Draft Ver # 09
(29-Aug-2014)

Perspective Transmission Plan

for

Twenty Years (2014-2034)

(August 2014)

Government of India
Ministry of Power
(Prepared in association with
Central Electricity Authority,
PGCIL and POSOCO)

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Executive Summary

1. Introduction and Approach

1.1 Objective for a Perspective Transmission Plan

Transmission planning is a continuous process of identification of transmission system addition requirements, their need and timeframe of implementation commensurate with generation addition and growth in demand for electricity. It has to be in consonance with principle of development of power system enshrined in Section 3 of the Electricity Act 2003, i.e. '…..for development of the power system based on optimal utilisation of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy'.

1.2 Present transmission system and developments

The development and present status of the transmission system(of 220kV and above voltage level) from 10th Plan onwards is indicated below:

Table – E.1 : Transmission Lines during 10th, 11th and 12th Plans

	At the end of 10th Plan	At the end of 11th Plan	12th Plan Period		
			Expected addition (as per Plan)	Added up to June 2014	Expected by end of 12th Plan
Transmission Lines: (in ckm)					
HVDC Bipole lines	5872	9432	7440	0	16872
765 kV	2184	5250	27000	7117	32250
400 kV	75722	106819	38000	20442	144819
220 kV	114629	135980	35000	9581	170980
Total Transmission Line, ckm	**198407**	**257481**	**107440**	**37140**	**364921**
HVDC Terminal: (in MW)					
HVDC back-to-back	3000	3000	0	0	3000
HVDC Bipole	5000	6750	12750	3750	19500
Total- HVDC Terminal Capacity, MW	8000	9750	12750	3750	22500
AC Substations: (in MVA)					
765 kV	0	25000	149000	63500	174000
400 kV	92942	151027	45000	29845	196027
220 kV	156497	223774	76000	34670	299774
Total- AC Substation capacity, MVA	**249439**	**399801**	**270000**	**130765**	**669801**

1.3 The Electricity Act, 2003 has opened up hitherto constrained electricity market which was characterized by long term PPAs and inability of Distribution Companies and consumers to have a choice of suppliers. Besides de-licensing generation and removing controls on captive generation, the provision regarding availability of non-discriminatory open access in transmission and distribution is an important feature of the Act. This creates an enabling environment for competition among generators/traders to choose their customers and vice-versa. However, the response of Distribution utilities for inviting case-1/ case-2 bids, to meet their long term requirement of power, is not satisfactory. The above situation, if aggravated further, would result in sub-optimal utilization in one part of grid or congestion in another part. This results in challenging situation for evolving an optimum transmission plan.

1.4 Approach for Perspective Transmission Plan

The '20-year Perspective Transmission Plan' has been formulated in two parts.

Part- I : Evolving Transmission System Additions for 13th Plan i.e. up to 2021-22

Part- II: Evolving Transmission Corridors for period 2022-34 i.e. 14th, 15th Plans and beyond up to 2034

The perspective transmission plan is basically indicative in nature and covers the transmission systems at 400kV and above voltage levels. The planned transmission

> **Part one, i.e. upto 13th Plan end, transmission system has been evolved based on State-wise demand projections and generation plants under various stages of implementation.**
>
> **Part two gives broad transmission corridors.**

systems would need to be reviewed based on the actual developments particularly relating to location of generation plants and demand and the programme and policies of various states. The planned systems may be Inter-State or Intra-state transmission system as may be firmed up later through the transmission planning process of Standing Committees on Power System Planning.

In respect of part one, i.e. up to 13th Plan end, transmission system has been evolved based on State-wise demand projections and generation plants under various stages of implementation.

In regard to part two, as the generation has been de-licensed and generation plants in this timeframe are yet to take off, it is not possible to identify the optimum generation plan for 2022-34. In such a scenario, it is prudent to identify the transmission plan in accordance with the location of generation resources/ generation potential along with projected demand. In this regard, the result of the Report of the "Working Group on Integrated Strategy for Bulk Transport of Energy", in respect of state-wise and fuel-wise generation capacity requirements has been used. This report is part of the Report of National Transport Development Policy Committee (NTDPC) setup by Cabinet Secretariat. The Report covers aspects related to fuel requirement of power plant and corresponding transport requirements for use of coal, production of petroleum, natural gas, and steel industries up to 2032.

1.5 Important factors in the context of implementation of Transmission Plan

- To ensure that the planned transmission network gets implemented as per the schedule, the issues related to ROW, forest clearance and various other clearances would need to be addressed with the appropriate Ministry.
- Providing mechanisms for secured operation of large Indian grid is an essential pre-requisite. This inter-alia involves implementation of Primary and Secondary response, Protection audit, Ancillary services, Reliability Standards, compliance to Grid Code and Standards etc. Intermittent and variable generation from renewable sources also impacts grid stability.

> - **Issues related to ROW and forest clearance need to be addressed.**
> - **Providing mechanisms for secured operation of large Indian grid is an essential pre-requisite.**
> - **To develop adequate balancing facilities and mechanisms for handling variable nature of renewable Energy sources of generation**

- There is need to develop adequate balancing facilities and mechanisms for handling variable nature of renewable Energy sources of generation which include creation of generation capacity for balancing, grid integrations of renewable sources of power control infrastructure, and enabling regulations.

1.6 New Technologies in Transmission of Electricity

The advent of new technologies in development and secure operation of our large integrated power system network are Voltage Source Converter(VSC) based HVDC technology, Dynamic reactive compensation, PMU/PDC based Synchro-phasor Technology/Wide Area Monitoring System (WAMS), Phase Shifting Transformers and Series Reactors and 1200kV UHVAC.

1.7 The Intra-state transmission systems

The intra-state transmission system (Intra-STS) is to be developed by the State Transmission Utilities. Their network planning, scheme formulation and the programme of intra-state transmission development need to take into account the transmission system requirements for evacuation of power from state sector and private sector generation projects for intra-state benefit, absorption of power made available through ISTS, meeting the load growth in different areas of the State and to improve the reliability of their system. For a coordinated development process aiming at perspective optimization in meeting the growth targets, it would be appropriate that the State Transmission Utilities prepare their State Electricity Plans taking advantage of development plans for regional grid system and focusing on the specific requirements of the concerned State.

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2. Load and Generation Assumptions for 13th Plan

The expanse of the transmission system depends on the load demand it is required to meet and the generation resources. It is essential to have load demand forecast for planning of transmission network. This includes peak demand projections, demand variations over various seasons/months during a year as well as daily variations.

2.1 Load Assumptions for 13th Plan

The planning of transmission network for the next 20 years is proposed to be based on the electricity demand projections of each state/region as per 18th EPS (Electric Power Survey) of the country which covers year-wise projections for the 12th and 13th Plan and projections for the terminal years of the 14th and 15th Plans i.e. up to 2031-32.

Table – E.2 : 18th EPS Forecast of Annual Peak Load for 12th and 13th Plans

(figs. in MW)

State/UTs	2016-17	2021-22
Northern Region	60934	86461
Western Region	62015	86054
Southern Region	57221	82199
Eastern Region	24303	35928
North Eastern Region	2966	4056
Andman & Nicobar Islands	67	89
Lakshadweep	11	18
All India	**199540**	**283470**

2.2 The transmission system is planned to meet the peak load demand. During 8760 hours of the year, the load varies on a diurnal and monthly/seasonal basis. In India there are distinct load behaviors in three seasons of Summer, Monsoon and Winter. There are also distinct hours of peak(peak load) and off-peak (base load) during a year. The planned transmission system must be able to meet the load demand for all hours in a year. The variation in demand is different in different regions and this gives rise to diversity of demand. It is important here to note that though the transmission system planned considering this diversity provides saving in generation resources in the country but it is more important to plan optimum corridors of transmission. Actually, it is this diversity which provides economic power flows on all-India basis as compared to if planning is done on only regional basis.

2.3 Generation Capacity up to end of 13th Plan

The present generation installed capacity in the country by end of July 2014 was about 250 GW including renewable generating resources of about 32 GW. During 12th plan about 40 GW generation capacity has been added, which also includes about 9600 MW of capacity that was not in the planned list of 88.537 GW. Further, about 20 GW of additional capacity may be also added during 12th Plan while some of the earlier identified capacity may slip to 13th Plan. For the purpose of this report, an assessment has been carried out to identify generation capacity state-wise and type-wise that is likely to be commissioned up to end of 13th Plan i.e.

> **The total Installed Capacity by the end of 13th Plan is expected to be of the order of 469 GW including renewable.**

2021-22. It is seen that about 113 GW of generation capacity may be added in the remaining period of 12th Plan and about 100 GW during 13th Plan. Further about 5 GW may be added in Bhutan for benefit of import to India. It is important to note here, that, these assessments have been for the purpose of transmission planning and not for assessing generation capacity required for meeting the demands. A more accurate assessment for 12th Plan may be carried out at the time of mid-term-review. Following table give the generation scenario that may be available by end of 13th Plan. The total Installed Capacity by the end of 13th Plan is expected to be of the order of 469 GW which also includes 65 GW of renewable capacity.

Table – E.3 : Installed Capacity during 12th and 13th Plans (All figures are in MW)

	Up to July 2014 (Actual) (A)	Balance in XII Plan (B)	Addition in XIII Plan (C)	Total (End of XIII Plan) (D = A+B+C)
NR	64387	20929	16890	102206
WR	91847	36709	20262	148818
SR	57232	38650	23076	118958
ER	33881	12738	31195	77813
NER	2910	3511	8202	14623
Bhutan	1416	3066	2120	6602
Total	**251673**	**115603**	**101745**	**469020**

3. Assessment of transmission needs for 13th Plan

3.1 The transmission system requirement needs to be evolved at State level which is aggregated on regional level and there on at National level. The aggregation of import export requirement of States within a region, and taking into consideration the diversity factor, translates into Inter-regional power transfer requirements. The transmission system is evolved to cater to the inter-state and inter-regional power transfer requirements.

3.2 Load Generation Balance:

In order to find out the requirement of transmission system, it is important to find out the surplus/deficit of each Region/State under various conditions which would give the import/export requirement of respective Region/State. Accordingly, the load-generation balance has been calculated with nil surplus/deficit condition for the Summer Peak, Monsoon Peak, Winter Peak and Winter Off-Peak condition and the same is tabulated below :

Table- E.4 – Load Generation Balance at the end of 13th Plan (2021-22) for Study

	Summer Peak			Monsoon Peak		
	Despatch (% of IC)	Demand	Sur(+) / Def(-)	Despatch (% of IC)	Demand	Sur(+) / Def(-)
NR	66000 (65%)	86500	-20500	64500 (63%)	83000	-18500
WR	93200 (63%)	81700	11500	79500 (53%)	77500	2000
SR	65000 (55%)	80500	-15500	57500 (48%)	74000	-16500
ER	53800 (69%)	36000	17800	56800 (73%)	34200	22600
NER	8000 (55%)	4100	3900	10000 (68%)	3900	6100
Bhutan	4000 (61%)	0	4000	5500 (83%)	0	5500
Bangladesh		1000	-1000		1000	-1000
Pakistan		200	-200		200	-200
All India	290000 (62%)	290000	0	273800(58%)	273800	0

	Winter Peak			Winter Off-Peak		
	Despatch (% of IC)	Demand	Sur(+) / Def(-)	Despatch (% of IC)	Demand	Sur(+) / Def(-)
NR	59800 (59%)	82000	-22200	40000 (39%)	61000	-21000
WR	97900 (66%)	86000	11900	75900 (51%)	60000	15900
SR	62900 (53%)	82000	-19100	45000 (38%)	58000	-13000
ER	5800 (75%)	33300	24700	45000 (58%)	25200	19800
NER	6700 (46%)	3900	2800	1500 (10%)	2900	-1400
Bhutan	3100 (47%)	0	3100	600 (9%)	0	600
Bangladesh		1000	-1000		700	-700
Pakistan		200	-200		200	-200
All India	288400 (61%)	288400	0	208000 (44%)	208000	0

The above load generation balance shows that NR is having a deficit of about 18500-22200 MW while the deficit of SR is about 13000 to 19100 MW at the end of 13th Plan condition. Surplus in WR is about 11500-15900 MW in Summer Peak, Winter Peak and Winter Off-peak condition while during Monsoon Peak

The load generation balance shows that NR is having a deficit of about 18500-22200 MW while the deficit of SR is about 13000 to 19100 MW at the end of 13th Plan condition.

condition the surplus gets reduced to about 2000 MW only. Surplus in ER, NER and Bhutan also varies from 17800-24700, 2800-6100 and 600-5500 respectively. NER is experiencing deficit of about 1400 MW during Winter Off-peak condition.

Regional Balance(Export-Import) due to additional RES Capacity in 13th Plan:

A RES capacity of about 65 GW has been considered up to 12th /13th Plan for which the location-wise quantum (MW) was available. In the absence of complete information about 13th Plan capacity additions (location-wise and type-wise) at this stage, the results of NTDPC report have been used to assess impact of additional RES capacity that may be installed during 13th Plan. The NTDPC report has estimated about 83 GW of RES capacity by 13th Plan and about 135 GW by end of 14th Plan. As detailed in the chapters 5 and 6, the impact of RES on inter-regional transmission corridor requirements for 14th and 15th Plans have been included as part of the comprehensive analysis. For the 13th Plan, it is seen that the impact of additional i.e. 83-65=18 GW on inter-regional transmission capacity requirement is quite minimal and gets adjusted in the margins. The RES capacities may give about 10% of benefit during peak hours, as the solar is not available at peak hours of evening and wind being intermittent in nature can not be relied upon for meeting peak demands. The additional RES may give a benefit of about 670 MW during peak hours in Northern region and about 280 MW in Southern region, thus the requirements of NR and SR would thus get slightly reduced, as these are deficit regions. The surplus in Western and Eastern would increase slightly by about 750 MW and 150 MW, respectively, which gets adjusted in the total inter-regional transmission capacity that have been planned for exporting about 17000 MW and 25000 MW of power from these regions. The detailed exercise to fully integrate the RES for 13th Plan period may be carried out as part of green-energy-corridor-part-2 studies.

4. Evolving Transmission System for 13th Plan

4.1 Power System Studies

Load Flow studies have been carried out for 13th plan end condition. The existing transmission system and generation projects as well as those planned to come up by 13th plan has been simulated in the study. In addition, transmission system has been planned to interconnect new generation projects envisaged to come up by 13th plan to the grid. The transmission system for 400kV and above system has been analysed from the study result. Based on requirement of power transfer emerged from the load flow study, various new transmission schemes for strengthening the transmission network has been planned. The details of the

400kV and above schemes planned for 13th plan period have been analysed in the subsequent articles.

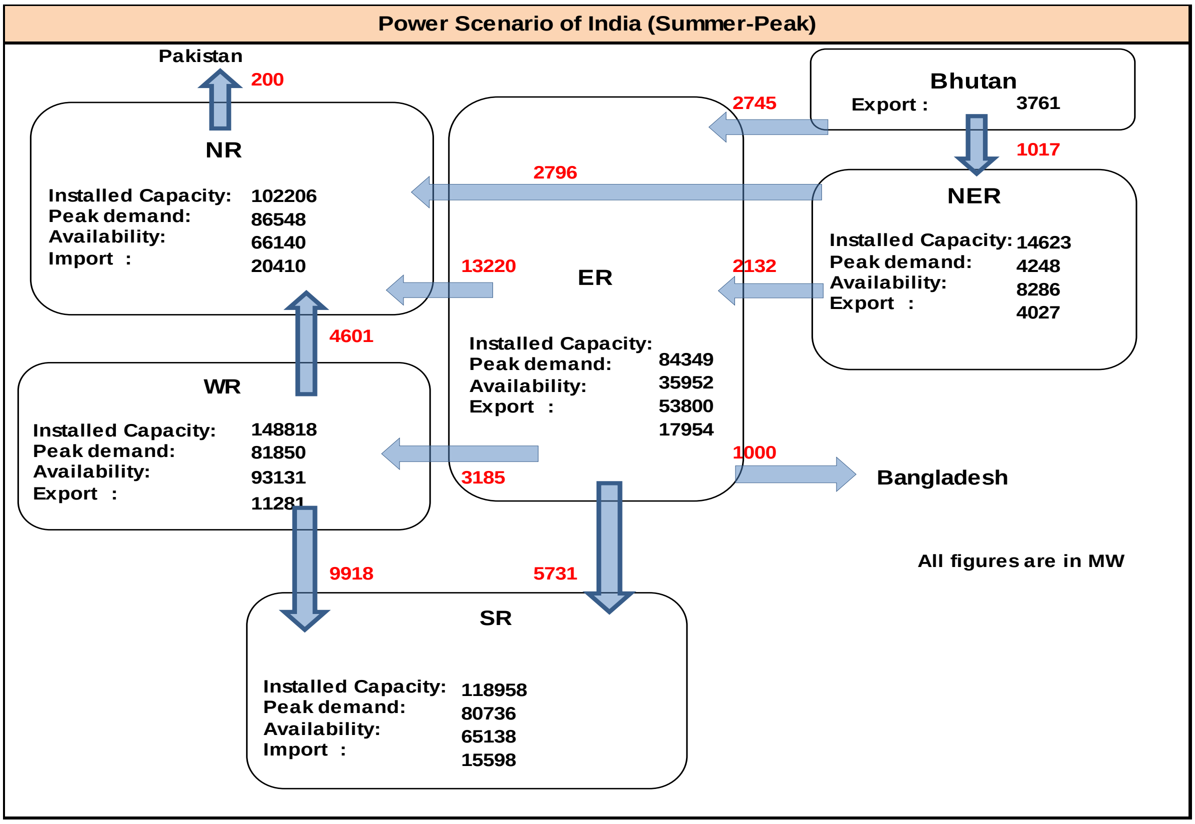

Fig- E.1 : Inter-regional power flow during **Summer-peak condition**

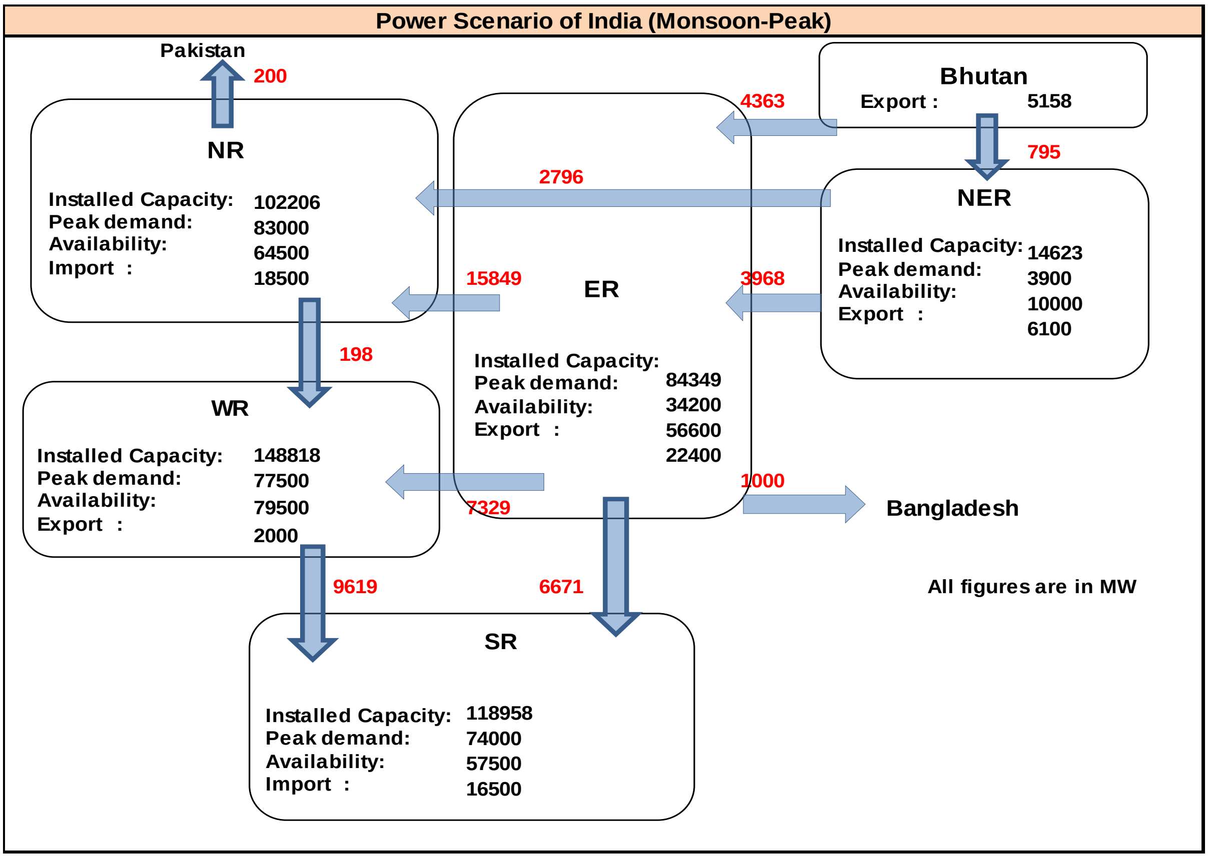

Fig- E.2 : Inter-regional power flow during **Monsoon-peak condition**

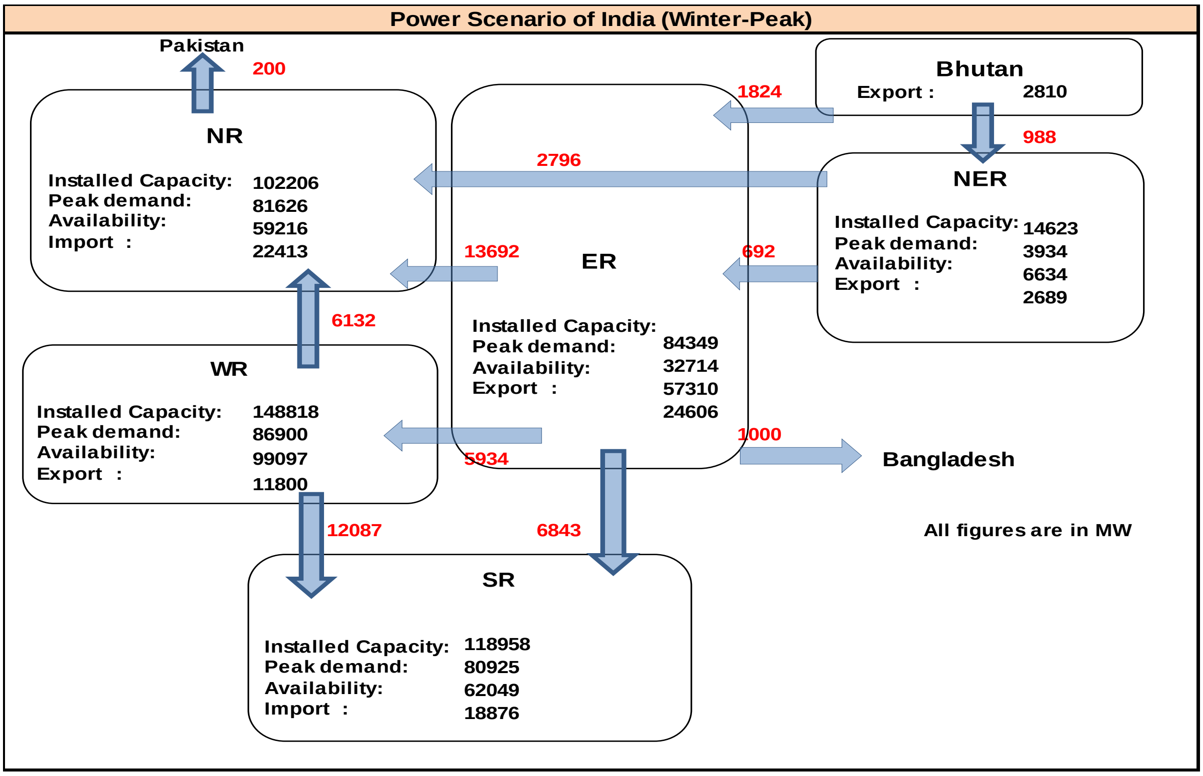

Fig- E.3 : Inter-regional power flow during **Winter-peak condition**

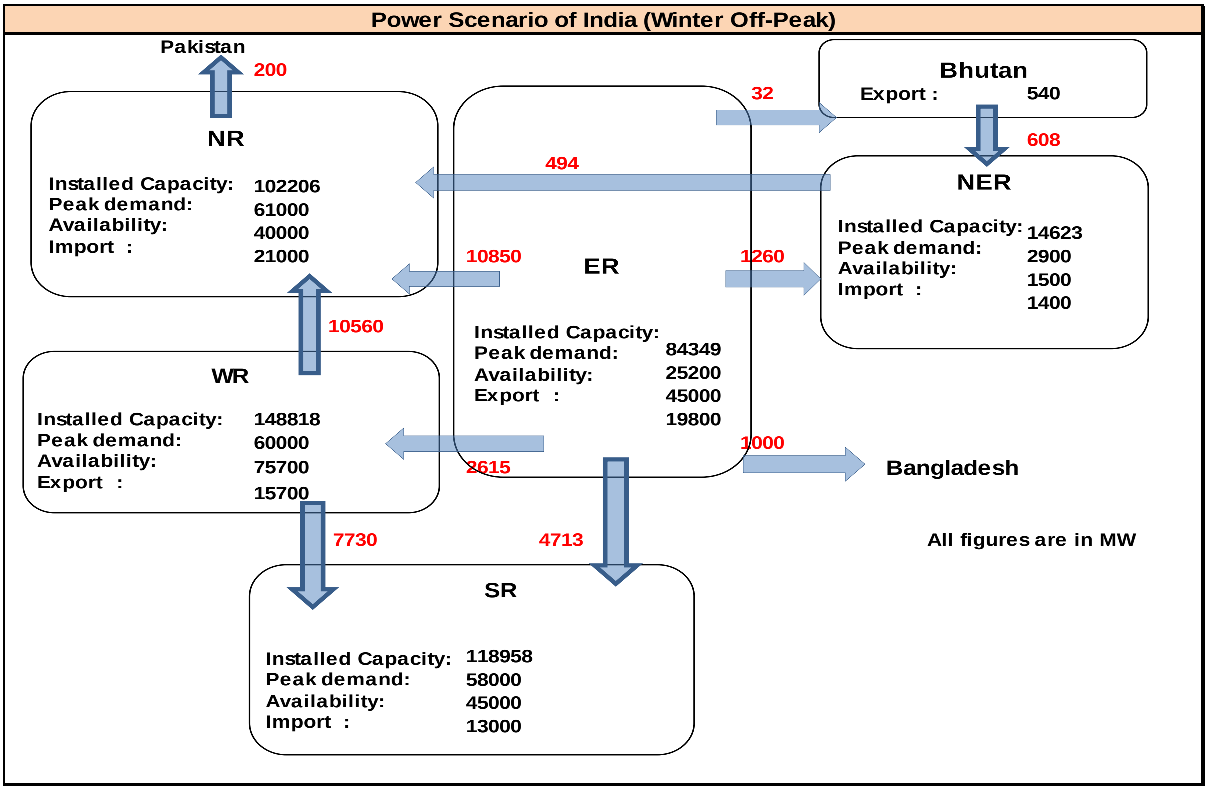

Fig- E.4 : Inter-regional power flow during **Winter-Off-peak condition**

4.2 Inter-regional transmission capacity addition requirements

The total inter-regional capacity addition during 13th plan is about 52,800 MW (or 46800 MW). With the above addition, the total inter-regional capacity would grow from 40,050 MW at present to about 1,26,650 MW by the end of 13 plan. The growth of inter-regional capacity from existing to 13th plan is given in Table E.5. The transmission highway corridors connecting various regions would appear as depicted in figure E.5.

