ROLLING PLAN 2028-29

INTER STATE TRANSMISSION SYSTEM (ISTS)

INTERIM REPORT

SEPTEMBER 2023

CENTRAL TRANSMISSION UTILITY

ROLLING PLAN 2028-29

INTER-STATE TRANSMISSION SYSTEM (ISTS)

(INTERIM REPORT)

Sep 2023

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Executive Summary

The Indian power sector is a crucial component of the country's infrastructure and economy. It plays a pivotal role in supporting industrialization, urbanization and overall economic growth. Over the past decade, India's power sector has undergone a remarkable transformation, aimed at providing reliable, affordable, and sustainable energy to its people. Significant strides have been made by the GOI in enhancing power generation capacity, expanding access to electricity, promoting renewable energy, and implementing innovative policies like the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya), Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), National Solar Mission etc. From being power deficit to power surplus, India has explored opportunities for cross-border electricity trade with neighbouring countries like Bhutan, Nepal, and Bangladesh (this trade allows for the exchange of surplus power and enhances regional energy cooperation).

India's journey towards a clean and green energy has gained global recognition. Today, India stands 4th globally in Renewable Energy Installed Capacity, with 43% of its total installed electricity capacity coming from non-fossil energy sources. India envisaged to enhance the non-Fossil fuel based installed generation capacity to 500 GW by 2030 and meet 50 percent of its energy requirements from renewable energy by 2030. During the current study timeframe i.e., by 2028-29, it is proposed to add 232 GW RE (including Large Hydro) which is more than 58.5% of the installed capacity.

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. Preparation of Load Generation Balance considering the diurnal, nocturnal and seasonal variation across the country with fair assumptions is the key to plan an optimised ISTS Transmission Network for Integration and evacuation of RE generation. Further, to address the intermittency aspect of RE generation, Energy Storage Devices such as (BESS, Pumped Storage Plant etc.) are also to be integrated to make the Grid Resilient. Adequate reactive compensation (including Dynamic Compensation) enhances the voltage stability of the Grid.

Considering the short gestation period of the RE Generation, corresponding Inter State Transmission System (ISTS) is to be in place for smooth evacuation of the integrated RE generation for which advance planning of ISTS is done considering the inputs from all the stakeholders.

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

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

Transmission system plays a very crucial role of facilitating integration of generation resources and demand centres to the National Grid, and therefore should be planned and developed adequately to enable seamless integration of generation projects and facilitate availability of reliable, secure, and affordable power to all the consumers.

In this direction, and as per Electricity (Transmission System Planning, Development and Recovery of Inter-State Transmission Charges) Rules, 2021, notified by Ministry of Power, Govt. of India, CTU has been publishing the ISTS Rolling Plan Reports on half-yearly basis (Interim Report in Sept and Final Report in March of every financial year) with last one being published on 31st Mar 2023. This ISTS Rolling Plan Report has been prepared to assess transmission system adequacy in ISTS for 2028-29 timeframe taking due consideration of *"Transmission System for Integration of over 500MW RE Capacity by 2030"* report.

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

In **Chapter-2**, installed capacity & peak demand as on Aug'23 and projected installed capacity & demand by FY 2028-29 have been presented. All India installed capacity & peak demand are expected to increase from 424GW (including about 131GW RE + 47GW Hydro) & 232 GW respectively as on Aug'23 to about 712GW (including about 339GW RE + 63GW Hydro + 31.8GW ESS) & 313GW respectively by FY 2028-29.

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

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

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

The Inter-Regional (IR) transmission capacity is expected to grow from present level of 1,12,340 MW to about 1,38,740MW by 2028-29. Due to diurnal and seasonal variation in RE generation, power flow on all IR corridors is observed in both directions. Maximum change is observed in WR→NR corridor, where power of the order of 20GW is flowing from WR to NR in summer evening peak scenario and power of the order of 12GW is flowing from NR to WR in winter solar max scenario. New high-capacity links in WR-SR, WR-NR, and WR-ER corridors are under various stages of Implementation to cater the increased inter-regional power transfer.

Chapter-4 to **Chapter-8** are dedicated to detailed study results pertaining to each of the five regions, i.e. one Chapter for each Region. Critically loaded lines & transformers under normal & N-1 condition, 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. In order to meet the drawl requirement of potential Green Hydrogen and Green Ammonia based industries in Paradeep area in the state of Odisha, a new 765/400kV substation has been planned under ISTS.

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

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

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Chapter 1: Background and Objective

The Indian power sector is a crucial component of the country's infrastructure and economy. It plays a pivotal role in supporting industrialization, urbanization and overall economic growth. Over the past decade, India's power sector has undergone a remarkable transformation, aimed at providing reliable, affordable, and sustainable energy to its people. Significant strides have been made by the GOI in enhancing power generation capacity, expanding access to electricity, promoting renewable energy, and implementing innovative policies like the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya), Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), National Solar Mission etc. From being power deficit to power surplus, India has explored opportunities for cross-border electricity trade with neighbouring countries like Bhutan, Nepal, and Bangladesh (this trade allows for the exchange of surplus power and enhances regional energy cooperation).

India's journey towards a clean and green energy has gained global recognition. Today, India stands 4th globally in Renewable Energy Installed Capacity, with 43% of its total installed electricity capacity coming from non-fossil energy sources. India envisaged to enhance the non-Fossil fuel based installed generation capacity to 500 GW by 2030 and meet 50 percent of its energy requirements from renewable energy by 2030. During the current study timeframe i.e., by 2028-29, it is proposed to add 232 GW RE (including Large Hydro) which is more than 58.5% of the installed capacity.

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. Preparation of Load Generation Balance considering the diurnal, nocturnal and seasonal variation across the country with fair assumptions is the key to plan an optimised ISTS Transmission Network for Integration and evacuation of RE generation. Further, to address the intermittency aspect of RE generation, Energy Storage Devices such as (BESS, Pumped Storage Plant etc.) are also to be integrated to make the Grid Resilient. Adequate reactive compensation (including Dynamic Compensation) enhances the voltage stability of the Grid.

Considering the short gestation period of the RE Generation, corresponding Inter State Transmission System (ISTS) is to be in place for smooth evacuation of the integrated RE generation for which advance planning of ISTS is done considering the inputs from all the stakeholders.

In line with the Ministry of Power Rules, 2021 published vide gazette notification dated 1st Oct 2021, CTU is drawing up plan for Inter-State Transmission System (ISTS) for up to next five years on Rolling basis every year, involving two cycles i.e., from April to September and October to March identifying specific transmission projects which are required to be taken up along with their implementation timelines. In this direction, reports on Network Plan 2024-25, Rolling Plan 2026-2027 & Rolling Plan 2027-28 has already been brought out on 31st Dec 2021, 31st March 2022 & 31st March 2023 respectively and the same is available on CTU

website. This ISTS Rolling Plan report is being brought out wherein transmission system adequacy in ISTS has been ascertained for 2028-29 timeframe.

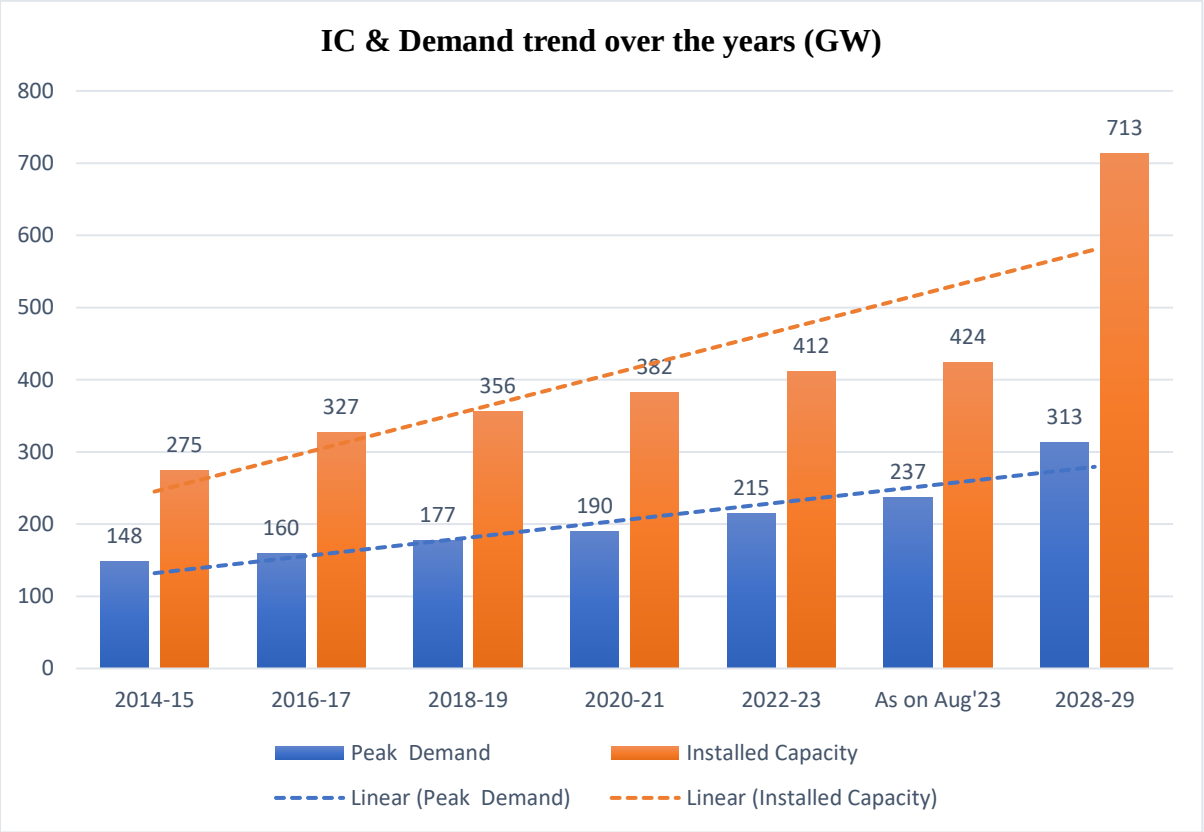
This report covers year wise ISTS planned and under implementation across the country to integrate the RE generation and to cater the growing demand. Detailed studies were carried out on the planned Transmission system including load flow, contingency analysis, voltage profile (reactive power management),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

Chapter 2: Power Supply Scenario

Presently, India's peak demand met is about 237 GW and as per 20th EPS it is projected to be about 313 GW by 2028-29. Furthermore, bulk consumers such as Green Hydrogen/Ammonia plants of about 10 GW are also planned to be integrated to the grid which will further enhance the projected peak demand. To meet this projected demand, generation capacity addition in the grid is being done at a CAGR of 11%.

Presently, Non-fossil fuel based Installed generation capacity is around 185 GW (44% of total installed capacity) which is planned to increase to around 418 GW (58% of total installed capacity) by 2028-29 at a CAGR of 17.6%. Installed capacity vis a vis peak demand trend from FY 2014-15 to FY 2028-29 is depicted in Figure 2-1.

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



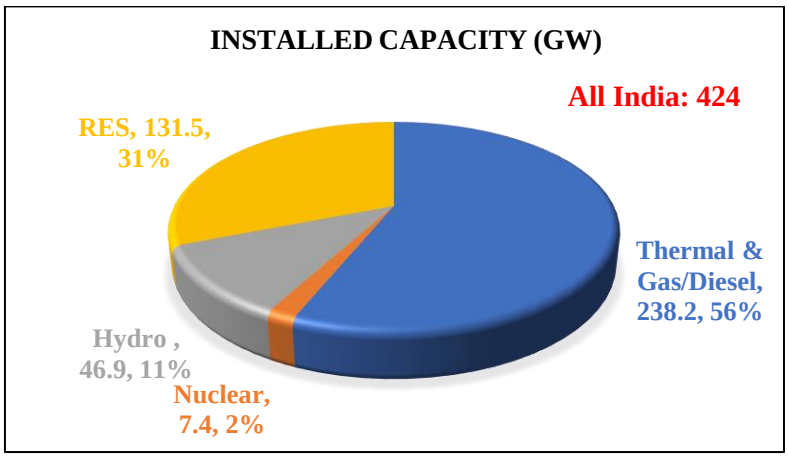
2.1 Power Supply Scenario as on August'23

Total installed capacity as on August'23 is about 424 GW and the All-India peak demand met is 237 GW which is the highest ever peak demand met till date. Region-wise breakup for the source wise installed capacity and peak demand met as of Aug'23 is given in the Table 2-1. Presently, Thermal based generation installed capacity accounts for 56% and Renewable Energy resources-based generation installed capacity accounts for 31% of total installed generation capacity, which is portrayed in Figure 2-2.

Table 2-1:Installed Capacity and Peak Demand in GW as on Aug'23

Region	Fossil			Non Fossil				Grand Total	Peak Demand Met
	Thermal	Gas/ Diesel	Total	Nuclear	Hydro	RES	Total		
NR	57.3	5.9	63.3	1.6	20.8	34.5	56.9	120.2	80.5
WR	76.0	10.8	86.8	2.5	7.6	42.4	52.5	139.3	72.6
SR	50.9	6.5	57.4	3.3	11.8	52.1	67.3	124.7	64.1
ER	28.2	0.1	28.3	0.0	4.8	1.9	6.7	35	29.3
NER	0.7	1.7	2.4	0.0	1.9	0.6	2.5	5	3.5
All India	**213.1**	**25**	**238.2**	**7.4**	**46.9**	**131.5**	**185.9**	**424.2**	**236.6**

Figure 2-2: Installed Capacity as on Aug'23



2.2 Envisaged Power Supply Scenario by 2028-29

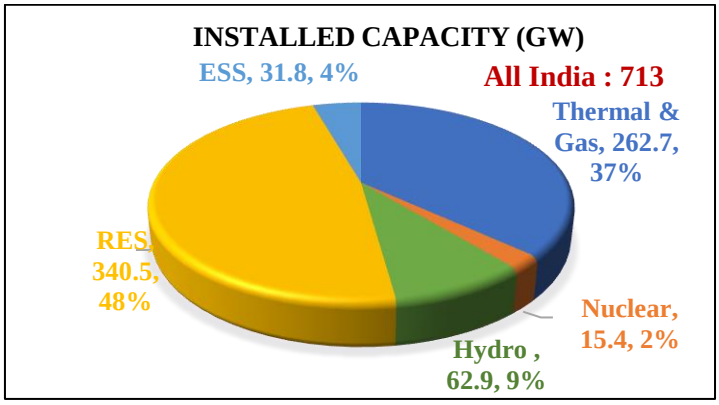
All India peak demand for 2028-29 is envisaged to be about 313 GW as per 20th Electric Power Survey (EPS) report of CEA. To meet the enhanced demand of about 73GW from present peak demand met of 237 GW, net generation capacity addition of about 288 GW is planned to be integrated in the grid after accounting the retirement of thermal generation by 2028-29 as anticipated in draft National Electricity Plan (NEP) of CEA.

Total installed generation capacity for 2028-29 shall be about 713 GW including the pumped and energy storage capacity as per report "Transmission System for Integration of 500 GW RE Capacity by 2030". The anticipated region-wise breakup of the installed capacity and projected peak demand for 2028-29 are summarised in *Table 2-2* . Renewable Energy resources generation installed capacity is expected to be about 48% of total installed generation capacity, which is shown in Figure 2-3.

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

Region	Fossil			Non Fossil				ESS	Grand Total	Peak Demand
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
NR	53.7	3.6	57.3	4.4	25.3	105.6	135.3	10.5	203.0	109.7
WR	88.8	10.1	98.9	3.2	6.1	95.3	104.6	3.6	207.1	100.2
SR	54.5	1.8	56.3	7.8	13.2	133.6	154.7	16.8	227.8	91.3
ER	47.7	0.0	47.7	0.0	13.9	4.4	18.3	0.9	66.9	42.5
NER	0.75	1.75	2.5	0.0	4.4	1.6	6.0	0.0	8.5	5.5
All India	**245.4**	**17.2**	**262.7**	**15.4**	**62.9**	**340.5**	**418.9**	**31.8**	**713.3**	**313**

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



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

Table 2-3: Peak demand & Generation IC in 2022-23 and 2028-29

Peak Demand (GW)

	Aug'23	*2028-29*	*Increment*	*CAGR*
NR	80.5	109.7	29.2	6.4%
WR	72.6	100.2	27.6	6.7%
SR	64.1	91.3	27.2	7.3%
ER	29.3	42.5	13.2	7.7%
NER	3.5	5.5	2	9.5%
All India	**236.6**	**313**	**76.4**	**5.8%**

Generation IC (GW)

	Aug'23	*2028-29*	*Diff*	*CAGR*
Thermal	211.05	245.4	34.35	3.1%
Gas	25.5	17.2	-8.3	-7.6%
Nuclear	7.40	15.4	8	15.8%
Hydro/ESS	46.85	94.8	47.95	15.1%
Solar	71.61	233.5	161.89	26.7%
Other RE	59.90	107.0	47.1	12.3%
Total	**422.31**	**713.3**	**290.99**	**11.1%**

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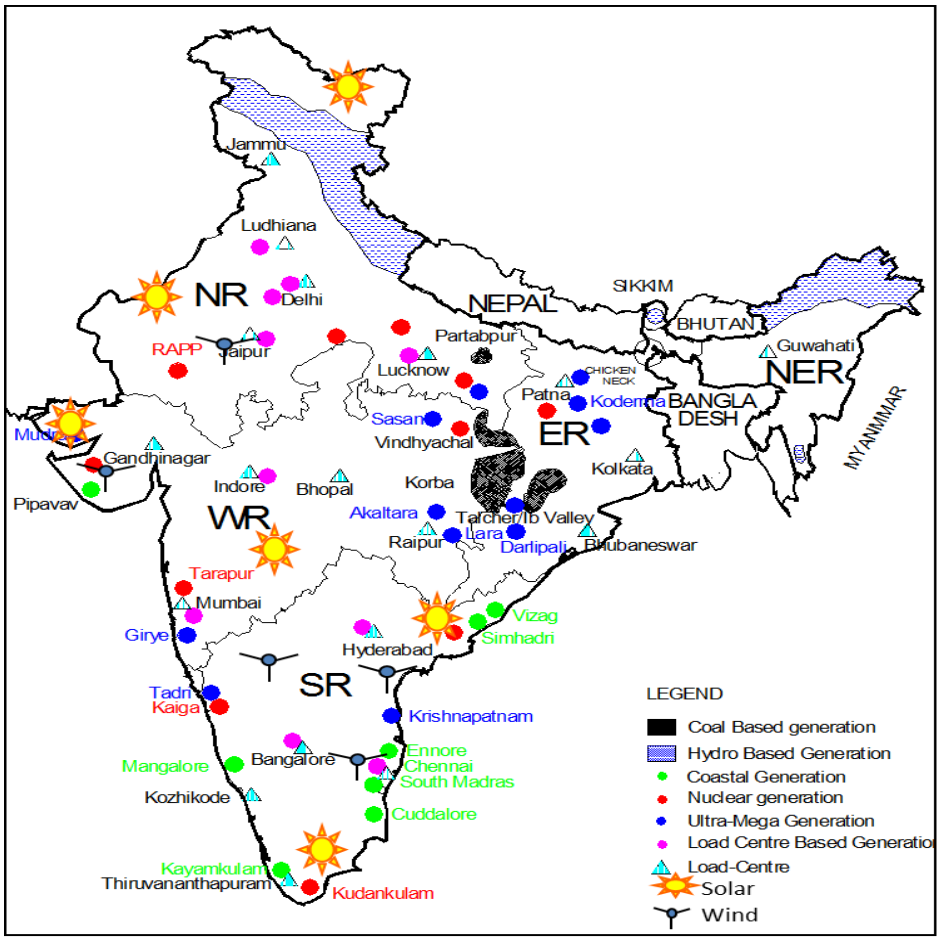
Chapter 3: All India

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

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



The present study has been carried out to identify power exchanges across the regions and adequacy of existing, approved and planned transmission systems to meet the power transfer requirement for the time-frame of 2028-29 with an all India perspective. Periodic assessment of transmission requirement under ISTS is also made part of this report. Here, it is to mention that substantial solar generation capacity addition has been envisaged in future which shall only generate in day time. A region having a high solar installed capacity shall become exporter of power during the afternoon and importer of the power during evening.

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

3.1 Load Generation Balance

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

- Aug'28: Solar max (Scenario-1), Evening Peak (Scenario-2) and Night off-peak (Scenario-3)
- Jun'28: Solar max (Scenario-4), Evening Peak (Scenario-5) and Night off-peak (Scenario-6)
- Feb'29: Solar max (Scenario-7), Evening Peak (Scenario-8) and Night off-peak (Scenario-9)

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

All India peak demand considered for current study time-frame 2028-29 is about 313 GW as per 20th EPS. Further an additional demand of about 10 GW has been considered as direct drawl from ISTS. To find out variation of this demand for nine scenarios, demand pattern of year 2022-23 for the three representative months of three seasons were collected from Grid Controller of India Ltd. for monsoon (Aug-22), summer (Jun-22) and for winter (Feb-23). The data comprises of demand profile of all the days of the month with resolution of 5 mins time interval. Three load conditions each corresponding to solar max, evening peak and night off peak were selected from the representative demand curve of three seasons as depicted in Figure 3-2, Figure 3-3 & Figure 3-4 below. For evening peak scenario and night off peak scenario, maximum demand (between 3:55 pm to 11:55 pm) and minimum demand (between midnight to 06:00 am) were considered respectively. However, for solar max scenario, maximum

demand corresponding to noon (12:00 pm) was considered. To obtain the demand factors for study time-frame of 2028-29, demand corresponding to these load condition were divided by maximum All India/regional demand of the corresponding year i.e. 2022-23. All India/regional demand factors for different scenarios of 2028-29 are shown in Figure 3-5.

Figure 3-2:Summer (June'22) Load Curve

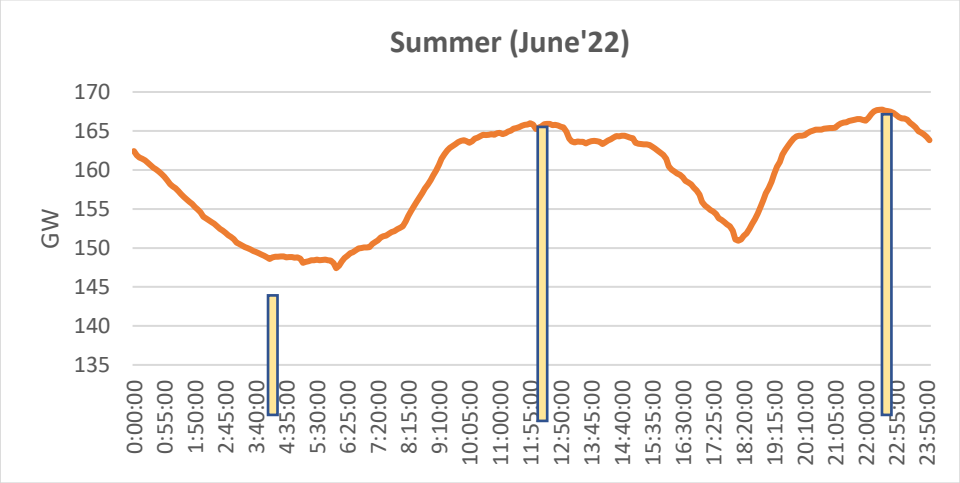


Figure 3-3: Monsoon (Aug'22) Load Curve

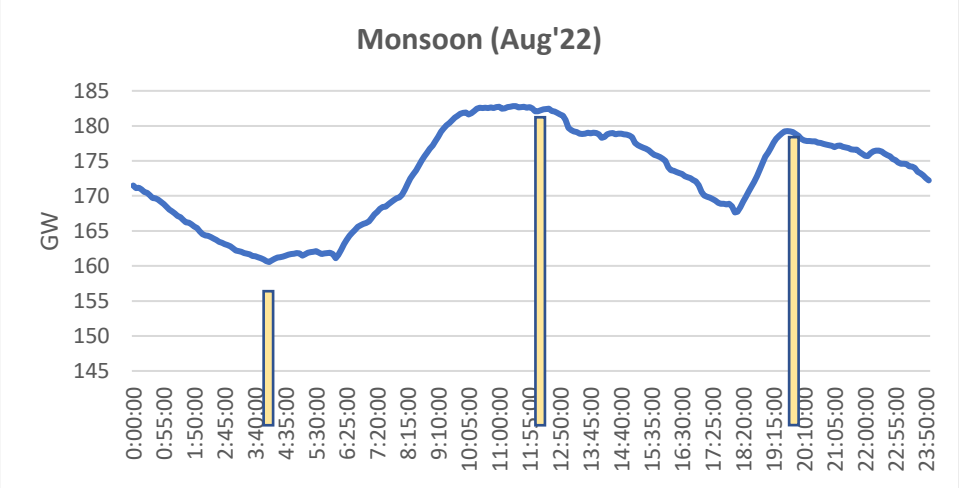


Figure 3-4:Winter (Feb'23) Load Curve

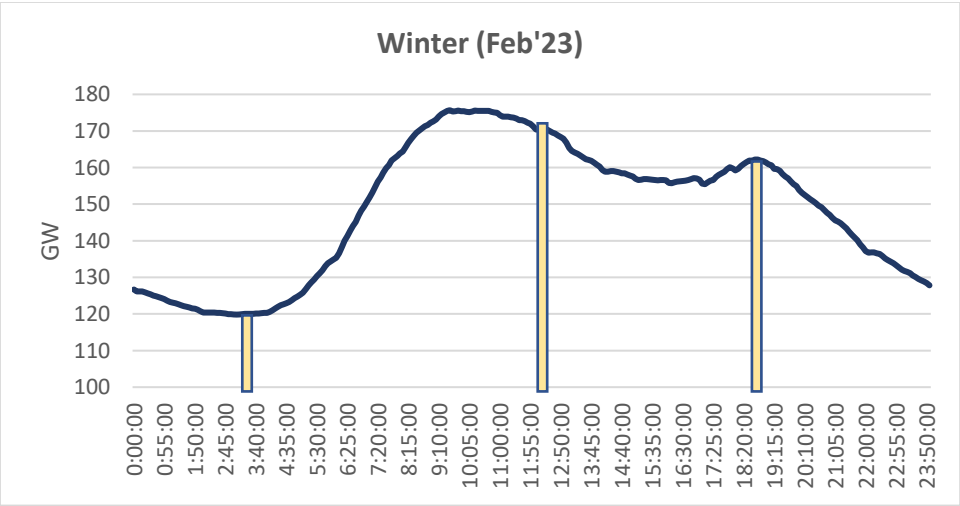
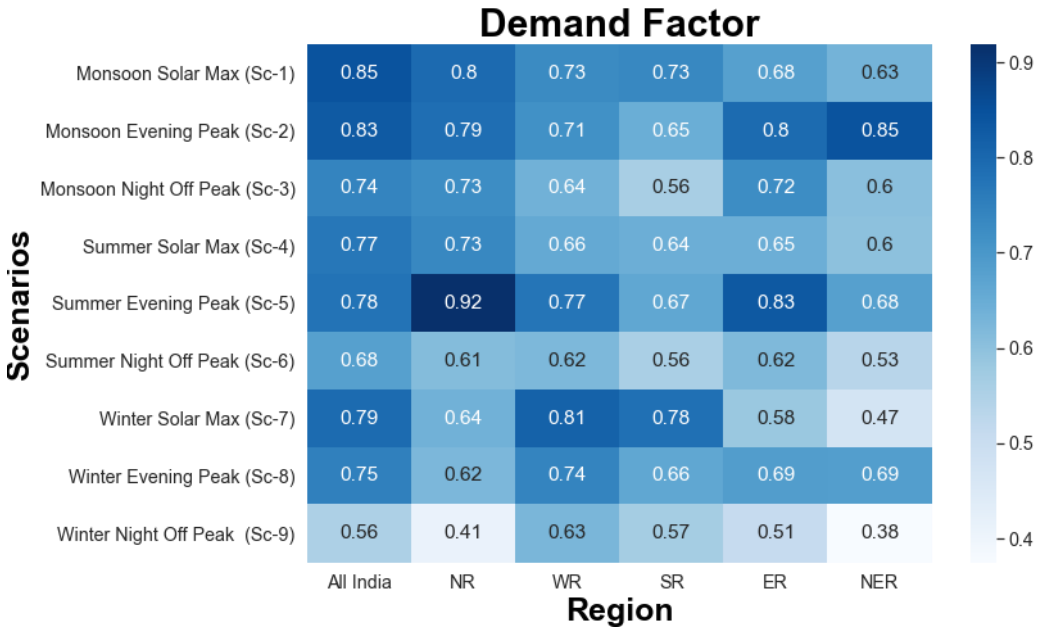


Figure 3-5:Demand factors considered for 2028-29-time frame



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

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

Evening peak scenario of each month was setup first as the number of thermal units required on bar shall be maximum. Total thermal generation requirement for the evening peak scenario was apportioned between State and Central sector thermal generations as per their installed capacity in each region. Further, state thermal generation requirement was divided among the states as per their maximum demand in respective month of 2022-23. After obtaining state thermal generation requirement, thermal units were dispatched at technical maximum (85%) in merit order for each state.

ISGS, CGS & IPP thermal plants with lower variable cost were dispatched at technical maximum (85%) region wise progressively. To meet the demand of any deficit region thermal generation dispatches from other regions considering all India merit order for evening peak scenario was considered. In winter evening peak scenario (scenario-8) even after dispatching all the ISGS, CGS and IPP thermal plants, generation shortfall of the order of 16 GW was observed to meet the demand, which indicates the requirement of installation of additional

thermal plants. Accordingly in the month of February the units were despatched higher than 85% to take care the deficit observed in the load generation balance. For night off-peak scenario, on bar thermal units were scaled down proportionately.

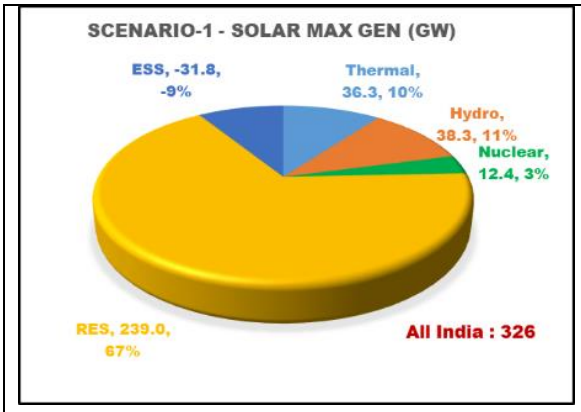
While preparing the present LGB for Solar max scenario, some plants were switched off to balance the load generation while running all the on-bar thermal plants at technical minimum of 40% as per recent CEA (Flexible operation of coal based thermal power generating units) regulation 2022 except in winter. Accordingly, thermal plants with higher cost (on merit order basis) were switched off region wise progressively till the LGB is balanced. In winter machines were scaled down to only 50% despatch and no plants were switched off.

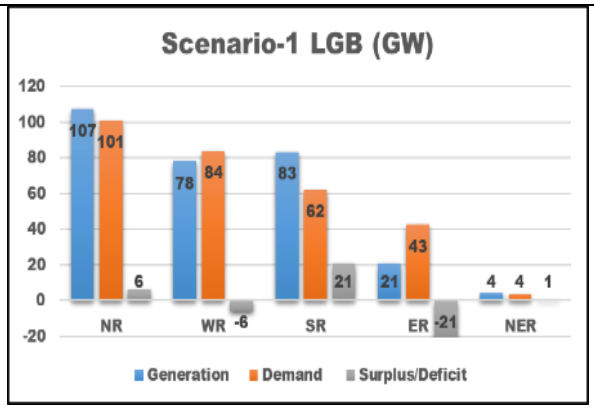
It is observed that in the Solar max scenario there is surplus power available in the grid. It is due to availability of peak solar generation and lesser demand in the noon. This surplus is on account of keeping the same number of thermal plants operating at technical minimum (40%) in Solar max scenario 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 25 GW dispatches is observed**.** To absorb the maximum RE generation during the daytime most of the thermal units are required to shut down necessitating the requirement of two-shift operation of thermal generation or more energy storage plants in the grid.

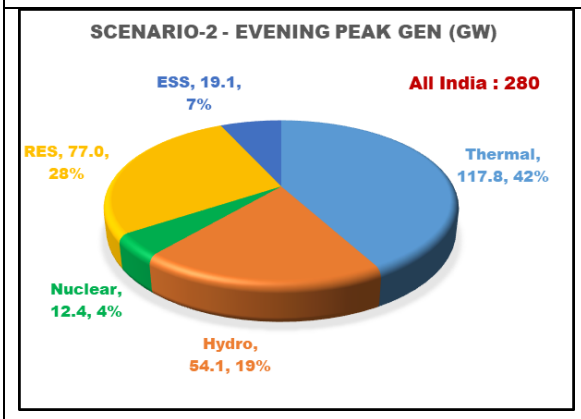
Based on above philosophy, LGB prepared for different scenarios are depicted in Figure 3-6, Figure 3-7, Figure 3-8 along with regional surplus/deficit scenario and details about the same are attached at **Annex-11.2.**

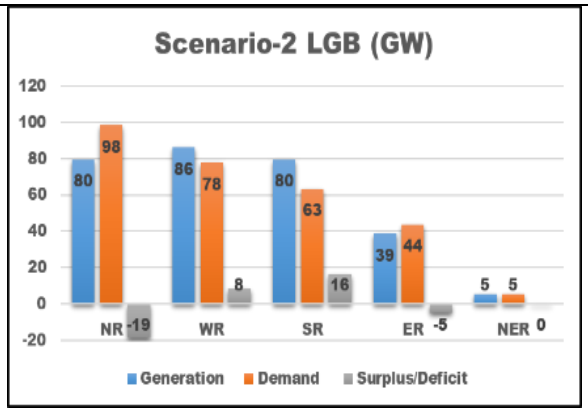
Monsoon Aug'2028

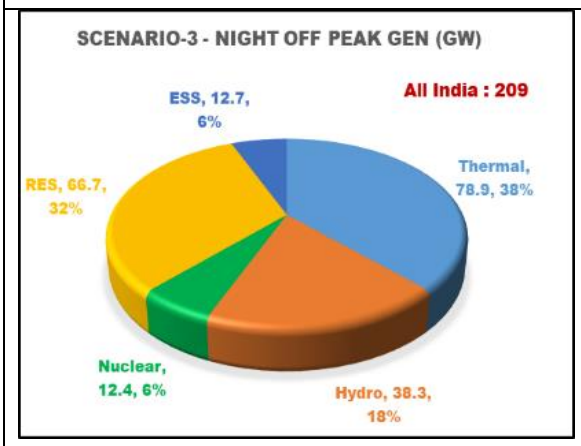
Figure 3-6:LGB for Monsoon Aug'2028

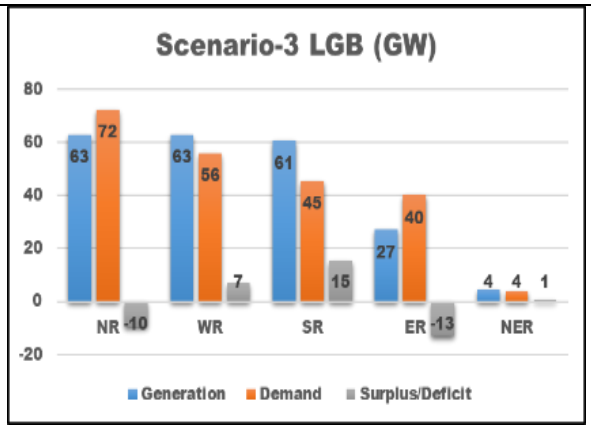






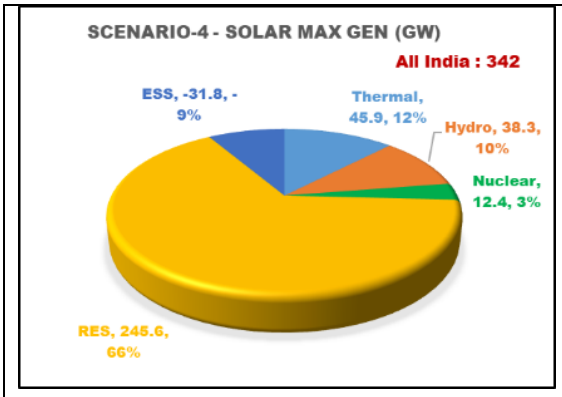


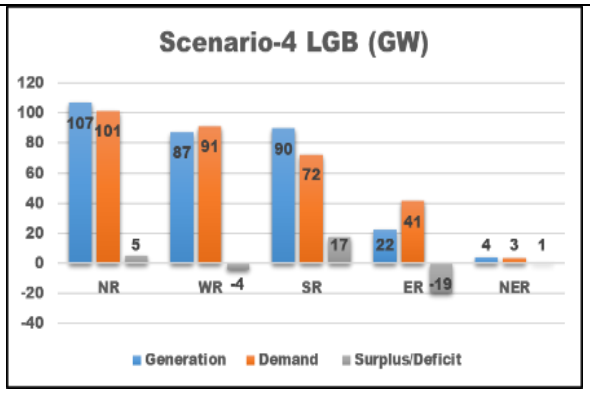


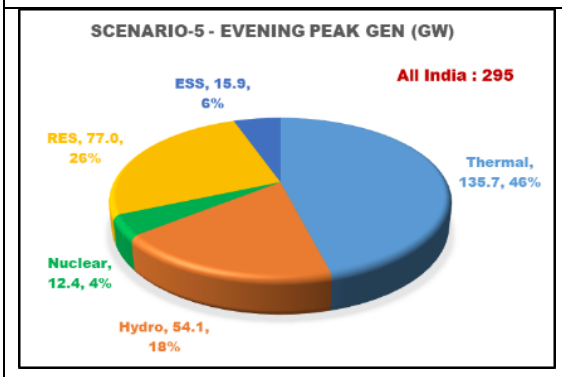


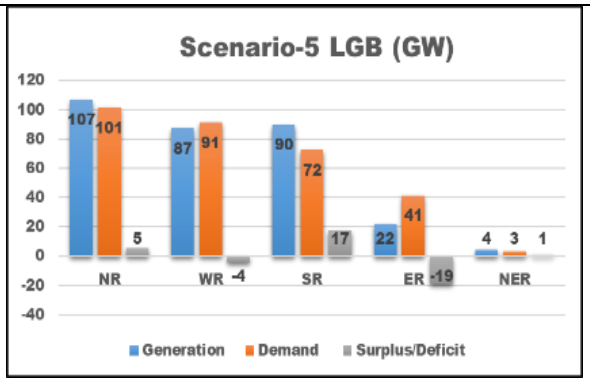
Summer June'2028

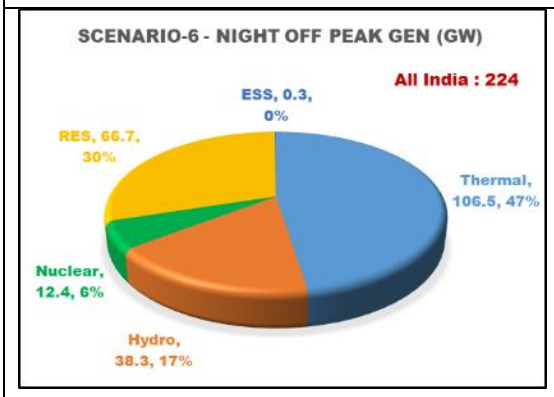
Figure 3-7: LGB for Summer June'2028

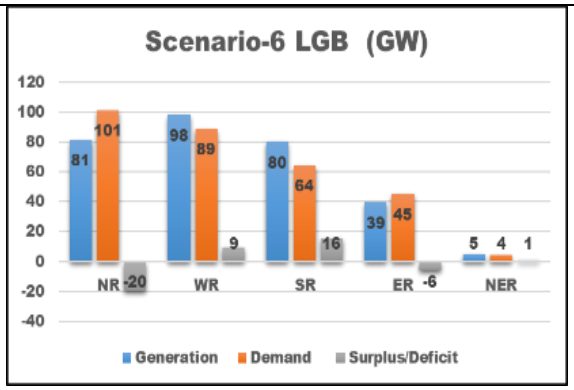






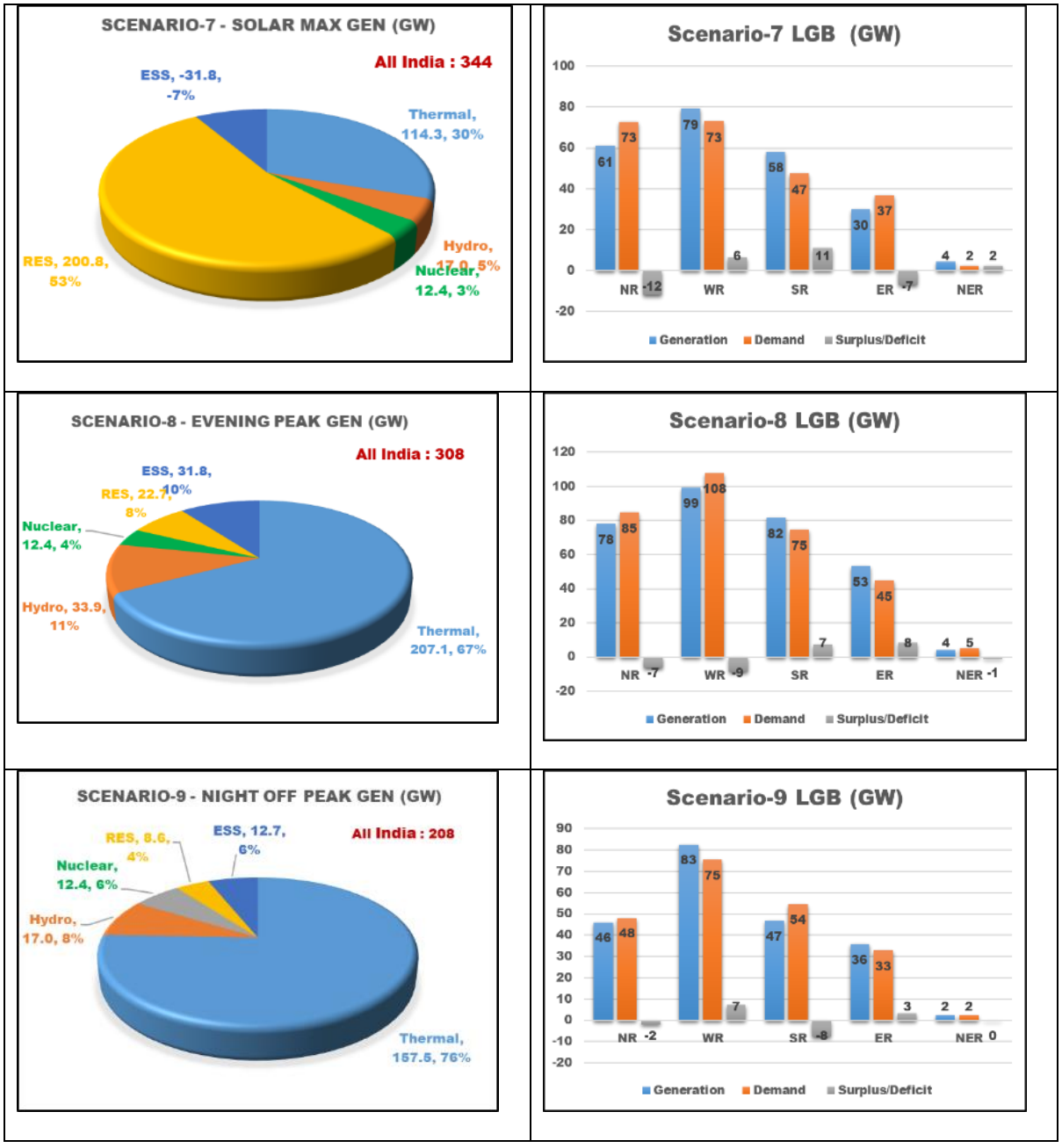






Winter Feb'2029

Figure 3-8:LGB for Winter Feb'2029



Out of these nine scenarios, Scenario-1(Aug'28 Solar max) and Scenario-9 (Feb'29 Night off peak) corresponds to two extreme cases with respect to demand i.e., highest demand (294 GW) and lowest demand (212 GW) scenarios respectively. In all other scenarios, all India demand is varying between these two demands as per demand factors. Further Scenario-4 corresponds to maximum RE generation share to meet the demand of that scenario. Based on LGB, region wise surplus/deficit in each scenario is summarised in Table 3-1:Regional Surplus/Deficit summary in MW. Furthermore, both maximum surplus and deficit of each region is highlighted too in Table 3-1.

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

Surplus (+) / Deficit (-)	Monsoon (Aug'28)			Summer (Jun'28)			Winter (Feb'29)		
Scenario No. / Region	1	2	3	4	5	6	7	8	9
	Solar Max	Evening Peak Load	Off Peak	Solar Max	Evening Peak Load	Off Peak	Solar Max	Evening Peak Load	Off Peak
NR	6305	-18717	-9522	5379	-19724	-11841	16518	-6509	-2103
WR	-5664	8407	6842	-4048	9276	6278	-8406	-8511	7286
SR	21095	16133	15323	17491	15898	10777	2816	7057	-7715
ER	-21405	-5119	-12977	-19287	-5803	-7068	-10040	8478	3111
NER	590	-279	533	932	777	2154	-604	-841	-154

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 generally exports the power with a maximum export of 9 GW in Summer (Jun) evening peak scenario. Due to low availability of RE during Winter (Feb) solar max & evening peak load scenario, WR becomes deficit to the tune of 8 GW.
- SR is mostly expected to export power except in winter season. Maximum export of power is 21 GW in Monsoon (Aug) solar max scenario, whereas maximum import of the order of 7 GW is taking place in the Winter (February) night off peak scenario.
- ER is importing power in high renewable generation scenarios due to RE RPO requirements of ER. It shall not be able to meet its RPO requirement from its own regional RE and has to import RE power from neighbouring regions.
- NER mostly exports power in different scenarios except for Winter (February) season where it is expected to import power.

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

3.2 Study Results and Analysis

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

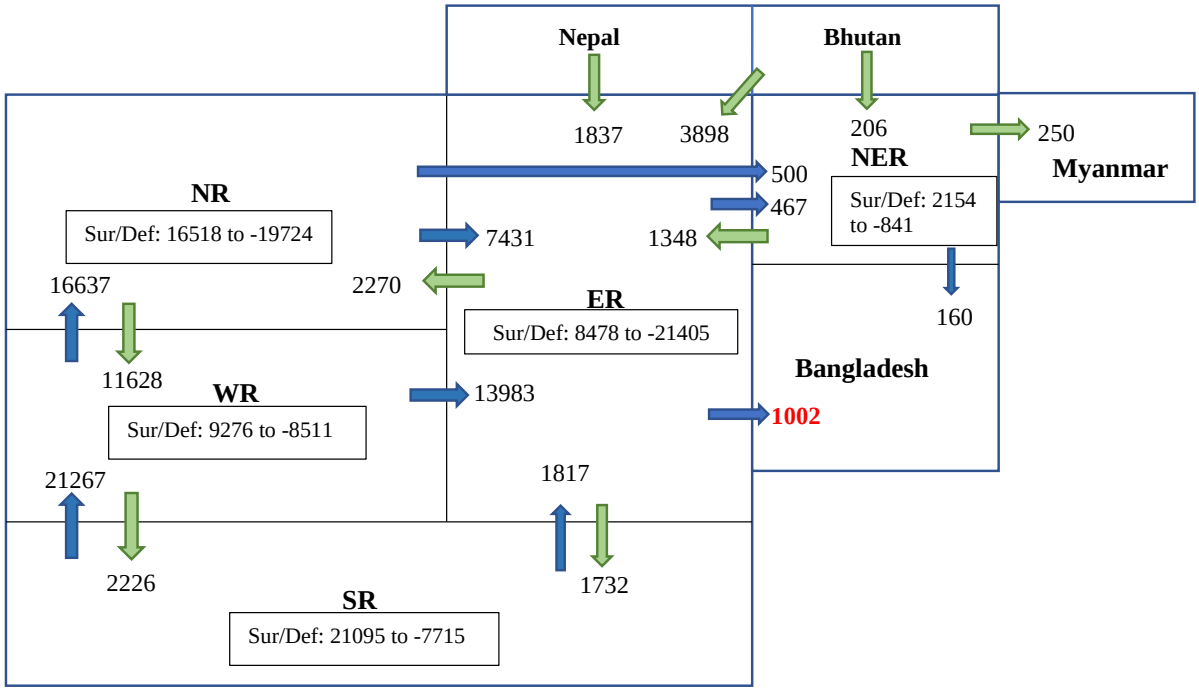
3.2.1 Power Flow Analysis

a) Inter-Regional Corridor

Inter-regional flows between various regions within India, based on simulation studies for current study timeframe of 2028-29 are summarised below in Table 3-2: IR flow summary in MW 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'28)			Summer (Jun'28)			Winter (Feb'29)		
Scenario No. / Corridor	1	2	3	4	5	6	7	8	9
	Solar Max	Peak Load	Off Peak	Solar Max	Peak Load	Off Peak	Solar Max	Peak Load	Off Peak
WR-NR	692	16637	10845	391	16087	10233	-11628	472	499
ER-NR	-7431	-2289	-4844	-6988	-912	-2781	-5603	2270	-137
ER-WR	-13983	-8454	-10625	-13558	-9405	-8114	-8711	-40	-3061
ER-SR	-1563	-1025	-1817	-1393	-348	-3	523	-425	1732
WR-SR	-21267	-17235	-15383	-17863	-18205	-13351	-6154	-9871	2226
ER-NER	-869	467	-701	-1348	-1214	-1265	46	-79	28



From the above it can be seen that-

- Power on WR-NR corridor is flowing in both directions in different scenarios. Maximum power of the order of 16 GW is flowing from WR to NR in June/August evening peak scenario whereas, maximum power flow of the order of 12 GW is flowing from NR to WR in February solar max scenario.

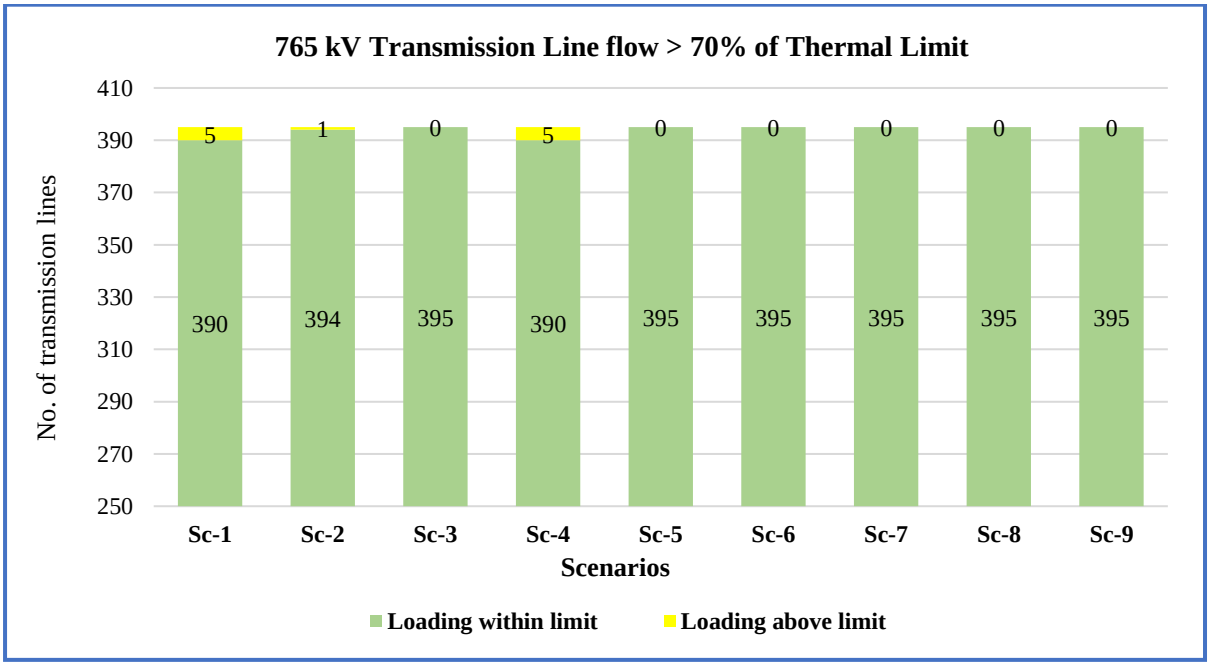
- Power on ER-NR corridor is flowing mostly towards ER in different scenarios. Maximum power of the order of 7 GW is flowing from NR to ER in monsoon solar max scenario whereas maximum power flow of the order of 2.2 GW is flowing from ER to NR in winter evening peak scenario.
- Power on ER-WR corridor is always flowing in the directions of WR to ER with maximum flow of 14 GW in Monsoon solar max scenario.
- Power on ER-SR corridor is flowing in both directions in different scenarios. Maximum power from SR to ER is 1.8 GW and power from ER to SR is 1.7 GW.
- Power on WR-SR corridor is mostly flowing towards WR from SR with maximum flow of 21 GW. However, about 2 GW power flows from WR to SR in winter night off peak.

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-2.2** and power flow exceeding 70% of thermal design limit are highlighted in yellow in the same annexure.

b) Transmission Line

All the 765 kV and 400 kV lines of ISTS and Intra-state were monitored for any possible overloading in the base case prepared for nine scenarios. There are about 395 nos. of 765 kV lines and about 2382 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-2.3**. In terms of percentage, less than 1% of total no. of lines (both 765 kV and 400 kV) are loaded beyond 70% of thermal limit. Summary of the results is shown below in Figure 3-9 & Figure 3-10.

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



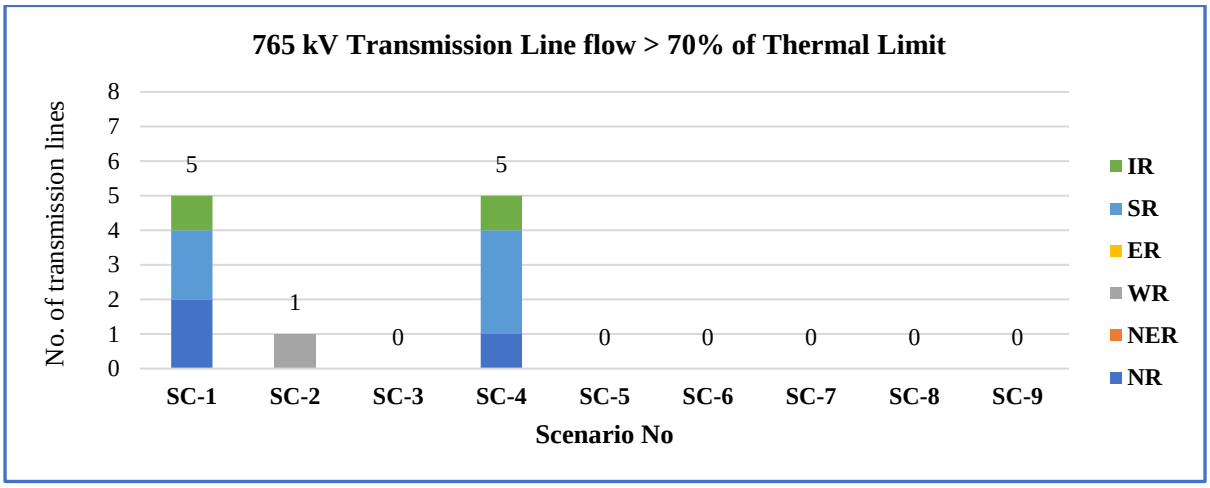
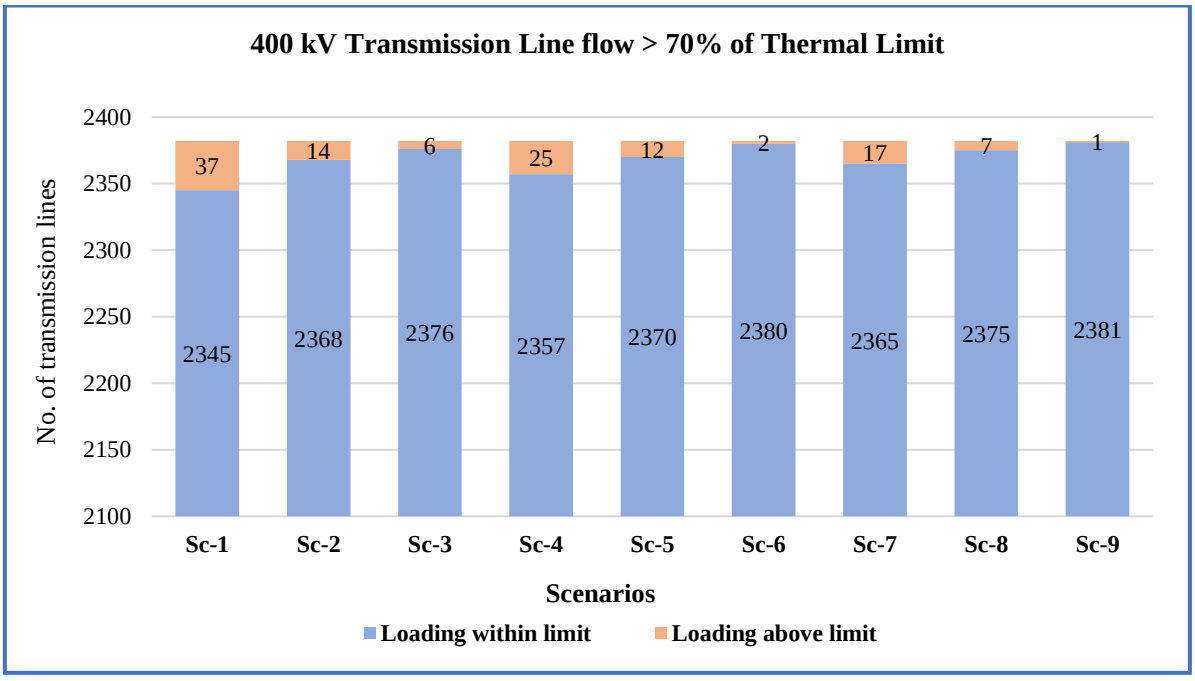
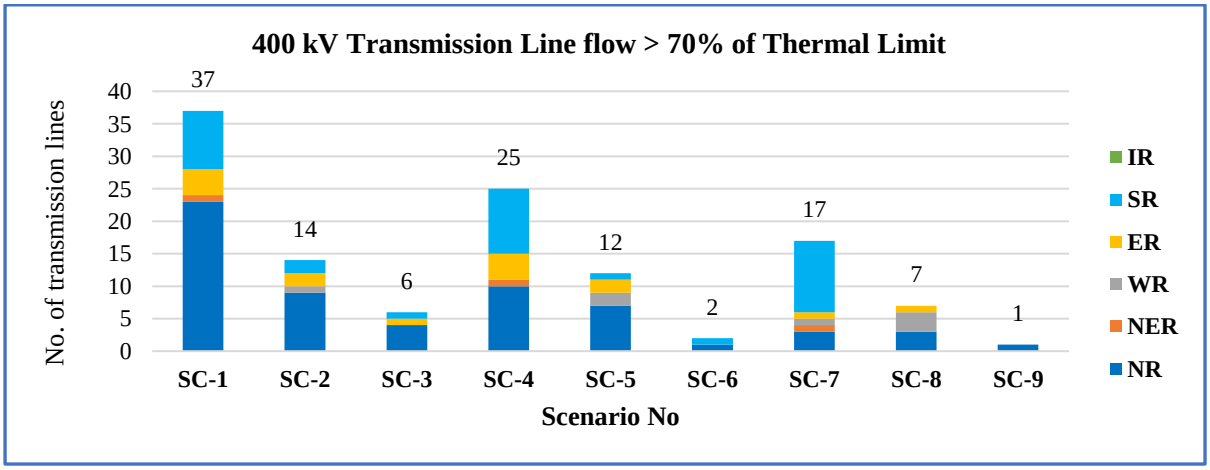


Figure 3-10: 400kV Tr. line flow > 70% of thermal limit under base case



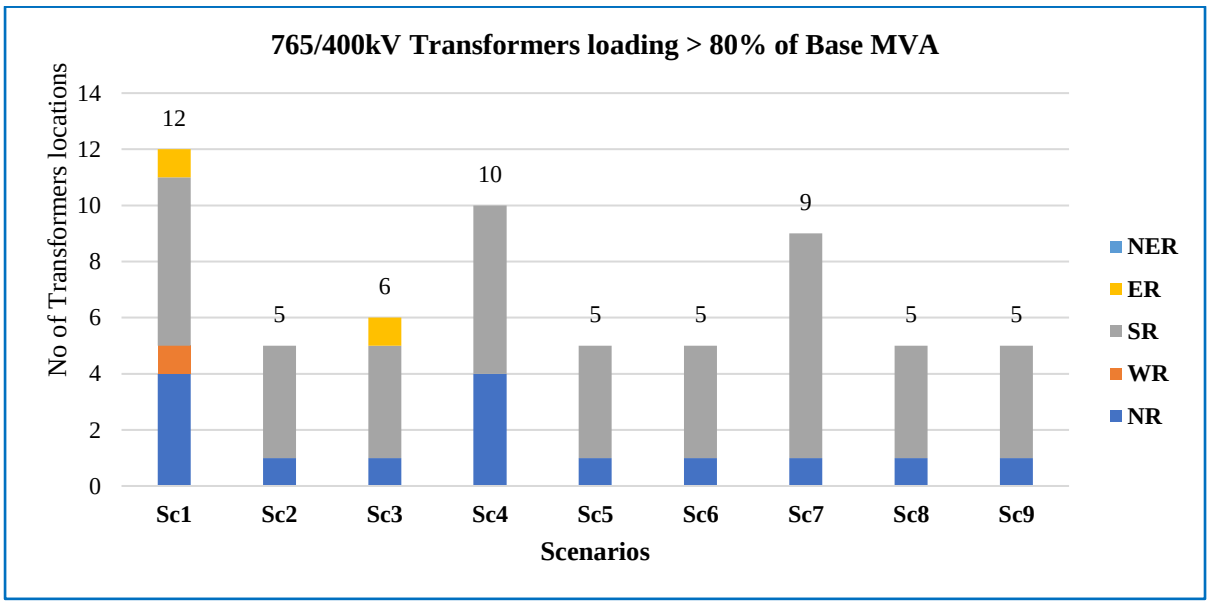


It was observed that about 5 nos. of 765 kV lines in Scenario-1 and 4 respectively are loaded beyond 70% of the thermal limit. About 37, 25 and 17 nos. of 400 kV lines in Scenarios-1, 4, and 7 (Solar max scenarios) respectively are loaded above 70% of the thermal limit. However, to analyse the criticality 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 378 nos. of 765/400 kV transformer at 144 nos. of 765/400 kV substations. Loading patterns of these transformers obtained from simulation studies are tabulated in **Annex-2.4** and loading more than 80% of their rating in any scenarios are also highlighted. Number of substations, where loading is more than 80% of rating in all scenarios are depicted in Figure 3-11 & Figure 3-12. However, in terms of percentage, less than 8% of transformers of 765/400 kV substations are loaded beyond 80% of their rating.

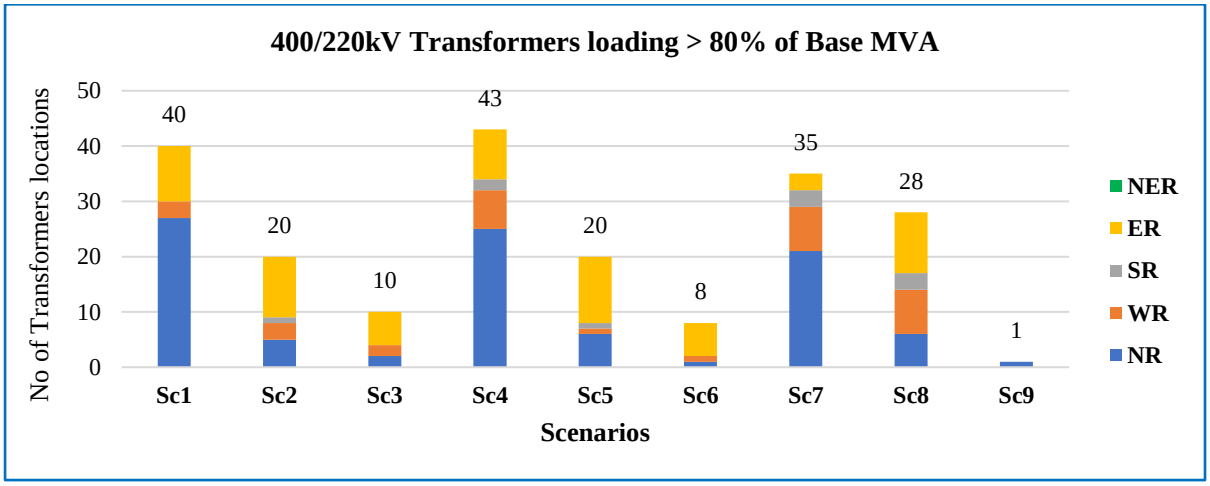
Figure 3-11: 765/400kV ICT Loading under base case.



Under solar max scenarios viz. Scenarios 1, 4 and 7 about 12, 10 and 9 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 in northern, western and southern region due to non-availability of transformers under N-1 contingency at RE pooling stations.

Similar analysis was carried out for 400/220 kV transformers. There are 1472 nos. of transformers located at about 553 nos. of 400/220 kV stations.

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



Under solar max scenarios viz. Scenarios 1, 4 and 7 about 40, 43 and 35 substations located in different region, where ICTs are getting loaded above 80% of MVA rating. However, if we see in terms of percentage, less than 3% of transformers of 400/220 kV substations 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.

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 transmission element. Results of the analysis are discussed below:

a) Transmission Line

765kV line loadings beyond 3000 MW under N-1 was assessed first. Thereafter, to carry out a sensitivity analysis, number of lines loaded beyond 3200 MW and 3500 MW under N-1 contingencies were also identified. The list of such lines is at **Annex-2.5** and the same has been summarised below in Figure 3-13**,** Figure 3-14 & Figure 3-15**.**

Figure 3-13: 765kV Tr. line loadings>3000MW under N-1 Contingency

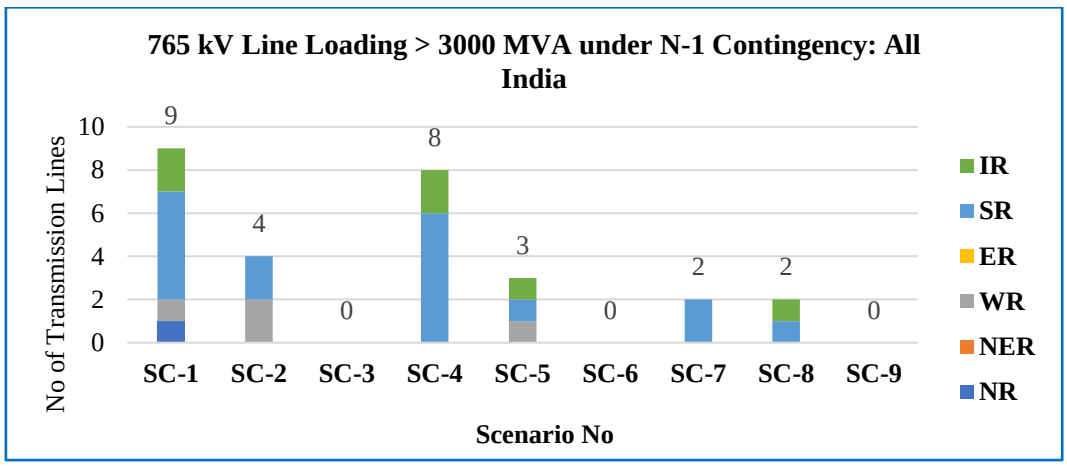


Figure 3-14: 765kV line loading>3200 MW under N-1 Contingency

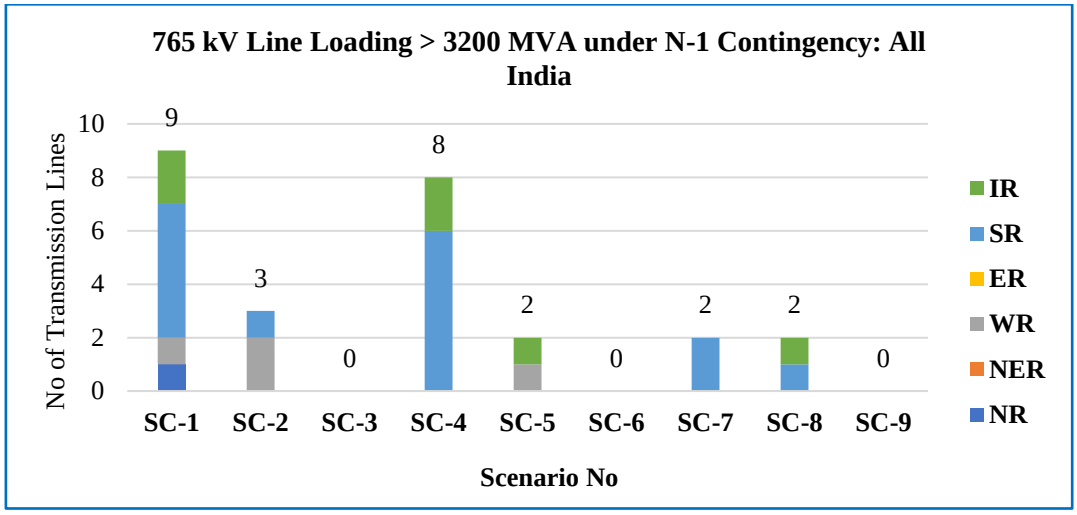
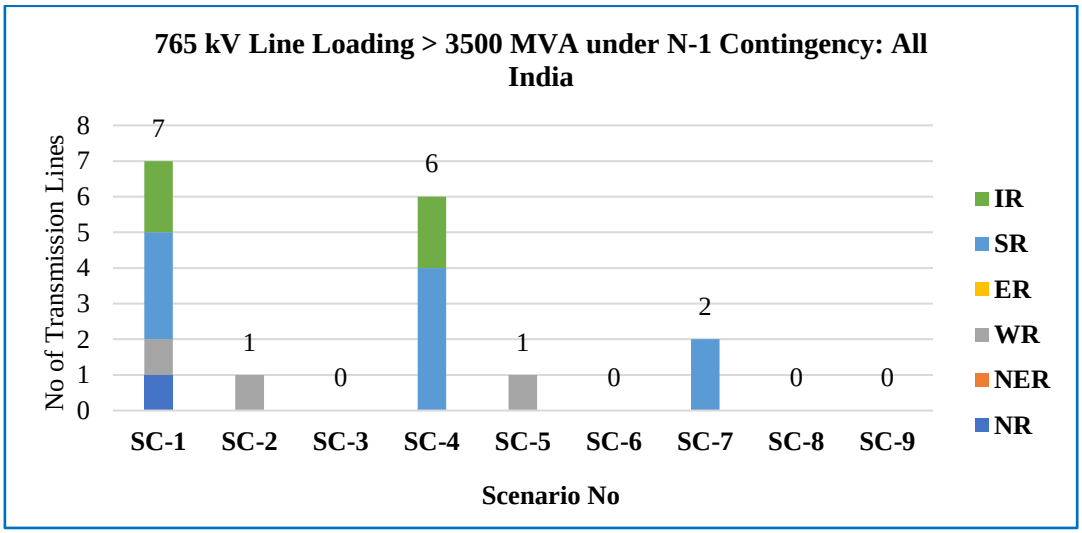


Figure 3-15: 765kV line loading>3500 MW under N-1 Contingency



The most critical 765 kV lines are Nizamabad-Nizamabad-2, Cudappah – Cudappah-2, Kurnool-Maheshwaram, Greater Noida-Aligarh, Pune-Narendra & Tamnar-Dhram_spl. 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-2.5.** The results are summarised below in Figure 3-16 & Figure 3-17.

