000
260.	2027-28	SR	Establishment of 3x1500 MVA, 765/400kV GH S/s near Mangalore with space provision for establishment of 220kV switchyard	765/400	3	1500	4500
261.	2027-28	SR	Augmentation of Tumkur-II PS by 400/220 kV, 6x500 MVA ICTs	400/220	6	500	3000
262.	2027-28	SR	Augmentation of Bellary PS by 400/220kV, 4x500 MVA ICTs.	400/220	4	500	2000
263.	2027-28	SR	Augmentation of transformation capacity by 2x500 MVA, 400/220kV ICTs (9th & 10th) at Bidar PS	400/220	2	500	1000
264.	2027-28	SR	Augmentation of transformation capacity of 1x1500 MVA (5th), 765/400kV ICT at Bidar PS	765/400	1	1500	1500
265.	2027-28	NR	Establishment of 4x1500 MVA 765/400 kV Robertsganj Pooling Station near Robertsganj area in Sonbhadra distt. (Uttar Pradesh) along with 2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors	765/400	4	1500	6000
266.	2027-28	NER	Establishment of new 400kV Bornagar (ISTS) switching station in Assam	400kV switching station	0	0	0
267.	2027-28	ER	Establishment of Gopalpur 765/400kV, 2x1500MVA GIS substation	765/400	2	1500	3000
268.	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
269.	2028-29	WR	Installation of 2x1500MVA, 765/400 kV ICTs at Vataman along with 1x125 MVAr (420kV) Bus Reactor	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)
270.	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
271.	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
272.	2028-29	WR	Establishment of 2x500 MVA, 400/220 kV Mahuva Onshore Pooling Station (GIS) (Mahuva PS)	400/220	2	500	1000
273.	2028-29	WR	Creation of 400kV switchyard along with Installation of 2x1500 MVA, 765/400 kV ICTs at Vataman (AIS)	765/400	2	1500	3000
274.	2028-29	WR	Establishment of 2x315 MVA, 220/66 kV Gujarat Offshore B3 Sub-Station Station-1 (B3-OSS-1)	220/66	2	315	630
275.	2028-29	WR	Augmentation of transformation capacity at Sipat STPS by 1x1500MVA, 765/400kV ICT (3rd)	765/400	1	1500	1500
276.	2028-29	SR	Establishment of Khammam-II 765/400 kV, 3x1500 MVA substation	765/400	3	1500	4500
277.	2028-29	SR	Augmentation by 3x1500 MVA, 765/400 kV ICTs at Kakinada substation	765/400	3	1500	4500
278.	2028-29	NR	Establishment of 5x1500MVA, 765/400KV ICTs at Fatehpur(HVDC)	765/400	5	1500	7500
279.	2028-29	NR	400/220/33kV, 315 MVA transformer at pang S/s	400/220	2	315	630
280.	2028-29	NR	765/400/33kV, 1500 MVA transformer at Kaithal S/s	765/400	3	1500	4500
281.	2028-29	NR	Augmentation of 765/400kV, 1500 MVA transformer of Bhiwani S/s	765/400	1	1500	1500
282.	2029-30	WR	Establishment of 6x1500MVA, 765/400 kV ICT at Nagpur SS	765/400	6	1500	9000
283.	2029-30	WR	Installation of additional 3x1500 MVA, 765/400 kV ICTs at Alephata S/s along with associated interconnections with HVDC Switchyard	765/400	3	1500	4500

Sr No	Time Frame	Region	Transformers	Voltage Ratio (kV)	No. of Transformer	Rating Of Transformer (MVA)	Total Transformation Capacity (MVA)
284.	2029-30	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 MSR with provision of expansion upto 5 GW.	400/220	2	500	1000
285.	2029-30	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	2	315	630