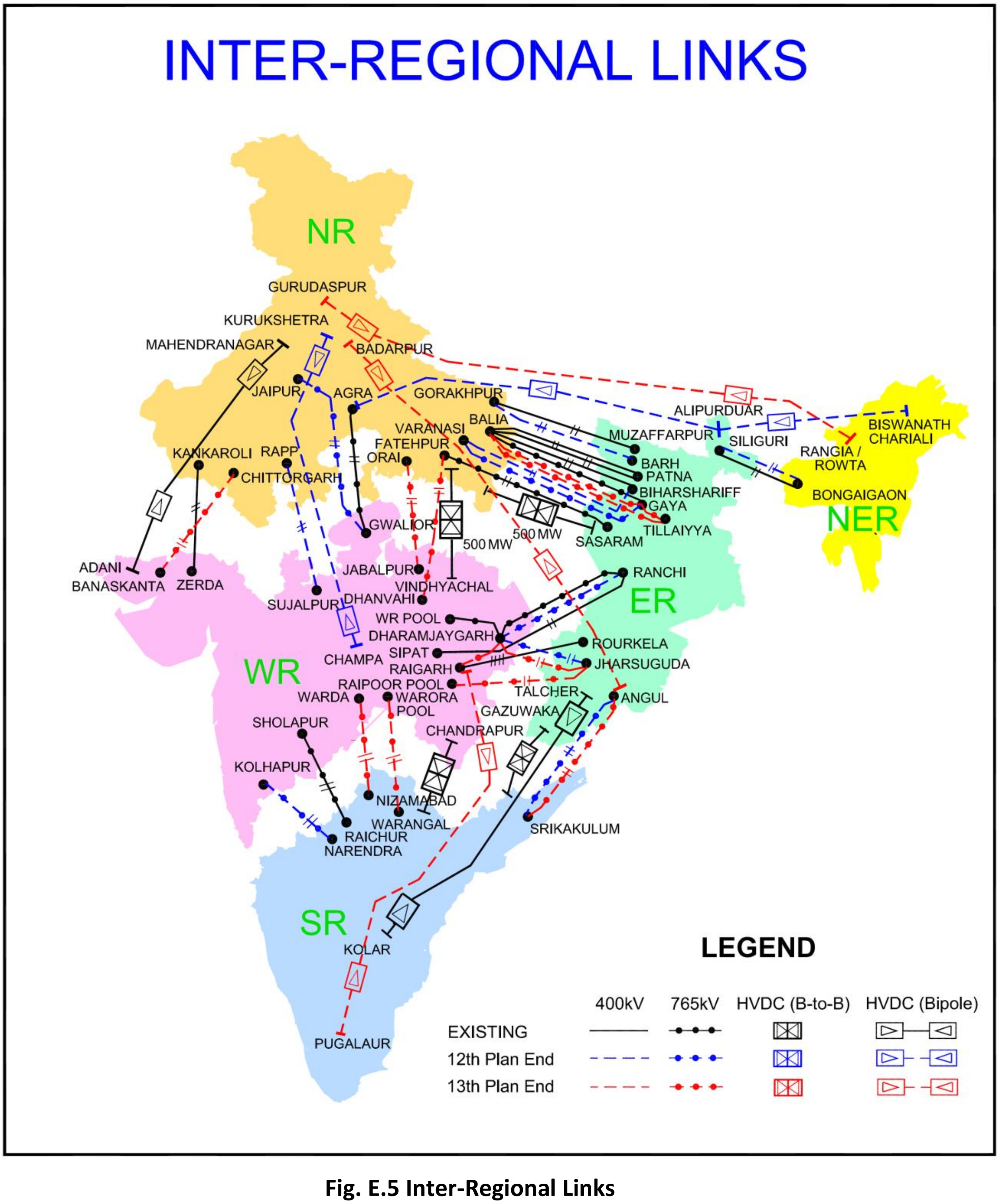

Fig. E.5 Inter-Regional Links

Table – E.5 : Summary of Inter- Regional Transmission Capacity

Transmission Corridor	Existing	12th Plan addition	End of 12th Plan	13th Plan addition	Total Transmission Capacity
EAST-NORTH	14230	5300	19530	7200*	26730
EAST-WEST	6490	6300	12790	8400	21190
EAST-SOUTH	3630	4200	7830	4200	12030
EAST- NER	1260	1600	2860	0	2860
WEST - NORTH	8720	8200	16920	15600	32520
WEST - SOUTH	5720	2200	7920	14400	22320
NER - NORTH	0	6000	6000	3000*	9000
Total	**40050**	**33800**	**73850**	**52800***	**126650**

*** Note - Tentative, may be required in 13th or 14th Plan, in which case 13th plan I-R capacity addition would be 46800 MW. One of these HVDC bipoles(of 3000 MW each) if needed may be planned towards Southern Region instead of towards Northern region.**

4.3 Total System Requirement – Physical Requirements for 13th Plan

A summary of the growth of 400kV and above transmission system from 11th to 13th Plans period is indicated below:

Table – E.6 : Transmission Lines (400kV and above system) (values in ckm)

	At end of 11th Plan	Expected Addition in 12th Plan	Expected by end of 12th Plan	Expected Addition in 13th Plan	Expected by end of 13th Plan
HVDC Bipoles	9432	7440	16872	10600	27472
765 kV	5250	27000	32250	22200	54450
400 kV	106819	38000	144819	30000	174819
Total	**121501**	**72440**	**193941**	**62800**	**256741**

Table – E.7 : Substations (AC & HVDC) (400kV and above) (values in MVA / MW)

	At end of 11th Plan	Expected Addition in 12th Plan	Expected by end of 12th Plan	Expected Addition in 13th Plan	Expected by end of 13th Plan
HVDC Terminals:					
HVDC b-to-b	3000	0	3000	0	3000
HVDC Bipoles	6750	12750	19500	15000	34500
Total- HVDC, MW	**9750**	**12750**	**22500**	**15000**	**37500**
AC Substations					
765 kV	25000	149000	174000	79000	253000
400 kV	151027	45000	196027	49000	245027
Total, MVA	**176027**	**194000**	**370027**	**128000**	**498027**

4.4 Fund requirement for the transmission system identified for 13th Plan period:

As estimated above, during 13th Plan Period, about 62800 circuit kilometers (ckm) of transmission lines, 15000 MW of HVDC terminal capacity and 128000 MVA of transformation capacity of the 400 kV and above voltage level transmission systems would be required. A majority of this system would be implemented as inter-State transmission system(ISTS). However, some part of it would be implemented as state transmission systems. Based on current cost of construction of the transmission systems being built by PGCIL, it is estimated that a total fund requirement for the above indicated system will be about 1,60,000 crores of rupees and considering about 1,00,000 crores for 220 kV and below systems most of which would be as state transmission systems. Accordingly, it is estimated that total fund requirement for 13th Plan would be of the order of Rupees 2,60,000 crore.

It is estimated that during 13th Plan Period, about 62800 circuit kilometers (ckm) of transmission lines, 15000 MW of HVDC terminal capacity and 128000 MVA of transformation capacity of the 400 kV and above voltage level transmission systems would be required.
Accordingly, it is estimated that total fund reqruiement for 13th Plan would be of the order of Rupees 2,60,000 crore.

4.5 Need for further studies while firming up the schemes

The transmission system that have been identified for the 13th Plan would be firmed up through further detailed studies which may include – transient stability studies, low frequency oscillations studies, transfer capability assessments, reactive power compensation requirements, short circuit studies and measures to limit fault level at critical nodes in the system etc as per the requirements of CEA's technical standards on connectivity and economic analysis for overall optimization

- **The transmission systems to be firmed up through further detailed studies**
- **The issues associated with multi-infeed HVDC systems must be studied in detail and addressed before finalizing the HVDC schemes.**

considering cost of generation, cost of transmission expansion and transmission losses, and the impact on transmission charges while finalizing individual schemes. The impact of too many HVDC inverter stations close by i.e. at Badarpur, Dadri, Agra, Kurukshetra, Mohindergarh, Bhiwadi which are within a short radius and may result in commutation issues which are associated with multi-infeed HVDC systems, also needs to be studied in detail before finalizing the HVDC schemes.

4.6 Strengthening of Existing Corridors

As part of the studies, the need for strengthening of existing transmission corridors has also been broadly taken into consideration. The following transmission corridors have been identified for strengthening through replacing the existing conductors with higher capacity conductors/upgrading to higher voltage levels.

Northern Region:

1. 400kV Singrauli-Anpara S/C
2. 400kV Meerut-Muzaffarnagar S/C
3. 220kV Ballabgarh-Badarpur

Southern Region

4. Kolar – Hosur 400 kV D/c line.
5. Kaiga – Guttur 400 kV D/c line.

Eastern Region

6. Jeypore-Jayanagar 220kV D/C
7. Maithon RB – Maithon 400kV D/C line
8. Maithon – Raghunathpur 400kV line

North-Eastern Region:

9. Biswanath Chariali – Balipara 400kV 2xD/c line
10. Reconductoring of Balipara - Bongaigaon 400kV D/c
11. Byrnihat – Misa 220 kV D/c line to be upgraded to 400kV high Capacity line

5. Load and Generation Assumptions for 14th and 15th Plans and up to 2033-34

5.1 The generation plants that may come up in these 12 years (2022-2034) is not known. The all-India peak demand, based on 18th EPS, is expected to rise from the current level of 140 GW to about 600 GW i.e. about 4.2 times by 2034. This implies roughly quadrupling the generation installed capacity as well as transmission systems of about 4 to 5 times the present capacities. The perspective plan for this period i.e. 2022-34 which includes 14th Plan, 15th Plan and first two years of 16th Plan, therefore, can at best be an indicative plan giving broad transmission corridors across various regions and possible international exchange corridors.

This assessment of indicative corridors requires an assessment of state-wise load growth and state-wise generation capacity additions of various fuel types i.e. coal, Gas nuclear, hydro, etc. As the assessment of optimum generation capacity addition during 2022-34 has been carried out in the "Report of the Working on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India – 2013 of National Transport Development Policy Committee (NTDPC). The assessment made in the NTDPC report has been supplemented with additional information as available with regard to nuclear, hydro projects in SAARC, gas resources. Accordingly, two generation addition scenarios have been identified for 14th and 15th Plan Periods and one generation scenario has been identified for 2022-34 period.

The assessment made in the NTDPC report has been supplemented with additional information as available with regard to nuclear, hydro projects in SAARC, gas resources. Accordingly, two generation addition scenarios have been identified for 14th and 15th Plan Periods and one generation scenario has been identified for 2022-34 period.

5.2 Assessment of electricity demand

The 18th EPS does not provide forecast for the year 2033-34. A forecast for 2034, by extrapolating the EPS figures has been made for the purpose of perspective transmission planning. The state-wise and region-wise annual peak load forecast are given below. The table below also gives corresponding figures for 14th and 15th plans for comparison purpose.

Table – E.8 : ALL INDIA & STATE WISE / UT WISE Annual Peak Demand

(in MW)

State/UTs	14th Plan (as per 18th EPS) 2026-27	15th Plan (as per 18th EPS) 2031-32	Estimates for 2033-34
Northern Region	121979	164236	184987
Western Region	120620	163222	184214
Southern Region	118764	165336	188730
Eastern Region	53053	72874	82740
North Eastern Region	6169	8450	9583
Andman & Nicobar Islands	125	172	195
Lakshadweep	23	30	33
All India	**400705**	**541823**	**611323**

5.3 Export to SAARC:

In addition to above, following peak export demand has also been assumed for neighbouring countries of SAARC region.

Table – E.9 : Expected Export Peak Demand for SAARC countries

(in MW)

State/UTs	14th Plan (as per 18th EPS) 2026-27	15th Plan (as per 18th EPS) 2031-32	Estimates for 2033-34
Bangladesh	1500	2000	2000
Nepal	400	500	500
SriLanka	500	800	1000
Pakistan	800	1000	1000
SAARC Exports	**3200**	**4300**	**4500**
Total All India + SAARC	**403800**	**546000**	**615700**

5.4 Possible generation resources:

The following aspects are broadly taken into consideration to assess the possible generation capacity from different modes to ensure planning of matching transmission network and meet demand. These aspects were taken into consideration in the report of the Working Group on Integrated Strategy for bulk transport of energy of NTDPC.

- Untapped hydro potential, particularly in the Himalayan belt covering North and North Eastern regions of the country, Bhutan and Nepal.

- Location of capacity of coal reserves, location of Gas fields, proposed gas pipelines and plans for LNG terminals and re-gasification capacities.
- Projected port traffic for coal.
- Potential for Renewable Energy Sources.

5.5 Hydro Power Resources

Hydro potential (25 MW & above) in the country has been estimated as 1,45,320 MW. Out of this potential, 35,944 MW hydro capacity is under operation (as on 30.06.2014) and 13,131 MW hydro capacity is under construction. In addition, nine Pumped Storage Schemes (PSS) of about 4,786 MW are under operation and two PSS of 1,080 MW are under construction. Hydro Capacity of 96,244 MW (66%) is yet to be developed. The likely installed capacity of hydro electric power plants is expected to be about 1,10,000 MW by the year 2031-32.

5.6 Nuclear Power Resources

Beyond the reactors presently in operation and under construction, sites for setting up additional 16 PHWRs of 700 MW each and 28 LWRs each of 1000 MW and higher capacity have been accorded 'in principle' approval of the Government. The actual realization during 13th Plan would however depend on the actual start of work on the projects. This in turn would depend on factors like acquisition of land, obtaining statutory clearances and resolution of issues, finalization of contracts etc. The likely installed capacity of nuclear power plants is expected to be about 35500 MW.

5.7 Coal Reserves

The major reserves of coal in the country have a geological resource of about 232 BT, more than 80 percent of the national resource and almost all of it is in the eastern part of the country. The bulk of the reserves are in three states – Odisha, Jharkhand and Chhattisgarh - which together have about 70 percent of the country's reserves of coal. However, it should be noted that much of this coal is of the poor quality (mostly grade F, and some D or E).

5.8 Estimated Renewable Energy Potential

The estimated medium-term (up to 2032) potential for power generation in the country from wind, small hydro, solar and biomass resources has been estimated at around 200 -250 GW, a part of which may become grid connected. This includes about 100 GW for each of Solar and Wind power generation, 15 GW from Small Hydro and about 25 GW from Biopower.

5.9 Generation Import Potential from Bhutan and Nepal

Following hydro generation capacity for import in India has been considered from Bhutan and Nepal during 2026-34.

Table – E.10 : Hydro Potential (capacities in MW) for Import from SAARC by 2034

Import From	By 2026-27	By 2031-32	By 2033-34
Bhutan	13986	26534	26534
Nepal	10000	20000	25000
Total SAARC Import	**23986**	**46534**	**51534**

5.10 Generation Addition Scenarios

Based on the above resource potentials, the NTDPC has optimized the capacity addition requirements up to 15th Plan end. The capacity addition figures in case of hydro, renewable and nuclear in the NTDPC report (the working Group report) appear to be reasonable and the same has been adopted for the purpose of present report on perspective transmission plan, which has been considered as **'Generation Scenario-I'** for 14th and 15th Plans. However in view of drastic change in likely gas scenario, it is felt that capacity addition from gas based power plants may be considerably lower and as such another scenario i.e. **'Generation Scenario-II'** has also been considered. In this scenario, it is assumed that additional imported coal would fill the load-generation gap. A generation capacity scenario for 2033-34 has been considered by scaling up the coal based and gas based capacities of scenario-I. An additional 5000 MW of hydro capacity has also been considered in Nepal for import to India.

6. Transmission corridors for 14th and 15th Plans and up to 2033-34

6.1 Growth in Generation and Demand for Scenario-I

The region-wise Installed Capacity and Demand at the end of 14th plan, 15th plan and 2033-34 condition is given in Table-6.3, 6.4 and 6.5 respectively.

Table – E.11 : Region-wise Installed Capacity and Demand at the end of 14th plan (Scenario-I)

Region	Installed Capacity by the end of 14th Plan (2026-27) (Scenario - I)							Peak Demand (2026-27) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	63959	7220	71179	38945	14946	39719	164789	121979
WR	128847	8240	137087	7879	19217	43402	207585	120620
SR	72907	6220	79127	13436	29214	47663	169440	118764
ER	87486	0	87486	9064	1779	3294	101623	53053
NER	810	0	810	18006	3043	1840	23699	6169
SAARC Exchange	0	0	0	23986	0	0	23986	3200
Total	**354009**	**21680**	**375689**	**111316**	**68199**	**135918**	**691122**	**403800**

Table – E.12 : Region-wise Installed Capacity and Demand by the end of 15th plan (Scenario-I)

Region	Installed Capacity by the end of 15th Plan (2031-32) (Scenario - I)							Peak Demand (2031-32) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	71846	10020	81866	43317	41058	64932	231173	164236
WR	155437	15089	170526	8011	32791	71568	282896	163222
SR	86834	10471	97305	13436	40791	66025	217557	165336
ER	111820	0	111820	9811	1779	5406	128816	72874
NER	810	0	810	35370	2463	2890	41533	8450
SAARC Exchange	0	0	0	46534	0	0	46534	4300
Total	**426747**	**35580**	**462327**	**156479**	**118882**	**210821**	**948509**	**546000**

Table – E.13 : Region-wise Installed Capacity and Demand by the end of 2033-34

Region	Installed Capacity by the end of 2033-34							Peak Demand (2033-34) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	82623	10020	92643	43317	45164	64932	246056	184987
WR	178753	15089	193842	8011	36070	71568	309491	184214
SR	99859	10471	110330	13436	44870	66025	234661	188730
ER	128593	0	128593	9811	1957	5406	145767	82740
NER	932	0	932	35370	2709	2890	41901	9583
SAARC Exchange	0	0	0	51534	0	0	51534	4500
Total	**490759**	**35580**	**526339**	**161479**	**130771**	**210821**	**1029410**	**615700**

6.2 Growth in Generation and Demand for Scenario-II

Under scenario-II, the region-wise installed capacity at demand for different types of fuel at the end of 14th and 15th plan as well as the corresponding demand growth is tabulated at 6.12 and 6.13 respectively. The generation data at the end of 2033-34 condition has been considered same as that of Scenario-I which has already been tabulated along with demand data at Table 6.5 above.

Table – E.14 : Region-wise Installed Capacity and Demand at the end of 14th plan (Scenario-II)

Region	Installed Capacity by the end of 14th Plan (2026-27) (Scenario - II)							Peak Demand (2026-27) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	68076	7220	75295.5	38945	10830	39719	164789	121979
WR	132554	8240	140794	7879	15511	43402	207585	120620
SR	82678	6220	88898	13436	19444	47663	169441	118764
ER	88272	0	88272	9064	993	3294	101623	53053
NER	1430	0	1430	18006	2423	1840	23699	6169
SAARC Exchange	0	0	0	23986	0	0	23986	3200
Total	**373009**	**21680**	**394689**	**111316**	**49200**	**135918**	**691123**	**403800**

Table – E.15 : Region-wise Installed Capacity and Demand at the end of 15th plan (Scenario-II)

Region	Installed Capacity by the end of 15th Plan (2031-32) (Scenario - II)							Peak Demand (2031-32) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	88743	10020	98762.5	43317	23886	64932	230897	164236
WR	165931	15089	181020	8011	22298	71568	282896	163222
SR	102394	10471	112865	13436	25232	66025	217558	165336
ER	112606	0	112606	9811	993	5406	128816	72874
NER	1208	0	1208	35370	2108	2890	41576	8450
SAARC Exchange	0	0	0	46534	0	0	46534	4300
Total	**470880**	**35580**	**506460**	**156479**	**74516**	**210821**	**948276**	**546000**

6.3 Requirements of Major Transmission Corridors

The region-wise demand-supply position along with maximum surplus / deficit at the end of 14th, 15th and 2033-34 condition under Scenario-I and Scenario-II is shown in the following figures. The Scenario-II of 2033-34 is same as that of Scenario-I. The requirement of broad transmission corridors has been estimated in order to meet the above Import / Export requirements under various time frames. As there is not significance difference between the maximum import/export requirements under Scenario-I and II, the maximum value of the import/export of Scenario I & II has been considered to find out the capacity of the new corridors. These transmission corridors would be a combination of both EHV AC as well as HVDC corridors. The details of various corridors would be worked out depending on the status of various future generation as well as transmission projects. As the average time period to commission a transmission project is about 4-5 years, the scope of transmission system under various projects need to be finalized well in advance so that the same may be commissioned matching with associated generation / other transmission projects. The plan-wise requirement of transmission corridor capacity has also been shown in the following figure.

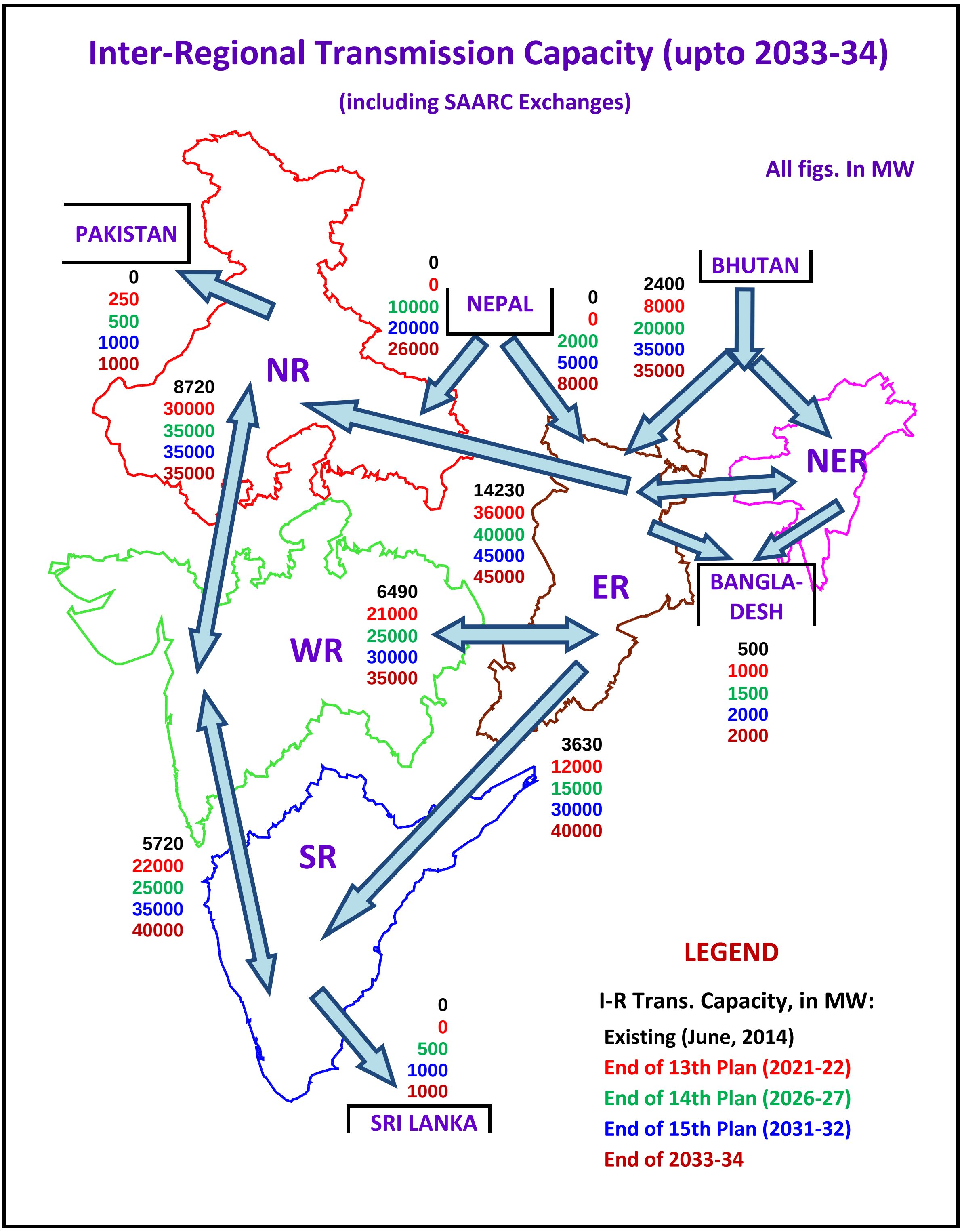

Fig E.6 : Transmission Capacity between various Regions / SAARC Countries

Chapter – 1

Introduction and Approach

1.1 Objective for a Perspective Transmission Plan

1.1.1 Transmission planning is a continuous process of identification of transmission system addition requirements, their need and timeframe of implementation commensurate with generation addition and growth in demand for electricity. It has to be in consonance with principle of development of power system enshrined in Section 3 of the Electricity Act 2003, i.e. '…..for development of the power system based on optimal utilisation of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy'.