Figure 3-16: 400kV line loading>90% of thermal limit under N-1 Contingency

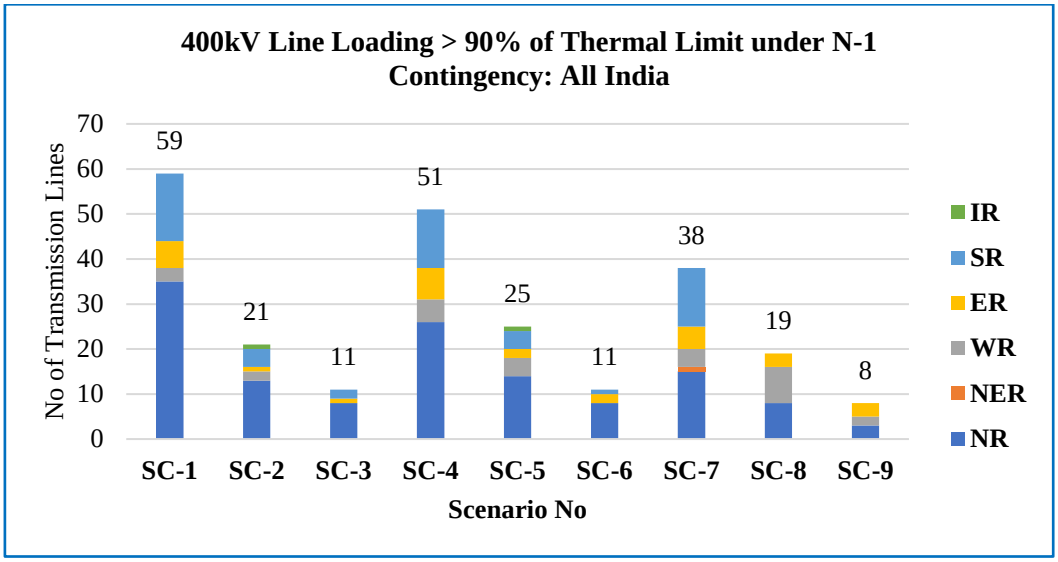
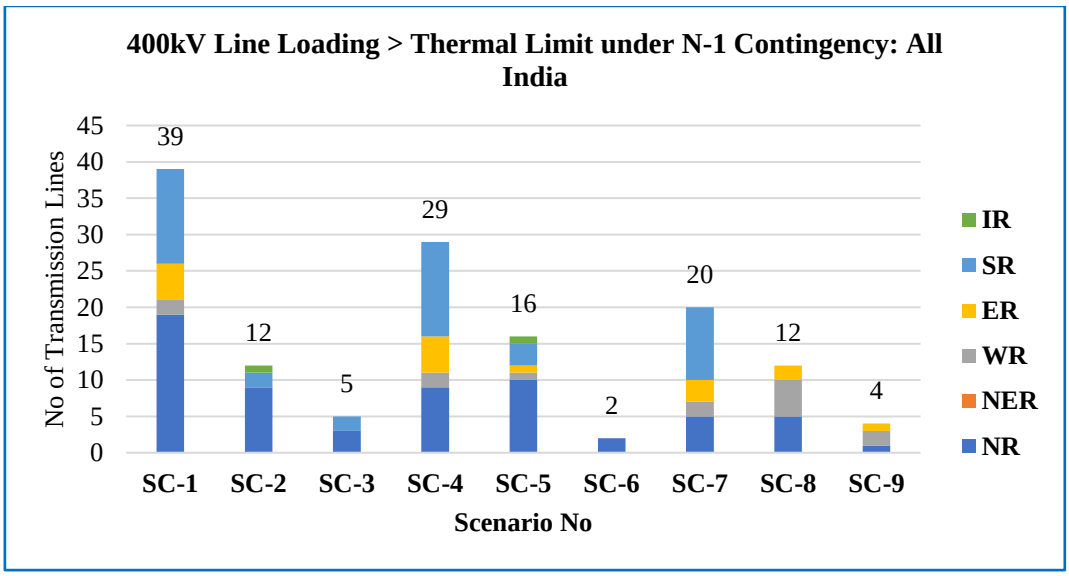


Figure 3-17: 400kV line loading>thermal limit under N-1 Contingency



Max no. of 400kV lines on which loadings exceeds 90% and 100% of thermal limit are 59 and 39 respectively in Solar max scenarios i.e. Scenario-1. Further, detailed analysis and studies are being carried to plan additional systems, if any.

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 3-18 & Figure 3-19 for 765/400 kV ICT and Figure 3-20 & Figure 3-21 for 400/220 kV ICT . Detailed results are attached at **Annex-2.6.**

Figure 3-18: 765/400kV ICT loading≥90% of MVA rating under N-1 Contingency

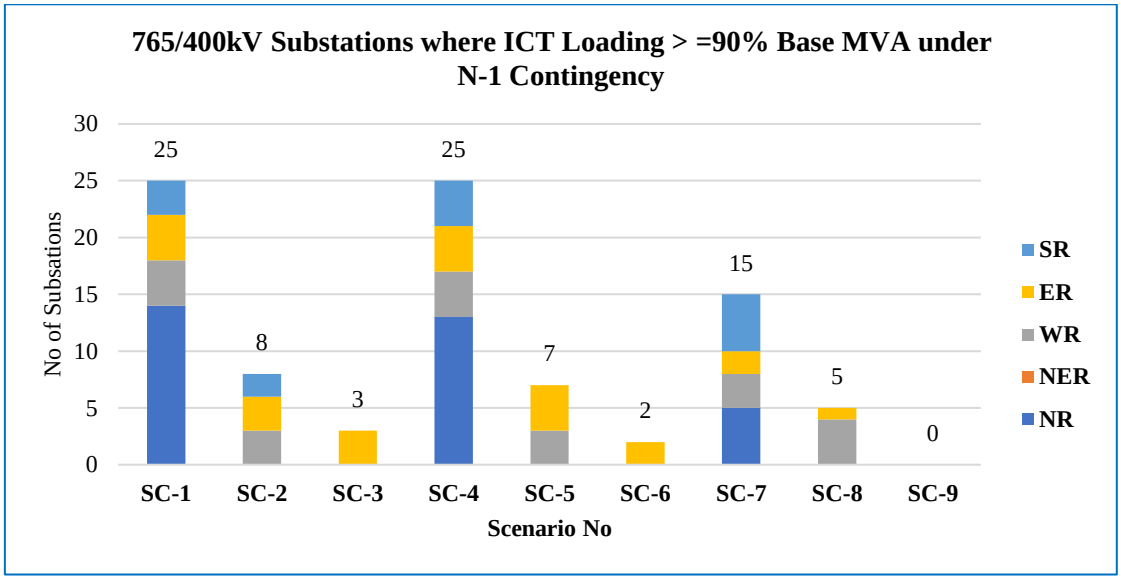
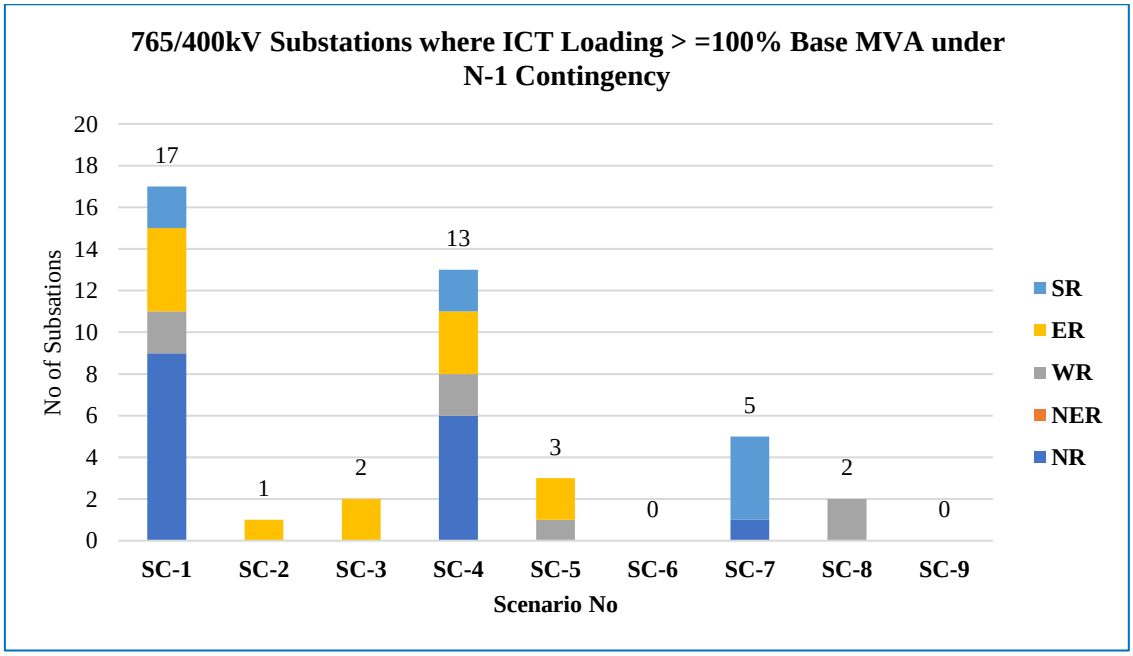


Figure 3-19: 765/400kV ICT loading≥100% of MVA rating under N-1 Contingency



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. Some of the locations corresponding to Scenario-1,4 and 7 where ICT loading violations have been observed are at Bikaner, Bhiwani-PG, Bhadla-3, Sipat, Duburi, Jhasurguda, Jeerat, Bareily, Jhatikala, Aurang, Kurnool, Maheshwaram, Gopalpur & Jodh Kankani. Few of these substations are RE pooling stations where ICTs have been planned considering N-0, as per Manual on Transmission Planning Criteria 2013. Thus, detailed studies are being carried out to plan for remedial measures.

Figure 3-20: 400/220kV ICT loadings≥ 90% of MVA rating under N-1 Contingency

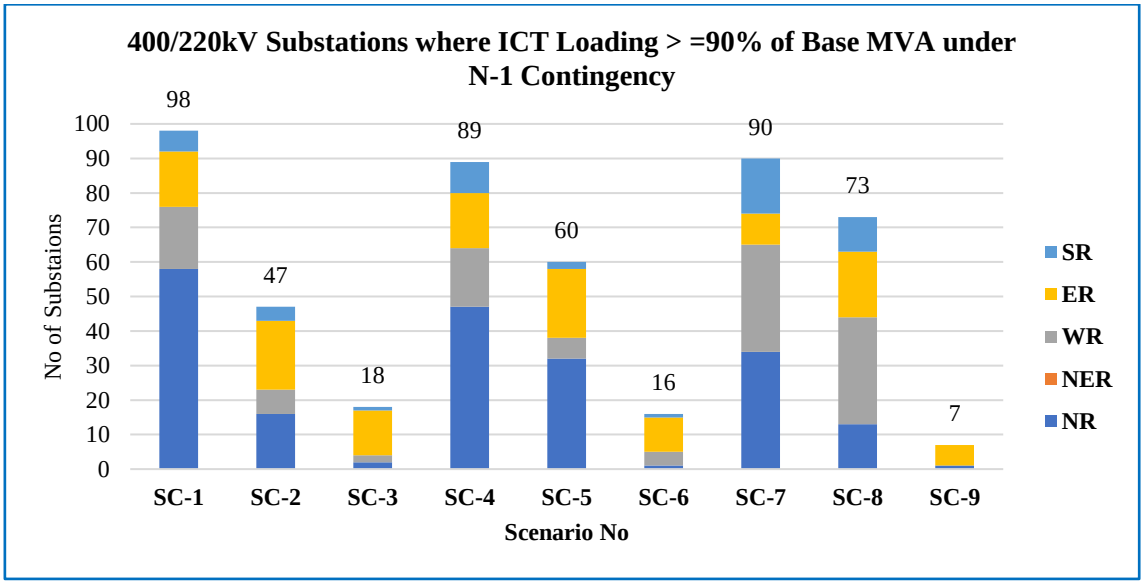
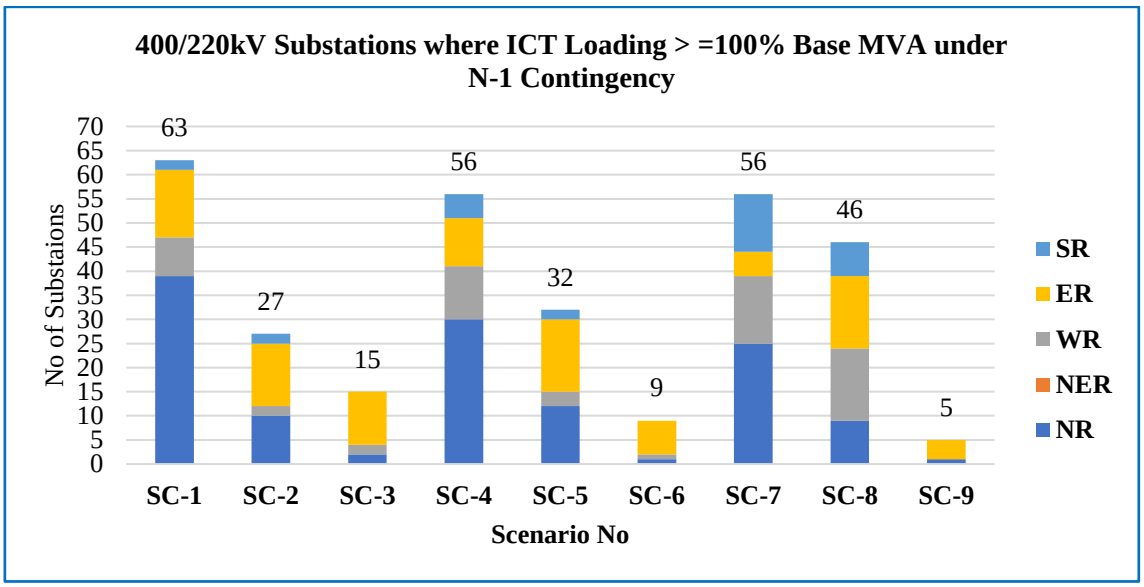


Figure 3-21: 400/220kV ICT loadings≥ 100% of MVA rating under N-1 Contingency



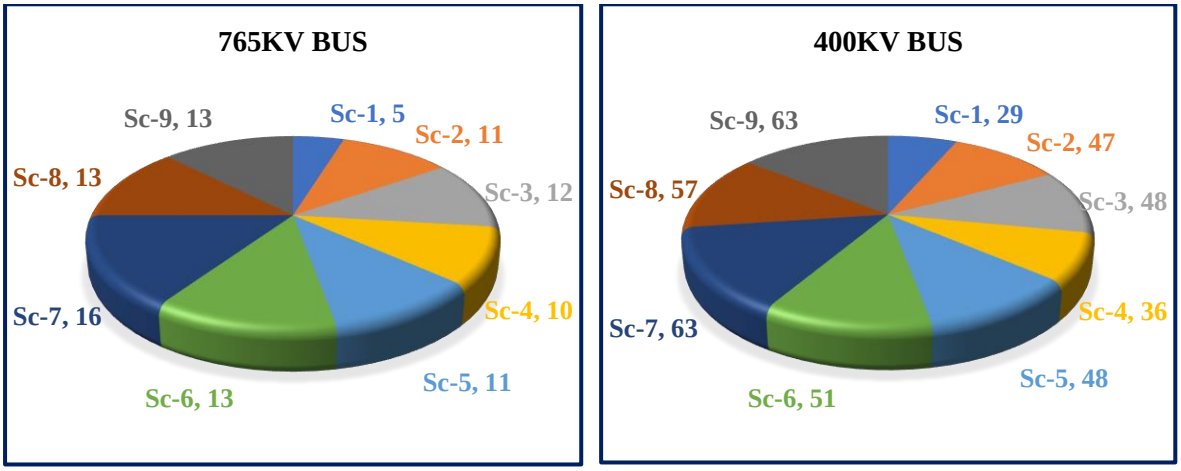
Maximum number of transformers exceeding the loading greater than MVA rating under N-1 contingency in each of the seasons are corresponding to Solar max scenarios viz. Scenarios-1, 4 and 7. Majority of these substations are RE pooling stations where ICTs have been planned considering N-0, as per Manual on Transmission Planning Criteria, 2013. Thus, about 63 no. of substations requires ICT augmentation, which 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. For conducting the short circuit studies, sub transient reactance (Xd") has been used for all thermal and hydro machines. Fault contribution from solar PV plants is limited to 1 p.u. as per various inverter capabilities during the studies After finding the fault level for all buses exceeding the design fault level under any scenario were identified. It was observed that no such violations

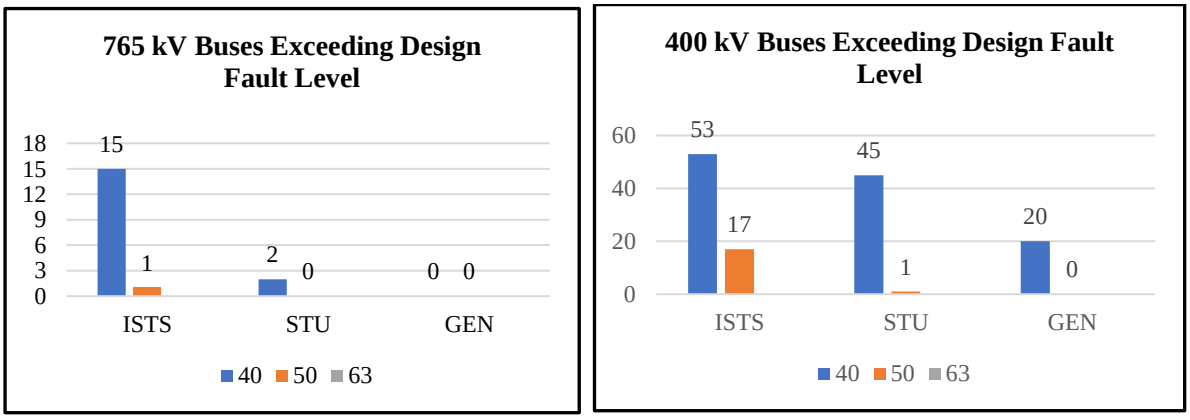
were found in 765 kV buses. Figure 3-22 shows the number of 765 kV and 400 kV buses exceeding the design fault current under different scenarios. About 16 no. of 765 kV busses were observed to be crossing the design fault current limit in Scenario-7. In 400 kV buses about 63 no. of busses were observed to be crossing the design fault current limit in Scenario-9 & 7. Details about the buses exceeding design fault current limit are attached at **Annex-2.7** under various scenarios.

Figure 3-22: Short circuit level 765 kV and 400 kV buses on pan India basis



From the above charts, it can be seen that number of fault level violations are highest in February scenario i.e. scenario - 7. 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. In Figure 3-23**,** the number of violation taking place at ISTS/STU/Gen buses in any of the scenarios are identified and same is represented below.

Figure 3-23: Violation of fault level at ISTS/STU/Gen buses at 765 kV and 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

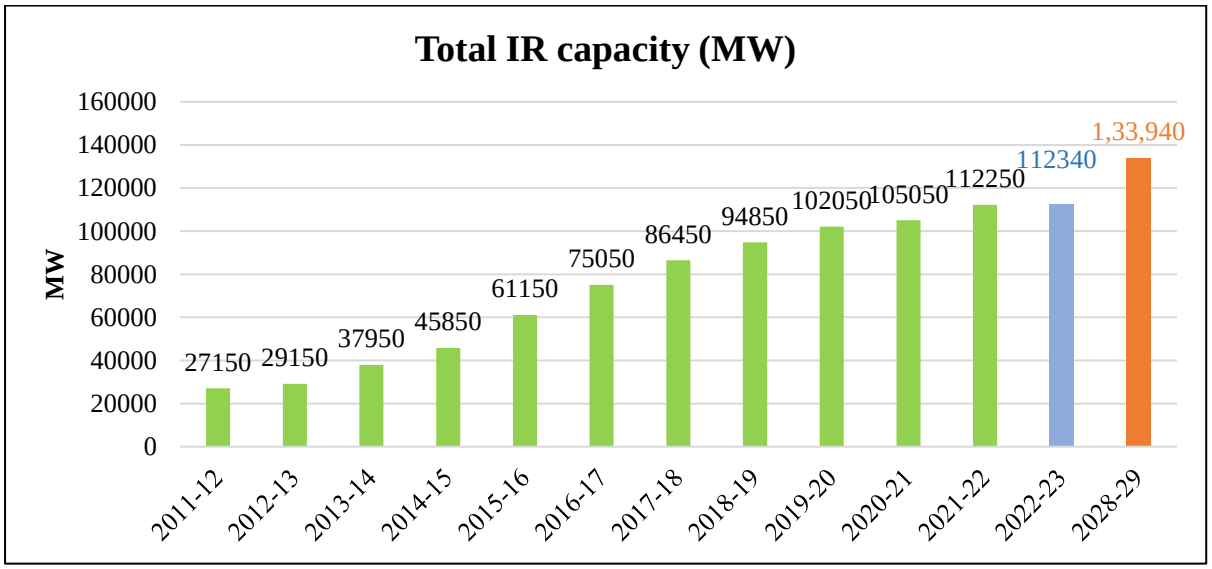
➢ 765 kV ISTS ▪ Jabalpur-Pool(50kA): 53kA ▪ Kurl (40kA): 53kA	➢ 400 kV ISTS ▪ Bikaner-II(40kA): 68kA ▪ Meerut(40kA): 66kA

➢ 765 kV STU ▪ Jaipur(40kA): 45kA ▪ GNOIDAU(40kA): 44kA	➢ 400 kV STU ▪ Dhanonda(40kA): 58KA ▪ Mandola (40kA): 54kA

3.3 Inter-Regional (IR) Capacity upto 2028-29

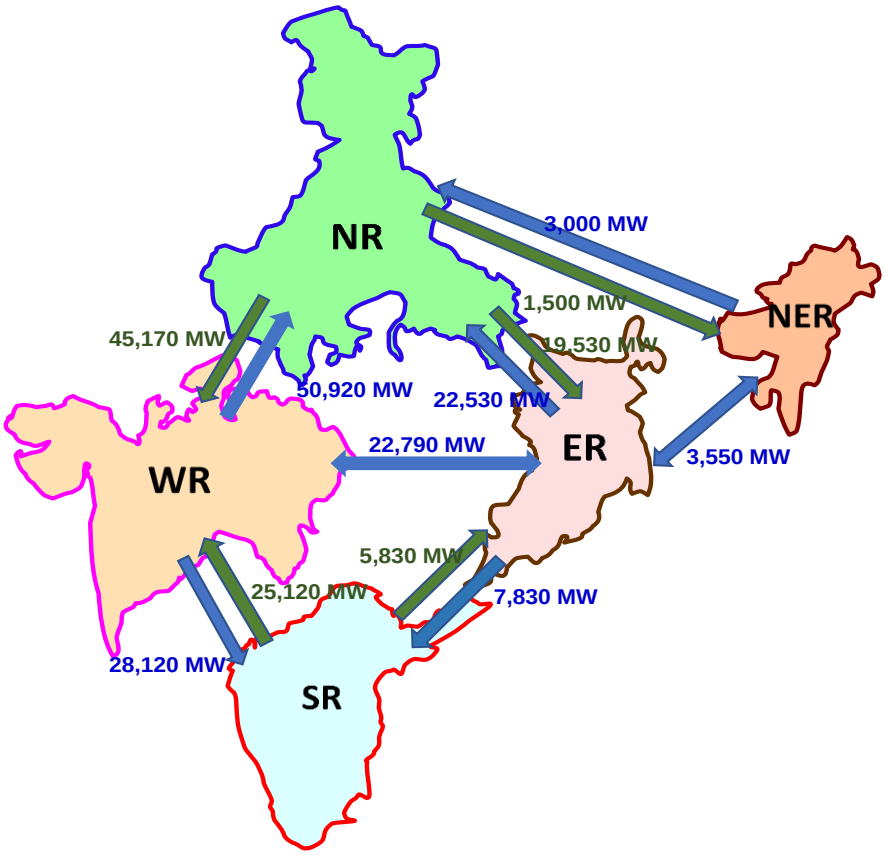
The progressive growth in Inter-Regional (IR) transmission capacity from 2011-12 till 2028-29 is given below in Figure 3-24. As on 2022-23 IR transmission capacity is 112 GW which is expected to increase to 134 GW by 2028-29.

Figure 3-24: Growth in IR Capacity



Details of approved Inter Regional corridor capacity are attached at **Annex-2.8** by 2028-29 and the schematic of the same is given below in Figure 3-25.

Figure 3-25: Inter-Regional Transmission Capacity by 2028-29



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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 Aug'23

As on Aug'2023, total Installed Capacity of Northern Region is about 120.2 GW and the peak demand is about 80.55 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 Aug'23

(All Fig in GW)

State	Generation							Grand Total	Peak Demand
	Fossil			Non Fossil					
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total		
Chandigarh	3.6	2.1	5.8	0.1	0.7	0.3	1.1	6.9	0.4
Delhi	8.8	0.6	9.4	0.1	2.3	1.5	4.0	13.4	7.4
Haryana	0.1	-	0.1	-	3.2	1.1	4.4	4.5	12.8
Himachal Pradesh	0.6	0.3	0.9	0.1	2.3	0.3	2.7	3.5	1.8
Jammu & Kashmir and Ladakh	8.2	0.2	8.4	0.2	3.8	2.0	6.0	14.3	2.9
Punjab	13.4	0.8	14.2	0.6	1.9	23.4	25.9	40.2	15.3
Rajasthan	20.4	1.0	21.4	0.3	3.4	4.9	8.6	30.0	17.2
UP	0.6	0.7	1.3	-	2.1	0.9	3.1	4.4	28.3
Uttrakhand	-	-	0.1	-	0.1	0.1	0.2	0.2	2.4
Central unallocated	1.4	0.3	1.7	0.2	0.8	-	1.0	2.7	-
NR	**57.3**	**6.0**	**63.3**	**1.6**	**20.8**	**34.5**	**56.9**	**120.2**	**80.55**

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 120.2 GW is 56.9 GW i.e. 47% of total IC. This share would further increase in envisaged scenario of 2028-29 timeframe.

4.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Northern Region demand for 2028-29 timeframe is expected to increase to about 103.7 GW. As per the inputs received from various stakeholders, total installed capacity of Northern Region for 2028-29 is expected to be about 203 GW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 4-2.**

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

(All Fig in GW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Delhi	0.5	1.5	2.0	-	-	-	-	-	2.0	10.5
Haryana	3.6	-	3.6	0.1	-	0.9	1.0	-	4.6	18.5
Himachal Pradesh	-	-	-	0.3	-	-	0.3	-	0.3	2.8
Jammu & Kashmir	-	0.2	0.2	1.2	-	-	1.2	-	1.4	4.0
Punjab	5.7	0.0	5.7	1.4	-	-	1.4	-	7.0	18.5
Rajasthan	10.0	0.2	10.2	0.5	-	20.7	21.3	-	31.5	23.6
UP	22.0	-	22.0	1.3	-	4.2	5.5	-	27.5	37.3
Uttrakhand	-	-	-	2.2	-	-	2.2	-	2.2	3.6
Chandigarh	-	-	-	-	-	-	-	-	-	0.5
Central	11.9	1.8	13.6	14.2	4.4	73.9	92.5	10.5	116.7	-
IPP	-	-	-	4.1	-	-	4.1	-	4.1	-
Rooftop / Other RE	-	-	-	-	-	5.9	5.9	-	5.9	-
NR	**53.7**	**3.6**	**57.3**	**25.3**	**4.4**	**105.6**	**135.3**	**10.5**	**203.1**	**109.7**

From above, it is observed that growth in installed capacity of Northern Region is majorly from non-fossil fuel based generation resources. Share of non-fossil fuel based generation capacity in total present installed capcity (IC) is expected to be increased from 47% to 67%. There is a growth in peak demand of Northen Region from present time-frame (2023-24) to 2028-29 with a CAGR of 6.38%. The state wise peak demand growth is given at **Table 4-3.**

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

(All Fig in MW)

	Peak Demand			
	2022-23	2028-29 (20th EPS)	Increase in demand	CAGR (%)
Chandigarh	411	519	108	4.78
Delhi	7,437	10,469	3,032	7.08
Haryana	12,844	18,478	5,634	7.55
Himachal Pradesh	1,809	2,829	1,020	9.36
Jammu & Kashmir & Ladakh	2,890	4,090	1,200	7.19

Punjab	15,293	18,478	3,185	3.86
Rajasthan	17,266	23,590	6,324	6.44
UP	28,284	37,270	8,986	5.67
Uttarakhand	2,436	3,623	1,187	8.26
NR	**80,548**	**1,09,714**	29,166	6.38

incl. 97MW of Ladakh

From the above data it is observed that the CAGR growth of peak demand is maximum for Himachal Pradesh (9.36%) and minimum for Punjab (3.86%).

4.3 Load Generation Balance for 2028-29 Timeframe

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

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

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

Scenario No & Name	Hydro	Nuclear	Solar	Wind	ESS	Gas	Regional DF
1-Aug Solar Max	70%	80%	90%	50%	-100%	0%	90%
2-Aug Peak Load	95%	80%	0%	70%	60%	50%	88%
3-Aug Night Off Peak	70%	80%	0%	60%	40%	50%	65%
4-Jun Solar Max	70%	80%	90%	50%	-100%	0%	91%
5-Jun Peak Load	95%	80%	0%	70%	50%	50%	91%
6-Jun Night Off Peak	70%	80%	0%	60%	1%	50%	65%
7-Feb Solar Max	30%	80%	90%	10%	-100%	0%	77%
8-Feb Peak Load	60%	80%	0%	35%	100%	50%	65%
9-Feb Night Off Peak	30%	80%	0%	10%	40%	30%	43%

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

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

(All Fig in MW)

IR Flows	Aug'28 (Monsoon)			Jun'28 (Summer)			Feb'29 (Winter)		
Scenario No. / Corridor	1 Solar Max	2 Peak Load	3 Off Peak	4 Solar Max	5 Peak Load	6 Off Peak	7 Solar Max	8 Peak Load	9 Off Peak
WR-NR	692	16637	10844	390	16087	10233	-11628	472	499

ER-NR	-7431	-2288	-4844	-6987	-912	-2781	-5603	2270	-136
NER-NR	-500	-	-	-500	-	-	-500	-	-
NEPAL-NR	1454	1869	1454	1454	1869	1454	623	1246	-
NR	5785	-16218	-7454	5642	-17045	-8906	17109	-3988	-362

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

4.4 ISTS Network Expansion Schemes Evolved from Mar'23 to Aug'23

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

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in Cr.)
Rajasthan and Inter Regional (MP)			
1.	Implementation of Bus Sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)	2024-25	17.11
2.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 : 5.5GW) (Jaisalmer/Barmer Complex)"	2025-26	20,080.45
3.	Transmission system strengthening for interconnections of Bhadla-III & Bikaner-III complex	2025-26	1382
4.	Augmentation of transformation capacity at 400/220kV Bikaner-II PS by 400/220kV, 1x500 MVA ICT (3rd)	2024-25	55.82
Haryana			
1.	Reconductoring of 220 kV Hisar (PG) - Hisar (IA) D/c line	2025-26	-
Uttarakhand			
1.	Augmentation of 1x500 MVA (4th) ICT at 400/220 kV Nallagarh substation	2025-26	63.08
Jammu and Kashmir			
1.	Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315 MVA, 400/220kV ICT (3rd)	2025-26	82.04
Uttar Pradesh			
1.	Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT	2024-25	61

Details of the schemes are reproduced below state-wise:

4.4.1 Rajasthan and Inter Regional (MP)

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

Details of the scheme are as under:

S. No.	Items	Details
1.	Name of Scheme	Implementation of Bus Sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)
2.	Scope of the scheme	➢ 1 Set of Bus sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)
3.	Depiction of the scheme on Transmission Grid Map	Refer to the schematic in Figure below
4.	Upstream/downstream system associated with the scheme	765/400/220kV Fatehgarh-III PS (new section) is being implemented by POWERGRID as part of Phase-III Part E1 scheme matching with an implementation timeframe of Rajasthan Phase-III Part A1 package. Fatehgarh-III PS (Section-2) will be connected with under implementation 765/400 kV Beawar S/s through a 765 kV 2xD/c line (one D/c proposed to be LILOed at Fatehgarh-IV PS (Section-2)) and with Fatehgarh-IV PS (Section-1) Bhadla-III and Barmer-I through 400 kV D/c lines.
5.	Objective / Justification	➢ The scheme includes 1 Set of Bus sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2) ➢ Transmission system for additional 20 GW REZ in NR (Phase-III) including Fatehgarh-III PS (new section) was agreed in the 3rd NRPC (TP) meeting held on 19.02.2021 and 49th NRPC meeting held on 27.09.2021. Subsequently in the 5th NCT meeting held on 25.08.2021 & 02.09.2021, above scheme was agreed for implementation. As part of above scheme, STATCOM along with MSC & MSR at Fatehgarh-III PS was also discussed and it was decided that its requirement would be reviewed at a later date. ➢ Subsequently in the 11th NCT meeting held on 28.12.22 and 17.01.23, It was agreed

S. No.	Items	Details
		that ±2x300 MVAr STATCOM along with 4x125 MVAr MSC, 2x125 MVAr MSR along with 2 Nos. of 400 kV bays at Fatehgarh-III PS will be implemented as part of transmission schemes "Transmission system for evacuation of power from REZ in Rajasthan (20 GW) Phase-III Part F" which is currently in bidding stage. ➢ In the 11th NCT meeting, it was also noted that ±300 MVAr STATCOM should be placed in each 400kV section of Fatehgarh-III PS (Phase-III Part E1). Therefore, One set of sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2) is required so as to place ±300 MVAr STATCOM units along with MSC & MSR in each 400kV section of Fatehgarh-III PS (Phase-III Part E1). ➢ Same was approved in 16th Consultation meeting for Evolving Transmission Schemes in NR held on 28.02.23 as per the scope given in S.No 2.
6.	Estimated Cost	₹ **17.11 Crore**
7.	Impact on the total Annual Transmission charges (ATC) in % along with the existing ATC	A. ATC (considering Levelized Tariff @15% of estimated cost): ₹ 2.567Crore B. Present ATC: ₹ **45536.18** Crore* C. A/B (%): Less than 0.00564%
8.	Need of phasing, if any	Not Applicable
9.	Implementation timeframe	Matching with Ph-III Part-E1 package as per MOP OM dated 01.12.21, Phase-III Part E1 implementation timeframe is to be matched with Phase-III Part A1). It is expected that SPV of Phase-III Part A1 package may be transferred by Jun'23 (18 months schedule) (LOI issued by BPC)
10.	Inclusion of any wildlife/protected area along the transmission line route	None envisaged
11.	Deliberations with RPC along with their comments	The estimated cost of the scheme is less than INR 500 Cr. Accordingly, the same is not required to be sent to WRPC for deliberation in line with MoP office order no. 15/3/2018-Trans-Pt(5) dated 28-10-2021 regarding reconstitution of NCT.
12.	System Study for the evolution of the proposal	NA

**Total YTC allowed for Jan'23, as per notification of transmission charges payable by DICs for billing month of March 2023 dated 25.02.2023 published on NLDC website.*

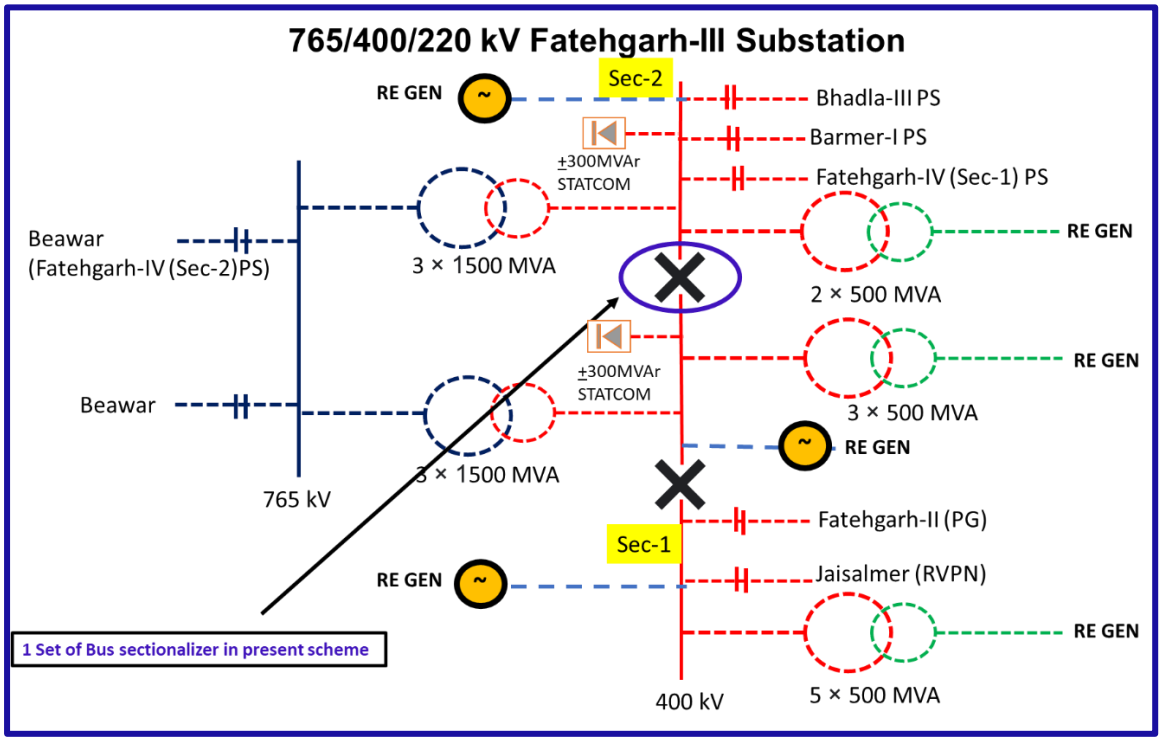

Figure : Implementation of Bus Sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2).

The work was allocated under RTM by CTU OM dated 21/04/2023 to the owner of the under implementation S/s i.e., POWERGRID Ramgarh Transmission *Ltd.* (as per Tariff Policy, 2016), as per details below:

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

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	1 Set of Bus sectionalizer at 400kV level of 765/400/220kV Fatehgarh-III PS (Section-2)	400 kV Bus sectionalizer – 1 set	Matching with Ph-III Part-E1 package (refer note 1)
		Total Estimated Cost:	**₹ 17.11 Crore**

Note: -

1. As per MOP OM dated 01.12.21, Phase-III Part E1 implementation timeframe is to be matched with Phase-III Part A1. It is expected that SPV of Phase-III Part A1 package may be transferred by Jun'23 (18 months schedule) (LOI issued by BPC).

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

RE potential and dispatches are considered based on report of "Transmission system for integration of over 500GW RE capacity by 2030" as well as SECI/MNRE inputs. As per the above report,100% solar dispatch and 50% wind dispatch considered in summer solar max

scenario, whereas in winter solar max scenario 100% solar dispatch and 10% wind dispatch considered. Details are as under:

Pooling Station	Total RE Potential (by 2030)		RE Potential (by 2027) for which system is planned	Net (Max) Dispatch Considered by 2027(GW) in summer	Net (Max) Dispatch Considered by 2027(GW) in Winter
	Source	Capacity (GW)	Capacity (GW)		
Fatehgarh-IV	Wind	6	4	4	2.4
	Solar	6	4		
	BESS	4	2		
Barmer-I	Wind	3	3	3.5	2.3
	Solar	4	3		
	BESS	1.5	1		
			Total (GW)	**7.5**	**4.7**

At present, a comprehensive scheme is planned for Hybrid RE potential (7.5 GW) with 7.5 GW RE dispatch in summer season and 4.7 GW RE dispatch in winter season as Wind contribution reduces significantly in winters. In case the scheme needs to be planned for 7.5 GW RE dispatch in winter scenario also, additional transmissions system is required due to critical loading beyond Jalore/Sirohi.

After conducting studies with incorporation of increased load of Rajasthan as suggested by Grid- India, CTUIL stated that transmission system is adequate for evacuation of about 5.5 GW RE power (solar) in summer & winter scenario. However, with development of wind or BESS capacity in above complex, evacuation capacity shall increase from 5.5 GW.

After detailed deliberations, the following were decided w.r.t. the transmission schemes:

S.No.	Scheme	Remarks
1.	Part A	TBCB
2.	Part B	TBCB
3.	Part C	Scheme of 2 GW Neemuch / Mandsaur to be merged. Combined scheme to be implemented under TBCB.
4.	Part D	TBCB

5.	Part E	TBCB
6.	Part F1	Part F1 and F2 to be combined. Combined scheme (Part F i.e. Part F1+F2) to be implemented under TBCB.
7.	Part F2	
8.	Part G	Deferred. To be taken up based on GIB clearance of RE generation DTL at Fatehgarh-II PS along with GIB clearance of Fatehgarh-II-Bhadla-III 400 kV D/C line
9.	Part H1	TBCB
10.	Part H2	RTM

Summary of the Part A of the scheme is as given below:

Sl.No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2: 5.5 GW) (Jaisalmer/Barmer Complex): Part A Tentative Implementation timeframe: 24 months from SPV transfer	2,206	Recommended to be implemented under TBCB.

Detailed scope of Part A of the scheme is given:

Sl. No.	**Description**	**Capacity/ckm**
1	Establishment of 4x1500 MVA, 765/400 kV & 5x500 MVA, 400/220 kV Fatehgarh-IV (Section-2) Pooling Station along with 2x240 MVAr (765 kV) Bus Reactor & 2x125 MVAr (400 kV) Bus Reactor	• 765/400 kV, 1500 MVA ICT- 4 Nos. (13x500 MVA including one spare unit) • 765 kV ICT bays- 4 Nos. • 240 MVAR, 765 kV Bus Reactor- 2 Nos. (7x80 MVAR including one spare unit) • 765 kV Bus reactor bays-2 Nos. • 765 kV line bays - 4 Nos. [for LILO of Fatehgarh-III - Beawer 765 kV D/c (2nd) line at Fatehgarh-IV (Section-2) PS]

Sl. No.	Description	Capacity/ckm
	[Future space provisions already approved at Fatehgarh-IV in 8th NCT meeting dated 25.03.22 would be utilized for the present scheme]	• 400/220 kV, 500 MVA ICT -5 Nos. • 400 kV ICT bays- 9 Nos. • 400 kV line bays - 2 Nos. [For Fatehgarh-IV (Sec-2) - Bhinmal (PG) D/c line] • 125 MVAR, 420 kV Bus Reactor-2 Nos. • 400 kV Bus reactor bays- 2 Nos. • 400 kV Sectionalisation bay: 1 set • 220 kV ICT bays- 5 Nos. • 220 kV line bays: 6 Nos. (for RE connectivity) • 220 kV BC (2 Nos.) and 220 kV TBC (2 Nos.) • 220 kV Sectionalisation bay: 1 set
2	Fatehgarh-IV (Section-2) PS – Bhinmal (PG) 400 kV D/c line (Twin HTLS) along with 50 MVAr switchable line reactor on each ckt at each end	Route Length: 200 km • 400 kV, 50 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 Nos. • 400 kV, 50 MVAr switchable line reactors at Bhinmal (PG) – 2 Nos. • Switching equipment for 400 kV 50 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 Nos. • Switching equipment for 400 kV 50 MVAr switchable line reactors at Bhinmal (PG) – 2 Nos.
3	LILO of both ckts of 765 kV Fatehgarh-III- Beawar D/c line (2nd) at Fatehgarh-IV (Section-2) PS along with 330 MVAr switchable line reactor at Fatehgarh-IV PS end of each ckt of 765 kV Fatehgarh-IV- Beawar D/c line (formed after LILO)	LILO length: 15 km • 330 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 nos. • Switching equipment for 330 MVAr switchable line reactors at Fatehgarh-IV (Section-2) PS – 2 nos. • 110 MVAr (765 kV) spare reactor single phase unit at Fatehgarh-IV (Section-2) PS end – 1 no.
4	2 nos. of 400 kV line bays at Bhinmal (PG)	400 kV line bays - 2 nos.

Note:

i. Transmission system for evacuation of about 2 GW RE power from REZ in Rajasthan (20 GW) under Phase-III Part A1 at Fatehgarh-IV (Section-1) is under bidding.

ii. Transmission system under Phase-IV (Part 2) is for evacuating 4-5 GW potential at Fatehgarh-IV (Section 2), which is utilising the future provision (approved in 8th NCT meeting dated 25.03.22) at Fatehgarh-IV approved under Phase-III scheme.

iii. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey
iv. POWERGRID to provide space for 2 nos. of 400 kV line bays at Bhinmal (PG) along with the space for switchable line reactors.
v. Implementation of A,B,C,D, E ,F, H1,H2 packages shall be aligned
vi. Switchable line reactors to be implemented with NGR bypass arrangement

Summary of the Part B of the scheme is as given below:

Sl.No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/Barmer Complex): Part B Implementation timeframe: 24 months from SPV transfer	3,279	Recommended to be implemented under TBCB.

Detailed scope of Part B of the scheme is given:

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

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

Note:

i. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.
ii. POWERGRID to provide space for 2 nos. of 400 kV line bays at Chittorgarh (PG)
iii. Developer of Fatehgarh-IV S/s (Section-2) to provide space for 2 nos. of 765 kV line bays at Fatehgarh-IV(Section-2) PS along with the space for switchable line reactor
iv. Implementation of A,B,C,D, E , F, H1, H2 packages shall be aligned

v. Switchable line reactors to be implemented with NGR bypass arrangement

Summary of the Part C of the scheme is as given below:

Sl. No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2: 5.5 GW) (Jaisalmer/Barmer Complex): Part C Implementation timeframe: 24 months from SPV transfer	2,708	Recommended to be implemented under TBCB route.

Detailed scope of Part C of the scheme is given:

Sl. No.	**Description**	**Capacity / line length km**
1.	Establishment of 3x1500MVA, 765/400/ kV & 5x500MVA 400/220kV Mandsaur Pooling Station along with 2x330 MVAr (765 kV) Bus Reactors (with 1x110 MVAr & 1x80 MVAr, 765 kV spare single phase reactor unit for line/bus reactor) **Future Provisions**: Space for: • 765/400 kV ICT along with bays- 3 no. • 765 kV line bays along with switchable line reactors – 12 nos. • 765 kV Bus Reactor along with bay: 2 no. • 765 kV Sectionaliser bay: 1 -set • 400 kV line bays along with switchable line reactor – 12 nos. • 400/220 kV ICT along with bays -5 nos. • 400 kV Bus Reactor along with bay: 2 no. • 400 kV Sectionalization bay: 1- set • 220 kV line bays: 11 nos. • 220 kV Sectionalization bay: 1 set • 220 kV BC and TBC: 1 no.	765/400 kV, 1500 MVA ICT – 3 (10 single phase units of 500 MVA including one spare unit) 400/220 kV, 500 MVA ICT – 5 (3 nos. on 220 kV bus section-1 & 2 nos. on 220 kV bus section-2) 765 kV ICT bays – 3 400 kV ICT bays – 8 330 MVAR 765 kV bus reactor-2 (7x110 MVAR single phase units including one spare unit) 765 kV bus reactor bay- 2 765 kV line bay- 2 (for Indore line) 110 MVAR, 765 kV, 1-ph reactor (spare unit)-1 80 MVAR, 765 kV, 1-ph reactor (spare unit)-1 125 MVAR 420 kV bus reactor-2 400 kV reactor bay- 2 220 kV ICT bays - 5 220 kV line bays – 7 (4 nos. on bus section-1 and 3 nos. on bus section-2) 220 kV Bus Sectionaliser – 1 set 220 kV TBC bay – 2 no. 220 kV BC bay – 2 no.

Sl. No.	Description	Capacity / line length km
	• STATCOM (± 300 MVAr) along with MSC (2x125 MVAr) & MSR (1x125 MVAr) along with one 400 kV bay.	
2.	Mandsaur PS – Indore(PG) 765 kV D/c Line	Route Length – 200 km
3.	1x330 MVAr switchable line reactor (SLR) on each ckt at Mandsaur end of Mandsaur PS – Indore(PG) 765 kV D/c Line	• 330 MVAr, 765 kV switchable line reactor- 2. • Switching equipments for 765 kV line reactor- 2
4.	2 nos. of 765 kV line bays at Indore(PG) for termination of Mandsaur PS – Indore(PG) 765 kV D/c Line	• 765 kV line bays – 2 Nos. (for Indore(PG) end)

Note:

i. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey
ii. POWERGRID to provide space for 2 nos. of 765 kV line bays at Indore S/s
iii. Implementation of A,B,C,D,E, F, H1, H2 packages shall be aligned
iv. Switchable line reactors to be implemented with NGR bypass arrangement

Summary of the Part D of the scheme is as given below:

Sl.No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2: 5.5 GW) (Jaisalmer/Barmer Complex): Part D Implementation timeframe: 24 months from SPV transfer	2,227	Recommended to be implemented under TBCB.

Detailed scope of Part D of the scheme is given:

S. No.	Description	Capacity/ckm
1	Beawar- Mandsaur PS 765 kV D/c line along with 240 MVAr switchable line reactor for each circuit at each end	Route Length – 260 km • 765 kV, 240 MVAr switchable line reactors at Beawar – 2 nos.

		• 765 kV, 240 MVAr switchable line reactors at Mandsaur PS – 2 nos. • Switching equipment for 765 kV, 240 MVAr switchable line reactors at Beawar – 2 nos. • Switching equipment for 765 kV, 240 MVAr switchable line reactors at Mandsaur PS – 2 nos.
2	2 no. of 765 kV line bays each at Beawar S/s & Mandsaur S/s	765 kV line bays - 4 nos (2 nos. each at Beawer S/s & Mandsaur PS)

Note:

i. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey
ii. Developer of Mandsaur PS to provide space for 2 nos. of 765 kV line bays at Mandsaur S/s along with the space for switchable line reactor
iii. Developer of Beawar S/s to provide space for 2 nos. of 765 kV line bays at Beawar S/s along with the space for switchable line reactor
iv. Implementation of A,B,C,D, E, F, H1, H2 packages shall be aligned
v. Switchable line reactors to be implemented with NGR bypass arrangement

Summary of the Part E of the scheme is as given below:

Sl. No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/Barmer Complex): Part E Implementation timeframe: 24 months from SPV transfer	3,251	Recommended to be implemented under TBCB.

Detailed scope of Part E of the scheme is given:

Sl. No.	**Description**	**Capacity/ckm**

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

Note:

i. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey
ii. Developer of Sirohi PS to provide space for 2 nos. of 765 kV line bays at Sirohi PS along with the space for switchable line reactors
iii. Developer of Mandsaur PS to provide space for 2 nos. of 765 kV line bays at Mandsaur PS
iv. Implementation of A,B,C,D, E ,F, H1, H2 packages shall be aligned
v. Switchable line reactors to be implemented with NGR bypass arrangement
vi. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Summary of the Part F (by clubbing F1 & F2) of the scheme is as given below:

Sl.No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/Barmer Complex): Part F Implementation timeframe: 24 months from SPV transfer	2,735	Recommended to be implemented under TBCB.

Detailed scope of Part F of the scheme is given:

Sl. No.	Description	Capacity/ckm
1	Establishment of 3x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Barmer-I Pooling Station along with 2x240 MVAr (765 kV) Bus Reactor & 2x125 MVAr (400 kV) Bus Reactor Future provisions: Space for ➢ 765/400kV ICT along with bays- 3 no. ➢ 765 kV line bays along with switchable line reactors – 4 nos. ➢ 765kV Bus Reactor along with bay: 1 no. ➢ 400 kV line bays –4 ➢ 400 kV line bays along with switchable line reactor –4 nos.	• 765/400 kV 1500 MVA ICT- 3 nos. (10x500 MVA including one spare unit) • 765 kV ICT bays-3 Nos. • 240 MVAr Bus Reactor-2 no. (7x80 MVAr, including one spare unit) • 765 kV Bus reactor bays-2 no. • 765 kV line bays- 2 Nos. (for D/c line to Sirohi PS) • 400/220 kV 500 MVA ICT -2 Nos • 400 kV ICT bays- 5 Nos. • 125 MVAr Bus Reactor-2 nos. • 400 kV Bus reactor bays- 2 nos. • 400 kV line bays - 2 nos. [for D/c line to Fatehgarh-III(Section-2) PS] • 220 kV ICT bays- 2 No.

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

Note:

i. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey
ii. Developer of Sirohi PS to provide space for 2 nos. of 765 kV line bays at Sirohi PS along with the space for switchable line reactor
iii. Developer of Fatehgarh-III PS (Section-2) to provide space for 2 nos. of 400 kV line bays at Fatehgarh-III PS (Section-2)
iv. Switchable line reactors to be implemented with NGR bypass arrangement
v. Implementation of A,B,C,D, E ,F, H1, H2 packages shall be aligned

Summary of the Part H1 of the scheme is as given below:

Sl.No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/Barmer Complex): Part H1 Implementation timeframe: 24 months from SPV transfer	3,674	Recommended to be implemented under TBCB.

Detailed scope of Part H1 of the scheme is given:

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
1.	Establishment of 765/400 kV (2x1500 MVA), 400/22 kV (2x500 MVA) & 220/132 kV (3x200 MVA) Kurawar S/s (with 1x500 MVA spare single phase transformer unit) with 2x330 MVAr 765 kV bus reactor and 1x125 MVAr 420 kV bus reactor (with 1x110 MVAr & 1x80 MVAr, 765 kV spare single phase reactor unit for line/bus reactor) **Future Provisions**: Space for • 765/400 kV ICT along with bays- 4 no. • 765 kV line bays along with switchable line reactors – 8 nos. • 765 kV Bus Reactor along with bay: 2 no. • 765 kV Sectionaliser bay: 1 -set • 400 kV line bays along with switchable line reactor – 10 nos. • 400/220 kV ICT along with bays -6 nos. • 420 kV Bus Reactor along with bay: 3no. • 400 kV Sectionalization bay: 1- set • 220 kV line bays: 12 nos. • 220 kV Sectionalization bay: 2 sets	• 765/400 kV, 1500 MVA ICT – 2 (7 single units of 500 MVA including one spare unit) • 400/220 kV, 500 MVA ICT – 2 • 220/132 kV, 200 MVA ICT – 3 • 765 kV ICT bays- 2 • 400 kV ICT bays- 4 • 220 kV ICT bays – 5 • 132 kV ICT bays - 3 • 330 MVAR 765 kV bus reactor-2 • 125 MVAR 420 kV bus reactor-1 • 765 kV reactor bay- 2 • 765 kV line bays- 4 • 400 kV line bays- 4 • 400 kV reactor bay- 1 • 220 kV BC – 1 • 220 kV TBC – 1 • 132 kV TBC – 1 • 110 MVAR, 765 kV, 1-ph reactor (spare unit)-1 • 80 MVAR, 765 kV, 1-ph reactor (spare unit)-1

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

Note:

i. The line lengths mentioned above are approximate as the exact length shall be obtained after the detailed survey.
ii. MPPTCL has confirmed availability of space for 2 nos. 400 kV bays at Ashta (MP) S/s and for 2 nos. additional bays, MPPTCL has informed that adjacent land is private land and may be purchased by the project developer at their cost as per requirement.
iii. Implementation of A,B,C,D, E ,F, H1 & H2 packages shall be aligned
iv. TSP of the subject scheme shall implement Inter-tripping scheme on Mandsaur – Kurawar 765 kV D/c line (for tripping of the switchable line reactor at Mandsaur/Kurawar end along with the main line breaker).
v. Switchable line reactors to be implemented with NGR bypass arrangement
vi. Developer of Mandsaur S/s to provide space for 2 Nos. 765 kV line bays for Mandsaur – Kurawar 765 kV D/c line.
vii. POWERGRID to provide space for 2 Nos. 400 kV line bays at Shujalpur S/s for Shujalpur – Kurawar 400 kV D/c line.
viii. The implementation timeline mentioned above is tentative. Final Timeline would be indicated in the RfP Document.

Part H2 Summary

Sl. No.	Name of the scheme and implementation timeframe	Estimated Cost (₹ Crores)	Remarks
1.	Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5 GW) (Jaisalmer/Barmer Complex): Part H2 Provision of NGR bypass arrangement and inter tripping scheme on 240 MVAr SW LR at Bhopal end of Kurawar – Bhopal 765 kV S/c line (~60 km.): Part H2 Implementation timeframe: In matching timeframe of H1 Scheme	0.45	To be awarded under RTM to BDTCL i.e. the TSP owing the Indore – Bhopal 765 kV S/c line .

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

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
1.	Provision of NGR bypass arrangement and inter tripping scheme on 240 MVAr Switchable Line Reactor at Bhopal end of	NGR bypass arrangement and inter tripping scheme (Bhopal end)

Sl. No.	Scope of the Transmission Scheme	Capacity / line length km
	Kurawar – Bhopal 765 kV S/c line (~Route length: 60 km)	

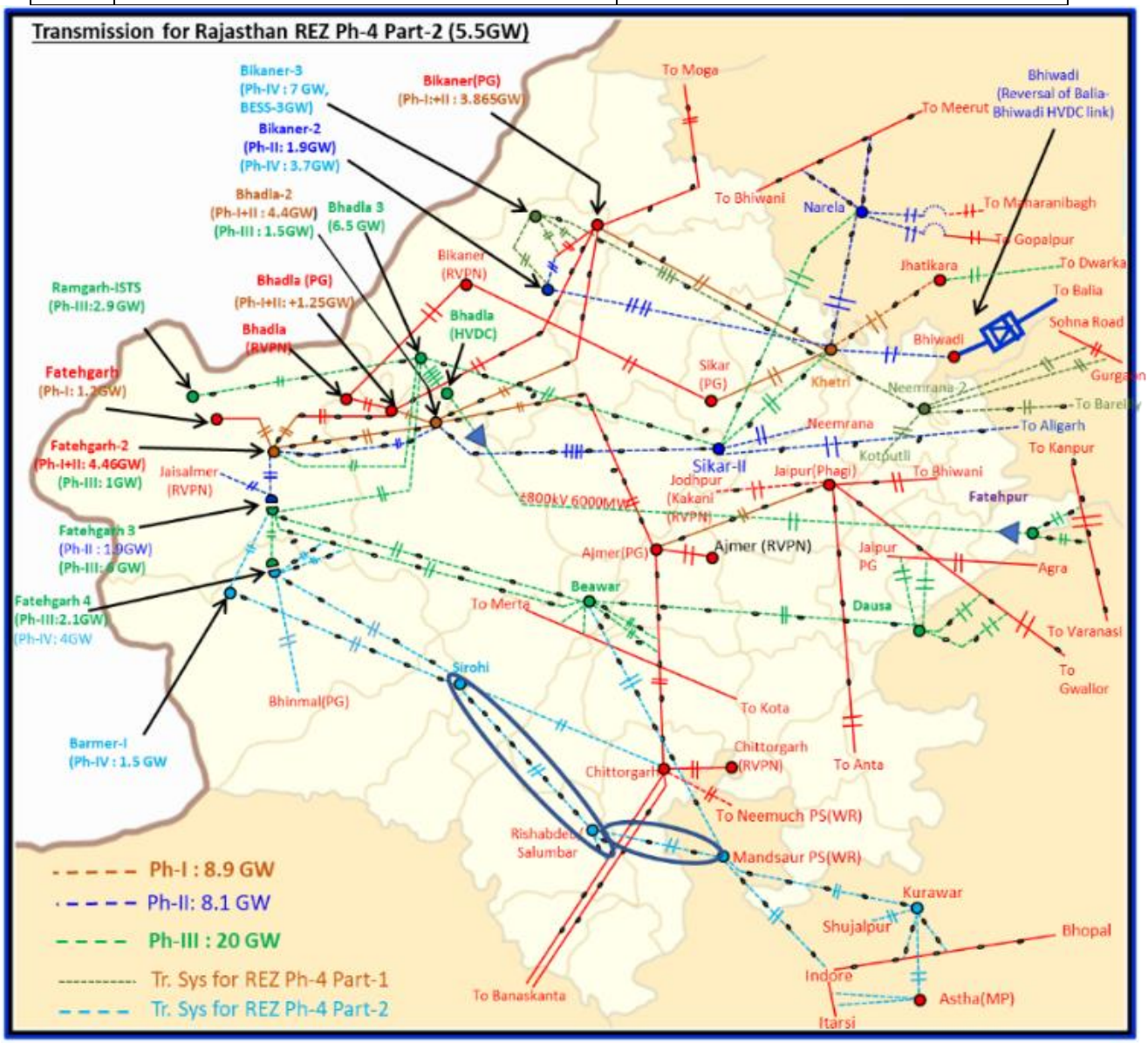

Fig -1: Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-2 :5.5GW) (Jaisalmer/Barmer Complex)

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

Comprehensive Transmission scheme for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex) is under bidding for power transfer of 7.7GW incl. 4GW from Bikaner-III PS. The scheme comprises 765kV EHVAC corridor from Bikaner-III PS towards load centers of Delhi/UP. About 0.85 GW connectivity application granted/received at

Bikaner-III PS (out of which few applications may be shifted at Bikaner-II PS to utilize vacated margin of about 0.675 GW at Bikaner-II PS in GNA). In view of that about 0.25GW RE applications will be available at Bikaner-III PS against 4GW RE evacuation capacity.

St-II Connectivity for about 3 GW and LTA of about 1GW, against the potential of 6.5 GW (under Ph-III), was received/granted at Bhadla-III PS. Earlier, St-II Connectivity for about 2.75 GW RE and LTA of 2.6GW, against the potential of 2.9 GW (under Ph-III), was received/granted at Ramgarh PS. However, M/s Adani surrendered 2.1 GW connectivity/LTA at Ramgarh PS under GNA, considering above, power transfer requirement from Ramgarh will be 0.65 GW (2.75GW-2.1GW) in GNA regime.

As part of Rajasthan REZ Ph-III (20GW) Transmission scheme, Bhadla-III & Ramgarh PS are being established for integration of 6.5GW & 2.9 GW RE potential respectively. Ramgarh PS is also being inter-connected with Bhadla-III for evacuation of RE power. In order to facilitate evacuation of 9.4GW RE power from Ramgarh/Bhadla-III PS (6.5GW+2.9GW) from Bhadla-III onwards, 765kV Bhadla-III - Sikar-II D/c line with implementation schedule of Dec'24 (Tentative) [for about 2.9GW power transfer requirement] as well as 6GW HVDC corridor (±800kV Bhadla (HVDC) -Fatehpur(HVDC)) with implementation schedule of Dec'26 (42 months schedule) is being implemented as part of Ph-III scheme.

As mentioned above, Connectivity for 3.65GW (0.65GW at Ramgarh + 3GW at Bhadla-III) is already granted/under process at Ramgarh/Bhadla-3 PS. In view of expected implementation schedule of HVDC system beyond Bhadla-3 (Dec'26), there is a need of additional corridor from Bhadla-3 onwards beyond 2.9GW RE potential of Ramgarh/Bhadla-3 PS.

Further, at Bikaner-III PS, application for only 0.25 GW is left against 4 GW planned evacuation capacity. Since, more injection is anticipated than planned EHVAC capacity at Bhadla-III, in the requisite time frames (25-26), there is a need for optimal utilization of Bikaner-III corridor capacity by forming a high capacity tie interconnection between Bhadla-III & Bikaner-III PS.

Accordingly, 765kV Bhadla-III - Bikaner-III D/c line is proposed to facilitate optimal utilization of EHVAC corridor beyond Bikaner-III PS for evacuation of RE generation including at Ramgarh/Bhadla-III PS.

Further, as part of committee report "Transmission system for integration of over 500GW capacity by 2030" as well as MNRE/SECI inputs, a Comprehensive transmission plan for evacuation of 75GW RE potential from Rajasthan is evolved comprising 10 GW RE potential (Wind: 4 GW, Solar: 6 GW) along with 3GW BESS(net evacuation 5 GW) at Ramgarh in Jaisalmer complex by 2030. Out of 10 GW potential by 2030, in its Ph-I (by 2025) 3GW potential (Wind: 2GW, Solar: 1GW) was informed at Ramgarh. As part of above committee report, additional 3 GW RE injection at Ramgarh PS and 2GW RE injection at Bhadla-III/Bhadla-IV PS is envisaged beyond 2025 (Ph-II/III), which will utilize the planned HVDC

corridor beyond Bhadla-3 as it will match implementation schedule of generation and transmission i.e. in 2026-27 timeframe.
GIB committee clearance is still pending for 400kV Fatehgarh-ll- Bhadla-lll D/c line under Ph-lll Part-B1 package as above line is emanating from Fatehgarh-ll PS, which is falling under GIB core area and adversely impacting progress of other linked packages. Accordingly, it was directed that process of delinking of 400kV Fatehgarh-ll- Bhadla-lll D/c line from Ph-lll Part-B1 may be carried out at the earliest and a separate package may be formed comprising this line. It is understood that RE developers are also facing challenges in getting DTL clearance from GIB committee at Fatehgarh-II PS. Deferment of 400kV Fatehgarh-ll- Bhadla-lll D/c line will also reduce the SCR at Bhadla-III PS/Bhadla HVDC which is already at boarder line. Therefore,765kV Bhadla-III PS - Bikaner-III PS D/c line shall also provide additional advantage to improve short circuit strength in Bhadla-III complex including for LCC HVDC terminal at Bhadla.

Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-3 :2 GW) (Ramgarh Complex) was deliberated in 17th CMETS-NR meeting held on 31.03.23 which included 765kV Ramgarh-Bhadla-III PS - Bikaner-III PS D/c Corridor. However considering connectivity surrendered at Ramgarh by M/s Adani (2100 MW) the proposal was reviewed as above.

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

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

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

RE pooling stations in western Rajasthan complex (Bikaner/Bhadla/Fatehgarh) are contagious to each other and power from above complexes shall flow towards load centres of Northern & Western region mainly through following high capacity corridors

- For Punjab (765kV Moga) and Delhi/NCR (765kV Jhatikara, Narela, Gurgaon) load centres through 765kV Bikaner and Khetri & Neemrana-II (via Bikaner-III)

- To UP load centres (Aligarh, Varanasi, Kanpur, Bareilly & Balia) through 765kV Bhadla-II/III (via 765kV Sikar-II), 400kV BhiwadI (via 400kV Bikaner-II), Fatehpur HVDC (via Bhadla-III HVDC) & Neemrana-II (via Bikaner-III)

- To Western Region load centres (765kV Gwalior & 765kV Mandsaur) through 765kV Beawar/Dausa (via Fatehgarh-III) & Sirohi/Rishabdeo (via Fatehgarh-IV/Barmer-I)

In view of integration of more than 50GW in ISTS system in western Rajasthan, most of RE pooling station i.e. Bikaner (PG) may be utilized for evacuation of about 7-9 GW RE generation (incl self RE generation of 4-6GW) towards load centers. To make the system more resilient, additional transmission system may be required which may increase the transmission system investment (up to 1.5 times) for evacuation of the RE power mainly through solar without BESS which is available only in day time. In view of this, detail deliberations are required on above matter on resilience of transmission system for RE vis-à-vis transmission system additional cost and optimal utilization of transmission system as above requirement is beyond transmission planning criteria.