3. Bus Reactors

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
1.	2025-26	WR	Establishment of 2x330 MVAR 765 kV bus reactor at KPS2	2	330	660
2.	2025-26	WR	Establishment of 2x125 MVAR 400 kV bus reactor at KPS2	2	125	250
3.	2025-26	WR	Augmentation of Khavda PS1 with 1x330 MVAR 765 kV bus reactor on 2nd 765 kV bus section	1	330	330
4.	2025-26	WR	Augmentation of Khavda PS1 with 1x125 MVAR 420 kV bus reactor on 2nd 400 kV bus section	1	125	125
5.	2025-26	WR	Establishment of 1X125 MVAR, 420 kV bus reactor at Chhatarpur PS	1	125	125
6.	2025-26	WR	2x330 MVAr (765kV) bus reactor at Navsari (New) South Gujarat (GIS) S/s	2	330	660
7.	2025-26	WR	125 MVAr (400kV) bus reactor at Navsari (New) South Gujarat (GIS) S/s	1	125	125
8.	2025-26	WR	Establishment of 1x330 MVAR 765 kV bus reactor at KPS3(GIS)	1	330	330
9.	2025-26	WR	Establishment of 1x125 MVAR 400 kV bus reactor at KPS3(GIS)	1	125	125
10.	2025-26	WR	Establishment of 1x330 MVAR 765 kV bus reactor at Ahmedabad S/s	1	330	330
11.	2025-26	WR	Establishment of 1x125 MVAR 400 kV bus reactor at Ahmedabad S/s	1	125	125
12.	2025-26	WR	Establishment of 125MVAR, 420kV Bus Reactor at Solapur PP (near Mohol)	1	125	125
13.	2025-26	WR	Establishment of 420kV 125 MVAR bus reactor at Wardha SEZ PP	1	125	125
14.	2025-26	WR	Establishment of 1x330MVAr, 765kV Bus reactor at Dholera PS	1	330	330
15.	2025-26	WR	Establishment of 1x125MVAr, 400kV Bus reactor at Dholera PS	1	125	125
16.	2025-26	WR	1x330 MVAr 765 kV bus reactor at Karera (near Datiya)+1 spare unit	1	330	330
17.	2025-26	WR	1x330 MVAr , 765 kV Bus reactor with 1 spare unit of 110MVAr at Ishanagar (New)	1	330	330
18.	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
19.	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
20.	2025-26	WR	Establishment of 2x330MVAr 765kV bus reactor at Boisar II GIS	2	330	660
21.	2025-26	WR	Establishment of 2x125MVAr 420kV bus reactor at Boisar II GIS	2	125	250
22.	2025-26	WR	Establishment of 2x330MVAr 765kV bus reactors at PuneIII	2	330	660
23.	2025-26	WR	Establishment of 2x125MVAr 420kV bus reactor at Pune III	2	125	250

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
24.	2025-26	WR	Establishment of 2x330 MVAR, 765 kV bus reactors at Navinal (Mundra) S/s (GIS)	2	330	660
25.	2025-26	WR	Establishment of 1x125 MVAr, 420 kV bus reactors at Navinal (Mundra) S/s (GIS)	1	125	125
26.	2025-26	WR	Establishment of 2x125MVAr, 420kV bus reactors at pooling station near Dhule, Maharashtra.	2	125	250
27.	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
28.	2025-26	WR	Creation of 400kV switchyard along with Installation of 2x1500 MVA, 765/400 kV ICTs at Vataman (AIS) with 2x125 MVAr (420 kV) Bus Reactors	2	125	250
29.	2025-26	SR	2X63 MVAr bus reactors at Kasargode Ss	2	63	126
30.	2025-26	SR	2x330 MVAr (765kV) bus reactor at Narendra (New) (GIS)	2	330	660
31.	2025-26	SR	1x240 MVAr Bus Reactor at Bidar	1	240	240
32.	2025-26	SR	1x125 MVAr Bus Reactor at Bidar	1	125	125
33.	2025-26	SR	2x125 MVAr (400kV) bus reactor at Anantapur PS	2	125	250
34.	2025-26	SR	2X330 MVAr Bus Reactors at 765kV Koppal-II	2	330	660
35.	2025-26	SR	2X125 MVAr Bus Reactors at 400kV Koppal-II	2	125	250
36.	2025-26	SR	2X125 MVAr Bus Reactors at 400kV Gadag-II	2	125	250
37.	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
38.	2025-26	NR	Establishment of 2x315MVA, 400/220kV Siot(Rajouri) S/s with 1x125 MVAR (420 kV) bus reactors	1	80	80
39.	2025-26	NR	125 MVAR (420kV) Bus Reactor at Nange (GIS) PS (1-Ph units along with one spare unit)	1	125	125
40.	2025-26	NR	125 MVAR (420kV) Bus Reactor at Koldam S/s (1-Ph units along with one spare unit)	1	125	125
41.	2025-26	NR	2X330 MVAr Bus Reactors at 765kV Bikaner-III	2	330	660
42.	2025-26	NR	2X125MVAr Bus Reactors at 765kV Bikaner-III	2	125	250
43.	2025-26	NR	2X330 MVAr Bus Reactors at 765kV Neemrana-2	2	330	660
44.	2025-26	NR	2X125MVAr Bus Reactors at 765kV Neemrana-2	2	125	250
45.	2025-26	NR	2X240MVAr Bus Reactors at 765kV Fatehgarh- IV (Section-2)	2	240	480
46.	2025-26	NR	2X125MVAr Bus Reactors at 765kV Fatehgarh- IV (Section-2)	2	125	250
47.	2025-26	NR	2X240MVAr Bus Reactors at 765kV Barmer-I PS	2	240	480
48.	2025-26	NR	2X125MVAr Bus Reactors at 400kV Barmer-I PS	2	125	250