1.1.2 Classically, the need for development of transmission system arises from new generation additions, increase in demand and general system strengthening for better reliability. These development goals are achieved based on a definite implementable 'transmission plan'. The National Electricity Plan (issued in November 2012) covers three plan periods i.e. review of 11th plan, detailed transmission plan for next five year i.e. 12th plan and indicative plan up to end of 13th plan period. In this context, the perspective plan of next 20 years can provide valuable information for optimizing transmission corridors, location of generating plants and industrial centers.

1.1.3 In the absence of affirmative information about new generation additions, the expected growth in load demand may serve as driving factor for a perspective transmission plan.

1.2 About present transmission infrastructure in the country

1.2.1 The transmission systems that are in place in the country consist of Inter-State Transmission System(ISTS) and Intra State Transmission System(Intra-STS).

The ISTS serves the following purpose:

(i) Evacuation of power from inter-state generation stations which have beneficiaries in more than one state.

(ii) Onwards transmission of power for delivery of power from inter-state generation stations up to the delivery point of the state grid.

(iii) Transfer of operational surpluses from surplus state(s) to deficit state(s) or from surplus region(s) to deficit region(s).

(iv) Economic dispatch and procurement of power as a competition enabler.

The Intra-STS serves the following purpose:

(i) Evacuation of power from the generating stations having beneficiaries in that State.

(ii) Onwards transmission within the State from ISTS boundary up to the various substations of the state grid network.

(iii) Transmission within the state grid for delivery of power to the load centers within the state.

1.2.2 The existing transmission system has enabled a thriving pan-India market. There has been no congestion in serving LTA. Some congestion has happened only in STOA and MTOA. Total congestion in 2013-14 was about 5.6 BU (0.6%) as against annual generation of about 950 BU. All this has happened due to all India national grid, which is one of the largest in the World and most advanced load dispatch centers operational in all the 5 five regions and National level.

1.2.3 In the last five years, transmission planning was done to match the upcoming UMPPs and IPPs. During this period, priority was accorded to evacuation system for IPPs though LTOA. Transmission system as conceived by CTU with new 11 high capacity corridor for evacuation of power from IPPs (about 50,000 MW capacity) is being constructed at an estimated cost of about Rs 67,000 crore. The corridors being implemented are 50-60% ready and are being put to use in stretches. The generation capacities for which these corridors were planned are expected to materialize in 12th and 13th Plan.

1.2.4 The country is presently having high capacity transmission systems with 765 kV and 400kV AC technology and HVDC systems deploying up to $\pm$800kV technology. At present, we have about 12000 circuit km of 765kV lines and 127000 circuit km of 400kV lines. The 765kV and 400kV substation capacities are 83000 MVA and 180000 MVA respectively. Efforts for adopting 1200kV technology as next higher voltage level have also been initiated. With a view to utilize transmission highways and to take care of variation in demand between peak and off season, Flexible AC

Transmission System (FACTS) including SVCs and switchable reactors also need to be provided.

1.2.5 Development of the transmission system (220kV and above voltage level) during 11th Plan period and expected to be added during 12th Plan period is indicated below:

Table – 2.1 : Transmission Lines during 10th, 11th and 12th Plans

Transmission Lines (both AC and HVDC) expected by end of 12th Plan (values in ckm)	At the end of 10th Plan	At end of 11th Plan	12th Plan Period		
			Expected addition (as per Plan)	Added up to June 2014	Expected by end of 12th Plan
HVDC Bipole lines	5872	9432	7440	0	16872
765 kV	2184	5250	27000	7117	32250
400 kV	75722	106819	38000	20442	144819
220 kV	114629	135980	35000	9581	170980
Total Transmission Line, ckm	**198407**	**257481**	**107440**	**37140**	**364921**

Table – 2.2 : Transmission Substations during 10th, 11th and 12th Plans

Substations(AC) and HVDC Terminals expected by end of 12th Plan (values in MVA / MW)	At the end of 10th Plan	At the end of 11th Plan	12th Plan Period		
			Expected addition (as per Plan)	Added up to June 2014	Expected by end of 12th Plan
HVDC Terminals:					
HVDC back-to-back	3000	3000	0	0	3000
HVDC Bipole terminals	5000	6750	12750	3750	19500
Total- HVDC Terminal Capacity, MW	**8000**	**9750**	**12750**	**3750**	**22500**
AC Substations					
765 kV	0	25000	149000	63500	174000
400 kV	92942	151027	45000	29845	196027
220 kV	156497	223774	76000	34670	299774
Total- AC Substation capacity, MVA	**249439**	**399801**	**270000**	**130765**	**669801**

1.2.6 The above figures also may give rough indications of transmission capacity that may be required to be added during next twenty years. However, total transmission capacity addition requirement depends on demand projections and generation addition programme / harnessing generation resource potential.

1.3 About present planning approach for transmission system

1.3.1 The planning of transmission system to meet long term requirements of generation projects is being carried out since 1975, however, at that time, the generating stations had known beneficiaries. The transmission system was developed with the prior knowledge of quantum of power, point of injection and point of drawal. Even for transfer of 15% unallocated power of central sector projects, to different parts of the country from time to time, there was rarely any problem of congestion because of the inherent margins built-up in transmission system were adequate take care of flexibility required for transfer this unallocated capacity.

1.3.2 Now more and more of private sector generation projects (IPPs) are being envisaged which intend to sell power to two or more States. The current generation addition programme of 88 GW during 12th Plan has about 47 GW capacity under private sector as compared to only 26 GW under central sector. Only a part of this 47 GW capacity has been tied up by State utilities under long/medium term contracts. By end of 11th Plan, IPP capacity was 54 GW out of total about 175 GW (i.e. 30.8 %) of conventional installed capacity. This is likely to increase to about 131 GW out of 350 GW (37.4 %) of conventional capacity by the end of 13th Plan. The renewable energy generations are mostly under private sector.

1.3.3 The Electricity Act, 2003 has opened up hitherto constrained electricity market which was characterized by long term PPAs and inability of Distribution Companies and consumers to have a choice of suppliers. Besides de-licensing generation and removing controls on captive generation, the provision regarding availability of non-discriminatory open access in transmission and distribution is an important feature of the Act. This creates enabling environment for competition among generators/traders to choose their customers and vice-versa. However, the response of Distribution utilities for inviting case-1/ case-2 bids, to meet their long term requirement of power, is not satisfactory.

1.3.4 The above situation, if aggravated further, would result in sub-optimal utilization in one part of grid or congestion in another part. This results in challenging situation for evolving an optimum transmission plan. In this respect, the concept of 'General Network Access (GNA)' proposed by CEA would not only optimize shape and size of the transmission network but would also provide flexibility in economic procurement of power.

1.4 Approach for Formulation of Perspective Transmission Plan for 2014-2034

1.4.1 The perspective transmission plan is basically indicative in nature and covers the transmission systems at 400kV and above voltage levels. The planed systems would need to be reviewed based on the actual developments particularly relating to location of generation plants and the programme and policies of various states. The planed systems may be Inter-State or Intra-state transmission system as may be decided and firmed up later through the transmission planning process of Standing Committees on Power System Planning.

1.4.2 The '20-year Perspective Transmission Plan' has been formulated in two parts.

Part- I : **Evolving Transmission System Additions for 13th Plan i.e. up to 2021-22**

Part- II: **Evolving Transmission Corridors for period 2022-34 i.e. 14th, 15th Plans and beyond up to 2034**

Part one is a detailed exercise covering ISTS and Intra-State expansion plan up to the end of 13th Plan (2021-22). Part two gives broad transmission corridors that may be required in next 20 years considering generation resource potentials and demand forecast for 14th and 15th Plan ends i.e. 2031-32 and up to 2034.

1.4.3 The planning has been done based on available information regarding generation addition and the load projections as per the 18th Electric Power Survey (EPS). The State Transmission Utilities were consulted in regard to future generation and transmission schemes in their States and also load projections. The generation addition information was updated in consultation the States. Almost all the States opined that he EPS demand forecasts can be made basis for the perspective plan. This information has been used to assess area/state/region-wise export/import requirements under various scenarios. The transmission system has been planned so as to cater to these import/export requirements. The possibility of increasing transmission capacity of the existing transmission lines by up-gradation of voltage level / re-conductoring has also been explored for optimum utilization of Right of Way available with existing transmission corridors.

1.4.4 In regard to part one i.e. up to end of 13^{th} plan(2021-22), a shelf of generation projects in various states is available. Using the available shelf of generation projects, state/region-wise import export scenarios for 13th plan has been assessed. Accordingly, assessment of additional transmission system, mainly under ISTS, has been made to meet these possible import/export requirements. The detailed Inter State transmission addition plan has been evolved through system studies by modeling the demand nodes, generation plants and existing/under implementation transmission system.

1.4.5 In regard to part two, i.e. for the period 2022 to 2034 (i.e. 14^{th} and 15^{th} plan and beyond) the information about generation addition programme is currently not available. Further, as the generation having de-licensed and generation plants in this timeframe are yet to take off, it is not possible to identify the optimum generation plan for 2022-34. In such scenario, it is prudent to identify the transmission plan in accordance with the location of generation resources/generation potential. The load projections, however, have been considered as per 18^{th} EPS of CEA. For the generation projects, the result of the Report of the "Working Group on Integrated Strategy for Bulk Transport of Energy", has been used. This report is part of the report of National Transport Development Policy Committee (NTDPC) set up by Cabinet Secretariat. The Report covers aspects related to fuel requirement of power plant and corresponding transport requirements for use of coal, production of petroleum, natural gas, and steel industries up to 2032.

1.4.6 India is centrally located in the SAARC region and would emerge as hub for large thermal projects in the SAARC region. Nepal and Bhutan would emerge as hubs for hydro generation. Pakistan, Bangladesh, Sri Lanka and also Nepal would be seeking import of electricity. Cross-border transmission links to cater to indicative load (or export from India) and generation potentials (or import into India) up to 2034 have been covered in this report.

1.5 The factors relevant in the context of Perspective Transmission Plan

1.5.1 To ensure that the planned transmission network gets implemented as per the schedule, the issues related to ROW, forest clearance and various other clearances would need to be addressed with the appropriate Ministry.

1.5.3 Providing mechanisms for secured operation of large Indian grid is an essential pre-requisite. This inter-alia involves implementation of Primary and Secondary response, Protection audit, Ancillary services, Reliability Standards, compliance to Grid Code and Standards etc. Intermittent and variable generation from renewable sources also impacts grid stability.

1.5.4 There is need to develop adequate balancing facilities and mechanisms for handling variable nature of renewable Energy sources of generation. These mechanisms would include creation/identification of generation capacity for balancing, grid integrations of renewable sources of power control infrastructure, and enabling regulations.

1.6 New Technologies in Transmission of Electricity

1.6.1 Some of the technological advances that would help in development of our large integrated power system network are VSC based HVDC technology, Dynamic reactive compensation, PMU/PDC based Synchro-phasor Technology/Wide Area Monitoring System (WAMS), Phase Shifting Transformers and Series Reactors and 1200kV UHVAC. Their brief introduction is given below:

1.6.2 **VSC Based HVDC Technology:** The present technology in use for HVDC systems is based on Line Commutated Converter (LCC) using thyristors which is generally called conventional HVDC technology. This technology suffers from technical restriction that commutation within the converter is driven by AC voltage of interconnected AC system requiring minimum short circuit level of surrounding AC system. The advent of Voltage Source Converter (VSC) HVDC transmission technology based on insulated gate bipolar transistors (IGBT) addresses some of the limitation of Conventional HVDC technology. It also provides better reactive power controls and can be helpful in inter connection of weak AC systems, island networks and renewable sources to a main grid. This technology is presently costlier than the LCC based technology and is still under development stage for bulk-power transmission requirements. In coming twenty years, this technology may become economical and more usable.

1.6.3 **Dynamic reactive compensation:** In order to maintain voltages in stipulated limits and grid stability, reactive compensation in the form of switchable/controlled bus reactors as well as STATCOM/SVC as dynamic compensators, at strategic locations are required.

1.6.4 **Synchro-phasor Technology/Wide Area Monitoring System (WAMS):** Dimension of Indian power system is growing manifolds and their complexity is increasing in all fronts which necessitate better visibility of grid system and fast update of operating scenario integrated with intelligent computation to capture dynamic behavior of power system towards safe, secure and reliable operation on real time basis. Application of synchrophasor technology using Phasor Measurement Unit (PMU), integrated with Phasor Data Concentrators (PDC) and high speed wideband fibre optic communication links has emerged to address above critical developments in the grid. This technology enables visualization of magnitude and angle of each phase of three phase voltage/current, frequency, rate of change of frequency, oscillations and angular separation at every few millisecond interval in the control centre. Thus the dynamic behavior of the power system can be observed in near real time at the control centre thereby improving/enhancing situational awareness for the operators and help increasing deliverability of the grid. For this, a scheme to establish Unified real time dynamic state measurement is already under implementation. This scheme when implemented along with research & development of applications, is likely to increase transfer capability of various inter-regional/inter-state corridors in the grid and reduce number of outages in the grid.

1.6.5 **Phase Shifting Transformers:** Existing transmission systems are often operated and stressed to the limit of their performance capability of their original design in order to maximize asset utilization. To ensure that under these conditions the economical, reliable and secure operation of the grid is maintained, the need for various aspects of power flow management within the power systems is becoming evident. Phase-shifting transformers(PST) help control the real power flow in transmission lines and systems inter-ties. They allow for better utilization of existing networks by balancing the loading in parallel paths. In this regard, it is worth mentioning that three PSTs have been planned in southern/western region and one of which has already been commissioned in the Andhra Pradesh.

1.6.6 Series Reactor: Power Demand in India is growing at rate of 9-10%. To meet the growing power demand generation and new lines are being added to meet this growth. All this has resulted in increase in short circuit level. As our generation resources are concentrated in selected areas, these are potential location where high short circuit is faced. Similarly area with high demand and is connected by many lines also face high short circuit level. To limit the short circuit level measures like splitting of the network has been studied. However such measures result in reduction in reliability and with growth in the network there parallel paths render them ineffective. Accordingly series reactor has been considered for limiting the fault current level. Series reactor can be provided in two methods for controlling fault current i.e. (i) Series bus reactors and (ii) Series line Reactors. The effect of the series bus reactor is very prominent in controlling the short circuit level of the bus on which it is installed. However effect of series bus reactor on adjacent buses is less. Series line reactor is very effective when small numbers of identified feeders are contributing maximum short circuit current. Series line reactors would be effective in reducing the short circuit level of both From bus and To bus between the line is connected. Detailed study has to be carried out to determine the configuration to be adopted and impedance level.

1.6.7 1200 kV UHVAC Technology : In India, in past one decade, 765kV Extra High Voltage (EHV) AC technology has been on forefront towards establishing high capacity transmission corridors. However in view of the growing Right-of-Way concerns and establishment of gigawatt scale generation complexes there is further need of increasing transmission of power in a given right-of-way. In this direction, world's highest transmission voltage level of 1200kV UHV-AC with the charging of National Test Station at Bina in M.P in 2012 has already established in India. This technology has been developed indigenously through establishment of a 1200kV Test Station by collaborative effort with leading Indian electrical equipment manufacturers, CPRI and CEA and POWERGRID. Despite being world's highest voltage level available only in India so far, the technology is expected on commercial basis in the 14th plan i.e. 2022 onwards. After getting adequate experience in regard to the operation of 1200kV lines and substation equipments of the test station at Bina, and based on system requirement for bulk transmission of power, more 1200kV lines may be planned in future. However, in case of low power transfer requirement in initial periods, lines may be operated at lower voltage levels, for example, the Wardha - Aurangabad 400kV D/C line has been designed so to convert it into a 1200kV line at a later date.

1.7 The Intra-state transmission systems

1.7.1 The intra-state transmission system (Intra-STS) is to be developed by the State Transmission Utilities. Their network planning, scheme formulation and the programme of intra-state transmission development have to take into account the transmission system requirements for evacuation of power from state sector and private sector generation projects for intra-state benefit, absorption of power made available through ISTS, meeting the load growth in different areas of the State and improve the reliability of their system. For a coordinated development process aiming at perspective optimization in meeting the growth targets, it would be appropriate that the State Transmission Utilities prepare their State Electricity Plans taking advantage of development plans for regional grid system and focusing on the specific requirements of the concerned State. The state authorities would need to build commensurate transmission, sub transmission and distribution system to carry forward power to the loads within the state. In case commensurate system is not developed by the States, it would not only result in stranded assets but also the lightly load transmission lines can adversely impact smooth operation of grid.

1.7.2 The Intra-State transmission systems would be firmed up based on the consultation with the State Transmission Utilities. These consultations with States would also include the 400kV and above voltage, as identified in this report and also the 220kV and below system down to 66kV voltage level for detailed transmission scheme formulations of each State. These consultations would require each State’s own load projections, state generation capacity addition programme, load centers and import/export requirement of each State through the Inter State Transmission System.

Perspective Transmission Plan

PART - I

Evolving Transmission System Additions for 13th Plan i.e. up to 2021-22

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Chapter – 2

Load and Generation Assumptions for 13th Plan

2.1 Introduction

2.1.1 The expanse of the transmission system depends on the load demand it is required to meet and the generation resources. It is essential to have load demand forecast for planning of transmission network. This includes peak demand projections, demand variations over various seasons/months during a year as well as daily variations.

2.2 Peak demand projections for period up to end of 13th Plan

2.2.1 The planning of transmission network for the next 20 years is proposed to be based on the electricity demand projections of each state/region as per 18th EPS (Electric Power Survey) of the country which covers year-wise projections for the 12th and 13th Plan and projections for the terminal years of the 14th and 15th Plans i.e. up to 2031-32. As per EPS projections, the peak demand would increase from 127 GW by end of 11th Plan, to 542 GW by 2032 in twenty years. EPS has projected an annual growth rate of about 9% during 12th Plan, 7.2% during 13th plan and then about 6.7% for next ten years. State-wise EPS projections for 12th, 13th five year plans are given in following table. More about EPS projections and methodology is given in the Part-II of this Report which covers Long Term Perspective Plan.

Table – 2.1 : 18th EPS Forecast of Annual Peak Load for 12th and 13th Plans

		(In MW)
State/UTs	**2016-17**	**2021-22**
Delhi	6398	9024
Haryana	10273	14244
Himachal Pradesh	1900	2589
Jammu & Kashmir	2687	4217
Punjab	12342	14552
Rajasthan	13886	19692
Uttar Pradesh	23081	36061
Uttrakhand	2189	2901
Chandigarh	426	559
Northern Region	**60934**	**86461**
Goa	815	1192

		(In MW)
State/UTs	**2016-17**	**2021-22**
Gujarat	19091	26973
Chhattisgarh	4687	6599
Madhya Pradesh	13904	18802
Maharashtra	28645	39622
D. & N. Haveli	944	1297
Daman & Diu	441	605
Western Region	**62015**	**86054**
Andhra Pradesh	22445	33194
Karnataka	13010	18403
Kerala	4669	6093
Tamil Nadu	20816	29975
Pudducherry	630	782
Southern Region	**57221**	**82199**
Bihar	5018	9306
Jharkhand	4616	6341
Orissa	5672	6749
West Bengal	11793	17703
Sikkim	144	176
Eastern Region	**24303**	**35928**
Assam	1817	2534
Manipur	346	497
Meghalaya	445	596
Nagaland	185	271
Tripura	340	472
Arunachal Pradesh	135	177
Mizoram	285	352
North Eastern Region	**2966**	**4056**
Andman & Nicobar Islands	67	89
Lakshadweep	11	18
All India	**199540**	**283470**

Note: In above estimates, the figures for Andhra Pradesh are for the undivided state

2.2.2 The transmission system is planned to meet the peak load demand. During 8760 hours of the year, the load varies on diurnal and monthly/seasonal basis. In India there are distinct load behaviors in three seasons of Summer, Monsoon and Winter. There are also distinct hours of peak (peak load) and off-peak (base load) during a year. These load profiles and their importance in perspective transmission planning is discussed in following sections.

2.2.3 The planned transmission system must be able to meet the load demand for all hours in a year. The daily variations in the demand met during different months over last six years are depicted below.