Following ISTS Transmission scheme was agreed:

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

  Estimated Cost : Rs 1382 Cr

Note : 765/400kV ICTs , 400/220kV ICTs and 220 kV line bays (for RE connectivity) at Bhadla-III shall be taken up separately based on RE development/applications at Bhadla-III PS

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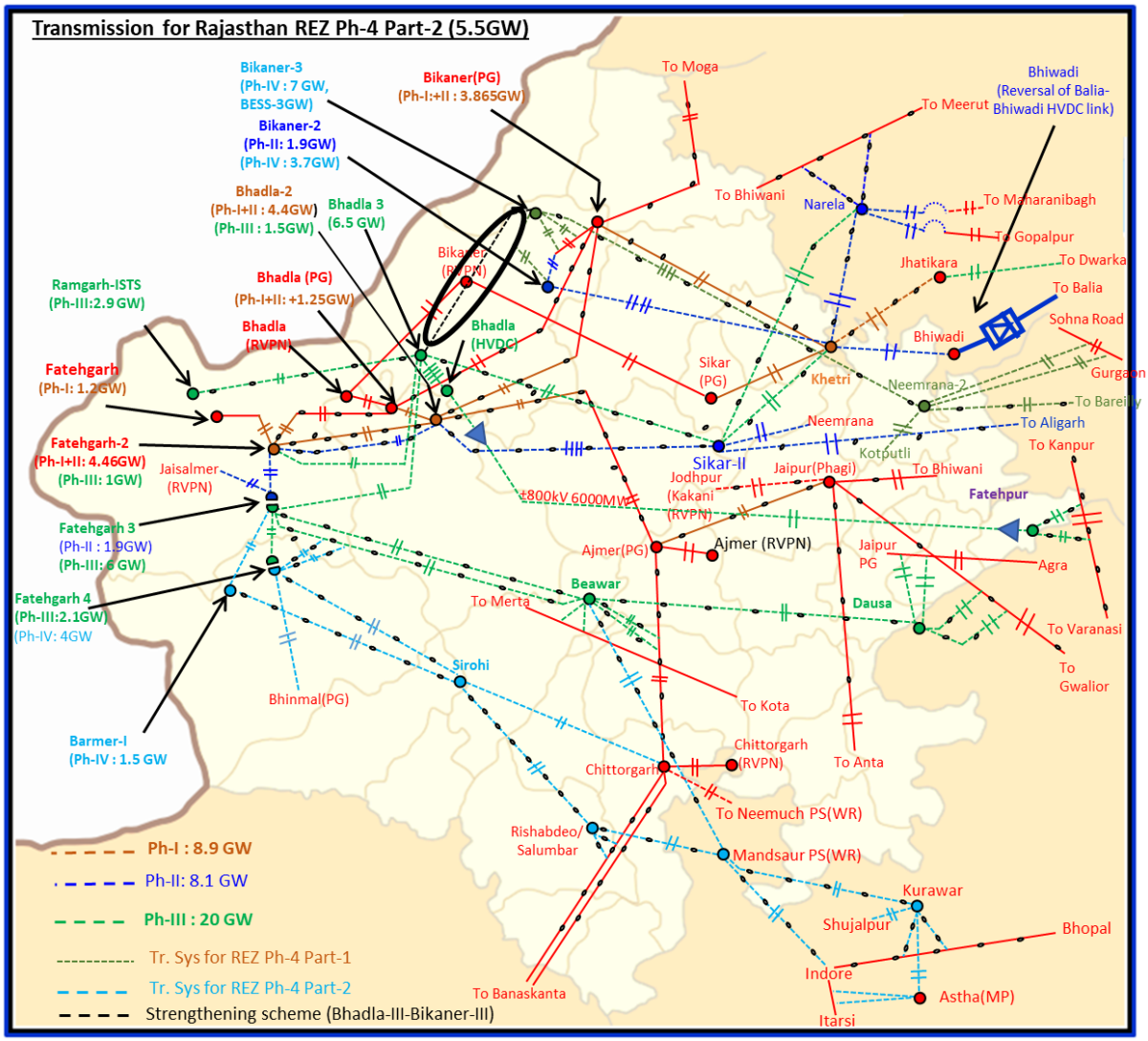


Fig: Transmission system strengthening for interconnection of Bhadla-III & Bikaner-III complex

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

Details of the scheme are as under:

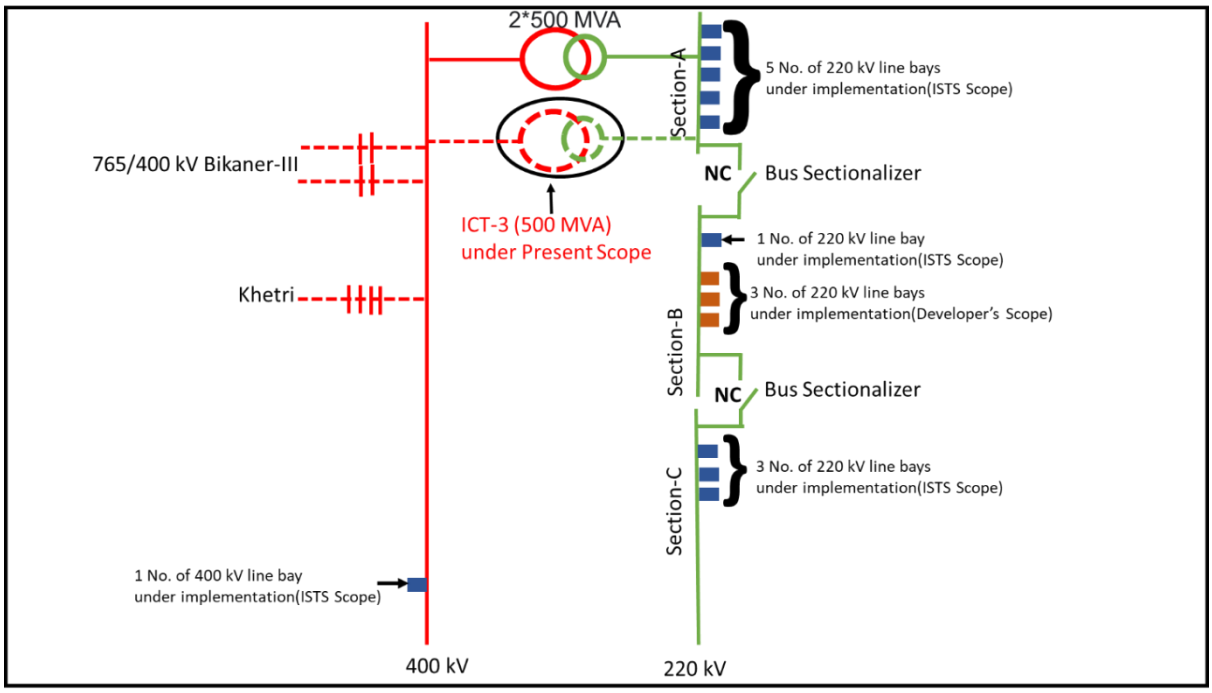
S. No.	Items	Details
1.	Name of Scheme	Augmentation of transformation capacity at 400/220kV Bikaner-II PS by 400/220kV, 1x500 MVA ICT (3rd)
2.	Scope of the scheme	➢ Augmentation of transformation capacity at 400/220kV Bikaner-II PS by 400/220kV, 1x500 MVA ICT (3rd) ➢ Implementation of associated ICT bays [1 no. 400kV (including associated tie bay) & 1no. 220kV ICT bay] at Bikaner-II PS
3.	Depiction of the scheme on Transmission Grid Map	Refer to the schematic in Figure 2.2.2

S. No.	Items	Details
4.	Upstream/downstream system associated with the scheme	400/220kV Bikaner-II S/s is currently under implementation by Power Grid Bikaner Transmission System Ltd. (a subsidiary of Power Grid Corporation of India Ltd.) as part of Transmission system for Solar Energy Zones in Rajasthan Phase-II Part F. Bikaner-II PS will be connected with existing 765/400kV Bikaner(PG) S/s through a 400kV D/c line(Quad) (to be LILOed at Bikaner-III PS) and with Khetri S/s through 400kV 2xD/c lines (Twin HTLS)
5.	Objective / Justification	➢ The scheme comprises augmentation of 400/220 kV, 1x500 MVA (3rd) ICT at 400/220 kV Bikaner-II PS. ➢ In the 1st Meeting of CTU Committee on Transmission Projects (CCTP) held on 15.11.2021, 2 no. of 400/220kV 500 MVA ICTs at Bikaner-II PS for evacuation of power from RE projects were approved and allocated to Powergrid Bikaner Transmission system Limited). POWERGRID informed commissioning schedule of above ICTs in JCC as Nov'23/Dec'23. ➢ As on date 4785 MW of Stage-II connectivity is granted at Bikaner-II out of which 3785 MW is granted at 220kV level. ➢ LTA quantum of 1024MW was granted at 220kV level of 400/220kV Bikaner-II PS. (incl. 62MW of LTA granted recently to M/s Grian Energy Pvt. Ltd.). Further, additional 468 MW of LTA application were also received/agreed for grant at 220kV level of 400/220kV of Bikaner-II PS. Accordingly cumulative LTA grant/under process) at Bikaner-II PS (220kV) has become 1492 MW, necessitating requirement of 3rd 400/220kV ICT. ➢ In the CCTP meeting, Tr. Plg.-NR Dept. informed that for 3785 MW connectivity granted at Bikaner-II PS (220kV), all applicants have opted for transition under GNA. Accordingly, there is a need to take up immediate evacuation system (ICTs) on an urgent basis. Further, as per the

S. No.	Items	Details
		latest schedule provided by applicants at Bikaner-II PS in GNA transition/JCC meeting, cumulative capacity of 3435MW is expected to be commissioned by Dec'24 and 150 MW scheduled for commission in Jan'25 thus makes the total quantum 3585MW by Jan'25. Balance 200 MW will commission afterwards (Mar'25 onwards). Accordingly, considering 2 nos. under implementation ICTs, 5 nos. additional ICT are required by Dec'24 and one no. by Jan'25. ➢ CCTP opined that though the process of transition of connectivity/LTA involves signing of agreements & submission of requisite bank guarantees (BGs) by the applicants in stipulated timelines, this may take 2 to 3 months to complete. It is to mention that ICT implementation takes a minimum of 18 months. Considering RE generation schedule informed by RE applicants, 6x500MVA, 400/220kV ICTs need to be taken up on an urgent basis without waiting for completion of process such as agreement signing, BG submission. ➢ In the meeting, Tr. Plg.-NR Dept. has also informed that 5x500 MVA ICTs at Bikaner-II PS were already approved in the 9th NCT meeting held on 28.09.2022. The same was allocated to Powergrid Bikaner Transmission system Ltd. vide NCT letter dated 15.11.2022 with the condition that the implementation of ICTs is to be taken up for evacuation requirement beyond 2000 MW at 220 kV level of Bikaner-II PS, with implementation timeframe matching with schedule of RE generation or 18 months from date of allocation, whichever is later. Since at that time, LTA was much less than 2000MW, above condition didn't trigger, whereas in May'23, upon GNA transition, ICT requirement is arising. ➢ In view of the above deliberations, CCTP opined that implementation of 1 no. of

S. No.	Items	Details
		500 MVA (3rd), 400/220 kV ICT at Bikaner-II PS is to be taken up on urgent basis to facilitate evacuation of RE power from Bikaner-II PS. ➢ Further, PBTSL may be informed to take up implementation of 5x500 MVA ICTs as per RE generation schedule i.e., 4x500 MVA by Dec'24 & 1x500 MVA by Jan'25 separately.
6.	Estimated Cost	₹ **55.82 Cr.**
7.	Impact on the total Annual Transmission charges (ATC) in % along with the existing ATC	A. ATC (considering Levelized Tariff @15% of estimated cost): ₹ 8.373 Crore B. Present ATC: ₹ **46405.37** Crore* C. A/B (%): Less than 0.018%
8.	Need of phasing, if any	Not Applicable
9.	Implementation timeframe	18 months from the issue of OM by CTUIL
10.	Inclusion of any wildlife/protected area along the transmission line route	None envisaged
11.	Deliberations with RPC along with their comments	The estimated cost of the scheme is less than INR 500 Cr. Accordingly, the same is not required to be sent to NRPC for deliberation in line with MoP office order no. 15/3/2018-Trans-Pt(5) dated 28-10-2021 regarding reconstitution of NCT.
12.	System Study for the evolution of the proposal	NA

**Total YTC allowed for Jan'23, as per notification of transmission charges payable by DICs for billing month of May 2023 dated 25.04.2023 published on NLDC website.*



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

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

In view of the above, scope of works was approved as per CTU OM dated 08/06/2023 for implementation under RTM through through *Power Grid Bikaner Transmission System Ltd. (a subsidiary of Power Grid Corporation of India Ltd.)*

4.4.2 Haryana

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

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

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

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

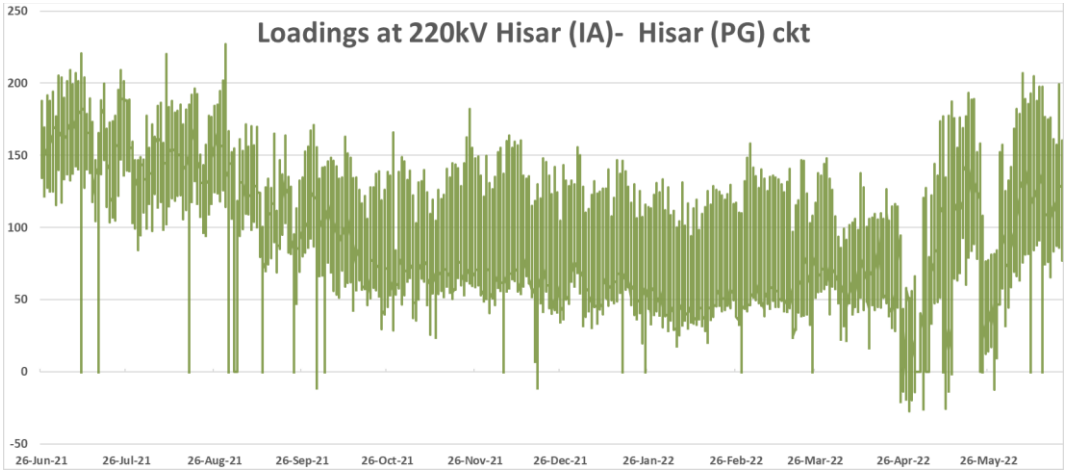


Fig: Loading of Hisar (PG)-Hisar(IA) D/c line of one year (Source: Grid-India)

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

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

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

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

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

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

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

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

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

line. HVPNL informed that INVAR conductor (TASCR) in above line is designed for150 degree with about 960 Ampere capacity.

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

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

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

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

For above reconductoring works, HVPNL to carry out the necessary bay upgradation works in Intra state in the matching time frame of above agreed ISTS scope

4.4.3 Himachal Pradesh

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

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

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

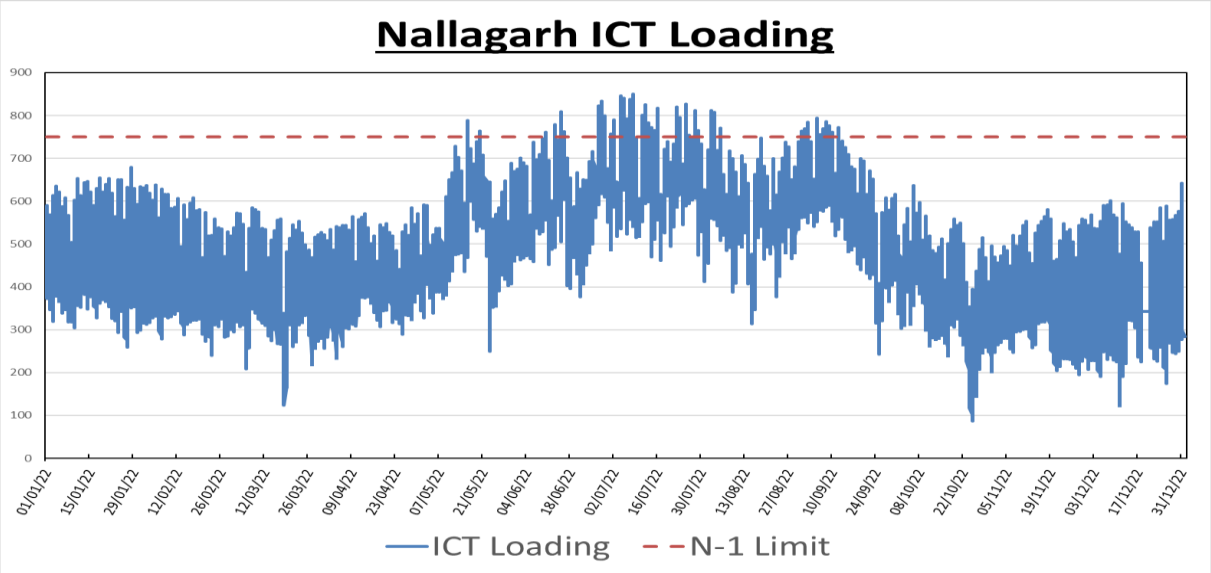


Figure: Loading of Nallagarh ICTs of Past one year (Source: Grid-India)

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:

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

Note: -

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

The above scope of works was approved as per CTU OM dated 08/06/2023 for implementation under RTM through *Power Grid Corporation of India Ltd*.

4.4.4 Jammu and Kashmir

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

Details of the scheme are as under:

S. No.	Items	Details
1.	Name of Scheme	Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315 MVA, 400/220kV ICT (3rd)
2.	Scope of the scheme	➢ Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315MVA, 400/220 kV ICT (3rd) (three single phase units of 105MVA) along with associated transformer bays
3.	Depiction of the scheme on Transmission Grid Map	Refer to the schematic in Figure 3.2.2.
4.	Upstream/downstream system associated with the scheme	Connectivity of existing 400/220 kV Amargarh S/s includes 400 kV D/c interconnection with Uri-I (NHPC), Wagoora (PG) & Samba (PG). On 220 kV side Amargarh (GIS) S/s is interconnected to Zainakote & Delina S/s and proposed to be interconnected with 220kV Sheeri S/s.
5.	Objective / Justification	➢ The Scheme comprises Augmentation of 400/220 kV, 315MVA (3rd) ICT (three single phase units of 105MVA) at Amargarh (GIS) S/s ➢ 400/220kV Amargarh S/s is the existing S/s of NRSS XXIX Transmission limited (NTL) (a subsidiary of India Grid Trust) with total transformation capacity of 630 MVA (2x315MVA) ➢ Augmentation of 400/220 kV ICT(3rd) at 400/220kV Amargarh (GIS) S/s was agreed in the 3rd NRPC(TP) held on 19.02.2021 with the time frame of March 2026. Same was taken up for discussion in 5th NCT was held on 25.08.2021 and 02.09.2021 wherein considering the timeframe of March, 2026, it was decided to defer the same and may be taken up later for approval. ➢ Recently, JKPTCL vide letter dated 17.02.2022 to CEA informed that the 630 MVA 400/220 kV GIS at Amargarh is

S. No.	Items	Details
		directly feeding the 450 MVA, 220/132 kV Zainakote GSS and the 320 MVA, 220/132 kV GSS Delina. The transmission plan (Kashmir region) for 2022-27 envisages addition of 2479 MVA at different voltage levels and stands approved in the CEA meeting held on 19-02-2021. The commissioning of the new Grid Stations necessitates provision of new sources or capacity augmentation at 400/220 kV level to enable the trickling down of the benefits of the new Grid stations to the consumers. In the JKPTCL letter, it was also stated that the existing sources of power shall not be able to cater to the increased demand of power and this necessitates immediate steps to augment the sources. It is proposed to augment the existing 220/132 kV GSS Zainakote from 450 MVA to 700 MVA and 220/132 kV GSS Delina from 320 MVA to 480 MVA by the end of 2023.The maximum drawl of power from 630 MVA Amargarh (GIS) during the present winter has been about 550 MW. In order to address the growing demand of power, it is imperative that Amargarh (GIS) S/s is augmented by atleast 50% i.e. 315 MVA. ➢ Further, in the Quarterly operational feedback of January 2023, Grid-India has also highlighted the issue of 'N-1' non-compliance of loading of ICTs at Amargarh S/s. In the report it was informed that with 2 no. of 315 MVA ICTs, loading of ICTs was more than 'N-1' compliance limit (>425MW) most of the time in 2022-23 (Quarter 3: Oct'22-Dec'22) during high demand of J&K. Grid-India recommended that new ICT augmentation at Amargarh (GIS) may be expedited. ➢ In the 202nd OCC meeting held on 16.12.22, NRLDC stated that "loading of 400/220kV Amagarh ICTs was above N-1 contingency limits for last 30 days. Therefore, till capacity is augmented at 400/220kV Amargarh, any N-1 contingency is likely to lead to tripping of both ICTs as they are loaded beyond their N-1 contingency limit and there would be load loss in valley area".

S. No.	Items	Details
		➢ Subsequently in the recent 62nd NRPC meeting held on 31.01.22, agenda for N-1 violation related issues in Himalayan states of NR during winter 2022-23 was deliberated. In the meeting, CTU stated that new ICT at 400/220kV Amargarh has already been approved and implementation of these ICTs before their timeline of 2026 would be discussed with CEA. ➢ In the 16th CMETS-NR meeting held on 28.02.23, it was deliberated that from the loading pattern of Amargarh ICTs (2x315 MVA), it is observed that the ICT loading is more than 425MW in the month of October to March and may become N-1 non-compliant. ➢ The S/s owner i.e. M/s INDIGRID confirmed that the space is available for the installation of 400/220kV, 315MVA ICT (3rd) (Three single phase units) at Amargarh SS, however space is not available for 500MVA ICT. Further, transportation of 500 MVA (single phase units) ICT through enroute tunnels may also pose challenge. The details regarding the expansion of PEB Building, GIS BUS -1 & 2, GIS Duct for the connection with ICT, Land levelling need to be explored / identified and same would be provided shortly. Subsequently, M/s IndiGrid vide mail 15.03.22 informed that for installation of 400/220kV, 315MVA ICT (3rd) (Three single phase units) at Amargarh SS, required new Diameter at both sides along with GIB (420kV & 245kV 1-ph indoor and outdoor GIB). ➢ In the meeting, M/s INDIGRID stated that implementation timeframe of 21 months is a bit Compressed timeline due to issues in manufacturing as well as transportation of above ICT. INDIGRID requested to increase the time line for implementation of ICT. In reply, it was stated that timeline for implementation of ICT at GIS S/s has been kept as 21 months whereas in AIS S/s it is 18 months. Additionally, 3rd ICT is required on urgent basis due to critical loading in 'N-1' contingency and based on request of JKPTCL. In view of that it is expected that 3rd

S. No.	Items	Details
		ICT would be available by Dec'24 (considering 21 months from expected approval in Mar'23), however efforts to be made for implementation of ICT in 18 months. JKPTCL also agreed for the same in meeting. ➢ GRID-INDIA stated that 315MVA ICT preferred over 500MVA ICT as spare (single phase unit of 105MVA) is already available at Amargarh S/s and will also be utilized with proposed 315MVA ICT also. CEA also concurred on installation of 400/220kV, 315MVA ICT (3rd) (Three single phase units) at Amargarh S/s ➢ Considering the growing demand of power in J&K, as well as to meet the N-1 criteria of loading of ICTs, it was agreed to implement one no. of 400/220kV, 315MVA ICT (3rd) (Single phase units of 105MVA) at Amargarh (GIS) S/s under ISTS in 16th CMETS-NR meeting held on 28.02.23 (Scope as per S.No 2)
6.	Estimated Cost	₹ **82.04 Crore**
7.	Impact on the total Annual Transmission charges (ATC) in % along with the existing ATC	A. ATC (considering Levelized Tariff @15% of estimated cost): ₹ 12.306 Crore B. Present ATC: ₹ **45536.18** Crore* C. A/B (%): Less than 0.027%
8.	Need of phasing, if any	NA
9.	Implementation timeframe	21 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)*
10.	Inclusion of any wildlife/protected area along the transmission line route	NA
11.	Deliberations with RPC along with their comments	NA
12.	System Study for the evolution of the proposal	NA

**Total YTC allowed for Jan'23, as per notification of transmission charges payable by DICs for billing month of March 2023 dated 25.02.2023 published on NLDC website.*

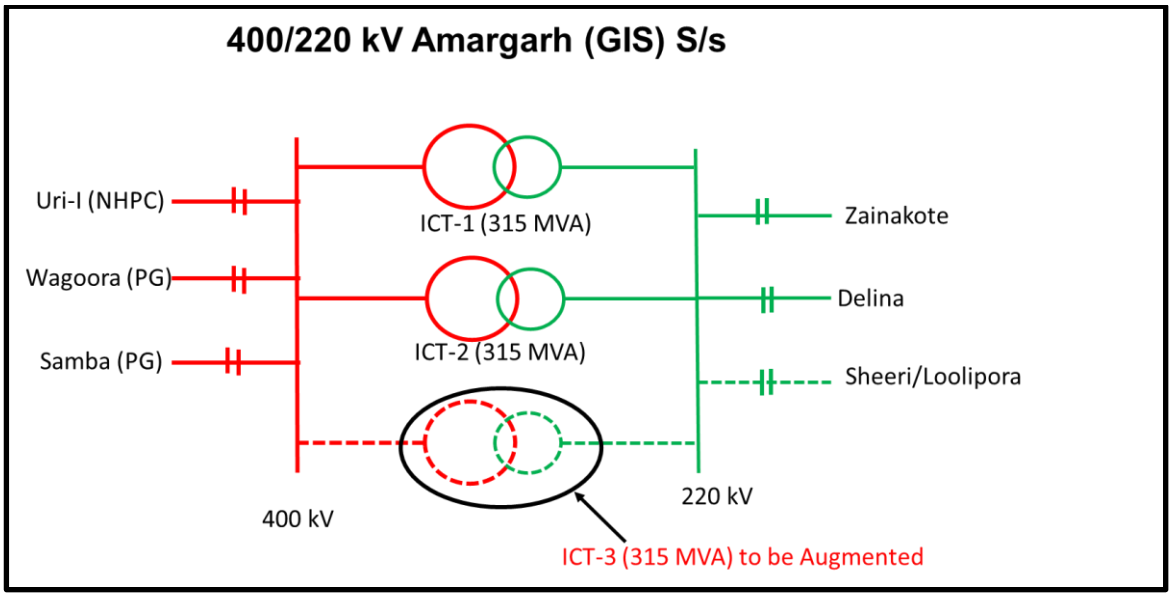


Figure: Augmentation of transformation capacity at Amargarh (GIS) S/s by 1x315 MVA, 400/220kV ICT (3rd)

The works was allocated under RTM by CTU OM dated 21/04/2023 to the owner of the existing S/s i.e., NRSS XXIX Transmission Ltd. (NTL) (a subsidiary of India Grid Trust) (as per Tariff Policy, 2016), as per details below:

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

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

Note: -

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

4.4.5 Uttar Pradesh

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

Details of the scheme are as under:

S. No.	Items	Details
1.	Name of Scheme	Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT.
2.	Scope of the scheme	➢ Augmentation of Transformation Capacity at 400/220kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT along with associated transformer bays (AIS) ➢ 220kV ICT side termination through 220kV Cable (2500m) along with cable termination kit (1no.)
3.	Depiction of the scheme on Transmission Grid Map	Refer to the schematic in Figure 2.2.2
4.	Upstream/downstream system associated with the scheme	400/220kV Allahabad S/s is the existing S/s of Power Grid Corporation of India Ltd. with total transformation capacity of 945 MVA (3x315MVA) Connectivity of existing 400/220 kV Allahabad (PG) S/s includes 400 kV interconnection with Fatehpur (PG), Varanasi (PG), Kanpur (765/400kV), Kanpur (400/220kV), Meja (MUNPL), Rihand (NTPC), Sasaram (PG) & Singrauli (NTPC). On 220 kV side Allahabad (PG) S/s is interconnected to Jhusi, Rewa Rd, Phulpur NCR Naini Railway S/s.

S. No.	Items	Details
5.	Objective / Justification	➢ The transmission scheme comprises Augmentation of 400/220 kV, 500 MVA (4th) ICT at Allahabad (PG) S/s. ➢ In 207th OCC meeting held on 19.05.23, POWERGRID agenda (as per their letter dated 20.04.23) for Non-Compliance of N-1 contingency in ICTs at Allahabad Substations was deliberated. In the meeting, POWERGRID highlighted that at present there are 3x315 MVA ICTs at Allahabad S/s and loading on these ICTs have increased substantially in past few years and requested forum to review the need for additional transformation capacity. It was decided in the meeting that CTU may be asked to do the system studies based on present and future forecasted load. ➢ Further, in the Quarterly operational feedback (Qtr 1 & 2) of FY-2022-23, Grid-India also highlighted the issue of 'N-1' non-compliance of loading of ICTs at Allahabad S/s. ➢ The proposal was deliberated in the 20th CMETS-NR meeting held on 30.06.23. In the meeting it was stated that from the loading pattern of Allahabad ICTs (3x315 MVA), it is observed that it is above N-1 limit for sufficient duration of time in most of time in year (except Oct-Dec). Loading of ICTs have reached maximum of about 860 MW in summer season (July'22, April'23 & May'23). From studies, it emerged that on 3 no. of 315 MVA ICTs, loading of ICTs was more than 'N-1' compliance limit (>750 MW) in evening peak demand scenario of summer season. ➢ POWERGRID vide mail dated 22.06.23 confirmed space availability for Augmentation of 1x500 MVA (4th), 400/220kV ICT at Allahabad Substation. However, 220kV side ICT bay will be AIS Type with ICT side termination through 220kV Cable/GIB. ➢ In the meeting, GRID-INDIA agreed for above proposal as the issue was already highlighted in operational feedback report.

S. No.	Items	Details
		➢ It was highlighted that Short Circuit level at 400 kV Allahabad S/s will increase to 52kA in next 5 years against the designed capacity of 40kA. With augmentation of one 500MVA ICT, short circuit level will further increase by 1 kA. ➢ In the CMETS-NR meeting, Grid-India informed that short circuit level of most of old substations in Singrauli/ Rihand/ Anpara complex is high, however ICT augmentation is required with UP confirmation on above proposal as well as any intra state plan to relieve the loading of Allahabad ICTs. ➢ UP informed that recently 400/220kV Jaunpur (1x315MVA +2x315MVA ICTs UC) S/s is commissioned which relieved Allahabad ICT loading marginally, however overloading is still there at Allahabad substation. In addition to that UPPTCL also do not have any future plan in nearby area to relieve the ICT loading at Allahabad. UP stated they have also carried out studies in Jun'24 timeframe in which 400/220kV Allahabad ICTs were observed to be overloaded and therefore ICT augmentation is required at 400/220kV Allahabad substation to meet the demand from 400/220kV Allahabad S/s reliably. ➢ Considering the growing demand of power in UP, as well as to meet the N-1 criteria of ICTs, it was agreed to implement one no. of 400/220kV, 500 MVA ICT (4th) at Allahabad (PG) S/s under ISTS in the 20th CMETS-NR meeting (Scope as per S. No. 2).
6.	Estimated Cost	**₹ 61 Crore**
7.	Impact on the total Annual Transmission charges (ATC) in % along with the existing ATC	A. ATC (considering Levelized Tariff @15% of estimated cost): ₹ 9.15 Crore B. Present ATC: ₹ **45753.99** Crore* C. A/B (%): Less than 0.01999%
8.	Need of phasing, if any	Not Applicable
9.	Implementation timeframe	18 months from the date of issue of OM by CTUIL.

S. No.	Items	Details
10.	Inclusion of any wildlife/protected area along the transmission line route	Not Applicable
11.	Deliberations with RPC along with their comments	The estimated cost of the scheme is less than INR 500 Cr. Accordingly, the same is not required to be sent to NRPC for deliberation in line with MoP office order no. 15/3/2018-Trans-Pt(5) dated 28-10-2021 regarding reconstitution of NCT.
12.	System Study for the evolution of the proposal	NA

**Total YTC allowed for May'23, as per notification of transmission charges payable by DICs for Billing Month of July 2023 dated 25.06.2023 published on NLDC website.*

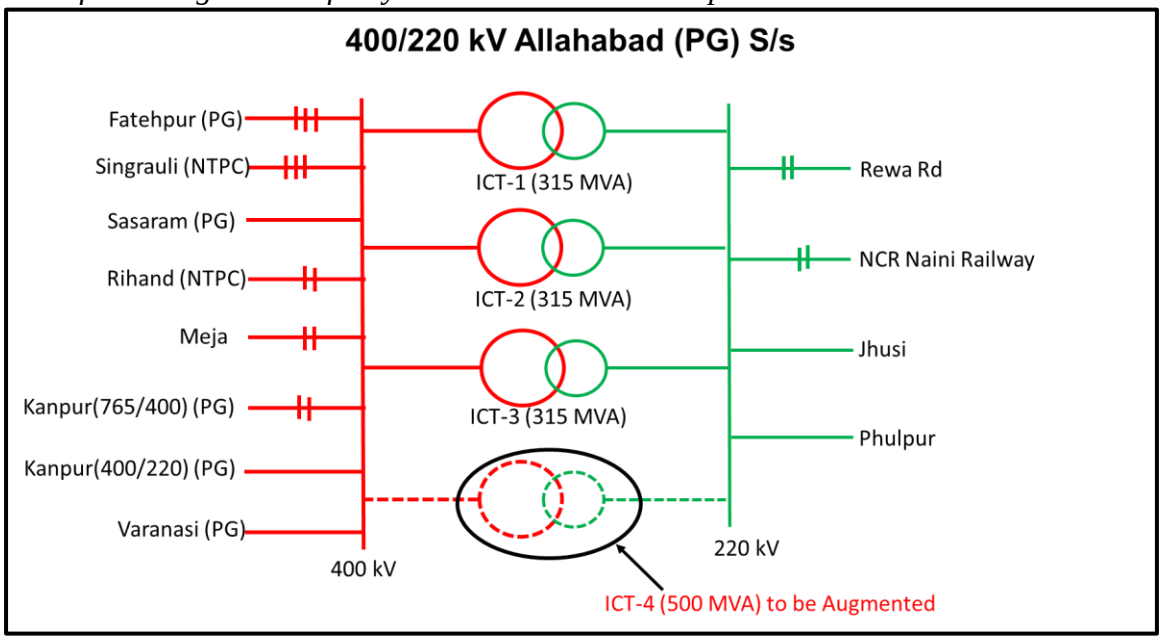


Figure: Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT

Augmentation of Transformation Capacity at 400/220 kV Allahabad (PG) substation by 400/220 kV, 1x500 MVA (4th) ICT is in the nature of technical up-gradation/augmentation, the works was allocated under RTM as per CTU OM dated 07/08/2023 to the owner of the existing s/s i.e., *Power Grid Corporation of India Ltd.* (as per Tariff Policy, 2016), as per details below:

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

Sl. No.	*Scope of the Transmission Scheme*	*Item Description*	*Implementation Timeframe.*
1.	Augmentation of Transformation Capacity at 400/220kV Allahabad (PG)	• 500 MVA, 400/220 kV ICT- 1 no.	18 months from the date of issue

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

4.5 System Study Analysis and Results for 2028-29 Timeframe

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 40 nos. of substations (765kV-1 nos., 400kV- 39 nos) in NR having fault level more than 105% of designed capacity

Out of above, 21 nos. of ISTS substations and 19 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 (1.2pu) in NR

Sl. No.	Substation Name	Scenario No.	Highest Fault level (kA)	Design Rating (kA)
1	765kV Aligarh	All	47	40
2	400kV Meerut	All	66	40
3	400kV Neemrana	All	55	40
4	400kV Lucknow	All	55	40
5	400kV Abdullapur	All	52	40
6	400kV Lucknow (765/400kV)	All	52	40
7	400kV Bassi	All	52	40
8	400kV Bhiwadi	All	51	40
9	400kV Ballabgarh	All	50	40
10	400kV Allahabad	All	52	40
11	400kV Patiala	All	48	40
12	400kV Jalandhar	All	45	40
13	400kV Panchkula	All	48	40
14	400kV Bhiwani	Most	55	50
15	400kV Mandola	Most	45	40
16	400kV Sikar	Most	44	40
17	400kV Bhadla Pg	7	53	50
18	400kV Bhadla-2	4,7	55	50
19	400kV Barel-PG	7, 9	53	50
20	400kV Bal74-Pg	All	48	40
21	400kV Aligarh	Most	42	40

STU/Generation Substations

Table 4-7: STU Buses Exceeding Designed Fault Level (1.2pu) in NR

Sl. No.	Substation Name	Owner State	Scenario No.	Highest Fault level (kA)	Design Rating(kA)
1	400kV Greater Noida	UP	All	60	40
2	400kV Greater Noida	UP	All	59	40

Sl. No.	Substation Name	Owner State	Scenario No.	Highest Fault level (kA)	Design Rating(kA)
3	400kV Dhanonda	Haryana	All	58	40
4	400kv Agra	UP	All	57	40
5	400kV Bawana	Delhi	Most	54	40
6	400kV Jaipur (Phagi)	Rajasthan	All	54	40
7	400kV Bawana Gas	Delhi	Most	54	40
8	400kV Daultabad	Haryana	Most	51	40
9	400kV Nakodar	Punjab	Most	44	40
10	400kV Sohnaroad	Haryana	2,6,9	42	40
11	400kV Kabulpur	Haryana	Most	45	40
12	400kV Bhadla	Rajasthan	1,4,7	45	40
13	400kV Bara	UP	All	45	40
14	400kV Hapur	UP	Most	43	40
15	400kV Gaziabad	UP	Most	44	40
16	400kV Unnao	UP	Most	43	40
17	400kV Sikanderabad	UP	Most	44	40
18	400kV Agranew	UP	Most	45	40
19	400kV Sarnath	UP	All	44	40

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

4.5.2 Contingency Analysis

a) Transmission Lines

In the base case file prepared for 2028-29 timeframe, in NR, 20 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	Baglihar – New Wanpoh 400kV S/C Line	1,2,4,7,8	ISTS	1089	1491	857 (Twin Moose)	174
2	Chamera-II-Kishenpur 400kV Line	1	ISTS	909	1012	857 (Twin Moose)	118
3	Kishenpur-NewWanpoh 400kV D/C Line	1	ISTS	694	1213	857	110
4	Chamera-II - Chamba Pool 400kV S/C Line	1	ISTS	606	947	857	110
5	JHAJAR - DHANONDA 400kV D/C Line	1	STU	580	983	857	114
6	400kV Bhiwani(PG)-Bhiwani(BBMB) Line	1,4	STU	1121	1251	587	146
7	400kV Bhiwani(PG)-Jind (PG D/C Line	1,4	ISTS	1017	1370	857	159
8	RAMGARH -BHADLA 400kV D/C Line	2,3,5	STU	812	1087	857	126
9	400kV Meja-Allahabad D/C Line	2,5,8	ISTS	699	1153	587	134
10	Bagpat Meerut 400kV D/C Line	1	ISTS	712	998	857	116
11	400kV Agra-Agra(UP) Line	1,2,4,5	ISTS	968	1202	857	140
12	400kV Lucknow (PG) -	1,4,7	ISTS	1084	2109	1714	123

Sl. No.	Name of the Line	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
	Lucknow (765) D/C Line						
13	ANPARA - Singrauli 400 kV S/C Line	3,6,8,9	ISTS	915	1253	857	146
14	HARIDWR-ROORKEE 400 kVS/C Line	2	PTCUL	480	613	560	109

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

b) Transformers

In the base case file prepared for 2028-29 timeframe, following 765/400 kV and 400/220kV ICTs are having critical loading. Details of transformers is as under Table 4-9 :

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

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
1	400/220kV, 3x315 Kishenpur ICTs	1,4,5,7,8	ISTS	567	710	225	315
2	400/220kV, 1x500 Ropar ICTs	1	STU	418	592	118	500
3	400/220kV, 2x315+1x500 Makhu ICTs	1	STU	261	347	110	315
4	400/220kV, 2x500 Nakodar ICTs	1	STU	370	527	105	500
5	400/220kV, 2x315+1x500 Jalandhar ICTs	1	ISTS	264	346	109	315

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
6	765/400kV, 3x1000 Bhiwani-Pg ICTs	1,4	ISTS	1169	1561	156	1000
7	765/400kV, 1x1500 Bhiwani-Pg ICTs	1,4	ISTS	1753	2106	140	1500
8	765/400kV, 1x1000 Bhiwani-Bhiwani SR ICTs	1,4	ISTS	942	1146	114	1000
9	400/220kV, 4x500 Dwarka ICTs	1,4	ISTS	388	532	106	500
10	400/220kV, 2x315 Merta ICTs	8	STU	242	337	107	315
11	400/220kV, 3x500 Akal ICTs	2,3,4,5	STU	583	728	145	500
12	400/220kV, 1x315 Akal ICTs	1,6	STU	337	421	133	315
13	400/220kV, 4x500 Ramgarh ICTs	2,3,5,8	STU	441	564	112	500
14	400/220kV, 1x315 Hirapura ICTs	4,7	STU	323	365	116	315
15	400/220kV, 3x250 Hirapura ICTs	4,7	STU	256	300	120	250
16	400/220kV, 2x315 Hindaun ICTs	4,5,7,8	STU	`280	415	131	315
17	400/220kV, 1x500 Kalisind ICTs	7,8,9	STU	594	671	134	500
18	400/220kV, 1x315 Rajwest ICTs	1,4	STU	226	392	124	315
19	400/220kV, 2x315 Deedwana ICTs	`1,4,7	STU	269	405	128	315
20	400/220kV, 2x315 Ajmer ICTs	4,5,7,8	STU	270	380	120	315
21	400/220kV, 2x315 Kota ICTs	4,7,8	ISTS	340	440	139	315

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
22	400/220kV, 3x315 Chittorgarh ICTs	4,7	STU	314	411	130	315
23	400/220kV, 3x315 Bassi ICTs	4,7	ISTS	277	372	118	315
24	400/220kV, 5x500 Bikaner ICTs	1,4,7	STU	945	1104	220	500
25	400/220kV, 2x315 Orai ICTs	1,2,4,5	STU	188	282	117	240
26	400/220kV, 2x315 Kanpur ICTs	1,4	ISTS	306	388	123	315
27	400/220kV, 2x315 Shahjahanpur ICTs	2,5	ISTS	230	340	108	315
28	765/400kV, 2x1500 Bareilly ICTs	1	ISTS	1110	1704	113	1500
29	400/132kV, 3x200 Mau ICTs	1	STU	179	216	108	200
30	400/220kV, 2x315 Kashipur ICTs	2	STU	248	341	108	315
31	400/220kV, 2x500 Aligarh ICTs	1,2,4,5	STU	422	587	117	500

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

Chapter 5: Western Region

Due to geographical location, 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 Solar & Wind capacity. Western part of Maharashtra, southern Gujarat and DD & DNH have high demand and less internal generation. Accordingly, power flows from Chhattisgarh/ Eastern Maharashtra through high capacity corridors to Western part of Maharashtra, Southern Gujarat, DD & DNH. Based on the generation availability and demand, Western Region imports power from other regions during high RE scenarios whereas it exports power to other regions during evening peak and night off peak load.

5.1 Power Supply Scenario as on Aug'23

As on Aug'2023, total Installed Capacity (IC) of Western Region was about 139GW which constitute capacity from fossil sources (62% share) & balance (38% share) from Non-fossil sources comprising of nuclear, renewable generation capacity including hydro and the peak demand was about 73 GW. The share from Non-fossil sources would further increase in future considering India's vision of generating 500 GW of non-fossil generation capacity by 2030. At present, there is no shortage of power supply in meeting these demands. State-wise breakup is summarised at **Table 5-1.**

Table 5-1:WR Installed Capacity and Demand met as on Aug'23

(All Fig in GW)

State	Generation								Peak Demand
	Fossil			Non-Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES (MNRE)	Total		
Gujarat	18.7	6.6	25.3	0.8	0.8	21.7	23.2	48.5	23.0
MP	15.9	0.3	16.2	0.4	3.2	6.2	9.8	26.0	13.6
Maharashtra	25.3	3.5	28.8	0.9	3.3	13.1	17.4	46.1	28.6
Chhattisgarh	12.2	0.0	12.2	0.1	0.2	1.3	1.6	13.9	5.8
DD	0.2	0.0	0.2	0.0	0.0	0.0	0.1	0.3	1.3
DNH	0.4	0.1	0.5	0.0	0.0	0.0	0.0	0.5	
Goa	0.5	0.1	0.6	0.0	0.0	0.0	0.1	0.6	0.7
Central unallocated	2.8	0.2	3.0	0.3	0.0	0.0	0.3	3.4	
WR	**76.0**	**10.8**	**86.8**	**2.5**	**7.6**	**42.4**	**52.5**	**139.3**	**72.6**

Source: CEA Monthly Report

5.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Western Region demand for 2028-29 timeframe is expected to increase to about 100 GW. The Installed capacity of Western Region is expected to be about 207GW. The state wise bifurcation of the same is given at **Table 5-2.**

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

(All Fig in GW)

State	Generation									Peak Demand
	Fossil			Non-Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES (MNRE)	Total			
Gujarat	7.8	2.8	10.6	0.0	0.3	15.9	16.2	0.2	27.0	31.5
MP	5.3	0.0	5.3	0.0	3.1	4.8	7.9	0.0	13.2	24.1
Maharashtra	19.5	1.2	20.7	0.0	2.5	10.0	12.6	0.4	33.7	39.9
Chhattisgarh	1.6	0.0	1.6	0.0	0.1	0.2	0.4	0.0	1.9	8.2
DD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
DNH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Goa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Central	19.0	3.3	22.3	3.2	0.0	59.9	63.1	3.0	88.4	
IPP	35.6	2.8	38.4	0.0	0.0	0.0	0.0	0.0	38.4	
WR	**88.8**	**10.1**	**98.9**	**3.2**	**6.1**	**95.3**	**104.6**	**3.6**	**207.1**	**100.2**

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

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

(All Fig in MW)

State	Peak Demand			
	Present (MW)	20th EPS (MW)	Increase in demand (MW)	*CAGR*
	2023-24 (Till Aug'23)	*2028-29*		
Gujarat	22972	31515	8543	6.5%
MP	13605	24091	10486	12.1%
Maharashtra	28584	39891	11307	6.9%
Chhattisgarh	5827	8152	2325	6.9%
UT of DD & DNH	1327	1970	643	8.2%
Goa	776	989	213	5%
WR	**72556**	**100246**	**27690**	**6.7%**

From the above data it is observed that the CAGR growth of peak demand is maximum for MP (12.1%) and minimum for Goa (5%).

5.3 Load Generation Balance for 2028-29 timeframe

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

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

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

Scenario No & Name	Generation Dispatch Factors						Demand Factors
	Hydro	Nuclear	Solar	Wind	ESS	Gas	
1-Aug Solar Max	40%	80%	80%	55%	-100%	0%	78%
2-Aug Peak Load	70%	80%	0%	75%	60%	50%	72%
3-Aug Night Off Peak	40%	80%	0%	65%	40%	50%	51%
4-Jun Solar Max	40%	80%	85%	55%	-100%	0%	85%
5-Jun Peak Load	70%	80%	0%	75%	50%	50%	83%
6-Jun Night Off Peak	40%	80%	0%	65%	1%	50%	67%
7-Feb Solar Max	20%	80%	90%	10%	-100%	0%	94%
8-Feb Peak Load	40%	80%	0%	20%	100%	50%	86%
9-Feb Night Off Peak	20%	80%	0%	20%	40%	30%	69%

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

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

All Fig in MW)

IR Flows	Import / Export of Western Region								
Scenario No / Corridors	Aug'28 Time Frame			Jun'28 Time Frame			Feb'29 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
WR-NR	692	16637	10845	391	16087	10233	-11628	472	499
ER-WR	-13983	-8454	-10625	-13558	-9405	-8114	-8711	-40	-3061

IR Flows	Import / Export of Western Region								
Scenario No / Corridors	Aug'28 Time Frame			Jun'28 Time Frame			Feb'29 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
WR-SR	-21267	-17235	-15383	-17863	-18205	-13351	-6154	-9871	2226
Western Region	-6593	7856	6087	-3915	7288	4995	-9071	-9359	5787

Out of these nine scenarios, Scenario-2 and Scenario-8 corresponds to two extreme cases with import / export requirement of Western Region i.e. Maximum import (9.4 GW) and maximum export (7.9 GW) scenarios respectively. In all other scenarios, the import / export of Western Region varies between these two extremes.

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

5.4 ISTS Network schemes evolved from Feb'23 to Aug'23

Various transmission systems have been planned for implementation in the Consultative Meeting for Evolution of Transmission System of WR (CMETS-WR) and joint study meetings from Feb'2023 to Aug'2023. 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

Sr. No.	Name of Scheme	Time frame	Tentative cost (in Crores)
Gujarat			
1.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part A	2025-26	4091
2.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part B	2025-26	4766
3.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part C	2025-26	5340
4.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part D	2025-26	3455
5.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E1	2025-26	216
6.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E2	2025-26	697

Sr. No.	Name of Scheme	Time frame	Tentative cost (in Crores)
7.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E3	2025-26	216
8.	Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW): Part E4	2025-26	235
9.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part A	Bipole-1: 2027-28 Bipole-2: 2028-29	24819
10.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part A1	2027-28	21
11.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part B	To be reviewed	433
12.	Transmission System for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-V (8 GW): Part C	2027-28	12000
13.	Network Expansion scheme in Gujarat for drawl of about 3.6 GW load under Phase-I in Jamnagar area	2025-26	3815
14.	Augmentation of transformation capacity at 400/220kV Bhachau S/s in Gujarat	2025-26	49
Maharashtra			
1.	Western Region Network Expansion scheme in Kallam area of Maharashtra	2025-26	160
2.	Implementation of 1 no. 400kV bay at Kallam PS for interconnection of RE project of Torrent Solar Power Pvt. Ltd. (TSPPL)	2024-25	17.1
3.	Implementation of 1no. 220kV bay at Parli (PG) for interconnection of RE project of Renew Tej Shakti Pvt. Ltd. (RTSPL).	2025-26	5.84
Madhya Pradesh			
1.	Augmentation of transformation capacity at 765/400kV Indore S/s in Madhya Pradesh	2025-26	126
2.	Replacement of 63 MVAr Bus reactor with 125 MVAr Bus reactor at 400kV level of Jabalpur S/s of POWERGRID	2025-26	17
UT of DD & DNH			
1.	Augmentation of transformation capacity at 400/220kV Magarwada GIS S/s in Dadra and Nagar Haveli and Daman and Diu	2025-26	64

5.4.1 Gujarat

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

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

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

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

In order to review the above schemes, joint study meetings were held amongst CEA, CTUIL and GRID-INDIA on 20.04.2023 and 09.05.2023 and the Khavda Phase-IV and Phase-V schemes were agreed to be modified (after incorporating certain Intra-state

schemes proposed by GETCO vide their letter dated 21.03.2023). The salient modifications agreed in the meetings are given below:

Phase-IV scheme:

- In order to enhance reliability and resiliency at KPS3, KPS3 – Lakadia 765 kV D/c line was planned instead of KPS3 – KPS2 765 kV 2nd D/c and KPS2 – Lakadia 765 kV 2nd D/c line
- To enhance redundancy and reliability of power supply to Navsari(New) S/s and further upto Boisar-II S/s, it was agreed to establish South Olpad 765/400/220kV (GIS) S/s and change the termination of the earlier proposed Vadodara – Navsari(New) and Navsari(New) – Boisar-II 765kV D/c lines from Navsari(New) to South Olpad S/s so as to form Vadodara –South Olpad and South Olpad – Boisar-II 765kV D/c lines. To enhance infeeds into South Olpad S/s, Ahmedabad – South Olpad(GIS) (220km.) 765kV D/c line was also agreed. To provide anchoring at 400kV level, LILO of Gandhar – Hazira 400kV D/c line is also planned at South Olpad (GIS) S/s.
- 400kV bus of Boisar-II S/s has been planned to be split into two sections for fault level control at Boisar-II/Velgaon(MH) substations and ±200MVAr STATCOM with 2x125 MVAr MSC, 1x125 MVAr MSR has been proposed at each section. Further, ± 300 MVAr STATCOM with 3x125 MVAr MSC, 1x125 MVAr MSR planned earlier at Navsari(New) S/s has been made part of Phase-IV scheme.
- 765/400kV ICT Augmentation at KPS2 & KPS3 has been suitably modified to suit the requirements of RE injection at the Pooling Stations and 400kV line bays for RE interconnection have been proposed for implementation at KPS2 (Bus sections I & II) and KPS3 (Bus section-II) along with the ICT augmentation scope.

Phase-V scheme

- Instead of 8000MW, ±800 kV HVDC Bipole link (LCC) between KPS2 and Akola-III, following has been agreed:
    - 6000MW, ±800 kV HVDC Bipole link (LCC) between KPS2 and Nagpur *[The shifting of LCC HVDC terminal from Akola-III to Nagpur would relieve the over loading of 765/400 kV ICTs at Aurangabad (PG)].*
    - 2400 MW, ± 525 kV HVDC Bipole link (VSC) between KPS3(HVDC) and South Olpad
- Augmentation of transformation capacity at KPS3(GIS) by 1x1500MVA, 765/400 kV ICT on Bus section-II (8th) (i.e. last 765/400kV ICT at KPS3) has been added to Phase-V scheme whose implementation is proposed to be taken up as per evacuation requirement at KPS3.

The final Transmission Systems for Evacuation of Power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7GW) and Phase-V (8GW) as agreed in above meetings was noted and agreed in 19th Consultation meeting for

Evolving Transmission Schemes in WR held on 30.05.2023 & 14th NCT meeting held on 09.06.2023.

Khavda Phase-IV (7GW)

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

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

The detailed scope of the agreed schemes are given below:

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

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

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
5.	±300 MVAR STATCOM with 1x125 MVAR MSC, 2x125 MVAR MSR at KPS3 400 kV Bus section-II	• ±300 MVAR STATCOM (with 1x125 MVAR MSC, 2x125 MVAR MSR) • 400 kV bay – 1 No.
6.	KPS1 (GIS)– Bhuj PS 765 kV 2nd D/C line	Route length: 110 km
7.	2 Nos. of 765 kV line bays each at KPS1 (GIS) & Bhuj PS for KPS1 (GIS) – Bhuj PS 765 kV D/C line	• 765 kV line bays (GIS) – 2 Nos. (at KPS1 end Bus section-II) • 765 kV line bays (AIS) – 2 Nos. (at Bhuj end)
8.	330 MVAR switchable line reactors at KPS3 end of KPS3 (GIS) – Lakadia 765 kV D/C line (with NGR bypass arrangement)	• 330 MVAR, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 1x110 MVAR spare switchable reactor unit at KPS3 (GIS) end

Note:

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

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

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

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

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

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

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

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

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	Establishment of 2x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV GIS S/s at a suitable location South of Olpad (between Olpad and Ichhapore) with 2x330 MVAR, 765 kV & 1x125 MVAR, 420 kV bus reactors **Future Provisions**: Space for o 765/400 kV ICT along with bays- 4 Nos. o 765 kV line bays along with switchable line reactors – 8 Nos. o 765 kV Bus Reactor along with bay: 2 Nos. o 765 kV Sectionaliser bay: 1 - set o 400 kV line bays along with switchable line reactor – 8 Nos. o 400/220 kV ICT along with bays - 8 Nos. o 420 kV Bus Reactor along with bay: 3 Nos. o 400 kV Sectionalization bay: 1- set o 220 kV line bays: 18 Nos. o 220 kV Sectionalization bay: 1 set o 220 kV BC: 1 Nos. o Establishment of 2500 MW, ± 500 kV South Olpad (HVDC) [VSC] terminal station (2x1250 MW)	765/400 kV, 1x1500 MVA ICT-2 Nos. (7x500 MVA single phase units including one spare unit) 400/220 kV, 500 MVA ICT – 2 Nos. 765 kV ICT bays- 2 Nos. 400 kV ICT bays- 4 Nos. 220 kV ICT bays- 2 Nos. 220 kV BC bay – 1 No. 330 MVAR, 765 kV bus reactor- 2 Nos. 125 MVAR, 420 kV bus reactor- 1 No. 765 kV reactor bay- 2 Nos. 765 kV line bay- 4 Nos. 400 kV reactor bay- 1 No. 400 kV line bay- 4 Nos. 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 No.
2.	Vadodara (GIS) –South Olpad (GIS) 765 kV D/C line	Route length: 140 km
3.	240 MVAR switchable line reactors on each ckt at Vadodara (GIS) end of Vadodara (GIS) –South Olpad (GIS) 765 kV D/C line (with NGR bypass arrangement)	• 240 MVAR, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 1x80 MVAR spare bus reactor available at Vadodara (GIS) to be used as spare
4.	2 Nos. of 765 kV line bays at Vadodara (GIS) for Vadodara (GIS) – South Olpad (GIS) 765 kV D/C line	• 765 kV line bays (GIS) – 2 Nos. (at Vadodara end)
5.	LILO of Gandhar – Hazira 400 kV D/c line at South Olpad (GIS) using twin HTLS conductor with minimum capacity of 1700 MVA per ckt at nominal voltage	LILO route length ~ 10 km.
6.	Ahmedabad – South Olpad (GIS) 765 kV D/c line	Route length: 250 km
7.	240 MVAR switchable line reactors on each ckt at Ahmedabad & South Olpad (GIS) end of	• 240 MVAR, 765 kV switchable line reactor- 4 Nos. [2 for

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
	Ahmedabad – South Olpad (GIS) 765 kV D/c line (with NGR bypass arrangement)	Ahmedabad end and 2 for South Olpad (GIS) end] • Switching equipment for 765 kV line reactor- 4 Nos. [2 for Ahmedabad end and 2 for South Olpad (GIS) end] • 1x80 MVAR, 765 kV 1-ph spare line reactor – 1 No. (for South Olpad end) • 1x80 MVAR, 765 kV 1-ph spare line reactor being implemented for Lakadia – Ahmedabad line (under Khavda Ph-II Part B scheme) at Ahmedabad S/s to be used as spare
8.	2 Nos. of 765 kV line bays at Ahmedabad S/s for Ahmedabad – South Olpad (GIS) 765 kV D/c line	• 765 kV line bays (AIS) – 2 Nos. (at Ahmedabad end)

Note:

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

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

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

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

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

Sl. No.	Scope of the Transmission Scheme	Capacity / Route length
1.	Establishment of 4x1500 MVA, 765/400 kV & 2x500 MVA, 400/220 kV Boisar-II (GIS) S/s with 2x330 MVAR, 765 kV bus reactors and 2x125 MVAR, 420 kV bus reactors. (2x1500 MVA, 765/400 kV ICTs shall be on each 400 kV section and 2x500 MVA, 400/220 kV ICTs shall be on 400 kV Bus Section-II. 2x125 MVAR Bus reactors shall be such that one bus reactor is placed on each 400 kV bus section. 400 kV Bus	765/400 kV, 1500 MVA ICT- 4 Nos. (13x500 MVA single phase units including one spare unit) 400/220 kV, 500 MVA ICT – 2 Nos. 765 kV ICT bays- 4 Nos.

Sl. No.	Scope of the Transmission Scheme	Capacity / Route length
	Sectionaliser to be kept under normally OPEN condition) **Future Provisions:** Space for ○ 765/400 kV ICT along with bays- 2 No. ○ 765 kV line bays along with switchable line reactors – 8 Nos. ○ 765 kV Bus Reactor along with bay: 2 No. ○ 765 kV Sectionaliser bay: 1 - set ○ 400 kV line bays along with switchable line reactor – 8 Nos. ○ 400/220 kV ICT along with bays - 6 Nos. ○ 420 kV Bus Reactor along with bay: 2 No. ○ 220 kV line bays: 12 Nos. ○ 220 kV Sectionalization bay: 1 set ○ 220 kV BC: 1 No.	400 kV ICT bays- 6 Nos. (2 Nos. on Bus Section-I and 4 Nos. on Bus Section-II) 400 kV Bus Sectionaliser-1 set 220 kV ICT bays- 2 Nos. 220 kV BC bay – 1 No. 330 MVAR, 765 kV bus reactor- 2 Nos. 125 MVAR, 420 kV bus reactor- 2 Nos. 765 kV reactor bays- 2 Nos. 765 kV line bays- 6 Nos. 400 kV reactor bays- 2 Nos. (one on each bus section) 400 kV line bay- 6 Nos. (4 Nos. on bus Section-I and 2 Nos. on bus Section-II) 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 No.
2.	South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line	Route length: 225 km
3.	2 Nos. of 765 kV line bays at South Olpad (GIS) for termination of South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line	765 kV line bays (GIS) – 2 Nos. (for South Olpad end)
4.	240 MVAR switchable line reactors on each ckt at South Olpad (GIS) & Boisar-II (GIS) end of South Olpad (GIS) – Boisar-II (GIS) 765 kV D/c line (with NGR bypass arrangement)	• 240 MVAR, 765 kV switchable line reactor- 4 [2 for Boisar-II (GIS) and 2 for South Olpad (GIS)] • Switching equipment for 765 kV line reactor- 4 (2 for Boisar-II (GIS) and 2 for South Olpad (GIS)) • 1x80 MVAR, 765 kV 1-ph spare line reactor – 1 No. (for Boisar-II end) • 1x80 MVAR, 765 kV 1-ph spare line reactor proposed for Ahmedabad – South Olpad (GIS) 765 kV line

Sl. No.	Scope of the Transmission Scheme	Capacity / Route length
		(under Khavda Ph-IV Part B scheme) at South Olpad (GIS) S/s to be used as spare
5.	LILO of Navsari (New) – Padghe (PG) 765 kV D/c line at Boisar-II	LILO route length: 25 km.
6.	Boisar-II (Sec-II) – Velgaon (MH) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	Route length: 10 km.
7.	2 Nos. of 400 kV line bays at Velgaon (MH) for termination of Boisar-II – Velgaon (MH) 400 kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	400 kV line bays (GIS) – 2 Nos. [for Velgaon (MH) end]
8.	LILO of Babhaleswar – Padghe (M) 400 kV D/c line at Boisar-II (Sec-I) using twin HTLS conductor with a minimum capacity of 1700 MVA per ckt at nominal voltage	LILO route length: 65 km.
9.	80 MVAR switchable line reactors at Boisar-II end of Boisar-II – Babhaleswar 400 kV D/c line (with NGR bypass arrangement) formed after above LILO	• 80 MVAR, 420 kV switchable line reactor including switching equipment- 2 Nos.
10.	±200 MVAR STATCOM with 2x125 MVAR MSC, 1x125 MVAR MSR at 400 kV bus section-I of Boisar-II and ±200 MVAR STATCOM with 2x125 MVAR MSC, 1x125 MVAR MSR at 400 kV bus section-II of Boisar-II	• ±200 MVAR STATCOM (with MSC/MSR) on 400 kV Section-I • 400 kV bay – 1 No. on Section-I • ±200 MVAR STATCOM (with MSC/MSR) on 400 kV section-II • 400 kV bay – 1 No. on Section-II
11.	± 300 MVAR STATCOM with 3x125 MVAR MSC, 1x125 MVAR MSR at 400 kV level of Navsari (New)(PG) S/s with 1 No. of 400 kV bay (GIS)	• ±300 MVAR STATCOM (with MSC/MSR) • 400 kV bay – 1 No.

Note:

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

ii. MSETCL shall carry out reconductoring of the balance portion of Padghe (M) – Boisar-II 400 kV D/c line (i.e. from LILO point upto Padghe(M)) and shall also

carry out corresponding upgradation of 400 kV bays at Padghe (M) as may be required in matching time-frame of the LILO line. MSETCL has confirmed the maximum capacity of the line which can be achieved after reconductoring considering clearances in existing towers of Babhaleswar – Padghe (M) 400 kV D/c line as 1700 MVA per ckt.

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

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

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

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

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

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

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

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

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
	○ 220 kV BC: 1 No. ○ STATCOM (±300 MVAR) along with MSC (3x125 MVAR) & MSR (1x125 MVAR): alongwith 1 No. 400 kV bay: 1 No. ○ 80 MVAR, 765 kV, 1-ph reactor (spare unit for line reactor)-1 No.	400 kV reactor bay- 2 Nos. 400 kV line bay- 2 Nos. 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor)-1 No.
2.	Boisar-II – Pune-III 765 kV D/c line	Route length: 200 km
3.	330 MVAR switchable line reactors at Pune-III end of Boisar-II – Pune-III 765 kV D/c line (with NGR bypass arrangement).	• 330 MVAR, 765 kV switchable line reactor- 2 Nos. • Switching equipment for 765 kV line reactor- 2 Nos. • 1x110 MVAR spare bus reactor available at Pune-III (GIS) to be used as spare
4.	2 Nos. of 765 kV line bays at Boisar-II for termination of Boisar-II – Pune-III 765 kV D/c line	• 765 kV line bays (GIS) – 2 Nos. (for Boisar-II end)
5.	LILO of Narendra (New) – Pune (GIS) 765 kV D/c line at Pune-III	LILO route length: 10 km.
6.	330 MVAR switchable line reactors at Pune-III end of Narendra (New) – Pune-III(GIS) 765 kV D/c line (with NGR bypass arrangement).	• 330 MVAR, 765 kV switchable line reactor- 2. • Switching equipment for 765 kV line reactor- 2 • 1x110 MVAR spare bus reactor (1-ph) available at Pune-III (GIS) to be used as spare
7.	LILO of Hinjewadi-Koyna 400 kV S/c line at Pune-III (GIS) S/s	LILO route length: 40 km.
8.	80 MVAR, 420 kV switchable Line Reactors on each ckt at Pune-III (GIS) end of Pune-III (GIS) – Koyna 400 kV line formed after above LILO (with NGR bypass arrangement).	• 80 MVAR, 420 kV switchable line reactor along with switching equipment- 2 Nos.

Note:

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

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

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

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

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

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

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

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

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

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

Note:

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

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

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

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

	Nos. 400 kV bays at Bus Section-I for RE interconnection and 3 Nos. 400 kV bays at Bus Section-II for RE interconnection	and balance 2 ICTs to be terminated in spare bays (one on each section)] 400 kV bays– 10 Nos. [4 Nos. ICT bays (2 on each section) & 5 Nos. line bays (2 on bus section-I & 3 on bus section-II) along with 1 No. bay on Bus Section-II for Dia completion]

Note:

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

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

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

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

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

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

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

Note:

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

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

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

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

Note:

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

Transmission Schemes in WR held on 30.05.2023 & 14th NCT meeting held on 09.06.2023.

Khavda Phase-V (8GW)

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

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

				Phase-V Part A scheme viz. Bipole-1 (2x1500 MW) ± 800 kV Nagpur (HVDC) [LCC] which is 48 months from SPV transfer.
3.	Part B	To be reviewed.	433	-
4.	Part C	TBCB	12,000	48 months from SPV transfer

The detailed scope of Khavda Ph-V scheme is given below:

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

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

Sl. No.	Scope	Capacity/ Route length
	○ 400 kV line bays along with switchable line reactor – 12 Nos. ○ 400 kV Bus sectionaliser- 1 Set ○ 400/220 kV ICT along with bays -9 Nos. (3 Nos. on 400 kV bus sections II & 6 Nos. on future bus section-III) ○ 400 kV Bus Reactor along with bay: 4 No. (1 each on 400 kV bus sections I & II and 2 on future 400 kV bus section-III) ○ 220 kV line bays: 16 Nos. ○ 220 kV Sectionalization bay: 2 set ○ 220 kV BC & TBC: 3 Nos. ○ 80 MVAR, 765 kV, 1-ph reactor (spare unit for line reactor)-1	• 400 kV reactor bay- 2 Nos. (one on each section) • 400 kV Bus sectionaliser - 1 Set • 110 MVAR, 765 kV, 1-ph reactor (spare unit for line/bus reactor) - 1 No.
5.	LILO of Wardha – Raipur 765 kV one D/c line (out of 2xD/c lines) at Nagpur	LILO route length: 30 km.
6.	Installation of 240 MVAR switchable line reactor at Nagpur end on each ckt of Nagpur – Raipur 765 kV D/c line	• 240 MVAR, 765 kV switchable line reactors- 2 Nos. (at Nagpur end) • Switching equipment for 765 kV line reactor- 2 Nos. (at Nagpur end) • 80 MVAR, 765 kV, 1-ph reactor (spare unit for line reactor)-1 No.

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

Note:

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

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

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

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

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

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

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

Note:

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

Phase-V: Part B:

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

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

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

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

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

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

Note:

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

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

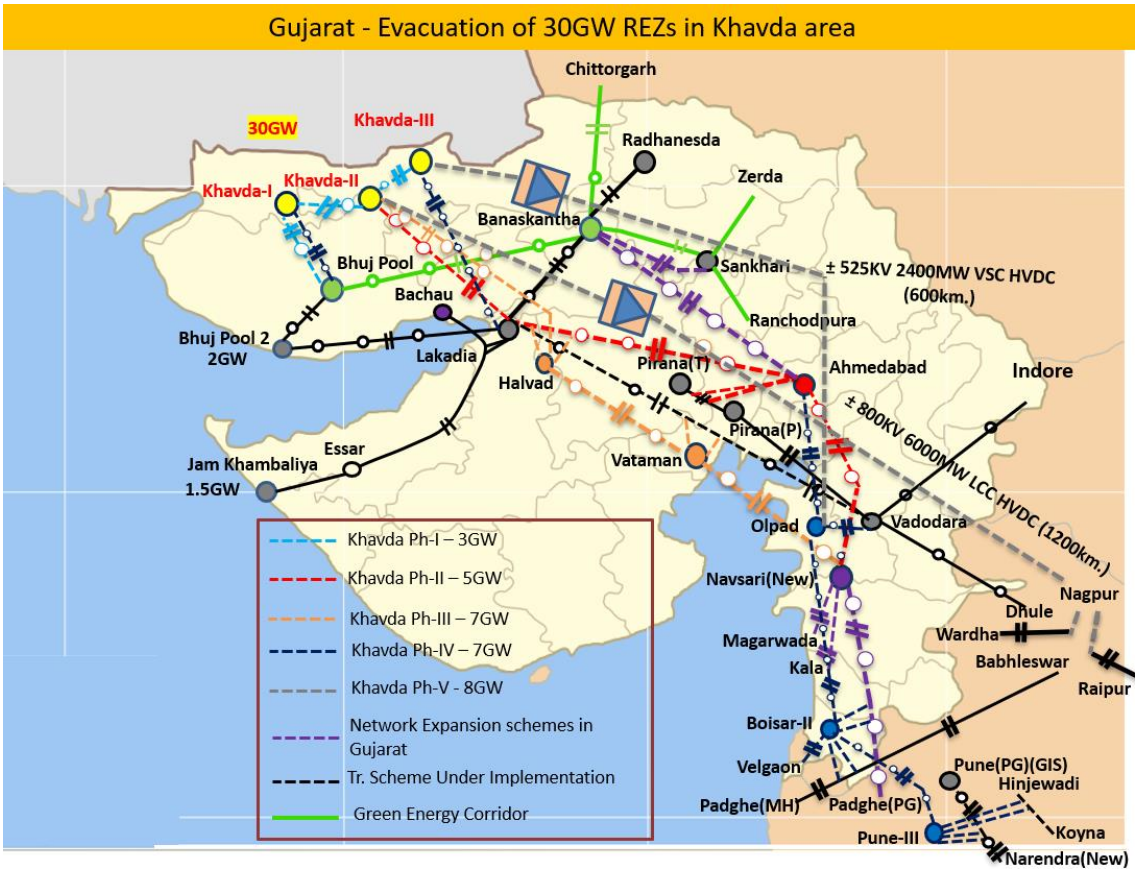
iii. The rated power transmission capacity as well as the rated transmission voltage shall be defined and guaranteed at the rectifier end of the AC yard.

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

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

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

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



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

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

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

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

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

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

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

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

Assumptions:

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

It was decided during the meeting that planning for an additional 2GW load in Jamnagar area shall be carried out at a later stage after identifying suitable 765kV in feeds to Jamnagar S/s and visibility of bulk consumer loads beyond 5GW. The proposed network

expansion scheme would also help to increase short circuit level at Jam Khambhaliya PS and also reliability of evacuation of power from Jam Khambhaliya PS.