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
49.	2025-26	NR	2X240MVAr Bus Reactors at 765kV Jalore PS	2	240	480
50.	2025-26	NR	2X125MVAr Bus Reactors at 400kV Jalore PS	2	125	250
51.	2025-26	NR	1X125MVAr Bus Reactors at 400kV Jhangi	1	125	125
52.	2025-26	NER	2x125 MVAr, 400 kV Bus reactors at Gogoamukh	2	125	250
53.	2025-26	NER	1 no 50MVAr Bus reactor at Namsai	1	50	50
54.	2025-26	NER	2X80MVAr Bus Reactors at 400kV Bokajan substation	2	80	160
55.	2025-26	NER	1x125MVAr Bus Reactor at 400kV Bongaigaon	1	125	125
56.	2025-26	NER	Decommissioning of 2x50MVAr Bus Reactor at 400kV Bongaigaon	-2	50	-100
57.	2025-26	NER	Decommissioning of existing 420kV, 50MVAr (Bus Reactor-1) and installation of new 420kV, 125MVAr bus reactor in its place along with replacement of associated main and tie bay equipment at Balipara (POWERGRID) S/s	1	125	125
58.	2025-26	NER	Installation of new 420 kV, 1x125 MVAr, 3-Ph Variable Shunt Reactor (VSR) having variable range from 63MVAr to 125MVAr (with at least 25 tap positions) along with associated GIS bay at Misa (POWERGRID) S/s	1	125	125
59.	2025-26	ER	Installation of new 420kV, 1x125MVAr bus reactor along with associated bay at Jamshedpur (POWERGRID) S/s	1	125	125
60.	2025-26	ER	2X125MVAr Bus Reactors at 400kV Paradeep GIS substation	2	125	250
61.	2025-26	ER	2X330MVAr Bus Reactors at 765kV Paradeep GIS substation	2	330	660
62.	2026-27	WR	Establishment of 1x125MVAR Bus Reactor at Xeldem S/s	1	125	125
63.	2026-27	WR	Establishment of 765kV Mandsaur Pooling Station along with 2x330MVAr (765kV) Bus Reactor	2	330	660
64.	2026-27	WR	Establishment of 2x125MVAr 765kV bus reactor at Mandsaur	2	125	250
65.	2026-27	WR	Establishment of 1x125MVAr 420kV bus reactor at Kurawar	1	125	125
66.	2026-27	WR	Establishment of 2x330MVAr, 765kV Bus reactor at Kurawar	2	300	600
67.	2026-27	WR	Establishment of 2x330 MVAr 765kV bus reactors at Akola-III (HVDC)	2	330	660
68.	2026-27	WR	Establishment of 2x125MVAr, 420kV bus reactors at Akola-III (HVDC)	2	125	250
69.	2026-27	WR	2X330MVAr Bus Reactors at 765kV Jamnagar GIS substation	2	330	660
70.	2026-27	WR	2X125MVAr Bus Reactors at 400kV Jamnagar GIS substation	2	125	250
71.	2026-27	WR	1x330MVAr Bus Reactor at KPS-3 (GIS) Section-II	1	330	330