Exhibit – 2.1: Hourly demand met during 2008-14 – Northern Region

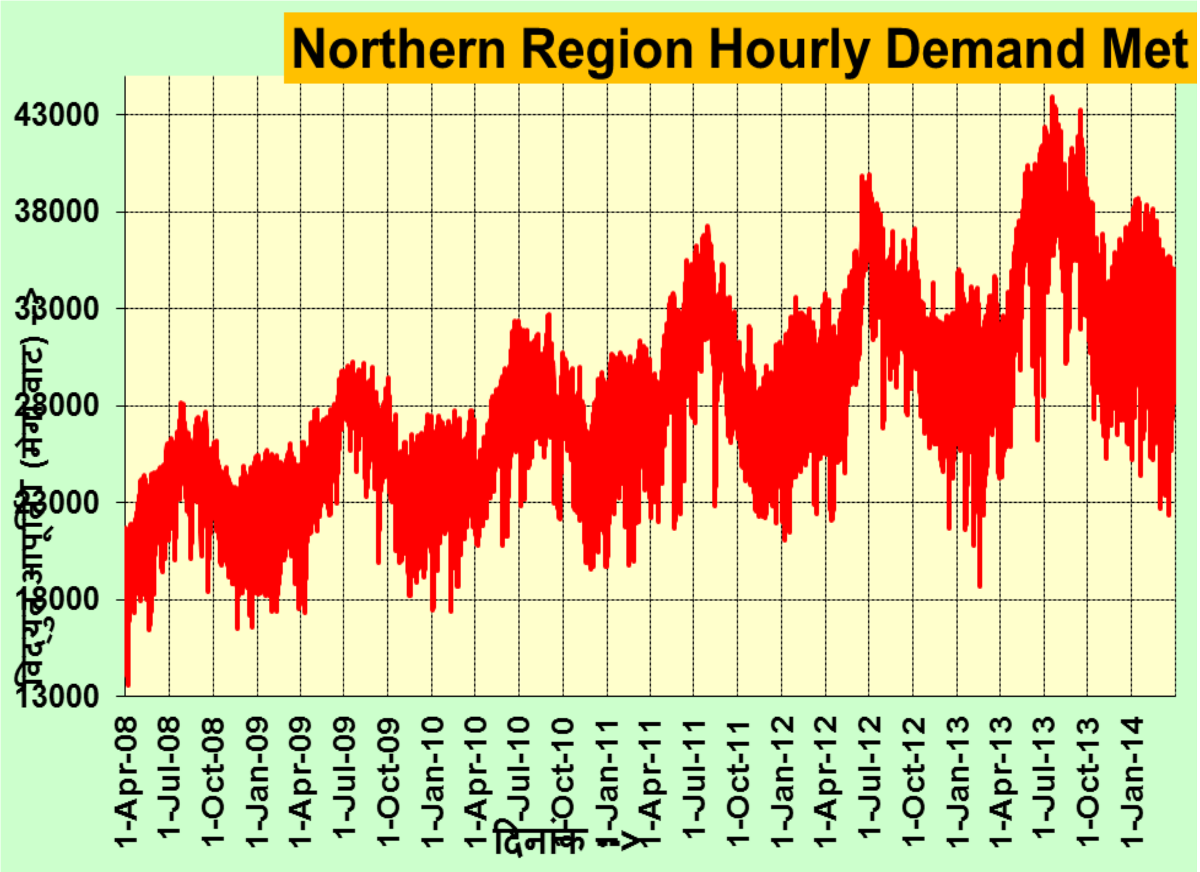


Exhibit – 2.2: Hourly demand met during 2008-14 – Western Region

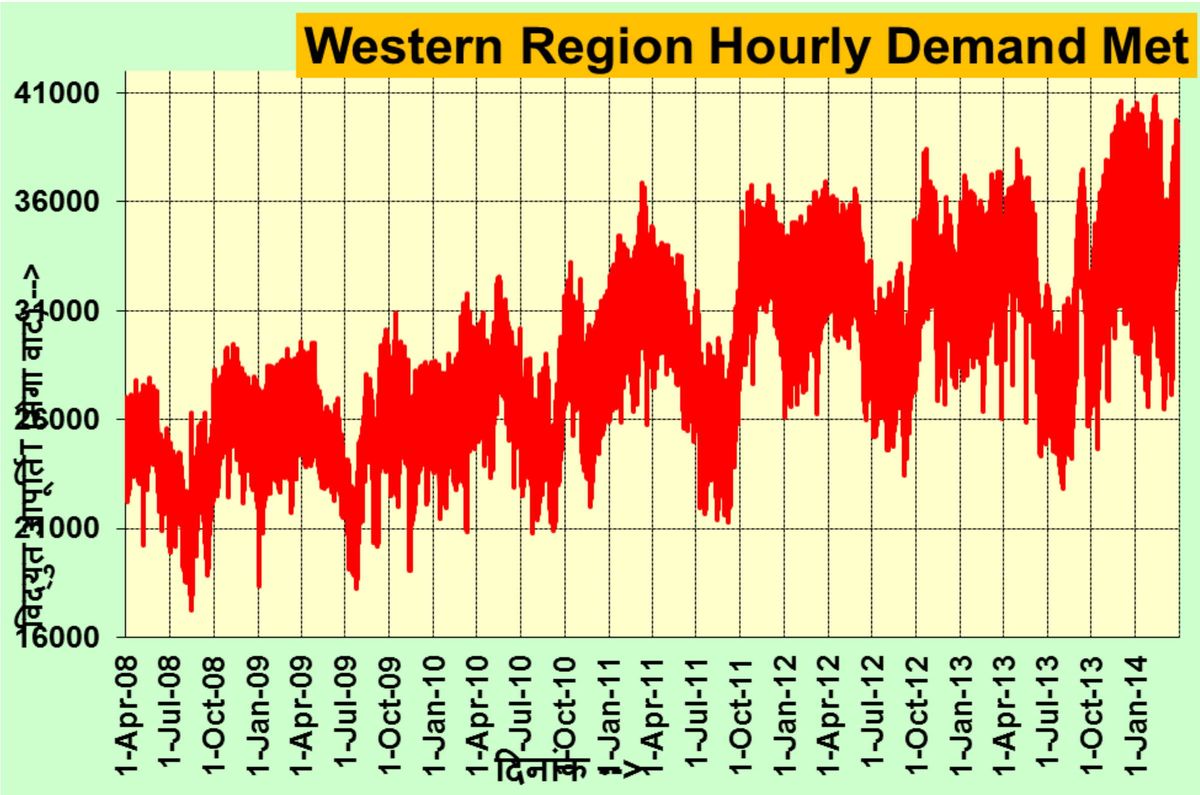


Exhibit – 2.3: Hourly demand met during 2008-14 – Southern Region

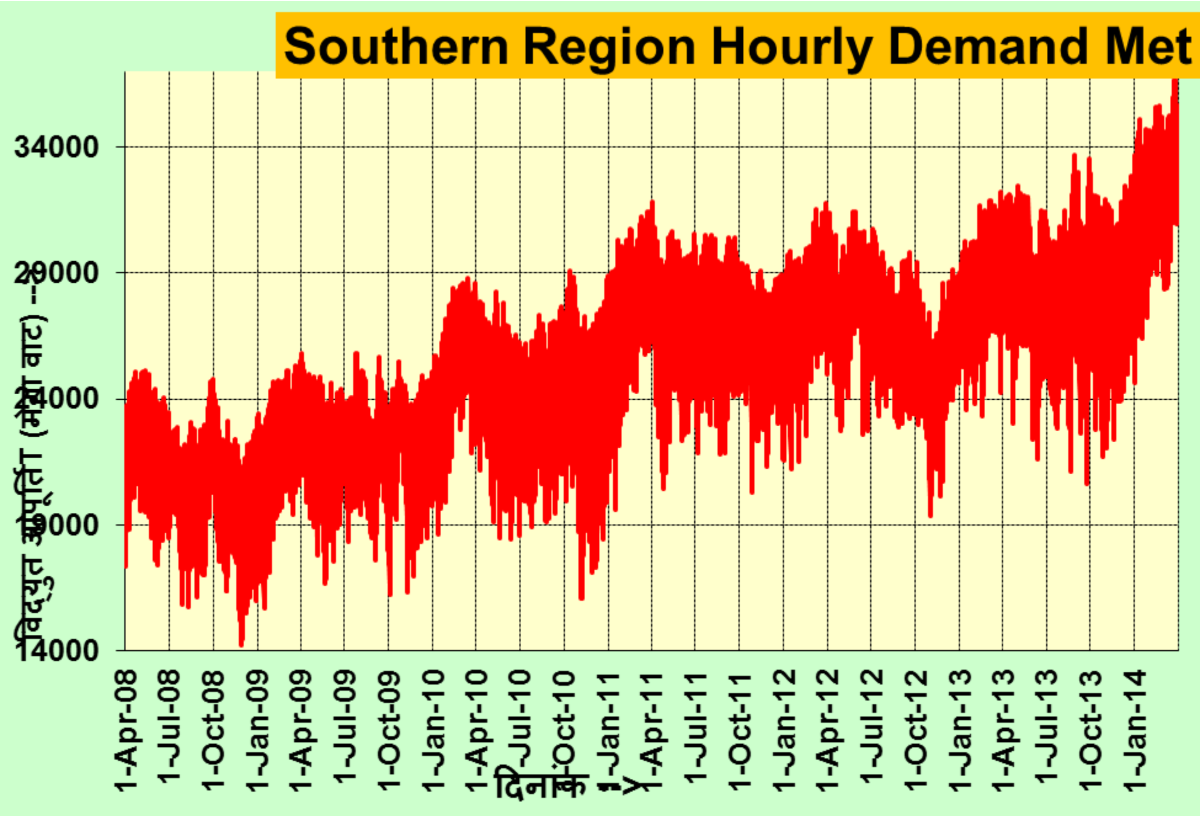


Exhibit – 2.4: Hourly demand met during 2008-14 – Eastern Region

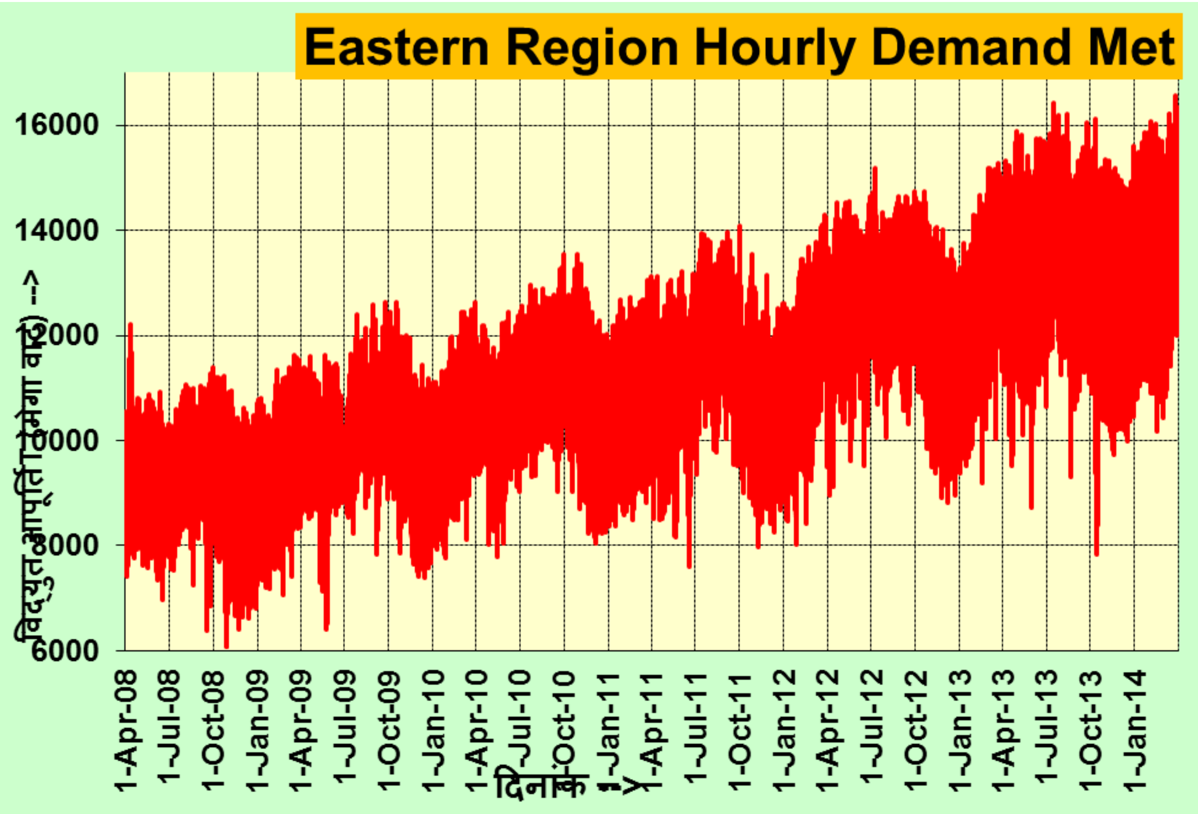


Exhibit – 2.5: Hourly demand met during 2008-14 – North eastern Region

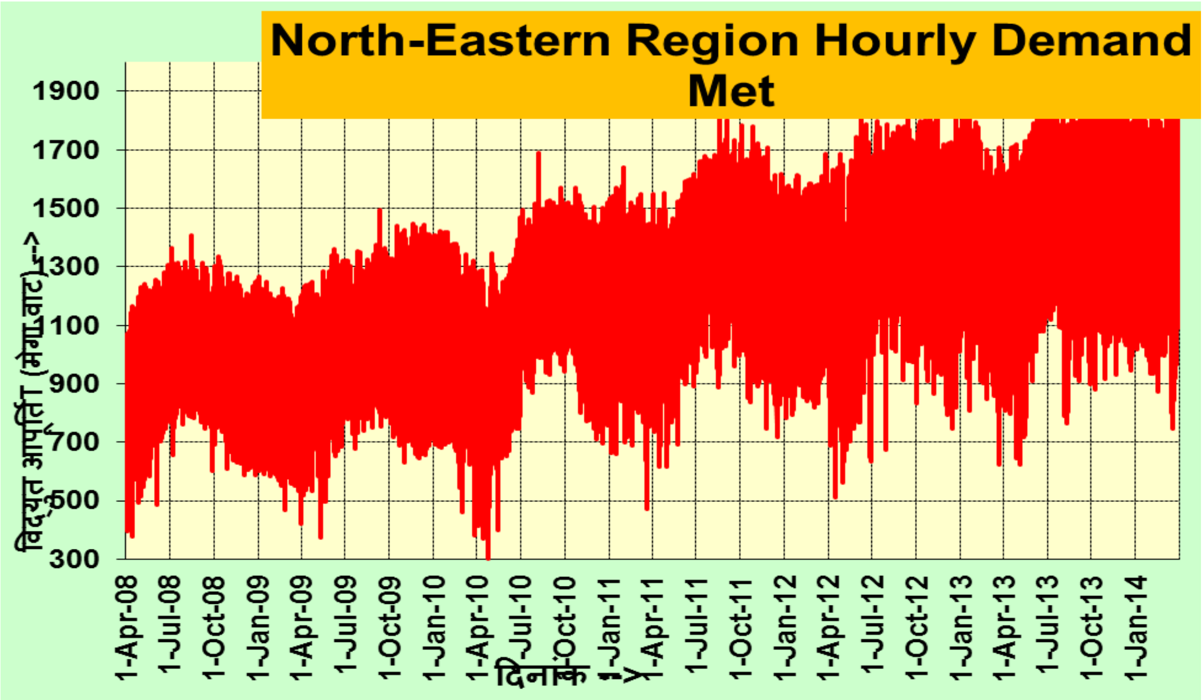
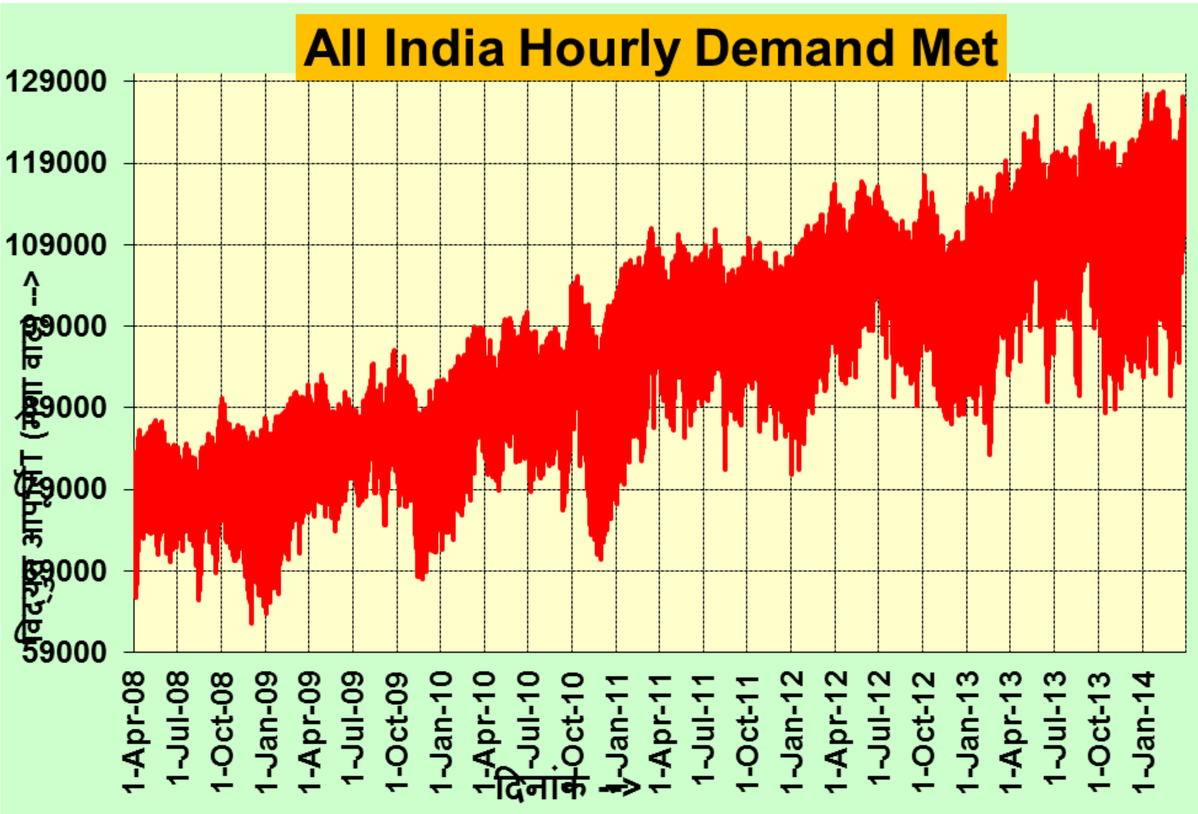


Exhibit – 2.6: Hourly demand met during 2008-14 – All India



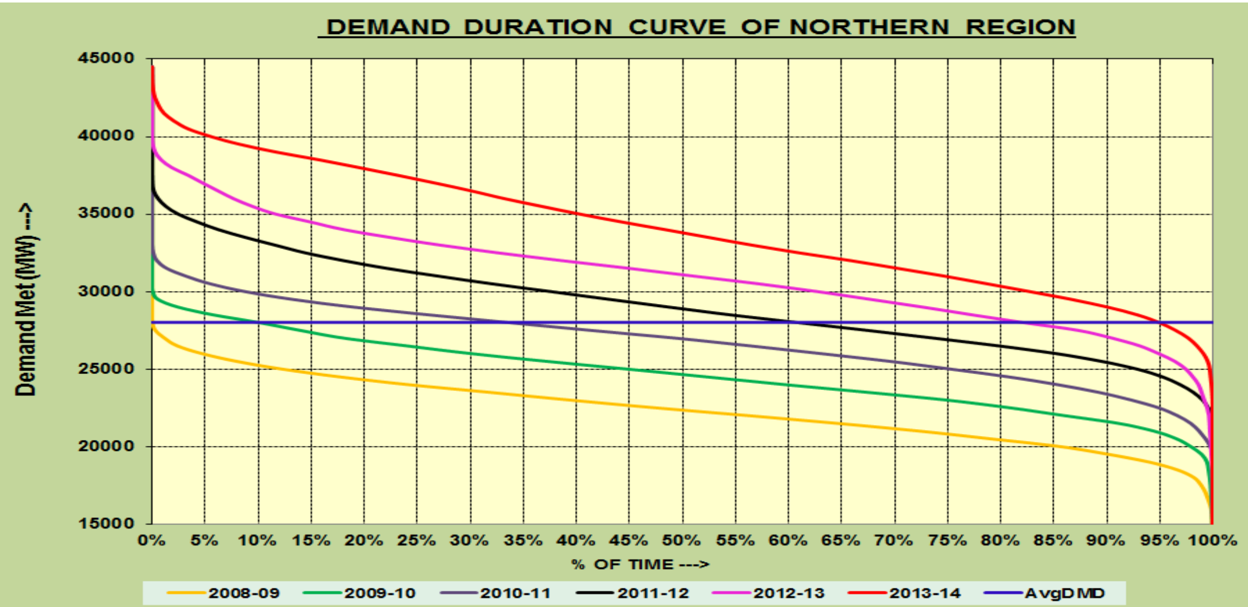
It may be seen from above that loads peak in different seasons in different regions. It is thus necessary to carry out transmission planning studies are carried out for three seasons and for peak as well off-peak time scenarios. A detailed analysis of these studies is given in subsequent chapters.

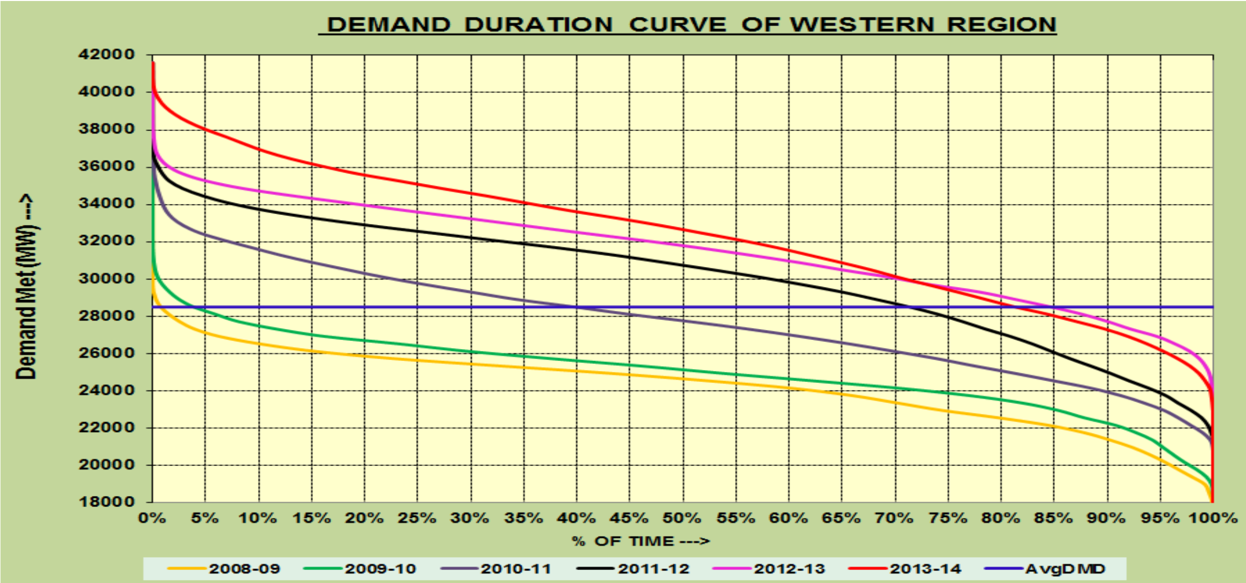
2.2.4 The load profile between peaks and base load periods is characterized by Load Duration Curve (LDC). Each region has its own profile and keeps changing over the years. To have a general idea of Indian load profile, it may be seen from all-India LDC, that the base load is about 70% of the peak load, up to 80% of the load remains for about 50% of the time, and the peak periods of 90-100% remain only for about 5% of the time.

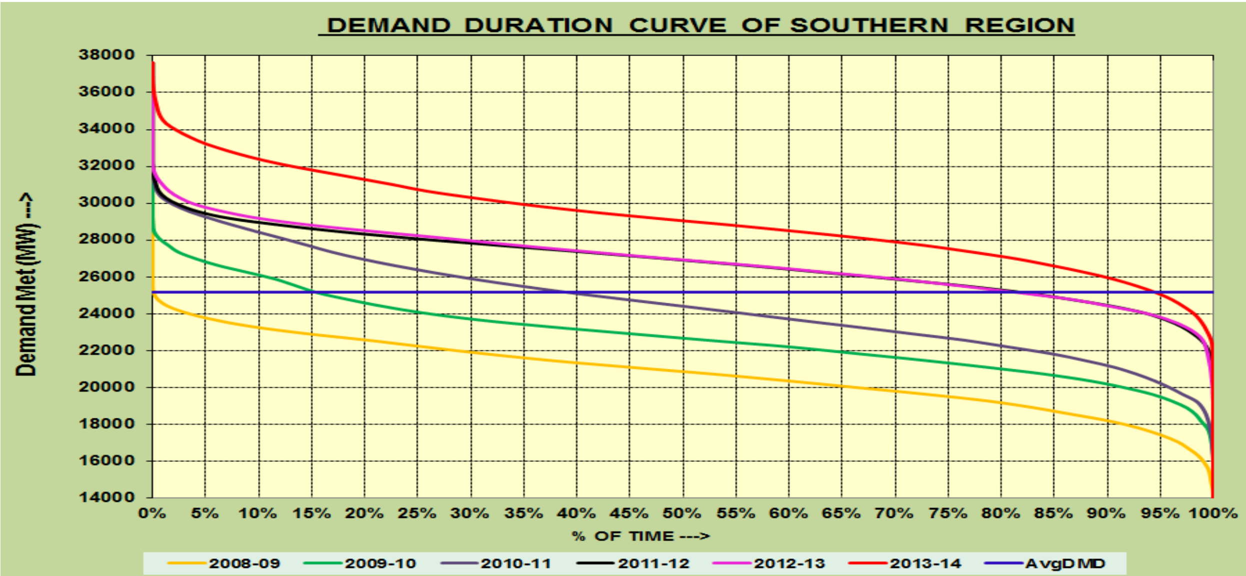
It is important to appreciate that it is still economical to plan a transmission system to meet peak loads, which may be only for about 5% of the time in a year. However, to control the grid parameters during rest of the period we would require additional measures like reactive power compensation etc.

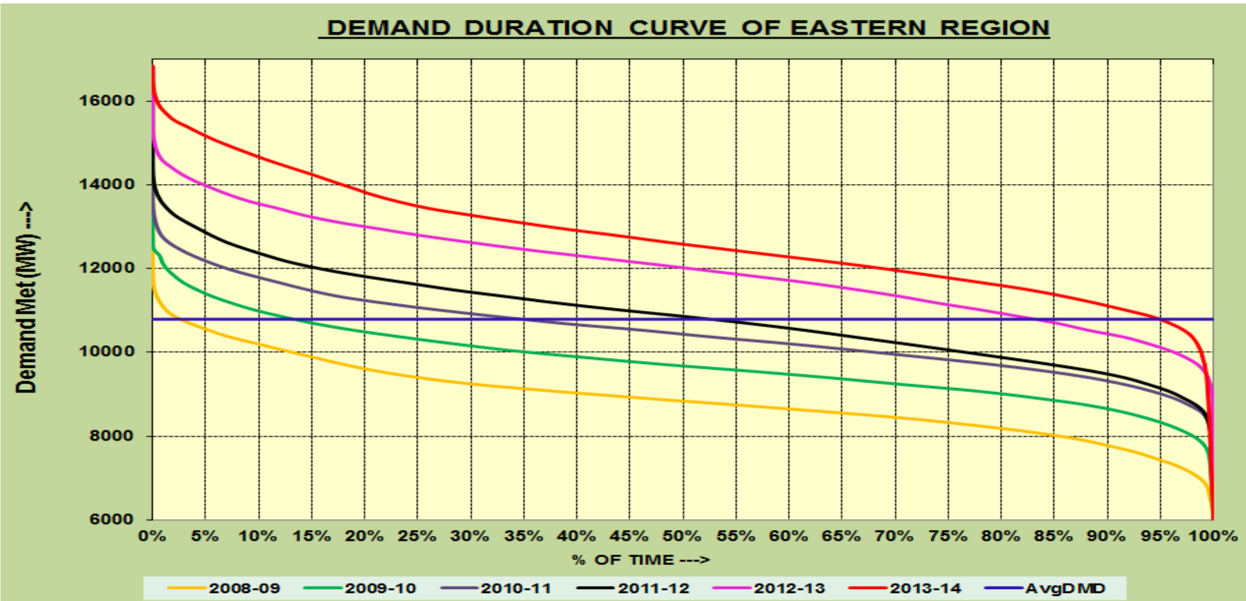
The LDC observed in the past six years is depicted in the following diagrams.