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

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

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

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

Sl. No.	Scope of the Transmission Scheme	Capacity/line length km
4.	330MVAr switchable line reactors on each ckt at Jamnagar end of Halvad – Jamnagar 765kV D/c line (with NGR bypass arrangement)	• 330 MVAr, 765 kV switchable line reactor- 2. • Switching equipments for 765 kV line reactor- 2
5.	LILO of Jam Khambhaliya PS – Lakadia 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage]	LILO route length 5km.
6.	50MVAr, 420kV switchable line reactors on each ckt at Jamnagar end of Jamnagar – Lakadia 400kV D/c line (with NGR bypass arrangement)	• 50 MVAr, 420 kV switchable line reactor- 2. • Switching equipments for 400 kV line reactor- 2
7.	Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	50km.
8.	2 nos. of 400kV line bays at Jam Khambhaliya for termination of Jamnagar – Jam Khambhaliya 400kV D/c (Quad ACSR/AAAC/AL59 moose equivalent) line	• 400 kV line bays (GIS) – 2 Nos. (for Jam Khambhaliya end)
9.	LILO of CGPL – Jetpur 400kV D/c (triple snowbird) line at Jamnagar with conductor having ampacity equivalent to triple snowbird at nominal voltage	LILO route length 65km.
10.	80MVAr, 420kV switchable line reactors on each ckt at Jamnagar end of Jamnagar – CGPL 400kV D/c line (with NGR bypass arrangement)	• 80 MVAr, 420 kV switchable line reactor- 2. • Switching equipments for 400 kV line reactor- 2
11.	LILO of both ckts of Kalavad – Bhogat 400kV D/c line (Twin AL-59) at Jam Khambhaliya PS with Twin AL59 Moose equivalent conductor	• LILO route length 10km.
12.	4 nos. of 400kV line bays at Jam Khambhaliya for LILO of both ckts of Kalavad – Bhogat 400kV D/c line	• 400 kV line bays (GIS) – 4 Nos. (for Jam Khambhaliya end)
13.	±400MVAr STATCOM with 3x125 MVAr MSC & 2x125 MVAr MSR at Jamnagar 400kV Bus section	• ±400MVAr STATCOM (with MSC/MSR) • 400kV bay – 1 no.

During the above meeting, it was also deliberated that the implementation timelines for the subject transmission shall be kept for 24 months. However, the transmission scheme shall be awarded for implementation after receipt of GNA / conversion of Connectivity into GNA beyond 1200MW in Jam Khambhaliya / Jamnagar complex. However, now conversion of Connectivity into GNA to the tune of 1900MW has been received at Jam Khambhaliya and the proposed scheme may be implemented in matching time-frame of

GNA applications viz. Mar'26 subject to minimum implementation time-frame of 24 months.

Note:

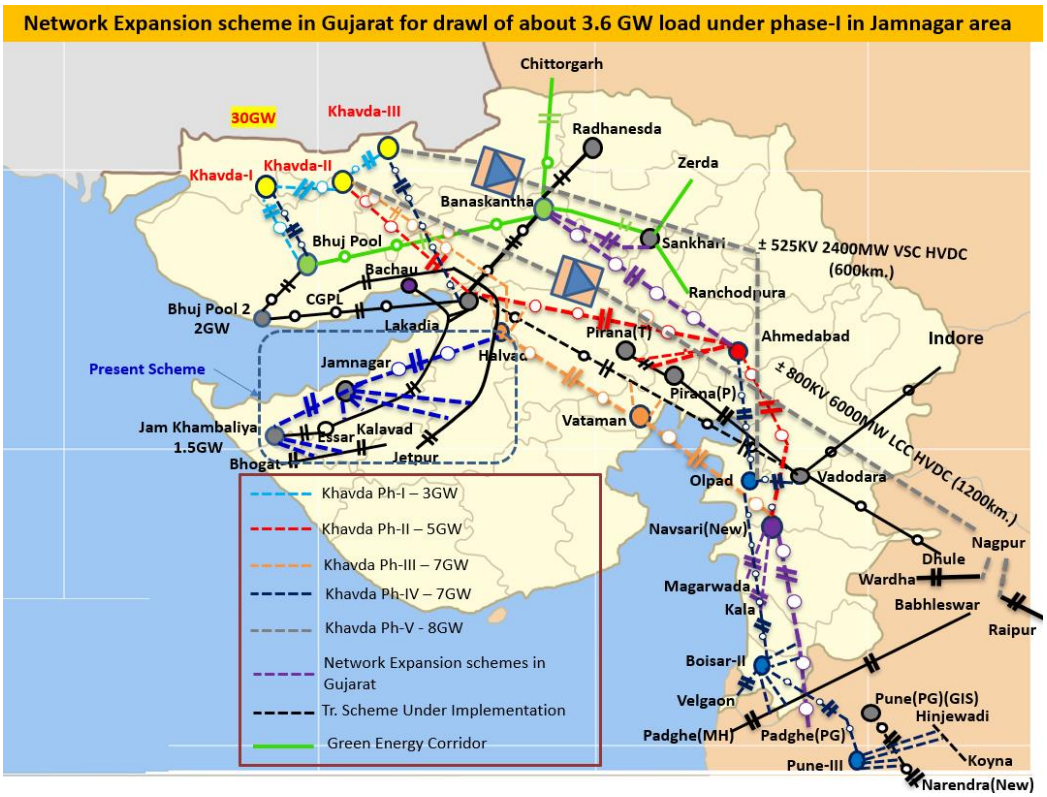
i. *Implementation Timeframe: 31.03.2026 subject to minimum implementation time-frame of 24 months from date of allocation to the implementing agency*

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

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

The transmission scheme was discussed and agreed in 47th WRPC meeting held on 15.06.2023.

Estimated Cost: 3815 Crore



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

2x315MVA, 400/220kV ICTs at Bhachau was observed to be overloaded (322MVA) beyond MVA rating under N-1 contingency in 2027-28 time-frame (Scenario-7, Feb Solar Max). To meet the N-1 reliability criteria, 1x500 MVA, 400/220 kV ICT (3^{th}) is required. The scheme was deliberated & agreed in 20th Consultation meeting for

Evolving Transmission Schemes in WR to be held on 04.08.2023 with following scope of work:

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

Implementation time-frame: 18 months

5.4.2 Maharashtra:

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

Govt. of India has set a target for establishing 500 GW capacity from non-fossil energy sources by 2030. In this direction, 2GW capacity has been identified at Kallam PS. Transmission System for evacuation of power from RE Projects in Osmanabad area (1 GW) in Maharashtra is presently under implementation by Kallam Transmission Ltd. which is expected by Oct'23. Further, augmentation of transformation capacity at Kallam PS by 2x500 MVA, 400/220 kV ICTs (3rd & 4th) along with 220kV bays for RE interconnection is also under implementation for enabling interconnection of additional 1GW at 220kV level of Kallam PS (expected by May'24).

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

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

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

The scheme was discussed and agreed in joint study meeting amongst CEA, CTU, GRID-INDIA and MSETCL held on 23.05.2023 and in the 19th Consultation Meeting for Evolving Transmission Schemes in Western Region (CMETS-WR) held on 30.05.2023. The subject Transmission system was subsequently approved in the 14th NCT meeting

held on 09.06.2023 & recommended for implementation of the subject transmission scheme through TBCB route.

Detailed Scope of Work

Western Region Network Expansion scheme in Kallam area of Maharashtra

Sl. No.	Scope of the Transmission Scheme	Capacity/ Route length
1.	LILO of both circuits of Parli(M) – Karjat(M)/Lonikand-II (M) 400 kV D/c line (twin moose) at Kallam PS	LILO route length~ 15 km.
2.	4 Nos. 400 kV line bays at Kallam PS for LILO of both circuits of Parli(M) – Karjat(M)/Lonikand-II(M) 400 kV D/c line (twin moose) at Kallam PS	400 kV line bays (AIS) – 4 Nos. (for Kallam PS end)
3.	63 MVAR, 420 kV switchable line reactor (with NGR bypassing arrangement) on each ckt at Kallam PS end of Karjat – Kallam 400 kV D/c line (~140km.)	63 MVAR, 420 kV switchable line reactor including Switching equipment - 2 Nos. (at Kallam end)

Note:

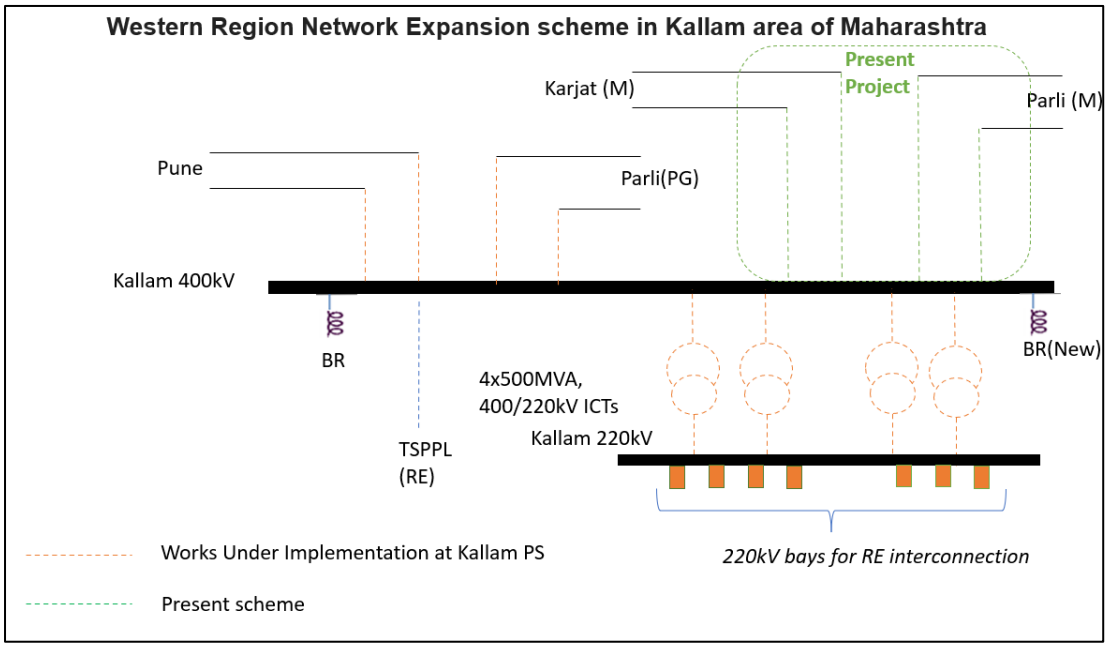
i. TSP of Kallam PS (Kallam Transmission Ltd.) shall provide requisite space at Kallam PS for above scope of work.

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

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

Implementation timeframe: 18 months from SPV transfer

Estimated Cost: 160 Crores.



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

Kallam PS is under implementation by Kallam Transmission Ltd. (a subsidiary of India Grid Trust) as a part of "Transmission System for evacuation of power from RE projects in Osmanabad area (1GW) in Maharashtra" transmission scheme through TBCB route with SCOD as 27.06.2023 (anticipated COD by 31.10.2023 as per project review with Transmission System Developers of WR meeting held on 31.03.2023)

The upstream generation project is Torrent Solar Power Private Limited (TSPPL) which has presently been granted 66MW Stage-II connectivity for its WPP. Subsequently, TSPPL has also applied for addl. Stage-II Connectivity for 92MW. Option for transition of Stage-II Connectivity of 158MW (66MW+92MW) to GNA has been exercised by TSPPL.

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

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

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe.
1.	400kV line bay at Kallam PS for interconnection of Torrent Solar Power Pvt. Ltd. (TSPPL)	• 400kV line bay (including	30.12.2024 (Matching with start date of connectivity of TPL)

Sl. No.	Scope of the Transmission Scheme	Item Description	Implementation Timeframe.
		associated tie bay) – 1no.	
		Total Estimated Cost:	**₹ 17.1 Crore**

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

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

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

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

Sl. No.	Scope of the Transmission Scheme	Item Descriptions	Implementation Timeframe.
1.	220kV line bay at Parli(PG) S/s for interconnection of Renew Tej Shakti Pvt. Ltd. (RTSPL)	• 220 kV line bay – 1no.	30.04.2025
		Total Estimated Cost:	**₹ 5.84 Crore**

5.4.3 Madhya Pradesh

a) Augmentation of transformation capacity at 765/400kV Indore S/s in Madhya Pradesh

2x1500MVA, 765/400V ICTs at Indore was observed to be overloaded (1673 on ICT at Section-B under outage of 1500MVA ICT on Section-A) beyond MVA rating under N-1 contingency in 2027-28 time-frame (Scenario-7, Feb Solar Max). To meet the N-1 reliability criteria, 1x1500MVA, 765/400kV ICT (3rd) on Section-A (with Indore & Khandwa 400kV D/c lines) is required. The scheme was deliberated & agreed in 20th Consultation meeting for Evolving Transmission Schemes in WR to be held on 04.08.2023 with following scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Augmentation of Transformation capacity at 765/400kV Indore S/s by 1x1500MVA ICT (3rd) [terminated on 400kV Bus section A with Indore & Khandwa 400kV D/c lines]	765/400kV, 1x1500MVA ICT – 1 No. 765kV bay – 1 No. 400kV bay – 1 No. (on bus section-A)

Implementation time-frame: 18 months

b) Replacement of 63 MVAr Bus reactor with 125 MVAr Bus reactor at 400kV level of Jabalpur S/s of POWERGRID

POWERGRID vide email dated 23rd May 2023 informed the WRPC that as per 41st meeting of WRPC, the replacement of 400kV 63 MVAR Bus reactor at 400/220kV Jabalpur S/s was approved under O&M Additional capitalization in line with the recommendation of CPRI based on RLA after completion of its useful service life. However, recently, CTU has proposed replacement of 63 MVAR bus reactor with 125 MVAR bus reactor based on system conditions (Voltage sensitivity of 0.6kV for 63MVAr reactor and 1.2kV for 125MVAr reactor was observed at Jabalpur S/s) and accordingly POWERGRID proposed to replace the existing 400KV 63 MVAR Bus reactor with 125 MVAR bus reactor at Jabalpur under ADD-CAP.

Subsequently, in the 567th OCC committee meeting as well as in the recently concluded 47th WRPC meeting held on 15.06.2023, POWERGRID informed that the useful life of 400KV 63 MVAR Bus reactor at 400/220kV Jabalpur S/s has been completed and hence the proposed replacement of 420kV, 63 MVAr Bus reactor with 420kV, 125MVAr bus reactor at Jabalpur (PG) S/s needs to be implemented as a new scheme. The above was noted in the WRPC meeting and it was decided that CTU shall take the scheme for further approvals in the ensuing CMETS-WR meeting. The matter was subsequently deliberated & agreed in 20th Consultation meeting for Evolving Transmission Schemes in WR to be held on 04.08.2023 with following scope of work:

Sl. No.	Scope of the Transmission Scheme	Capacity /km
1.	Replacement of 420kV, 63 MVAr Bus reactor with 420kV, 125MVAr bus reactor at Jabalpur (PG) S/s along with associated civil works	420kV, 125MVAr bus reactor – 1 No.

Implementation time-frame: 27 months

5.4.4 UT of DD & DNH

a) Augmentation of transformation capacity at 400/220kV Magarwada GIS S/s in Dadra and Nagar Haveli and Daman and Diu

2x315MVA, 400/220kV ICTs at Magarwada was observed to be overloaded (375MVA) beyond MVA rating under N-1 contingency in 2027-28 time-frame (Scenario-7, Feb Solar Max). To meet the N-1 reliability criteria, 1x500 MVA, 400/220 kV ICT (3rd) is

required. The scheme was deliberated & agreed in 20th Consultation meeting for Evolving Transmission Schemes in WR to be held on 04.082023 with following scope of work:

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

Implementation time-frame: 21 months

5.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in section 1.3, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are expected to be commissioned in 2028-29 timeframe are considered for conducting these studies. Results of these studies were analysed and the same are deliberated below-

5.5.1 Power Flow Studies

The base case file was prepared for 2028-29 timeframe. The study results are detailed in subsequent sections.

5.5.2 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

List of 765kV ISTS lines loaded about 3500MW under N-1 contingency are summarized below at **Table 5-7:**

Table 5-7: 765kV ISTS Transmission lines not meeting N-1 Criteria in WR

Sl. No.	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under n-1	Rating	% Loading
1	Tamnar – Dharamjaigarh 765kV one line	Tamnar – Dharamjaigarh 765kV other line	1,2,5	ISTS	2860	4842	3500	138
2	Sasan – Vindhyachal 765kV one line	Sasan – Vindhyachal 765kV other line	2	ISTS	2012	3430	3500	98

Due to high generation in Chattisgarh, and low generation in West Bengal, high power is flowing on Tamnar – Dharamjaigarh-Ranchi-Mednipur 765kV D/c corridor. Suitable network augmentation would be planned in consultation with respective STUs. Sasan- Vindhyachal

Pool 765kV D/c line length is only about 5km and with 3400MW loading no issues are envisaged.

Further, 400kV ISTS/STU lines loaded beyond 100% of thermal rating under N-1 contingency are summarized below at **Table 5-8:**

Table 5-8: 400kV Transmission lines not meeting N-1 Criteria in WR

Sl. No.	Name of the Line	Contigency	Scenario No.	Owner	Base case Loading	Loading under N-1	% Loading	Rating
1	Khargar - Navi Mumbai 400kV line	Khargar - Padghe 400kV line one ckt	4,7,8	ISTS	402	1144	133	857
2	A'bad – I – A'bad – II 400kV D/c line one ckt	A'bad – I – A'bad – II 400kV D/c line other ckt	1,4	STU	502	950	111	857
3	Kalwa-Padghe 400kV D/c line one ckt	Kalwa-Padghe 400kV D/c line other ckt	8	ISTS	624	889	104	857

Reconductoring of Kharghar - Navi Mumbai 400kV line may be done by MSETCL to mitigate the overloading issue. A'bad-I and A'bad-II substations are interconnected through very short lines and the issue to resolve overloading alongwith high short circuit issues at the above subsations has been discussed in WR-CMETS meeting and adequate scheme would be evolved in consultation with MSETCL. Detailed studies are being carried out and suitable measures shall be included in the final report of Rolling Plan.

b) 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

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, 2X315MVA Navi Mumbai ICTs	1,7	ISTS	299	352	112	315
2	400/220kV, 2x315MVA Aurangabad ICTs	7,8	ISTS	252	349	111	315
3	765/400kV, 2x1500MVA Aurangabad ICTs	1,4	ISTS	1149	1626	108	1500
4	400/220kV, 2x500MVA Datiya New ICTs	4,7	ISTS	485	754	151	500
5	400/220kV, 3x500MVA, Navsari (New) ICTs	4	ISTS	458	580	116	500
6	400/220kV, 2x500MVA, Vadodara ICTs	4	ISTS	467	605	121	500

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Base Case Flow	Maximum Loading under N-1 of ICT	% Loading	Rating
7	400/220kV, 2x315MVA+ 1x500MVA, Kala ICTs	8	ISTS	232	319	101	315

In MP, high loading of ICTs at Datiya (New) is observed with integration of 2.5GW RE potential at Morena under 181.5GW REZ through Morena PS –Datiya (New) 400 kV D/c line under Ph-II. Adequate system augmentation at Datiya (New) would be finalised after discussions with concerned stakeholders.

In Gujarat/ UT of DD & DNH, high loading of ICTs at Vadodara & Kala is observed due to high RE integration in Gujarat coupled with high demand in Gujarat & DNH and low self-generation in DNH. The above RE power is also overloading Kala ICTs. Adequate system augmentation in consultation with GETCO/ UT of DD & DNH would be evolved.

In Maharashtra, high loading of ICTs at Navi Mumbai & Aurangabad ICTs are observed due to high demand in western part of Maharashtra and low self-generation. Import capability (ATC) constraints for Maharashtra have been reported by WRLDC and associated system augmentation in consultation with MSETCL would be evolved. 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. Detailed studies are being carried out and suitable measures shall be included in the final report of Rolling Plan.

List of STU/GENCO ICTs loaded beyond MVA rating under N-1 contingency are summarized below at **Table 5-10:**

Table 5-10: STU ICTs not meeting N-1 Criteria in WR

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Base Case Flow	Maximum Loading under N-1 of ICT	% Loading	Rating
1	400/220kV, (2X315) + (1X500) MVA Nagothane ICTs	1,7	MSETCL	445	580	116	500
2	400/220kV, 2X315 MVA Mundra APL ICTs	2,3	APL	341	467	149	315
3	765/400kV, 2X1000 MVA Sipat ICTs	1,4	NTPC	837	1267	127	1000
4	400/220kV, (3X315) MVA SUGEN ICTs	4,7,8	TPL	305	379	120	315

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Base Case Flow	Maximum Loading under N-1 of ICT	% Loading	Rating
5	400/220kV, (2X500) MVA Sankhari ICTs	8	GETCO	389	518	104	500
6	400/220kV, (2X500) MVA Prantij ICTs	4	GETCO	339	509	102	500
7	400/220kV, (2X315) MVA Halvad ICTs	8	GETCO	270	340	108	315
8	400/220kV, (2X315+1x500) MVA Julwania ICTs	8	MPPTCL	207	319	101	315
9	400/220kV, (3X315) MVA Bhilai ICTs	8	CSPTCL	275	329	104	315
10	400/220kV, 3x315 + 1x600 + 1x500MVA Padghe ICTs	4,5,8	MSETCL	297	387	123	315
11	400/220kV, (2x500MVA) MVA Padghe Split ICTs	1,4,7	MSETCL	388	557	111	500
12	400/220kV, 3x500MVA Vikhroli ICT	1,7,8	MSETCL	461	541	108	500
13	400/220kV, (2x500MVA) MVA Kalwa Split ICTs	7,8	MSETCL	407	517	103	500
14	400/220kV, 2x315 + 1x500MVA Kharghar ICTs	7	MSETCL	286	335	106	315

From above, it is observed that ICT loadings i.r.o 6 nos. of substation in Maharashtra, 5 nos. in Gujarat, 1 no. in MP & 2 nos. in Chhattisgarh are not complying with N-1 criteria in 2028-29 timeframe. 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.

5.5.3 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 is emerged that there as 4 nos. of 765kV substations and 25 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:

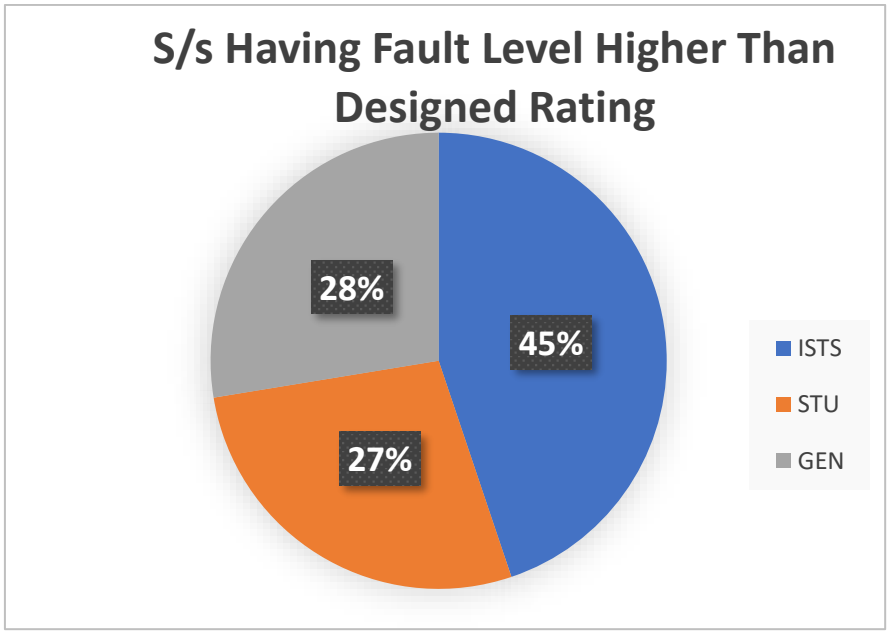


Figure 5-1: Substations crossing the design limit in WR at 400kV buses

Details of the ISTS buses exceeding design fault level by more than 5% under different scenarios 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 Jabalpur Pool	7,9	53	50
2	765kV Wardha	2,3,5,6,7,8,9	45	40
3	765kV Bilaspur Pool	2,3,4,5,6,7,8,9	45	40
4	765kV Gwalior	3,6,7,9	43	40
5	400kV Pirana (PG)	3,5,6,7,8,9	42	40
6	400kV Banaskantha	7,8,9	53	50
7	400kV Bhachau	3,5,6,7,8,9	42	40
8	400kV Boisar	2,3,4,5,6,7,8,9	46	40
9	400kV Bilaspur Pool	All	47	40
10	400kV Bina	2,3,4,5,6,7,8,9	44	40
11	400kV Jabalpur	7,8,9	43	40
12	400kV Solapur	1,4,7,8,9	50	40
13	400kV Aurangabad	7	53	50

From the above, it can be seen that 13 nos. of buses i.e. 400kV & 765kV Bilaspur PS, 765kV Jabalpur PS, 765kV Gwalior, 400kV Jabalpur, 400kV Bina, 400kV Pirana (PG), Bhachau &

Banaskantha, 400kV Boisar & 765kV Wardha, 400kV Solapur & 400kV Aurangabad buses violates the design fault level by more than 5%. Studies shall be carried out to mitigate the same in consultation with various stakeholders of WR.

Further, following STU buses exceeding the substation design fault level by more than 5% under different scenarios are mentioned at **Table 5-12:**

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 Nagda	MP	All	43	40
2	400kV Bina	MP	2,3,4,5,6,7,8,9	44	40
3	400kV Aurangabad-I	Maharashtra	2,3,4,5,6,7,8,9	49	40
4	400kV Aurangabad-II	Maharashtra	2,3,4,5,6,7,8,9	48	40
5	400kV Aurangabad-III	Maharashtra	2,3,5,6,7,8,9	46	40
6	400kV Bableshwar	Maharashtra	7,8,9	45	40
7	400kV Soja	Gujarat	7,8,9	42	40
8	400kV Sankhari	Gujarat	7,8	42	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 CGPL	Gujarat	All	46	40
2	Mundra-APL	Gujarat	5,6,7,8,9	43	40
3	400kV Jindal	Chhattisgarh	All	46	40
4	400kV Chandrapur-I	Maharashtra	5,6,7,8,9	46	40
5	400kV Chandrapur-II	Maharashtra	5,6,7,8,9	46	40
6	400kV Chandrapur SW	Maharashtra	5,6,7,8,9	44	40
7	400kV TAPS4	Maharashtra	2 to 9	44	40
8	400kV Solapur STPP	Maharashtra	7,9	45	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. MSETCL 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, MSETCL may explore possibility of reducing fault levels at above substations through suitable splitting / bypassing arrangement with or without series bus / line reactors.

Further, STUs/Generators are required to take necessary actions such as bus splitting, bypassing of lines, fault limiting reactors etc to resolve the issue of high fault level at their buses.

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Chapter 6: Southern Region

Southern Region is connected to Western and Eastern Regions through high capacity 765kV AC links, Back-to-Back HVDC and Bi-pole HVDC links. The thermal generating stations of Southern Region are predominantly concentrated in the States of Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. The States of Tamil Nadu, Karnataka and Andhra Pradesh are rich in RE comprising of large scale Solar & Wind potential. Southern part of Karnataka (Bangalore), Kerala and Central part of Telangana (Hyderabad) has high demand and less internal generation. With the continuous increase in demand and limited conventional generation availability, Southern Region imports power from NEW Grid during peak demand period whereas it exports power to NEW Grid during high RE scenario / off peak demand period.

6.1 Power Supply Scenario as on Feb'23

As on Aug, 2023 total Installed Capacity (IC) of Southern Region was about 125 GW and the peak demand was about 64 GW. Southern Region has touched the maximum export of about 7 GW and maximum import of about 17.5 GW till date. The state-wise breakup of installed capacity and peak demand is summarised at **Table 6-1** below.

Table 6-1: SR Installed Capacity and Peak Demand as on Aug'23

(All Fig in GW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total		
Andhra Pradesh	11.5	4.1	15.5	0.1	1.7	9.4	11.2	26.7	12.9
Telangana	9.5	0.8	10.3	0.1	2.5	5.2	7.8	18.1	14.8
Karnataka	10.5	0.0	10.5	0.7	3.6	17.8	22.1	32.6	17.0
Kerala	2.5	0.5	3.1	0.4	1.9	1.2	3.4	6.5	5.0
Tamil Nadu	14.8	1.0	15.8	1.4	2.2	18.5	22.2	38.0	19.0
Puducherry	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.5
NLC and Lakshadweep	0.3	0.0	0.3	0.1	0.0	0.0	0.1	0.4	0.0
Central unallocated	1.9	0.0	1.9	0.5	0.0	0.0	0.5	2.3	0.0
SR	**50.9**	**6.5**	**57.4**	**3.3**	**11.8**	**52.1**	**67.3**	**124.7**	**64.1**

Source: CEA monthly report

From above, it can be concluded that share of non-fossil fuel based generation capacity in total present installed capacity (IC) of 124.7 GW is 67.3 GW i. e 54% of total IC. This share would further increase in envisaged scenario of 2028-29 timeframe.

6.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Southern Region demand for 2028-29 timeframe is expected to increase to about 91 GW. As per the inputs received from various stakeholders, total installed capacity of Southern Region for 2028-29 is expected to be about 221 GW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 6-2**

Table 6-2: SR Installed Capacity and peak demand (2028-29)

(All Fig in GW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Andhra Pradesh	6.4	0.5	6.9	3.2	0.0	7.7	10.9	1.4	19.1	20.5
Telangana	10.8	0.0	10.8	0.9	0.0	2.7	3.6	1.6	16.0	22.5
Karnataka	7.7	0.4	8.1	4.9	0.0	12.6	17.5	0.0	25.5	19.4
Kerala	0.0	0.4	0.4	2.4	0.0	0.2	2.5	0.0	2.9	6.1
Tamil Nadu	12.1	0.6	12.6	1.9	0.0	16.3	18.2	0.9	31.7	24.3
Puducherry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Central	12.9	0.0	12.9	0.0	7.8	0.0	7.8	0.0	20.7	-
IPP	4.6	0.0	4.6	0.0	0.0	87.5	87.5	13.0	105.2	-
SR	**54.5**	**1.8**	**56.3**	**13.2**	**7.8**	**127**	**148**	**16.8**	**221.2**	**91.3**

From above, it is observed that growth in installed capacity of Southern Region is majorly from non-fossil fuel based generation resources. Share of non-fossil fuel based generation capacity in total present installed capacity (IC) has increased from 54% to 74%.

Compound annual growth rate in peak demand of Southern Region from present time-frame to 2028-29 is around 7.3 %. The state wise peak demand growth is given at **Table 6-3:**

Table 6-3: Increase in Peak Demand of Various States of SR

(All Fig in MW)

Peak Demand (MW)				
State	**2022-23**	**2028-29**	**Difference**	**% CAGR**
Andhra Pradesh	12508	20461	7953	10.3
Telangana	14816	22488	7672	8.7
Karnataka	16968	19352	2384	2.7
Kerala	4357	6101	1744	7.0
Tamil Nadu	18007	24276	6269	6.2
Puducherry	496	602	106	3.9
SR	**64103**	**91285**	**27182**	**7.3**

Therefore, annual growth rate in peak demand is maximum for Andhra Pradesh (10.3 %) and minimum for Puducherry (3.9%).

6.3 Load Generation Balance for 2028-29 Timeframe

In chapter-1, all India Load Generation Balance (LGB) for identified nine scenarios was prepared as per the methodology finalized in consultation with CTU, CEA and Grid-India (Erstwhile GRID INDIA). This section elaborates the Southern Region Load Generation Balance (LGB) for 2028-29 time-frame. For Southern Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned 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%	1%	50%	51%
7-Feb Solar Max	20%	80%	90%	0%	-100%	0%	93%
8-Feb Peak Load	40%	80%	0%	20%	100%	50%	68%
9-Feb Night Off Peak	20%	80%	0%	0%	40%	30%	59%

Using the above dispatch and demand factors, PSSE base case files for nine scenarios have been prepared. The despatch from thermal generations have been considered based on merit order. Based on the LGB, import / export of SR and the inter regional flows through various corridors are summarised in **Table 6-5**. Further, maximum and minimum is also highlighted in table below.

Table 6-5: Surplus/Deficit of Southern Region

All Fig in (MW)

State / UTs	Import / Export of Southern Region								
Scenario No / Corridors	Aug'28 Time Frame			Jun'28 Time Frame			Feb'29 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
SR-ER	1563	1025	1817	1393	348	3	-523	425	-1732
SR-WR	21267	17235	15383	17863	18205	13351	6154	9871	-2226
Southern Region	22830	18260	17200	19256	18553	13354	5630	10296	-3958

Out of these nine scenarios, Scenario-1 and Scenario-9 corresponds to two extreme cases with respect to export/import i.e. highest export (22.8 GW) and highest import (3.9 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 23 GW and deficit to the extent of about 7 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. 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 17 GW.

6.4 ISTS Network Expansion Schemes Evolved from Mar'23 to Aug'23

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Southern Region (CMETS-SR) from March 2023 to August 2023. Brief of all such deliberated transmission schemes are tabulated below at **Table 6-6:**

Table 6-6: Details of the schemes evolved in SR

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in Cr.)
Karnataka			
1.	Transmission Scheme for integration of Bellary REZ (1.5 GW Solar) in Karnataka	2027-28	620
2.	Augmentation of 1x500 MVA(3rd), 400/220 kV transformation capacity at Hassan S/s	2024-25	49
Tamil Nadu			
1.	Transmission System requirement for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW)	2026-27	1677
2.	Augmentation of transformation capacity by 1x500 MVA, 400/ 220-230 kV ICT at Tuticorin-II PS to meet N-1 reliability of RE Polling Station	2025-26	79
Telanagana			
1.	Transmission System for integration of Karimnagar REZ (2.5 GW Solar)	2027-28	620

Details of the schemes are reproduced below state-wise:

6.4.1 Karnataka

(a) Transmission Scheme for integration of Bellary REZ (1.5 GW Solar) in Karnataka

Govt. of India has set a target of 500 GW addition capacity from non-fossil fuel-based generation capacity by 2030. In this direction, MNRE has identified the 181.5 GW of 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. Out of the 17 GW RE Potential identified in the State of Karnataka, transmission system for evacuation capacity of about 11 GW has been identified considering the Solar-Wind dispatch factors and Energy Storage System.

Details of the potential identified in the state of Karnataka is given below:

State/ District	Pooling Station	Identified Potential (GW)		Maximum Dispatch (GW)	BESS (GW)	Evacuation System (GW)
		Wind	Solar			
Karnataka (17 GW)						
Koppal	Koppal-II	2	2	3	1	2
Gadag	Gadag-II	2	2	3	1	2
Devanagere/ Chitradurga	Devanagere/ Chitradurga	2	2	3	1	2
Bijapur	Bijapur	2	0	2		2
Bellary	Bellary	0	1.5	1.5		1.5
Tumkur	Tumkur-II	0	1.5	1.5		1.5
Sub Total (Karnataka)		**8**	**9**	**14**	**3**	**11**

The transmission system for integration of additional RE potential in Koppal-II and Gadag-II area of Karnataka is already under implementation. Further, a meeting was held under the chairmanship of Chairperson, CEA on 03.11.2022 to discuss the implementation of Transmission system for RE Zones at Ananthapuram, Kurnool, Bidar and some other RE Potential zones wherein it was decided that transmission system for evacuation of power from other RE Zones suggested by SECI viz. Devangere/Chitradurga & Tumkur-II in Karnataka would be put up to NCT after deliberations in CMETS and SRPC forum. Based on the request of SECI and decision in the meeting, transmission system for integration of Devangere/Chitradurga REZ (2 GW Wind, 2 GW Solar, 1 GW BESS) and transmission system for integration of Tumkur REZ (1.5 GW Solar) as identified in the CEA report was deliberated with the SR Constituents in the 14th CMETS-SR held on 26.12.2022.
Further, a meeting was held on 11.01.2023 under the chairmanship of Secretary (Power) to review the progress of under construction/under bidding/planned transmission projects for evacuation of renewable energy projects and constraints, if any, in evacuating RE energy. During the meeting, it was decided that in order to reduce time taken for implementation of ISTS required for RE evacuation, approval of National Committee on Transmission/Ministry of Power could be taken in advance and bidding could be started based on ground situation of visibility of RE generations. Accordingly, CTUIL was requested to expedite the same. Accordingly, transmission system for integration of Bijapur (1 GW Wind) was deliberated with the SR Constituents in the 15th CMETS-SR.

The transmission schemes for Davangere/Chitradurga, Tumkur and Bujapur REZs has been sent to NCT along with the SRPC views.

Furter, Transmission System for integration of Bellary REZ (1.5 GW Solar) was deliberated in the 20th CMETS-SR (minutes awaited). Out of the identified (17 GW) RE Potential in Karnataka, 1.5 GW has been identified in the Bellary area for implementation under Phase-II by December, 2027. Further, for optimal utilization of transmission system, power from other RE Zones in Karnataka viz. Gadag-II, Davangere, Bijapur and Bellary area would be pooled at Koppal-II PS through 400 kV lines for further transfer of power. Accordingly, Bellary REZ is being integrated with Koppal-II PS through Bellary PS – Koppal-II PS 400kV (Quad ACSR moose) D/c line.

Details of transmission system as identified in CEA report for integration of above RE zone is mentioned below:

Transmission System for integration of Bellary REZ (1.5 GW Solar)

- Establishment of 4x500 MVA, 400/220kV Pooling Station near Bellary (Bellary PS), Karnataka
- Bellary PS – Koppal-II PS 400kV (Quad ACSR moose) D/c line (~100 km)
- 2x125MVAr 420 kV bus reactors at Bellary PS

Based on the observations received from STUs and considering the large number of applications at Koppal-II PS & Gadag-II PS, the transmission system for integration of Bellary REZ at Koppal-II is being reviewed

6.4.2 Telangana

(a) Transmission System for integration of Karimnagar REZ (2.5 GW Solar)

Out of the identified (86 GW) RE Potential in Southern Region, 13 GW has been identified in the State of Telangana. MNRE have indicated that out of the 13 GW REZ potential in Telangana, transmission system for evacuation capacity of about 8.5 GW may be identified considering the Energy Storage System. A comprehensive transmission system has been identified for immediate integration and evacuation of the above potential. The details of identified potential REZs in Telangana are given below :

State/District	Pooling Station	Identified Potential (GW)		Maximum Dispatch (GW)	BESS (GW)	Evacuation System (GW)
		Wind	Solar			
Telangana (13 GW)						
Rangareddy	Rangareddy	1	2.5	3	1	2
Medak	Medak	1	2.5	3	1	2
Nizamabad	Nizamabad-II	1	2.5	3	1	2
Karimnagar	Karimnagar	0	2.5	2.5	0	2.5
Sub Total (Telangana)		**3**	**10**	**11.5**	**3**	**8.5**

Based on the communication from SECI, a meeting was held under the chairmanship of Chairperson, CEA on 03.11.2022 to discuss the implementation of Transmission system for RE Zones at Ananthapuram, Kurnool, Bidar and some other RE Potential zones. During the meeting, it was decided that transmission system for evacuation of power from other RE Zones suggested by SECI viz. Nizamabad-II in Telangana would be put up to NCT after deliberations in CMETS and SRPC forum. Based on the request of SECI and decision

in the Chairperson, CEA meeting, transmission system for integration of Nizamabad-II (2 GW Wind, 2.5 GW Solar, 1 GW BESS) as identified in the CEA report published on 07.12.2022 was deliberated with the SR Constituents in the 14th CMETS-SR held on 26.12.2022.

Further, a meeting was held on 11.01.2023 under the chairmanship of Secretary (Power) to review the progress of under construction / under bidding / planned transmission projects for evacuation of renewable energy projects and constraints, if any, in evacuating RE energy. During the meeting, it was decided that in order to reduce time taken for implementation of ISTS required for RE evacuation, approval of National Committee on Transmission/Ministry of Power could be taken in advance and bidding could be started based on ground situation of visibility of RE generations (copy attached at Annexure-V).

Accordingly, transmission system for integration of RE potential in Medak and Rangareddy areas of Telangana was deliberated in 15th SR-CMETS.

Subsequently, Further, in the 16th CMETS-SR, held on 28.02.2023, it was agreed to implement the Transmission System for integration of Nizamabad REZ (1 GW Wind, 2.5 GW Solar, 1 GW BESS) into two phases. Transmission System for integration of Nizamabad REZ (1 GW Wind, 1 GW Solar) under Phase-I is with time schedule of March 2025 and Transmission System for integration of Nizamabad REZ (1.5 GW Solar, 1 GW BESS) under Phase-II is with time schedule of December 2027. Further, SRLDC in various meetings has stressed upon the requirement of STATCOMs at major RE pooling stations in Southern Region including Nizamabad-II considering the SCR and for improving the dynamic stability of the system. In view of the above, ± 300 MVAr STATCOM with 2x125 MVAr MSR and 1x125 MVAr MSC at 400 kV level has been proposed at Nizamabad-II PS under Phase-I. It was also agreed that the 2x125 MVAr bus reactors at 400kV level of Nizamabad-II PS may be deferred from the Phase-I scope and adequate space provision may be included at Nizamabad-II PS for bus reactors as future requirements. Accordingly, following detailed scope of Transmission System for integration of Nizamabad REZ was agreed:

I. Transmission System for integration of Nizamabad REZ (1 GW Wind, 1 GW Solar) under Phase I

- Establishment of 3x1500 MVA, 765/400 kV and 2x500 MVA, 400/220 kV Pooling Station near Nizamabad (Nizamabad-II) along with 2x330 MVAr (765 kV) at Nizamabad-II PS
- Nizamabad-II PS – Nizamabad (PG) 765 kV D/c line (~30 km)
- ± 300MVAr STATCOM with 2x125 MVAr MSR and 1x125 MVAr MSC at 400 kV level of Nizamabad-II PS.
- Future Space for 2x125 MVAr (420kV) bus reactors at Nizamabad-II PS

II. Transmission System for integration of Nizamabad REZ (1.5 GW Solar, 1 GW BESS) under Phase II

- Augmentation of 3x1500 MVA, 765/400 kV and 1x500 MVA, 400/220 kV ICTs at Nizamabad-II PS
- Augmentation by 1x1500 MVA, 765/400 kV ICT at Nizamabad (PG) S/s
- Nizamabad-II PS – Warangal (New) 765 kV D/c line with 330 MVAr SLR at Nizamabad-II PS (~180 km)
- Nizamabad-II PS – Nizamabad (PG) 765 kV D/c (2nd) line (~30 km)

Transmission system for integration of RE potential at Nizamabad, Medak and Rangareddy has been sent to NCT along with the SRPC views.

Further, Transmission System for integration of Karimnagar REZ (2 GW Solar) was deliberated in the 20th CMETS-SR (minutes awaited). Out of 2.5 GW RE in Karimnagar area, 2 GW has been phased out for implementation under Phase-II by December, 2027. Further, for optimal utilization of transmission system, power from other RE Zones in Telangana viz. Medak, Rangareddy and Karimnagar area would be pooled at Nizamabad-II PS through 400 kV lines for further transfer of power. Accordingly, Karimnagar REZ is being integrated with Nizamabad-II PS through Karimnagar PS – Nizamabad-II PS 400kV (Quad ACSR moose) D/c line.

Details of transmission system as identified in CEA report for integration of above RE zone is mentioned below:

Transmission System for integration of Karimnagar REZ (2 GW Solar)

- Establishment of 3x500 MVA, 400/220kV Pooling Station near Karimnagar (Karimnagar PS) in Telangana
- Karimnagar PS – Nizamabad-II PS 400kV (Quad ACSR moose) D/c line (~100 km)
- 2x125MVAr 420 kV bus reactors at Karimnagar PS

Based on the observations received from STUs, the transmission system for integration of Karimnagar REZ is being reviewed

6.4.3 Tamil Nadu

(a) Proposal for grant of LTA to M/s Nuclear Power Corporation of India Ltd. for 2000 MW (for Unit 3&4) and grant of connectivity for 2000 MW (for unit 5&6)

LTA application was received from M/s NPCIL in the month of May, 2022 for transfer of power from Kudankulam Nuclear Power Plant – 3 & 4 (2x1000 MW) to Southern Region beneficiaries on target basis. The LTA application was discussed in the 8th, 9th, 10th and 11th CMETS-SR meetings wherein it was decided that analysis for requirement of LTA transmission system shall be carried out during the Joint Study meeting of Southern Regional constituents scheduled to be held at SRPC, Bengaluru.

Further, M/s Nuclear Power Corporation of India Ltd has applied for conventional Connectivity for 2000 MW for its proposed Kudankulam Nuclear Power Plant – 5 & 6 (2x1000 MW) in September, 2022. The connectivity application was discussed in the 12th CMETS-SR, wherein connectivity was agreed to be granted through 400kV bus extension from generation pooling station of Kudankulam Units 3 & 4 to generation Pooling Station of Kudankulam (KNPP) units 5 & 6 of M/s NPCIL.

However, the transmission system for KNPP - 3 & 4 and KNPP - 5 & 6 could not be finalized due to various reasons viz lack of firm allocations from KNPP-3&4, lack of clarity on space availability of bays at both KNPP - 3 & 4 and KNPP - 5 & 6 generation switchyards etc. After detailed deliberations, it was decided that a separate meeting may be convened for finalization of the transmission system for the evacuation of power from KNPP - 3 & 4 as well as transmission system required for Connectivity of KNPP – 5 & 6.

Accordingly, Joint Studies were conducted from 21st to 22nd February, 2023 at SRPC, Bengaluru wherein "**Transmission System requirement for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW) and Kudankulam Unit - 5 & 6 (2x1000 MW)**" was finalised (Minutes of the Joint Study meeting attached at **Annexure-II)**. During the Joint Study meeting, based on the study of various alternatives, a comprehensive transmission system was evolved for evacuation of power from KKNPP – 3 & 4 (2x1000 MW) and KKNPP – 5 & 6 (2x1000 MW) and members recommended the Transmission

System unanimously for further approval and implementation. The matter as discussed in the 16th SR CMETS wherein the following transmission system was agreed :

A. Transmission System requirement for evacuation of power from Kudankulam Unit - 3 & 4 (2x1000 MW)

- KKNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line (~120 km) **{Line & bays at Tuticorin-II GIS under ISTS scope and bays at KKNPP under NPCIL scope}**
- KKNPP 3&4 – Samugarangapuram (TN) 400kV (quad) D/c line (~30 km) **{Line & bays at Samugarangapuram (TN) under TANTRANSCO scope and bays at KKNPP 3&4 under NPCIL scope}**
- Shifting of one circuit of KKNPP 1&2 – Tirunelveli 400kV (quad) D/c line to KKNPP 3&4 to form KKNPP 3&4 – Tirunelveli 400kV (quad) S/c line **{NPCIL scope}**
- Interconnection between KKNPP 1&2 and KKNPP 3&4 generation switchyards through laying of 400kV overhead transmission line or cable and to be kept open under normal operating conditions **{NPCIL scope}**
- 2x125 MVAr (420kV) bus reactors at KKNPP - 3&4 **{NPCIL scope]**
- Upgradation of Tuticorin PS - Salem 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level with 1x330 MVAr switchable Line Reactor on both ends of each circuit **{ISTS scope}**
- Upgradation of Tuticorin PS to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors **{ISTS scope}**
- Upgradation of Dharmapuri (Salem New) to its rated voltage of 765kV level along with 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors **{ISTS scope}**
- Separate arrangement for auxiliary power supply at 230kV level one from KKNPP 1 & 2 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

B. Transmission System requirement for evacuation of power from Kudankulam Unit - 5 & 6 (2x1000 MW)

- Interconnection of KKNPP-3&4 and KKNPP-5&6 switchyards with 400kV quad D/c line **{NPCIL scope}**
- Shifting of KKNPP-3&4 – Tuticorin-II GIS 400kV (quad) D/c line to KKNPP-5&6 to form KKNPP-5&6 – Tuticorin-II GIS 400kV (quad) D/c line and with provision of SLR at terminating bays of KKNPP-5&6 **{NPCIL scope}**
- KKNPP-5&6 – Viruddanagar (TN) 400kV (quad) D/c line with 80 MVAR SLR in each circuit at KKNPP-5&6 (~170 km) **{Line along with reactor at KKNPP-5 & 6 and line bays at Viruddanagar under scope of TANTRANSCO and Line bays & bays for switchable Line Reactor at KKNPP-5&6 under NPCIL scope}**
- 3x125 MVAr (420kV) bus reactors at KNPP - 5&6 **{NPCIL scope}**
- Separate arrangement for auxiliary power supply at 230kV level one from KNPP-3 & 4 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

CTU informed that the transmission system for KNPP Unit - 3&4 and Unit - 5&6 has been identified under the scope of ISTS and TANTRANSCO. The transmission system under the scope of TANTRANSCO shall facilitate in drawl of its share allocation from Kudankulam Unit-3&4 and Unit-5&6 and shall relieve TANTRANSCO from payment of ISTS charges. The transmission system under the scope of ISTS shall facilitate in evacuation & transfer of power to other beneficiaries in Southern Region from Kudankulam Unit-3&4 and Unit-5&6 generation project.

It was also informed that KKNPP 3&4 – Samugarangapuram (TN) 400kV (quad) D/c line shall be implemented by TANTRANSCO in matching time frame of KKNPP-3 & 4 generation project and requested TANTRANSCO for coordination with NPCIL for timely implementation of the line. It was also informed that KKNPP-5&6 – Virudhunagar (TN) 400kV (quad) D/c line with 80 MVAR SLR in each circuit at KKNPP-5&6 shall be implemented by TANTRANSCO in matching time frame of KKNPP-5 & 6 generation project and same shall be associated with LTA system for KKNPP-5&6 after receipt of LTA application for KKNPP-5&6 generation project. Further, in case of delay in implementation of generation project / transmission line, applicable compensation shall be paid to TSP or TANTRANSCO / generation project developer as per applicable Regulations. **It was also agreed that TANTRANSCO shall implement the quad D/c lines with 45º / 85º design temperature of conductors to avoid any overloading in drawl of power from KKNPP-3&4 and KKNPP-5&6 generation projects.**

Accordingly, following was agreed for grant of Connectivity / LTA to the applications of M/s NPCIL:

a. Proposal for grant of LTA to M/s Nuclear Power Corporation of India Ltd. for 2000 MW (KKNPP-3&4) for LTA application no. 1200003911 with start date of LTA as 31.05.2025 for injection of power from Kudankulam – 3 & 4 in Tamil Nadu and Drawl as SR (target)

Transmission System for grant of LTA for Unit - 3 & 4 (2x1000 MW)

- KKNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line (~120 km) **{Line & bays at Tuticorin-II GIS under ISTS scope and bays at KKNPP under NPCIL scope}**
- KKNPP 3&4 – Samugarangapuram (TN) 400kV (quad) D/c line (~30 km) **{Line & bays at Samugarangapuram (TN) under TANTRANSCO scope and bays at KKNPP 3&4 under NPCIL scope}**
- Shifting of one circuit of KKNPP 1&2 – Tirunelveli 400kV (quad) D/c line to KKNPP 3&4 to form KKNPP 3&4 – Tirunelveli 400kV (quad) S/c line **{NPCIL scope}**
- Interconnection between KKNPP 1&2 and KKNPP 3&4 generation switchyards through laying of 400kV overhead transmission line or cable and to be kept open under normal operating conditions **{NPCIL scope}**
- 2x125 MVAr (420kV) bus reactors at KKNPP - 3&4 **{NPCIL scope]**
- Upgradation of Tuticorin PS - Salem 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level with 1x330 MVAr switchable Line Reactor on both ends of each circuit **{ISTS scope}**
- Upgradation of Tuticorin PS to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors **{ISTS scope}**
- Upgradation of Dharmapuri (Salem New) to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors **{ISTS scope}**
- Separate arrangement for auxiliary power supply at 230kV level one from KKNPP 1 & 2 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

b. Proposal for grant of connectivity to M/s Nuclear Power Corporation of India Ltd. for 2000 MW (KKNPP-5&6) for connectivity application no. 0052300006 with start date of connectivity as 31.03.2025.

Transmission System for grant of connectivity to M/s NPCIL for Kudankulam Unit - 5 & 6 (2x1000 MW)

- Interconnection of KKNPP-3&4 and KKNPP-5&6 switchyards with 400kV quad D/c line **{NPCIL scope}**
- Shifting of KKNPP-3&4 – Tuticorin-II GIS 400kV (quad) D/c line to KKNPP-5&6 to form KKNPP-5&6 – Tuticorin-II GIS 400kV (quad) D/c line and with provision of SLR at terminating bays of KKNPP-5&6 **{NPCIL scope}**
- 3x125 MVAr (420kV) bus reactors at KNPP - 5&6 **{NPCIL scope}**
- Separate arrangement for auxiliary power supply at 230kV level one from KNPP-5 & 6 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

Subsequently, NPCIL opted for transition of connectivity/under process LTA of 2000 MW from KNPP U-3&4 under the GNA Regulations. Same was discussed in the 22nd CMETS-SR held on 25.08.2023 wherein it was agreed to grant connectivity/GNA to NPCIL under the GNA Regulations with the following transmission system :

Grant of Connectivity under GNA Regulations for KKNPP U-3 :

Connectivity Transmission system under GNA for KNPP Unit-3:

I. **Dedicated Connectivity Tr. System**

- Interconnection between KKNPP 1&2 and KKNPP 3&4 generation switchyards through laying of 400kV overhead transmission line or cable and to be kept open under normal operating conditions **{NPCIL scope}**
- Shifting of one circuit of KKNPP 1&2 – Tirunelveli 400kV (quad) D/c line to KKNPP 3&4 to form KKNPP 3&4 – Tirunelveli 400kV (quad) S/c line **{NPCIL scope}**
- 2x125 MVAr (420kV) bus reactors at KKNPP - 3&4 **{NPCIL scope}**
- Separate arrangement for auxiliary power supply at 230kV level one from KKNPP 1 & 2 and other from independent source of TANTRANSCO substation **{NPCIL scope}**

II. **Associated Transmission System for GNA:**

Under ISTS

- KKNPP 3&4 – Tuticorin-II GIS PS 400kV (quad) D/c line (~120 km) **{Line along with bays at Tuticorin-II GIS under ISTS scope and bays at KKNPP under NPCIL scope}**

Under STU

- KKNPP 3&4 – Samugarangapuram (TN) 400kV (quad) D/c line (~30 km) **{Line along with bays at Samugarangapuram (TN) under TANTRANSCO scope and bays at KKNPP 3&4 under NPCIL scope}**

III. **Common Transmission system required for effectiveness of connectivity/GNA (System strengthening without ATS)**:

- Upgradation of Tuticorin PS - Salem 765kV D/c line (presently charged at 400kV level) at its rated 765kV voltage level with 1x330 MVAr switchable Line Reactor on both ends of each circuit {ISTS scope}

- Upgradation of Tuticorin PS to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors {ISTS scope}
- Upgradation of Dharmapuri (Salem New) to its rated voltage of 765kV level alongwith 3x1500 MVA, 765/400kV ICTs and 2x330 MVAr, 765kV bus reactors {ISTS scope}
- ISTS Network Expansion scheme in Western Region & Southern Region for export of surplus power during high RE scenario in Southern Region as per **Annexure-II**.

Start date of Connectivity: 31.12.2026 with the availability of ATS and common transmission system required for effectiveness of GNA.

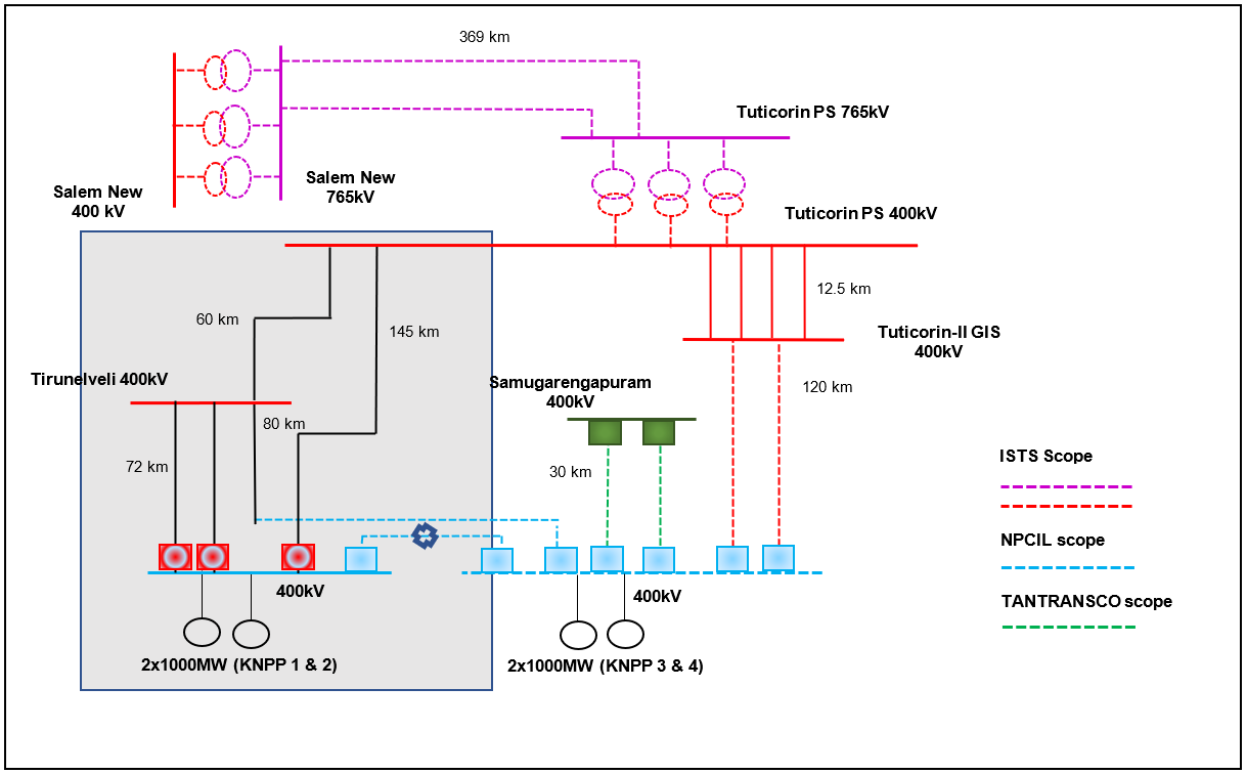
Grant of Connectivity under GNA Regulations for KKNPP U-4 :

- **Connectivity Transmission system under GNA for KNPP Unit-4:**

  Connectivity Transmission system under GNA is same as mentioned for KNPP Unit-3

Start date of Connectivity : 31.08.2027 with the availability of ATS and common transmission system required for effectiveness of GNA.

Transmission system for evacuation of power from KNPP-3&4



(b) Augmentation of transformation capacity by 1x500 MVA, 400/ 220-230 kV ICT at Tuticorin-II PS to meet N-1 reliability of RE Polling Station

Manual on Transmission Planning Criteria 2023, effective from 01.04.2023, provides that N-1 reliability criteria may be considered for ICTs at the ISTS/ STU pooling stations for renewable energy based generation of more than 1000 MW after capacity factor of

renewable generating station. However, same provision was not available under *Manual on Transmission Planning Criteria 2013*.

Tuticorin-II PS was planned as part of Green Energy Corridor with 2x500 MVA, 400/230 kV transformation capacity. Subsequently, 1x500 MVA, 400/230 kV ICT (3rd) has been implemented & under operation and 2x500 MVA, 400/230 kV ICTs (4th and 5th) are under implementation and expected by August/ September 2023.

Presently, RE developers have already granted Connectivity for 2220.1 MW and LTA for 2170 MW at Tuticorin-II PS. Further, LTA corresponding to 1330 MW has already been operationalized and balance 840 MW shall be operationalized with commissioning of 4th and 5th ICTs. To meet the N-1 reliability criteria, 1x500 MVA, 400/230 kV ICT (6th) is required. In view of above, augmentation of 1x500 MVA, 400/230 kV ICT (6th) at Tuticorin-II PS was proposed in the 20th CMETS. As Southern Region constituents had varied views on the scheme, the augmentation of transformation capacity by 1x500 MVA, 400/230 kV ICT (6th) at Tuticorin-II PS for meeting N-1 criteria as per CEA's revised Planning Criteria may be submitted to next higher forum for consideration along with the views of Southern Region constituents.

(c) Augmentation of 1x500 MVA(3rd), 400/220 kV transformation capacity at Hassan S/s

POWERGRID, vide letter dated 31.07.2023, has mentioned that Hassan S/s is installed with 2x315 MVA, 400/220 kV transformation capacity. These ICTs are loaded most of the time near to full load capacity and not complying to N-1 contingency criteria. Loading pattern provided by POWERGRID for the CY 2022 and 2023 (till 31.07.2023) is attached at **Annexure-1**. Further, POWERGRID informed that space is available for augmentation of transformation capacity at Hassan S/s.

From the loading pattern it is observed that in the CY 2023, 2x315MVA ICTs are continuously loaded above 80% of the rating for sufficient duration of time. SRLDC in its Q4 (2022-23) and Q1 (2023-24) reports has also mentioned that about 50% of times during peak demand period, ICTs at Hassan are not complying to N-1 criteria. The respective ICT loading graphs indicated in the SRLDC reports for Q4 (2022-23) and Q1 (2023-24) are given below. The matter was also discussed in the 204th OCC meeting, held on 11.07.2023, wherein it was concluded that POWERGRID may submit the request for augmentation of ICT at Hassan so that same may be deliberated in CMETS meeting. In view of above, augmentation of transformation capacity by 1x500 MVA (3rd), 400/220 kV at Hassan S/s was proposed in the 20th CMETS wherein same was agreed.

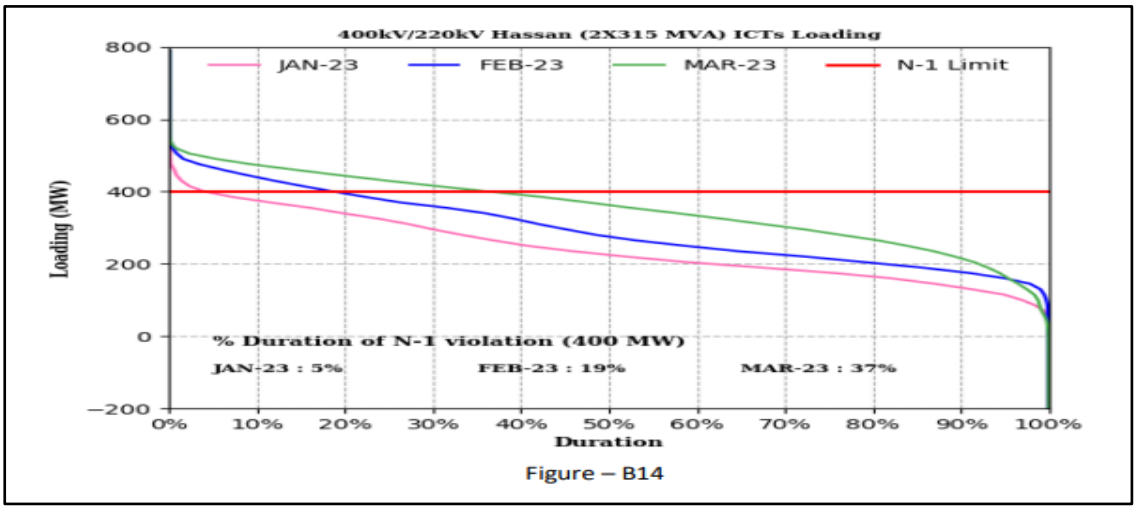


Figure – B14

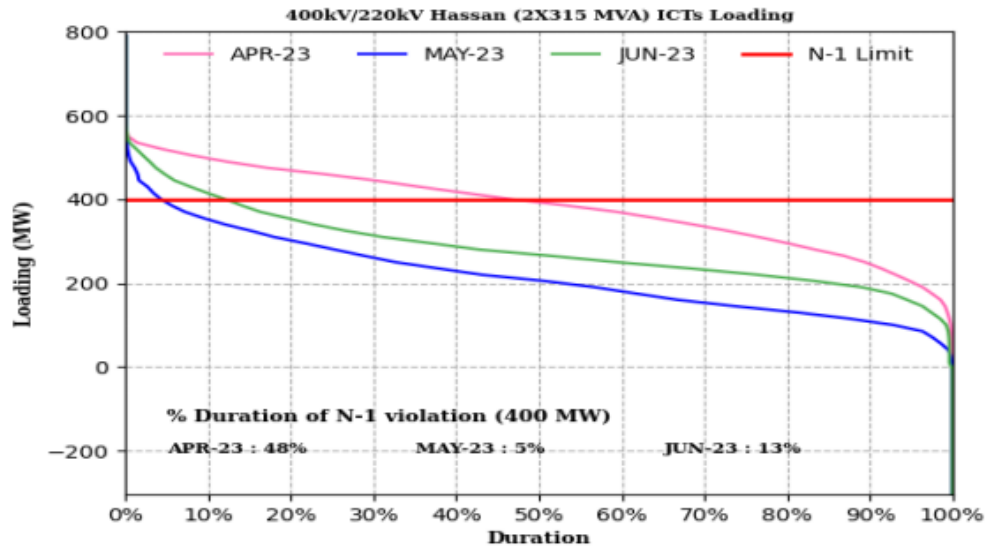


Figure – B12

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. Planned/ Under implementation Transmission system that are expected to be commissioned in 2028-29 timeframe are considered for conducting these studies. Further, Govt. of India has set a target of 500 GW generation capacity from non-fossil fuel resources by 2030. In this direction to achieve the target of Govt. of India, MNRE has identified additional 181.5 GW RE potential in the States of Andhra Pradesh, Telangana, Karnataka, Rajasthan, Madhya Pradesh and Tamil Nadu (Offshore). Out of the identified 181.5 GW Potential, 86 GW RE Potential is identified in the State of Andhra Pradesh (51 GW), Telangana (13 GW), Karnataka (17 GW) and Tamil Nadu (5 GW: Offshore) in Southern Region. The transmission system for integration of 181.5 GW RE Potential has been identified by CEA and a report on Transmission System for Integration of over 500 GW RE Capacity has been published by CEA on 07.12.2022. In the report, implementation of transmission system has been phased out in 3 parts; Phase-I by March 2025, Phase-II by December 2027 and Phase-III by December 2030. Therefore, complete phase-I & phase-II potential and associated transmission system has also been considered in the PSSE files prepared for Rolling Plan of 2027-28 timeframe. Off Shore wind potential in Tamil Nadu has not been considered in the files.

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

6.5.1 Power Flow Analysis

a) Transmission Lines

In the base case file prepared for 2028-29 timeframe, 3 nos. of 765kV and 11 nos. of 400 kV lines are having loading more than 70% of the thermal limit of the line. Scenarios where loading is more than 70% of rating and maximum loading obtained on these transmission lines in the simulation studies are tabulated below at **Table 6-7**.

Table 6-7: Transmission Lines Loading in the Base Cases

(All Fig in MVA)

Sl. No.	Name of the Line	Scenario No.	Owner	Maximum Loading	Rating
1.	Cuddapah-II – Cuddapah 765kV D/c line	4	ISTS	2563	3500
2.	Kurnool-III – Maheshwaram 765kV D/c line	1 & 4	ISTS	3164	3500
3.	Nizamabad-II – Nizamabad 765kV D/c line	1 & 4	ISTS	2691	3500
4.	Anantpur - Cuddapah 400kV D/c line	1, 4, 7	ISTS	1827	2186 (Quad Moose)
5.	Maheshwaram - Hyderabad 400kV S/c line	1, 2, 3, 4, 5, 6, 7	ISTS	1658	850 (Twin Moose)
6.	Cuddapah – Chittoor 400kV S/c line	1, 4, 7	ISTS & STU (AP)	805	850 (Twin Moose)
7.	Cuddapah – N Sagar 400kV D/c line	1 & 4	ISTS	776	850 (Twin Moose)
8.	Malekottiyar – Thiruvalam 400kV D/c line	7	ISTS	672	850 (Twin Moose)
9.	SP Budur – SV Chatram 400kV S/c line	2	ISTS	681	850 (Twin Moose)
10.	Kurnool – Srisailam LB 400kV S/c line	4, 7	APTRANSCO	1257	850 (Twin Moose)
11.	VTPS-IV – Vijaywada PG 400kV S/c line	4 & 7	APTRANSCO	737	850 (Twin Moose)
12.	Somanhally – Bidadi 400kV D/c line	7	KPTCL	686	850 (Twin Moose)
13.	Gooty-Neelmangala 400 kV D/c line	7	ISTS	804	850 (Twin Moose)
14.	Edyarpalayam-Coimbatore 400 kV D/c line	7	TANTRANSCO	669	850 (Twin Moose

b) Transformers

In the base case file prepared for 2028-29 timeframe, transformers at 5 nos. of 765/400 kV substations and 9 nos. of 400/220kV substations are having loading more than 70% of the ICT rating. Scenarios where loading is more than 80% of rating and maximum loading hit by these transformers in the simulation studies are tabulated below at Table 6-8.

Table 6-8: Transformers Loading in the Base Cases

(Max Loading in MVA)

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Loading	Rating (MVA)
1.	765/400kV, 6x1500 MVA Kurnool-III ICTs	1 & 4	ISTS	1354	1500

Sl. No.	Name of the Element	Scenario No.	Owner	Maximum Loading	Rating (MVA)
2.	765/400kV, 3x1500 MVA Maheshwaram ICTs	1, 4, 7	ISTS	1291	1500
3.	765/400kV, 4x1500 MVA Nizamabad ICTs	7	ISTS	1237	1500
4.	765/400kV, 2x1500 MVA Ariyalur ICTs	7	TANTRANSCO	1441	1500
5.	765/400kV, 2x1500 MVA Coimbatore ICTs	7	TANTRANSCO	1238	1500
6.	400/220kV, 2x315 MVA Cuddapah ICTs	4	ISTS	268	315
7.	400/220kV, 1x500 MVA Cuddapah ICT	4	ISTS	425	500
8.	400/220kV, 2x500 MVA Narendra ICT	7	ISTS	480	500
9.	400/220kV, 2x315 MVA Davangere ICTs	7	KPTCL	324	315
10.	400/220kV, 3x315 MVA N Sagar ICTs	4	ISTS	262	315
11.	400/230kV, 2x250 MVA Neyveli TS-II ICTs	8	NLC	229	250
12.	400/230kV, 2x500 MVA NNTPS ICTs	7,8	NLC	496	500
13.	400/220kV, 2x315 MVA Trichy ICTs	8	ISTS	257	315
14.	400/220kV, 1x500 MVA Trichy ICTs	8	ISTS	407	500

6.5.2 Contingency Analysis

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

a) Transmission Lines

ISTS lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below at **Table 6-10.**

Table 6-9: ISTS Transmission lines not meeting N-1 Criteria in SR

(All Fig in MW)

Sl. .	Name of the Line	Contingency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Cuddapah-II – Cuddapah 765kV D/c line	Cuddapah-II – Cuddapah 765kV one ckt	1, 4, 7	ISTS	2564	4353	3500 (Hexa Zebra)	131
Remark: Power from Cuddapah II & Anantpur 2 is getting pooled at Cudddapah and causing overloading of Cuddapah – Cuddapah 2 765kV D/c line.								
2.	Koppal-II-Narendra 765kV D/c line	Koppal-II-Narendra 765kV one ckt	4 & 8	ISTS	2000	3430	3500 (Hexa Zebra)	93
Remark: This is being observed in Sc-4 & 8 wherein wind dispatch is 75% and BESS is also in discharging mode.								