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
72.	2026-27	WR	1x125MVAr Bus Reactor at KPS-3 (GIS) Section-II	1	125	125
73.	2026-27	WR	2x330MVAr Bus Reactor at South Olpad	2	330	660
74.	2026-27	WR	1x125MVAr Bus Reactor at at South Olpad	1	125	125
75.	2026-27	WR	2x330MVAr Bus Reactor at Boisar-II (GIS) SS	2	330	660
76.	2026-27	WR	2x125MVAr Bus Reactor at Boisar-II (GIS) SS	2	125	250
77.	2026-27	WR	2x330MVAr Bus Reactor at Pune-III (GIS) SS	2	330	660
78.	2026-27	WR	2x125MVAr Bus Reactor at Pune-III (GIS) SS	2	125	250
79.	2026-27	WR	Installation of 1x330MVAr 765kV Bus Reactor (2nd) along-with associated bay	1	330	330
80.	2026-27	WR	Installation of 2x330MVAr, 765kV Bus Reacto at Navinal (Mundra) S/s (GIS)	2	330	660
81.	2026-27	WR	Installation of 1x125MVAr, 420kV Bus Reactor at Navinal (Mundra) S/s (GIS)	1	125	125
82.	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
83.	2026-27	SR	2X330MVAr Bus Reactors at 765kV Davangere/Chitradurga	2	330	660
84.	2026-27	SR	2X330MVAr Bus Reactors at 765kV Madhugiri (upgradatoin)	2	330	660
85.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Tumkur-II	2	125	250
86.	2026-27	SR	2X125MVAr Bus Reactors at 400kV Bijapur	2	125	250
87.	2026-27	SR	2X330MVAr Bus Reactors at 765kV Kurnool-IV	2	330	660
88.	2026-27	SR	2X330MVAr Bus Reactors at 765kV Anantapur-II	2	330	660
89.	2026-27	NR	2x80 MVAr (420kV) Bus Reactors at Kaza PS	2	80	160
90.	2026-27	NR	2x240 MVAr (765kV) Bus Reactor at Bikaner-IV PS 2x240 MVAr (765kV) Bus Reactor Bus Reactor at Siwani	4	240	960
91.	2026-27	NR	2x125 MVAr (420kV) Bus Reactor at Bikaner-IV PS 2x125 MVAr (420kV) Bus Reactor at Siwani	4	125	500
92.	2026-27	NR	2x240 MVAr bus reactor at Merta-II S/s	2	240	480
93.	2026-27	NR	2x125 MVAr bus reactor at Merta-II S/s	2	125	250
94.	2026-27	NR	110MVAr spare reactor unit (1 no.) at Barmer-I PS (single phase)	1	110	110
95.	2026-27	NR	2x240 MVAr bus reactor at Ghiror S/s (UP)	2	240	480