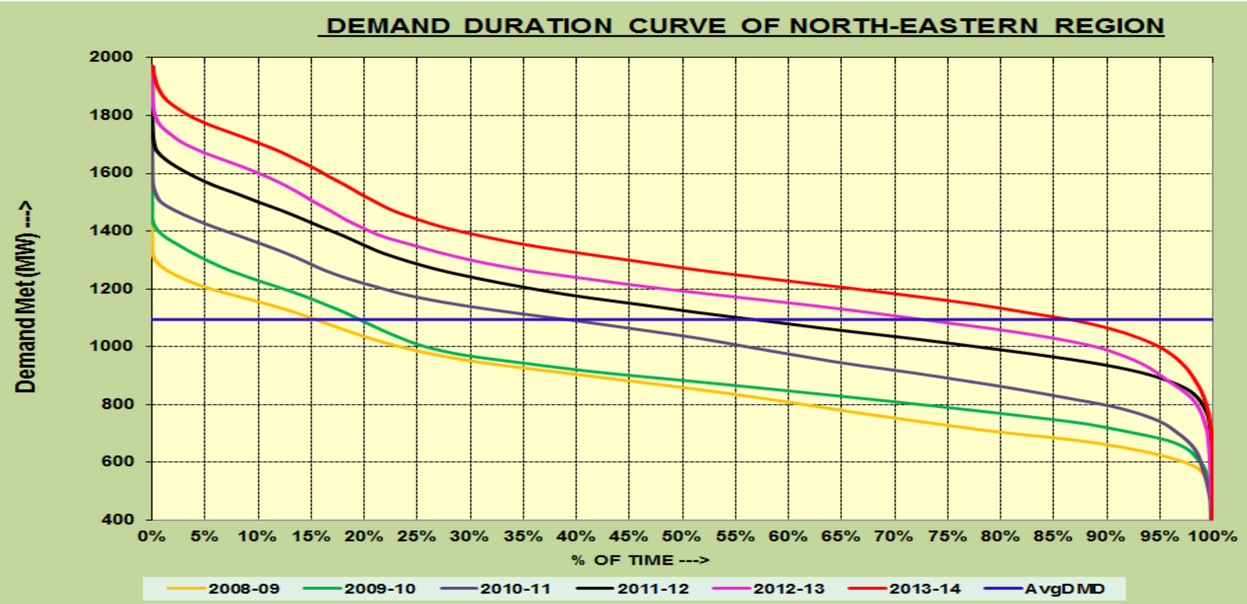
<u>Exhibits – 2.7 to 2.12: Regional and All-India Load Duration Curves</u>

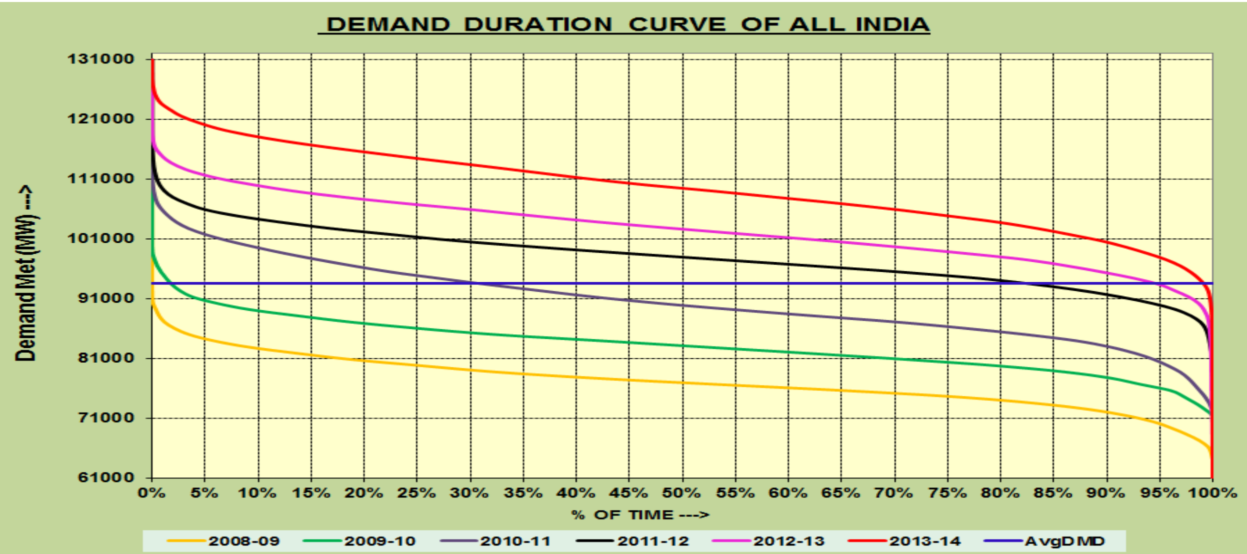



DEMAND DURATION CURVE OF WESTERN REGION
Demand Met (MW) --->
42000
40000
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55% 60% 65% 70% 75% 80% 85% 90% 95% 100%
% OF TIME --->
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
AvgDMD


DEMAND DURATION CURVE OF SOUTHERN REGION
Demand Met (MW) --->
38000
36000
34000
32000
30000
28000
26000
24000
22000
20000
18000
16000
14000
0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55% 60% 65% 70% 75% 80% 85% 90% 95% 100%
% OF TIME --->
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
AvgDMD


DEMAND DURATION CURVE OF EASTERN REGION
Demand Met (MW) --->
16000
14000
12000
10000
8000
6000
0% 5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55% 60% 65% 70% 75% 80% 85% 90% 95% 100%
% OF TIME --->
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
AvgDMD





2.2.5 As may be seen from above, the variation in demand is different in different regions and this gives rise to diversity of demand. The diversity of demand as projected in the 18th EPS region-wise and on all-India basis is given in following table. It is important here to note that though the transmission system planned considering this diversity provides saving in generation resources in the country but it is more important to plan optimum corridors of transmission. Actually, it is this diversity which provides economic power flows on all-India basis as compared to if planning is done on only regional basis.

Table – 2.2 : Diversity Factors

Region	Terminal year of the Plan periods			
	2016-17	2021-22	2026-27	2031-32
Northern	20.1%	20.1%	21.1%	22.1%
Western	10.5%	10.5%	11.5%	12.5%
Southern	7.6%	7.6%	8.6%	9.6%
Eastern	12.1%	12.1%	13.1%	14.1%
North_East	19.8%	20.8%	16.3%	17.3%
All –India (Inter-Regional)	**4.0%**	**4.0%**	**5.0%**	**6.0%**
All –India (Inter-State)	**17.3%**	**17.4%**	**19.4%**	**21.6%**

2.3 Generation Capacity up to end of 13th Plan

2.3.1 During 12th five year plan, about 88537 MW of conventional generation capacity addition was envisaged. This was assessed based on the progress and mile-stones achieved by various generation projects that were under implementation. State-wise/region-wise capacity is given in following tables.

Table – 2.3 : Generation Capacity Addition during 12th Plan (2012-17)

Sl. No.	STATE/ UTs	HYDRO	COAL	GAS	DIESEL	NUCLEAR	TOTAL (Conventional)
1	DELHI	0	0	750		0	750
2	HARYANA	0	1160	0		0	1160
3	HIMACHAL PRADESH	3583	0	0		0	3583
4	JAMMU & KASHMIR	1109	0	0		0	1109
5	PUNJAB	0	3920	0		0	3920
6	RAJASTHAN	0	1370	160		1400	2930
7	UTTAR PRADESH	0	4730	0		0	4730
8	UTTARAKHAND	1025	0	0		0	1025
9	CHANDIGARH	0	0	0		0	0
SUB TOTAL NORTHERN REGION		**5717**	**11180**	**910**		**1400**	**19207**
10	CHHATTISGARH	0	12840	0		0	12840
11	GUJARAT	0	2150	702		1400	4252
12	MAHARASHTRA	0	10300	0		0	10300
13	MADHYA PRADESH	400	6980	0		0	7380

Sl. No.	STATE/ UTs	HYDRO	COAL	GAS	DIESEL	NUCLEAR	TOTAL (Conventional)
14	GOA	0	0	0		0	0
15	DAMAN & DIU	0	0	0		0	0
16	DADRA & NAGAR HAVELI	0	0	0		0	0
SUB TOTAL WESTERN REGION		**400**	**32270**	**702**		**1400**	**34772**
17	ANDHRA PRADESH	410	8360	0		0	8770
18	KARNATAKA	0	0	0		0	0
19	KERALA	100	0	0		0	100
20	TAMIL NADU	60	4710	0		2500	7270
21	PUDUCHERRY	0	0	0		0	0
SUB TOTAL SOUTHERN REGION		**570**	**13070**	**0**		**2500**	**16140**
22	BIHAR	0	4690	0		0	4690
23	JHARKHAND	0	2080	0		0	2080
24	ORISSA	0	3960	0		0	3960
25	SIKKIM	2066	0	0		0	2066
26	WEST BENGAL	292	1800	0		0	2092
SUB TOTAL EASTERN REGION		**2358**	**12530**	**0**		**0**	**14888**
27	ARUNACHAL PRADESH	1710	0	0		0	1710
28	ASSAM	0	750	100		0	850
29	MANIPUR	0	0	0		0	0
30	MIZORAM	60	0	0		0	60
31	MEGHALYA	82	0	0		0	82
32	NAGALAND	0	0	0		0	0
33	TRIPURA	0	0	827.6		0	828
SUB TOTAL N.EASTERN REGION		**1852**	**750**	**928**		**0**	**3530**
34	A & N ISLANDS	0	0			0	0
35	LAKSHDWEEP	0	0			0	0
	TOTAL	**10897**	**69800**	**2540**		**5300**	**88537**

Note: In above estimates, the figures for Andhra Pradesh are for the undivided state

2.3.2 During the 12th Plan, about 40 GW generation capacity has been added, which also includes about 9600 MW of capacity that was not in the above list. This additional capacity commissioned is given in following table. Further, about 20 GW of additional capacity may be also added during 12th Plan while some of the earlier identified capacity may slip to 13th Plan.

Table – 2.4 : Additional generation capacity commissioned till June2014 (in MW)

State	Project Name	Impl Agency	Unit No.	Cap. (MW)	Act. Comm. Date
STATE SECTOR					
Gujarat	Dhuvaran CCPP-III	GSECL	Block-1	376.1	21.05.14
Tripura	Rokhia CCPP	Govt.of Tripura	GT-9	21	31.08.13
WB	Durgapur TPS Extn U-8	DPL	U-8	250	31.03.14
		Sub-Total		**647.1**	
PRIVATE SECTOR					
AP	Simhapuri Energy Ph-II	Madhucon Projects Ltd.	U-3	150	21.02.14
Chhattisgarh	Chakabura TPP	ACB India	U-1	30	28.03.14
Gujarat	DGEN Mega CCPP	Torrent Energy Ltd	Module-1	400	12.01.14
			Module-2	400	23.04.14
			Module-3	400	09.03.14
Gujarat	Mundra UMTPP	Tata Power Co.	U-3	800	16.10.12
			U-4	800	16.01.13
			U-5	800	18.03.13
	Unosugen Mega CCPP	Torrent Energy Ltd	Module-1	382.5	20.01.13
Maharashtra	Butibori TPP Ph-II	Vidarbha Industries Power	U-2	300	31.03.14
	Tirora TPP Ph-II	Adani Power Ltd	U-2	660	23.03.14
MP	Mahan TPP	Essar Power MP Ltd	U-1	600	24.02.13
	Niwari TPP	BLA Power Ltd	U-1	45	01.12.13
	Sasan UMPP	Reliance Power Ltd.	U-1	660	21.05.14
			U-4	660	25.03.14
Rajasthan	Jallipa-Kapurdi TPP	Raj West Power Ltd.(JSW)	U-7	135	16.03.13
			U-8	135	28.02.13
	Kawai TPP	Adani Power Ltd.	U-1	660	28.05.13
			U-2	660	24.12.13
TN	Tuticorin TPP-II(Ind barath)	Ind Barath	U-1	150	10.03.13
			U-2	150	30.12.13
		Sub-Total		**8977.5**	
Total up to 30.06.14				**9624.6**	

2.3.3 Thus for the purpose of transmission planning for end of 13th plan at this stage, it is more important to know the capacity addition during combined 12th and 13th Plans. The present generation installed capacity in the country by end of July 2014 was about 250 GW including renewable generating resources of about 32 GW. During 12th plan about 40 GW generation capacity has been added, which also includes about 9600 MW of capacity that was not in the planned list of 88.537 GW. Further, about 20 GW of additional capacity may be also added during 12th Plan while some of the earlier identified capacity may slip to 13th Plan. For the purpose of this report, an assessment has been carried out to identify generation capacity state-wise and type-wise that is likely to be commissioned up to end of 13th Plan i.e. 2021-22. It is seen that about 113 GW of generation capacity may be added in the remaining period of 12th Plan and about 100 GW during 13th Plan. Further about 5 GW may be added in Bhutan for benefit of import to India. It is important to note here, that, these assessments have been for the purpose of transmission planning and not for assessing generation capacity required for meeting the demands. A more accurate assessment for 12th Plan may be carried out at the time of mid-term-review.

Following tables give the generation scenario that may be available by end of 13th Plan. The total Installed Capacity by the end of 13th Plan is expected to be of the order of 469 GW which also includes 65 GW of renewable capacity.

Table – 2.5 : Installed Capacity during 12th and 13th Plans (All figures are in MW)

Plan-Wise Generation Addition (Region - Wise)				
	Up to July 2014 (Actual) (A)	Balance in XII Plan (B)	Addition in XIII Plan (C)	Total (End of XIII Plan) (D = A+B+C)
NR	64387	20929	16890	102206
WR	91847	36709	20262	148818
SR	57232	38650	23076	118958
ER	33881	12738	31195	77813
NER	2910	3511	8202	14623
Bhutan	1416	3066	2120	6602
Total	**251673**	**115603**	**101745**	**469020**

Fuel Mix of Generation (Region Wise) (end of XIII Plan)						
	Coal	Nuclear	Gas	Hydro	Renewable	Total
NR	51238	4420	6714	26656	13178	102206
WR	106478	3940	11804	7879	18717	148818
SR	59520	4820	9673	12765	32180	118958
ER	68617	0	207	8572	417	77813
NER	810	0	1803	11358	651	14623
Bhutan	0	0	0	6602	0	6602
Total	**286663**	**13180**	**30202**	**73832**	**65143**	**469020**

Table – 2.6 : Installed Capacity during 12th and 13th Plans -State-wise

	Up to XI Plan	Addition in XII Plan	Addition in XIII Plan	Total (End of XIII Plan)
		Northern Region		
Delhi	2593	808	-285	3116
Haryana	5379	1042	2560	8981
Himachal	7919	4864	1206	13989
J&K	2671	1583	1943	6197
Punjab	4132	3920	1306	9358
Rajasthan	10329	10950	4660	25938
U.P	17826	6658	2370	26854
Uttarkhand	3616	1025	3130	7771
Total	**54467**	**30849**	**16890**	**102206**
		Western Region		
Goa	48	0	0	48
Gujarat	22646	14690	1744	39079
Chhatisgarh	9464	15940	6340	31744
M.P	9230	12630	6760	28620
Maharashtra	24676	19233	5418	49327
Total	**66064**	**62492**	**20262**	**148818**
		Southern Region		
Andhra Pradesh	11715	12780	7386	31881
Karnataka	14079	8790	1600	24469
Kerala	2853	100	0	2953
Tamilnadu	19663	16603	11190	47456
Telangana	7512	1788	2900	12199
Total	**55821**	**40061**	**23076**	**118958**
		Eastern Region		
Bihar	3037	5190	4620	12847
Jharkhand	3974	1645	8890	14509
Odisha	7817	5185	13005	26007
West Bengal	14305	2772	3505	20582
Sikkim	627	2066	1175	3868
Total	**29761**	**16858**	**31195**	**77813**
		North Eastern Region		
Assam	1401	784	-60	2125
Manipur	156	0	66	222
Nagaland	106	22	186	314
Tripura	253	879	0	1133
Arunachal	509	1710	7550	9769
Mizoram	110	60	460	630
Meghalaya	348	82	0	430
Total	**2884**	**3537**	**8202**	**14623**
Bhutan	**1416**	**3066**	**2120**	**6602**

- The minus figures are de-rating/de-commissioning of old projects

2.3.4 The above generation capacities of 469 GW would be adequate to meet the annual peak load demand of 284 GW by the end of 13th Plan. More on these adequacy assessments from the transmission planning point of view would be discussed in next Chapter.

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Chapter – 3

Assessment of Transmission needs for meeting Demand and Evacuation of Generation for 13th Plan

3.1 Introduction

The transmission system requirement needs to be evolved at State level which is aggregated on regional level and there on at National level. In any given state there can be State sector generation tied up completely to the host state, Central sector generation serving more than one State as well as generating stations belong to State sector and Inter-State IPPs. Further, each State has its own power demand. The net of power availability from all the sources in a State and its demand gives net import or export out of that State. The aggregation of import export requirement of States within a region, and taking into consideration the diversity factor, translates into Inter-regional power transfer requirements. The transmission system is evolved to cater to the inter-state and inter-regional power transfer requirements.

3.2 Present Load Generation Scenario

The present installed capacity and unrestricted peak demand as per the CEA Load Generation report for the year 2014-15 is given below:

Table – 3.1 : State-wise Present Load Generation Scenario

State/ Region	Installed Capacity (MW)	Demand (MW)	Availability (MW) (incl CS shares)	Surplus/Deficit (MW)
Chandigarh	115	345	345	0
Delhi	7829	6,035	5,653	-382
Haryana	8292	8,114	8,114	0
Himachal Pradesh	4036	1,561	1,392	-169
Jammu & Kashmir	2593	2,500	1,998	-502
Punjab	9053	10,089	8,733	-1,356
Rajasthan	15200	10,047	10,038	-9
Uttar Pradesh	14411	13,089	12,327	-762
Uttarakhand	2661	1,826	1,826	0
Northern Region	**67873**	**45,934**	**42,774**	**-3,160**

State/ Region	Installed Capacity (MW)	Demand (MW)	Availability (MW) (incl CS shares)	Surplus/Deficit (MW)
Chhattisgarh	9975	3,365	3,320	-45
Gujarat	28424	12,201	12,201	0
Madhya Pradesh	14465	9,716	9,716	0
Maharashtra	35168	19,276	17,621	-1,655
Daman & Diu	48.3	322	297	-25
Dadra & Nagar Haveli	80	661	661	0
Goa	400	529	529	0
Western Region	**88956**	**41,335**	**40,331**	**-1,004**
Andhra Pradesh	17731	14,072	13,162	-910
Karnataka	14270	9,940	9,223	-717
Kerala	3892	3,671	3,573	-98
Tamil Nadu	21293	13,522	12,492	-1,030
Puducherry	284	351	333	-18
Lakshadweep	10	9	9	0
Southern Region	**59069**	**39,015**	**36,048**	**-2,967**
Bihar	2198	2,465	2,312	-153
DVC	6839	2,745	2,745	0
Jharkhand	2580	1,111	1,069	-42
Odisha	8337	3,727	3,722	-5
West Bengal	8959	7,325	7,294	-31
Sikkim	314	90	90	0
Andaman & Nicobar	70	40	32	-8
Eastern Region	**30681**	**15,888**	**15,598**	**-290**
Arunachal Pradesh	250	125	124	-1
Assam	1143	1,329	1,220	-109
Manipur	179	134	133	-1
Meghalaya	455	343	330	-13
Mizoram	150	84	82	-2
Nagaland	118	109	106	-3
Tripura	433	254	250	-4
North-East. Reg.	**2910**	**2,164**	**2,048**	**-116**
All India	**2,49,489**	**1,35,918**	**1,29,815**	**-6,103**

From the above table it is seen that while all regions are under peak deficit, Northern and Southern regions have the highest deficit of the order of 3000 MW each. The Western region has a deficit of about 1000 MW and the same for Eastern and North-Eastern Regions is in the range of 100-300 MW. The total all India peak deficit is in the range of 6000 MW which is about 4.5% of the peak demand.

3.3 Growth in Load & Generation

As per the 18th EPS, the peak demand on all India basis is projected to grow to about 284 GW during 2021-22 time frame from present level of 136 GW i.e., in the coming seven year period the load is projected to grow to more than double from the present. The total installed capacity at the end of the 11th plan from the conventional and renewable generation source (excluding import from Bhutan) was 176 GW and 33 GW respectively (Total 209 GW). During 12th plan, generation addition program of about 122 GW and 32 GW have been envisaged from conventional and renewable sources respectively, out of which about 41GW have already been commissioned and balance 113 GW is planned for commissioning by year 2016-17. During 13th plan, capacity addition of 100 GW from conventional sources has been envisaged. With the generation addition during balance period of 12th plan and 13th plan, the total installed capacity of by 2021-22 generation shall be about 462 GW (including 397 GW from conventional sources). The region-wise growth of generation as well as peak demand is given below :

Table – 3.2 : Growth in Generation and Demand

	Generation						Demand		
	Up to 11th Plan	Addition in 12th Plan	Present Installed Capacity	Balanced during 12th Plan	Addition in 13th Plan	Total (End of 13th Plan)	Present	12th Plan	13th Plan
NR	54467	30849	67873	17443	16890	102206	45,934	60934	86461
WR	66064	62492	88956	39600	20262	148818	41,335	62015	86054
SR	55821	40061	59069	36813	23076	118958	39,015	57221	82199
ER	29761	16858	30681	15937	31195	77813	15,888	24303	35928
NER	2884	3537	2910	3511	8202	14623	2,164	2966	4056
Total	**208996**	**153797**	**249489**	**113304**	**99625**	**462418**	**1,35,918**	**199540**	**283470**

The State-wise analysis of load growth has also been carried out with an objective to find out how much of the total requirement is likely to be met by state-owned generation. The remaining generation needs to be procured from central sector/IPP projects through Inter-State Transmission System. A details of the State-wise present and future load growth and the requirement of procurement of power other than State owned generation projects is given at Table 3.3, which shows that majority of the States need to draw more than 50% power from the grid through Inter-State Transmission System.

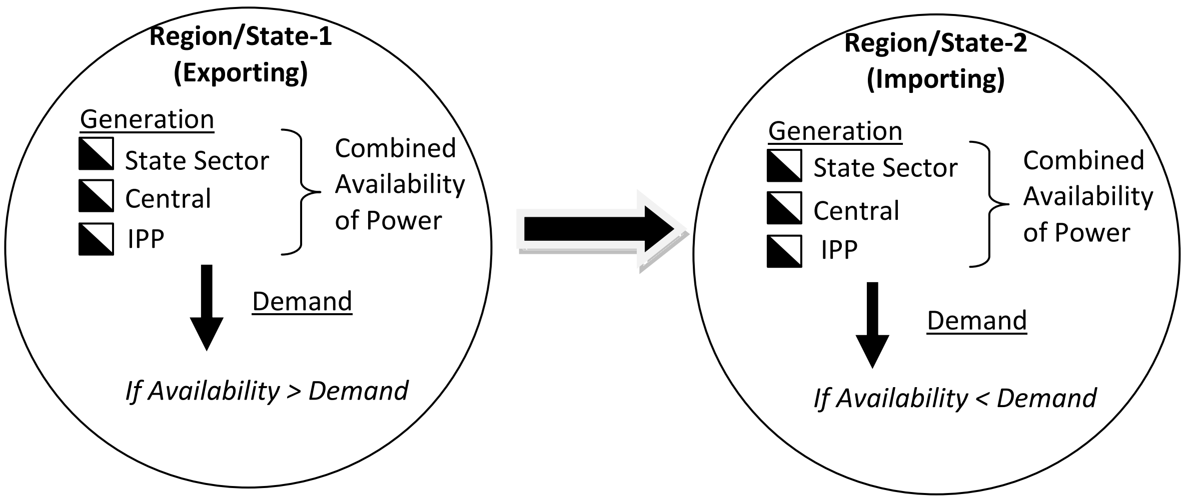
Table – 3.3 : State-wise Growth in Generation and Demand

State	2013-14				2021-22							
	Peak Demand - as per EPS (MW)	Actual Peak Demand (MW)	Demand met (MW)	Deficit (MW)	Peak Demand as per EPS (MW)	Increment Load (MW)	State Generation (MW)				Import required through ISTS	
							Existing	Addition	Total	Disptach	MW	Percentage of Peak
STATES OF THE NORTHERN REGION												
Delhi	5358	6035	5653	-382	9024	3371	2696	0	2696	538	8486	94%
Haryana	7779	8114	8114	0	14244	6130	4665	1680	6345	4977	9267	65%
Himachal Pradesh	1535	1561	1392	-169	2589	1197	1378	2237	3615	1140	1449	56%
Jammu & Kashmir	2086	2500	1998	-502	4217	2219	983	1017	2000	730	3487	83%
Punjab	9776	10089	8733	-1356	14552	5819	5208	4086	9294	6838	7714	53%
Rajasthan	10100	10047	10038	-9	19692	9654	9490	10754	20244	9712	9980	51%
Uttar Pradesh	15667	13089	12327	-762	36061	23734	8511	4960	13471	10076	25985	72%
Uttarkhand	1898	1826	1826	0	2901	1075	1842	0	1842	915	1986	68%
Chandigarh	370	345	345	0	559	214	0	0	0	0	559	100%
STATES OF THE WESTERN REGION												
Goa	630	529	529	0	1192	663	0	0	0	0	1192	100%
Gujarat	14062	12201	12201	0	26973	14772	11542	8079	19621	8221	18752	70%
Chhatisgarh	3707	3365	3320	-45	6599	3234	0	1965	1965	2474	4125	63%
Madhya Pradesh	10592	9716	9716	0	18802	9086	6145	1965	8110	5507	13295	71%
Maharashtra	21685	19276	17621	-1655	39622	20346	19496	9681	29177	16126	23496	59%
D&N Haveli	746	661	661	0	1297	636	0	0	0	0	1297	100%
Daman & Diu	355	322	297	-25	605	283	0	0	0	0	605	100%

State	2013-14				2021-22							
	Peak Demand - as per EPS (MW)	Actual Peak Demand (MW)	Demand met (MW)	Deficit (MW)	Peak Demand as per EPS (MW)	Increment Load (MW)	State Generation (MW)				Import required through ISTS	
							Existing	Addition	Total	Disptach	MW	Percentage of Peak
STATES OF THE SOUTHERN REGION												
Andhra Pradesh	8155	6755	6318	-437	15933	9615	7632	9680	17312	9697	6236	39%
Karnataka	10198	9940	9223	-717	18403	9180	10905	7390	18295	7763	10640	58%
Kerala	3903	3671	3573	-98	6093	2520	2679	100	2779	1119	4974	82%
Tamilnadu	15352	13873	12825	-1048	29975	17150	17068	13913	30981	13053	16922	56%
Telangana	8835	7317	6844	-473	17261	10417	4389	2690	7079	3949	13312	77%
STATES OF THE EASTERN REGION												
Bihar	3150	2465	2312	-153	9306	6994	697	500	1197	841	8465	91%
Jharkhand	3727	1925	1883	-42	6341	4458	3539	1820	5359	4234	2107	33%
Odisha	5174	3727	3722	-5	6749	3027	2767	1600	4367	2821	3928	58%
West Bengal	8841	9256	9225	-31	17703	8478	10518	6440	16958	12868	4836	27%
Sikkim	119	90	90	0	176	86	52	0	52	8	168	96%
STATES OF THE NORTH EASTERN REGION												
Assam	1526	1329	1220	-109	2534	1314	764	100	864	217	2317	91%
Manipur	229	134	133	-1	497	364	5	66	71	34	463	93%
Nagaland	153	109	106	-3	271	165	51	0	51	15	256	94%
Tripura	276	254	250	-4	472	222	165	0	165	32	440	93%
Arunachal	102	125	124	-1	177	53	104	0	104	16	161	91%
Mizoram	201	84	82	-2	352	270	58	0	58	16	336	95%
Meghalaya	392	343	330	-13	596	266	40	40	80	178	418	70%

3.4 Load Generation Balance:

In order to find out the requirement of transmission system, it is important to find out the surplus/deficit of each Region/State under various conditions which would give the import/export requirement of respective Region/State. For this, the total power available within a Region/State has been considered based on the generation projects physically located in the Region/State irrespective of its classification. Based on the combined availability of power from central sector/State sector/IPP projects in the Region / State as well as the projected demand, the import / export requirement has been worked out as shown below :



The basic load generation scenario has been worked out subjected to different scenarios corresponding to seasonal load & generation variations, variation in despatch due to economic considerations, variation in peak demand due to accelerated growth specifically in importing areas etc.