3.	Maheshwaram – Warangal 765kV D/c line	Maheshwaram – Warangal 765kV one ckt	1 & 4	ISTS	2400	**3248**	3500 (Hexa Zebra)	**95**
Remark: Major portion of RE power from Kurnool area is getting pooled at 765kV Maheshwaram and causing over loading of Maheshwaram – Warangal 765kV D/c line.								
4.	Nizamabad – Nizamabad-II 765kV D/c line	Nizamabad – Nizamabad-II 765kV one ckt	1,2,4,5,7	ISTS	2690	**5012**	3500 (Hexa Zebra)	**147**
Remark: Only one Nizamabad – Nizamabad-II 765kV D/c line was considered, 2nd D/c may be taken up based on the materialization of RE generation in Telangana(part of 181.5 GW).								
5.	Kurnool III – Maheshwaram 765kV D/c line	Kurnool III – Maheshwaram 765kV one ckt	1 & 4	ISTS	3192	**4276**	3500 (Hexa Zebra)	**117**
Remark: Integration of 4.5 GW additional potential (part of 181.5 GW) at Kurnool-III is causing overloading of Kurnool – Kurnool-III 765kV D/c line and Kurnool-III – Maheshwaram 765kV D/c line.								
6.	Maheshwaram – Bidar 765kV D/c line	Maheshwaram – Bidar 765kV one ckt	1,4	ISTS	2170	**3388**	3500 (Hexa Zebra)	**101**
Remark: Some part of 4 GW potential at Kurnool-IV (part of 181.5 GW) is pushing towards Bidar and causing overloading of Maheshwaram – Bidar 765kV D/c line.								
7.	Anantpur - Cuddapah 400kV (Quad) D/c line	Cuddapah – Anantpur 400kV (Quad) one ckt	1, 4, 7	ISTS	1980	**2650**	2186 (Quad Moose)	**103**
Remark: Major portion RE power at Anantpur (7 GW) is getting evacuated through Anantpur - Cuddapah 400kV D/c line and causing overloading of the line.								
8.	Koppal PS-II – Davangere 400kV D/c line	Koppal PS-II – Davangere 400kV one ckt	1,2,3,4,5, 6	ISTS	1117	**2233**	2186 (Quad Moose)	**144**
Remark: This is being observed in Sc-2 wherein wind dispatch is 75% and BESS is also in discharging mode.								
9.	Pugalur New – Karur 400kV D/c line	Pugalur New – Karur 400kV one ckt	1, 2, 5	ISTS	1300	**2230**	2186 (Quad Moose)	**102**
Remark: In high RE scenario wherein Southern Region is exporting power to NEW Grid and Raigarh – Pugalur HVDC is considered in reverse mode, more power rush towards Karur. This causes overloading of Pugalur New – Karur 400kV D/c line.								
10.	Gadag-II – Koppal-II 400kV D/c line	Gadag-II – Koppal-II 400kV one ckt	2 & 5	ISTS	1127	**2230**	2186 (Quad Moose)	**109**
Remark: This is being observed in Sc-2 wherein wind dispatch is 75% and BESS is also in discharging mode.								
11.	Nizamabad – Dichipally 400kV D/c line	Nizamabad – Dichipally 400kV one ckt	7	ISTS	1172	**2384**	2186 (Quad Moose)	**107**
Remark: Some portion of RE power getting pooled at 765kV Nizamabad is going down at 400kV and major power from 400kV Nizamabad getting evacuated through Dichipally line.								
12.	Somanhally – Bidadi 400kV D/c line	Somanhally – Bidadi 400kV one ckt	7	ISTS	582	**980**	850 (Twin Moose	**123**
Remark: During peak RE scenario of Karnataka, high loading is observed on Somanhally – Bidadi D/c for some time. Line does not comply N-1 criteria during this time.								
13.	Thiruvalam – Malekottiyar 400kV D/c line	Thiruvalam – Malekottiyar 400kV one ckt	7	ISTS	685	**915**	850 (Twin Moose	**108**

Remark: During Low thermal generation (VTPS, North Chennai) in Chennai area, loads at Malekottiyar is being met through this line & is causing overloading of line. Suitable strengthening would be planned based on the operational feedback.

In the rolling plan PSSE files of 2028-29 timeframe, entire Phase-I & Phase-II potential of additional 181.5 GW RE capacity by 2030 has been considered. Overloading of transmission lines and ICTs are observed at locations where this potential is getting pooled. The main cause of overloading of transmission lines is mentioned in the remark below the lines. However, these loadings of transmission lines may significantly differ in case of deferment in materialization of RE generations in SR grid. Therefore, measures to control overloading of the transmission system part of 181.5 GW RE potential would be planned based on materialization of the RE potential.

Further, STU lines loaded beyond 90% of thermal rating under N-1 contingency are summarized below at **Table 6-11.**

Table 6-10: STU Transmission lines not meeting N-1 Criteria in SR

(All Fig in MW)

Sl. No.	Name of the Line	Contigency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Vijaywada AP – Thalayapalem 400kV D/c line	Vijaywada AP – Thalayapalem 400kV one ckt	1 & 4	APTRANSCO	530	**964**	850 (Twin Moose)	**106**
2.	Hoody – Devanhally 400kV D/c line	Hoody – Devanhally 400kV one ckt	7	KPTCL	627	1090	850 (Twin Moose)	**136**
3.	Edyarpalayam – Coimbatore 400 kV D/c line	Edyarpalayam – Coimbatore 400 kV one ckt	7	TANTRANSCO	657	909	857	**107**

b) Transformers

ISTS ICTs loaded beyond 90% of MVA rating under N-1 contingency are summarized below at **Table** 6-12.

Table 6-11: ISTS ICTs not meeting N-1 Criteria in SR

(All Fig in MVA)

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
1.	765/400kV, 3x1500 MVA Maheshwaram ICTs	1, 4, 7	PGCIL	1297	1682	112	1500
2.	765/400kV, 6x1500 MVA Kurnool-III ICTs	1&4	PGCIL	1384	1643	110	1500
3.	765/400kV, 2x1500 MVA C Peta ICTs	4	PGCIL	988	1499	100	1500

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
1.	765/400kV, 3x1500 MVA Maheshwaram ICTs	1, 4, 7	PGCIL	1297	1682	112	1500
4.	765/400kV, 4x1500 MVA Nizamabad ICTs	7	PGCIL	1253	1567	105	1500
5.	765/400kV, 2x1500 MVA Warangal ICTs	7	PGCIL	913	1437	96	1500
6.	400/220kV, 2x315 + 1X500 MVA MVA Cuddapah ICTs	1, 4	PGCIL	271	372	118	315
7.	400/230kV, 2X500 MVA NNTPS ICTs	2,5,7, 8	NLC	502	694	139	500
8.	400/220kV, 3x315 MVA N Sagar ICTs	4	PGCIL	268	925	103	315
9.	400/230kV, 2x315 MVA Trichy ICTs	2,7,8	PGCIL	266	378	120	315
10.	400/230kV, 2x250 MVA Neyveli TS ICTs	2,8	NLC	235	274	110	250
11.	400/220kV, 2x500 MVA Kudgi ICTs	7	NTPC	377	563	113	500
12.	400/220kV, 2x315 MVA +1x500 MVA Hiriyur ICTs	4	PGCIL	198	289	92	315
13.	400/220kV, 2x500 MVA Narendra ICTs	1,4,7	PGCIL	497	754	151	500
14.	400/220kV, 2x500 MVA Bidadi ICTs	7	PGCIL	358	510	102	500
15.	400/220kV, 2x500 MVA Yelahanka ICTs	7	PGCIL	421	583	117	500
16.	400/220kV, 3x315 MVA Trivandrum ICTs	4, 7, 8	PGCIL	235	320	102	315
17.	400/220kV, 2x315 + 1x500 MVA Pugalur ICTs	8	PGCIL	251	351	111	315

Requirement of additional transformation augmentation wherever necessary would be planned subsequently in coordination with respective STUs.

STU ICTs loaded beyond 90% of MVA rating under N-1 contingency are summarized below at **Table 6-13.**

Table 6-12: STU ICTs not meeting N-1 Criteria in SR

(All Fig in MVA)

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
1.	765/400kV, 2x1500 MVA Ariyalur ICTs	2, 7	TANTRANSCO	1469	2269	152	1500
2.	765/400kV, 2x1500 MVA Coimbatore ICTs	7	TANTRANSCO	1253	1994	133	1500

3.	400/220kV, 2x315 MVA Kottayam ICTs	4,7,8	KSEB	242	329	104	315
4.	400/220kV, 2X500 MVA Jagalur ICTs	4	KPTCL	321	491	98	500
5.	400/220kV, 3x500 MVA Maheshwaram TS ICTs	1, 4 ,7	TSTRANSCO	399	505	101	500
6.	400/230kV, 2X315 MVA Kamuthi ICTs	1, 4, 7	TANTRANSCO	199	398	126	315
7.	400/220kV, 2X315 MVA Kanarpatty ICTs	1 & 4	TANTRANSCO	164	329	104	315
8.	400/110kV, 3X200 MVA Kanarpatty ICTs	1 & 4	TANTRANSCO	187	244	122	200
9.	400/110kV, 2X200 MVA Thenampatty ICTs	1, 4, 7	TANTRANSCO	164	321	161	200
10.	400/110kV, 2X200MVA Cuddalore ICTs	All	TANTRANSCO	274	416	208	200
11.	400/110kV, 2X200 MVA Velalavidu ICTs	3, 4, 5, 6, 7, 8	TANTRANSCO	244	354	177	200
12.	400/110kV, 2X200 MVA Kamuthi ICTs	1, 4, 7	TANTRANSCO	196	327	164	200
13.	400/110kV, 2X200 MVA Arni ICTs	All	TANTRANSCO	280	367	183	200
14.	400/110kV, 2X200 MVA Palavadi ICTs	2, 4, 5, 7, 8	TANTRANSCO	228	342	171	200
15.	400/230kV, 2X315 MVA Palavadi ICTs	8	TANTRANSCO	236	315	100	200
16.	400/110kV, 2X200 MVA Kayathar ICTs	1, 2, 3, 4, 5, 6	TANTRANSCO	156	266	133	200
17.	400/110kV, 3X200MVA Salem ICTs	1, 2, 5, 7, 8	TANTRANSCO	231	287	144	200
18.	400/110kV, 2X200 MVA Alagarkoil ICTs	2, 5, 7, 8	TANTRANSCO	209	294	147	200
19.	400/110kV, 3X100 MVA Rasipalayam ICTs	3, 5, 6	TANTRANSCO	85	114	114	100
20.	400/110kV, 3X200 MVA Shollingur ICTs	2,7,8	TANTRANSCO	182	240	120	100
21.	400/110kV, 2X200 MVA Edayarpalayam ICTs	7 & 8	TANTRANSCO	244	290	145	200
22.	400/230kV, 2X315 MVA Parali ICTs	7	TANTRANSCO	231	297	95	315

23.	400/110kV, 2x200 MVA S P Badur ICTs	7	TANTRANSCO	154	211	105	200
24.	400/220kV, 2x315 MVA Kethireddypalli TS ICTs	7	TSTRANSCO	230	292	93	315
25.	400/220kV, 2x315 MVA Davangere ICTs	7	KPTCL	329	418	132	315
26.	400/220kV, 3x500 MVA Hoody ICTs	7	KPTCL	432	564	113	500
27.	400/220kV, 2x500 MVA Gulberga ICTs	8	KPTCL	277	454	91	500
28.	400/220kV, 3x500 MVA Davanhalli ICTs	7	KPTCL	423	574	115	500

From above, it is observed that one ICT in Kerala, 2 nos. of ICT in Telangana, 5 nos. of ICT in Karnataka and 20 nos. of ICT in Tamil Nadu are not complying N-1 criteria in 2028-29 timeframe. Some of them are violating the limits in present timeframe also and are continuously flagged by GRID INDIA in their Operational Feedback. Therefore, STUs are required to take immediate measures to mitigate this issue of high transformer loading.

6.5.3 Short Circuit Analysis

Short circuit level was calculated for all 765 and 400 kV buses of Southern Region and buses having fault level more than the design rating under any scenario were identified. From analysis, it is emerged that 3 nos. of 765kV substations and 6 nos of 400kV substations in SR are having fault level more than designed capacity.

Details of the ISTS buses exceeding design fault level under any scenario are tabulated below at **Table 6-14.**

Table 6-13: ISTS Buses Exceeding Designed Fault Level in SR

(All Fig in kA)

Sl. No.	Substation Name	Owner	Scenario No.	Highest Fault level	Design Rating
1.	765kV Kurnool	ISTS	All	53	40
2.	765kV Cuddapah	ISTS	6, 7, 9	43	40
3.	765kV Nizamabad	ISTS	3,5,6,7,8,9	44	40
4.	765kV Maheshwaram	ISTS	All	51	40
5.	400kV Kurnool New	ISTS	All	55	50
6.	400kV Narendra New	ISTS	7,8,9	55	54
7.	400kV Tirunelveli	ISTS	All	54	40
8.	400kV Udumalpet	ISTS	All	51	40
9.	400kV Pugalur	ISTS	8, 9	43	40

From the above, it can be seen that 765kV Kurnool, 765kV Cuddapah, 765kV Nizamabad, 765kV Maheshwaram, 400kV Pugalur, 400kV Kurnool New, 400kV Tirunelveli and 400kV Udumalpet violates the design fault level. 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 meeting 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 6-15.**

Table 6-14: STU Buses Exceeding Designed Fault Level in SR

(All Fig in kA)

Sl. No.	Substation Name	Owner	Scenario No.	Highest Fault level	Designed Rating
1.	400kV Kurnool	AP	All	53	40
2.	400kV Vemagiri	AP	2, 3, 5, 6, 8, 9	46	40
3.	400kV Vijaywada	AP	2, 3, 5, 6, 8, 9	45	40
4.	400kV Dichipally	TSTRANSCO	All	51	40
5.	400kV Gajwel	TSTRANSCO	7	42	40
6.	400kV Neelmangala	KPTCL	6,7,9	43	40
7.	400kV Raichur	KPTCL	7, 8, 9	44	40

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 Aug'23

As on Aug'2023, total Installed Capacity (IC) of Eastern Region was about 34.96 GW and the peak demand met was about 29.3 GW. The state-wise breakup of installed capacity and peak demand is summarised at **Table 7-1** below.

Table 7-1: ER Installed Capacity and Peak Demand as on Aug'23

(All Fig in MW)

State	Generation (MW)								Peak Demand (MW)
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES* (MNRE)	Total		
Bihar	7397	-	7397	-	110	415	525	7922	7509
Jharkhand	2373	-	2373	-	191	140	331	2704	2077
West Bengal	8650	80	8730	-	1396	636	2032	10762	11626
DVC	3037	-	3037	-	186	-	186	3223	3420
Odisha	5020	-	5020	-	2163	640	2803	7823	6659
Sikkim	14	-	14	-	633	60	693	707	106
Central unallocated	1737	-	1737	-	85	-	85	1822	54
ER	**28229**	**80**	**28309**	**-**	**4764**	**1891**	**6655**	**34964**	**29299**

Source: CEA monthly report

7.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, Eastern Region demand for 2028-29 timeframe is expected to increase to about 42.5 GW. As per the inputs received from various stakeholders, total installed capacity

of Eastern Region for 2028-29 is expected to be about 67GW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 7-2.**

Table 7-2: ER Installed Capacity and Peak Demand (2028-29)

(All Fig in MW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS / PSS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Bihar	2040	0	2040	0	45	1115	1160	0	3200	12326
Jharkhand	2820	0	2820	0	130	140	270	0	3090	4297
West Bengal	7100	0	7100	0	574	636	1210	900	9210	14530
DVC	1380	0	1380	0	84	1415	1499	0	2879	4814
Odisha	2490	0	2490	0	2193	1043	3236	0	5726	8514
Sikkim	0	0	0	0	14	60	74	0	74	1201
Central	27430	0	27430	0	5735	0	5735	0	33165	-
IPP	4500	0	4500	0	5132	0	5132	0	9632	-
ER	**47760**	**0**	**47760**	**0**	**13907**	**4409**	**18316**	**900**	**66976**	**42546**

There is a growth in peak demand of Eastern Region from present time-frame (2023-24) to 2028-29 with a CAGR of 7.9%. The state wise peak demand growth is given at **Table 7-3**.

Table 7-3: Increase in Peak Demand of Various States of ER

(All Fig in MW)

State	2023-24	2028-29	Increase in demand	CAGR
Bihar	7509	12326	4817	10.4%
Jharkhand	2077	4297	2220	15.7%
West Bengal	11626	14530	2904	4.6%
DVC	3420	4814	1394	7.1%
Odisha	6659	8514	1855	5.0%
Sikkim	106	1201	95	13.7%
Andaman	54	70	16	5.3%
ER	**27218**	**42546**	**15328**	**9.3%**

From the above data it is observed that the CAGR growth of peak demand is maximum for Jharkhand (15.7%) and minimum for Odisha (5.0%). The CAGR of demand of ER is about 9.3% which is more than the National Average of 5.8%. In addition to above, bulk power demand has been considered at various upcoming green hydrogen/ green ammonia, bulk consumers/distribution licensees directly connected to ISTS in the following areas: Paradeep: 1500MW, Gopalpur: 3000MW, New Duburi: 1500MW, Vedanta: 180MW and Maithon:100MW.

The hydro generations of Bhutan (about 4500MW) and Nepal (3200MW) and demand of Bangladesh (1000MW) have been considered in 2028-29 timeframe as a part of Eastern Region for study purpose.

7.3 Load Generation Balance for 2028-29 timeframe

In the chapter 3, All India Load Generation Balance (LGB) for identified nine scenarios was prepared as per the methodology finalized in a meeting among CTU, CEA and Grid-India.

This section elaborates the Eastern Region Load Generation Balance (LGB) for 2028-29 time-frame. For Eastern Region also, three points on the daily load curve i.e. Solar max (afternoon), Peak load (evening) and Off-peak load (night) for three seasons viz. Monsoon (August), Summer (June) and Winter (February) have been considered.

Load generation balance has been prepared considering the generation despatch factors as mentioned at **Table 7-4** for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 7-4: Eastern Region Generation Dispatch and Demand Factors

Scenario No & Name	Generation Dispatch Factors			Demand Factors
	Hydro	Solar	Pump storage	
1-Aug Solar Max	70%	80%	-100%	93%
2-Aug Peak Load	90%	0%	60%	97%
3-Aug Night Off Peak	70%	0%	40%	74%
4-Jun Solar Max	70%	85%	-100%	84%
5-Jun Peak Load	90%	0%	50%	97%
6-Jun Night Off Peak	70%	0%	0%	74%
7-Feb Solar Max	30%	90%	-100%	73%
8-Feb Peak Load	60%	0%	100%	79%
9-Feb Night Off Peak	30%	0%	40%	57%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import / export of ER and the inter-regional flows though 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'27 Time Frame			Jun'27 Time Frame			Feb'28 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
ER-NR	-7431	-2289	-4844	-6988	-912	-2781	-5603	2270	-137
ER-WR	-13983	-8454	-10625	-13558	-9405	-8114	-8711	-40	-3061
ER-SR	-1563	-1025	-1817	-1393	-348	-3	523	-425	1732
ER-NER	-869	467	-701	-1348	-1214	-1265	46	-79	28
ER - Cross Border	-3034	-4150	-3028	-3043	-4184	-3039	-720	-2441	-1018
Eastern Region	-26880	-15451	-21015	-26330	-16063	-15202	-14465	-715	-2456

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-1 and Scenario-8 corresponds to two extreme cases of import requirement of Eastern Region i.e. Maximum import (26.88GW) and minimum import (715MW). In all other scenarios, the import of Eastern Region varies between these two extremes.

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

7.4 ISTS Network Expansion Schemes Evolved from Feb'23 to Jul'23

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of Eastern Region (CMETS-ER) from Feb'23 to Jul'23. The brief of all such transmission schemes are tabulated below in **Table 7-6:**

Table 7-6: Approved Transmission Schemes in this Rollnig Plan

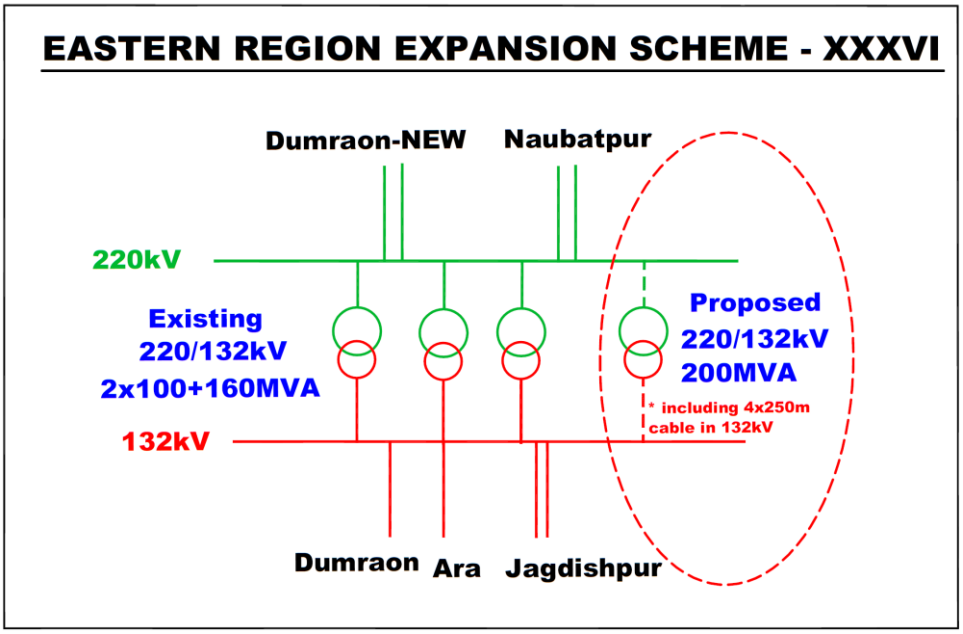
Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in ₹Cr.)
Bihar			
1.	Eastern Region Expansion Scheme-XXXVI (ERES-XXXVI) – Arrah ICT	Oct 24	27
2.	Eastern Region Expansion Scheme-XXXVII (ERES-XXXVII) – Lakhisarai ICT	May 25	121
West Bengal			
1.	Eastern Region Expansion Scheme-XL (ERES-XL) – Malda Line Reactor	Feb 25	32
2.	Eastern Region Expansion Scheme-41 (ERES-41) – Rajarhat ICT	2025-26	86
Jharkhand			
1.	Eastern Region Expansion Scheme-XXXVIII (ERES-XXXVIII) – Ranchi Bypass	2025-26	42
Odisha			
1.	Eastern Region Expansion Scheme-XXXIX (ERES-XXXIX) - Gopalpur	2025-26	2898
2.	Eastern Region Bay Scheme-I (ERBS-I) – Talcher-III	Sep 26	82
Sikkim			
1.	Eastern Region Expansion Scheme-XXXV (ERES-XXXV) – Rangpo Bypass	Dec 24	7
2.	Eastern Region Bay Scheme-II (ERBS-II) - Rammam	Jul 26	14

7.4.1 Bihar

(i) ERES-XXXVI - Arrah

Presently, 220/132kV Ara (POWERGRID) S/s is having the transformation capacity of 360MVA (2 x 100MVA + 1 x 160MVA). In 13th CMETS-ER, it was mentioned that the reliability criteria of 'N-1' is not being fulfilled at Ara S/s under outage of 1x160MVA ICT. Further, load demand is expected to increase in coming years. However, commissioning of Buxar TPS (2x660MW) and its connection to Buxar, Dumraon and

Ara areas, could relieve the Ara substation. BSPTCL had mentioned in the meeting that they would provide their views on requirement of augmentation of transformation capacity at Ara S/s.



Subsequently, upon the review of their load growth, BSPTCL vide letter dated 07-03-2023 informed that there would be requirement of augmentation of transformation capacity at Ara S/s even after commissioning of Buxar TPS.

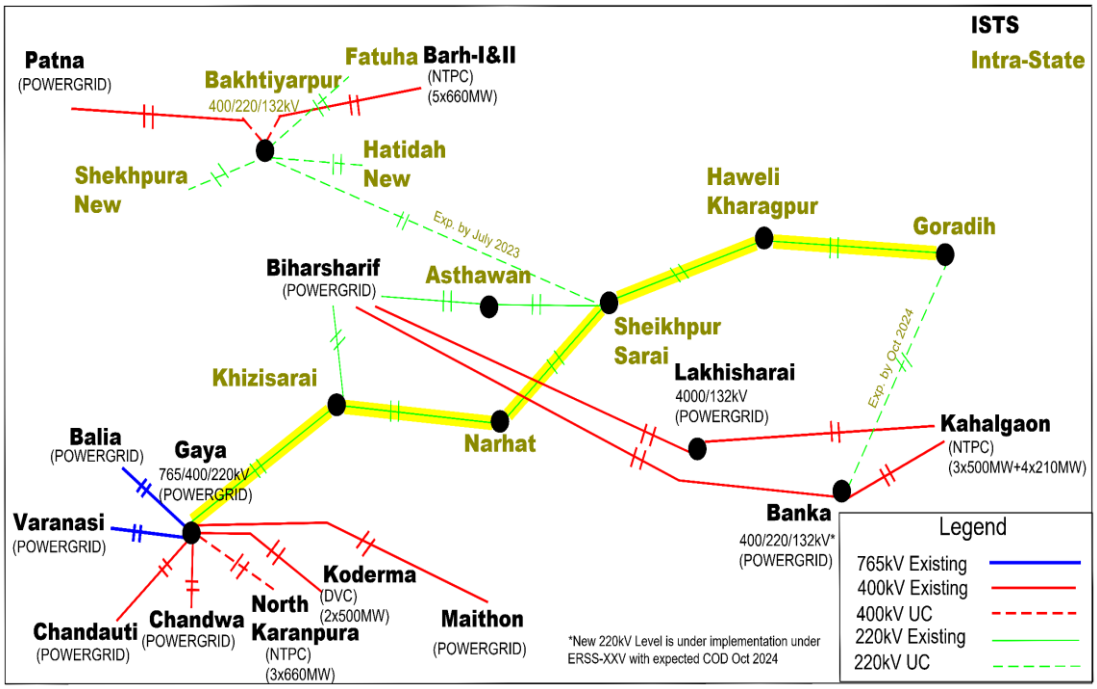
Thus, keeping in view the power drawl requirement by BSPTCL at Ara (POWERGRID) 220/132kV S/s in present time-frame and keeping in view future power drawl requirements, augmentation of transformation capacity at Ara S/s has been agreed in the 17th CMETS-ER held on 29-03-2023.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Installation of new 220/132kV, 1x200MVA (4th) ICT at Ara (POWERGRID) S/s with associated bays in AIS (220kV bay no. 203 & 132kV bay no. 6)	220/132kV, 1x200MVA ICT (4th) – 1 no. 220kV ICT bay – 1 no. 132kV ICT bay – 1 no.
2	Interconnection between 132kV side of 4th ICT and 132kV ICT bay (no. 6) through 1C, 1200sqmm XLPE Cu cable	1C, 1200sqmm XLPE Cu cable – 1 km (4 runs, each of 250m)

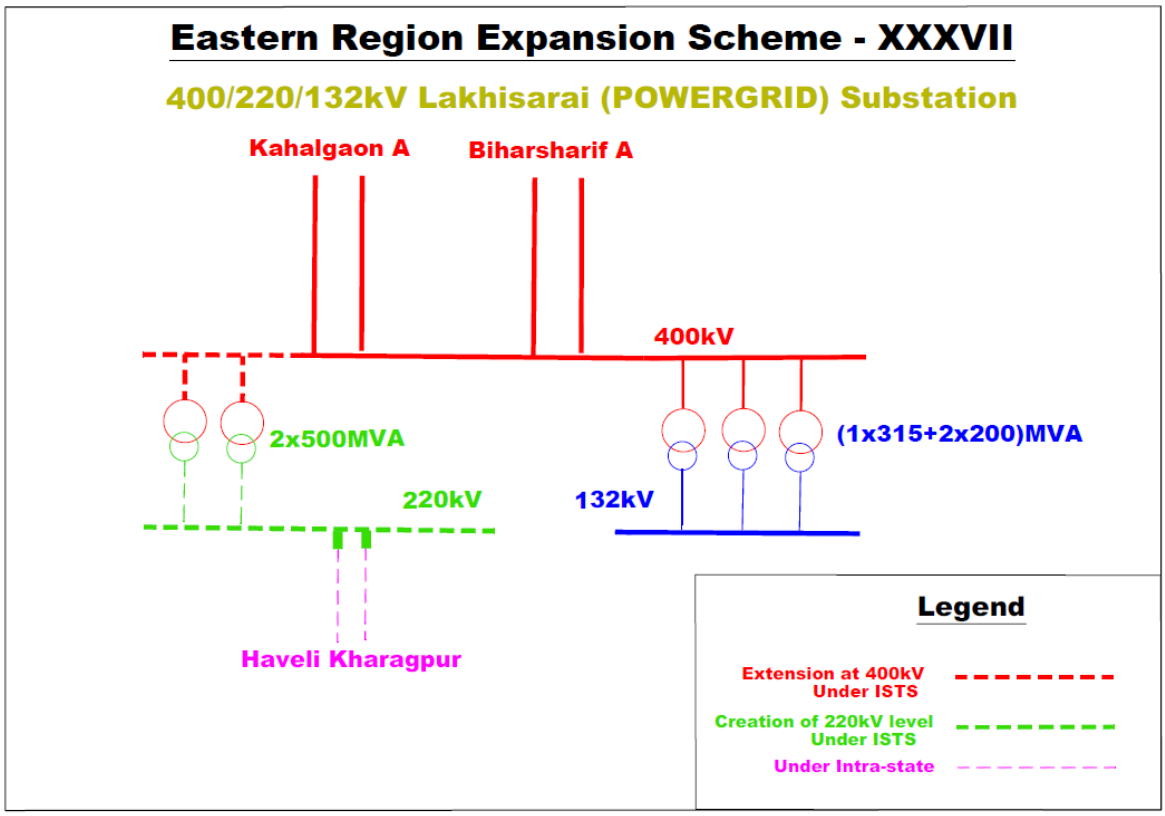
Implementation time-frame: 24 months from allocation

(ii) ERES-XXXVII - Lakhisarai

Presently, 400/132kV Lakhisarai (POWERGRID) S/s is having the transformation capacity of 715MVA (2 x 200MVA + 1 x 315MVA). About 750MW new solar projects are expected to come at Kajra, Pirpainti and surrounding areas, and is planned to be injected into intra-state network in the Gaya (POWERGRID) – Khizersarai (BSPTCL) – Narhat (BSPTCL) – Sheikhpur Sarai (BSPTCL) – Haveli Kharagpur (BSPTCL) – Goradih (BSPTCL) 220kV link (refer figure below).



Studies were carried out in consultation with BSPTCL officials for two different load-generation conditions in 2027-28 time-frame viz. Sc-2 (peak demand without solar) and Sc-7 (off-peak demand with all India high solar). It was observed that during peak load condition, power flow on 400/220kV ICTs at Banka and Lakhisarai is towards 220kV level, however, during peak solar generation, power flow would be towards 400kV level from 220kV level. It was observed in the studies that the power transfer requirement in 2027-28 time-frame with additional 750MW solar generation in the above mentioned 220kV link can be fulfilled with only 400/220kV ICTs at Banka. However, BSPTCL mentioned in the 17th CMETS-ER held on 29-03-2023 that in view of present and future power drawl requirement in this area and also to improve reliability & security of power supply through the Gaya (POWERGRID) – Khizersarai (BSPTCL) – Narhat (BSPTCL) – Sheikhpur Sarai (BSPTCL) – Haveli Kharagpur (BSPTCL) – Goradih (BSPTCL) 220kV link, it is essential to establish 220kV level at Lakhisarai 400/132kV S/s along with 220kV interconnection to Haveli Kharagpur. This would system also be required to meet high solar and non-solar power exchange requirement between ISTS and state network.



Thus, keeping in view the requirement of BSPTCL, creation of 220kV level along with installation of 2x500MVA, 400/220kV ICTs at existing Lakhisarai (POWERGRID) S/s was agreed in the 17th CMETS-ER held on 29-03-2023.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Creation of 220kV level in GIS (in Double Main Switching Scheme including 1 no. bus coupler bay) at Lakhisarai (POWERGRID) 400/132kV S/s along with 2 no. 220kV line bays *[for termination of Lakhisarai – Haveli Kharagpur 220kV D/c line to be implemented by BSPTCL under intra-state]*	220kV level in GIS 220kV GIS line bays – 2 no. 220kV bus coupler bay – 1 no.
2	Installation of 400/220kV, 2x500MVA ICTs along with associated bays at Lakhisarai (POWERGRID) 400/132kV S/s	400/220kV, 2x500MVA ICTs – 2 no. 400kV ICT bays – 2 no. 220kV ICT bays (in GIS) – 2 no.

Implementation time-frame: 24 months from allocation

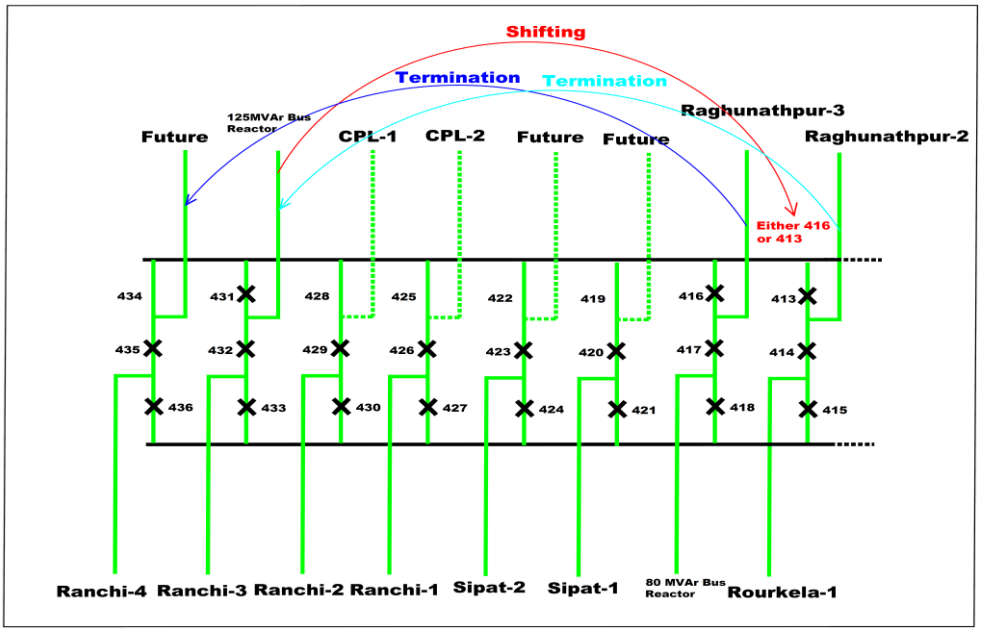
7.4.2 Jharkhand

(i) ERES-XXXVIII – Ranchi bypass

Fault level at 400kV bus at Ranchi (POWERGRID) 400/220kV S/s is about 44kA (designed limit is 40kA) in present timeframe which is expected to further increase to about 51kA by 2027-28 timeframe. After studies for 2027-28 timeframe and detailed analysis, it is observed that after bypassing Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line (of DVC) at Ranchi (POWERGRID) with any two ckts of Ranchi (POWERGRID) – Ranchi New (POWERGRID) 400kV 2xD/c (Quad) lines (of POWERGRID) so as to form Ranchi New (POWERGRID) – Raghunathpur (DVC) 400kV (Quad) D/c line, fault level can be brought down to about 39kA from 51kA. The matter was deliberated in the 17th CMETS-ER held on 29-03-2023 and bypassing of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c line at Ranchi (POWERGRID) S/s so as to form Ranchi New (POWERGRID) – Raghunathpur (DVC) 400kV (Quad) D/c line was agreed.

For implementation of this bypassing scheme from within the substation through switching arrangement following major works is required:

- The bus reactor installed in bay 431 needs to be shifted in bay 413 so that adjacent bays viz. 416 and 419 shall be available for termination of a D/c line in future, if required.
- Shifting of equipment of bay no. 416 *[released upon shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV ckt-3]* to bay no. 434 for completion/establishment of bay no. 434.
- Shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line to bays 431 and 434 in diameters 431-432-433 and 434-435-436: about 1.27km new line section



With the said works, the Ranchi New (POWERGRID) – Raghunathpur (DVC) 400kV (Quad) D/c line would be in same diameter with Ranchi – Ranchi (New) 400kV D/c (Quad) ckt-3 & ckt-4. The two lines can be bypassed from Ranchi S/s through tie circuit breakers of diameters 431-432-433 and 434-435-436. This arrangement shall give operational flexibility.

The matter was deliberated and agreed in the 19th CMETS-ER meeting held on 30th May 2023.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	#Shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line to bays 431 and 434 in diameters 431-432-433 and 434-435-436: about 1.27km new line section.	400kV D/c (Quad) line – 1.27 km
2	$Dismantling of 1355m section of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV D/c (Quad) line of DVC at Ranchi end from location 433 to 438 and scraping of the same.	-
3	Shifting of 420kV, 125MVAr bus reactor installed in bay no. 431 to bay no. 413 [vacated after shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV ckt-2].	-
4	Shifting of equipment of bay no. 416 [released upon shifting of Ranchi (POWERGRID) – Raghunathpur (DVC) 400kV ckt-3] to bay no. 434 for completion/establishment of bay no. 434.	
5	Installation of 420kV, 1x80MVAr switchable line reactor, one each in both circuits of Raghunathpur (DVC) – Ranchi-New (POWERGRID) 400kV D/c (Quad) line [formed after bypassing of Ranchi (POWERGRID) – Raghunathpur (DVC) and Ranchi (POWERGRID) – Ranchi-New (POWERGRID) ckt-3 & 4 of 400kV D/c (Quad) lines from Ranchi-New through tie circuit breaker in diameters 431-432-433 and 434-435-436] at Ranchi-New (POWERGRID) end along 400ohm NGR (including NGR bypass scheme).	420kV, 1x80MVAr switchable line reactor with 500ohm NGR (including NGR bypass scheme) – 2 no.

Implementation time-frame: 24 months from allocation

7.4.3 West Bengal

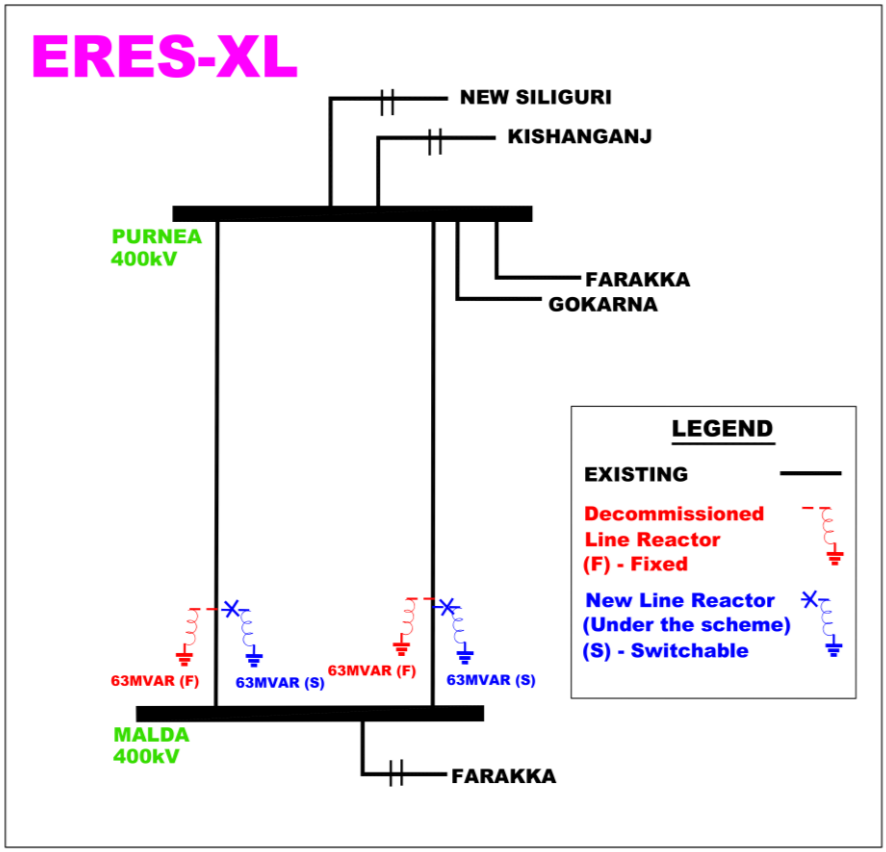
(i) <u>ERES-XL – Malda line reactor</u>

Malda 400/220/132kV and Purnea 400/220kV substations belong to POWERGRID.

The existing 420kV, 63MVAr line reactor (along with associated 542ohm NGR) in each circuit of Purnea – Malda 400kV D/c line at Malda (POWERGRID) end was commissioned in 1994 and after serving close to 30 years, it has been observed by

POWERGRID that any major maintenance at this juncture may not be fruitful enough to ensure a further longer service period considering cellulose ageing and fault history. POWERGRID informed that the said line reactors have already experienced designed electrical life and started to deteriorate, which requires replacement as individual component change would not resolve the issues. Further, spare/supports are also very difficult for such ageing reactor from OEM. Moreover, it was observed that presently there is no bus reactor at Malda S/s, and voltage profile at Malda S/s showed that the average bus voltage is around 406kV and the maximum voltage is 417kV, which is above the nominal voltage level.

After studies, it was observed that without the said line reactors, voltage rise (about 9-12kV) occurs at Malda as well as Purnea ends upon line charging. Accordingly, line reactor in the Malda – Purnea 400kV D/c line is technically required. Further, the new line reactor was planned to be installed as switchable (with NGR bypass arrangement) so that the same can be used as bus reactor also as per instructions of RLDC.



In view of the above, in the 19th CMETS-ER held on 30-05-2023, it was agreed that the existing line reactors viz. 1x63MVAr line reactor (along with associated 542ohm NGR) in each circuit may be decommissioned and new 1x63MVAr switchable line reactor [along with 450ohm NGR (including NGR bypassing scheme)] may be installed in each circuit of Purnea – Malda 400kV D/c line upon decommissioning of old line reactors.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Decommissioning of existing 1x63MVAr line reactor (along with associated 542ohm NGR) at Malda end installed in each circuit of Purnea – Malda 400kV D/c line, and installation of new 1x63MVAr switchable line reactor [along with 450 ohm NGR (including NGR bypassing scheme)] in each circuit of Purnea – Malda 400kV D/c line upon decommissioning of line reactors	1x63MVAr switchable line reactor [along with 450 ohm NGR (including NGR bypassing scheme)] – 2 no.

Implementation time-frame: 18 months from allocation

(ii) ERES-41 – Rajarhat

Rajarhat, 400/220kV, 2x500MVA S/s belong to POWERGRID.

Maximum drawl of about 850MW has been observed at Rajarhat S/s in last one year with N-1 being violated during most of the months (8/12 months), with about 18% time the loading being beyond 500MW. To resolve the N-1 contingency, 3rd 400/220kV, 1x500MVA ICT along with associated bays in GIS may be installed under ISTS at Rajarhat GIS (POWERGRID) S/s in 21 months (in view of GIS) from date of allocation. Due to GIS, it was mentioned that as the Rajarhat substation is GIS complete diameter with three CB (one and half scheme) needs to be implemented for installation of 3rd ICT.

Further, WBSETCL has already uprated some of its 220kV drawl lines at Rajarhat and some are also under implementation for enhanced drawl.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Installation of 400/220kV, 1x500MVA (3rd ICT) along with associated bays at Rajarhat GIS (POWERGRID) 400kV S/s	400/220kV, 1x500MVA ICTs – 1 no. 400kV ICT bays* – 1 no. 220kV ICT bays – 1 no.

Implementation time-frame: 21 months from allocation

Note: In view of GIS substation, complete diameter with three Circuit Breakers (one and half switching scheme) needs to be implemented at 400kV level for installation of 3rd ICT in one 400kV bay. Utilisation of other 400kV bay of the diameter shall be identified in future.

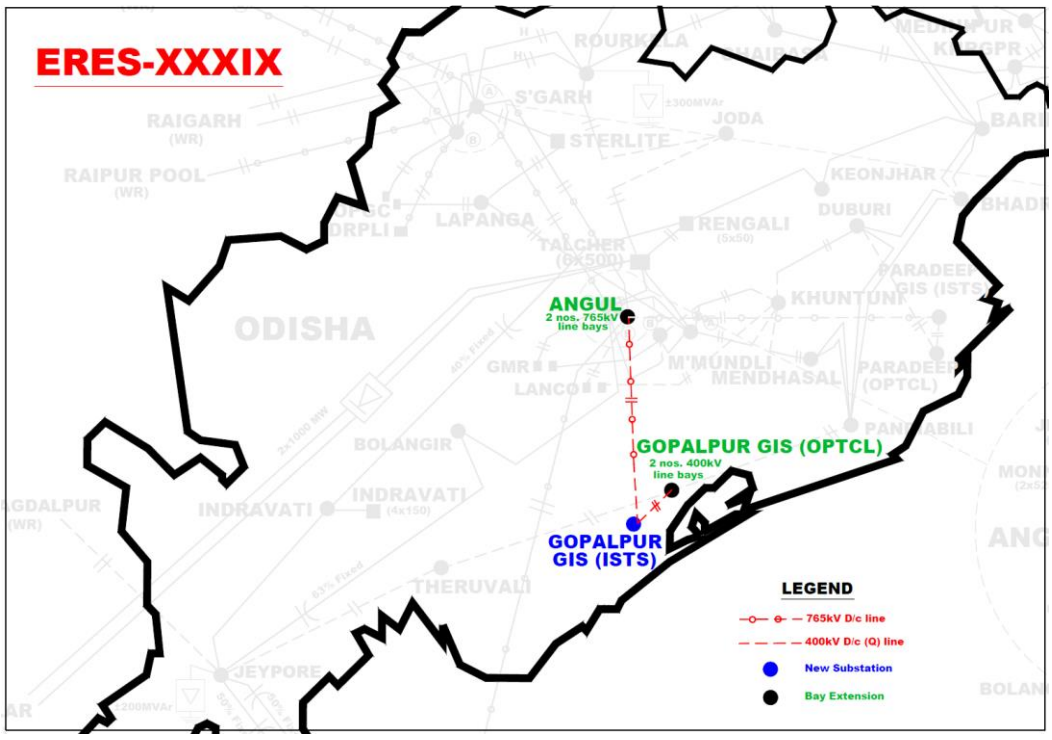
7.4.4 Odisha

(i) ERES-XXXIX - Gopalpur

Additional Chief Secretary to Government, Department of Energy, Govt. of Odisha vide letter dated 08-02-2023 addressed to Secretary (Power), Ministry of Power, Govt. of Odisha has proposed for construction of Gopalpur 765kV substation under ISTS. As per the said inputs, new industrial demand from Green Hydrogen & Green Ammonia industries in the range of about 3GW is expected in Gopalpur area starting from FY 2025-26 onwards. Gopalpur is emerging as Green Hydrogen hub and various industries have expressed investment intentions to set up Green Hydrogen and Green Ammonia plants in Gopalpur due its location advantage.

There is a requirement of ISTS corridor to supply RE power from outside Odisha to such industries, to meet the RPO. Thus, keeping in view critical nature of large industrial demand and quantum of power requirement it is essential that Gopalpur substation is feed reliably from ISTS, and with high capacity lines. The quantum of power requirement by some of the industries as informed by OPTCL are Avaada Ventures (700MW), and Ocior Energy (1400MW). In addition to above, additional industries by Renew Power, SMP Energy and WAREE Energy are also envisaged. Accordingly, it is proposed to establish a 765/400kV substation at Gopalpur under ISTS.

As Gopalpur is in coastal area and within 60km form coastline, Gopalpur (ISTS) S/s is planned to be implemented in GIS in line with the recommendation of Report of Task Force on Cyclone Resilient Robust Electricity Transmission and Distribution Infrastructure in coastal area published by CEA in May 2021 for construction of new substations upto 60km from the coastline.



The present scheme is for establishment of Gopalpur 765/400kV new substation along with Angul – Gopalpur 765kV D/c line & Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line, which has been approved in the 18th CMETS-ER held on 27th Apr 2023.

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
1.	Establishment of new 765/400kV, 2x1500MVA GIS substation at Gopalpur in Odisha **Additional space for future expansion**: - 765/400kV, 4x1500MVA ICTs (12x500MVA single phase units) along with associated ICT bays at both voltage levels - 400/220kV, 4x500MVA ICTs along with associated ICT bays at both voltage levels - 765kV, 2x330MVAr (6x110MVAr single phase units) bus reactor along with associated bays - 420kV, 2x125MVAr bus reactor along with associated bays - 8 nos. of 765kV line bays (along with space for switchable line reactor) for future lines - 10 nos. of 400kV line bays (along with space for switchable line reactor) for future lines - 12 nos. of 220kV line bays for future lines - 765kV bus sectionaliser bay: 1 set - 400kV bus sectionaliser bay: 1 set - 220kV bus sectionaliser bay :1 set - 220kV bus coupler bay: 2 no.	765/400kV, 1500MVA ICTs: 2 nos. (7x500MVA single phase units including one spare) 765kV ICT bays: 2 nos. 400kV ICT bays: 2 nos. 765kV, 330MVAr Bus reactor: 2 nos. (7x110MVAr single phase units including one spare unit for both bus and line reactors) 765kV Bus reactor bays: 2 nos. 420kV, 125MVAr Bus reactor: 2 nos. 400kV Bus reactor bays: 2 nos. 765kV line bays: 2 nos. *[for termination of Angul (POWERGRID) – Gopalpur 765kV D/c line along with 765kV, 1x330MVAr switchable line reactor at Gopalpur end in both circuits]* 400kV line bays: 2 nos. *[for termination of Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line]* 765kV, 330MVAr (3x110MVAr single phase units) switchable line reactor along with associated bay and 500ohm NGR (with NGR bypass arrangement) *[at Gopalpur end in both circuits of Angul (POWERGRID) – Gopalpur 765kV D/c line]*: 2 nos.
2.	Angul – Gopalpur 765kV D/c line	205km

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
3.	Extension at 765kV level at Angul (POWERGRID) S/s including bus extension in GIS	765kV AIS line bays (along with space for future switchable line reactor): 2 nos. *[for termination of Angul (POWERGRID) – Gopalpur 765kV D/c line]* Bus extension in GIS: about 3000m
4.	Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line[@]	[@]30km
5.	Extension at 400kV level at [#]Gopalpur (OPTCL) GIS S/s	400kV GIS line bays: 2 nos. *[for termination of Gopalpur – Gopalpur (OPTCL) 400kV D/c (Quad) line]*

Implementation time-frame: 24 months from allocation

Note:

(a) Implementation of this scheme to be taken up only upon receipt of Connectivity/GNA applications by CTU/OPTCL, as agreed in the 18th CMETS-ER.

(b) [@]To be reviewed based on inputs of OPTCL regarding availability of contagious land for establishment of both 765/400kV (ISTS) and 400/220kV (Intra-state) substations at Gopalpur.

(c) [#]The bus scheme of 400kV level at Gopalpur (OPTCL) GIS S/s shall be one and half breaker scheme, 2 nos. full diameter i.e. 4 nos. of GIS bays needs to be implemented in the scheme for requirement of 2 nos. GIS bays for termination of Gopalpur (OPTCL) – Gopalpur 400kV D/c (Quad) line in two different diameters. Utilisation of other 2 nos. GIS bays of these diameters shall be identified in future.

(d) OPTCL shall provide space at under implementation Gopalpur (OPTCL) 400/220kV GIS S/s for implementation of 2 nos. of 400kV GIS line bays for termination of Gopalpur (ISTS) – Gopalpur (OPTCL) 400kV D/c (Quad) line. 2 nos. full diameter i.e. 4 nos. GIS bays shall be established.

(e) POWERGRID shall provide space at Angul (POWERGRID) 765/400kV S/s for implementation of 2 nos. of 765kV line bays (along with space for future switchable line reactor) along with bus extension in GIS for termination Angul (POWERGRID) – Gopalpur 765kV D/c line.

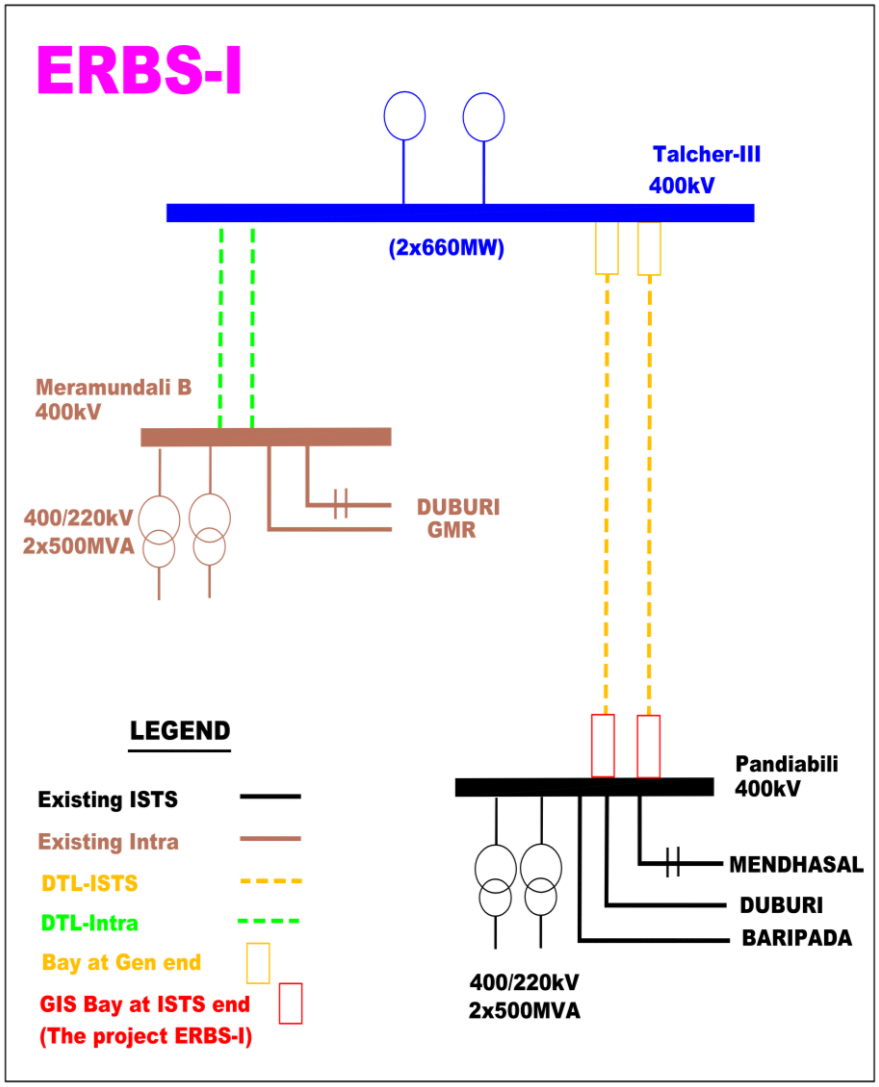
(f) As decided in the CMETS-ER the scheme is being taken up for approval at various forums, but implementation activity viz. bidding/allocation would be taken up only after receipt of Connectivity/GNA applications by CTU/OPTCL.

(ii) ERBS-I - Talcher-III

NTPC Ltd. applied for 660MW connectivity to ISTS for its 2x660MW generation project. For balance 660MW they applied to OPTCL, Odisha for intra state connectivity. The matter was deliberated and the following transmission system was agreed in the 19th CMETS-ER meeting held on 30-05-2023:

- **For intra state connectivity:** Talcher-III – Meramundali-B 400kV D/c (Quad) line
- **For ISTS connectivity:** Talcher-III – Pandiabili 400kV D/c line

NTPC Ltd. has requested for implementation of terminal bays of DTL at ISTS end under ISTS. Accordingly, the terminal bays at ISTS end were agreed to be implemented under ISTS scheme namely Eastern Region Bay Scheme-I (ERBS-I) with completion schedule of 30-09-2026 i.e. matching with start date of Connectivity.



Pandiabili (POWERGRID) S/s is GIS having one and half breaker switching scheme. Accordingly, 2 nos. full diameter i.e. 4 nos. of GIS bays needs to be implemented in the scheme for requirement of 2 nos. GIS line bays for termination of Talcher-III – Pandiabili

400kV D/c dedicated transmission line in line bays of two different diameters. Utilisation of other 2 nos. GIS bays of these diameters shall be identified in future. Further, as utilisation of other two bays is presently not identified, which could also be used to terminate even a 400kV D/c (Quad) line, the two nos. full diameters under the scheme may be implemented with 3150A rating.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Extension at Pandiabili 400/220kV GIS substation	400kV GIS line bays: #2 nos. *[for termination of Talcher-III – Pandiabili 400kV D/c dedicated transmission line (line under the scope of NTPC Ltd.)]*

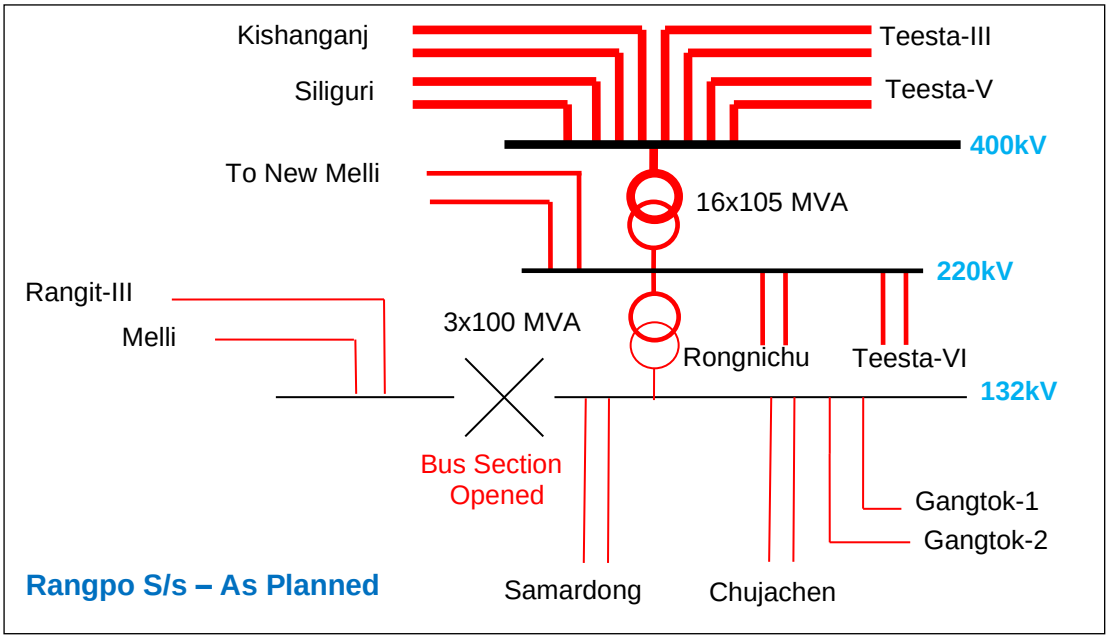
Implementation time-frame: 30-09-2023

Note: *#Pandiabili (POWERGRID) S/s is GIS having one and half breaker switching scheme. Accordingly, 2 nos. full diameter i.e. 4 nos. of GIS bays needs to be implemented in the scheme for requirement of 2 nos. GIS line bays for termination of Talcher-III – Pandiabili 400kV D/c dedicated transmission line in line bays of two different diameters. Utilisation of other 2 nos. GIS bays of these diameters shall be identified in future. Further, as utilisation of other two bays is presently not identified, which could also be used to terminate even a 400kV D/c (Quad) line, the two nos. full diameters under the scheme may be implemented with 3150A rating.*

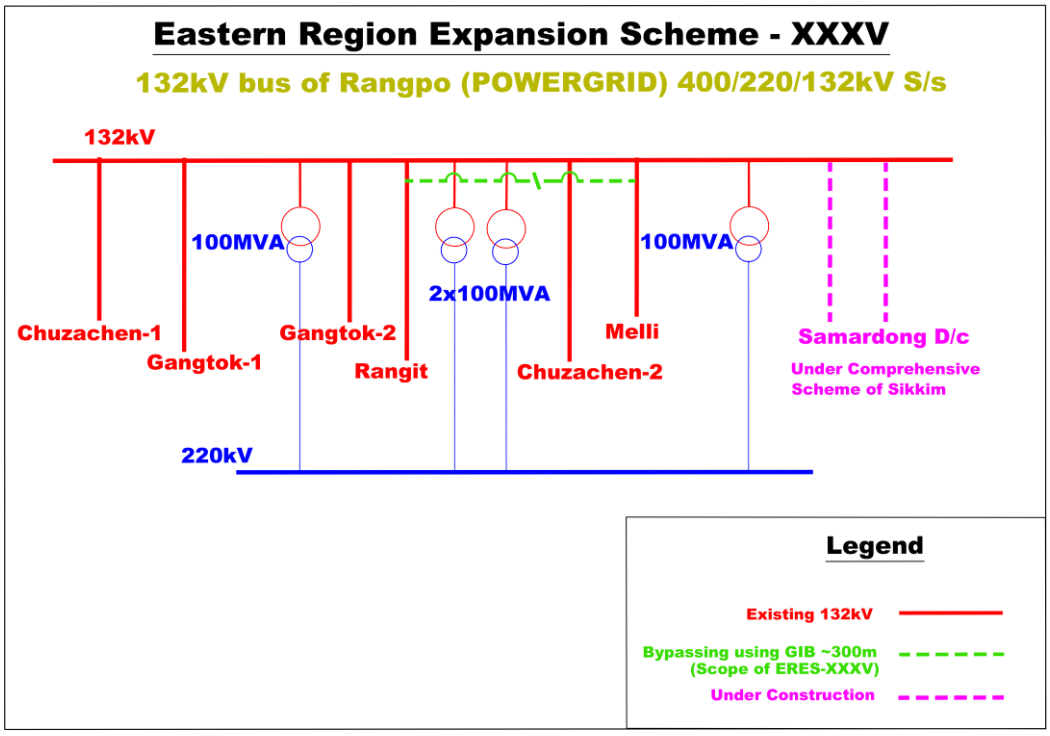
7.4.5 Sikkim

(i) ERES-XXXV – Rangpo bypass

Rangpo 400/220/132kV (POWERGRID) substation was commissioned in 2016 as part of transmission system implemented for phase-1 generation projects in Sikkim. In this scheme, split bus arrangement at 132kV bus of Rangpo S/s was planned wherein the Melli and Rangit-III 132kV feeders were planned to be on one side of the split bus section and all other 132kV feeders to be on other side (refer below figure). This arrangement was planned due to anticipated overloading in the Rangit-III & Melli 132kV feeders during high hydro generation scenario.



As per inputs from POWERGRID, the bus split arrangement at Rangpo S/s at 132kV level has been implemented differently (refer below figure). Rangpo 132kV bus is having double bus (single CB) switching scheme. It is understood that presently the substation is being operated with two single buses at 132kV level (by keeping the bus couplers open and bus sectionalisers closed) with Rangit-III and Melli feeders in first bus and remaining feeders on the second bus.



In order to facilitate the operational flexibility requirement of bypassing of Rangpo – Melli and Rangpo – Rangit 132kV S/c lines as per original plan and to rectify the implemented arrangement, a scheme comprising of bypassing of these lines within the

substation premises through GIB was discussed and agreed in the 17th CMETS-ER held on 29-03-2023.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Switching arrangement within the Rangpo (POWERGRID) GIS S/s premises such that Rangpo-Melli and Rangpo-Rangit 132kV S/c lines can be bypassed at Rangpo S/s end, such that the lines can either be terminated at Rangpo 132kV bus or bypassed, as per operational requirement. • 132kV, 1250A, SF_6, 3-Ph GIB – Approx. 250m to 300m length • 3 Phase, 1250A, SF_6 to Air bushing – 02 nos. • 132kV, 1250A, 31.5kA, AIS Disconnector with one E/S – 01 no. • 132kV BPI AIS – Approx. 05 nos.	-

Implementation time-frame: 18 months from allocation

(ii) ERBS-II - Rammam

NTPC Ltd. has applied for 120MW connectivity to ISTS for its Rammam HEP. The matter was deliberated and the following transmission system was agreed in the 19th CMETS-ER meeting held on 30-05-2023:

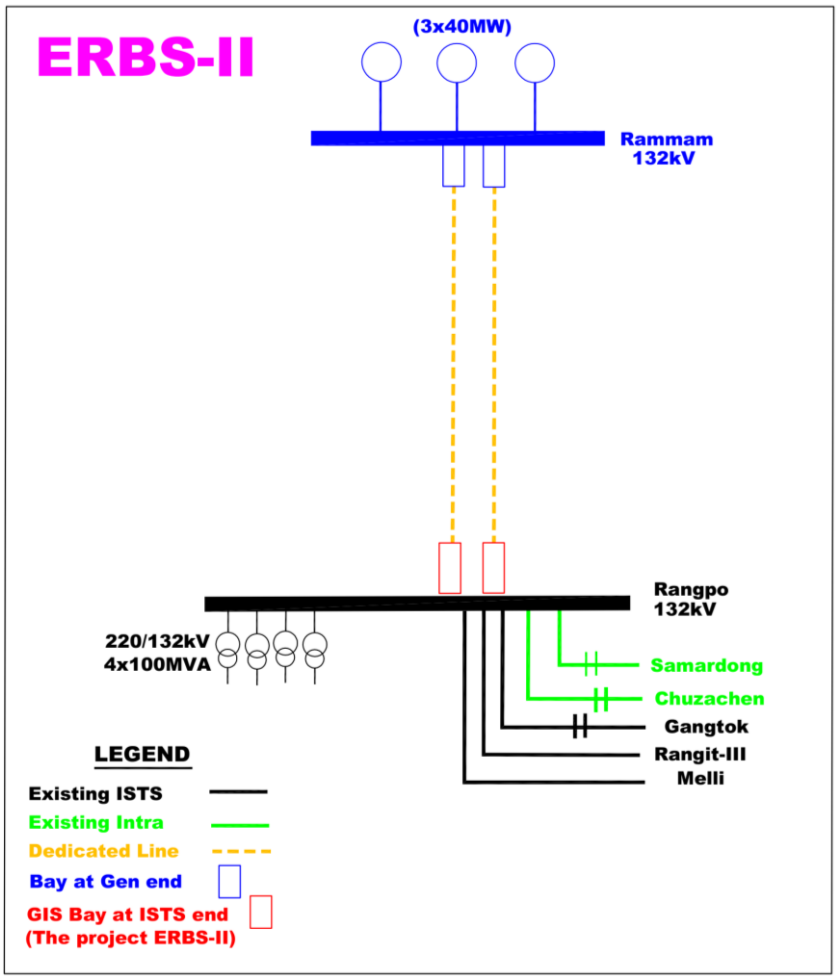
- **For ISTS connectivity:** Rammam – Rangpo 132kV D/c line

NTPC Ltd. has requested for implementation of terminal bays of DTL at ISTS end under ISTS. Accordingly, the terminal bays at ISTS end were agreed to be implemented under ISTS scheme namely Eastern Region Bay Scheme-II (ERBS-II) with completion schedule of 30-07-2026 i.e. matching with start date of Connectivity.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1	Extension at Rangpo 400/220/132kV GIS substation	132kV GIS Line bays: 2 nos. (bay no. 117 & 118) *[for termination of Rammam – Rangpo (POWERGRID) 132kV D/c dedicated transmission line (line under the scope of NTPC Ltd.)]*

Implementation time-frame: 30-07-2023

Note: *ISTS licensee should build the 132kV line bays of rating commensurate with rating of the dedicated transmission line.*



7.5 System Study Results and Analysis

Based on the load-generation scenarios as elaborated in **section 7.3**, various system studies have been carried out in PSSE. Planned/ Under implementation Transmission system that are expected to be commissioned in 2028-29 timeframe are considered for conducting these studies. Results of these studies were analysed and the same are deliberated below-

7.5.1 Power Flow Analysis

The base case file was prepared for 2028-29 timeframe. The study results are detailed in subsequent sections.

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 7-7.**

Table 7-7: ISTS Transmission lines not meeting N-1 Criteria in ER

(All Fig in MW)

Sl. No.	Name of the Line	Contigency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	Kahalgaon – Farakka 400kV line-1	Kahalgaon – Farakka 400kV line-2	7 & 8	ISTS	827	1191	852	140%
2.	Ranchi – New Purulia 400kV line-1	Ranchi – New Purulia 400kV line-2	1 & 4	ISTS	893	1266	1093	116%
3.	Ranchi – Sipat 400kV line-1	Ranchi – Sipat 400kV line-2	1 & 4	ISTS	741	913	850	107%

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. However, the loading of Kahagaon – Farakka in Scenarion 7 & 8 are due to higher despatch of thermal generations (more than 95%) and relative less demand in Eastern Region.

STU lines loaded beyond 100% of thermal rating under N-1 contingency are summarized below at Table 7-8**.**

Table 7-8: STU Transmission lines not meeting N-1 Criteria in ER

(All Fig in MW)

Sl. No.	Name of the Line	Contigency	Scenario No.	Owner	Base case Loading	Loading under N-1	Rating	% Loading
1.	OPGC – Lapanga 400kV Line-1	OPGC – Lapanga 400kV Line-2	5 & 9	OPTCL	665	1137	1093	104%
2.	Purulia New – Purulia PS 400kV Line-1	Purulia New – Purulia PS 400kV Line-2	1,4,7	WBSETCL	582	1041	850 (Twin Moose)	121%

STU may initiate action to control the overloading of the line in 2028-29 timeframe.

b) Transformers

ISTS ICTs loaded beyond 100% of MVA rating under N-1 contingency are summarized below at **Table 7-9**

Table 7-9: 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	% Loading	Rating (MVA)
1.	400/220kV, 2x500MVA ICTs at Kishanganj	5	ISTS	377	528	106%	500

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
2.	400/220kV, 2x315MVA ICTs at Bolangir	3	ISTS	206	340	108%	315
3.	765/400kV, 3X1500 MVA ICTs at Gopalpur	1,3,4, & 5	ISTS	1116	1591	106%	1500
4.	400/220kV, 2x500MVA ICTs at Pandiabili	2,3,4,5,6 & 8	ISTS	394	565	113%	500
5.	765/400kV, 2X1500 MVA ICTs at Jharsuguda-B	1 & 4	ISTS	1125	1778	119%	1500
6.	765/400kV, 2X1500 MVA ICTs at Jeerat-New	1	ISTS	1037	1720	114%	1500
7.	400/220kV, 3x500MVA ICTs at Durgapur-B	All except 7 & 9	ISTS	299	381	121%	315

Requirement of additional transformation augmentation wherever necessary would be planned subsequently in coordination in the CMETS meeting and the same would be included in the final Rolling Plan.