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
96.	2026-27	NR	2x125 MVAr bus reactor at Ghiror S/s (UP)	2	125	250
97.	2026-27	NR	2x240 MVAr (765kV) bus reactor at Ghiror S/s (UP)	2	240	480
98.	2026-27	NR	2x125 MVAr (420kV) bus reactor at Ghiror S/s (UP)	2	125	250
99.	2026-27	NER	Installation of new 420kV, 125MVAr Bus Reactor at Biswanath Chariali (POWERGRID) S/s along with associated bays	1	125	125
100.	2027-28	WR	Establishment 3x1500 MVA, 765/400 kV Substation near Raghanesda (GIS) with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor	2	330	660
101.	2027-28	WR	Establishment 3x1500 MVA, 765/400 kV Substation near Raghanesda (GIS) with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor	2	125	250
102.	2027-28	WR	Establishment of 3X1500 MVA 765/400 kV Kandla (GIS) with 2X330 MVAR 765 kV bus reactor and 2X125 MVAR 420 kV bus reactor	2	330	660
103.	2027-28	WR	Establishment of 3X1500 MVA 765/400 kV Kandla (GIS) with 2X330 MVAR 765 kV bus reactor and 2X125 MVAR 420 kV bus reactor	2	125	250
104.	2027-28	WR	Establishment of 6x1500 MVA, 765/400 kV Navinal-II (Mundra) S/s (GIS) with 2x330 MVAR, 765 kV & 2x125MVAr, 420 kV bus reactors (In 2 bus sections)	2	330	660
105.	2027-28	WR	Establishment of 6x1500 MVA, 765/400 kV Navinal-II (Mundra) S/s (GIS) with 2x330 MVAR, 765 kV & 2x125MVAr, 420 kV bus reactors (In 2 bus sections)	2	125	250
106.	2027-28	WR	Establishment 2x1500 MVA, 765/400 kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor.	2	330	660
107.	2027-28	WR	Establishment 2x1500 MVA, 765/400 kV Substation near South of Kalamb with 2x330 MVAR, 765 kV bus reactor and 2x125 MVAR, 420 kV bus reactor.	2	125	250
108.	2027-28	WR	Installation of 1x125 MVAR, 420 kV bus reactor (2nd) at Neemuch PS	1	125	125
109.	2027-28	WR	Establishment of 2x500MVA, 400/220kV S/s at Handiya with 2x125MVAr 420kV Bus Reactors	2	125	250
110.	2027-28	WR	Installation of 1x125 MVAR, 420 kV bus reactor at Pachora PS (400kV Bus Section-II)	1	125	125
111.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Nizamabad-II	2	125	250
112.	2027-28	SR	2X330MVAr Bus Reactors at 765kV Nizamabad-II	2	330	660
113.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Medak	2	125	250
114.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Rangareddy	2	125	250
115.	2027-28	SR	2X125MVAr Bus Reactors at 400kV karimnagar	2	125	250

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
116.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Bellary-II	2	125	250
117.	2027-28	SR	2X330MVAr Bus Reactors at 400kV Kadapa-II	2	330	660
118.	2027-28	SR	2X125MVAr Bus Reactors at 400kV Kadapa-II	2	125	250
119.	2027-28	SR	1x330 MVAR, 765kV bus reactor (3rd) at Angul Substation	1	330	330
120.	2027-28	SR	2x330 MVAr Bus reactor at 765/400 kV Shadnagar Station	2	330	660
121.	2027-28	SR	1x240 MVAr Bus reactor at 765/400kV Mangalore	1	240	240
122.	2027-28	SR	2x330 MVAr (765 kV) bus reactors at CN'Halli	2	330	660
123.	2027-28	ER	2X125MVAr Bus Reactors at 400kV Gopalpur GIS substation	2	125	250
124.	2027-28	ER	2X330MVAr Bus Reactors at 765kV Gopalpur GIS substation	2	330	660
125.	2027-28	ER	2X125MVAr Bus Reactors at 400kV Bishnupur (ISTS) SWITCHING STATION	2	125	250
126.	2028-29	WR	2x330MVAr 765kV Bus Reactor at South Kalamb S/s (MH)	2	330	660
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
129.	2028-29	WR	Establishment of 2x500 MVA, 400/220 kV Mahuva Onshore Pooling Station (GIS) (Mahuva PS) alongwith 1x125 MVAR, 420 kV bus reactor	1	125	125
130.	2028-29	WR	Creation of 400kV switchyard along with Installation of 2x1500 MVA, 765/400 kV ICTs at Vataman (AIS) with 2x125 MVAr (420 kV) Bus Reactors	2	125	250
131.	2028-29	WR	420 kV, 1x125 MVAR Variable Bus Shunt Reactor with OLTC (control range between 50 – 125 MVAr for VSR) with 1 No. of 400 kV bay	1	125	125
132.	2028-29	WR	245 kV, 3x50 MVAr Bus Reactors at 220 kV level of Mahuva PS (GIS)	3	50	150
133.	2028-29	NR	2x330MVAr (765kV) bus reactor at Fatehpur	2	330	660
134.	2029-30	WR	2x330MVAr Bus Reactor at Nagpur SS	2	330	660
135.	2029-30	WR	2x125MVAr Bus Reactor at Nagpur SS	2	125	250
136.	2029-30	WR	2x125MVAr Bus Reactor at KPS3 (HVDC)	2	125	250
137.	#N/A	#N/A	1x330 MVAr Bus Reactor at Tuticorin PS	1	330	330