The base Load Generation scenario has been evolved for 3 seasons viz. winter, summer and monsoon and peak and off-peak conditions for each of the seasons. The power exchanges with neighboring SAARC countries considered for 13 plan period include about 6600 MW import from Bhutan, 1000 MW export to Bangladesh and 200 MW export to Pakistan. With Nepal, the interconnection would be utilized for both import and export of power and net exchange has been considered as negligible. The region wise installed capacity and peak demand at the end of 13th plan, considering the import and export with the neighboring SAARC countries is given below.

Table 3.4 - Installed Capacity and Peak Demand at the end of 13th Plan (2021-22)

Region	Installed Capacity, up to 13th Plan							Peak Demand MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Renew able	Total	
NR	51238	4420	55658	26656	6714	13178	102206	86461
WR	106478	3940	110418	7879	11804	18717	148818	86054
SR	59520	4820	64340	12765	9673	32180	118958	82199
ER	68617	0	68617	8572	207	417	77813	35928
NER	810	0	810	11358	1804	651	14623	4056
Bhutan	-	-	-	6602	-	-	6602	
Bangladesh (Export)								1000
Pakistan(Export)								200
Total	**286663**	**13180**	**299843**	**73832**	**30202**	**65143**	**469020**	**283470 #**

with diversity without Bangladesh Export

The PLF for various type of generation types and the seasonal load variations have been considered based on the factors given in new transmission planning criteria. However, due to low availability of Gas and uncertainty of Renewable generation, a low availability factor is taken for Gas and Renewable projects. The availability factors for various types of generation considered for peak and off-peak conditions of 3 seasons are given below :

Table 3.5 – Generation Availability Factors

	Summer Peak				Monsoon Peak				Winter Peak			
	Thermal	Hydro	Gas	Res.	Thermal	Hydro	Gas	Res.	Thermal	Hydro	Gas	Res.
NR	80%	70%	60%	10%	80%	90%	20%	10%	80%	50%	60%	0%
WR	80%	70%	60%	10%	80%	90%	20%	10%	80%	50%	60%	0%
SR	80%	70%	60%	10%	80%	90%	20%	10%	80%	50%	60%	0%
ER	80%	70%	60%	10%	80%	90%	20%	10%	80%	50%	60%	0%
NER	80%	70%	60%	10%	80%	90%	20%	10%	80%	50%	60%	0%
Bhutan	80%	70%	60%	10%	80%	90%	20%	10%	80%	50%	60%	0%

	Summer Off-Peak				Monsoon Off-Peak				Winter Off-Peak			
	Thermal	Hydro	Gas	Res.	Thermal	Hydro	Gas	Res.	Thermal	Hydro	Gas	Res.
NR	80%	40%	0%	10%	80%	60%	0%	10%	80%	10%	0%	10%
WR	80%	40%	0%	10%	80%	60%	0%	10%	80%	10%	0%	10%
SR	80%	40%	0%	10%	80%	60%	0%	10%	80%	10%	0%	10%
ER	80%	40%	0%	10%	80%	60%	0%	10%	80%	10%	0%	10%
NER	80%	40%	0%	10%	80%	60%	0%	10%	80%	10%	0%	10%
Bhutan	80%	40%	0%	10%	80%	60%	0%	10%	80%	10%	0%	10%

Table 3.6 – Region-Wise Demand Factors for seasonal variation of Load

	Summer Peak	Summer Off-peak	Monsoon Peak	Monsoon Off-peak	Winter Peak	Winter Off-peak
NR	100%	70%	96%	70%	95%	70%
WR	95%	70%	90%	70%	100%	70%
SR	98%	70%	90%	70%	100%	70%
ER	100%	70%	95%	70%	95%	70%
NER	100%	70%	95%	70%	95%	70%
Bangladesh	100%	70%	100%	70%	100%	70%
Pakistan	100%	70%	100%	70%	100%	70%

Based on the region wise availability and demand factors as given above, the season wise Load Generation balance for different regions has been calculated as below:

Table 3.7 – Region-wise Load Generation Balance for seasonal variation of Load

	Summer Peak			Monsoon Peak			Winter Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	68532	86461	-17929	71178	83003	-11825	61883	82138	-20255
WR	102803	81751	21052	99657	77449	22209	99356	86054	13302
SR	69429	80555	-11126	68113	73979	-5866	63658	82199	-18541
ER	61060	35928	25132	62692	34132	28560	59304	34132	25172
NER	9746	4056	5690	11296	3853	7443	7409	3853	3556
Bhutan	4621	0	4621	5942	0	5942	3301	0	3301
Bangladesh		1000	-1000		1000	-1000		1000	-1000
Pakistan		200	-200		200	-200		200	-200
All India	**316192**	**289951**	**26241**	**318878**	**273615**	**45263**	**294911**	**289576**	**5335**
	Summer Off-Peak			**Monsoon Off-Peak**			**Winter Off-Peak**		
	Availability	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**
NR	56507	60523	-4016	61838	60523	1315	48510	60523	-12013
WR	93357	60238	33119	94933	60238	34695	90994	60238	30756
SR	59796	57539	2257	62349	57539	4810	55967	57539	-1573
ER	58364	25150	33215	60079	25150	34929	55793	25150	30643
NER	5256	2839	2417	7528	2839	4689	1849	2839	-990
Bhutan	2641	0	2641	3961	0	3961	660	0	660
Bangladesh		700	-700		700	-700		700	-700
Pakistan		140	-140		140	-140		140	-140
All India	**275921**	**207129**	**68793**	**290688**	**207129**	**83559**	**253772**	**207129**	**46643**

On close observation of the above table, it is seen that Northern and Southern regions generally emerge as the deficit regions, the power to which need to be available from the surplus power of Eastern, Western & North-Eastern regions. Among the seasons, the peak condition for winter is the most severe in which the deficit of Northern and Southern regions becomes maximum and reaches to about 20GW and 18.5GW respectively. The overall power available is barely adequate to meet the Winter Peak condition. However, the overall surplus varies from 26000 to 84000 during the other conditions.

3.5 Load Generation Balance - Scenarios

For identification of new transmission system it is important to carry out study for peak scenarios of three seasons i.e. Summer, Monsoon and Winter along with Winter Off-peak scenario. For the load flow study a zero surplus / deficit condition has been simulated for the above cases considering the following despatch conditions :

Table 3.8 – Availability Factors considered for Study

	Summer Peak				Monsoon Peak			
	Thermal	**Hydro**	**Gas**	**Res.**	**Thermal**	**Hydro**	**Gas**	**Res.**
NR	80%	70%	23%	10%	80%	60%	30%	15%
WR	80%	30%	14%	5%	66%	50%	10%	10%
SR	80%	50%	41%	10%	70%	62%	10%	10%
ER	73%	40%	0%	10%	76%	50%	10%	10%
NER	20%	70%	5%	0%	80%	70%	70%	20%
Bhutan	80%	62%	60%	10%	80%	85%	20%	10%
	Winter Peak				**Winter Off-Peak**			
	Thermal	**Hydro**	**Gas**	**Res.**	**Thermal**	**Hydro**	**Gas**	**Res.**
NR	80%	40%	60%	0%	68%	8%	0%	0%
WR	80%	50%	48%	0%	68%	11%	0%	0%
SR	80%	50%	50%	0%	66%	20%	0%	0%
ER	80%	35%	0%	0%	64%	12%	0%	0%
NER	80%	40%	80%	0%	70%	5%	25%	0%
Bhutan	80%	48%	60%	0%	80%	10%	0%	0%

With the region-wise availability factors for various types of generations as mentioned above, the load-generation balance has been calculated with nil surplus/deficit condition for the Summer Peak, Monsoon Peak, Winter Peak and Winter Off-Peak condition and the same is tabulated below :

Table-3.9 – Load Generation Balance at the end of 13th Plan (2021-22) for Study

	Summer Peak			Monsoon Peak		
	Despatch (% of IC)	Demand	Sur(+) / Def(-)	Despatch (% of IC)	Demand	Sur(+) / Def(-)
NR	66000 (65%)	86500	-20500	64500 (63%)	83000	-18500
WR	93200 (63%)	81700	11500	79500 (53%)	77500	2000
SR	65000 (55%)	80500	-15500	57500 (48%)	74000	-16500
ER	53800 (69%)	36000	17800	56800 (73%)	34200	22600
NER	8000 (55%)	4100	3900	10000 (68%)	3900	6100
Bhutan	4000 (61%)	0	4000	5500 (83%)	0	5500
Bangladesh		1000	-1000		1000	-1000
Pakistan		200	-200		200	-200
All India	290000 (62%)	290000	0	273800(58%)	273800	0

	Winter Peak			Winter Off-Peak		
	Despatch (% of IC)	Demand	Sur(+) / Def(-)	Despatch (% of IC)	Demand	Sur(+) / Def(-)
NR	59800 (59%)	82000	-22200	40000 (39%)	61000	-21000
WR	97900 (66%)	86000	11900	75900 (51%)	60000	15900
SR	62900 (53%)	82000	-19100	45000 (38%)	58000	-13000
ER	5800 (75%)	33300	24700	45000 (58%)	25200	19800
NER	6700 (46%)	3900	2800	1500 (10%)	2900	-1400
Bhutan	3100 (47%)	0	3100	600 (9%)	0	600
Bangladesh		1000	-1000		700	-700
Pakistan		200	-200		200	-200
All India	288400 (61%)	288400	0	208000 (44%)	208000	0

The above load generation balance shows that NR is having a deficit of about 18500-22200MW while the deficit of SR is about 13000 to 19100 MW at the end of 13th Plan condition. Surplus in WR is about 11500-15900 MW in Summer Peak, Winter Peak and Winter Off-peak condition while during Monsoon Peak condition the surplus gets reduced to about 2000MW only. Surplus in ER, NER and Bhutan also varies from 17800-24700, 2800-6100 and 600-5500 respectively. NER is experiencing deficit of about 1400MW during Winter Off-peak condition. The above load generation condition has been simulated in the studies reported in the next Chapter.

Regional Balance(Export-Import) due to additional RES capacity in 13th Plan:

As given in Chapter-2, a RES capacity of about 65 GW has been considered up to 12th /13th Plan for which the location-wise quantum (MW) was available. In the absence of complete information about 13th Plan capacity additions (location-wise and type-wise) at this stage, the results of NTDPC report have been used to assess impact of additional RES capacity that may be installed during 13th Plan. The NTDPC report has estimated about 83 GW of RES capacity by 13th Plan and about 135 GW by end of 14th Plan. As detailed in the chapters 5 and 6, the impact of RES on inter-regional transmission corridor requirements for 14th and 15th Plans have been included as part of the comprehensive analysis. For the 13th Plan, the impact of additional i.e. 83-65=18 GW on inter-regional transmission capacity requirement is assessed as given below. The RES capacities may give about 10% of benefit during peak hours, as the solar is not available at peak hours of evening and wind being intermittent in nature can not be relied upon for meeting peak demands.

(All figures in MW)

Regions	13th Plan	13th Plan as per NTDPC	Difference	Impact of additional RES on I-R Corridors during peak hours
	(A)	(B)	(C) =(B)-(A)	(D)=10% of (C)
Northern (NR)	13178	19870	6692	669.2 : less deficit
Western (WR)	18717	26223	7506	750.6 : more surplus
Southern (SR)	32180	34948	2768	276.8 : less deficit
Eastern (ER)	417	1879	1462	146.2 : more surplus
Northern Eastern (NER)	651	705	54	5.4
Total	**65143**	**83625**	**18482**	

It is seen from above that additional RES may give a benefit of about 670 MW during peak hours in Northern region and about 280 MW in Southern region, thus the requirements of NR and SR would thus get slightly reduced, as these are deficit regions. The surplus in Western and Eastern would increase slightly by about 750 MW and 150 MW, respectively, which gets adjusted in the total inter-regional transmission capacity that have been planned for exporting about 17000 MW and 25000 MW of power from these regions. The detailed exercise to fully integrate the RES for 13th Plan period may be carried out as part of green-energy-corridor-part-2 studies.

3.6 Load Generation Balance - States

Load Generation balance of individual states are given below :

Table – 3.10 : Load Generation Balance of Individual States - 13th Plan (2021-22)

	Installed Capacity (MW)							Availability (MW)					Peak Demand (2021-22)	Regional Deficit/ Surplus
State	**Coal**	**Nuclear**	**Thermal (Coal+Nuclear)**	**Hydro**	**Gas**	**Res.**	**Total**	**Thermal**	**Hydro**	**Gas**	**Res.**	**Total**		
States of Northern Region														
Delhi	420	0	420	0	2680	16	3116	336	0	536	2	874	9024	-8150
Haryana	7660	700	8360	62	436	123	8981	6688	31	87	12	6819	14244	-7425
Himachal	0	0	0	12082	0	1907	13989	0	6041	0	191	6232	2589	3643
J & K	0	0	0	5392	184	622	6197	0	2696	37	62	2795	4217	-1422
Punjab	7650	0	7650	1411	0	297	9358	6120	706	0	30	6855	14552	-7697
Rajasthan	11935	3280	15215	526	1020	9177	25938	12172	263	204	918	13557	19692	-6135
Uttar Pradesh	23573	440	24013	502	1493	846	26854	19210	251	299	85	19845	36061	-16216
Uttarkhand	0	0	0	6681	900	190	7771	0	3341	180	19	3540	2901	639
Chandigarh	0	0	0	0	0	0	0	0	0	0	0	0	559	-559
Total	**51238**	**4420**	**55658**	**26656**	**6714**	**13178**	**102206**							
States of Western Region														
Goa	0	0	0	0	48	0	48	0	0	10	0	10	1192	-1182
Gujarat	17931	1840	19771	1990	8386	8932	39079	15817	995	1677	1340	19829	26973	-7144
Chhatisgarh	31315	0	31315	120	0	309	31744	25052	60	0	46	25158	6599	18559
M. P.	24482	700	25182	2794	0	644	28620	20146	1397	0	97	21639	18802	2837
Maharashtra	32750	1400	34149.5	2975	3370	8832	49327	27320	1488	674	1325	30806	39622	-8816
D&N Haveli	0	0	0	0	0	0	0	0	0	0	0	0	1297	-1297
Daman & Diu	0	0	0	0	0	0	0	0	0	0	0	0	605	-605
Total	**106478**	**3940**	**110418**	**7879**	**11804**	**18717**	**148818**							

	Installed Capacity (MW)							Availability (MW)					Peak Demand (2021-22)	Regional Deficit/ Surplus
State	**Coal**	**Nuclear**	**Thermal (Coal+Nuclear)**	**Hydro**	**Gas**	**Res.**	**Total**	**Thermal**	**Hydro**	**Gas**	**Res.**	**Total**		
States of Southern Region														
Andhra Pradesh	16020	0	16020	4630	7231	4000	31881	12816	2315	1446	600	17177	15933	1244
Karnataka	10880	880	11760	3530	234	8945	24469	9408	1765	47	1342	12562	18403	-5841
Kerala	0	0	0	1921	769	263	2953	0	961	154	39	1154	6093	-4939
Tamil Nadu	23340	3940	27280	2160	1439	16577	47456	21824	1080	288	2487	25678	30757	-5079
Telangana	9280	0	9280	524	0	2395	12199	7424	262	0	359	8045	17261	-9216
Total	59520	4820	64340	12765	9673	32180	118958							
States of Eastern Region														
Bihar	12590	0	12590	143	0	114	12847	10072	72	0	17	10161	9306	855
Jharkhand	14265	0	14265	134	90	20	14509	11412	67	18	3	11500	6341	5159
Odisha	23880	0	23880	2028	0	100	26007	19104	1014	0	15	20133	6749	13384
West Bengal	17882	0	17882	2457	112	131	20582	14306	1228	22	20	15576	17703	-2127
Sikkim	0	0	0	3811	5	52	3868	0	1906	1	8	1914	176	1738
Bhutan	0	0	0	6602	0	0	6602	0	3301	0	0	3301	0	3301
Total	**68617**	**0**	**68617**	**8572**	**207**	**417**	**84415**							
States of North-Eastern Region														
Assam	810	0	810	300	586	430	2125	648	150	117	64	980	2534	-1554
Manipur	0	0	0	171	45	5	222	0	86	9	1	95	497	-402
Nagaland	0	0	0	283	2	29	314	0	142	0	4	146	271	-125
Tripura	0	0	0	0	1117	16	1133	0	0	223	2	226	472	-246
Arunachal	0	0	0	9665	0	104	9769	0	4833	0	16	4848	177	4671
Mizoram	0	0	0	542	52	36	630	0	271	10	5	287	352	-65
Meghalaya	0	0	0	397	2	31	430	0	199	0	5	204	596	-392
Total	**810**	**0**	**810**	**11358**	**1803**	**651**	**14623**							

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Chapter – 4

Evolving Transmission System for 13th Plan

4.1 Introduction

The requirement of transmission system has been assessed based on the power system studies with representation of the power system network of the state as well as inter-state transmission system. The load generation balance calculated in the previous chapter has been represented to simulate different seasons all through the year and the transmission system has been evolved to cater to the power transfer requirement under the above conditions.

4.2 Power System Studies

Load Flow studies have been carried out for 13th plan end condition. The existing transmission system and generation projects as well as those planned to come up by 13th plan has been simulated in the study. In addition, transmission system has been planned to interconnect new generation projects envisaged to come up by 13th plan to the grid. The transmission system for 400kV and above system has been analysed from the study result. Based on requirement of power transfer emerged from the load flow study, various new transmission schemes for strengthening the transmission network has been planned. The details of the 400kV and above schemes planned during 13th plan period have been analysed in the subsequent articles. The study results are represented in terms of the power flow between regions as well as between states in each region. For different conditions the power flows are shown as below :

Region/States	Case Studies			
	Summer-Peak	Monsoon Peak	Winter Peak	Winter Off-Peak
All India	Fig-4.1	Fig-4.2	Fig-4.3	Fig-4.4
NR States	Annex-4.2a			
WR States	Annex-4.2b			
SR States	Annex-4.2c			
ER States	Annex-4.2d			
NER States	Annex-4.2e			