STU ICTs loaded beyond 100% of MVA rating under N-1 contingency are summarized below at **Table 7-10**

Table 7-10: 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	% Loading	Rating (MVA)
1.	400/220kV, 2x500MVA ICTs at Buxar TPP	8	BSPTCL	311	501	100%	500
2.	400/220kV, 2x315MVA ICTs at Duburi	All except 7	OPTCL	391	540	171%	315
3.	400/220kV, 3x315MVA ICTs at Mendhasal	All except 7 & 9	OPTCL	332	410	130%	315
4.	765/400kV, 2X1500 MVA ICTs at Duburi	1,2, 3,4, & 5	OPTCL	1259	1891	126%	1500
5.	400/220kV, 2x315MVA ICTs at Lapanga	All	OPTCL	326	458	145%	315
6.	400/220kV, 4x315MVA ICTs at Jeerat	1,2,5 & 8	WBSETCL	318	372	118%	315

Sl. No.	Name of the Element	Scenario No.	Owner	Base Case Flow	Loading of ICT under N-1	% Loading	Rating (MVA)
7.	400/220kV, 2x315MVA ICTs at Kolaghat TPS	All except 6 & 9	WBSETCL	383	573	182%	315
8.	400/220kV, 3x315MVA ICTs at Chanditala	All except 6 & 9	WBSETCL	378	463	147%	315
9.	400/220kV, 3x315MVA ICTs at Kharagpur	All except 6& 9	WBSETCL	324	446	142%	315
10.	400/220kV, 3x315MVA ICTs at Gokoarna	1,2,5 & 8	WBSETCL	287	356	113%	315
11.	400/132kV, 2x315MVA ICTs at New Laxmikantpur	1,2,5 &8	WBSETCL	251	369	117%	315
12.	400/220kV, 2x500MVA ICTs at Satgachia	1 & 5	WBSETCL	334	515	103%	500
13.	400/220kV, 3x315MVA ICTs at Bidhannagar	1	WBSETCL	271	344	109%	315
14.	400/220kV, 2x500MVA ICTs at Durgapur TPS	All except 7	DVC	514	739	148%	500
15.	400/220kV, 2x315MVA ICTs at Mejia-B TPS	All except 7	DVC	299	413	131%	315
16.	400/220kV, 2x500MVA ICTs at Durgapur TPS	All except 7	DVC	514	739	148%	500
17.	400/220kV, 2x315MVA ICTs at Mejia-B TPS	All except 7	DVC	299	413	131%	315
18.	400/220kV, 2x315MVA ICTs at Ramkanali-B	8	DVC	251	338	107%	315

From above, it is observed that 1 nos. of S/s of BSPTCL, 4 nos. of S/s of OPTCL and 8 nos. of S/s of WBSETCL/WBSEDCL and 5 nos. of S/s of DVC are not complying N-1 criteria in 2028-29 timeframe. Some of them are violating the limits in present timeframe also and are continuously flagged by Grid-India in their Operational Feedback. STUs may initiate action to control the overloading of the ICTs in 2028-29 timeframe.

7.5.3 Short Circuit Analysis

Short circuit level was calculated for all 765 and 400 kV buses of Eastern Region and buses having fault level more than the design rating under any scenario were identified. From analysis, it is emerged that 2 nos. of 400kV ISTS S/s and 1 nos STU S/s in ER have crossed their designed fault level rating.

Details of the ISTS buses exceeding the designed fault level by more than 5% under different scenario are tabulated below at **Table 7-11**: ISTS Buses Exceeding Designed Fault Level in ER

Table 7-11: 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	All except 1 & 4	47	40
2.	400kV Barh	NTPC	7,8,9	43	40

From the above, it can be seen that 2 nos. of buses i.e. 400kV Farakka, 400kV Barh violates the design fault level. The fault level control measures for Farakka have been implemented. Detailed studies are being carried out for the balance 1 no. S/s and the same would be discussed in the upcoming CMETS-ER meeting and the corrective measures shall be included in the final Rolling Plan.

Details of the STU buses exceeding the designed fault level by more than 5% under different scenario are tabulated below at **Table 7-12.**

Table 7-12: STU 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 Sagardighi	WBSEDCL	All except 1 & 4	46	40

WBSETCL/WBSEDCL may 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 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 its energy requirement throughout the year.

8.1 Power Supply Scenario as on Aug'23

As on Aug'23, total Installed Capacity (IC) of North Eastern Region was about 4989MW and the peak demand met was about 3541MW. 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 Aug'23

(All Fig in MW)

State	Generation								Peak Demand
	Fossil			Non Fossil				Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES (MNRE)	Total		
Assam	403	742	1144	-	522	192	714	1858	2390
Arunachal Pradesh	37	47	84	-	545	145	689	773	165
Meghalaya	52	110	161	-	417	73	490	652	332
Tripura	56	487	543	-	68	34	102	645	362
Manipur	83	82	165	-	87	18	106	270	213
Nagaland	32	74	106	-	66	36	102	208	174
Mizoram	31	60	91	-	98	76	174	265	127
Central unallocated	113	64	176	-	140	-	140	316	-
NER	**806**	**1665**	**2471**	**-**	**1944**	**574**	**2518**	**4989**	**3541**

Source: CEA monthly report

8.2 Envisaged Power Supply Scenario by 2028-29

As per the 20th EPS, North Eastern Region demand for 2028-29 timeframe is expected to increase to about 5481MW. As per the inputs received from various stakeholders, total installed capacity of North Eastern Region for 2028-29 is expected to be about 8489MW. The state wise bifurcation of installed capacity and peak demand is summarized below at **Table 8-2.**

Table 8-2: NER Installed Capacity and peak demand (2028-29)

(All Fig in MW)

State	Generation									Peak Demand
	Fossil			Non Fossil				ESS	Grand Total	
	Thermal	Gas	Total	Nuclear	Hydro	RES	Total			
Assam	-	347	347	-	220	192	412	-	759	3449
Arunachal Pradesh	-	-	-	-	24	145	169	-	169	246
Meghalaya	-	-	-	-	490	73	563	-	563	528
Tripura	-	149	149	-	-	34	34	-	183	605
Manipur	-	-	-	-	-	18	18	-	18	383
Nagaland	-	-	-	-	24	36	60	-	60	213
Mizoram	-	-	-	-	28	76	104	-	104	268
Central	750	1253	2003	-	3630	1000	4630	-	6633	-
NER	**750**	**1749**	**2499**	**-**	**4416**	**1574**	**5990**	**-**	**8489**	**5481**

There is a massaive growth in peak demand of North Eastern Region from present time-frame (2023-24) to 2028-29 with a CAGR of 7.4%. The state wise peak demand growth is given at **Table 8-3.**

Table 8-3: Increase in Peak Demand of Various States of NER

(All Fig in MW)

State	2023-24	2028-29	Increase in demand	CAGR
Assam	2390	3449	1059	7.6%
Arunachal Pradesh	165	246	81	8.3%
Meghalaya	332	528	196	9.7%
Tripura	362	605	243	10.8%
Manipur	213	383	170	12.5%
Nagaland	174	213	39	4.1%
Mizoram	127	268	141	16.1%
NER	**3603**	**5481**	**1878**	**8.8%**

From the above data it is observed that the CAGR growth of peak demand is maximum for Mizoram (16.1%) and minimum for Nagaland (4.1%). The CAGR of demand of NER is about 8.8% which is more than the National Average of 5.8%. In addition to above, 250MW demand of Myanmar & 160MW demand of Bangladesh is also considered as a part of North Eastern Region for study purpose.

8.3 Load Generation Balance for 2028-29 timeframe

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

Load generation balance has been prepared considering the generation despatch factors as mentioned at **Table 8-4** for the 9 scenarios. Further, thermal generators have been despatched as per the merit order.

Table 8-4: North Eastern Region Generation Dispatch and Demand Factors

Scenario No & Name	Generation Dispatch Factors			Demand Factors
	Hydro	Solar	Gas	
1-Aug Solar Max	70%	80%	0%	80%
2-Aug Peak Load	90%	0%	50%	100%
3-Aug Night Off Peak	70%	0%	50%	53%
4-Jun Solar Max	70%	85%	0%	60%
5-Jun Peak Load	90%	0%	50%	79%
6-Jun Night Off Peak	70%	0%	50%	38%
7-Feb Solar Max	30%	90%	0%	59%
8-Feb Peak Load	60%	0%	50%	78%
9-Feb Night Off Peak	30%	0%	30%	42%

The despatch from thermal generations have been done considering merit order despatch. Based on the LGB, import / export of NER and the inter-regional flows through various corridors is summarised in **Table 8-5**. Further, both maximum and minimum is also highlighted in table below.

Table 8-5: Import / Export of North Eastern Region

(All Fig in MW)

State / UTs	Import / Export of North Eastern Region								
Scenario No / Corridors	Aug'27 Time Frame			Jun'27 Time Frame			Feb'28 Time Frame		
	1 (Solar Max)	2 (Peak Load)	3 (Off Peak)	4 (Solar Max)	5 (Peak Load)	6 (Off Peak)	7 (Solar Max)	8 (Peak Load)	9 (Off Peak)
NER-ER	869	-467	701	1348	1214	1265	-46	79	-28
NER-NR	-500	0	0	-500	0	0	-500	0	0
NER-Cross Border	331	276	326	340	309	335	365	324	358
North Eastern Region	700	-191	1027	1188	1523	1600	-181	403	330

Out of these nine scenarios, Scenario-2 and Scenario-6 corresponds to two extreme cases with export/import requirement of North Eastern Region i.e. Maximum import (191MW) and maximum export (1600MW) scenarios respectively. In all other scenarios, the import / export of North Eastern Region varies between these two extremes.

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

8.4 ISTS Network Expansion Schemes evolved from Feb'23 to Jul'23

Various transmission schemes have been discussed/finalized in the Consultative Meeting for Evolution of Transmission System of North Eastern Region (CMETS-NER) from Feb '23 to Jul '23. The details of the schemes are summarized below in **Table 8-6**:

Table 8-6: Approved Transmission Schemes in this Rolling Plan

Sl. No.	Name of the Transmission Scheme	Expected Timeframe	Tentative Cost (in ₹Cr.)
Meghalaya			
1.	NERES-XXI (Part-A) - Khliehriat	2026-27	110
Assam			
1.	NERES-XXI (Part-B) - Badarpur	2025-26	48
2.	NERGS-I - Bokajan	31-12-2025	214

8.4.1 Meghalaya

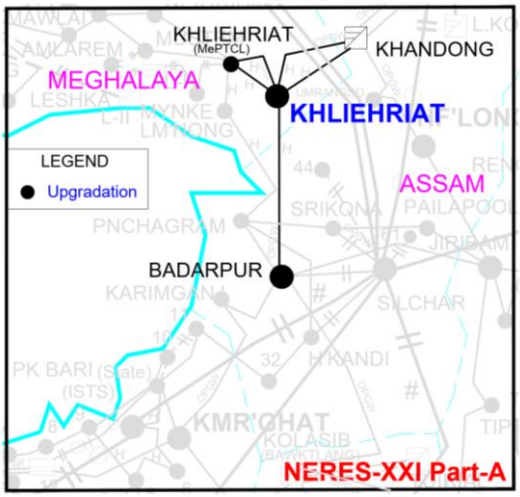
(i) NERES-XXI (Part-A) - Khliehriat

The existing 132kV Khliehriat (POWERGRID) switching station was commissioned in 1999 and shall be completing 25 years in service by 2024. POWERGRID the owner of the substation has informed that they are facing issues in O&M of the switching station and to improve the reliability it would be prudent to upgrade the switching station from single main and transfer bus scheme to double main transfer bus scheme by converting from AIS to GIS.

The scheme was also discussed in the 23rd TCC & NERPC meetings held on 18th-19th Nov 2022 wherein the subject upgradation was agreed to be carried out in GIS. The proposal was deliberated in 16th CMETS-NER held on 24-02-2023 wherein following was decided to be implemented in ISTS:

- Upgradation of Single Main and Transfer Bus to Double Bus arrangement with GIS at 132kV Khliehriat (POWERGRID) switching station

Upon finalization of the above scope a committee with officials from CTU and POWERGRID visited Khliehriat substation for finalization of the implementation modalities of the above agreed scope of works. The committee submitted a report wherein it is suggested the scope of works may be refined as per the actual site conditions. Accordingly, the proposal was once again discussed in the 20th CMETS-NER meeting held on 23rd June 2023 and revised scope of works (as mentioned below) under subject scheme with an implementation schedule of 24 months was agreed.



Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Upgradation of Single Main & Transfer Bus to Double Bus arrangement with GIS at 132kV Khliehriat (POWERGRID) switching station along with upgradation of necessary Control, Protection, Communication, Automation & LT auxiliary system	-

Implementation time-frame: 24 months from allocation

Note: *1 no. 132kV AIS line bay owned by MePTCL of Khlierihat (POWERGRID) – Khliehriat (MePTCL) line-2 is also included for upgradation in GIS under this scheme. The ownership of the new line bay would be with the implementation agency. The existing AIS line bay for the said line may be dismantled and handed over to MePTCL on as is where is basis and the implementing agency will coordinate with MePTCL for the same.*

8.4.2 Assam

(i) NERES-XXI (Part-B) - Badarpur

The existing 132kV Badarpur (POWERGRID) switching station was commissioned in 1999 and shall be completing 25 years in service by 2024. POWERGRID the owner of the substation has informed that they are facing issues in O&M of the switching station and to improve the reliability it would be prudent to upgrade the switching station from single main and transfer bus scheme to double main transfer bus scheme by converting from AIS to GIS.

Further, towards adoption of new technology in the Indian Grid, it was proposed that the upgradation could be carried out as Green GIS instead of conventional GIS owing to the following benefits:

- Green GIS is a new technology in which SF_6 gas is not used and this technology is being adopted by several countries in the world.
- This would help in the reduction of usage of Green House Gas and would be a step towards achieving sustainable development targets.

The scheme was also discussed in the 23rd TCC & NERPC meetings held on 18th-19th Nov 2022 wherein the subject upgradation was agreed to be carried out in Green GIS.

The proposal was deliberated in 16th CMETS-NER held on 24-02-2023 wherein following was decided to be implemented in ISTS:

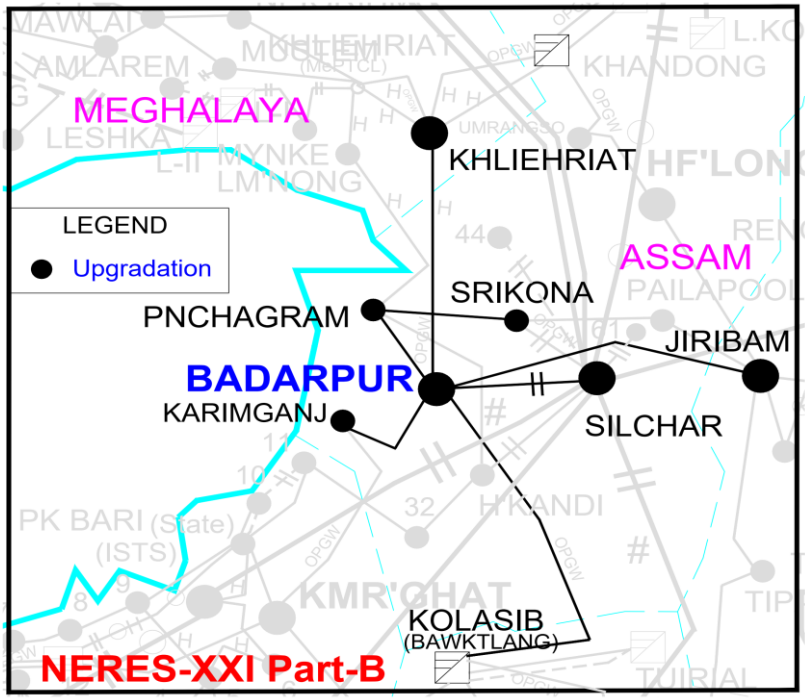
- Upgradation of Single Main and Transfer Bus to Double Bus arrangement with Green GIS at 132kV Badarpur (POWERGRID) switching station

Upon finalization of the above scope a committee comprising of officials from CTU and POWERGRID visited Badarpur substation for finalization of the implementation modalities of the above agreed scope of works. The committee submitted a report wherein it is suggested the scope of works may be refined as per the actual site conditions. Accordingly, the proposal was once again discussed in the 20th CMETS-NER meeting held on 23rd June 2023 and revised scope of works (as mentioned below) under subject scheme was agreed with an implementation schedule of 30 months keeping in view implementation of new technology of Green GIS in ISTS.

Sl. No.	Scope of the Transmission Scheme	Capacity/ km
1.	Upgradation of Single Main & Transfer Bus to Double Bus arrangement with Green GIS at 132kV Badarpur (POWERGRID) switching station along with upgradation of necessary Control, Protection, Communication, Automation & LT auxiliary system	-

Implementation time-frame: 30 months from allocation

Note: *As the Green GIS is being introduced for first time in ISTS in the Indian network, the ISTS transmission licensee shall involve CTU officials at various stages of implementation such as detailed engineering, design, testing, commissioning etc., and also after commissioning, so as to assess the environmental impact, operational performance, ageing characteristics etc. of the Green GIS.*



(ii) NERGS-I - Bokajan

M/s Assam Power Distribution Company Limited (APDCL) applied for ISTS Connectivity under GNA Regulations 2022 for its new solar generation of 1000MW to be installed in Karbi Anglong, Bokajan, Assam.

The application was deliberated in the 20th CMETS-NER meeting held on 23-06-2023. Brief of deliberations and outcomes/agreements by the stakeholders including the applicant is given below:

a) SECI mentioned that it has not identified/declared any solar potential in the Karbi Anglog and nearby area.

b) Various alternatives for interconnection of this solar generation with the ISTS was explored:

   i. APDCL – Misa 400kV S/c line as DTL

   ii. APDCL – New Kohima 400kV S/c line as DTL

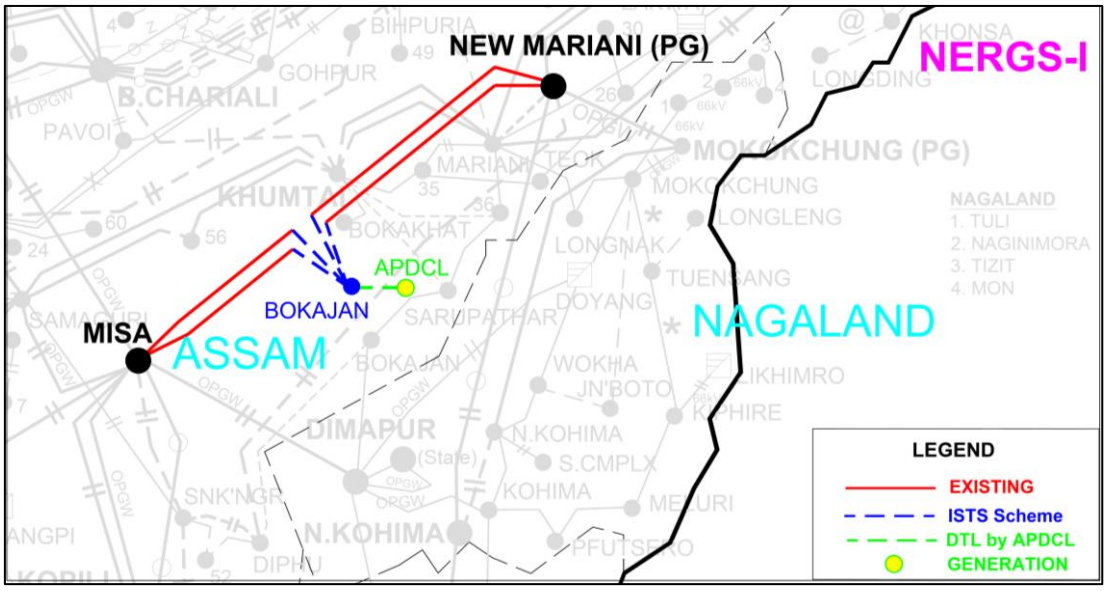
   iii. Establishment of a new 400kV switching station at Bokajan through LILO of both circuits of Misa – New Mariani 400kV D/c line & connection of generation to this switching station through DTL i.e. Bokajan – APDCL 400kV S/c line, with bay for termination of DTL at Bokajan station to be constructed under ISTS

   iv. Establishment of a new 400kV switching station at Bokajan through LILO of both circuits of New Mariani – New Kohima 400kV D/c line & connection of generation to this switching station through DTL i.e. Bokajan – APDCL 400kV S/c line, with bay for termination of DTL at Bokajan station to be constructed under ISTS

c) Considering the forest issues, hilly terrain of NER and completion timeline constraints, the alternative at b)iii. above was agreed for grant of Connectivity under GNA Regulations to M/s APDCL.

d) Presently, 50MVAr fixed line reactor is installed at Misa end in original Misa – New Mariani 400kV D/c line. With the LILO of the line at Bokajan, the tentative length of line sections Misa – Bokajan and Bokajan – New Mariani would be about 120km and 140km respectively. Keeping in view reactive compensation requirements, 50MVAr switchable line reactor is planned at Bokajan end in the Bokajan – New Mariani 400kV line section.

e) AEGCL mentioned that presently there is no requirement for drawal of power in Bokajan area but requested that space for installation of 400/220kV ICTs and creation of 220kV level may be kept for future interconnection to feed the loads in nearby area of Bokajan.



In view of the above, it was decided that connectivity of 1000MW may be granted to M/s APDCL for its solar generation project under GNA Regulations, 2022 with the identified augmentation in ISTS to be carried out under subject scheme and the same to be treated as Associated Transmission System (ATS).

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
1	Establishment of new 400kV switching station (to be upgraded to 400/220kV level in future) at Bokajan in Assam **Additional space for future expansion**: - 400/220kV, 4x500MVA ICTs along with associated ICT bays at both voltage levels - 420kV, 2x125MVAr bus reactor along with associated bays - 9 nos. of 400kV line bays (along with space for switchable line reactor) for future lines - 10 nos. of 220kV line bays for future lines - 400kV bus sectionaliser bay: 1 set - 220kV bus sectionaliser bay :1 set - 220kV bus coupler bay: 2 no. - 220kV transfer bus coupler bay: 2 no.	420kV, 80MVAr bus reactor: 2 nos. 400kV bus reactor bays: 2 nos. 420kV, 50MVAr switchable line reactor: 2 nos. (one in each circuit of Bokajan – New Mariani 400kV D/c line formed after LILO of both circuits of Misa (POWERGRID) – New Mariani (POWERGRID) 400kV D/c line at Bokajan) 400kV line bays: 5 nos. *[4 nos. for termination of LILO of both circuits of Misa – New Mariani 400kV D/c line at Bokajan (LILO under this scheme) & 1 no. for termination of APDCL – Bokajan dedicated transmission line (line under scope of M/s APDCL)]*

Sl. No.	Scope of the Transmission Scheme	Capacity (MVA) / Line length (km)/ Nos.
2	LILO of both circuits of Misa (POWERGRID) – New Mariani (POWERGRID) 400kV D/c line at Bokajan	20km (10km Loop in and 10km Loop out)

Implementation time-frame: 31-12-2025

Note: *The scheme is required by 31-12-2025 matching with start date of Connectivity of M/s APDCL's 1000MW solar plant*

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 208-29 timeframe are considered for conducting these studies. Results of these studies were analysed and the same are deliberated below:

8.5.1 Power Flow Analysis

The base case file was prepared for 2028-29 timeframe. The study results are detailed in subsequent sections.

8.5.2 Contingency Analysis

Contingency analysis has been performed on all the 400kV transmission lines & transformers to ascertain the loading levels under outage of any other 400kV transmission element. No ISTS or STU lines/ICTs are observed to be loaded beyond 100% of thermal rating under N-1 contingency. The detailed analysis of 132kV system would be carried out in the final rolling plan report.

8.5.3 Short Circuit Analysis

Short circuit level was calculated for all 400kV and above buses of North Eastern Region and it was observed that no 400kV and above buses were crossing their designed limit.

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Chapter 9: Cross-Border Interconnection

Due to geographical location, India shares its boundaries with many South Asian countries and can play an important role in exchange of power to these countries for optimal utilisation of resources in particular and development of economy in general. Transmission of power is economical than transportation of fuel. Towards this, it is important to establish electrical interconnections with neighbouring countries which would be beneficial in meeting growing power demand, sharing of various types of energy resources, decreasing operational cost through better resource management, utilizing renewable energy resources and deferring investment by optimizing spinning reserve.

The details of existing, under-construction and under-discussion interconnections with the neighbouring countries viz. Bangladesh, Bhutan, Myanmar, Nepal & Sri Lanka with Indian grid to facilitate transfer of power for the benefit of both sides is given below:

9.1 India-Bangladesh

(i) Present interconnection

- 1160MW is being transferred to Bangladesh through following two links:
  - ***1000MW*** *through Baharampur (India) – Bheramara (Bangladesh) 400kV 2xD/c line along with 2x500MW HVDC Back-to-Back terminal at Bheramara.*
  - ***160MW*** *through Surajmaninagar (Tripura) – North Comilla (Bangladesh) – South Comilla 400kV D/c radial interconnection (operated at 132kV).*

(ii) Planned interconnection

- Katihar (Bihar) – Parbotipur (Bangladesh) – Bornagar (Assam) 765kV D/c line
  India is going ahead with the financing and construction of the entire cross border link. The Bangladesh side may synchronize through this link at Parbotipur at an appropriate time for 1000MW drawl of power.

9.2 India-Bhutan

(i) Present interconnection

- 2070MW is being transferred from Bhutan to India through following lines in synchronous mode of operation
  - *Kurichu HEP – Geylephu (Bhutan) – Salakati 132kV S/c*
  - *Deothang/Motonga – Rangia 132kV S/c*
  - *Chukha HEP – Birpara 220kV (3 circuits)*
  - *Tala HEP – Siliguri 400kV 2xD/c*
  - *Mangdechu HEP (Bhutan) – Jigmeling (Bhutan) – Punatsangchuu-I&II HEP (bypassed as generations are delayed) – Alipurduar 400kV D/c (Quad) line*
  - *Jigmeling (Bhutan) – Alipurduar 400kV D/c (Quad) line*

(ii) Under Construction interconnection

- With the commissioning of Punatsangchu-I and II generation by 2024-25, the power transfer capacity would increase to about 4290MW.

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
- Various 11kV S/c lines from Nagaland, India to Myanmar

9.4 India-Nepal

(i) Present interconnection

- 1200MW can be transferred from India to Nepal through following links in radial mode of operation:
  - *About 350-400MW through 132kV & below radial lines*
  - *About 800MW of power through the first high-capacity link i.e., 400kV D/c Dhalkebar (Nepal) – Muzaffarpur (India) line.*

(ii) Under Construction interconnection

- Additional 1900MW can be transferred from Nepal to India through following links:
  - Sitamarhi (POWERGRID) – Dhalkebar (Nepal) 400kV D/c (Quad) line (associated with Arun-3 HEP, Nepal): Expected by Dec 2023 – 800MW
  - Gorakhpur (India) – New Butwal (Nepal) 400kV D/c (Quad) line: Requisite approvals are being obtained to take up implementation. – 1000MW
- 2nd circuit stringing of Kataiya (India) – Kusaha (Nepal) 132kV S/c on D/c line – 50MW
- 2nd circuit stringing of Raxaul (India) – Parwanipur (Nepal) 132kV S/c on D/c line - 50MW

(iii) Under Discussion interconnection

- New Purnea (India) - Inaruwa (Nepal) 400kV (Quad) D/c line – 1500MW
- Bareilly New (India) - Lumki (Nepal) 400kV (Quad) D/c line – 1500MW
- Nanpara (India) - Kohlapur (Nepal) 132kV D/c line – 35MW
- New Nautanwa (India) - Mainhiya (Nepal) 132kV D/c line – 35MW
- Upgradation of Tanakpur – Mahendranagar 132 kV Corridor

9.5 India-Sri Lanka

(i) Under Discussion interconnection

- ±320kV, 1000MW Madurai-New (India) to Mannar (Sri Lanka) HVDC line (overhead) along with 500MW VSC based HVDC terminals at both ends

The cross-border transmission capacity of India with neighbouring countries in present time-frame and through under construction interconnections is summarized below in Table 9-1**:**

Table 9-1: Cross-border power transfer capacity by 2028-29

(All fig in MW)

Country	Existing	Under Construction	Planned	Total
India-Bangladesh	1160	0	1000	2160
India-Bhutan	2070	2220	0	4290
India-Myanmar	3	0	505	508
India-Nepal	1200	1900	3070	6170
India-Sri Lanka	0	0	500	500
Total	**4433**	**4120**	**5075**	**13628**

A schematic of the existing, under-construction and proposed cross-border interconnections is given in Figure 9-1 below:

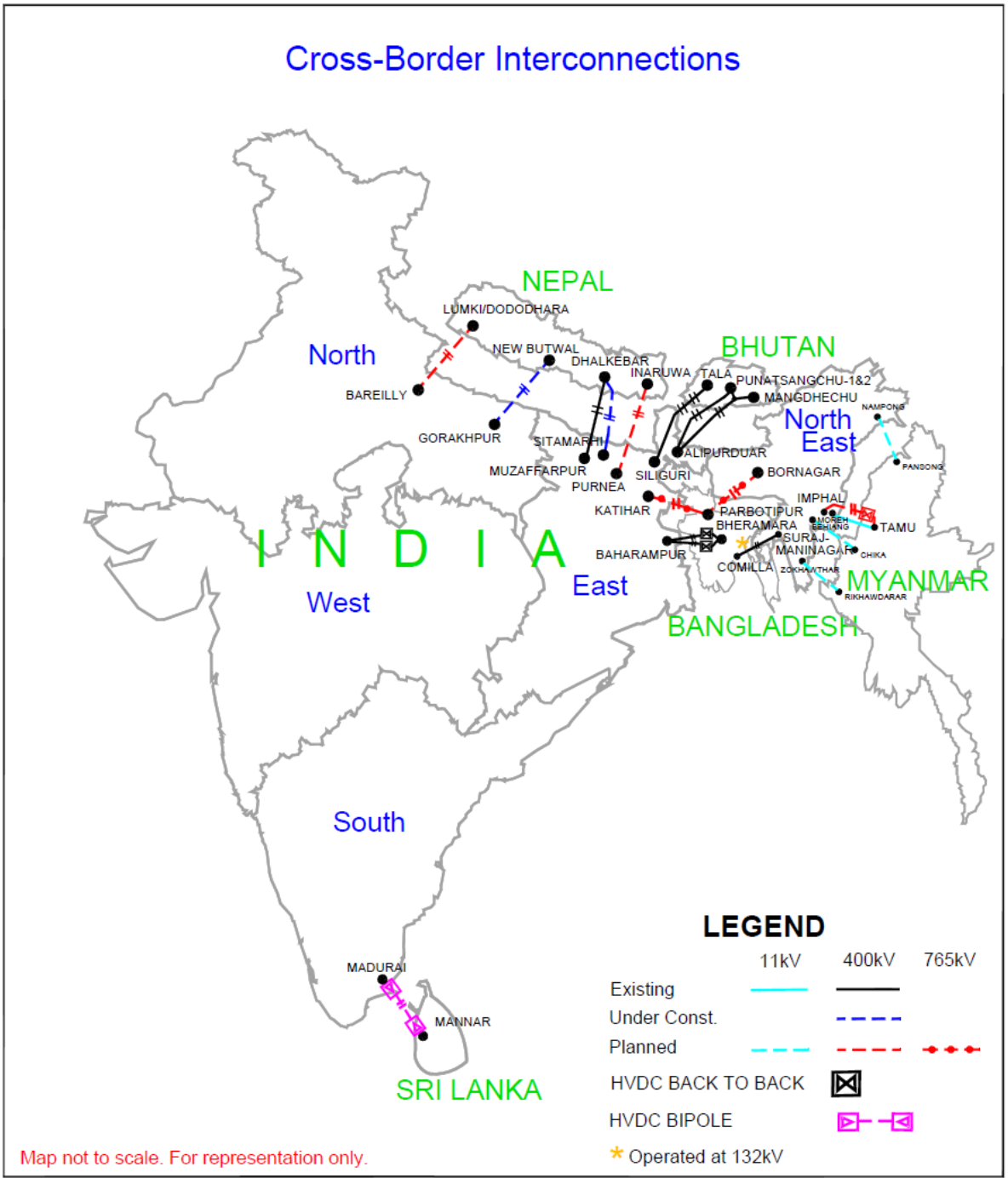

Figure 9-1 Cross-Border interconnections

Chapter 10: Conclusion

The installed capacity of generation in Indian grid is expected to increase to about 712 GW by 2028-29 from 424 GW as on Aug'23. It will witness an increase in contribution of non-fossil fuel-based energy sources from 44% to 63%, whereas contribution of fossil fuel-based energy source will see a decline from 56% to 37% in total installed capacity in same timeframe. This will create a pathway for India's commitment in COP26, wherein India is projected to have total installed capacity of non-fossil fuel-based generation of 500GW by the year 2030.

Power scenario of the country is quite diverse and varies continuously. RE integration with grid further enhance its complexity. Large RE complexes are expected to be established in Northern, Western, and Southern regions by 2028-29 time-frame. The transmission system for integrating the same into the grid has already been planned and is currently under various stages of approval/implementation. As substantial solar generation addition has been envisaged in Rajasthan, this has resulted in NR becoming exporter of power around noon solar max period and importer during the evening peak demand period, in all seasons. 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 284 GW and 161 GW has been considered while working out the LGBs for 2028-29 timeframe.

While preparing the LGB, it has been observed that to dispatch maximum RE generation during the noon time, on bar thermal units required to meet evening peak demand are to be operated below the present technical minimum of 40% which highlights the need of energy storage in the grid to facilitate the RE integration by 2028-29. As of now, the portion of energy and peak demand met by RE as compared to total requirement is quite low. However, this will not be the case of future when a large quantum of RE will integrate with grid.

Various system studies and analysis have been conducted like power flow, contingency and short-circuit studies on All India basis as well as on Regional basis to analyse the power flow patterns on existing and planned transmission system in 2028-29 timeframe. This caters to a power transmission network planned in a manner that offers techno-feasible solution considering all the aspects without compromising the security, reliability and robustness of National Grid.

Load flow including N-1 contingency studies have been conducted for all scenarios to check and analyse the power flow pattern on EHV transmission lines and inter connecting transformers. During the studies it was observed that most of the transmission lines and transformers loading are within limits except for few cases which are highlighted in report and their detailed analysis is included in regional chapters. Further mitigation measures required, if any, for addressing loading observed beyond limit shall be taken care in subsequent transmission planning exercises.

Short circuit studies have also been performed on all the scenarios and fault MVA violations at 765kV and 400kV beyond the design rating are also highlighted in the report. Fault level at many of the 400 kV buses including the STU and generating station buses are observed to be beyond the design limits. Measures like bus split, bypassing of the lines and installation of series reactor to control the fault MVA level are under planning at ISTS buses. However, same also needs to be taken up at STU and generating station level by respective utilities.

In summary, existing and planned/proposed transmission network is found to be adequate for meeting the demand and integrating anticipated generation to be commissioned by 2028-29 timeframe. Further, basic network parameters of the Indian grid are within their operating limits except for few cases which are being studied in detail and necessary mitigation measures will be taken in subsequent transmission planning exercises.

Brief of transmission systems and observations from system studies for each region are as below:

Northern Region (NR)

The total installed generation capacity of NR as on Feb'23 is about 117 GW which constitute capacity from fossil sources (46% share) & balance (54% share) from Non-fossil sources in which (53%) 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 2027-28 timeframe is expected to increase to about 103 GW. As per the inputs received from various stakeholders, total installed capacity of NR for 2027-28 is expected to be about 200 GW.

Various transmission schemes i.e. Scheme to relieve high loading of 400 kV Bhinmal -Zerda line (WR-NR IR scheme), transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex) and Ph-IV (Part-2 : 7.5GW) (Jaisalmer/Barmer Complex), transmission system for evacuation of power from Shongtong Karcham HEP (450MW) and Tidong HEP (150 MW), Augmentation of ICTs at RE pooling substations to take care N-1 Contingency, line reactors to address high voltages and enhancement of ATC/TTC for Punjab due to unprecedented load growth of summer/ paddy season planned in the Consultation Meeting for Evolution of Transmission System in Northern Region (CMETS-NR) from Mar'22 to Feb'23 for implementation. In this Rolling Plan, transmission schemes of about

3,650 ckm of transmission lines and 46,065 MVA of transformation capacity has been formulated at an estimated cost of Rs. 29,987 Cr.

For mitigation of the issues highlighted in Rolling Plan of 2026-27-time frame, some of augmentation works have been identified in ISTS and in STU network. Same was discussed in the Joint Study /CMETS-NR meetings i.e. Implementation of N -1 contingency at RE pooling substations in NR, Enhancement of ATC/TTC for Punjab have been evolved in NR to relieve overloadings on ICTs. These schemes either been approved or under various stages of approval. Similarly, a few ISTS have also been evolved to resolve import capability, overloading issues and to meet the growing demands of the states. Further, new expansions in Northern 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 2027-28, transmission schemes comprising of 18,736 ckm of transmission lines and transformation capacity of 1,30,135 MVA at estimated cost of Rs 1,03,594 Cr. is expected to be added in the grid.

Western Region (WR)

The total installed generation capacity of WR as on Aug'23 is about 139GW which constitute capacity from fossil sources (62% share) & balance (38% share) from Non-fossil sources comprising of nuclear, renewable generation capacity including hydro.

Western Region is connected to Northern, Southern and Eastern Regions through 765kV & 400kV high-capacity corridors along with Back to Back HVDCs and Bi-Pole HVDC links. The thermal generating stations of Western Regions are predominantly concentrated in the coal rich states of Chhattisgarh, Eastern part of Maharashtra and Madhya Pradesh. Further, Gujarat, Maharashtra and Madhya Pradesh are RE rich states comprising of large Solar & Wind capacity. Western part of Maharashtra, southern Gujarat and DD & DNH have high demand and less internal generation.

To meet the growing demand, Western region is continuously progressing in generation capacity addition majorly through thermal and non-conventional/renewable sources. The peak demand of Western Region for 2028-29 timeframe is expected to increase to about 100 GW. In addition to above, the demand of about 7 to 8 GW corresponding to bulk consumer / distribution licensees is expected to be added to the grid by 2028-29. As per the inputs received from various stakeholders, total installed capacity of Western Region for 2028-29 is expected to be about 207 GW.

Various transmission schemes from Feb'23 to Aug'23 have been evolved such as Transmission System for Evacuation of power from potential renewable energy zone in Khavda area of Gujarat under Phase-IV (7 GW) & Phase-IV (8 GW) & Network Expansion scheme in Kallam area of Maharashtra and is expected to play a major role in fulfilling India's vision of generating 500 GW of non-fossil generation capacity by 2030. Further, augmentation of ICTs at Magarwada, Indore, Bhachau & Network Expansion scheme in Gujarat for drawl of about 3.6 GW load under Phase-I in Jamnagar area have also been evolved to meet the

growing demand in WR & to cater to bulk consumer loads. In this Interim Rolling Plan, 20 nos. of transmission schemes have been formulated at an estimated cost of about Rs. 60,542 Cr. These schemes either have been approved or are under various stages of approval. Further, new network expansions in Western Region are being taken up on a continuous basis and the mitigation measures identified would be taken up for detailed analysis.

Southern Region (SR)

The total installed generation capacity of SR as on Feb'23 is about 122 GW which constitute capacity from fossil sources (47% share) & balance (53% share) from Non-fossil sources in which (50%) contribution in total regional IC is from renewable generation capacity including hydro and balance (3%) is from nuclear.

Southern Region is connected to Western and Eastern regions through high capacity 765kV AC links, Back-to-Back HVDC and Bi-pole HVDC links. The thermal generating stations of Southern Region are predominantly concentrated in the States of Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. Further, Tamil Nadu, Karnataka and Andhra Pradesh are RE rich states comprising of largescale Solar & Wind capacity. Southern part of Karnataka (Bangalore), Kerala and Central part of Telangana (Hyderabad) has high demand and less internal generation.

To meet the growing demand, Southern region is continuously progressing in generation capacity addition majorly through thermal and non-conventional/renewable sources. Southern Region demand for 2027-28 timeframe is expected to increase to about 87 GW. As per the inputs received from various stakeholders, total installed capacity of Southern Region for 2027-28 is expected to be about 228 GW.

Various transmission systems have been evolved in the Consultation Meeting for Evolution of Transmission System in SR (CMETS-SR) from Mar'22 to Feb'23 for implementation. These schemes have either been approved or under various stages of approval. Transmission system for integration of additional RE potential of about 14.5 GW in Karnataka in Gadag, Koppal, Davangere, Bijapur and Tumkur area and RE potential of about 6.5 GW in Telangana in Nizamabad, Medak, Rangareddy have been evolved. The proposed scheme will facilitate in integration and immediate evacuation of RE potential areas of Karnataka and Telangana which are under various stages of approval. Further, Reconductoring of Raichur – Veltoor (Mahabubnagar) 400 kV S/c line with HTLS conductor has also been approved to relive the overloading of transmission line. In this Rolling Plan, transmission schemes of about 3830 ckm of transmission lines and 70,500 MVA of transformation capacity has been formulated at an estimated cost of Rs.20,501 Cr.

During the system studies for 2027-28 timeframe, few Short Circuit issues are observed in Tamil Nadu, Telangana, Karnataka and Andhra Pradesh due to large interconnections. Further, some transformers are also observed to be loaded beyond limit in Tamil Nadu, Telangana, Karnataka, Kerala and Andhra Pradesh. Most of these ICTs are located in Tamil Nadu. Some of the lines such as, Maheshwaram – Hyderabad 400kV S/c line, Cuddapah – Chittoor 400kV S/c line, Kurnool – Srisalem LB 400kV S/c line, Somanhally – Bidadi 400kV D/c line,

Thiruvalam – Malekottiyar 400kV D/c line and Nizamabad – Dichipally 400kV (Quad) D/c line etc. are critically loaded under Base case / N-1 contingency. New network expansions schemes and mitigation measures to address above issues in Southern Region are being taken up on a continuous basis and would be taken up in the subsequent rolling plan after detailed analysis.

As per the timelines provided in the CEA report for integration of over 500 GW RE capacity by 2030, entire Phase-I & Phase-II potential of additional 181.5 GW RE capacity by 2030 has been considered in this Rolling Plan. Some of the transmission lines and ICTs are observed to be critically loaded at locations where RE potential is getting pooled from various pockets. Measures to control these loadings shall be planned in coordinated manner upon materialization of the RE potential (part of 181.5 GW REZs).

Thus, cumulatively by 2027-28, transmission schemes comprising of 8,170 ckm of transmission lines and transformation capacity of 121,000 MVA at estimated cost of Rs 36,568 Cr. is expected to be added in the grid.

Eastern Region (ER)

The total installed generation capacity of ER as on Aug'23 is about 35GW which constitute capacity from fossil sources (81% share) & balance (19% share) from Non-fossil sources comprising of renewable generation capacity including hydro.

Eastern Region is connected to all other regions though 765kV & 400kV high-capacity corridors along with HVDC Back to Back/ HVDC Bipole lines. The thermal generating stations of ER are predominantly located in Bihar, Jharkhand and Odisha whereas hydro generation are concentrated primarily in Sikkim. Eastern region is also connected to other countries such as Nepal, Bhutan and Bangladesh through high-capacity AC and HVDC links.

To meet the growing demand, Eastern region is continuously progressing in generation capacity addition majorly through thermal and hydro generation sources. The peak demand of Eastern Region for 2028-29 timeframe is expected to increase to about 42.5 GW. In addition to above, the demand of about 6.28GW corresponding to bulk consumer / distribution licencees is expected to added to the grid by 2028-29. As per the inputs received from various stakeholders, total installed capacity of Eastern Region for 2027-28 is expected to be about 67 GW (including 3.2GW in Nepal and 4.5GW in Bhutan).

Various transmission schemes such as establishment of Gopalpur 765/400kV (ISTS) GIS S/s through Angul – Gopalpur 765kV D/c corridor & Gopalpur (ISTS) – Gopalpur (OPTCL) 400kV D/c (quad) line, augmentation of ICTs at Arrah, Lakhisarai & Rajarhat S/s, line reactors at Malda, bypassing at Ranchi & Rangpo and lines bays at ISTS end for Talcher-III and Rammam HEP have been evolved in the Consultation Meeting for Evolution of Transmission System in Eastern Region (CMETS-ER) from Feb'23 to Jul'23. In this Rolling Plan, 9 nos. of transmission schemes have been formulated at an estimated cost of Rs. 3,309 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.

North Eastern Region (NER)

The total installed generation capacity of NER as on Aug'23 is about 5GW which constitute capacity from fossil sources (49.5% share) & balance (50.5% share) from Non-fossil sources comprising of renewable generation capacity including hydro.

North Eastern Region is connected to Eastern Region and North Region though 400kV high-capacity corridors along with multi-terminal HVDC. The thermal generating stations of Northern Eastern Region are located in Assam, gas generations are situated in Assam and Tripura whereas hydro generation is concentrated primarily in Arunachal, Manipur & Meghalaya.

To meet the growing demand, NER is continuously progressing in generation capacity addition majorly through hydro generation sources. The peak demand of North Eastern Region for 2028-29 timeframe is expected to increase to about 5.5 GW. As per the inputs received from various stakeholders, total installed capacity of Northern Eastern Region for 2028-29 is expected to be about 8.5 GW.

Various transmission schemes i.e. transmission system for evacuation of power from 1000MW APDCL Solar at Bokajan, upgradation of Khliehriat 132kV switching station from AIS to GIS and Badarpur 132kV Switching Station from AIS to Green GIS have been approved in the Consultation Meeting for Evolution of Transmission System in North Eastern Region (CMETS-NER) from Feb'23 to Jul'23. In this Rolling Plan, 3 nos. of transmission schemes have been formulated at an estimated cost of Rs. 372 Cr. These schemes have either been approved or are under various stages of approval.

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 4433MW (2070MW: Bhutan, 1160MW: Bangladesh, 1200MW: Nepal and 3MW: Myanmar) with the neighbouring countries. With the commissioning of under-construction cross-border interconnections which are expected in 2-3 years, the power transfer would enhance by about 4120MW resulting in total of about 8553MW (4290MW: Bhutan, 1160MW: Bangladesh, 3100MW: Nepal and 3MW: Myanmar).

Annexures

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Annex-2.1

Load Generation Balance (LGB)

Monsoon (Aug'28)

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
NR	11880	41838	0	53718	4420	25269	86320	4500	13401	1360	10500	3583	203070	109714	98351	**0**
WR	19000	34160	35602	88762	3240	6078	54458	4500	36359	0	3602	10139	207138	100246	89864	**4500**
SR	12870	36988	4640	54498	7820	13212	73154	4500	53852	2119	16835	1781	227770	91285	81831	**0**
ER	29480	14450	4500	48430	0	14026	2518	400	0	0	900	0	66274	42546	38140	**6280**
NER	750	0	0	750	0	4375	1100	100	0	0	0	1854	8179	5481	4913	**0**
	73980	**127435**	**44742**	**246157**	**15480**	**62960**	**217550**	**14000**	**103612**	**3479**	**31837**	**17356**	**712431**	**313098**	313098	10780
		246157						**401601**						349272	**323878**	

Scenario 1 : Solar Max Aug 2028

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	22%	23%	0%	43%	80%	70%	90%	0%	50%	0%	-100%	0%		92%	90%
WR	23%	3%	22%	-2%	80%	40%	80%	0%	55%	0%	-100%	0%		79%	78%
SR	0%	0%	10%	7%	80%	40%	80%	0%	55%	0%	-100%	0%		68%	67%
ER	23%	16%	26%	20%	80%	70%	80%	0%	0%	0%	-100%	0%		85%	84%
NER	40%	0%	0%	33%	80%	70%	80%	0%	0%	0%	-100%	0%		67%	65%
	19%	10%	21%	14%										90%	282430

Availabilit	Central	State	IPP	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	2628	9605	0	23118	3536	17688	77688	0	6701	84887	-10500	0	107346	101041	6305	107346	101041
WR	4336	900	7856	-1501	2592	2431	43566	0	19997	86252	-3602	0	78077	83741	-5664	78077	79241
SR	0	0	458	3814	6256	5285	58523	0	29619	68976	-16835	0	83306	62211	21095	83306	62211
ER	6687	2376	1164	9709	0	9818	2014	0	0	33756	-900	0	21160	42565	-21405	21160	36285
NER	300	0	0	248	0	3063	880	0	0	3404	0	0	4243	3652	590	4243	3652
Total	**13951**	**12881**	**9478**	**35389**	**12384**	**38285**	**182672**	**0**	**56317**	**277274**	**-31837**	**0**	**294131**	**293210**	**922**	**294131**	**282430**
		36311					**277274**							277432			

Scenario 2 : Peak load Aug 2028

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas	0	National DF	Regional DF
NR	60%	66%	0%	87%	80%	95%	0%	0%	70%	0%	60%	50%		90%	88%
WR	62%	35%	59%	30%	80%	70%	0%	0%	75%	0%	60%	50%		73%	72%
SR	2%	30%	30%	25%	80%	70%	0%	0%	75%	0%	60%	50%		69%	68%
ER	42%	74%	55%	56%	80%	90%	0%	0%	0%	0%	60%	50%		88%	87%
NER	40%	0%	0%	388%	80%	90%	0%	0%	0%	0%	60%	50%		99%	98%
	43%	48%	56%	48%										89%	**277839**

Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	7115	27483	0	46562	3536	24005	0	0	9381	40138	6300	1791	79611	98328	-18717	79611	98328
WR	11696	12055	20970	27053	2592	4254	0	0	27269	40784	2161	5069	86066	77660	8407	86066	73160
SR	200	11076	1415	13580	6256	9248	0	0	40389	32615	10101	890	79575	63442	16133	79575	63442
ER	12331	10659	2474	27245	0	12623	0	0	0	15961	540	0	38627	43746	-5119	38627	37466
NER	300	0	0	2907	0	3938	0	0	0	1609	0	927	5164	5443	-279	5164	5443
Total	**31642**	**61273**	**24858**	**117347**	**12384**	**54069**	**0**	**0**	**77039**	**131108**	**19102**	**8678**	**289044**	**288619**	**425**	**289044**	**277839**
		117772					**131108**							273214			

Scenario 3 : off peak load Aug 2028

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	60%	49%	0%	57%	80%	70%	0%	0%	60%	0%	40%	50%		66%	65%
WR	42%	17%	39%	16%	80%	40%	0%	0%	65%	0%	40%	50%		51%	51%
SR	2%	14%	23%	10%	80%	40%	0%	0%	65%	0%	40%	50%		50%	49%
ER	29%	49%	27%	56%	80%	70%	0%	0%	0%	0%	40%	50%		79%	78%
NER	40%	0%	0%	205%	80%	70%	0%	0%	0%	0%	40%	50%		69%	68%
	33%	30%	36%	32%										66%	206713

Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	7115	20510	0	30741	3536	17688	0	0	8041	32134	4200	1791	62881	72403	-9522	62881	72403
WR	8015	5896	13743	14225	2592	2431	0	0	23633	32651	1441	5069	62820	55978	6842	62820	51478
SR	200	5212	1056	5322	6256	5285	0	0	35004	26111	6734	890	60637	45314	15323	60637	45314
ER	8596	7077	1214	26904	0	9818	0	0	0	12778	360	0	27066	40043	-12977	27066	33763
NER	300	0	0	1541	0	3063	0	0	0	1288	0	927	4289	3756	533	4289	3756
Total	**24226**	**38696**	**16012**	**78734**	**12384**	**38285**	**0**	**0**	**66678**	**104963**	**12735**	**8678**	**217693**	**217493**	**200**	**217693**	**206713**
		78934					**104963**							203628			

Summer (Jun'28)

Scenario 4 : Solar Max Jun 2028

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF		
NR	22%	22%	0%	40%	80%	70%	90%	0%	50%	0%	-100%	0%		93%	91%		
WR	31%	11%	28%	4%	80%	40%	85%	0%	55%	0%	-100%	0%		87%	85%		
SR	5%	4%	23%	23%	80%	40%	85%	0%	55%	0%	-100%	0%		79%	78%		
ER	26%	16%	26%	16%	80%	70%	85%	0%	0%	0%	-100%	0%		83%	81%		
NER	40%	0%	0%	-16%	80%	70%	85%	0%	0%	0%	-100%	0%		61%	60%		
	23%	13%	27%	18%										96%	299035		
Availabilit	Central	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	2628	9129	0	21560	3536	17688	77688	0	6701	86895	-10500	0	106870	101491	5379	106870	101491
WR	5963	3628	9868	3931	2592	2431	46289	0	19997	88293	-3602	0	87167	91214	-4048	87167	86714
SR	643	1603	1056	12288	6256	5285	62161	0	29619	70608	-16835	0	89808	72317	17491	89808	72317
ER	7541	2376	1164	7772	0	9818	2140	0	0	34555	-900	0	22139	41427	-19287	22139	35147
NER	300	0	0	-118	0	3063	935	0	0	3484	0	0	4298	3366	932	4298	3366
Total	**17075**	**16736**	**12088**	**45433**	**12384**	**38285**	**189234**	**0**	**56317**	**283835**	**-31837**	**0**	**310281**	**309815**	**466**	**310281**	**299035**
		45899					**283835**							293649			

36% StateTh

Scenario 5 : Peak Load Jun 2028

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF		
NR	65%	71%	0%	94%	80%	95%	0%	0%	70%	0%	50%	50%		92%	91%		
WR	69%	47%	78%	43%	80%	70%	0%	0%	75%	0%	50%	50%		84%	83%		
SR	7%	33%	36%	29%	80%	70%	0%	0%	75%	0%	50%	50%		70%	69%		
ER	45%	74%	55%	59%	80%	90%	0%	0%	0%	0%	50%	50%		91%	90%		
NER	40%	0%	0%	247%	80%	90%	0%	0%	0%	0%	50%	50%		80%	79%		
	47%	54%	72%	55%										**93%**	**292567**		
Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	7709	29630	0	50310	3536	24005	0	0	9381	40138	5250	1791	81302	101025	-19724	81302	101025
WR	13056	16109	27877	38505	2592	4254	0	0	27269	40784	1801	5069	98028	88752	9276	98028	84252
SR	852	12198	1650	15824	6256	9248	0	0	40389	32615	8418	890	79901	64003	15898	79901	64003
ER	13171	10659	2474	28768	0	12623	0	0	0	15961	450	0	39377	45180	-5803	39377	38900
NER	300	0	0	1851	0	3938	0	0	0	1609	0	927	5164	4387	777	5164	4387
Total	**35088**	**68595**	**32000**	**135258**	**12384**	**54069**	**0**	**0**	**77039**	**131108**	**15919**	**8678**	**303772**	**303347**	**425**	**303772**	**292567**
		135683					**131108**							287663			

51% StateTh

Scenario 6 : Off peak Load Jun 2028

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF		
NR	60%	54%	0%	66%	80%	70%	0%	0%	60%	0%	1%	50%		66%	65%		
WR	58%	36%	63%	37%	80%	40%	0%	0%	65%	0%	1%	50%		68%	67%		
SR	7%	23%	23%	26%	80%	40%	0%	0%	65%	0%	1%	50%		52%	51%		
ER	37%	47%	55%	50%	80%	70%	0%	0%	0%	0%	1%	50%		72%	71%		
NER	40%	0%	0%	-11%	80%	70%	0%	0%	0%	0%	1%	50%		39%	38%		
	41%	40%	58%	43%										71%	221724		
Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	7115	22759	0	35309	3536	17688	0	0	8041	32134	105	1791	61034	72875	-11841	61034	72875
WR	11022	12210	22371	32739	2592	2431	0	0	23633	32651	36	5069	79365	73087	6278	79365	68587
SR	852	8682	1056	13991	6256	5285	0	0	35004	26111	168	890	58193	47417	10777	58193	47417
ER	10811	6810	2474	24202	0	9818	0	0	0	12778	9	0	28921	36989	-7068	28921	30709
NER	300	0	0	-79	0	3063	0	0	0	1288	0	927	4289	2136	2154	4289	2136
Total	**30099**	**50461**	**25900**	**106161**	**12384**	**38285**	**0**	**0**	**66678**	**104963**	**318**	**8678**	**232803**	**232504**	**299**	**232803**	**221724**
		106460					**104963**							217925			

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Winter (Feb'29)

Scenario 7 : Solar max Feb 2029

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	50%	40%	0%	48%	80%	30%	90%	0%	10%	0%	-100%	0%		78%	77%
WR	50%	35%	50%	38%	80%	20%	90%	0%	10%	0%	-100%	0%		96%	94%
SR	50%	61%	50%	78%	80%	20%	90%	0%	0%	0%	-100%	0%		95%	93%
ER	50%	29%	50%	23%	80%	30%	90%	0%	0%	0%	-100%	0%		71%	70%
NER	50%	0%	0%	81%	80%	30%	90%	0%	0%	0%	-100%	0%		60%	59%
	50%	43%	50%	46%										96%	301478

Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	5940	16543	0	25916	3536	7581	77688	0	1340	66857	-10500	0	102128	85609	16518	102128	85609
WR	9500	11861	17801	33702	2592	1216	49012	0	3636	67730	-3602	0	92015	100422	-8406	92015	95922
SR	6435	22425	2320	42681	6256	2642	65839	0	0	54164	-16835	0	89082	86265	2816	89082	86265
ER	14690	4127	2250	11074	0	4208	2266	0	0	26507	-900	0	26641	36681	-10040	26641	30401
NER	375	0	0	609	0	1313	990	0	0	2673	0	0	2678	3281	-604	2678	3281
Total	**36940**	**54955**	**22371**	**113981**	**12384**	**16959**	**195795**	**0**	**4976**	**217730**	**-31837**	**0**	**312543**	**312258**	**285**	**312543**	**301478**
		114266					**217730**							295664			

48% StateTh

Scenario 8 : Peak Load Feb 2029

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	98%	74%	0%	96%	80%	60%	0%	0%	35%	0%	100%	50%		77%	65%
WR	98%	73%	98%	89%	80%	40%	0%	0%	20%	0%	100%	50%		103%	86%
SR	98%	66%	98%	67%	80%	40%	0%	0%	20%	0%	100%	50%		82%	68%
ER	98%	74%	98%	76%	80%	60%	0%	0%	0%	0%	100%	50%		91%	76%
NER	98%	0%	0%	467%	80%	60%	0%	0%	0%	0%	100%	50%		94%	78%
	98%	71%	98%	84%										98%	**306223**

Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	11642	30845	0	51505	3536	15161	0	0	4690	17343	10500	1791	78167	84675	-6509	78167	84675
WR	18620	24805	34890	78906	2592	2431	0	0	7272	17622	3602	5069	99281	107792	-8511	99281	103292
SR	12613	24472	4547	38537	6256	5285	0	0	10770	14093	16835	890	81668	74611	7057	81668	74611
ER	28890	10659	4410	37001	0	8416	0	0	0	6897	900	0	53275	44797	8478	53275	38517
NER	735	0	0	3506	0	2625	0	0	0	695	0	927	4287	5128	-841	4287	5128
Total	**72500**	**90780**	**43847**	**207454**	**12384**	**33918**	**0**	**0**	**22733**	**56650**	**31837**	**8678**	**316677**	**317003**	**-326**	**316677**	**306223**
		207128					**56650**							256630			

44% StateTh

Scenario 9: Off peak Load Feb 2029

Availabilit	Thermal	Thermal	Thermal	Thermal	Nuclear	Hydro	Solar	Rooftop	Wind	Other RE	ESS	Gas		National DF	Regional DF
NR	65%	49%	0%	59%	80%	30%	0%	0%	10%	0%	40%	30%		44%	43%
WR	76%	65%	85%	68%	80%	20%	0%	0%	20%	0%	40%	30%		71%	69%
SR	57%	55%	66%	63%	80%	20%	0%	0%	0%	0%	40%	30%		60%	59%
ER	70%	52%	69%	60%	80%	30%	0%	0%	0%	0%	40%	30%		62%	61%
NER	40%	0%	0%	194%	80%	30%	0%	0%	0%	0%	40%	30%		42%	42%
	68%	55%	81%	64%										65%	202160

Availabilit	Thermal	Thermal	Thermal	Reqd	Nuclear	Hydro	Solar	Solar rooftop	Wind	RE RPO	ESS	Gas	Total	Demand	Surplus/Defi	Net Availability	Net Demand
NR	7709	20618	0	31522	3536	7581	0	0	1340	7828	4200	1075	46058	48161	-2103	46058	48161
WR	14512	22307	30262	60328	2592	1216	0	0	7272	7954	1441	3042	82643	75357	7286	82643	70857
SR	7318	20186	3044	34545	6256	2642	0	0	0	6361	6734	534	46715	54430	-7715	46715	54430
ER	20558	7545	3110	29196	0	4208	0	0	0	3113	360	0	35780	32669	3111	35780	26389
NER	300	0	0	1452	0	1313	0	0	0	314	0	556	2169	2322	-154	2169	2322
Total	**50397**	**70656**	**36415**	**157043**	**12384**	**16959**	**0**	**0**	**8612**	**25571**	**12735**	**5207**	**213365**	**212940**	**425**	**213365**	**202160**
		157468					**25571**							198514			

45% StateTh

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Annex-2.2

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	13	-70	-23	-56	13	63	295	388	285	267
SAHUPU_N	PUSAULI BSPT	220	170	85	207	175	26	129	110	-6	32	267
SALAKATI	GELEPHU1	132	-37	-79	-44	-28	-48	-33	-26	-50	-31	84
RAIGR2	BUDHIPADAR	220	190	182	261	253	195	211	136	104	129	268
PUNE-III	NARENDERA NW	765	-2574	-2076	-1891	-2692	-2312	-1876	-1374	-2302	-686	3500
BALIMELA	UPPERSILERU	220	-325	-239	-393	-234	-225	-181	-86	-347	-28	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	250	0	0	250	0	0	250	0	0
IR	AGRA	BISWANATH-CH	800	250	0	0	250	0	0	250	0	0
IR	ALIPURDUAR	AGRA	800	0	300	300	0	300	300	0	300	300
IR	ALIPURDUAR	AGRA	800	0	300	300	0	300	300	0	300	300
NORTH	BAL74-PG	BHIWADI	1	0	501	501	0	501	501	0	501	501
NORTH	BAL74-PG	BHIWADI	1	0	501	501	0	501	501	0	501	501
NORTH	BHADLA-3 HVD	FATEH VSC	800	2999	300	300	2999	300	300	2999	300	300
NORTH	BHADLA-3 HVD	FATEH VSC	800	2999	300	300	2999	300	300	2999	300	300
IR	BHADR4	CHANDRAPR	70	50	50	50	50	50	50	50	50	50
IR	BHADR4	CHANDRAPR	70	50	50	50	50	50	50	50	50	50
NORTH	BHIWADI	BAL74-PG	500	1006	0	0	1006	0	0	1006	0	0
NORTH	BHIWADI	BAL74-PG	500	1006	0	0	1006	0	0	1006	0	0
NORTH	BIKANER-3	BATHINDA	800	0	0	0	0	0	0	0	0	0
NORTH	BIKANER-3	BATHINDA	800	0	0	0	0	0	0	0	0	0
IR	BISWANATH-CH	ALIPURDUAR	800	0	150	150	0	150	150	0	150	150
IR	BISWANATH-CH	ALIPURDUAR	800	0	150	150	0	150	150	0	150	150
IR	CHAMPA SPLT	KURUKSHETR	800	500	2512	2008	500	2512	2512	500	2512	2512
IR	CHAMPA_POOL	KURUKSHETR	800	500	2512	2008	500	2512	2512	500	2512	2512
IR	CHANDRAPR-SR	BHADR4	70	0	0	0	0	0	0	0	0	0
IR	CHANDRAPR-SR	BHADR4	70	0	0	0	0	0	0	0	0	0
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702
WEST	CHANDRAPUR I	PADGH4	480	702	702	702	702	702	702	702	702	702
NORTH	FATEHG-5	MODIPURAM (PG)	800	0	0	0	0	0	0	0	0	0

Area	From Name	To Name	Voltage	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9
NORTH	FATEHG-5	MODIPURAM (PG)	800	0	0	0	0	0	0	0	0	0
IR	GAZUWAKA-ER	GAZU-SR	70	327	327	327	327	327	327	327	327	327
IR	GAZUWAKA-ER	GAZU-SR	70	327	327	327	327	327	327	327	327	327
WEST	KHAVDA-II	NAGPUR-B	800	2513	0	0	2513	0	0	2512	0	0
WEST	KHAVDA-IIS	NAGPUR-A	800	2514	0	0	2514	0	0	2513	0	0
WEST	KUDUS	ARAY-220	320	1000	1000	1000	1000	1000	1000	1000	1000	1000
IR	MAHIN_HV	MUNDRA-APL	500	626	0	0	626	0	0	626	0	0
IR	MAHIN_HV	MUNDRA-APL	500	626	0	0	626	0	0	626	0	0
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	1003	0	1003	1003	0	1003	501
IR	MUNDRA-APL	MAHIN_HV	500	0	1003	1003	0	1003	1003	0	1003	501
IR	PUGALUR-NEW	RAIGARH_POOL	800	1002	1505	1002	0	1505	1002	501	0	0
IR	PUGALUR-NEW	KOTRA SPLT	800	1002	1505	1002	0	1505	1002	501	0	0
SOUTH	PUGALUR-NEW	TCR-HVDC	600	1003	1003	1003	1003	1003	1003	1003	1003	1003
SOUTH	PUGALUR-NEW	TCR-HVDC	600	1003	1003	1003	1003	1003	1003	1003	1003	1003
IR	RAIGARH_POOL	PUGALUR-NEW	800	0	0	0	1002	0	0	0	3018	1505
IR	KOTRA SPLT	PUGALUR-NEW	800	0	0	0	1002	0	0	0	3018	1505
NORTH	RIHAN-HV	DADR-HVD	500	753	753	753	753	753	753	753	753	753
NORTH	RIHAN-HV	DADR-HVD	500	753	753	753	753	753	753	753	753	753
EAST	SASARAM-ER	SASARAM-NR	70	251	251	251	251	251	251	251	251	251
IR	TALCHER	KOLAR	500	501	250	401	250	501	501	250	501	501
IR	TALCHER	KOLAR	500	501	250	401	250	501	501	250	501	501
IR	VINDH_1-2-3	VINDHYBT	70	125	125	125	125	125	125	125	125	125
IR	VINDH_1-2-3	VINDHYBT	70	125	125	125	125	125	125	125	125	125

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Annex-2.3

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	NARELA ISTS	MERUT-PG	2750	571	403	2250	366	188	1927	-33	-154	3500
NORTH	GNOIDAUP	ALIGARH	-3263	-1872	-1001	-2770	-1763	-852	-1549	-542	68	3500
WEST	RAIGARH_KOTR	KOTRA SPLT	-2070	-2471	-1609	-1523	-1915	-773	-1045	1788	1132	3500
IR	PUNE-III	NARENDERA NW	-2574	-2076	-1891	-2692	-2312	-1876	-1374	-2302	-686	3500
SOUTH	CUDP800	CUDP2_7	-2414	-1850	-1358	-2563	-1647	-839	-2173	-1439	-672	3500
SOUTH	KURNOOL-III	MAHESHWARAM	3084	1849	1769	3164	1885	1446	1731	976	348	3500
SOUTH	NIZAMABAD	NIZAMBD2_7	-2538	-1746	-1463	-2691	-1715	-1036	-2159	-1645	-675	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	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
NORTH	BAGLIHAR4	NEWWANPO	1	1104	766	378	952	584	358	946	804	405	857
NORTH	KISHENPUR	CHAMERA-2	1	909	439	273	719	263	180	314	-13	-167	857
NORTH	KISTAWAR	PAKALDUL	1	-904	-1367	-1008	-1008	-1367	-1008	-433	-864	-433	1714
NORTH	KISTAWAR	KIRU	1	-424	-601	-444	-444	-601	-443	-190	-380	-190	857
NORTH	WANGTOO	JANGI-THOPAN	1	-522	-231	-170	-521	-231	-170	-424	-146	-73	560
NORTH	CHAMERA-2	CHAM-POL	1	604	371	245	502	270	191	220	65	-63	857
NORTH	PARBT-PO	HAMIRPUR	1	610	611	422	513	531	424	411	524	277	857
NORTH	RAJPURA4	BHIWANI	1	-657	-141	42	-398	129	110	-365	13	101	857
NORTH	MOGA SPLT4	BHIWANI-PG	1	-690	-250	-55	-457	16	6	-432	-110	26	857
NORTH	MALERKOTLA4	KURUKSHETR	2	-688	-616	-379	-403	-320	-410	-477	-505	-418	857
NORTH	MALERKOTLA4	KAITHAL	1	-649	-108	67	-361	214	150	-401	-20	114	857
NORTH	BHIWANI	BHIWANI-PG	1	-1114	-376	-69	-791	-68	39	-608	-118	126	857
NORTH	BHIWANI-PG	JINDPG	2	1017	127	-111	733	-100	-247	444	-111	-363	857
NORTH	MERTA	JODH KANKANI	1	-703	-353	-321	-686	-305	-232	-487	-216	-45	857
NORTH	RAMGARH	BHADLA	2	494	812	755	425	743	576	-41	577	170	857
NORTH	BHADLA	BIKANE-4	1	1156	249	231	1213	231	157	1023	190	24	1714
NORTH	KOTA	ANTA-4	1	155	-24	-38	92	-197	-116	-220	-640	-489	857
NORTH	BABAI	SIKAR	1	-608	-93	29	-490	-7	80	-313	81	156	857
NORTH	CHIT-NEW	SIROHI	1	-361	-164	-136	-414	-210	-104	-389	-243	-111	560
NORTH	BASSI	KOTPUT	1	603	400	194	388	319	136	4	-114	-152	857
NORTH	SIKAR	BIKANE-4	1	-604	-193	-135	-510	-166	-97	-401	-43	11	857
NORTH	DAUSA	AGRA	1	634	251	174	510	208	92	226	-96	-110	857
NORTH	DAUSA	AGRA	2	634	251	174	510	208	92	226	-96	-110	857
NORTH	MEJA	ALLAHABA	1	438	697	383	442	678	456	427	598	291	857