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
138.	#N/A	#N/A	1x240 MVAr Bus Reactor at Dharmapuri (Salem New)	1	240	240
139.	#N/A	#N/A	1x240 MVAr Bus Reactor at Madhugiri (Tumkur)	1	240	240
140.	2027-28	SR	1x240 MVAr Bus reactor at 765/400kV Kakinada GH GIS	1	240	240
141.	2027-28	SR	1x240 MVAr Bus reactor at 765/400kV Tuticorin GH GIS	1	240	240
142.	2027-28	SR	1x330 MVAr (765 kV) bus reactors at Tuticorin PS	1	330	330
143.	2027-28	SR	1x330 MVAr (765 kV) bus reactors at Dharmapuri (Salem New)	1	330	330
144.	2027-28	WR	2x330 MVAR, 765 kV bus reactor Substation near Kalyanpur (GIS)	2	330	660
145.	2027-28	WR	2x125 MVAR, 420 kV bus reactor Substation near Kalyanpur (GIS)	2	125	250
146.	2027-28	WR	2x330 MVAR 765kV bus reactor Lakadia-II (Near Chitrod)	2	330	660
147.	2027-28	WR	2x125 MVAR 400kV bus reactor Lakadia-II (Near Chitrod)	2	125	250
148.	2027-28	WR	2x330 MVAR 765kV bus reactor Nasik S/s (towards South of Nasik)	2	330	660
149.	2027-28	WR	2x125 MVAR 400kV bus reactor Nasik S/s (towards South of Nasik)	2	125	250
150.	2027-28	WR	2x330 MVAR 765kV bus reactor Alephata S/s	2	330	660
151.	2027-28	WR	2x125 MVAR 400kV bus reactor Alephata S/s	2	125	250
152.	2027-28	WR	2x330 MVAR, 765 kV bus reactor Substation near Raghanesda (GIS)	2	330	660
153.	2027-28	WR	2x125 MVAR, 400 kV bus reactor Substation near Raghanesda (GIS)	2	125	250
154.	2027-28	WR	2x330 MVAR 765 kV bus reactor Morena PS (South of Sabalgarh)	2	330	660

Sr No	Time frame	Region	Bus Reactors	No of Reactor	Rating of Reactor	Total reactive compensation (MVAR)
155.	2027-28	WR	2x125 MVAR 400kV bus reactor Morena PS (South of Sabalgarh)	2	125	250
156.	2027-28	NR	2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors at Robertsganj Pooling Station	2	240	480
157.	2027-28	NR	2x240 MVAr 765 kV & 2x125 MVAr 400 kV bus reactors at Robertsganj Pooling Station	2	125	250
158.	2027-28	NR	2x330 MVAr 765 kV Bus reactors at Prayagraj Substation	2	330	660

Annex 3.10

Inter-Regional Transmission Capacity (MW)

Transmission line	Present	Capacity at the End of 2030
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	1600	1600
Siliguri/Alipurduar - Bongaigaon 400kV D/c (Quad)	1600	1600
Sub-total	**3,550**	**3,550**
NORTH EAST - NORTH		
Biswanath Chariali - Agra ±800kV HVDC Bipole with 3000MW converter	3000	3000
Sub-total	**3,000**	**3,000**
WEST - NORTH		

Transmission line	Present	Capacity at the End of 2030
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
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	1600	1,600
Mandsaur PS - Rishabhdeo 765 kV D/c	-	4,200
Mandsaur PS -Beawar 765 kV D/c	-	4,200
Sasan- Prayagraj 765kV D/c	-	4,200
Sub-total	38,320	50,920
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	1,18,740	1,38,740
** 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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Central Transmission Utility of India Limited

"भविष्य की भविष्यवाणी करने का सबसे अच्छा तरीका उसका अनुकरण करना है।"

"The only way to do great work is to love what you do"

- Steve Jobs

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