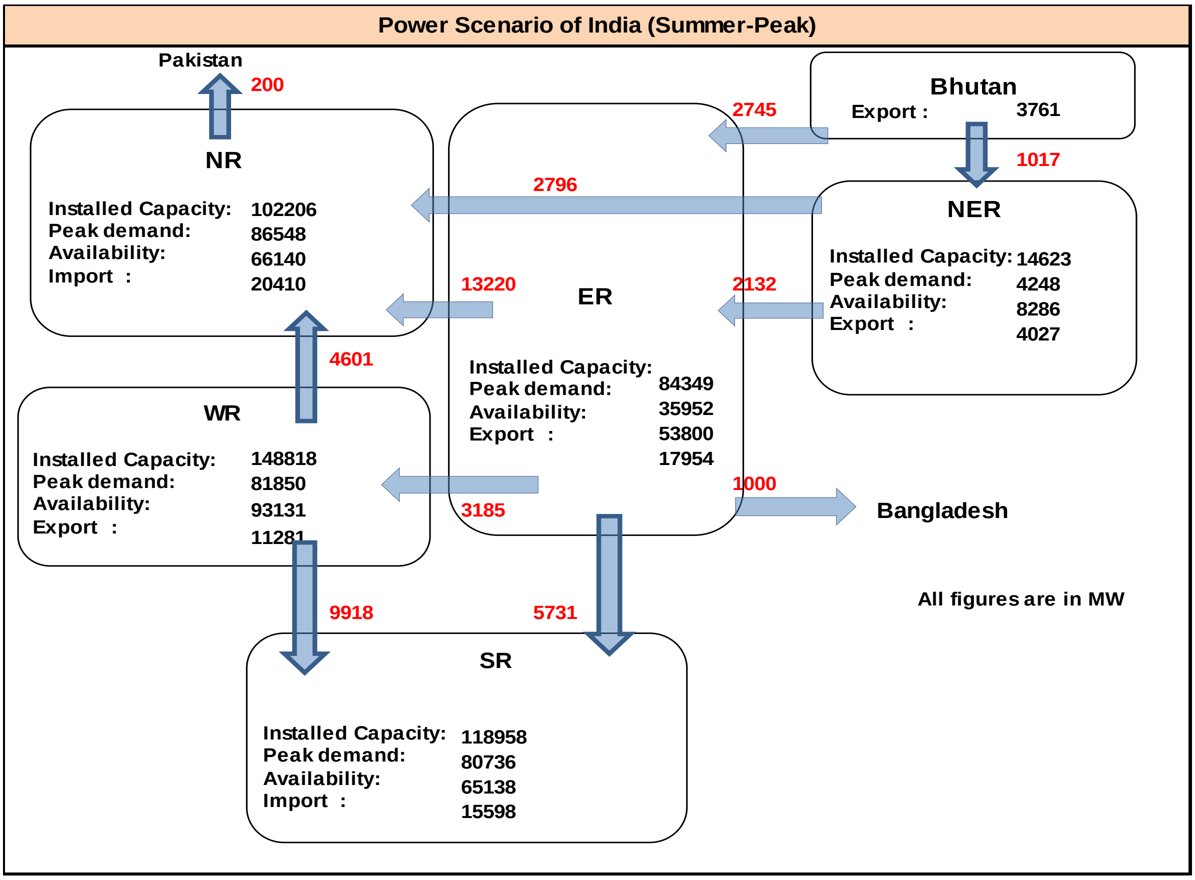


Fig-4.1 : Inter-regional power flow during **Summer-peak condition**

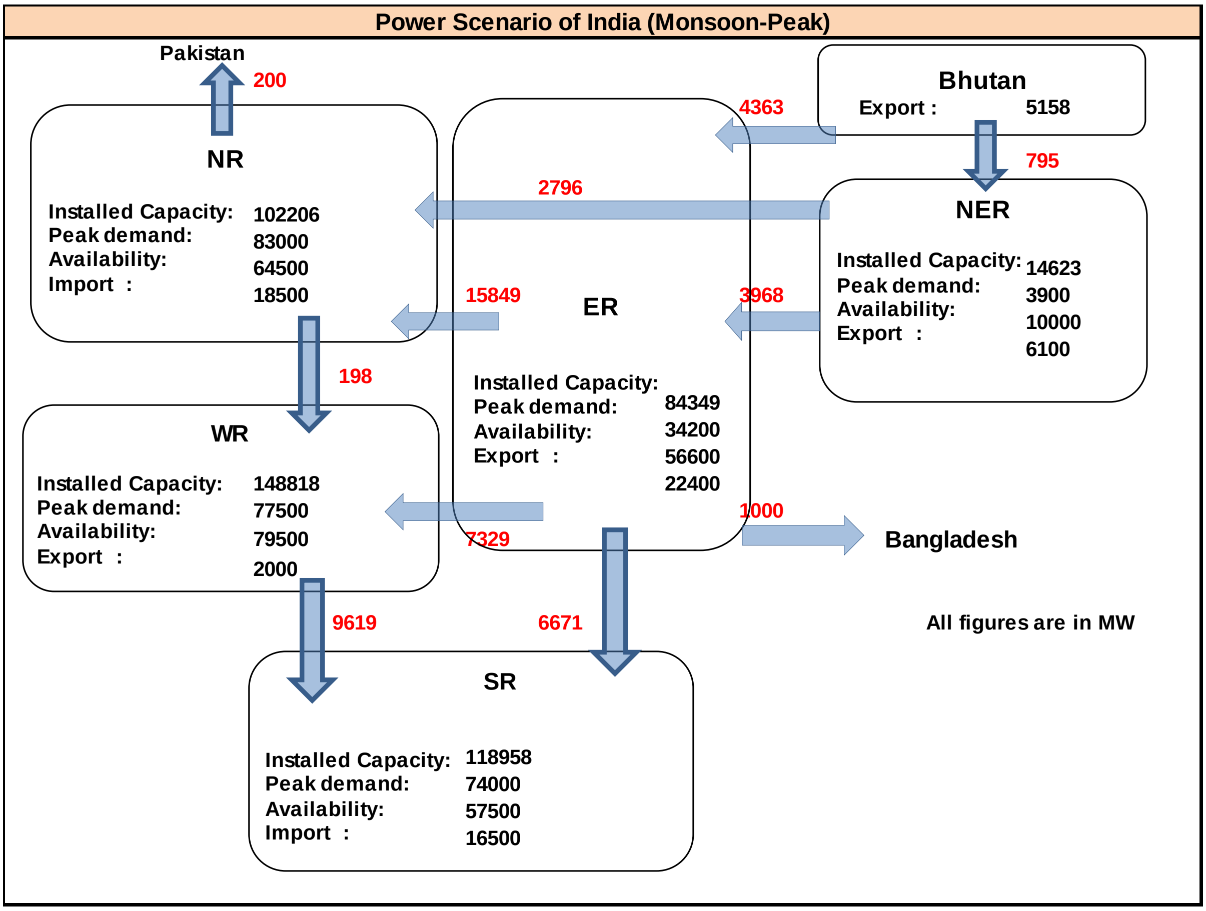


Fig-4.2 : Inter-regional power flow during **Monsoon-peak condition**

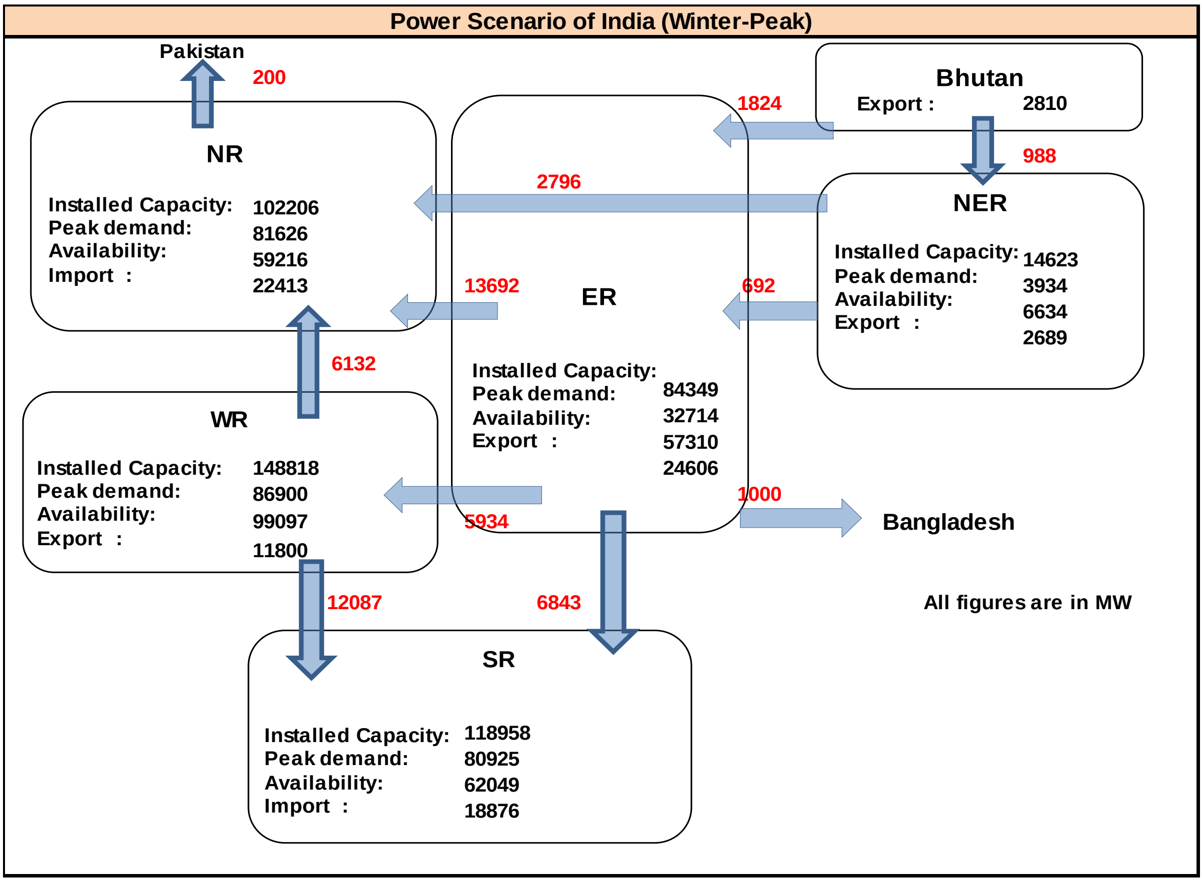


Fig-4.3 : Inter-regional power flow during **Winter-peak condition**

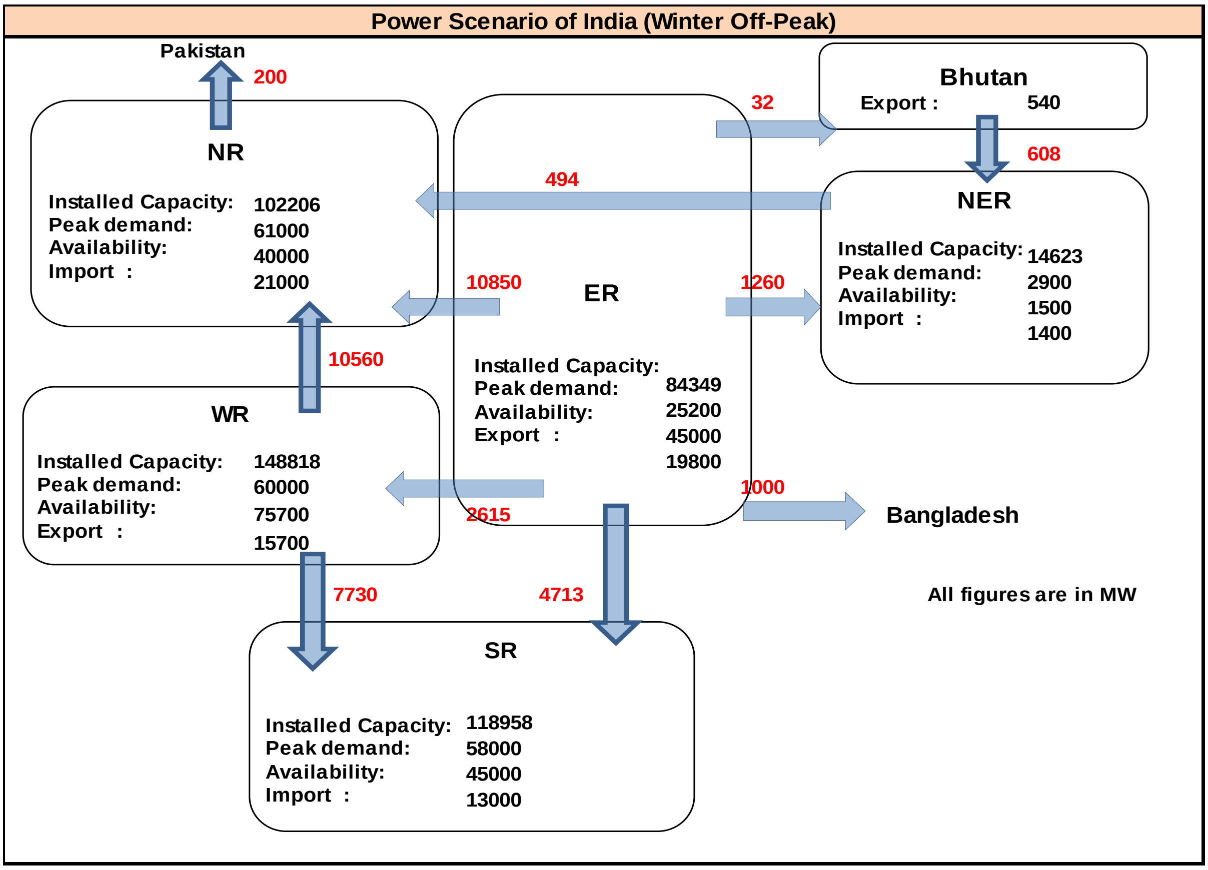


Fig-4.4 : Inter-regional power flow during **Winter-Off-peak condition**

4.3 Inter-Regional Transmission System

Based on the power flow study, the need is felt for strengthening corridors between various regions. Some of the corridors have already been planned / under implementation. However some new inter-regional corridors have also been identified which are as below :

A. <u>Between ER & NR</u> :

Angul (ER- Orissa) – Badarpur (NR-Delhi) ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity :

This HVDC corridor has been planned for transfer of power from Angul pooling point in Orissa of Eastern Region, where a large quantum of thermal generation is being pooled, to load centers in NR at Badarpur in Delhi. The capacity of this link would be 6000 MW, however the terminal capacity at Angul and Delhi would be 3000MW each initially, which would be upgraded to 6000 MW at a later stage.

B. <u>Between ER & SR</u> :

Angul (ER-Orissa) – Srikakulum (SR- Andhra Pr) 765kV D/c line (2nd)

This inter-regional corridor is a part of the Angul – Srikakulum – Vemagiri – C'peta 765kV D/c line which has been planned to strengthen the under construction/planned Angul-Srikakulum-Vemagiri-C'peta 765kV corridor and would be useful to transfer power from thermal generation reach Angul/Jharsuguda area of Eastern Region to Southern Region.

C. <u>Between NER & NR</u> :

Rangia/Rowta (NER-Assam) – Gurudaspur (NR – Punjab) ±800kV 6000/6500 MW HVDC bipole with 3000MW terminal Capacity

This inter-regional corridor has been planned for transfer of hydro power from NER to load centre in Gurudaspur of Punjab in NR. This would be a multi-terminal HVDC corridor which would pass through Bangladesh with one 500/1000 MW HVDC terminal in Bangladesh for delivery of power. The requirement of this corridor was discussed and agreed in the Joint Steering Committee (JSC) meeting on Cooperation in Power Sector between India and Bangladesh held on 3rd April 2014 in Dhaka.

D. Between WR & NR :

Dhanvahi(WR – MP) – Fatehpur (NR – UP) 765kV D/c line

This inter-regional corridor is a part of high capacity 765kV D/c corridor viz. Bilaspur Pool (WR) – Dhanvahi (WR) – Fatehpur (NR) – Lucknow(NR) – Aligarh(NR) – Muzaffarnagar(NR) – Mohali(NR) – Gurudaspur(NR) which would be beneficial for exchange of power between Western and Northern Region.

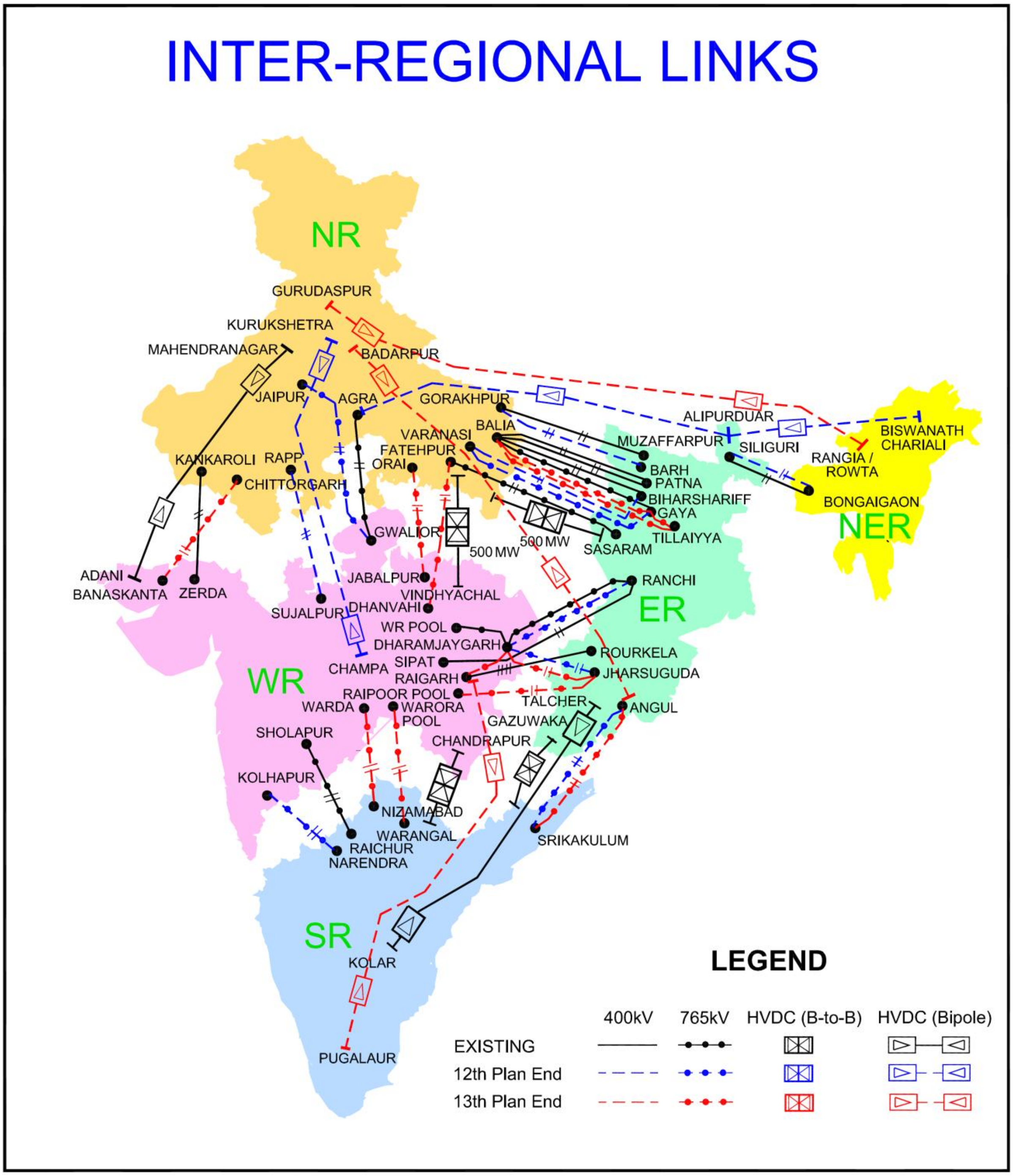
With the above new corridors, the list of transmission corridors required to be added between various regions during 13 plan period is as below :

Table – 4.1 : Inter- Regional Transmission Capacity during 13th Plan

Sl.	Name of link	Capacity (MW)	Status
A	**EAST-NORTH**		
1	Tillaiyya (ER-Bihar) – Balia (NR–UP) 765kV D/c line, one ckt via Gaya	4200	Planned
2	Angul (ER- Orissa) – Badarpur (NR-Delhi) ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity	3000	New*
	Sub-total	**7200**	
B	**EAST-WEST**		
3	Jharsuguda (ER-Orissa) – Dharamjaygarh (WR-Chhatisgarh) (to be LILOed at Raigarh Tamnar) 765kV D/c line (2nd)	4200	UC
4	Jharsuguda (ER-Orissa) – Raipur Pool (WR-Chhatisgarh) 765kV D/c line	4200	Planned
	Sub-total	**8400**	
C	**WEST- NORTH**		
5	Upgradation of Champa (WR-Chhatisgarh) – Kurukshetra (NR-Haryana) ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity	3000	UC
6	Jabalpur (WR – MP) – Orai (NR – UP) 765kV D/c line	4200	Planned
7	Banaskanta(WR-Gujarat) – Chittorgarh (NR-Rajasthan) 765kV D/c line	4200	Planned
8	Dhanvahi(WR – MP) – Fatehpur (NR – UP) 765kV D/c line	4200	New
	Sub-total	**15600**	
D	**EAST- SOUTH**		
9	Angul (ER-Orissa) – Srikakulum (SR- Andhra Pr) 765kV D/c line (2nd)	4200	New
E	**WEST- SOUTH**		
10	Wardha (WR-Maharastra) – Nizamabad (SR- Telangana) 765kV D/c line	4200	Planned
11	Raigarh (WR-Chhatisgarh) – Pugalur (SR-TN) +/- 800kV, 6000 Bi-pole	6000	Planned
12	Warora Pool (WR-Maharastra) – Warangal (SR-Telangana) 765kV D/c line	4200	Planned
	Sub-total	**14,400**	
F	**NORTH EAST-NORTH**		
13	Rangia/Rowta (NER-Assam) – Gurudaspur (NR – Punjab) ±800kV, 6000/6500MW HVDC bipole with 3000MW terminal Capacity	3000	New*
	Total	**52,800***	

*** - Tentative, may be required in 13th or 14th Plan, in which case 13th plan I-R capacity addition would be 46800 MW. One of these HVDC bipoles if needed may be planned towards Southern Region instead of towards Northern region.**

With the above new corridors, the transmission highway corridors connecting various regions would appear as depicted in following figure:



The total inter-regional capacity addition during 13th plan is about 52,800MW (or 46800MW). With the above addition, the total inter-regional capacity would grow from 40,050MW at present to about 1,26,650MW by the end of 13 plan. The growth of inter-regional capacity from existing to 13th plan is tabulated below.

Table – 4.2 : Summary of Inter- Regional Transmission Capacity

Transmission Corridor	Existing	12th Plan	End of 12th Plan	13th Plan	Total Transmission Capacity
EAST-NORTH	14230	5300	19530	7200	26730
EAST-WEST	6490	6300	12790	8400	21190
EAST-SOUTH	3630	4200	7830	4200	12030
EAST-NORTH EAST	1260	1600	2860	0	2860
WEST - NORTH	8720	8200	16920	15600	32520
WEST - SOUTH	5720	2200	7920	14400	22320
NORTH EAST - NORTH	0	6000	6000	3000	9000
Total	**40050**	**33800**	**73850**	**52800**	**126650**

The total list of interregional corridors is given at **Annex- 4.1**.

4.4 Total System Requirement – Physical and Fund Requirements

4.4.1 Along with the Inter-Regional Transmission System stated above, various high capacity transmission systems within the regions have been planned. Accordingly, the growth of 400kV and above transmission system from 11th to 13th Plan period is indicated below:

Table – 4.3 : Transmission Lines (400kV and above system) (values in ckm)

	At end of 11th Plan	Expected Addition in 12th Plan	Expected by end of 12th Plan	Expected Addition in 13th Plan	Expected by end of 13th Plan
HVDC Bipole lines	9432	7440	16872	10600	27472
765 kV	5250	27000	32250	22200	54450
400 kV	106819	38000	144819	30000	174819
Total	**121501**	**72440**	**193941**	**62800**	**256741**

Table – 4.4 : Substations (AC & HVDC) (400kV and above) (values in MVA / MW)

	At end of 11th Plan	Expected Addition in 12th Plan	Expected by end of 12th Plan	Expected Addition in 13th Plan	Expected by end of 13th Plan
HVDC Terminals:					
HVDC back-to-back	3000	0	3000	0	3000
HVDC Bipole terminals	6750	12750	19500	15000	34500
Total- HVDC Terminal Capacity, MW	**9750**	**12750**	**22500**	**15000**	**37500**
AC Substations					
765 kV	25000	149000	174000	79000	253000
400 kV	151027	45000	196027	49000	245027
Total- AC Substation capacity, MVA	**176027**	**194000**	**370027**	**128000**	**498027**

4.4.2 Fund requirement for the transmission system identified for 13th Plan period:

As estimated above, during 13th Plan Period, about 62800 circuit kilometers (ckm) of transmission lines, 15000 MW of HVDC terminal capacity and 128000 MVA of transformation capacity of the 400 kV and above voltage level transmission systems would be required. A majority of this system would be implemented as inter-State transmission system(ISTS). However, some part of it would be implemented as state transmission systems. As indicated earlier in this report, this segregation would be carried out while firming up individual transmission schemes for implementation. Based on current cost of construction of the transmission systems being built by PGCIL, it is estimated that a total fund requirement for the above indicated system will be about 1,60,000 crores of rupees, out of which about 30,000 – 40,000 crores would be needed for state transmission systems and the remaining as ISTS. Accordingly, about 1,30,000 crores of Rupees would be needed for ISTS and similar amount for state transmission systems after considering about 1,00,000 crores for 220 kV and below systems most of which would be as state transmission systems. Accordingly, it is estimated that total fund requirement for 13th Plan would be of the order of Rupees 2,60,000 crore.

4.4.3 The transmission system that have been identified for the 13th Plan would be firmed up through further detailed studies which may include – transient stability studies, low frequency oscillations studies, transfer capability assessments, reactive power compensation requirements, short circuit studies and measures to limit fault level at critical nodes in the system etc as per the requirements of CEA's technical standards on connectivity and economic analysis for overall optimization considering cost of generation, cost of transmission expansion and transmission losses, and the impact on transmission charges while finalizing individual schemes. As explained earlier in this report, the Intra-State transmission system at 220kV and below voltage levels in each state is also required to be planned to effectively utilize the main transmission system that have been identified in this chapter. The impact of too many HVDC inverter stations close by i.e. at Badarpur, Dadri, Agra, Kurukshetra, Mohindergarh, Bhiwadi which are within a short radius and may result in commutation issues which are associated with multi-infeed HVDC systems, also needs to be studied in detail before finalizing the HVDC schemes.

4.4.4 The total list of transmission system under different regions is given at **Annex- 4.3**. The important transmission system strengthening identified within various regions during 13th plan time frame is as below.

4.5 Transmission System - Northern Region

1. 765kV D/c Corridor from Fatehpur(UP) to Gurudaspur(Punjab)

In the inter-regional scheme described above, a high capacity 765kV D/c network for transfer of power from Dhanvahi in WR to Fatehpur in NR has been proposed. To distribute the power imported in Northern region, the 765kV corridor has been extended up to Punjab with touch points at Muzaffar Nagar, Mohali and Gurudaspur. To facilitate states to access power at various touch points, 400kV network has also been proposed. Accordingly, the following system is being proposed as a part of strengthening system in Northern region

- Dhanvahi-Fatehpur 765kV D/c -540 ckm
- Fatehpur-Lucknow-765kV D/c -270 ckm
- Lucknow-Aligarh -765kV D/c -680 ckm
- Aligarh-Muzzafarnagar765kV D/c -400ckm

- Muzaffarnagar-Mohali 765kV D/c – 420ckm
- Mohali-Gurdaspur765kV D/c – 500ckm
- LILO of Kishenpur-Moga 765kV line at Gurudaspur -40ckm
- Gurdaspur-Amritsar 400kV D/c -70ckm
- Gurdaspur-Jallandhar400kV D/c -70ckm
- LILO of Patiala-Ludhiana 400kV D/c - 40ckm
- Mohali-Panchkula400kV D/c - 40ckm
- Muzaffarnagar 765/400kV – Muzaffarnagar existing-40ckm
- Establishment of 2x1500MVA, 765/400kV substation at Muzaffarnagar, Mohali and Gurudaspur

2. Strengthening scheme at Badarpur associated with Angul (ER-Orissa) – Badarpur (NR-Delhi) ±800kV, 6000MW HVDC bipole line :

HVDC corridor has been planned for transfer of 3000/6000MW of power from Angul pooling point in Eastern to Badarpur in Delhi. The capacity of this link would be 6000MW with 3000MW terminal capacity initially to be upgraded to 6000MW at a later stage. Badarpur is an existing generating station with strong 220kV connectivity. For transfer of power being pooled at Badarpur following system is proposed:

- ±800kV, 6000MW HVDC bipole line from Angul to Badarpur in NR with 3000MW terminal at either end.
- 3x500MVA, 400/220kV transformers at Badarpur
- Badarpur-Ballabgarh 400kV D/c (Quad) – 40ckm
- Badarpur-Tuglqabad400kV D/c (Quad) – 40ckm

3. Balia – Lucknow 765kV S/c line

Power from Tillaiyya UMPP is to be pooled at Balia via Tillaiyya (ER-Bihar) – Balia (NR–UP) 765kV D/c line, one circuit via Gaya. Balia has a strong network for transfer of power beyond Balia which includes HVDC, 765kV and 400kV lines. To augment the system beyond Balia, Balia - Lucknow 765kV S/c (2^{nd}ckt) has been proposed.

4.6 Transmission System - Western Region

4. Transmission System associated with Jaitapur APP (3480MW)

NPCIL is setting up an atomic power plant of 3480MW capacity at Jaitapur in Maharashtra. From this plant, power shall be transferred to WR beneficiaries. The immediate evacuation from Jaitapur APP project has been planned with 765kV 2xD/c line to Kolhapur sub-station. The system strengthening involves 765kV 2nd ckt from Aurangabad to Dhule and Dhule to Vadodara.