Area	From Name	To Name	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
NORTH	BAGPAT	MEERUT	1	-709	-190	2	-516	3	68	-477	-140	60	857
NORTH	AGRAUP4	AGRA	2	-968	-787	-572	-733	-749	-482	-210	-180	-53	857
NORTH	NOIIDA-148	NOIDA-SEC123	1	605	498	343	495	459	332	455	403	211	857
NORTH	DADR-NCR	GNOIDA4	1	506	1093	1410	565	1173	1323	812	1249	1114	1988
NORTH	LUCK74-P	KANPRNEW	1	-651	-405	-346	-588	-357	-300	-494	-155	-140	857
NORTH	ANPARA4	SINGRL4	1	-170	-468	-909	-133	-416	-730	-295	-546	-756	857
NORTH	BAREILY	KHURPIA FARM	1	410	0	61	0	214	82	0	0	0	560
NORTH	KHURJA TPS	ALIGARH	1	662	358	277	577	355	219	340	45	-10	857
NORTH	SIDCL HARDWR	ROORKEE	1	429	479	318	340	403	212	131	325	80	560
NORTH	SIDCL HARDWR	RISHIKE4_PT	1	-602	-612	-402	-481	-537	-281	-281	-515	-180	560
NRTHEAST	APDCL	BOKAJAN	1	880	0	0	935	0	0	990	0	0	1100
WEST	KNTPC	BHATP4	1	364	505	461	379	477	481	461	610	576	857
WEST	KHANDWA-4	CHEGAON	1	199	455	339	463	320	264	693	650	5	857
WEST	KARAD4	JEJ4	3	528	654	555	569	700	563	265	522	227	857
WEST	RGPPL	NAGOTHANE	1	461	558	501	454	614	517	271	558	257	857
WEST	PUNE-PG-AIS	VIKROLI400	1	482	446	295	573	566	454	454	618	287	857
EAST	KAHALGAON-B	FARAKKA	1	468	210	251	450	137	167	826	630	548	852
EAST	SAGARDIGHI_4	FARAKKA	1	-889	-337	-502	-820	-407	-493	-600	-472	-478	1093
EAST	PPSP_NEW	RANCHI-NEW	1	-875	-397	-367	-790	-413	-385	-727	-224	-258	1093
EAST	RANCHI	RNC-SIPT FSC	2	-705	-622	-670	-677	-618	-538	-285	-45	-151	850
SOUTH	NSAGAR	FSC-3	1	-776	-194	-330	-765	-263	-282	-355	56	-40	948
SOUTH	VIJW	VIJTP-IV	1	-657	-224	-283	-737	-209	-128	-172	198	234	874
SOUTH	CUDP	CHITOR	1	773	472	249	639	366	126	805	94	-37	852
SOUTH	CUDP	ANANTPUR	1	-1713	-553	-368	-1827	-496	-315	-1563	-281	-122	2186
SOUTH	CUDP	FSC-3	1	814	197	336	801	267	287	362	-55	40	948
SOUTH	GOOT	FSC-1	1	104	277	-9	315	185	27	804	520	301	948

Area	From Name	To Name	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	Thermal Limit
SOUTH	GOOT	FSC-2	2	144	298	38	241	211	48	686	376	209	948
SOUTH	KURNOOL4	SSLBPH4	1	1294	301	450	1257	352	396	685	-245	-60	850
SOUTH	SIMHADRI	SIMHD-II	1	-556	-112	-205	-647	-167	-200	-416	-273	-124	852
SOUTH	FSC-1	NELMANG4	1	104	277	-9	315	185	27	804	520	301	948
SOUTH	FSC-2	SMNH	2	144	298	38	241	211	48	686	376	209	948
SOUTH	HYDERABAD	MAHESWRM	1	-1658	-746	-808	-1586	-832	-638	-1234	-205	-353	874
SOUTH	DAVANGR_4	KOPPAL PS-II	1	900	1129	918	952	1079	723	417	721	200	1600
SOUTH	SPBUDUR4	SVCHTRM	1	291	552	199	-68	417	150	681	330	128	852
SOUTH	MALEKTT	TIRUVLM SE-A	1	-524	-526	-307	-462	-490	-257	-672	-428	-196	850
SOUTH	EDARPLYM	COIMBTR4	1	-197	-285	-91	28	-282	-131	-669	-83	-131	857

Note: Highlighted cell indicates Power flow > 70% of Thermal limit

Annex-2.4

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	-1161	-327	-19	-922	-97	109	-621	-8	241	1000
NORTH	BHIWANI-PG	400	BHIWN-PG	765	-1161	-327	-19	-922	-97	109	-621	-8	241	1000
NORTH	BHADLA-2	400	BHADLA-2	765	1315	108	94	1257	85	70	1172	31	-11	1500
NORTH	BHADLA-2	400	BHADLA-2	765	1315	108	94	1257	85	70	1172	31	-11	1500
NORTH	BHADLA-2	400	BHADLA-2	765	1315	108	94	1257	85	70	1172	31	-11	1500
NORTH	BHADLA-2	400	BHADLA-2	765	1315	108	94	1257	85	70	1172	31	-11	1500
WEST	SIPAT4	400	SIPAT	765	-834	-596	-580	-766	-628	-519	-467	-211	-181	1000
EAST	DUBURI ISTS	400	DUBURI ISTS	765	-1254	-1034	-1244	-1178	-1086	-989	-839	-765	-656	1500
SOUTH	KURNOOL-III	400	KURNOOL-III	765	1316	504	475	1354	524	493	841	90	-41	1500
SOUTH	KURNOOL-III	400	KURNOOL-III	765	1316	504	475	1354	524	493	841	90	-41	1500
SOUTH	KURNOOL-III	400	KURNOOL-III	765	1316	504	475	1354	524	493	841	90	-41	1500
SOUTH	KURNOOL-III	400	KURNOOL-III	765	1316	504	475	1354	524	493	841	90	-41	1500
SOUTH	KURNOOL-III	400	KURNOOL-III	765	1316	504	475	1354	524	493	841	90	-41	1500
SOUTH	NIZAMABAD	400	NIZAMABAD	765	-1061	-516	-518	-1003	-586	-455	-1237	-330	-608	1500
SOUTH	NIZAMABAD	400	NIZAMABAD	765	-1061	-516	-518	-1003	-586	-455	-1237	-330	-608	1500
SOUTH	NIZAMABAD	400	NIZAMABAD	765	-1061	-516	-518	-1003	-586	-455	-1237	-330	-608	1500
SOUTH	MAHESWRM	400	MAHESHWARAM	765	-1215	-724	-563	-1291	-683	-494	-1244	-385	-493	1500
SOUTH	MAHESWRM	400	MAHESHWARAM	765	-1215	-724	-563	-1291	-683	-494	-1244	-385	-493	1500
SOUTH	ARIYALUR4	400	ARIYALUR7	765	-573	-910	-352	-323	-837	-341	-1441	-690	-341	1500
SOUTH	COIMBTR4	400	COIMBTR7	765	-382	-476	-145	-212	-473	-218	-1238	-522	-381	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	Id	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	1	-551	-379	-204	-448	-266	-186	-438	-362	-181	315
NORTH	KISHENPUR	220	KISHENPUR	400	2	-551	-379	-204	-448	-266	-186	-438	-362	-181	315
NORTH	PANG220SP2	220	PANG400SP2	400	1	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP2	220	PANG400SP2	400	2	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP2	220	PANG400SP2	400	3	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP2	220	PANG400SP2	400	4	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP2	220	PANG400SP2	400	5	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP3	220	PANG400SP3	400	1	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP3	220	PANG400SP3	400	2	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP3	220	PANG400SP3	400	3	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP3	220	PANG400SP3	400	4	271	0	0	271	0	0	271	0	0	315
NORTH	PANG220SP3	220	PANG400SP3	400	5	271	0	0	271	0	0	271	0	0	315
NORTH	PATRAN42	220	PATRAN4	400	1	-471	-280	-149	-319	-113	-123	-263	-142	-56	500
NORTH	PATRAN42	220	PATRAN4	400	2	-471	-280	-149	-319	-113	-123	-263	-142	-56	500
NORTH	ROPAR42	220	ROPAR4	400	1	-402	-312	-189	-318	-216	-152	-146	-119	-38	500
NORTH	MALERKOTLA4	220	MALERKOTLA	400	1	-259	-198	-119	-183	-114	-111	-132	-104	-53	315
NORTH	MALERKOTLA4	220	MALERKOTLA	400	2	-259	-198	-119	-183	-114	-111	-132	-104	-53	315
NORTH	MOGA42	220	MOGA SPLT4	400	1	-260	-204	-134	-192	-133	-123	-132	-101	-44	315
NORTH	MOGA42	220	MOGA SPLT4	400	2	-411	-322	-213	-304	-210	-195	-209	-160	-69	500
NORTH	MOGA42	220	MOGA SPLT4	400	3	-411	-322	-213	-304	-210	-195	-209	-160	-69	500
NORTH	LUDHIANA42	220	LUDHIANA4	400	1	-261	-222	-147	-187	-146	-140	-146	-130	-66	315
NORTH	LUDHIANA42	220	LUDHIANA4	400	2	-414	-351	-233	-296	-230	-221	-231	-206	-104	500
NORTH	LUDHIANA42	220	LUDHIANA4	400	3	-414	-351	-233	-296	-230	-221	-231	-206	-104	500
NORTH	JALANDHAR42	220	JALANDHAR4	400	1	-256	-198	-140	-178	-128	-129	-174	-146	-73	315
NORTH	JALANDHAR42	220	JALANDHAR4	400	2	-256	-198	-140	-178	-128	-129	-174	-146	-73	315

Area	From Name	Voltage	To Name	Voltage	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
NORTH	PATIALA42	220	PATIALA4	400	1	-272	-215	-134	-198	-134	-123	-143	-115	-52	315
NORTH	PATIALA42	220	PATIALA4	400	2	-272	-215	-134	-198	-134	-123	-143	-115	-52	315
NORTH	PATIALA42	220	PATIALA4	400	3	-432	-341	-212	-314	-212	-195	-227	-182	-83	500
NORTH	HISAR-PG	220	HISSAR	400	1	-252	-172	-93	-210	-126	-65	-134	-113	-13	315
NORTH	HISAR-PG	220	HISSAR	400	2	-252	-172	-93	-210	-126	-65	-134	-113	-13	315
NORTH	DEEDWANA-42	220	DEEDWANA	400	1	-216	-155	-130	-266	-182	-115	-229	-149	-98	315
NORTH	HINDAU-4	220	HINDAU-4	400	1	-199	-184	-160	-277	-235	-155	-273	-235	-165	315
NORTH	HIRAPURA	220	HERAPU-4	400	1	-226	-193	-167	-320	-242	-156	-300	-228	-154	315
NORTH	HIRAPURA	220	HERAPU-4	400	2	-179	-153	-132	-254	-192	-124	-238	-181	-122	250
NORTH	HIRAPURA	220	HERAPU-4	400	3	-179	-153	-132	-254	-192	-124	-238	-181	-122	250
NORTH	CHITTOR-42	220	CHITTOR4	400	1	-171	-152	-118	-306	-210	-100	-310	-185	-136	315
NORTH	CHITTOR-42	220	CHITTOR4	400	2	-171	-152	-118	-306	-210	-100	-310	-185	-136	315
NORTH	AKAL-2	220	AKAL-4	400	1	535	550	581	512	544	517	135	324	86	500
NORTH	AKAL-2	220	AKAL-4	400	2	535	550	581	512	544	517	135	325	86	500
NORTH	AKAL-2	220	AKAL-4	400	3	535	550	581	512	544	517	135	325	86	500
NORTH	BASSI	220	BASSI	400	1	-203	-161	-140	-275	-202	-130	-254	-179	-123	315
NORTH	BASSI	220	BASSI	400	2	-203	-161	-140	-275	-202	-130	-254	-179	-123	315
NORTH	BHADLA-S	220	BHADLA	400	1	525	4	-16	433	-40	-23	349	-124	-113	500
NORTH	BHADLA-S	220	BHADLA	400	2	525	4	-16	433	-40	-23	349	-124	-113	500
NORTH	BHADLA-S	220	BHADLA	400	3	525	4	-16	433	-40	-23	349	-124	-113	500
NORTH	AJMER42	220	AJMER	400	1	-118	-170	-154	-256	-231	-145	-259	-235	-172	315
NORTH	BHIWADI	220	BHIWADI	400	1	-173	-225	-185	-226	-254	-173	-187	-228	-152	315
NORTH	BHIWADI	220	BHIWADI	400	2	-174	-225	-185	-226	-254	-173	-187	-228	-152	315
NORTH	JODHPURN-42	220	JODH KANKANI	400	1	-11	-130	-147	-113	-203	-154	-162	-309	-242	315
NORTH	BHADLA-PG	220	BHADLA PG	400	1	458	0	0	458	0	0	458	0	0	500
NORTH	BHADLA-PG	220	BHADLA PG	400	2	458	0	0	458	0	0	458	0	0	500
NORTH	BHADLA-PG	220	BHADLA PG	400	3	458	0	0	458	0	0	458	0	0	500

Area	From Name	Voltage	To Name	Voltage	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
NORTH	BHADLA-PG	220	BHADLA PG	400	4	458	0	0	458	0	0	458	0	0	500
NORTH	BHADLA-PG	220	BHADLA PG	400	5	458	0	0	458	0	0	458	0	0	500
NORTH	RAMGARH_RE	220	RAMGARH	400	1	191	438	412	170	399	295	-36	408	144	500
NORTH	RAMGARH_RE	220	RAMGARH	400	2	191	438	412	170	399	295	-36	408	144	500
NORTH	RAMGARH_RE	220	RAMGARH	400	3	191	438	412	170	399	295	-36	408	144	500
NORTH	RAMGARH-I	220	RAMG-I	400	1	439	0	0	439	0	0	439	0	0	500
NORTH	FATEH-2	220	FATEHG-2	400	1	405	0	0	405	0	0	405	0	0	500
NORTH	FATEH-2	220	FATEHG-2	400	2	405	0	0	405	0	0	405	0	0	500
NORTH	FATEH-2	220	FATEHG-2	400	3	405	0	0	405	0	0	405	0	0	500
NORTH	FATEH-2	220	FATEHG-2	400	4	405	0	0	405	0	0	405	0	0	500
NORTH	FATEH-2	220	FATEHG-2	400	5	405	0	0	405	0	0	405	0	0	500
NORTH	FATEHG-3	220	FATEHG-3	400	1	472	0	0	472	0	0	472	0	0	500
NORTH	FATEHG-3	220	FATEHG-3	400	2	472	0	0	472	0	0	472	0	0	500
NORTH	FATEHG-3	220	FATEHG-3	400	3	472	0	0	472	0	0	472	0	0	500
NORTH	FATEHG-3	220	FATEHG-3	400	4	472	0	0	472	0	0	472	0	0	500
NORTH	FATEHG-4	220	FATEHG-4	400	1	402	0	0	402	0	0	402	0	0	500
NORTH	FATEHG-4	220	FATEHG-4	400	2	402	0	0	402	0	0	402	0	0	500
NORTH	FATEHG-4	220	FATEHG-4	400	3	402	0	0	402	0	0	402	0	0	500
NORTH	FATEHG-4	220	FATEHG-4	400	4	402	0	0	402	0	0	402	0	0	500
NORTH	BHADLA-3	220	BHADLA-3	400	1	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA-3	220	BHADLA-3	400	2	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA-3	220	BHADLA-3	400	3	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA-3	220	BHADLA-3	400	4	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA-2	220	BHADLA-2	400	1	474	0	0	474	0	0	474	0	0	500
NORTH	BHADLA-2	220	BHADLA-2	400	2	474	0	0	474	0	0	474	0	0	500
NORTH	BHADLA-2	220	BHADLA-2	400	3	474	0	0	474	0	0	474	0	0	500
NORTH	BHADLA-2	220	BHADLA-2	400	4	474	0	0	474	0	0	474	0	0	500

Area	From Name	Voltage	To Name	Voltage	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
NORTH	BHAD-2 SPLT	220	BHADLA-2	400	1	462	0	0	462	0	0	461	0	0	500
NORTH	BHAD-2 SPLT	220	BHADLA-2	400	2	462	0	0	462	0	0	461	0	0	500
NORTH	BIKANER-3	220	BIKANER-3	400	1	406	153	111	406	127	3	406	277	111	500
NORTH	BIKANER-3	220	BIKANER-3	400	2	406	153	111	406	127	3	406	277	111	500
NORTH	BIKANER-3	220	BIKANER-3	400	3	406	153	111	406	127	3	406	277	111	500
NORTH	BIKANER-3	220	BIKANER-3	400	4	406	153	111	406	127	3	406	277	111	500
NORTH	KOTA	220	KOTA	400	1	-197	-191	-181	-338	-232	-153	-340	-275	-200	315
NORTH	FATEH-SPL 2	220	FATEHG-2	400	1	401	0	0	401	0	0	401	0	0	500
NORTH	FATEH-SPL 2	220	FATEHG-2	400	2	401	0	0	401	0	0	401	0	0	500
NORTH	FATEH-SPL 2	220	FATEHG-2	400	3	401	0	0	401	0	0	401	0	0	500
NORTH	FATEH-SPL 2	220	FATEHG-2	400	4	401	0	0	401	0	0	401	0	0	500
NORTH	FATEH-SPL 2	220	FATEHG-2	400	5	401	0	0	401	0	0	401	0	0	500
NORTH	BHADLA3-SPL	220	BHADLA-3	400	1	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA3-SPL	220	BHADLA-3	400	2	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA3-SPL	220	BHADLA-3	400	3	439	0	0	439	0	0	439	0	0	500
NORTH	BHADLA3-SPL	220	BHADLA-3	400	4	439	0	0	439	0	0	439	0	0	500
NORTH	OBRA2	220	OBRA4	400	1	-179	-270	-200	-171	-270	-209	-155	-242	-144	315
NORTH	OBRA2	220	OBRA4	400	2	-179	-270	-200	-171	-270	-209	-155	-242	-144	315
NORTH	ALIGARH	220	ALIGARH	400	1	-391	-387	-272	-369	-408	-282	-287	-285	-141	500
NORTH	KANPU-PG	220	KANPUR	400	1	-300	-221	-173	-274	-224	-161	-164	-75	-52	315
WEST	RAIPUR2	220	RAIPUR SPLT	400	1	-150	-163	-138	-139	-175	-138	-200	-262	-195	315
WEST	RAIPUR2	220	RAIPUR SPLT	400	2	-150	-163	-138	-139	-175	-138	-200	-262	-195	315
WEST	BHILAI	220	BHI4	400	1	-227	-222	-197	-216	-225	-181	-233	-268	-228	315
WEST	BHILAI	220	BHI4	400	2	-227	-222	-197	-216	-225	-181	-233	-268	-228	315
WEST	RAIPUR POOL	220	RAIPUR_POOL	400	1	-258	-165	-116	-210	-182	-121	-236	-184	-83	315
WEST	RAIPUR POOL	220	RAIPUR_POOL	400	2	-258	-165	-116	-210	-182	-121	-236	-184	-83	315
WEST	GANDHAR	220	GANCS4	400	1	-203	-8	45	-254	-62	-21	-243	-98	-47	315

Area	From Name	Voltage	To Name	Voltage	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
WEST	SUGEN	220	SUGEN	400	1	-221	-176	-121	-303	-249	-195	-267	-272	-150	315
WEST	SUGEN	220	SUGEN	400	2	-221	-176	-121	-303	-249	-195	-267	-272	-150	315
WEST	MUNDRA-APL	220	MUNDRA-APL	400	1	112	338	294	102	207	225	-36	89	64	315
WEST	ZERDA2	220	ZERDA	400	1	-101	-112	-75	-162	-188	-153	-178	-264	-164	315
WEST	ZERDA2	220	ZERDA	400	2	-101	-112	-75	-162	-188	-153	-178	-264	-164	315
WEST	ZERDA2	220	ZERDA	400	3	-101	-112	-75	-162	-188	-153	-178	-264	-164	315
WEST	HALWAD NEW	220	HALVAD NEW	400	1	-80	15	17	-127	-82	-54	-225	-265	-195	315
WEST	VADODARAPG	220	VADODARA	400	1	-306	-230	-163	-446	-344	-265	-370	-354	-161	500
WEST	NAVSARI-NEW	220	NAVSARI-NEW	400	1	-322	-182	-103	-452	-287	-203	-385	-328	-159	500
WEST	NAVSARI-NEW	220	NAVSARI-NEW	400	2	-322	-182	-103	-452	-287	-203	-385	-328	-159	500
WEST	INDORE-42	220	INDORE-4	400	1	-168	-147	-120	-183	-161	-103	-258	-227	-129	315
WEST	INDORE-42	220	INDORE-4	400	2	-168	-147	-120	-183	-161	-103	-258	-227	-129	315
WEST	INDORE-42	220	INDORE-4	400	3	-168	-147	-120	-183	-161	-103	-258	-227	-129	315
WEST	MANDSOUR-42	220	MANDSAUR-4	400	1	-144	-123	-69	-159	-107	-54	-264	-222	-85	315
WEST	DATIYA NEW2	220	DATIYA NEW4	400	1	-313	-127	-107	-345	-165	-125	-484	-303	-193	500
WEST	WARDH_PG	220	WARDHA SPLT	400	2	-273	-148	-107	-254	-142	-140	-242	-145	-77	315
WEST	WARDH_PG	220	WARDHA SPLT	400	3	-273	-148	-107	-254	-142	-140	-242	-145	-77	315
WEST	KHARGR22	220	KHARGAR	400	1	-239	-180	-97	-245	-205	-180	-279	-256	-190	315
WEST	KHARGR22	220	KHARGAR	400	2	-239	-180	-97	-245	-205	-180	-279	-256	-190	315
WEST	NAGOTHA2	220	NAGOTHANE	400	1	-268	-121	-164	-197	-126	-143	-211	-146	-145	315
WEST	NAGOTHA2	220	NAGOTHANE	400	2	-424	-191	-260	-312	-199	-227	-335	-231	-230	500
WEST	PADGHE22	220	PADGH4	400	1	-426	-442	-319	-461	-486	-421	-448	-544	-372	600
WEST	PADGHE22	220	PADGH4	400	2	-345	-359	-259	-376	-396	-343	-365	-442	-302	500
WEST	PADGHE22	220	PADGH4	400	3	-219	-227	-164	-237	-249	-216	-230	-280	-191	315
WEST	PADGHE22	220	PADGH4	400	4	-219	-227	-164	-237	-249	-216	-230	-280	-191	315
WEST	NAVI-MUM220	220	NAVI-MUM	400	1	-249	-180	-103	-254	-204	-182	-289	-255	-196	315
WEST	VIKROLI220	220	VIKROLI400	400	1	-389	-324	-179	-412	-377	-327	-450	-445	-305	500

Area	From Name	Voltage	To Name	Voltage	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
WEST	VIKROLI220	220	VIKROLI400	400	2	-389	-324	-179	-412	-377	-327	-450	-445	-305	500
WEST	KALLAM	220	KALLAM	400	1	336	491	426	336	491	426	61	131	131	500
WEST	KALLAM	220	KALLAM	400	2	336	491	426	336	491	426	61	131	131	500
WEST	KALLAM	220	KALLAM	400	3	336	491	426	336	491	426	61	131	131	500
EAST	DUBRI NEW	220	DUBURI	400	1	-338	-314	-366	-340	-352	-303	-216	-273	-231	315
EAST	MENDHASAL	220	MENDHASAL	400	1	-260	-293	-311	-289	-304	-280	-217	-301	-239	315
EAST	MENDHASAL	220	MENDHASAL	400	2	-260	-293	-311	-289	-304	-280	-217	-301	-239	315
EAST	LAPANGA2	220	LAPANGA	400	1	-315	-286	-322	-317	-312	-289	-280	-318	-236	315
EAST	KTPS220	220	KOLAGHAT	400	1	-381	-275	-232	-315	-290	-194	-276	-246	-173	315
EAST	CHANDITALA_N	220	CHANDITALA_N	400	1	-369	-350	-282	-316	-369	-235	-279	-319	-229	315
EAST	CHANDITALA_N	220	CHANDITALA_N	400	2	-369	-350	-282	-316	-369	-235	-279	-319	-229	315
EAST	KHARAGPR-WB	220	KHARAGPR-WB	400	1	-323	-297	-230	-270	-307	-194	-237	-261	-179	315
EAST	KHARAGPR-WB	220	KHARAGPR-WB	400	2	-323	-297	-230	-270	-307	-194	-237	-261	-179	315
EAST	GOKARNA	220	GOKARNA	400	1	-283	-261	-226	-249	-284	-199	-208	-256	-192	315
EAST	GOKARNA	220	GOKARNA	400	2	-283	-261	-226	-249	-284	-199	-208	-256	-192	315
EAST	DURGAPUR-A	220	DURGAPUR-B	400	1	-247	-261	-258	-267	-273	-275	-224	-267	-230	315
EAST	DURGAPUR-A	220	DURGAPUR-B	400	2	-247	-261	-258	-267	-273	-275	-224	-267	-230	315
EAST	JEERAT	220	JEERAT	400	1	-300	-309	-242	-255	-313	-200	-235	-284	-200	315
EAST	JEERAT	220	JEERAT	400	2	-300	-309	-242	-255	-313	-200	-235	-284	-200	315
EAST	JEERAT	220	JEERAT	400	3	-300	-309	-242	-255	-313	-200	-235	-284	-200	315
EAST	BIDHANNGR-WB	220	BIDHAN NGR	400	1	-269	-203	-208	-240	-214	-188	-177	-196	-162	315
EAST	BIDHANNGR-WB	220	BIDHAN NGR	400	2	-269	-203	-208	-240	-214	-188	-177	-196	-162	315
EAST	DURGAPUR TPS	220	DURGAPUR TPS	400	1	-362	-487	-389	-386	-497	-415	-327	-451	-375	500
EAST	MEJIA-B	220	MEJIA-B	400	1	-243	-250	-259	-274	-255	-269	-242	-253	-242	315
SOUTH	CHINAKAMPALL	220	CUDP	400	1	-224	-127	-97	-268	-135	-83	-176	-81	-76	315
SOUTH	CHINAKAMPALL	220	CUDP	400	2	-224	-127	-97	-268	-135	-83	-176	-81	-76	315
SOUTH	TALLAPALLI	220	NSAGAR	400	1	-225	-4	-23	-262	-18	-55	-196	55	-9	315

Area	From Name	Voltage	To Name	Voltage	Id	P-Sc1	P-Sc2	P-Sc3	P-Sc4	P-Sc5	P-Sc6	P-Sc7	P-Sc8	P-Sc9	MVA Rating
SOUTH	TALLAPALLI	220	NSAGAR	400	2	-225	-4	-23	-262	-18	-55	-196	55	-9	315
SOUTH	GUTTUR	220	DAVAN4	400	1	-29	-32	9	-130	-13	-20	-324	-216	-183	315
SOUTH	NARENDRA	220	NAREND-4	400	1	-5	-3	45	-182	42	30	-480	-260	-271	500
SOUTH	KOPPAL	220	KOPPAL	400	1	292	414	359	292	414	359	0	111	0	500
SOUTH	KOPPAL	220	KOPPAL	400	2	292	414	359	292	414	359	0	111	0	500
SOUTH	KOPPAL	220	KOPPAL	400	3	292	414	359	292	414	359	0	111	0	500
SOUTH	KOPPAL	220	KOPPAL	400	4	292	414	359	292	414	359	0	111	0	500
SOUTH	NLCTS22	230	NYVL TS 2	400	1	-166	-196	-177	-181	-164	-125	-143	-229	-102	250
SOUTH	ALUNDR42	230	TRICHY	400	1	-154	-208	-149	-130	-198	-139	-239	-257	-137	315
SOUTH	ALUNDR42	230	TRICHY	400	2	-154	-208	-149	-130	-198	-139	-239	-257	-137	315
SOUTH	NNTPS2	230	NEY(REP)4	400	1	-241	-376	-199	-207	-396	-231	-496	-429	-235	500

- **Note: Highlighted cell indicates Power flow > 80% of MVA rating**

Annex-2.5

N-1 Contingency of 765 kV Transmission Lines

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	4709.92	4825.39	3500	137.87	SC-1
508049 KURNOOL-III 765.00 518051 MAHESHWARAM 765.00 1	OPEN LINE FROM BUS 508049 [KURNOOL-III 765.00] TO BUS 518051 [MAHESHWARAM 765.00] CKT 2	4158.82	4229.19	3500	120.83	SC-1
508007 CUDP800 765.00 508888 CUDP2_7 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508888 [CUDP2_7 765.00] CKT 2	4101.63	4197.88	3500	119.94	SC-1
378901 PUNE-III 765.00 528002 NARENDERA NW765.00 1	OPEN LINE FROM BUS 378901 [PUNE-III 765.00] TO BUS 528002 [NARENDERA NW765.00] CKT 2	3637.59	3888.54	3500	111.1	SC-1
177265 GNOIDAUP 765.00 177512 ALIGARH 765.00 1	OPEN LINE FROM BUS 157001 [NARELA ISTS 765.00] TO BUS 177707 [MERUT-PG 765.00] CKT 2	3829.47	3844.04	3802	101.11	SC-1
318031 TAMNAR 765.00 318998 DHRAM_SPL 765.00 1	OPEN LINE FROM BUS 318031 [TAMNAR 765.00] TO BUS 318998 [DHRAM_SPL 765.00] CKT 2	3959.82	3993.81	4363	91.54	SC-1
318031 TAMNAR 765.00 318998 DHRAM_SPL 765.00 1	OPEN LINE FROM BUS 318031 [TAMNAR 765.00] TO BUS 318998 [DHRAM_SPL 765.00] CKT 2	4076.59	4067.57	4363	93.23	SC-2
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	5012.8	5149.75	3500	147.14	SC-4
508007 CUDP800 765.00 508888 CUDP2_7 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508888 [CUDP2_7 765.00] CKT 2	4352.95	4485.78	3500	128.17	SC-4
508049 KURNOOL-III 765.00 518051 MAHESHWARAM 765.00 1	OPEN LINE FROM BUS 508049 [KURNOOL-III 765.00] TO BUS 518051 [MAHESHWARAM 765.00] CKT 2	4276.66	4365.53	3500	124.73	SC-4
378901 PUNE-III 765.00 528002 NARENDERA NW765.00 1	OPEN LINE FROM BUS 378901 [PUNE-III 765.00] TO BUS 528002 [NARENDERA NW765.00] CKT 2	3813.23	3962.45	3500	113.21	SC-4
318031 TAMNAR 765.00 318998 DHRAM_SPL 765.00 1	OPEN LINE FROM BUS 318031 [TAMNAR 765.00] TO BUS 318998 [DHRAM_SPL 765.00] CKT 2	4842.87	4837.79	4363	110.88	SC-5

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
518062 NIZAMABAD 765.00 518888 NIZAMBD2_7 765.00 1	OPEN LINE FROM BUS 518062 [NIZAMABAD 765.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 2	4004.24	4066.61	3500	116.19	SC-7
508007 CUDP800 765.00 508888 CUDP2_7 765.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508888 [CUDP2_7 765.00] CKT 2	3723	3713.5	3500	106.1	SC-7

N-1 Contingency of 400 kV Transmission Lines

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 518051 [MAHESHWARAM 765.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 1	1815.48	1865.49	874	213.44	SC-1
114401 BAGLIHAR4 400.00 114476 NEWWANPO 400.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	1491.52	1493	857	174.21	SC-1
144469 BHIWANI-PG 400.00 144480 JINDPG 400.00 1	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 144480 [JINDPG 400.00] CKT 2	1370.02	1406.34	857	164.1	SC-1
124001 WANGTOO 400.00 124041 JANGI-THOPAN400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124042 [SHANGTONG 400.00] CKT 1	914.67	914.59	560	163.32	SC-1
504013 KURNOOL4 400.00 514011 SSLBPH4 400.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	1369.41	1373.25	850	161.56	SC-1
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1328.57	1328.57	857	155.03	SC-1
144420 BHIWANI 400.00 144469 BHIWANI-PG 400.00 1	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 144480 [JINDPG 400.00] CKT 1	1251.86	1285.05	857	149.95	SC-1
444010 SAGARDIGHI_4400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	1504.96	1558.02	1093	142.55	SC-1
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	1202.57	1202.57	857	140.32	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	1188.62	1190.9	850	140.11	SC-1
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	1000.29	1130.77	857	131.94	SC-1
194272 SIDCL HARDWR400.00 194426 RISHIKE4_PT 400.00 1	OPEN LINE FROM BUS 174001 [NEHTAUR 400.00] TO BUS 194426 [RISHIKE4_PT 400.00] CKT 1	699.65	709.28	560	126.66	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
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	2109.98	2109.98	1714	123.1	SC-1
114422 KISHENPUR 400.00 124401 CHAMERA-2 400.00 1	OPEN LINE FROM BUS 114401 [BAGLIHAR4 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	1012.27	1032.39	857	120.47	SC-1
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	1012.71	1022.16	857	119.27	SC-1
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	983.51	1017.85	857	118.77	SC-1
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	998.36	1016.24	857	118.58	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	1265.69	1265.69	1093	115.8	SC-1
524886 DAVANGR_4 400.00 524888 KOPPAL PS-II400.00 1	OPEN LINE FROM BUS 524886 [DAVANGR_4 400.00] TO BUS 524888 [KOPPAL PS-II400.00] CKT 2	1774.78	1824.68	1600	114.04	SC-1
114422 KISHENPUR 400.00 114476 NEWWANPO 400.00 1	OPEN LINE FROM BUS 114401 [BAGLIHAR4 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	1213.11	1237.23	1093	113.2	SC-1
504007 CUDP 400.00 504025 ANANTPUR 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504025 [ANANTPUR 400.00] CKT 2	2460.41	2460.41	2186	112.55	SC-1
124401 CHAMERA-2 400.00 124448 CHAM-POL 400.00 1	OPEN LINE FROM BUS 124401 [CHAMERA-2 400.00] TO BUS 124411 [CHAMERA-1 400.00] CKT 1	947.94	957.81	857	111.76	SC-1
174491 KHURJA TPS 400.00 174512 ALIGARH 400.00 1	OPEN LINE FROM BUS 177265 [GNOIDAUP 765.00] TO BUS 177512 [ALIGARH 765.00] CKT 1	944.58	949.45	857	110.79	SC-1
504026 VIJ-AP 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	916.97	935.91	852	109.85	SC-1
164400 MERTA 400.00 164434 JODH KANKANI400.00 1	OPEN LINE FROM BUS 167773 [JAIPUR 765.00] TO BUS 167799 [JODH KANKANI765.00] CKT 1	882.88	903	857	105.37	SC-1
124041 JANGI-THOPAN400.00 124042 SHANGTONG 400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124041 [JANGI-THOPAN400.00] CKT 1	589.17	589.03	560	105.18	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
504003 NSAGAR 400.00 504998 FSC-3 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504999 [FSC-4 400.00] CKT 2	978.47	994.9	948	104.95	SC-1
504003 NSAGAR 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	978.47	994.9	948	104.95	SC-1
504007 CUDP 400.00 504998 FSC-3 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504999 [FSC-4 400.00] CKT 2	978.47	994.9	948	104.95	SC-1
504007 CUDP 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	978.47	994.9	948	104.95	SC-1
174420 ALIGARH-PG 400.00 174491 KHURJA TPS 400.00 1	OPEN LINE FROM BUS 174420 [ALIGARH-PG 400.00] TO BUS 174491 [KHURJA TPS 400.00] CKT 2	895.8	897.93	857	104.78	SC-1
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	1995.67	2079.45	1988	104.6	SC-1
504007 CUDP 400.00 504024 CHITOR 400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 1	864.9	880.44	852	103.34	SC-1
124401 CHAMERA-2 400.00 124411 CHAMERA-1 400.00 1	OPEN LINE FROM BUS 124401 [CHAMERA-2 400.00] TO BUS 124448 [CHAM-POL 400.00] CKT 1	878.57	878.57	857	102.52	SC-1
514886 RANGARDY_4 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514886 [RANGARDY_4 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1637.11	1637.11	1600	102.32	SC-1
514196 KARIMNAGAR 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514196 [KARIMNAGAR 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1635.31	1635.31	1600	102.21	SC-1
514887 MEDAK_4 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514887 [MEDAK_4 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1624.82	1624.82	1600	101.55	SC-1
474046 RANCHI 400.00 474048 RNC-SIPT FSC400.00 2	OPEN LINE FROM BUS 474046 [RANCHI 400.00] TO BUS 474049 [RNC-SIPT FSC400.00] CKT 1	913.51	846.24	850	99.56	SC-1
474046 RANCHI 400.00 474049 RNC-SIPT FSC400.00 1	OPEN LINE FROM BUS 474046 [RANCHI 400.00] TO BUS 474048 [RNC-SIPT FSC400.00] CKT 2	909.9	843.31	850	99.21	SC-1
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1970.09	1970.09	857	229.88	SC-2

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
524886 DAVANGR_4 400.00 524888 KOPPAL PS-II400.00 1	OPEN LINE FROM BUS 524886 [DAVANGR_4 400.00] TO BUS 524888 [KOPPAL PS-II400.00] CKT 2	2233.03	2297.35	1600	143.58	SC-2
194272 SIDCL HARDWR400.00 194426 RISHIKE4_PT 400.00 1	OPEN LINE FROM BUS 174001 [NEHTAUR 400.00] TO BUS 194426 [RISHIKE4_PT 400.00] CKT 1	754.93	764.43	560	136.51	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	1153.52	1153.52	857	134.6	SC-2
164403 RAMGARH 400.00 164404 BHADLA 400.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 164404 [BHADLA 400.00] CKT 2	1087.64	1104.82	857	128.92	SC-2
114597 KWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1405.42	1405.42	1093	128.58	SC-2
114401 BAGLIHAR4 400.00 114476 NEWWANPO 400.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	992.02	992.02	857	115.76	SC-2
114541 KISTAWAR 400.00 114542 PAKALDUL 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114598 [KIRU 400.00] CKT 1	1972.93	1972.93	1714	115.11	SC-2
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	974.9	974.9	857	113.76	SC-2
194272 SIDCL HARDWR400.00 194425 ROORKEE 400.00 1	OPEN LINE FROM BUS 174001 [NEHTAUR 400.00] TO BUS 194426 [RISHIKE4_PT 400.00] CKT 1	613.62	621.34	560	110.95	SC-2
174927 GORAKHPU 400.00 814002 BUTWAL 400.00 1	OPEN LINE FROM BUS 174927 [GORAKHPU 400.00] TO BUS 814002 [BUTWAL 400.00] CKT 2	1889.34	1889.34	1714	110.23	SC-2
524887 GADAG PS-II 400.00 524888 KOPPAL PS-II400.00 1	OPEN LINE FROM BUS 524887 [GADAG PS-II 400.00] TO BUS 524888 [KOPPAL PS-II400.00] CKT 2	2229.55	2294.78	2186	104.98	SC-2
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1452.11	1452.11	857	169.44	SC-3
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	1253.44	1253.44	857	146.26	SC-3
164403 RAMGARH 400.00 164404 BHADLA 400.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 164404 [BHADLA 400.00] CKT 2	1014.12	1034.15	857	120.67	SC-3

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
524886 DAVANGR_4 400.00 524888 KOPPAL PS-II400.00 1	OPEN LINE FROM BUS 524886 [DAVANGR_4 400.00] TO BUS 524888 [KOPPAL PS-II400.00] CKT 2	1844.59	1844.59	1600	115.29	SC-3
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 518051 [MAHESHWARAM 765.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 1	888.54	872.83	874	99.87	SC-3
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 518051 [MAHESHWARAM 765.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 1	1738.26	1795.1	874	205.39	SC-4
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1452.14	1452.14	857	169.45	SC-4
124001 WANGTOO 400.00 124041 JANGI-THOPAN400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124042 [SHANGTONG 400.00] CKT 1	913.06	912.68	560	162.98	SC-4
504013 KURNOOL4 400.00 514011 SSLBPH4 400.00 1	OPEN LINE FROM BUS 508007 [CUDP800 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	1337.04	1340.47	850	157.7	SC-4
114401 BAGLIHAR4 400.00 114476 NEWWANPO 400.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	1272.86	1272.86	857	148.52	SC-4
444010 SAGARDIGHI_4400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	1489.08	1541.08	1093	141	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	1110.03	1111.16	850	130.72	SC-4
504007 CUDP 400.00 504025 ANANTPUR 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504025 [ANANTPUR 400.00] CKT 2	2649.59	2649.59	2186	121.21	SC-4
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	1006.51	1033.88	857	120.64	SC-4
524886 DAVANGR_4 400.00 524888 KOPPAL PS-II400.00 1	OPEN LINE FROM BUS 524886 [DAVANGR_4 400.00] TO BUS 524888 [KOPPAL PS-II400.00] CKT 2	1882.48	1923.48	1600	120.22	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	2044.13	2044.13	1714	119.26	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
144469 BHIWANI-PG 400.00 144480 JINDPG 400.00 1	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 144480 [JINDPG 400.00] CKT 2	985.98	991.61	857	115.71	SC-4
504005 VIJW 400.00 504030 VIJTP-IV 400.00 1	OPEN LINE FROM BUS 508092 [VEM-II80 765.00] TO BUS 508099 [CPETA800 765.00] CKT 1	930.34	1002.25	874	114.67	SC-4
504026 VIJ-AP 400.00 504037 THALAYAPALEM400.00 1	OPEN LINE FROM BUS 504026 [VIJ-AP 400.00] TO BUS 504037 [THALAYAPALEM400.00] CKT 2	911.98	963.92	852	113.14	SC-4
514886 RANGARDY_4 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514886 [RANGARDY_4 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1776.77	1776.77	1600	111.05	SC-4
514887 MEDAK_4 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514887 [MEDAK_4 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1738.57	1760.47	1600	110.03	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	949.87	937.28	857	109.37	SC-4
514196 KARIMNAGAR 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514196 [KARIMNAGAR 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1744.45	1744.44	1600	109.03	SC-4
174400 AGRAUP4 400.00 174922 AGRA 400.00 2	OPEN LINE FROM BUS 177265 [GNOIDAUP 765.00] TO BUS 177512 [ALIGARH 765.00] CKT 1	927.12	927.12	857	108.18	SC-4
124041 JANGI-THOPAN400.00 124042 SHANGTONG 400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124041 [JANGI-THOPAN400.00] CKT 1	588.69	588.51	560	105.09	SC-4
144420 BHIWANI 400.00 144469 BHIWANI-PG 400.00 1	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 144480 [JINDPG 400.00] CKT 1	890.09	895.17	857	104.45	SC-4
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	1139.94	1139.94	1093	104.29	SC-4
504003 NSAGAR 400.00 504998 FSC-3 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504999 [FSC-4 400.00] CKT 2	966.05	981.26	948	103.51	SC-4
504003 NSAGAR 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	966.05	981.26	948	103.51	SC-4
504007 CUDP 400.00 504998 FSC-3 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504999 [FSC-4 400.00] CKT 2	966.05	981.26	948	103.51	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
504007 CUDP 400.00 504999 FSC-4 400.00 2	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504998 [FSC-3 400.00] CKT 1	966.05	981.26	948	103.51	SC-4
194272 SIDCL HARDWR400.00 194426 RISHIKE4_PT 400.00 1	OPEN LINE FROM BUS 174001 [NEHTAUR 400.00] TO BUS 194426 [RISHIKE4_PT 400.00] CKT 1	576.04	575.75	560	102.81	SC-4
474046 RANCHI 400.00 474048 RNC-SIPT FSC400.00 2	OPEN LINE FROM BUS 474046 [RANCHI 400.00] TO BUS 474049 [RNC-SIPT FSC400.00] CKT 1	860.09	817.04	850	96.12	SC-4
474046 RANCHI 400.00 474049 RNC-SIPT FSC400.00 1	OPEN LINE FROM BUS 474046 [RANCHI 400.00] TO BUS 474048 [RNC-SIPT FSC400.00] CKT 2	856.76	814.26	850	95.79	SC-4
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1970.34	1970.34	857	229.91	SC-5
524886 DAVANGR_4 400.00 524888 KOPPAL PS-II400.00 1	OPEN LINE FROM BUS 524886 [DAVANGR_4 400.00] TO BUS 524888 [KOPPAL PS-II400.00] CKT 2	2129.01	2199.28	1600	137.46	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	1121.73	1121.73	857	130.89	SC-5
114597 KWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1405.42	1405.42	1093	128.58	SC-5
194272 SIDCL HARDWR400.00 194426 RISHIKE4_PT 400.00 1	OPEN LINE FROM BUS 174001 [NEHTAUR 400.00] TO BUS 194426 [RISHIKE4_PT 400.00] CKT 1	686.48	694.29	560	123.98	SC-5
164403 RAMGARH 400.00 164404 BHADLA 400.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 164404 [BHADLA 400.00] CKT 2	996.63	1011.26	857	118	SC-5
114541 KISTAWAR 400.00 114542 PAKALDUL 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114598 [KIRU 400.00] CKT 1	1972.43	1972.43	1714	115.08	SC-5
174927 GORAKHPU 400.00 814002 BUTWAL 400.00 1	OPEN LINE FROM BUS 174927 [GORAKHPU 400.00] TO BUS 814002 [BUTWAL 400.00] CKT 2	1892.89	1892.89	1714	110.44	SC-5
174400 AGRAUP4 400.00 174922 AGRA 400.00 2	OPEN LINE FROM BUS 174414 [AGRANEW 400.00] TO BUS 174922 [AGRA 400.00] CKT 2	917.59	922.71	857	107.67	SC-5
424050 LAPANGA 400.00 424200 OPGC-OD 400.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 424200 [OPGC-OD 400.00] CKT 2	1109	1109	1061	104.52	SC-5

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
134406 RAJPURA_TH4 400.00 134407 RAJPURA4 400.00 1	OPEN LINE FROM BUS 134406 [RAJPURA_TH4 400.00] TO BUS 134407 [RAJPURA4 400.00] CKT 2	887.09	887.09	857	103.51	SC-5
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 518051 [MAHESHWARAM 765.00] TO BUS 518079 [WARANGAL NEW765.00] CKT 1	909.39	898.94	874	102.85	SC-5
544016 PUGALUR-NEW 400.00 544033 KARUR II 400.00 1	OPEN LINE FROM BUS 544016 [PUGALUR-NEW 400.00] TO BUS 544033 [KARUR II 400.00] CKT 2	2231.12	2231.12	2186	102.06	SC-5
124467 KALAAMB 400.00 124498 KALAAMBFSC2 400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124468 [KALAAMBFSC 400.00] CKT 1	863.32	844.92	850	99.4	SC-5
124467 KALAAMB 400.00 124468 KALAAMBFSC 400.00 2	OPEN LINE FROM BUS 124204 [SORANG 400.00] TO BUS 124498 [KALAAMBFSC2 400.00] CKT 2	856.82	838.63	850	98.66	SC-5
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1451.85	1451.85	857	169.41	SC-6
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	1072.68	1072.68	857	125.17	SC-6
514002 HYDERABAD 400.00 514101 MAHESWRM 400.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 514104 [MAH-TS SEC-A400.00] CKT 1	1332.58	1348.87	874	154.33	SC-7
114401 BAGLIHAR4 400.00 114476 NEWWANPO 400.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	1299.57	1299.57	857	151.64	SC-7
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	1144.06	1212.25	857	141.45	SC-7
414010 KAHALGAON-B 400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 414010 [KAHALGAON-B 400.00] TO BUS 444019 [FARAKKA 400.00] CKT 2	1190.97	1190.97	852	139.79	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	1089.79	1164.89	852	136.72	SC-7
124001 WANGTOO 400.00 124041 JANGI-THOPAN400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124042 [SHANGTONG 400.00] CKT 1	731.28	730.73	560	130.49	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
524001 SMNH 400.00 524077 BIDADI 400.00 1	OPEN LINE FROM BUS 524001 [SMNH 400.00] TO BUS 524077 [BIDADI 400.00] CKT 2	979.3	1052.79	852	123.57	SC-7
444074 PPSP_NEW 400.00 444075 PURULIAPS 400.00 1	OPEN LINE FROM BUS 444074 [PPSP_NEW 400.00] TO BUS 444075 [PURULIAPS 400.00] CKT 2	1025.27	1026.13	850	120.72	SC-7
514196 KARIMNAGAR 400.00 514888 NIZAMBD2_4 400.00 1	OPEN LINE FROM BUS 514196 [KARIMNAGAR 400.00] TO BUS 514888 [NIZAMBD2_4 400.00] CKT 2	1840.29	1840.29	1600	115.02	SC-7
444010 SAGARDIGHI_4400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	1248.86	1248.86	1093	114.26	SC-7
504007 CUDP 400.00 504024 CHITOR 400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 1	915.5	925.45	852	108.62	SC-7
544086 MALEKTT 400.00 544087 TIRUVLM SE-A400.00 1	OPEN LINE FROM BUS 544086 [MALEKTT 400.00] TO BUS 544087 [TIRUVLM SE-A400.00] CKT 2	890.19	914.4	850	107.58	SC-7
514021 DICHPAL4 400.00 514061 NIZAMABAD 400.00 1	OPEN LINE FROM BUS 514021 [DICHPAL4 400.00] TO BUS 514061 [NIZAMABAD 400.00] CKT 2	2283.52	2343.98	2186	107.23	SC-7
544122 EDARPLYM 400.00 544128 COIMBTR4 400.00 1	OPEN LINE FROM BUS 544122 [EDARPLYM 400.00] TO BUS 544128 [COIMBTR4 400.00] CKT 2	908.09	914.19	857	106.67	SC-7
544002 SPBUDUR4 400.00 544090 SVCHTRM 400.00 1	OPEN LINE FROM BUS 544084 [TIRUVLM SE-B400.00] TO BUS 544085 [TIRUVLM SE-C400.00] CKT 1	884.41	895.13	852	105.06	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	1808.7	1798.63	1714	104.94	SC-7
124041 JANGI-THOPAN400.00 124042 SHANGTONG 400.00 1	OPEN LINE FROM BUS 124001 [WANGTOO 400.00] TO BUS 124041 [JANGI-THOPAN400.00] CKT 1	578.61	578.41	560	103.29	SC-7
124040 KAZA SP 400.00 124041 JANGI-THOPAN400.00 1	OPEN LINE FROM BUS 124040 [KAZA SP 400.00] TO BUS 124041 [JANGI-THOPAN400.00] CKT 2	574.9	576.66	560	102.97	SC-7
504007 CUDP 400.00 504025 ANANTPUR 400.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 504025 [ANANTPUR 400.00] CKT 2	2212.65	2212.65	2186	101.22	SC-7
114541 KISTAWAR 400.00 114598 KIRU 400.00 1	OPEN LINE FROM BUS 114541 [KISTAWAR 400.00] TO BUS 114542 [PAKALDUL 400.00] CKT 1	1245.35	1245.35	857	145.32	SC-8

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
374002 KHARGAR 400.00 374217 NAVI-MUM 400.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 374051 [PADGHEGIS 400.00] CKT 1	1022.42	1103.22	857	128.73	SC-8
114401 BAGLIHAR4 400.00 114476 NEWWANPO 400.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 114476 [NEWWANPO 400.00] CKT 1	1074.96	1074.96	857	125.43	SC-8
174000 MEJA 400.00 174474 ALLAHABA 400.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 2	1005.1	1004.76	857	117.24	SC-8
374001 KALWA4 400.00 374012 PADGH4 400.00 3	OPEN LINE FROM BUS 374001 [KALWA4 400.00] TO BUS 374012 [PADGH4 400.00] CKT 4	889.04	959.54	857	111.96	SC-8
194272 SIDCL HARDWR400.00 194426 RISHIKE4_PT 400.00 1	OPEN LINE FROM BUS 174001 [NEHTAUR 400.00] TO BUS 194426 [RISHIKE4_PT 400.00] CKT 1	616.78	616.78	560	110.14	SC-8
414010 KAHALGAON-B 400.00 444019 FARAKKA 400.00 1	OPEN LINE FROM BUS 414010 [KAHALGAON-B 400.00] TO BUS 444019 [FARAKKA 400.00] CKT 2	909.03	909.03	852	106.69	SC-8
424018 ANGUL-A 400.00 424030 JINDAL-JITPL400.00 1	OPEN LINE FROM BUS 424018 [ANGUL-A 400.00] TO BUS 424030 [JINDAL-JITPL400.00] CKT 2	1176.96	1176.95	1106	106.42	SC-8
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	888.14	888.14	857	103.63	SC-8
174468 ANPARA4 400.00 174923 SINGRL4 400.00 1	BLOCK TWOTERMDC RIHAH-DADRI1	1098.76	1098.77	857	128.21	SC-9
424050 LAPANGA 400.00 424200 OPGC-OD 400.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 424200 [OPGC-OD 400.00] CKT 2	1136.66	1136.66	1061	107.13	SC-9

Annex-2.6

N-1 Contingency of 765/400 kV Transformers

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164505 BIKANER-3 400.00 167505 BIKANER-3 765.00 3	OPEN LINE FROM BUS 164505 [BIKANER-3 400.00] TO BUS 167505 [BIKANER-3 765.00] CKT 1	1104.65	1104.65	500	220.93	SC-1
144469 BHIWANI-PG 400.00 147704 BHIWN-PG 765.00 1	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 147704 [BHIWN-PG 765.00] CKT 3	1561	1561	1000	156.1	SC-1
144469 BHIWANI-PG 400.00 147704 BHIWN-PG 765.00 3	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 147704 [BHIWN-PG 765.00] CKT 1	2106.07	2106.07	1500	140.4	SC-1
164484 BHADLA-3 400.00 167484 BHADLA-3 765.00 1	BLOCK TWOTERMDC BHADL-FATEH1	1934.86	1934.86	1500	128.99	SC-1
314008 SIPAT4 400.00 318007 SIPAT 765.00 1	OPEN LINE FROM BUS 314008 [SIPAT4 400.00] TO BUS 318007 [SIPAT 765.00] CKT 2	1266.93	1266.93	1000	126.69	SC-1
424024 DUBURI ISTS 400.00 428024 DUBURI ISTS 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI ISTS 400.00] TO BUS 428024 [DUBURI ISTS 765.00] CKT 2	1890.82	1890.82	1500	126.05	SC-1
424091 JHARSUGUDA-B400.00 428091 JHARSUGUDA-B765.00 3	OPEN LINE FROM BUS 424091 [JHARSUGUDA-B400.00] TO BUS 428091 [JHARSUGUDA-B765.00] CKT 4	1778.08	1778.08	1500	118.54	SC-1
144669 BHIWANI SR 400.00 147704 BHIWN-PG 765.00 2	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 147704 [BHIWN-PG 765.00] CKT 3	1146.82	1146.82	1000	114.68	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	1719.54	1719.54	1500	114.64	SC-1
174483 BAREILY 400.00 177806 BAREILLY 765.00 1	OPEN LINE FROM BUS 174483 [BAREILY 400.00] TO BUS 177806 [BAREILLY 765.00] CKT 2	1704.77	1704.77	1500	113.65	SC-1
154463 JHATIKALA-PG400.00 157708 JHATI-PG 765.00 2	OPEN LINE FROM BUS 154463 [JHATIKALA-PG400.00] TO BUS 157708 [JHATI-PG 765.00] CKT 1	1668.13	1668.14	1500	111.21	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
374043 AURANG-CHTPM400.00 378043 AURANG-CHTPM765.00 1	OPEN LINE FROM BUS 374043 [AURANG-CHTPM400.00] TO BUS 378043 [AURANG-CHTPM765.00] CKT 2	1625.86	1625.86	1500	108.39	SC-1
504049 KURNOOL-III 400.00 508049 KURNOOL-III 765.00 1	OPEN LINE FROM BUS 504049 [KURNOOL-III 400.00] TO BUS 508049 [KURNOOL-III 765.00] CKT 2	1589.33	1589.33	1500	105.96	SC-1
164498 BHADLA-2 400.00 167498 BHADLA-2 765.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 167498 [BHADLA-2 765.00] CKT 2	1584.2	1584.2	1500	105.61	SC-1
514101 MAHESWRM 400.00 518051 MAHESHWARAM 765.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 518051 [MAHESHWARAM 765.00] CKT 2	1578.13	1578.13	1500	105.21	SC-1
424020 GOPALPUR 400.00 428020 GOPALPUR 765.00 2	OPEN LINE FROM BUS 424020 [GOPALPUR 400.00] TO BUS 428020 [GOPALPUR 765.00] CKT 3	1558.46	1558.46	1500	103.9	SC-1
164434 JODH KANKANI400.00 167799 JODH KANKANI765.00 1	OPEN LINE FROM BUS 164434 [JODH KANKANI400.00] TO BUS 167799 [JODH KANKANI765.00] CKT 2	1509.33	1509.33	1500	100.62	SC-1
424024 DUBURI ISTS 400.00 428024 DUBURI ISTS 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI ISTS 400.00] TO BUS 428024 [DUBURI ISTS 765.00] CKT 2	1554.26	1554.27	1500	103.62	SC-2
424024 DUBURI ISTS 400.00 428024 DUBURI ISTS 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI ISTS 400.00] TO BUS 428024 [DUBURI ISTS 765.00] CKT 2	1879.78	1879.78	1500	125.32	SC-3
424020 GOPALPUR 400.00 428020 GOPALPUR 765.00 2	OPEN LINE FROM BUS 424020 [GOPALPUR 400.00] TO BUS 428020 [GOPALPUR 765.00] CKT 3	1591.07	1591.07	1500	106.07	SC-3
164505 BIKANER-3 400.00 167505 BIKANER-3 765.00 3	OPEN LINE FROM BUS 164505 [BIKANER-3 400.00] TO BUS 167505 [BIKANER-3 765.00] CKT 1	1080.76	1080.76	500	216.15	SC-4
144469 BHIWANI-PG 400.00 147704 BHIWN-PG 765.00 1	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 147704 [BHIWN-PG 765.00] CKT 3	1246.26	1246.26	1000	124.63	SC-4
164484 BHADLA-3 400.00 167484 BHADLA-3 765.00 1	BLOCK TWOTERMDC BHADL-FATEH1	1805.35	1805.35	1500	120.36	SC-4
424024 DUBURI ISTS 400.00 428024 DUBURI ISTS 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI ISTS 400.00] TO BUS 428024 [DUBURI ISTS 765.00] CKT 2	1772.19	1772.19	1500	118.15	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
314008 SIPAT4 400.00 318007 SIPAT 765.00 1	OPEN LINE FROM BUS 314008 [SIPAT4 400.00] TO BUS 318007 [SIPAT 765.00] CKT 2	1161.09	1161.09	1000	116.11	SC-4
424091 JHARSUGUDA-B400.00 428091 JHARSUGUDA-B765.00 3	OPEN LINE FROM BUS 424091 [JHARSUGUDA-B400.00] TO BUS 428091 [JHARSUGUDA-B765.00] CKT 4	1692.59	1692.59	1500	112.84	SC-4
144469 BHIWANI-PG 400.00 147704 BHIWN-PG 765.00 3	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 147704 [BHIWN-PG 765.00] CKT 1	1682.36	1682.36	1500	112.16	SC-4
514101 MAHESWRM 400.00 518051 MAHESHWARAM 765.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 518051 [MAHESHWARAM 765.00] CKT 2	1682.28	1682.28	1500	112.15	SC-4
504049 KURNOOL-III 400.00 508049 KURNOOL-III 765.00 1	OPEN LINE FROM BUS 504049 [KURNOOL-III 400.00] TO BUS 508049 [KURNOOL-III 765.00] CKT 2	1643.14	1643.14	1500	109.54	SC-4
374043 AURANG-CHTPM400.00 378043 AURANG-CHTPM765.00 1	OPEN LINE FROM BUS 374043 [AURANG-CHTPM400.00] TO BUS 378043 [AURANG-CHTPM765.00] CKT 2	1590.46	1590.46	1500	106.03	SC-4
424020 GOPALPUR 400.00 428020 GOPALPUR 765.00 2	OPEN LINE FROM BUS 424020 [GOPALPUR 400.00] TO BUS 428020 [GOPALPUR 765.00] CKT 3	1540.45	1540.45	1500	102.7	SC-4
164498 BHADLA-2 400.00 167498 BHADLA-2 765.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 167498 [BHADLA-2 765.00] CKT 2	1529.69	1529.68	1500	101.98	SC-4
144669 BHIWANI SR 400.00 147704 BHIWN-PG 765.00 2	OPEN LINE FROM BUS 144469 [BHIWANI-PG 400.00] TO BUS 147704 [BHIWN-PG 765.00] CKT 3	1017.66	1017.66	1000	101.77	SC-4
424024 DUBURI ISTS 400.00 428024 DUBURI ISTS 765.00 1	OPEN LINE FROM BUS 424024 [DUBURI ISTS 400.00] TO BUS 428024 [DUBURI ISTS 765.00] CKT 2	1635.12	1635.12	1500	109.01	SC-5
424020 GOPALPUR 400.00 428020 GOPALPUR 765.00 2	OPEN LINE FROM BUS 424020 [GOPALPUR 400.00] TO BUS 428020 [GOPALPUR 765.00] CKT 3	1509.12	1509.12	1500	100.61	SC-5
164505 BIKANER-3 400.00 167505 BIKANER-3 765.00 3	OPEN LINE FROM BUS 164505 [BIKANER-3 400.00] TO BUS 167505 [BIKANER-3 765.00] CKT 1	1010.71	1010.71	500	202.14	SC-7
544127 ARIYALUR4 400.00 548127 ARIYALUR7 765.00 1	OPEN LINE FROM BUS 544127 [ARIYALUR4 400.00] TO BUS 548127 [ARIYALUR7 765.00] CKT 2	2269.05	2269.05	1500	151.27	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
544128 COIMBTR4 400.00 548128 COIMBTR7 765.00 1	OPEN LINE FROM BUS 544128 [COIMBTR4 400.00] TO BUS 548128 [COIMBTR7 765.00] CKT 2	1994.1	1994.11	1500	132.94	SC-7
514101 MAHESWRM 400.00 518051 MAHESHWARAM 765.00 1	OPEN LINE FROM BUS 514101 [MAHESWRM 400.00] TO BUS 518051 [MAHESHWARAM 765.00] CKT 2	1629.91	1629.91	1500	108.66	SC-7
514061 NIZAMABAD 400.00 518062 NIZAMABAD 765.00 1	OPEN LINE FROM BUS 514061 [NIZAMABAD 400.00] TO BUS 518062 [NIZAMABAD 765.00] CKT 2	1566.69	1566.69	1500	104.45	SC-7
374048 AURANGBD-III400.00 378048 AURANGBD-III765.00 1	OPEN LINE FROM BUS 374048 [AURANGBD-III400.00] TO BUS 378048 [AURANGBD-III765.00] CKT 2	1507.33	1507.33	1500	100.49	SC-8

N-1 Contingency of 400/220 kV Transformers

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
114422 KISHENPUR 400.00 112235 KISHENPUR 220.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 112235 [KISHENPUR 220.00] CKT 2	710.29	710.29	315	225.49	SC-1
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	573.24	573.24	315	181.98	SC-1
164422 RAMG-I 400.00 162422 RAMGARH-I 220.00 1	OPEN LINE FROM BUS 164422 [RAMG-I 400.00] TO BUS 162422 [RAMGARH-I 220.00] CKT 2	883.01	883.01	500	176.6	SC-1
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	486.63	486.63	315	154.48	SC-1
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	462.29	462.29	315	146.76	SC-1
164459 BHADLA PG 400.00 162659 BHADLA-SPLT 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162659 [BHADLA-SPLT 220.00] CKT 2	720.34	720.34	500	144.07	SC-1
374028 NAGOTHANE 400.00 372150 NAGOTHA2 220.00 1	OPEN LINE FROM BUS 374028 [NAGOTHANE 400.00] TO BUS 372150 [NAGOTHA2 220.00] CKT 2	445.87	445.87	315	141.55	SC-1
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	445.67	445.67	315	141.48	SC-1
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	444.39	444.39	315	141.08	SC-1
164498 BHADLA-2 400.00 162499 BHAD-2 SPLT 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162499 [BHAD-2 SPLT 220.00] CKT 2	695.48	695.48	500	139.1	SC-1
164401 AKAL-4 400.00 162280 AKAL-2 220.00 4	OPEN LINE FROM BUS 164401 [AKAL-4 400.00] TO BUS 162280 [AKAL-2 220.00] CKT 3	421.52	421.52	315	133.82	SC-1
164404 BHADLA 400.00 162285 BHADLA-S 220.00 1	OPEN LINE FROM BUS 164404 [BHADLA 400.00] TO BUS 162285 [BHADLA-S 220.00] CKT 2	669.01	669.01	500	133.8	SC-1
164413 RAJWEST 400.00 162278 RAJWEST 220.00 1	OPEN LINE FROM BUS 164402 [BARMER-4 400.00] TO BUS 164413 [RAJWEST 400.00] CKT 1	392.14	392.14	315	124.49	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
174431 KANPUR 400.00 172103 KANPU-PG 220.00 1	OPEN LINE FROM BUS 174431 [KANPUR 400.00] TO BUS 172103 [KANPU-PG 220.00] CKT 2	388.8	388.8	315	123.43	SC-1
134484 PATRAN4 400.00 132241 PATRAN42 220.00 1	OPEN LINE FROM BUS 134484 [PATRAN4 400.00] TO BUS 132241 [PATRAN42 220.00] CKT 2	610.99	610.99	500	122.2	SC-1
124419 DEHAR 400.00 122218 DEHAR 220.00 1	OPEN LINE FROM BUS 124419 [DEHAR 400.00] TO BUS 134407 [RAJPURA4 400.00] CKT 1	381.57	381.57	315	121.13	SC-1
164498 BHADLA-2 400.00 162498 BHADLA-2 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162498 [BHADLA-2 220.00] CKT 2	594.44	594.44	500	118.89	SC-1
134322 ROPAR4 400.00 132322 ROPAR42 220.00 1	OPEN LINE FROM BUS 134322 [ROPAR4 400.00] TO BUS 132322 [ROPAR42 220.00] CKT 2	592.67	592.67	500	118.53	SC-1
164481 FATEHG-3 400.00 162481 FATEHG-3 220.00 1	OPEN LINE FROM BUS 164481 [FATEHG-3 400.00] TO BUS 162481 [FATEHG-3 220.00] CKT 2	591.54	591.54	500	118.31	SC-1
374028 NAGOTHANE 400.00 372150 NAGOTHA2 220.00 2	OPEN LINE FROM BUS 374028 [NAGOTHANE 400.00] TO BUS 372150 [NAGOTHA2 220.00] CKT 1	580.28	580.28	500	116.06	SC-1
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	356.03	356.03	315	113.02	SC-1
444024 GOKARNA 400.00 442566 GOKARNA 220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 2	353.74	353.74	315	112.3	SC-1
544132 KAMUTHI4 400.00 542130 KAMUDHI42 230.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 542130 [KAMUDHI42 230.00] CKT 2	352.67	352.67	315	111.96	SC-1
174058 ORAI 400.00 172124 ORAI 42 220.00 3	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 2	268.47	268.47	240	111.86	SC-1
174512 ALIGARH 400.00 172087 ALIGARH 220.00 1	OPEN LINE FROM BUS 174512 [ALIGARH 400.00] TO BUS 172087 [ALIGARH 220.00] CKT 2	558.15	558.15	500	111.63	SC-1
134925 MALERKOTLA4 400.00 132911 MALERKOTLA42220.00 1	OPEN LINE FROM BUS 134925 [MALERKOTLA4 400.00] TO BUS 132911 [MALERKOTLA42220.00] CKT 3	348.78	348.78	315	110.72	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
134403 MAKHU4 400.00 132284 MAKHU42 220.00 1	OPEN LINE FROM BUS 134403 [MAKHU4 400.00] TO BUS 132284 [MAKHU42 220.00] CKT 3	347.49	347.49	315	110.32	SC-1
164459 BHADLA PG 400.00 162359 BHADLA-PG 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162359 [BHADLA-PG 220.00] CKT 2	550.88	550.88	500	110.18	SC-1
134918 JALANDHAR4 400.00 132918 JALANDHAR42 220.00 1	OPEN LINE FROM BUS 134918 [JALANDHAR4 400.00] TO BUS 132918 [JALANDHAR42 220.00] CKT 3	346.41	346.41	315	109.97	SC-1
164484 BHADLA-3 400.00 162484 BHADLA-3 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 162484 [BHADLA-3 220.00] CKT 2	549.81	549.81	500	109.96	SC-1
164484 BHADLA-3 400.00 163484 BHADLA3-SPL 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 163484 [BHADLA3-SPL 220.00] CKT 2	549.81	549.81	500	109.96	SC-1
444421 BIDHAN NGR 400.00 442686 BIDHANNGR-WB220.00 1	OPEN LINE FROM BUS 444421 [BIDHAN NGR 400.00] TO BUS 442686 [BIDHANNGR-WB220.00] CKT 3	343.79	343.79	315	109.14	SC-1
134442 PATIALA4 400.00 132942 PATIALA42 220.00 1	OPEN LINE FROM BUS 134442 [PATIALA4 400.00] TO BUS 132942 [PATIALA42 220.00] CKT 3	342.25	342.25	315	108.65	SC-1
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	542.34	542.34	500	108.47	SC-1
134442 PATIALA4 400.00 132942 PATIALA42 220.00 3	OPEN LINE FROM BUS 134442 [PATIALA4 400.00] TO BUS 132942 [PATIALA42 220.00] CKT 4	542.13	542.13	500	108.43	SC-1
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	340.52	340.52	315	108.1	SC-1
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	339.64	339.64	315	107.82	SC-1
444010 SAGARDIGHI_4400.00 442010 SAGARDIGHI_2220.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	338.86	338.86	315	107.57	SC-1
154497 DWARKA 400.00 152287 DWARKA-II 220.00 3	OPEN LINE FROM BUS 154497 [DWARKA 400.00] TO BUS 152287 [DWARKA-II 220.00] CKT 4	532.69	532.69	500	106.54	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
134405 NAKODAR4 400.00 132214 NAKODAR42 220.00 1	OPEN LINE FROM BUS 134405 [NAKODAR4 400.00] TO BUS 132214 [NAKODAR42 220.00] CKT 3	527.71	527.71	500	105.54	SC-1
134917 LUDHIANA4 400.00 132913 LUDHIANA42 220.00 1	OPEN LINE FROM BUS 134917 [LUDHIANA4 400.00] TO BUS 132913 [LUDHIANA42 220.00] CKT 2	328.16	328.17	315	104.18	SC-1
114013 PANG400SP3 400.00 114011 PANG220SP3 220.00 1	OPEN LINE FROM BUS 114013 [PANG400SP3 400.00] TO BUS 114011 [PANG220SP3 220.00] CKT 2	327.91	327.91	315	104.1	SC-1
114012 PANG400SP2 400.00 114010 PANG220SP2 220.00 1	OPEN LINE FROM BUS 114012 [PANG400SP2 400.00] TO BUS 114010 [PANG220SP2 220.00] CKT 2	327.89	327.89	315	104.09	SC-1
114008 PANG 400 SP1400.00 114009 LEH_PANG SP 220.00 1	OPEN LINE FROM BUS 114008 [PANG 400 SP1400.00] TO BUS 114009 [LEH_PANG SP 220.00] CKT 2	327.87	327.87	315	104.09	SC-1
374912 PADGHE-SPLT 400.00 372963 PADGHE-SPLT2220.00 5	OPEN LINE FROM BUS 374912 [PADGHE-SPLT 400.00] TO BUS 372963 [PADGHE-SPLT2220.00] CKT 4	520.34	520.34	500	104.07	SC-1
524050 JAGALUR4 400.00 522158 JAGALUR2 220.00 1	OPEN LINE FROM BUS 524050 [JAGALUR4 400.00] TO BUS 522158 [JAGALUR2 220.00] CKT 2	520.27	520.27	500	104.05	SC-1
134917 LUDHIANA4 400.00 132913 LUDHIANA42 220.00 2	OPEN LINE FROM BUS 134917 [LUDHIANA4 400.00] TO BUS 132913 [LUDHIANA42 220.00] CKT 3	519.81	519.81	500	103.96	SC-1
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	327	327	315	103.81	SC-1
134438 MOGA SPLT4 400.00 132912 MOGA42 220.00 1	OPEN LINE FROM BUS 134438 [MOGA SPLT4 400.00] TO BUS 132912 [MOGA42 220.00] CKT 2	326.9	326.9	315	103.78	SC-1
164415 DEEDWANA 400.00 162093 DEEDWANA-42 220.00 1	OPEN LINE FROM BUS 164415 [DEEDWANA 400.00] TO BUS 162093 [DEEDWANA-42 220.00] CKT 2	326.34	326.34	315	103.6	SC-1
134438 MOGA SPLT4 400.00 132912 MOGA42 220.00 2	OPEN LINE FROM BUS 134438 [MOGA SPLT4 400.00] TO BUS 132912 [MOGA42 220.00] CKT 3	517.8	517.8	500	103.56	SC-1
174495 SHAMLI 400.00 172040 SHAMLI2 220.00 1	OPEN LINE FROM BUS 174495 [SHAMLI 400.00] TO BUS 172040 [SHAMLI2 220.00] CKT 2	516.15	516.15	500	103.23	SC-1

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
374217 NAVI-MUM 400.00 372365 NAVI-MUM220 220.00 1	OPEN LINE FROM BUS 374217 [NAVI-MUM 400.00] TO BUS 372365 [NAVI-MUM220 220.00] CKT 2	322.03	322.03	315	102.23	SC-1
164456 BIKANE-4 400.00 162253 BIKANE-4 220.00 1	OPEN LINE FROM BUS 164404 [BHADLA 400.00] TO BUS 164456 [BIKANE-4 400.00] CKT 1	320.5	320.5	315	101.75	SC-1
164505 BIKANER-3 400.00 162505 BIKANER-3 220.00 1	OPEN LINE FROM BUS 164505 [BIKANER-3 400.00] TO BUS 162505 [BIKANER-3 220.00] CKT 2	508.57	508.57	500	101.71	SC-1
444112 KATWA-TPS 400.00 442111 NEW KATWA 220.00 1	OPEN LINE FROM BUS 444112 [KATWA-TPS 400.00] TO BUS 442111 [NEW KATWA 220.00] CKT 2	508.51	508.51	500	101.7	SC-1
144480 JINDPG 400.00 142286 JINDPG 220.00 1	OPEN LINE FROM BUS 144480 [JINDPG 400.00] TO BUS 142286 [JINDPG 220.00] CKT 2	504.57	504.57	500	100.91	SC-1
164482 FATEHG-4 400.00 162482 FATEHG-4 220.00 1	OPEN LINE FROM BUS 164482 [FATEHG-4 400.00] TO BUS 162482 [FATEHG-4 220.00] CKT 2	503.52	503.52	500	100.7	SC-1
374068 VIKROLI400 400.00 372460 VIKROLI220 220.00 1	OPEN LINE FROM BUS 374068 [VIKROLI400 400.00] TO BUS 372460 [VIKROLI220 220.00] CKT 2	503.29	503.29	500	100.66	SC-1
174058 ORAI 400.00 172124 ORAI 42 220.00 2	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 3	315.61	315.61	315	100.19	SC-1
114422 KISHENPUR 400.00 112235 KISHENPUR 220.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 112235 [KISHENPUR 220.00] CKT 2	481.15	481.15	315	152.75	SC-2
354015 MUNDRA-APL 400.00 352015 MUNDRA-APL 220.00 1	OPEN LINE FROM BUS 354015 [MUNDRA-APL 400.00] TO BUS 352015 [MUNDRA-APL 220.00] CKT 2	468.6	468.6	315	148.76	SC-2
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	739.08	739.08	500	147.82	SC-2
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	457.31	457.31	315	145.18	SC-2
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	442.08	442.08	315	140.34	SC-2

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164401 AKAL-4 400.00 162280 AKAL-2 220.00 1	OPEN LINE FROM BUS 164401 [AKAL-4 400.00] TO BUS 162280 [AKAL-2 220.00] CKT 2	688.58	688.58	500	137.72	SC-2
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	414.98	414.98	315	131.74	SC-2
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	656.95	656.95	500	131.39	SC-2
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	410.43	410.43	315	130.3	SC-2
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	402.71	402.71	315	127.84	SC-2
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	387.65	387.65	315	123.06	SC-2
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	367.28	367.28	315	116.6	SC-2
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	366.41	366.41	315	116.32	SC-2
174265 REWA 400.00 172112 REWAROAD 220.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 1	362.98	362.98	315	115.23	SC-2
164403 RAMGARH 400.00 162403 RAMGARH_RE 220.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 162403 [RAMGARH_RE 220.00] CKT 2	564.04	564.04	500	112.81	SC-2
174058 ORAI 400.00 172124 ORAI 42 220.00 3	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 2	268.54	268.54	240	111.89	SC-2
174472 OBRA4 400.00 172062 OBRA2 220.00 3	OPEN LINE FROM BUS 174472 [OBRA4 400.00] TO BUS 172062 [OBRA2 220.00] CKT 1	266	266	240	110.83	SC-2
174512 ALIGARH 400.00 172087 ALIGARH 220.00 1	OPEN LINE FROM BUS 174512 [ALIGARH 400.00] TO BUS 172087 [ALIGARH 220.00] CKT 2	552.66	552.66	500	110.53	SC-2

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	342.15	342.15	315	108.62	SC-2
194467 KASHIPU4 400.00 192221 KASHIPU2 220.00 1	OPEN LINE FROM BUS 194467 [KASHIPU4 400.00] TO BUS 192221 [KASHIPU2 220.00] CKT 2	341.67	341.67	315	108.47	SC-2
424033 PANDIABILI 400.00 422033 PANDIABILI 220.00 2	OPEN LINE FROM BUS 424033 [PANDIABILI 400.00] TO BUS 422033 [PANDIABILI 220.00] CKT 1	526.64	526.64	500	105.33	SC-2
444010 SAGARDIGHI_4400.00 442010 SAGARDIGHI_2220.00 1	OPEN LINE FROM BUS 504885 [ANANTPR2_4 400.00] TO BUS 508885 [ANANTPR2_7 765.00] CKT 1	330.8	330.8	315	105.02	SC-2
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	523.47	523.47	500	104.69	SC-2
444024 GOKARNA 400.00 442566 GOKARNA 220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 2	327.94	327.94	315	104.11	SC-2
524022 KOPPAL 400.00 522370 KOPPAL 220.00 1	OPEN LINE FROM BUS 524022 [KOPPAL 400.00] TO BUS 522370 [KOPPAL 220.00] CKT 2	519.83	519.83	500	103.97	SC-2
174467 SHAHJ-PG 400.00 172107 SHAHJAHAN4 220.00 1	OPEN LINE FROM BUS 174467 [SHAHJ-PG 400.00] TO BUS 172107 [SHAHJAHAN4 220.00] CKT 2	325.1	325.1	315	103.21	SC-2
174058 ORAI 400.00 172124 ORAI 42 220.00 2	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 3	315.33	315.33	315	100.11	SC-2
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	539.85	539.85	315	171.38	SC-3
164401 AKAL-4 400.00 162280 AKAL-2 220.00 1	OPEN LINE FROM BUS 164401 [AKAL-4 400.00] TO BUS 162280 [AKAL-2 220.00] CKT 2	728.73	728.73	500	145.75	SC-3
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	457.72	457.72	315	145.31	SC-3
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	405.79	405.79	315	128.82	SC-3

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
354015 MUNDRA-APL 400.00 352015 MUNDRA-APL 220.00 1	OPEN LINE FROM BUS 354015 [MUNDRA-APL 400.00] TO BUS 352015 [MUNDRA-APL 220.00] CKT 2	405.02	405.02	315	128.58	SC-3
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	632.98	632.98	500	126.6	SC-3
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	373.78	373.78	315	118.66	SC-3
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	568.9	568.9	500	113.78	SC-3
424033 PANDIABILI 400.00 422033 PANDIABILI 220.00 1	OPEN LINE FROM BUS 424033 [PANDIABILI 400.00] TO BUS 422033 [PANDIABILI 220.00] CKT 2	559.11	559.11	500	111.82	SC-3
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	350.21	350.21	315	111.18	SC-3
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	345.86	345.86	315	109.8	SC-3
424016 BOLANGIR 400.00 422611 BOLANGIR 220.00 1	OPEN LINE FROM BUS 424016 [BOLANGIR 400.00] TO BUS 422611 [BOLANGIR 220.00] CKT 2	340.31	340.31	315	108.04	SC-3
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	336.83	336.83	315	106.93	SC-3
164403 RAMGARH 400.00 162403 RAMGARH_RE 220.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 162403 [RAMGARH_RE 220.00] CKT 2	532.3	532.3	500	106.46	SC-3
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	317.86	317.86	315	100.91	SC-3
114422 KISHENPUR 400.00 112235 KISHENPUR 220.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 112235 [KISHENPUR 220.00] CKT 2	566.29	566.29	315	179.77	SC-4
164422 RAMG-I 400.00 162422 RAMGARH-I 220.00 1	OPEN LINE FROM BUS 164422 [RAMG-I 400.00] TO BUS 162422 [RAMGARH-I 220.00] CKT 2	883.01	883.01	500	176.6	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	489.66	489.66	315	155.45	SC-4
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	474.99	474.99	315	150.79	SC-4
164459 BHADLA PG 400.00 162659 BHADLA-SPLT 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162659 [BHADLA-SPLT 220.00] CKT 2	724.34	724.34	500	144.87	SC-4
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	447.17	447.17	315	141.96	SC-4
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	438.95	438.95	315	139.35	SC-4
164498 BHADLA-2 400.00 162499 BHAD-2 SPLT 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162499 [BHAD-2 SPLT 220.00] CKT 2	696.12	696.12	500	139.22	SC-4
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	415.23	415.23	315	131.82	SC-4
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	407.29	407.29	315	129.3	SC-4
164415 DEEDWANA 400.00 162093 DEEDWANA-42 220.00 1	OPEN LINE FROM BUS 164415 [DEEDWANA 400.00] TO BUS 162093 [DEEDWANA-42 220.00] CKT 2	405.85	405.85	315	128.84	SC-4
164401 AKAL-4 400.00 162280 AKAL-2 220.00 1	OPEN LINE FROM BUS 164401 [AKAL-4 400.00] TO BUS 162280 [AKAL-2 220.00] CKT 3	641.12	641.12	500	128.22	SC-4
164428 CHITTOR4 400.00 162228 CHITTOR-42 220.00 1	OPEN LINE FROM BUS 164428 [CHITTOR4 400.00] TO BUS 162228 [CHITTOR-42 220.00] CKT 2	402.17	402.17	315	127.67	SC-4
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	637.07	637.07	500	127.41	SC-4
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	395.75	395.75	315	125.64	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	395.19	395.19	315	125.46	SC-4
354035 VADODARA 400.00 352210 VADODARAPG 220.00 1	OPEN LINE FROM BUS 354035 [VADODARA 400.00] TO BUS 352210 [VADODARAPG 220.00] CKT 2	605.12	605.12	500	121.02	SC-4
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	380.2	380.2	315	120.7	SC-4
354012 SUGEN 400.00 352012 SUGEN 220.00 1	OPEN LINE FROM BUS 354012 [SUGEN 400.00] TO BUS 352012 [SUGEN 220.00] CKT 2	378.84	378.84	315	120.27	SC-4
164406 HERAPU-4 400.00 162211 HIRAPURA 220.00 2	OPEN LINE FROM BUS 164406 [HERAPU-4 400.00] TO BUS 162211 [HIRAPURA 220.00] CKT 1	300.32	300.32	250	120.13	SC-4
544132 KAMUTHI4 400.00 542130 KAMUDHI42 230.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 542130 [KAMUDHI42 230.00] CKT 2	378.15	378.15	315	120.05	SC-4
164413 RAJWEST 400.00 162278 RAJWEST 220.00 1	OPEN LINE FROM BUS 164402 [BARMER-4 400.00] TO BUS 164413 [RAJWEST 400.00] CKT 1	376	376	315	119.37	SC-4
164498 BHADLA-2 400.00 162498 BHADLA-2 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162498 [BHADLA-2 220.00] CKT 2	595.01	595.01	500	119	SC-4
164431 BASSI 400.00 162283 BASSI 220.00 1	OPEN LINE FROM BUS 164431 [BASSI 400.00] TO BUS 162283 [BASSI 220.00] CKT 3	372.98	372.98	315	118.41	SC-4
164481 FATEHG-3 400.00 162481 FATEHG-3 220.00 1	OPEN LINE FROM BUS 164481 [FATEHG-3 400.00] TO BUS 162481 [FATEHG-3 220.00] CKT 2	591.54	591.54	500	118.31	SC-4
504007 CUDP 400.00 502216 CHINAKAMPALL220.00 1	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 502216 [CHINAKAMPALL220.00] CKT 3	371.95	371.95	315	118.08	SC-4
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	371.76	371.76	315	118.02	SC-4
164406 HERAPU-4 400.00 162211 HIRAPURA 220.00 1	OPEN LINE FROM BUS 164406 [HERAPU-4 400.00] TO BUS 162211 [HIRAPURA 220.00] CKT 2	365.6	365.6	315	116.06	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
354208 NAVSARI-NEW 400.00 352298 NAVSARI-NEW 220.00 1	OPEN LINE FROM BUS 354208 [NAVSARI-NEW 400.00] TO BUS 352298 [NAVSARI-NEW 220.00] CKT 2	580.04	580.04	500	116.01	SC-4
164404 BHADLA 400.00 162285 BHADLA-S 220.00 1	OPEN LINE FROM BUS 164404 [BHADLA 400.00] TO BUS 162285 [BHADLA-S 220.00] CKT 2	557.91	557.91	500	111.58	SC-4
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	351.29	351.29	315	111.52	SC-4
174431 KANPUR 400.00 172103 KANPU-PG 220.00 1	OPEN LINE FROM BUS 174431 [KANPUR 400.00] TO BUS 172103 [KANPU-PG 220.00] CKT 2	350.23	350.23	315	111.19	SC-4
164459 BHADLA PG 400.00 162359 BHADLA-PG 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162359 [BHADLA-PG 220.00] CKT 2	551.69	551.69	500	110.34	SC-4
424033 PANDIABILI 400.00 422033 PANDIABILI 220.00 2	OPEN LINE FROM BUS 424033 [PANDIABILI 400.00] TO BUS 422033 [PANDIABILI 220.00] CKT 1	550.55	550.55	500	110.11	SC-4
164484 BHADLA-3 400.00 162484 BHADLA-3 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 162484 [BHADLA-3 220.00] CKT 2	549.81	549.81	500	109.96	SC-4
164484 BHADLA-3 400.00 163484 BHADLA3-SPL 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 163484 [BHADLA3-SPL 220.00] CKT 2	549.81	549.81	500	109.96	SC-4
364189 DATIYA NEW4 400.00 362189 DATIYA NEW2 220.00 1	OPEN LINE FROM BUS 364189 [DATIYA NEW4 400.00] TO BUS 362189 [DATIYA NEW2 220.00] CKT 2	548.6	548.6	500	109.72	SC-4
154497 DWARKA 400.00 152287 DWARKA-II 220.00 3	OPEN LINE FROM BUS 154497 [DWARKA 400.00] TO BUS 152287 [DWARKA-II 220.00] CKT 4	528.45	528.45	500	105.69	SC-4
174058 ORAI 400.00 172124 ORAI 42 220.00 3	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 2	252.54	252.54	240	105.22	SC-4
164431 BASSI 400.00 162283 BASSI 220.00 3	OPEN LINE FROM BUS 164431 [BASSI 400.00] TO BUS 162283 [BASSI 220.00] CKT 1	524.97	524.97	500	104.99	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	328.73	328.73	315	104.36	SC-4

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
114013 PANG400SP3 400.00 114011 PANG220SP3 220.00 1	OPEN LINE FROM BUS 114013 [PANG400SP3 400.00] TO BUS 114011 [PANG220SP3 220.00] CKT 2	327.91	327.91	315	104.1	SC-4
114012 PANG400SP2 400.00 114010 PANG220SP2 220.00 1	OPEN LINE FROM BUS 114012 [PANG400SP2 400.00] TO BUS 114010 [PANG220SP2 220.00] CKT 2	327.89	327.89	315	104.09	SC-4
114008 PANG 400 SP1400.00 114009 LEH_PANG SP 220.00 1	OPEN LINE FROM BUS 114008 [PANG 400 SP1400.00] TO BUS 114009 [LEH_PANG SP 220.00] CKT 2	327.87	327.87	315	104.09	SC-4
504007 CUDP 400.00 502216 CHINAKAMPALL220.00 3	OPEN LINE FROM BUS 504007 [CUDP 400.00] TO BUS 502216 [CHINAKAMPALL220.00] CKT 1	518.48	518.48	500	103.7	SC-4
174512 ALIGARH 400.00 172087 ALIGARH 220.00 1	OPEN LINE FROM BUS 174512 [ALIGARH 400.00] TO BUS 172087 [ALIGARH 220.00] CKT 2	517.11	517.11	500	103.42	SC-4
504003 NSAGAR 400.00 502271 TALLAPALLI 220.00 1	OPEN LINE FROM BUS 504003 [NSAGAR 400.00] TO BUS 502271 [TALLAPALLI 220.00] CKT 2	324.75	324.75	315	103.1	SC-4
354050 PRANTIJ 400.00 352151 PRANTIJ2 220.00 1	OPEN LINE FROM BUS 354050 [PRANTIJ 400.00] TO BUS 352151 [PRANTIJ2 220.00] CKT 2	508.86	508.86	500	101.77	SC-4
164505 BIKANER-3 400.00 162505 BIKANER-3 220.00 1	OPEN LINE FROM BUS 164505 [BIKANER-3 400.00] TO BUS 162505 [BIKANER-3 220.00] CKT 2	508.57	508.57	500	101.71	SC-4
164482 FATEHG-4 400.00 162482 FATEHG-4 220.00 1	OPEN LINE FROM BUS 164482 [FATEHG-4 400.00] TO BUS 162482 [FATEHG-4 220.00] CKT 2	503.52	503.52	500	100.7	SC-4
374012 PADGH4 400.00 372163 PADGHE22 220.00 6	OPEN LINE FROM BUS 374012 [PADGH4 400.00] TO BUS 372163 [PADGHE22 220.00] CKT 1	317.17	317.17	315	100.69	SC-4
374912 PADGHE-SPLT 400.00 372963 PADGHE-SPLT2220.00 5	OPEN LINE FROM BUS 374912 [PADGHE-SPLT 400.00] TO BUS 372963 [PADGHE-SPLT2220.00] CKT 4	501.77	501.77	500	100.35	SC-4
374012 PADGH4 400.00 372163 PADGHE22 220.00 3	OPEN LINE FROM BUS 374012 [PADGH4 400.00] TO BUS 372163 [PADGHE22 220.00] CKT 1	315.82	315.82	315	100.26	SC-4
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	490.17	490.17	315	155.61	SC-5

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	774.99	774.99	500	155	SC-5
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	463.37	463.37	315	147.1	SC-5
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	440.14	440.14	315	139.73	SC-5
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	434.47	434.47	315	137.93	SC-5
164401 AKAL-4 400.00 162280 AKAL-2 220.00 1	OPEN LINE FROM BUS 164401 [AKAL-4 400.00] TO BUS 162280 [AKAL-2 220.00] CKT 2	680.91	680.91	500	136.18	SC-5
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	424.06	424.06	315	134.62	SC-5
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	656.95	656.95	500	131.39	SC-5
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	402.25	402.25	315	127.7	SC-5
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	372.21	372.21	315	118.16	SC-5
174512 ALIGARH 400.00 172087 ALIGARH 220.00 1	OPEN LINE FROM BUS 174512 [ALIGARH 400.00] TO BUS 172087 [ALIGARH 220.00] CKT 2	587.56	587.56	500	117.51	SC-5
174058 ORAI 400.00 172124 ORAI 42 220.00 3	OPEN LINE FROM BUS 174058 [ORAI 400.00] TO BUS 172124 [ORAI 42 220.00] CKT 2	282.02	282.02	240	117.51	SC-5
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	368.43	368.43	315	116.96	SC-5
174265 REWA 400.00 172112 REWAROAD 220.00 1	OPEN LINE FROM BUS 174000 [MEJA 400.00] TO BUS 174474 [ALLAHABA 400.00] CKT 1	368.23	368.23	315	116.9	SC-5

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	357.89	357.89	315	113.62	SC-5
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	357.76	357.76	315	113.58	SC-5
444024 GOKARNA 400.00 442566 GOKARNA 220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 2	355.77	355.77	315	112.94	SC-5
444010 SAGARDIGHI_4400.00 442010 SAGARDIGHI_2220.00 1	OPEN LINE FROM BUS 504885 [ANANTPR2_4 400.00] TO BUS 508885 [ANANTPR2_7 765.00] CKT 1	353.17	353.17	315	112.12	SC-5
174472 OBRA4 400.00 172062 OBRA2 220.00 3	OPEN LINE FROM BUS 174472 [OBRA4 400.00] TO BUS 172062 [OBRA2 220.00] CKT 1	266.7	266.7	240	111.12	SC-5
424033 PANDIABILI 400.00 422033 PANDIABILI 220.00 2	OPEN LINE FROM BUS 424033 [PANDIABILI 400.00] TO BUS 422033 [PANDIABILI 220.00] CKT 1	550.96	550.96	500	110.19	SC-5
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	547.45	547.45	500	109.49	SC-5
174467 SHAHJ-PG 400.00 172107 SHAHJAHAN4 220.00 1	OPEN LINE FROM BUS 174467 [SHAHJ-PG 400.00] TO BUS 172107 [SHAHJAHAN4 220.00] CKT 2	340.7	340.7	315	108.16	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	338.18	338.18	315	107.36	SC-5
114422 KISHENPUR 400.00 112235 KISHENPUR 220.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 112235 [KISHENPUR 220.00] CKT 2	334.77	334.77	315	106.28	SC-5
414071 KISHANGANJ 400.00 412101 KISHENGAN-PG220.00 1	OPEN LINE FROM BUS 414071 [KISHANGANJ 400.00] TO BUS 412101 [KISHENGAN-PG220.00] CKT 2	527.98	527.98	500	105.6	SC-5
524022 KOPPAL 400.00 522370 KOPPAL 220.00 1	OPEN LINE FROM BUS 524022 [KOPPAL 400.00] TO BUS 522370 [KOPPAL 220.00] CKT 2	527.44	527.44	500	105.49	SC-5
374012 PADGH4 400.00 372163 PADGHE22 220.00 6	OPEN LINE FROM BUS 374012 [PADGH4 400.00] TO BUS 372163 [PADGHE22 220.00] CKT 1	330.68	330.68	315	104.98	SC-5

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
444112 KATWA-TPS 400.00 442111 NEW KATWA 220.00 1	OPEN LINE FROM BUS 444112 [KATWA-TPS 400.00] TO BUS 442111 [NEW KATWA 220.00] CKT 2	515.8	515.8	500	103.16	SC-5
164403 RAMGARH 400.00 162403 RAMGARH_RE 220.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 162403 [RAMGARH_RE 220.00] CKT 2	514.04	514.04	500	102.81	SC-5
174002 BAGPAT 400.00 172114 BAGPAT-PG 220.00 1	OPEN LINE FROM BUS 174002 [BAGPAT 400.00] TO BUS 172114 [BAGPAT-PG 220.00] CKT 2	512.78	512.78	500	102.56	SC-5
374012 PADGH4 400.00 372163 PADGHE22 220.00 1	OPEN LINE FROM BUS 374012 [PADGH4 400.00] TO BUS 372163 [PADGHE22 220.00] CKT 2	608.92	608.92	600	101.49	SC-5
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	722.35	722.35	500	144.47	SC-6
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	441.92	441.92	315	140.29	SC-6
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	412.51	412.51	315	130.96	SC-6
164401 AKAL-4 400.00 162280 AKAL-2 220.00 4	OPEN LINE FROM BUS 164401 [AKAL-4 400.00] TO BUS 162280 [AKAL-2 220.00] CKT 2	407.64	407.64	315	129.41	SC-6
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	407.33	407.33	315	129.31	SC-6
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	381.14	381.14	315	121	SC-6
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	371.09	371.09	315	117.81	SC-6
374072 KALLAM 400.00 372498 KALLAM 220.00 1	OPEN LINE FROM BUS 374072 [KALLAM 400.00] TO BUS 372498 [KALLAM 220.00] CKT 2	568.9	568.9	500	113.78	SC-6
424033 PANDIABILI 400.00 422033 PANDIABILI 220.00 2	OPEN LINE FROM BUS 424033 [PANDIABILI 400.00] TO BUS 422033 [PANDIABILI 220.00] CKT 1	509.61	509.61	500	101.92	SC-6

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164422 RAMG-I 400.00 162422 RAMGARH-I 220.00 1	OPEN LINE FROM BUS 164422 [RAMG-I 400.00] TO BUS 162422 [RAMGARH-I 220.00] CKT 2	882.84	882.84	500	176.57	SC-7
114422 KISHENPUR 400.00 112235 KISHENPUR 220.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 112235 [KISHENPUR 220.00] CKT 2	553.87	553.87	315	175.83	SC-7
524047 NAREND-4 400.00 522047 NARENDRA 220.00 1	OPEN LINE FROM BUS 524047 [NAREND-4 400.00] TO BUS 522047 [NARENDRA 220.00] CKT 2	754.02	754.02	500	150.8	SC-7
364189 DATIYA NEW4 400.00 362189 DATIYA NEW2 220.00 1	OPEN LINE FROM BUS 364189 [DATIYA NEW4 400.00] TO BUS 362189 [DATIYA NEW2 220.00] CKT 2	753.7	753.7	500	150.74	SC-7
164459 BHADLA PG 400.00 162659 BHADLA-SPLT 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162659 [BHADLA-SPLT 220.00] CKT 2	715.1	715.11	500	143.02	SC-7
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	440.49	440.49	315	139.84	SC-7
164498 BHADLA-2 400.00 162499 BHAD-2 SPLT 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162499 [BHAD-2 SPLT 220.00] CKT 2	694.84	694.84	500	138.97	SC-7
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	693.15	693.15	500	138.63	SC-7
524004 DAVAN4 400.00 522004 GUTTUR 220.00 1	OPEN LINE FROM BUS 524004 [DAVAN4 400.00] TO BUS 522004 [GUTTUR 220.00] CKT 2	418.12	418.12	315	132.74	SC-7
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	412.94	412.94	315	131.09	SC-7
164428 CHITTOR4 400.00 162228 CHITTOR-42 220.00 1	OPEN LINE FROM BUS 164428 [CHITTOR4 400.00] TO BUS 162228 [CHITTOR-42 220.00] CKT 2	411.45	411.45	315	130.62	SC-7
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	405.41	405.41	315	128.7	SC-7
544132 KAMUTHI4 400.00 542130 KAMUDHI42 230.00 1	OPEN LINE FROM BUS 544132 [KAMUTHI4 400.00] TO BUS 542130 [KAMUDHI42 230.00] CKT 2	397.64	397.64	315	126.24	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	392.35	392.35	315	124.56	SC-7
164498 BHADLA-2 400.00 162498 BHADLA-2 220.00 1	OPEN LINE FROM BUS 164498 [BHADLA-2 400.00] TO BUS 162498 [BHADLA-2 220.00] CKT 2	593.92	593.92	500	118.78	SC-7
164481 FATEHG-3 400.00 162481 FATEHG-3 220.00 1	OPEN LINE FROM BUS 164481 [FATEHG-3 400.00] TO BUS 162481 [FATEHG-3 220.00] CKT 2	591.43	591.43	500	118.29	SC-7
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	371.19	371.19	315	117.84	SC-7
524084 YELAHNKA 400.00 522084 YELAH220 220.00 1	OPEN LINE FROM BUS 524084 [YELAHNKA 400.00] TO BUS 522084 [YELAH220 220.00] CKT 2	583.23	583.23	500	116.65	SC-7
524025 DHANLLI 400.00 523025 DHALLI 220.00 1	OPEN LINE FROM BUS 524025 [DHANLLI 400.00] TO BUS 523025 [DHALLI 220.00] CKT 2	574.13	574.13	500	114.83	SC-7
524005 HOODI4 400.00 522005 HOOD 220.00 1	OPEN LINE FROM BUS 524005 [HOODI4 400.00] TO BUS 522005 [HOOD 220.00] CKT 2	563.6	563.6	500	112.72	SC-7
524034 KUDGI-NT 400.00 522144 KUDGI-NTPC 220.00 1	OPEN LINE FROM BUS 524034 [KUDGI-NT 400.00] TO BUS 522144 [KUDGI-NTPC 220.00] CKT 2	562.68	562.68	500	112.54	SC-7
164406 HERAPU-4 400.00 162211 HIRAPURA 220.00 2	OPEN LINE FROM BUS 164406 [HERAPU-4 400.00] TO BUS 162211 [HIRAPURA 220.00] CKT 1	280.44	280.44	250	112.18	SC-7
374217 NAVI-MUM 400.00 372365 NAVI-MUM220 220.00 1	OPEN LINE FROM BUS 374217 [NAVI-MUM 400.00] TO BUS 372365 [NAVI-MUM220 220.00] CKT 2	352.44	352.44	315	111.88	SC-7
374912 PADGHE-SPLT 400.00 372963 PADGHE-SPLT2220.00 5	OPEN LINE FROM BUS 374912 [PADGHE-SPLT 400.00] TO BUS 372963 [PADGHE-SPLT2220.00] CKT 4	557.51	557.51	500	111.5	SC-7
544004 TRICHY 400.00 542048 ALUNDR42 230.00 1	OPEN LINE FROM BUS 544004 [TRICHY 400.00] TO BUS 542048 [ALUNDR42 230.00] CKT 3	348.66	348.66	315	110.69	SC-7
164459 BHADLA PG 400.00 162359 BHADLA-PG 220.00 1	OPEN LINE FROM BUS 164459 [BHADLA PG 400.00] TO BUS 162359 [BHADLA-PG 220.00] CKT 2	552.11	552.11	500	110.42	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164412 KALISI-4 400.00 162300 KALISIND 220.00 2	OPEN LINE FROM BUS 164412 [KALISI-4 400.00] TO BUS 164485 [SANGOD 400.00] CKT 1	550.68	550.68	500	110.14	SC-7
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	346.34	346.34	315	109.95	SC-7
164484 BHADLA-3 400.00 162484 BHADLA-3 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 162484 [BHADLA-3 220.00] CKT 2	549.71	549.71	500	109.94	SC-7
164484 BHADLA-3 400.00 163484 BHADLA3-SPL 220.00 1	OPEN LINE FROM BUS 164484 [BHADLA-3 400.00] TO BUS 163484 [BHADLA3-SPL 220.00] CKT 2	549.71	549.71	500	109.94	SC-7
164415 DEEDWANA 400.00 162093 DEEDWANA-42 220.00 1	OPEN LINE FROM BUS 164415 [DEEDWANA 400.00] TO BUS 162093 [DEEDWANA-42 220.00] CKT 2	346.19	346.19	315	109.9	SC-7
164431 BASSI 400.00 162283 BASSI 220.00 1	OPEN LINE FROM BUS 164431 [BASSI 400.00] TO BUS 162283 [BASSI 220.00] CKT 3	342.77	342.77	315	108.82	SC-7
164406 HERAPU-4 400.00 162211 HIRAPURA 220.00 1	OPEN LINE FROM BUS 164406 [HERAPU-4 400.00] TO BUS 162211 [HIRAPURA 220.00] CKT 2	341.42	341.42	315	108.39	SC-7
374068 VIKROLI400 400.00 372460 VIKROLI220 220.00 1	OPEN LINE FROM BUS 374068 [VIKROLI400 400.00] TO BUS 372460 [VIKROLI220 220.00] CKT 2	541.26	541.26	500	108.25	SC-7
374028 NAGOTHANE 400.00 372150 NAGOTHA2 220.00 1	OPEN LINE FROM BUS 374028 [NAGOTHANE 400.00] TO BUS 372150 [NAGOTHA2 220.00] CKT 2	337.28	337.28	315	107.07	SC-7
374002 KHARGAR 400.00 372125 KHARGR22 220.00 1	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 372125 [KHARGR22 220.00] CKT 3	335.03	335.03	315	106.36	SC-7
164405 BHINMAL 400.00 162914 BHINM-PG 220.00 1	OPEN LINE FROM BUS 164405 [BHINMAL 400.00] TO BUS 162914 [BHINM-PG 220.00] CKT 2	334.57	334.57	315	106.21	SC-7
354012 SUGEN 400.00 352012 SUGEN 220.00 1	OPEN LINE FROM BUS 354012 [SUGEN 400.00] TO BUS 352012 [SUGEN 220.00] CKT 2	332.55	332.55	315	105.57	SC-7
534048 KOTTAYAM4 400.00 532259 KOTTAYAM2 220.00 1	OPEN LINE FROM BUS 534048 [KOTTAYAM4 400.00] TO BUS 532259 [KOTTAYAM2 220.00] CKT 2	328.85	328.85	315	104.4	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	328.07	328.07	315	104.15	SC-7
114013 PANG400SP3 400.00 114011 PANG220SP3 220.00 1	OPEN LINE FROM BUS 114013 [PANG400SP3 400.00] TO BUS 114011 [PANG220SP3 220.00] CKT 2	327.85	327.85	315	104.08	SC-7
114012 PANG400SP2 400.00 114010 PANG220SP2 220.00 1	OPEN LINE FROM BUS 114012 [PANG400SP2 400.00] TO BUS 114010 [PANG220SP2 220.00] CKT 2	327.83	327.83	315	104.07	SC-7
114008 PANG 400 SP1400.00 114009 LEH_PANG SP 220.00 1	OPEN LINE FROM BUS 114008 [PANG 400 SP1400.00] TO BUS 114009 [LEH_PANG SP 220.00] CKT 2	327.81	327.81	315	104.07	SC-7
374996 KALWA-SPLT 400.00 372996 KALWA-SPLT 220.00 1	OPEN LINE FROM BUS 374996 [KALWA-SPLT 400.00] TO BUS 372996 [KALWA-SPLT 220.00] CKT 2	516.69	516.69	500	103.34	SC-7
524077 BIDADI 400.00 522180 BIDADI 220.00 1	OPEN LINE FROM BUS 524077 [BIDADI 400.00] TO BUS 522180 [BIDADI 220.00] CKT 2	509.56	509.56	500	101.91	SC-7
164505 BIKANER-3 400.00 162505 BIKANER-3 220.00 1	OPEN LINE FROM BUS 164505 [BIKANER-3 400.00] TO BUS 162505 [BIKANER-3 220.00] CKT 2	508.41	508.41	500	101.68	SC-7
164444 KOTPUT 400.00 162343 KOTPU-PG 220.00 1	OPEN LINE FROM BUS 164444 [KOTPUT 400.00] TO BUS 162343 [KOTPU-PG 220.00] CKT 3	318.34	318.34	315	101.06	SC-7
514104 MAH-TS SEC-A400.00 512082 MAHESH-TS2 220.00 1	OPEN LINE FROM BUS 514104 [MAH-TS SEC-A400.00] TO BUS 512082 [MAHESH-TS2 220.00] CKT 2	504.5	504.5	500	100.9	SC-7
374043 AURANG-CHTPM400.00 372340 PG-AURANGABD220.00 1	OPEN LINE FROM BUS 374043 [AURANG-CHTPM400.00] TO BUS 372340 [PG-AURANGABD220.00] CKT 2	317.58	317.58	315	100.82	SC-7
354004 WANAKBORI 400.00 352004 WANAKBORI 220.00 1	OPEN LINE FROM BUS 354001 [ASOJ4 400.00] TO BUS 354004 [WANAKBORI 400.00] CKT 1	317.39	317.39	315	100.76	SC-7
164482 FATEHG-4 400.00 162482 FATEHG-4 220.00 1	OPEN LINE FROM BUS 164482 [FATEHG-4 400.00] TO BUS 162482 [FATEHG-4 220.00] CKT 2	503.42	503.42	500	100.68	SC-7
374002 KHARGAR 400.00 372125 KHARGR22 220.00 3	OPEN LINE FROM BUS 374002 [KHARGAR 400.00] TO BUS 372125 [KHARGR22 220.00] CKT 1	501.25	501.25	500	100.25	SC-7

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
114422 KISHENPUR 400.00 112235 KISHENPUR 220.00 1	OPEN LINE FROM BUS 114422 [KISHENPUR 400.00] TO BUS 112235 [KISHENPUR 220.00] CKT 2	457.57	457.57	315	145.26	SC-8
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	448.47	448.47	315	142.37	SC-8
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	428.29	428.29	315	135.96	SC-8
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	673.43	673.43	500	134.69	SC-8
164412 KALISI-4 400.00 162300 KALISIND 220.00 2	OPEN LINE FROM BUS 164412 [KALISI-4 400.00] TO BUS 164485 [SANGOD 400.00] CKT 1	671.05	671.05	500	134.21	SC-8
424022 MENDHASAL 400.00 422586 MENDHASAL 220.00 1	OPEN LINE FROM BUS 424022 [MENDHASAL 400.00] TO BUS 422586 [MENDHASAL 220.00] CKT 2	409.63	409.63	315	130.04	SC-8
444015 CHANDITALA_N400.00 442015 CHANDITALA_N220.00 1	OPEN LINE FROM BUS 444015 [CHANDITALA_N400.00] TO BUS 442015 [CHANDITALA_N220.00] CKT 2	401.08	401.08	315	127.33	SC-8
374012 PADGH4 400.00 372163 PADGHE22 220.00 6	OPEN LINE FROM BUS 374012 [PADGH4 400.00] TO BUS 372163 [PADGHE22 220.00] CKT 1	386.66	386.66	315	122.75	SC-8
544046 NEY(REP)4 400.00 542184 NNTPS2 230.00 1	OPEN LINE FROM BUS 544046 [NEY(REP)4 400.00] TO BUS 542184 [NNTPS2 230.00] CKT 2	607.88	607.88	500	121.58	SC-8
544004 TRICHY 400.00 542048 ALUNDR42 230.00 1	OPEN LINE FROM BUS 544004 [TRICHY 400.00] TO BUS 542048 [ALUNDR42 230.00] CKT 3	377.38	377.38	315	119.8	SC-8
374012 PADGH4 400.00 372163 PADGHE22 220.00 1	OPEN LINE FROM BUS 374012 [PADGH4 400.00] TO BUS 372163 [PADGHE22 220.00] CKT 2	710.74	710.74	600	118.46	SC-8
444012 KOLAGHAT 400.00 442012 KTPS220 220.00 1	OPEN LINE FROM BUS 444012 [KOLAGHAT 400.00] TO BUS 442012 [KTPS220 220.00] CKT 2	368.8	368.8	315	117.08	SC-8
444018 KHARAGPR-WB 400.00 442018 KHARAGPR-WB 220.00 1	OPEN LINE FROM BUS 444018 [KHARAGPR-WB 400.00] TO BUS 442018 [KHARAGPR-WB 220.00] CKT 2	358.87	358.87	315	113.93	SC-8

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
164420 KOTA 400.00 162919 KOTA 220.00 1	OPEN LINE FROM BUS 164420 [KOTA 400.00] TO BUS 162919 [KOTA 220.00] CKT 2	357.37	357.37	315	113.45	SC-8
424033 PANDIABILI 400.00 422033 PANDIABILI 220.00 2	OPEN LINE FROM BUS 424033 [PANDIABILI 400.00] TO BUS 422033 [PANDIABILI 220.00] CKT 1	564.79	564.79	500	112.96	SC-8
164409 HINDAU-4 400.00 162207 HINDAU-4 220.00 1	OPEN LINE FROM BUS 164409 [HINDAU-4 400.00] TO BUS 162207 [HINDAU-4 220.00] CKT 2	351.25	351.25	315	111.51	SC-8
444422 DURGAPUR-B 400.00 442682 DURGAPUR-A 220.00 1	OPEN LINE FROM BUS 444422 [DURGAPUR-B 400.00] TO BUS 442682 [DURGAPUR-A 220.00] CKT 2	350.85	350.85	315	111.38	SC-8
544013 PUGALUR4 400.00 542094 PUGALR42 230.00 1	OPEN LINE FROM BUS 544013 [PUGALUR4 400.00] TO BUS 542094 [PUGALR42 230.00] CKT 3	350.78	350.78	315	111.36	SC-8
374043 AURANG-CHTPM400.00 372340 PG-AURANGABD220.00 1	OPEN LINE FROM BUS 374043 [AURANG-CHTPM400.00] TO BUS 372340 [PG-AURANGABD220.00] CKT 2	348.8	348.8	315	110.73	SC-8
374067 KARJAT 400.00 372418 KARJAT 220.00 1	OPEN LINE FROM BUS 374067 [KARJAT 400.00] TO BUS 372418 [KARJAT 220.00] CKT 2	553.25	553.25	500	110.65	SC-8
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	347.51	347.51	315	110.32	SC-8
544001 NYVL TS 2 400.00 542012 NLCTS22 230.00 1	OPEN LINE FROM BUS 544001 [NYVL TS 2 400.00] TO BUS 542012 [NLCTS22 230.00] CKT 2	274.26	274.26	250	109.7	SC-8
164416 AJMER 400.00 162329 AJMER42 220.00 1	OPEN LINE FROM BUS 164416 [AJMER 400.00] TO BUS 162329 [AJMER42 220.00] CKT 2	344.26	344.26	315	109.29	SC-8
444010 SAGARDIGHI_4400.00 442010 SAGARDIGHI_2220.00 1	OPEN LINE FROM BUS 514888 [NIZAMBD2_4 400.00] TO BUS 518888 [NIZAMBD2_7 765.00] CKT 1	340.48	340.48	315	108.09	SC-8
354036 HALVAD NEW 400.00 352140 HALWAD NEW 220.00 1	OPEN LINE FROM BUS 354036 [HALVAD NEW 400.00] TO BUS 352140 [HALWAD NEW 220.00] CKT 2	340.16	340.16	315	107.99	SC-8
454016 RAMKANALI B 400.00 452016 RAMKANALIB 220.00 1	OPEN LINE FROM BUS 454016 [RAMKANALI B 400.00] TO BUS 452016 [RAMKANALIB 220.00] CKT 2	338.38	338.38	315	107.42	SC-8

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
374068 VIKROLI400 400.00 372460 VIKROLI220 220.00 1	OPEN LINE FROM BUS 374068 [VIKROLI400 400.00] TO BUS 372460 [VIKROLI220 220.00] CKT 2	536.85	536.85	500	107.37	SC-8
444008 JEERAT 400.00 442685 JEERAT 220.00 1	OPEN LINE FROM BUS 444008 [JEERAT 400.00] TO BUS 442685 [JEERAT 220.00] CKT 2	337.92	337.92	315	107.28	SC-8
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	337.59	337.59	315	107.17	SC-8
354012 SUGEN 400.00 352012 SUGEN 220.00 1	OPEN LINE FROM BUS 354012 [SUGEN 400.00] TO BUS 352012 [SUGEN 220.00] CKT 2	337.14	337.14	315	107.03	SC-8
164403 RAMGARH 400.00 162403 RAMGARH_RE 220.00 1	OPEN LINE FROM BUS 164403 [RAMGARH 400.00] TO BUS 162403 [RAMGARH_RE 220.00] CKT 2	525.49	525.49	500	105.1	SC-8
314049 RAIPUR SPLT 400.00 312002 RAIPUR2 220.00 1	OPEN LINE FROM BUS 314049 [RAIPUR SPLT 400.00] TO BUS 312002 [RAIPUR2 220.00] CKT 2	329.78	329.78	315	104.69	SC-8
314004 BHI4 400.00 312004 BHILAI 220.00 1	OPEN LINE FROM BUS 314004 [BHI4 400.00] TO BUS 312004 [BHILAI 220.00] CKT 2	328.66	328.66	315	104.34	SC-8
534048 KOTTAYAM4 400.00 532259 KOTTAYAM2 220.00 1	OPEN LINE FROM BUS 534048 [KOTTAYAM4 400.00] TO BUS 532259 [KOTTAYAM2 220.00] CKT 2	327.2	327.2	315	103.87	SC-8
544004 TRICHY 400.00 542048 ALUNDR42 230.00 3	OPEN LINE FROM BUS 544004 [TRICHY 400.00] TO BUS 542048 [ALUNDR42 230.00] CKT 1	518.71	518.71	500	103.74	SC-8
354137 SANKHARI 400.00 352142 SANKHARI_N 220.00 1	OPEN LINE FROM BUS 354137 [SANKHARI 400.00] TO BUS 352142 [SANKHARI_N 220.00] CKT 2	518.11	518.11	500	103.62	SC-8
174265 REWA 400.00 172112 REWAROAD 220.00 1	OPEN LINE FROM BUS 177262 [MAINPURIUP 765.00] TO BUS 177263 [BARA 765.00] CKT 1	322.78	322.78	315	102.47	SC-8
444024 GOKARNA 400.00 442566 GOKARNA 220.00 1	OPEN LINE FROM BUS 444024 [GOKARNA 400.00] TO BUS 442566 [GOKARNA 220.00] CKT 2	321.46	321.46	315	102.05	SC-8
534951 TRIVNDRM4 400.00 532951 TRIVDRUM2 220.00 1	OPEN LINE FROM BUS 534951 [TRIVNDRM4 400.00] TO BUS 532951 [TRIVDRUM2 220.00] CKT 2	320.39	320.39	315	101.71	SC-8

Monitored Element	Contingency	Maximum Flow	Flow under Contingency	Rate	% loading	Scenario
374996 KALWA-SPLT 400.00 372996 KALWA-SPLT 220.00 1	OPEN LINE FROM BUS 374996 [KALWA-SPLT 400.00] TO BUS 372996 [KALWA-SPLT 220.00] CKT 2	508.1	508.1	500	101.62	SC-8
334003 KALA DNH 400.00 332003 KALA 220.00 1	OPEN LINE FROM BUS 334003 [KALA DNH 400.00] TO BUS 332003 [KALA 220.00] CKT 3	319.68	319.68	315	101.49	SC-8
364032 JULWNIA-4 400.00 362085 JULWANIA-42 220.00 1	OPEN LINE FROM BUS 364032 [JULWNIA-4 400.00] TO BUS 362085 [JULWANIA-42 220.00] CKT 3	319.24	319.24	315	101.34	SC-8
414094 BUXAR 400.00 412094 BUXAR 220.00 1	OPEN LINE FROM BUS 414094 [BUXAR 400.00] TO BUS 412094 [BUXAR 220.00] CKT 2	500.93	500.93	500	100.19	SC-8
164434 JODH KANKANI400.00 162334 JODHPURN-42 220.00 2	OPEN LINE FROM BUS 164434 [JODH KANKANI400.00] TO BUS 162334 [JODHPURN-42 220.00] CKT 1	315.29	315.29	315	100.09	SC-8
454001 DURGAPUR TPS400.00 452001 DURGAPUR TPS220.00 1	OPEN LINE FROM BUS 454001 [DURGAPUR TPS400.00] TO BUS 452001 [DURGAPUR TPS220.00] CKT 2	550.18	550.18	500	110.04	SC-9
424050 LAPANGA 400.00 422805 LAPANGA2 220.00 1	OPEN LINE FROM BUS 424050 [LAPANGA 400.00] TO BUS 422805 [LAPANGA2 220.00] CKT 2	331.63	331.63	315	105.28	SC-9
424014 DUBURI 400.00 422564 DUBRI NEW 220.00 1	OPEN LINE FROM BUS 424014 [DUBURI 400.00] TO BUS 422564 [DUBRI NEW 220.00] CKT 2	330.75	330.75	315	105	SC-9
454002 MEJIA-B 400.00 452002 MEJIA-B 220.00 1	OPEN LINE FROM BUS 454002 [MEJIA-B 400.00] TO BUS 452002 [MEJIA-B 220.00] CKT 2	328.96	328.96	315	104.43	SC-9
164412 KALISI-4 400.00 162300 KALISIND 220.00 2	OPEN LINE FROM BUS 164412 [KALISI-4 400.00] TO BUS 164485 [SANGOD 400.00] CKT 1	506.93	506.93	500	101.39	SC-9

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Annex 2.7

765kV Buses Exceeding Design Fault Current

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
NORTH	JHATI-PG 765.00	35	41	41	37	41	41	41	41	41	41	40	ISTS
NORTH	BHADLA-2 765.00	39	37	37	40	37	38	42	37	38	42	40	ISTS
NORTH	JAIPUR 765.00	40	43	43	41	44	45	45	45	45	45	40	STU
NORTH	GNOIDAUP 765.00	39	44	44	40	44	44	44	44	44	44	40	STU
NORTH	ALIGARH 765.00	41	46	46	43	46	47	46	46	47	47	40	ISTS
WEST	BLPSR WR 765.00	41	43	43	43	44	44	45	44	44	45	40	ISTS
WEST	BHUJ POOL 765.00	40	36	37	40	36	35	42	38	37	42	40	ISTS
WEST	GWALIOR 765.00	39	42	42	41	42	42	43	42	43	43	40	ISTS
WEST	BINA-PG-7 765.00	37	39	39	39	39	40	40	39	40	40	40	ISTS
WEST	JABALPR-POOL765.00	46	51	52	51	52	52	53	52	53	53	50	ISTS
WEST	WARDHA 765.00	40	42	43	42	43	43	45	43	44	45	40	ISTS
WEST	AURANG-CHTPM765.00	37	38	39	38	39	39	40	38	39	40	40	ISTS
SOUTH	CUDP800 765.00	39	41	41	39	41	42	42	42	43	43	40	ISTS
SOUTH	KURL800 765.00	49	50	51	50	50	51	53	52	52	53	40	ISTS
SOUTH	KURNOOL-III 765.00	43	42	42	43	42	42	44	42	43	44	40	ISTS
SOUTH	MAHESHWARAM 765.00	47	48	48	47	48	49	51	50	51	51	40	ISTS
SOUTH	NIZAMABAD 765.00	40	42	42	41	42	43	44	44	44	44	40	ISTS
SOUTH	WARANGAL NEW765.00	38	40	40	38	40	41	42	41	42	42	40	ISTS
SOUTH	RAIC800 765.00	38	39	39	38	39	40	41	40	41	41	40	ISTS

- **Highlighted cell indicates 765 kV Bus Fault Current > Design level**

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	NAKODAR4 400.00	40	44	44	41	43	44	44	44	44	44	40	STU
NORTH	PATIALA4 400.00	45	48	48	46	48	48	48	48	48	48	40	ISTS
NORTH	JALANDHAR4 400.00	42	45	45	43	45	45	45	45	45	45	40	ISTS
NORTH	MALERKOTLA4 400.00	38	41	41	39	41	41	42	41	42	42	40	ISTS
NORTH	SONAROAD 400.00	37	42	42	39	42	42	41	42	42	42	40	STU
NORTH	DAULATABAD4 400.00	42	51	51	44	51	51	50	51	51	51	40	STU
NORTH	JHAJAR_N 400.00	36	48	48	39	48	48	47	48	48	48	40	GEN
NORTH	KABULPUR 400.00	37	45	45	39	45	45	44	45	45	45	40	STU
NORTH	DHANONDA 400.00	47	58	58	50	58	58	58	58	58	58	40	STU
NORTH	GURGAON 400.00	44	52	52	46	52	52	52	52	52	52	50	ISTS
NORTH	PANCHKULA-PG400.00	44	47	47	45	47	47	47	47	48	48	40	ISTS
NORTH	BHIWANI-PG 400.00	48	54	54	51	54	54	55	54	54	55	50	ISTS
NORTH	ABDULLAP 400.00	46	52	52	48	51	52	52	52	52	52	40	ISTS
NORTH	KAITHAL 400.00	37	42	42	40	41	42	42	42	42	42	40	ISTS
NORTH	BALLABHG 400.00	43	50	49	45	49	49	48	49	49	50	40	ISTS
NORTH	BAWANA-G 400.00	41	54	53	43	54	53	47	53	51	54	40	STU
NORTH	BAWANA 400.00	41	54	53	43	54	53	47	53	51	54	40	STU
NORTH	MANDOLA 400.00	38	45	45	40	45	45	43	45	45	45	40	ISTS
NORTH	MUNDKA 400.00	34	42	41	36	42	42	40	41	41	42	40	STU
NORTH	JHATIKALA-PG400.00	34	40	40	36	40	40	39	40	40	40	40	ISTS
NORTH	MANDOLASP2 400.00	38	45	45	40	45	45	43	45	45	45	40	ISTS
NORTH	MANDOLASP3 400.00	38	45	45	40	45	45	43	45	45	45	40	ISTS
NORTH	TUGHLAKABAD 400.00	36	41	41	38	41	41	41	41	41	41	40	ISTS
NORTH	GOPAL PUR 400.00	39	46	45	41	45	46	44	45	46	46	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	JHATIKARASP 400.00	37	42	41	38	41	41	41	41	42	42	40	ISTS
NORTH	BHADLA 400.00	43	39	39	43	40	40	45	39	40	45	40	STU
NORTH	CHIT-NEW 400.00	39	42	40	40	40	40	40	39	40	42	40	ISTS
NORTH	BASSI 400.00	47	51	50	49	51	51	52	51	51	52	40	ISTS
NORTH	NEEMR-PG 400.00	47	55	55	50	55	55	55	55	55	55	40	ISTS
NORTH	SIKAR 400.00	40	43	43	41	44	44	44	44	44	44	40	ISTS
NORTH	JAIPUR_RS 400.00	49	53	52	50	53	53	54	53	53	54	40	STU
NORTH	BIKANER-NW 400.00	59	55	55	61	55	55	62	55	55	62	40	ISTS
NORTH	BHADLA PG 400.00	50	45	44	51	45	45	53	45	45	53	50	ISTS
NORTH	ANTA-4 400.00	31	32	32	32	36	36	36	41	41	41	40	STU
NORTH	JAIPUR_PG 400.00	38	39	39	39	39	39	41	39	39	41	40	ISTS
NORTH	FATEHG-2 400.00	55	46	46	55	46	46	58	46	47	58	50	ISTS
NORTH	FATEHG-3 400.00	56	53	52	56	53	53	57	51	52	57	40	ISTS
NORTH	BIKANER-II 400.00	66	58	58	67	58	59	68	58	59	68	40	ISTS
NORTH	BHADLA-2 400.00	52	46	45	53	46	46	55	46	46	55	50	ISTS
NORTH	BHIWADI 400.00	44	51	50	46	51	51	51	51	51	51	40	ISTS
NORTH	DAUSA 400.00	42	36	36	44	36	36	46	36	36	46	40	ISTS
NORTH	MEJA 400.00	48	49	48	48	48	49	49	48	49	49	40	GEN
NORTH	MAINPURIUP 400.00	39	41	42	40	41	42	42	41	42	42	40	STU
NORTH	BARA 400.00	44	45	45	44	45	45	45	44	45	45	40	STU
NORTH	REWA 400.00	39	40	40	40	40	40	40	40	40	40	40	STU
NORTH	GNOIDAUP 400.00	53	60	59	54	59	60	59	59	60	60	40	STU
NORTH	HAPUR 400.00	39	43	43	41	42	43	43	43	43	43	40	STU
NORTH	GAZIABAD 400.00	40	44	44	42	43	44	44	44	44	44	40	STU
NORTH	UNNAO4 400.00	41	42	43	41	42	43	43	42	43	43	40	STU
NORTH	BARELI4 400.00	38	40	40	39	39	40	40	40	40	40	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	SIKANDERABAD400.00	39	43	43	41	43	43	43	43	44	44	40	STU
NORTH	BAREL-PG 400.00	49	52	52	50	52	52	53	52	53	53	50	ISTS
NORTH	AGRANEW 400.00	40	44	44	42	44	44	44	44	45	45	40	STU
NORTH	DADR-NCR 400.00	46	60	59	48	60	59	55	59	59	60	40	GEN
NORTH	GNOIDA4 400.00	49	59	58	51	58	58	56	58	58	59	40	STU
NORTH	LUCK4-PG 400.00	51	54	54	52	54	54	55	54	54	55	40	ISTS
NORTH	LUCK74-P 400.00	49	52	52	50	52	52	53	52	52	53	40	ISTS
NORTH	DADR-HVD 400.00	45	59	58	47	58	58	54	58	58	59	40	GEN
NORTH	FATEH-PG 400.00	45	50	50	46	50	50	50	50	51	51	50	ISTS
NORTH	SHAHJ-PG 400.00	38	39	40	39	39	40	40	40	40	40	40	ISTS
NORTH	ANPARA4 400.00	53	53	53	53	53	53	54	53	53	54	40	GEN
NORTH	ANPARA-D 400.00	46	47	47	46	47	47	47	47	47	47	40	GEN
NORTH	ANPARAC 400.00	51	52	52	52	52	52	52	52	52	52	40	GEN
NORTH	ALLAHABA 400.00	49	51	51	50	51	51	52	50	51	52	40	ISTS
NORTH	BAL74-PG 400.00	44	46	46	44	46	46	48	48	48	48	40	ISTS
NORTH	VARANASI 400.00	48	50	50	49	49	50	51	50	51	51	50	ISTS
NORTH	SARNATH4 400.00	42	43	43	43	43	43	44	44	44	44	40	STU
NORTH	BAREILY 400.00	48	52	51	50	51	51	52	52	52	52	50	ISTS
NORTH	KANPRNEW 400.00	47	50	50	48	49	50	50	50	50	50	50	ISTS
NORTH	ALIGARH 400.00	39	42	42	40	42	42	42	42	42	42	40	ISTS
NORTH	MEERUT 400.00	59	66	66	61	66	66	65	66	66	66	40	ISTS
NORTH	AGRA 400.00	52	57	57	54	56	57	57	57	57	57	40	STU
NORTH	SINGRL4 400.00	42	43	43	43	43	43	43	43	43	43	40	GEN
NORTH	TIKRI KHURD 400.00	37	47	47	39	47	47	42	46	45	47	40	STU
WEST	KSK MAHNADI 400.00	21	22	22	22	40	40	40	40	40	40	40	GEN
WEST	JINDAL_EX 400.00	43	45	45	45	45	45	45	46	46	46	40	GEN

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	BIL-POOL 400.00	43	46	47	46	47	47	47	47	47	47	40	ISTS
WEST	RAIPUR_POOL 400.00	40	40	41	40	40	41	41	41	41	41	40	ISTS
WEST	GANCS4 400.00	36	40	41	37	41	41	38	41	41	41	40	#N/A
WEST	ASOJ4 400.00	36	39	40	38	40	40	39	41	41	41	40	STU
WEST	PIRANA_P 400.00	39	41	42	40	42	42	41	42	42	42	40	ISTS
WEST	DEHGM4 400.00	34	36	36	35	38	38	40	41	40	41	40	ISTS
WEST	RANCHODPURA 400.00	38	40	40	39	41	42	41	42	42	42	40	STU
WEST	SOJA4 400.00	36	38	38	37	40	40	42	42	42	42	40	STU
WEST	MUNDRA-APL 400.00	23	24	24	24	42	42	43	43	43	43	40	GEN
WEST	BACHAU 400.00	40	41	42	41	42	42	42	42	42	42	40	ISTS
WEST	CGPL 400.00	45	46	46	46	46	46	46	46	46	46	40	GEN
WEST	VADODARA 400.00	46	49	50	47	50	50	49	51	51	51	50	ISTS
WEST	BANASKANTHA 400.00	48	49	49	49	51	51	53	52	52	53	50	ISTS
WEST	SANKHARI 400.00	38	39	40	39	41	41	42	42	41	42	40	STU
WEST	BHOPAL-4 400.00	38	40	40	40	40	41	40	39	40	41	40	STU
WEST	BINA-4 400.00	40	43	43	43	43	43	44	42	43	44	40	STU
WEST	INDORE-4 400.00	39	40	41	40	41	41	41	40	41	41	40	STU
WEST	NAGDA-4 400.00	42	43	42	42	43	43	43	43	43	43	40	STU
WEST	JABALPUR-4 400.00	36	41	41	41	41	41	43	42	43	43	40	ISTS
WEST	KHANDWA-4 400.00	37	38	38	38	40	40	41	40	41	41	40	ISTS
WEST	BINA-PG-74 400.00	40	43	43	43	43	43	44	42	43	44	40	ISTS
WEST	KHARGAR 400.00	36	40	41	39	40	41	39	39	40	41	40	STU
WEST	CHANDRAPUR I400.00	23	39	40	38	44	44	46	45	45	46	40	GEN
WEST	BHADR4 400.00	23	35	36	34	40	41	42	41	41	42	40	ISTS
WEST	BABLESWAR 400.00	37	38	40	39	39	39	45	44	45	45	40	STU
WEST	AURANGBD-I 400.00	41	44	45	44	45	45	49	47	48	49	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	TAPS4 400.00	40	43	44	43	44	44	43	43	43	44	40	GEN
WEST	BOISAR 400.00	41	44	46	43	45	45	44	44	44	46	40	ISTS
WEST	CHANDRPR-II 400.00	24	39	40	38	44	44	46	45	45	46	40	GEN
WEST	SOLAPUR-PG 400.00	42	40	41	43	40	41	50	45	46	50	40	ISTS
WEST	AURANG-CHTPM400.00	46	49	51	49	50	51	53	50	51	53	50	ISTS
WEST	PUNE-PG-GIS 400.00	47	50	51	49	50	51	51	49	51	51	50	ISTS
WEST	AURANGABD-II400.00	40	43	44	43	44	44	48	46	47	48	40	STU
WEST	AURANGBD-III400.00	39	42	43	41	42	43	46	44	45	46	40	STU
WEST	CHNDPUR_SW 400.00	23	38	39	37	42	42	44	43	43	44	40	GEN
WEST	SOLAPUR STPP400.00	37	35	36	38	35	36	45	41	42	45	40	GEN
EAST	BARH-I 400.00	28	29	29	28	29	29	43	43	43	43	40	GEN
EAST	PURNEA-NW-PG400.00	36	38	38	35	38	38	40	40	40	40	40	ISTS
EAST	VEDANTA 400.00	50	51	52	51	52	52	51	52	52	52	50	STU
EAST	SAGARDIGHI_4400.00	32	45	44	32	45	44	45	46	45	46	40	GEN
EAST	FARAKKA 400.00	41	46	46	40	46	46	47	47	47	47	40	ISTS
EAST	SILIGURI-PG 400.00	38	39	40	37	39	39	40	40	41	41	40	ISTS
EAST	PATRATU 400.00	40	39	40	39	40	39	41	41	41	41	40	GEN
EAST	RANCHI 400.00	37	37	37	37	37	37	41	41	40	41	40	ISTS
SOUTH	KURNOOL4 400.00	52	51	52	52	52	53	53	52	53	53	40	STU
SOUTH	VEMAGIR4 400.00	38	43	43	36	44	44	42	46	46	46	40	STU
SOUTH	VIJ-AP 400.00	40	43	43	40	43	44	44	44	45	45	40	STU
SOUTH	KURL-NEW 400.00	54	54	54	54	54	55	55	54	55	55	50	ISTS
SOUTH	KURNOOL-III 400.00	56	50	50	56	50	50	53	50	51	56	40	ISTS
SOUTH	RAMGUNDM STP400.00	27	28	28	27	28	29	42	41	41	42	40	ISTS
SOUTH	HYDERABAD 400.00	36	38	39	37	38	39	42	41	41	42	40	ISTS
SOUTH	KHAMMAM 400.00	35	38	38	36	38	39	41	40	40	41	40	ISTS

Area	Bus Name	Sc-1	Sc-2	Sc-3	Sc-4	Sc-5	Sc-6	Sc-7	Sc-8	Sc-9	Max	Design Level	Remark
SOUTH	DICHPAL4 400.00	45	48	48	47	48	49	51	51	51	51	40	STU
SOUTH	GAJWEL4 400.00	34	38	38	38	38	39	42	42	42	42	40	STU
SOUTH	RAIC 400.00	37	38	38	37	38	39	43	44	44	44	40	STU
SOUTH	NELMANG4 400.00	40	41	41	41	41	42	43	42	43	43	40	STU
SOUTH	NARDR-NW 400.00	44	43	44	45	43	44	54	54	54	54	50	ISTS
SOUTH	KUDGI-NT 400.00	40	39	40	41	39	40	50	51	51	51	50	ISTS
SOUTH	MADURAI4 400.00	35	36	36	36	37	37	38	40	40	40	40	ISTS
SOUTH	UDMP 400.00	46	48	47	46	48	48	47	50	51	51	40	ISTS
SOUTH	PUGALUR4 400.00	38	41	40	39	41	41	40	43	43	43	40	ISTS
SOUTH	TIRUNEL4 400.00	48	48	48	48	49	48	51	54	54	54	40	ISTS

Highlighted cell indicates 400 kV Bus Fault Current > Design level

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Annex 2.8

Inter-Regional Transmission Capacity (MW)

Transmission Line	Present	Capacity at the end of 2029
EAST - NORTH		
Dehri/Sasaram - Sahupuri 220kV S/c	130	130
Sasaram HVDC back-to-back	500	500
Muzaffarpur - Gorakhpur 400kV D/c (with Series Comp.+TCSC)	2000	2000
Patna - Balia 400kV D/c (Quad)	1600	1600
Biharshariff - Balia 400kV D/c (Quad)	1600	1600
Barh/Patna - Balia 400kV D/c (Quad)	1600	1600
Gaya - Balia 765kV S/c	2100	2100
Sasaram bypassing (additional capacity)	500	500
Sasaram - Fatehpur 765kV S/c	2100	2100
Barh-II/Motihari - Gorakhpur 400kV D/c (Quad)	1600	1600
Gaya-Varanasi 765kV 2xS/c	4200	4200
Biharsharif-Varanasi 400kV D/c (Quad)	1600	1600
LILO of Biswanath Chariali - Agra ±800kV HVDC Bipole at new pooling station in Alipurduar and addition of 3000MW module	3000	3000
Sub-total	**22,530**	**22,530**
EAST - WEST		
Budhipadar-Korba 220kV S/c	130	130
Budhipadar-Korba 220kV D/c	260	260
Rourkela/Jharsuguda - Raigarh/Raipur 400kV D/c (with Series Comp.+TCSC)	1400	1400
Ranchi - Sipat 400 kV D/c with series comp.	1200	1200
Rourkela/Jharsuguda - Raigarh/Raipur 400kV (2nd) D/c (with Series Comp.)	1400	1400
Ranchi - Dharamjayagarh/WR Pooiling 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
Jeypore - Jagdalpur 400 kV D/c		1600
Sub-total	**21,190**	**22,790**
EAST - SOUTH		

Transmission Line	Present	Capacity at the end of 2029
Balimela - Upper Sileru 220kV S/c	130	130
Gazuwaka HVDC back-to-back	1000	1000
Talcher - Kolar HVDC bipole	2000	2000
Upgradation of Talcher-Kolar HVDC Bipole	500	500
Angul - Srikakulum 765kV D/c	4200	4200
Sub-total	**7,830**	**7,830**
EAST - NORTH EAST		
Birpara/Alipurduar - Salakati 220kV D/c	350	350
Siliguri - Bongaigaon 400kV D/c	1000	1600
Siliguri/Alipurduar - Bongaigaon 400kV D/c (Quad)	1600	1600
Sub-total	**2,950**	**2,950**
NORTH EAST - NORTH		
Biswanath Chariali - Agra ±800kV HVDC Bipole with 3000MW converter	3000	3000
Sub-total	**3,000**	**3,000**
WEST - NORTH		
Auriya - Malanpur 220kV D/c	260	260
Kota - Ujjain 220kV D/c	260	260
Vindhyachal HVDC back-to-back	500	500
Gwalier - Agra 765kV 2xS/c	4200	4200
Zerda - Kankroli 400kV D/c	1000	1000
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 Banasakntha – Chittorgarh D/c at Rishabdeo**	2100	2100
Vindhyachal - Varanasi 765kV D/c	4200	4200
Neemuch-Chittorgarh 400 kV D/c		1600
Mandsaur PS - Rishabdeo 765 kV D/c		4200
Mandsaur PS -Beawar 765 kV D/c		4200

Transmission Line	Present	Capacity at the end of 2029
Sub-total	**36,720**	**46,720**
WEST - SOUTH		
Chandrapur HVDC back-to-back	1000	1000
Kolhapur - Belgaum 220kV D/c	260	260
Ponda - Nagajhari 220kV D/c	260	260
Raichur - Sholapur 765kV S/c	2100	2100
Raichur - Sholapur 765kV (2nd) S/c	2100	2100
Narendra - Kolhapur 765kV D/c (operated at 400kV)	2200	2200
Wardha - Nizamabad 765kV D/c	4200	4200
Warora Pool - Warangal (New) 765kV D/c	-	4200
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	-	4200
Sub-total	**18,120**	**28,120**
TOTAL	**112,340**	**133,940**
* Barsur (WR) – L. Sileru (SR) 220kV HVDC Monopole of 200MW capacity is currently not in operation. **Banaskantha-Chhitorgarh is presently 765 D/c out of which one ckt is proposed to be LILOed at Rishabdeo by 2027.		

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Prepared by
Central Transmission Utility (CTU)

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