5. Transmission System associated with Barethi TPP (NTPC Ltd) (2640MW)

NTPC is setting up a thermal power plant of 2640MW capacity at Barethi in Madhya Pradesh. From this plant, power shall be transferred to WR beneficiaries. The immediate evacuation from Barethi TPP project has been planned with 765kV D/c line to Jabalpur Pooling Station. From Jabalpur Pooling Station, a 765kV line (2nd S/c) to Bhopal and further to Indore has been proposed.

6. Transmission System associated with Khargone TPP (NTPC Ltd) (1600MW)

NTPC is setting up a thermal power plant of 1600MW capacity at Khargone in Madhya Pradesh. From this plant, power shall be transferred to WR beneficiaries.
The immediate evacuation from Khargone TPP project has been planned with 400kV high Capacity line to Indore sub-station. The system strengthening involves 765kV 2ndckt from Indore to Vadodara and from Indore to Bina.

7. System Strengthening in Saurashtra Area of Gujarat

In Gujarat, a no of generation projects are coming up whereas the transmission network in Saurashtra area is not sufficient. Therefore, system strengthening in Saurashtra area by establishing 765/400kV substation is planned. This substation shall be connected to various generating stations in the area and to major load centers in Gujarat. From this substation, a 765kV D/c line to Banaskanta and to Vadodara has been planned.

4.7 Transmission System - Southern Region

The Southern Region, as per the Generation Capacity addition programme and the projected load growth, has been assessed to remain in deficit situation in the 13th Plan. To meet the projected load demand, Southern Region is required to import

Power from NEW Grid mainly from Chhattisgarh in WR & Odisha in ER which are projected as Surplus in Generation. Accordingly, High Capacity 765kV Transmission Corridors viz. Angul – Srikakulum 765 kV D/c line & Warora – Warangal 765kV D/c line have been planned for import of Power from NEW Grid. Further, 6000 MW HVDC Bi-Pole from Raigarh to Pugalur has also been planned which is directly from Generation Complex in Chhattisgarh. The following Intra-Regional Strengthening Works have been planned to facilitate power drawl from ISTS network by beneficiary States in Southern Region:

8. Strengthening Works related with Angul – Srikakulum 765 kV Transmission Corridor and Strengthening of transmission system beyond Vemagiri

(i) Vemagiri-II – Chilakaluripeta 765kV D/c line with 240 MVAR switchable line reactor at both ends.

(ii) Chilakaluripeta – Cuddapah 765kV D/c line with 240 MVAR switchable line reactor at both ends.

(iii) Narsaraopeta – Podili 400kV (quad) D/c line

(iv) Chilakaluripeta – Narsaraopeta 400kV (quad) D/c line

(v) Cuddapah – Madhugiri 400kV (quad) D/c line with 80 MVAR switchable line reactor at both ends.

(vi) Cuddapah-Hindupur 400kV (quad) D/c line with 80 MVAR switchable line reactor at Hindupur end.

(vii) Srikakulum Pooling Station – Garividi 400 kV (Quad) D/c line with 80 MVAR switchable line reactor at Garividi end.

(viii) Establishment of 765/400kV substations at Chilakaluripeta and Cuddapah with 2x1500 MVA transformers and 2x240 MVAR bus reactors each.

(ix) Establishment of 400/220kV substations at Podili with 2x315 MVA transformers and 2x125 MVAR bus reactors.

9. Additional inter-Regional AC link for import into Southern Region i.e. Warora-Warangal - Hyderabad- Kurnool 765kV link

(i) Establishment of 765/400kV substations at Warangal (New) with 2x1500 MVA transformer and 2x240 MVAR bus reactors.

(ii) Warora Pool -Warangal (New) 765 kV D/c line with 240 MVAR switchable line reactor at both ends.

(iii) Warangal (New) –Hyderabad765 kV D/c line with 330 MVAR switchable line reactor at Warangal end.

(iv) Warangal (New) – Warangal (existing) 400 kV (quad) D/c line.

(v) Hyderabad– Kurnool 765 kV D/c line with 240 MVAR switchable line reactor at Kurnool end.

(vi) Warangal (New) – Chilakaluripeta 765kV D/c line with 240 MVAR switchable line reactor at both ends.

(vii) LILO of Kurnool-Thiruvelam 765 kV D/c at Cuddapah

(viii) Cuddapah- Hoodi 400kV (quad) D/c line with 63 MVAR switchable line reactor at both ends.

10. HVDC Bipole link between Western region (Chhattisgarh) and Southern region (Tamil Nadu)

(i) Raigarh(HVDC Stn) – Pugalur (HVDC Stn) 6000 MW HVDC bipole

(ii) Establishment of Raigarh HVDC Stn and Pugalur HVDC Stn with 6000 MW HVDC terminals (with alternate of having 3000 MW in first phase)

(iii) Raigarh HVDC Station – Raigarh(Existing) 400kV (quad) 2xD/c lines (or with bay extension)

(iv) Pugalur HVDC Station – Pugalur (Existing) 400kV (quad) D/c line.

(v) Pugalur HVDC Station – Arasur 400kV (quad) D/c line with 80 MVAR switchable line reactor at Arasur end.

(vi) Pugalur HVDC Station – Thiruvalam 400kV (quad) D/c line with 80 MVAR switchable line reactor at both ends.

(vii) Pugalur HVDC Station – Edayarpalayam 400 kV (quad) D/c line with 63 MVAR switchable line reactor at Edayarpalayam end.

(viii) Edayarpalayam – Udumulpeta 400 kV (quad) D/c line.

(ix) Establishment of 400/220kV substation with 2x500 MVA transformers at Edayarpalayam and 2x125 MVAR bus reactors.

11. System Strengthening in Southern Region associated with Cheyyur UMPP.

Cheyyur UMPP with an Installed Capacity of 4000 MW located at Cheyyur in Tamil Nadu is expected to come up during 2018-19. The step-up voltage is envisaged at 765kV for evacuation. The beneficiaries of Cheyyur UMPP are mainly Southern Region Constituents. The immediate connectivity for Cheyyur UMPP is envisaged as follows:

(i) TNUMPP – Thiruvalam 765kV 2xS/c line

(ii) TNUMPP- Salem New (Dharmapuri) 765kV S/c line

4.8 Transmission System - Eastern Region

12. Transmission System associated with Odisha UMPP (4000 MW)

Odisha UMPP with an Installed Capacity of 4000 MW (5x800 MW) located at Bhedabahal in Odisha is expected to come up during 2017-18. The step-up voltage is envisaged at 765kV for evacuation.

The immediate evacuation from Odisha UMPP project has been planned with 765kV 2xD/c line to Jharsuguda pooling station and 400kV D/c lines to state substation like Lapanga and Kesinga. The system strengthening involves creation of a ±800kV, 6000MW HVDC corridor from Angul (Odisha) to Badarpur (NR-Delhi) with 3000MW terminal at either ends initially. The transmission system planned for Odisha UMPP is as below :

(a) For Immediate Evacuation from UMPP Project

- Odisha UMPP – Sundergarh (Jharsuguda) 765kV 2xD/c line
- Odisha UMPP – Lapanga 400kV D/c line (quad/HTLS)
- Odisha UMPP – Kesinga 400kV D/c line (quad/HTLS)

(b) Strengthening System for UMPP Project

- ±800kV, 6000MW HVDC bipole line from Angul to Badarpur in NR with 3000MW terminal at either end.

13. 765kV System Strengthening Scheme in Eastern Region

From the future load generation scenario in Eastern Region, it is observed that while there is a steady growth in the load all over the region, the generation projects are mainly coming up in the central and western part of Eastern Region (Odisha, Jharkhand, Bihar), however in the Eastern part (West Bengal) no substantial generation projects are coming up. While Eastern Region has 765kV substations acting as power hubs (Ranchi, Gaya, Angul, Jharsuguda) for export of power to other regions viz. Northern and Western Regions, there is hardly any 765kV corridor for distribution of power within the region. Accordingly, need is felt for establishment of a high capacity 765kV D/c network within the region in order to ensure better distribution of power within the region as well as exchange of power with the neighbouring regions. Accordingly, the following system was finalised as a part of strengthening system in Eastern Region:

1. Establishment of 765/400 kV new substations at Banka (New),Gokarna(New), Medinipur, Jeerat (New) and Jajpur Road.
2. Interconnection of the above mentioned 765kV substation through Angul-JajpurRoad – Medinipur – Jeerat(New) – Gokarna(New) – Banka(New) –Gaya – Ranchi (New) – Medinipur765kV D/c lines.
3. Interconnection of 765/400kV substations with the nearby 400kV substations viz. Banka (PG), Gokarna (WBSETCL), Chanditala (WBSETCL), Kharagpur(WBSETCL), Haldia New-NIZ (WBSETCL), Durgapur(PG), Subhasgram(PG), Jeerat (WBSETCL) and Duburi (OPTCL)through 400kV high capacity D/c lines.

The list of the transmission elements is as below :

- Establishment of 765/400 kV new substations at Banka (New), Gokarna(New), Medinipur, Jeerat (New) and Jajpur Road.
- Angul – Jajpur Road 765kV D/c line
- Jajpur Road – Medinipur 765kV D/c line
- Ranchi (New) – Medinipur 765kV D/c line
- Medinipur – Jeerat (New) 765kV D/c line
- Jeerat (New) – Gokarna (New) 765kV D/c line
- Gokarna(New) – Banka(New) 765kV D/c line
- Gaya – Banka (New) 765kV D/c line
- Gaya – Ranchi (New) 765kV D/c line
- Jajpur Road – Duburi 400kV D/c line (quad/HTLS)
- Medinipur – Haldia New (NIZ) (WBSETCL) 400kV D/c line (quad/HTLS)
- LILO of Chandithala – Kharagpur 400kV D/c line at Medinipur
- Jeerat (New) – Subhasgram 400kV D/c line(quad/HTLS)
- Jeerat (New) – Jeerat 400kV D/c line (quad/HTLS)
- LILO of Sagardighi – Subhasgram 400kV S/c line at Rajarhat
- LILO of Sagardighi – Rajarhat 400kV S/c line (formed through LILO of Sagardighi – Subhasgram 400kV S/c line at Rajarhat) at Jeerat
- Gokarna (New) – Gokarna 400kV D/c line (quad/HTLS)
- Gokarna (New) – Durgapur (PG) 400kV D/c line (quad/HTLS)
- Banka (New) – Banka 400kV D/c line (quad/HTLS)

14. Interconnection of ER with Bhutan

For import of power from generation projects in Bhutan following 400kV high capacity lines have been planned :

- Alipurduar – Jigmelling (Bhutan) 400kV D/c line (quad)
- Alipurduar – Siliguri 400kV D/c line (quad)
- Kishanganj – Darbhanga 400kV D/c line (quad)

4.9 Transmission System - North-Eastern Region

15. Evacuation System of Demwe(1750 MW), Tato-II(700 MW), Kalai-II (1200 MW)

The upcoming hydro power projects in different basins of Arunachal Pradesh viz. Demwe(1750 MW), Tato-II(700 MW), Kalai-II (1200 MW) expected to come up by 13th plan end has been planned to be pooled at Silapathar pooling station and from Silapathar the pooled power would be brought at Bishwanath Chariali pooling station and further to Rangia/Rowta pooling station through high capacity 400kV line. From Biswanath Chariali and Rangia/Rowta, power would be transferred to NR through $\pm$800kV, 6000MW Biswanath Chariali – Agra and Rangia/Rowta - Gurudaspur HVDC bipole lines. The following scheme has been identified for evacuation of power from Demwe, Tato-II, Kalai-II projects in NER :

- 400kV pooling substation at Silapathar (Assam)
- Demwe – Silapathar 400kV 2xD/c with High Capacity / HTLS conductor
- Tato-II – Silapathar 400kV D/c line (High Capacity / HTLS)
- Kalai-II – Silapathar 400kV D/c line (High Capacity / HTLS)
- Silapathar – Bishwanath Chariali 400kV 2x D/c line (High Capacity / HTLS)
- GMR Londa(225 MW) – Biswanath Chariali 400kV D/c line (High Capacity / HTLS)
- Reconductoring of Biswanath Chariali – Balipara 400kV 2x D/c (twin moose) to high capacity / HTLS
- LILO of Balipara - Bongaigaon 400kV D/c (quad) at Rangia (with removal of FSC at Balipara)
- Reconductoring of Balipara - Bongaigaon 400kV D/c (twin moose) to high capacity / HTLS

16. Interconnection of NER with Bhutan

For import of power from projects in Bhutan following 400kV high capacity lines have been planned :

- Rangia/Rowta – Yangbari(Bhutan) 400KV 2x D/c line (quad)

Power from Rangia/Rowta would be further transferred to other parts of Indian grid through Rangia/Rowta – Gurudaspur HVDC bipole line.

4.10 Strengthening of Existing Corridors

As part of the studies, the need for strengthening of existing transmission corridors has also been broadly taken into consideration. The following transmission corridors have been identified for strengthening through replacing the existing conductors with higher capacity conductors/upgrading to higher voltage levels.

4.10.1 Northern Region

1. 400kV Singrauli-Anpara S/C

Rihand/Singrauli generation complex and Anapara/Obra generation complex are connected through 400kV S/c. Depending on system conditions, the power flow on the line reaches 700-800MW resulting in critical loading. To cater to above conditions, Rihand-Anpara 400kV D/c is being considered. As per Transmission Planning Criteria the system should be designed for (n-1-1) condition. Accordingly to meet the reliability criteria it is proposed to strengthen the line by replacing existing conductor by High capacity HTLS conductors.

2. 400kV Meerut-Muzaffarnagar S/C

Muzaffarnagar is an important load center of Uttar Pradesh. Further Muzaffarnagar is connected to Roorkee through 400kV line. Hence Meerut-Muzaffarnagar 400kV line helps in meeting the demand of both Muzaffarnaagr and Roorkee. However due to high demand in these areas the line gets critically loaded. To meet the power demand of Roorkee and nearby area Bareilly-Kashipur-Roorkee 400kV D/c is under construction. However to cater to contingency conditions it is proposed to upgrade the line with High capacity HTLS conductors.

3. 220kV Ballabgarh-Badarpur

Badarpur-Ballabgarh line experiences high loading of the order of 160MW/ckt in both directions depending on system condition. Even under (n-1) condition the other circuit would get critically loaded. Accordingly it is proposed to upgrade the line by replacing with High capacity HTLS conductors.

4.10.2 Southern Region

4. Kolar – Hosur 400 kV D/c line.

Due to direct Connectivity with Kolar HVDC, this link becomes vital for transfer of power to S2 Area (Tamil Nadu, Kerala) of Southern Region. As this link is critically loaded, it is envisaged to re-conductor existing transmission line with High Capacity/ HTLS Conductor utilising the same Right of Way.

5. Kaiga – Guttur 400 kV D/c line.

This link was planned for immediate evacuation of Kaiga generation. It is presently critically loaded during high generation at Kaiga. Looking into criticality of evacuation of power from Kaiga and RoW problem, it is envisaged to re-conductor existing transmission line with High Capacity Conductor.

4.10.3 Eastern Region

6. Jeypore-Jayanagar 220kV D/C

This link belongs to the state of Orissa and is very important for the state to draw power from Jeypore substation. At present, the line remains critically loaded. It is therefore proposed that this line may be reconductored with high capacity HTLS line so as to enhance the transmission capacity in this corridor.

7. Maithon RB – Maithon 400kV D/C line

Maithon RB generation project is connected through 400kV D/c line with Maithon and Ranchi. Whenever there is import of power from Western Region, the Maithon RB – Maithon line remains critically loaded. It is therefore proposed to enhance the capacity of this line by reconductoring it by high capacity HTLS conductor.

8. Maithon – Raghunathpur 400kV line

For evacuation of power from Raghunathpur (1200 MW) project of DVC, 400kV Raghunathpur – Ranchi D/c line with quad conductor along with LILO of Maithon – Ranchi 400kV line at Raghunathpur has been proposed. The power flow study shows that this Maithon – Raghunathpur line remains critically loaded. It is therefore proposed to enhance the capacity of the Maithon – Raghunathpur line by reconductoring of the same with high capacity HTLS conductor.

4.10.4 North-Eastern Region:

9. Biswanath Chariali – Balipara 400kV 2xD/c line

With pooling of about 6000MW power from projects like Demwe(1750 MW), Tato-II(700 MW), Kalai-II (1200 MW), Lower Subansiri(2000 MW) and Ranganadi (410

MW) at Biswanath Chariali it is required to strengthen the Biswanath Chariali-Balipara 400kV line corridor from twin moose to high capacity HTLS conductor.

10. Reconductoring of Balipara - Bongaigaon 400kV D/c (twin moose) to high capacity / HTLS

The Balipara – Bongaigaon corridor has one 400kV D/c line with high capacity quad conductor while other 400kV D/c line with twin moose conductor. For effective utilisation of this corridor the twin moose line need to be reconductored with high capacity 400kV quad D/c line.

11. Byrnihat – Misa 220 kV D/c line to be upgraded to 400kV high Capacity/HTLS line.

Both Byrnihat and Misa are 400kV substation in NER however connected with low capacity 220kV line. The line may be upgraded to 400kV with high capacity conductor so as to enable enhanced flow of power between these substations.

4.11 Integration of Green energy with the Regional grid

About 33,000 MW renewable generation capacity is envisaged to be added during 12th plan period in eight (8) RE resource rich states viz. Rajasthan, Gujarat, Tamil Nadu, Maharashtra, Karnataka, Andhra Pradesh, Himachal Pradesh and J&K through Wind/Solar & Small Hydro generation. State wise details of Renewable capacity addition programme are given below :

Table 4.5 : Renewable addition plan in RE rich states

State	RE capacity at the end of 11th Plan (MW) [Wind+Solar]	Addition in 12th Plan (MW [Wind+Solar]	Total capacity (MW) [Wind+Solar]
Tamil Nadu	6377	7353	13730
Karnataka	1789	3872	5661
Andhra Pradesh	252	4827	5079
Gujarat	3200	4729	7929
Maharashtra	2477	4063	6540
Rajasthan	2300	5694	7994
Jammu & Kashmir	2	114	116
Total	**16397**	**30652**	**47049**

*Moreover, SHP capacity addition of **2100 MW** (H.P: 1281 MW; Karnataka: 418MW; J&K-360MW) is envisaged in 12th plan*

In order to facilitate integration of such large scale renewable generation capacity in 12th plan, a comprehensive transmission plan comprising intra state and inter state transmission system strengthening has been identified. Further, other control infrastructure like forecasting of renewable generation, balancing Infrastructure, dynamic compensation, establishment of Renewable Energy Management centers (REMC) at SLDC/RLDC/NLDC level, real time measurement/monitoring etc. have also been identified as part of the green energy corridors.

A Joint Declaration of Intent was also signed between Govt. of Germany and Govt of India regarding establishment of Green Energy Corridors by which German side expressed its willingness to provide concessional loans of up to 1 billion Euro for development of Green Energy Corridors. Transmission schemes have been prioritized for posing to KfW loan in three (3) Tranches (Tranche-I : 250 Million; Tranche-II : 500 Million; Tranche-III : 250 Million) for inter state and intra state transmission scheme.

High capacity transmission corridor, as part of Inter-state transmission system, connecting major renewable pockets is being proposed right from the Bhuj Pooling station in Gujarat (WR) to Moga in Punjab (NR) via Chittorgarh/Ajmer/Suratgarh in Rajasthan (NR) and Tirunelveli Substation and its interconnection in Tamil Nadu is proposed as part of ISTS strengthening.

The above proposed transmission is prioritized and accordingly divided into four parts, out of which three parts are considered for KfW soft loan (Euro 1 billion) and the scheme is to be implemented by 2016-17. Schematic showing the high capacity inter-state transmission corridor for envisaged renewable generation in 12th plan is as under:

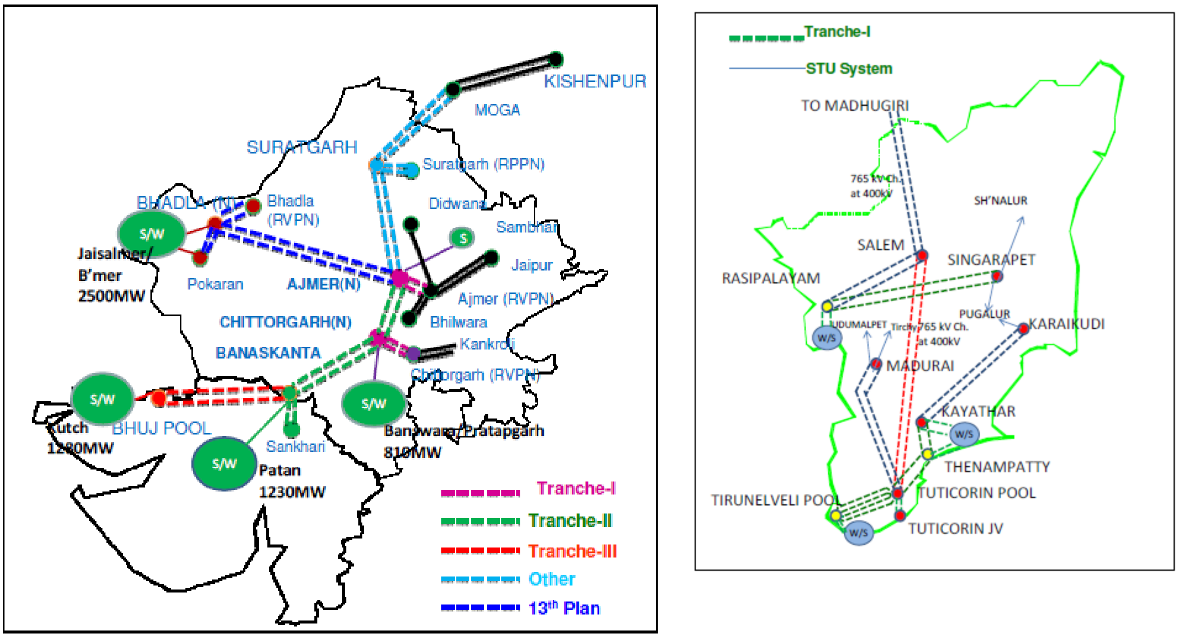


Figure 4.6 : High capacity inter-state transmission corridor for RE

Summary of proposed intra state and inter-state transmission system strengthening posed for funding as a part of Greene Energy Corridor is as under

Table 4.6 : Summary of proposed Inter-state & Intra state transmission system

S.No	Item	Ckm length	Substation capacity MVA	Estimated Cost (Rs Cr)
1	Intra State	13600	16650	11920
2	Inter State	3400	18000	9081
	Total	**17000**	**34650**	**21001**

The overall inter-state transmission scheme proposed as part of green energy corridor is as below :

A. Inter State Transmission Scheme for Trenche-1

Rajasthan (Northern region)

- Ajmer (New)- Ajmer (RVPN) 400kV D/c (Quad)
- Chittorgarh (New)- Chittorgarh (RVPN) 400kV D/c (Quad)
- Establishment of 2x1500 MVA, 765/400kV S/s at Chittorgarh
- Establishment of 2x1500 MVA, 765/400kV S/s at Ajmer (New)
- Associated reactive compensation (Bus reactor each at 765kV Ajmer & 765kV Chittorgarh S/s)

Tamil Nadu (Southern region)

- Tirunelveli Pooling Station – Tuticorin Pooling Station 400 kV 2xD/c (Quad)
- Establishment of 2x500 MVA, 400/230kV S/s at Tirunelveli Pooling Station
- Associated reactive compensation (Bus reactor)

B. Inter State Transmission Scheme for Trenche-2

Gujarat (Western Region)

- Establishment of 765/400/220kV (765/400 kV-2x1500 MVA & 400/220kV-2x500MVA) sub-station at Banaskanta
- Banaskanta – Chittorgarh 765kV D/c
- Banaskanta-Sankhari 400 kV D/c
- Associated reactive compensation (Bus reactor at 765kV Banaskanta & line reactors)

Rajasthan (Northern region)

- Chittorgarh – Ajmer(New) 765kV D/c
- Associated line reactors

C. Inter State Transmission Scheme for Trenche-3 (Euro 250 million)

Gujarat (Western Region)

- Establishment of 765/400/220kV (765/400 kV-2x1500 MVA & 400/220kV-2x500MVA) sub-station at Bhuj Pool

- Bhuj Pool – Banaskanta 765kV D/c
- Associated reactive compensation (Bus reactor at 765kV Bhuj PS & line reactors)

D. Balance Inter State Transmission Scheme
Rajasthan (Northern region)

- Ajmer(New) – Suratgarh(New) 765kV D/c
- Suratgarh(New)-Moga(PG) 765kV D/c
- Suratgarh (New)- Suratgarh (existing) 400kV D/c (Quad)
- Establishment of 2x1500 MVA, 765/400kV S/s at Suratgarh (New)
- Associated reactive compensation (Bus reactor /Line reactors)

The Renewable capacity likely to be added during 13th plan and the corresponding transmission system for integration of the renewable capacity to the grid is under evolution.

4.12 Interconnection with Neighbouring Countries

A. Indian and Bangladesh

A1. Existing Interconnection

An electrical grid interconnection between India and Bangladesh has been established in Sep.'13 through 100km long 400kV transmission line between Baharampur (India) and Bheramara (Bangladesh) along with 500MW HVDC back-to-back terminal at Bheramara to facilitate power exchange up to 500 MW between the two countries. Power flow up to 500 MW through the above Interconnection is taking place from Oct, 2013 onward. The transmission system is given below :

India portion

- Baharampur (India)- Indian border 400kV D/C line: 71 km
- LILO of Farakka - Jeerat 400kV S/C line at Baharampur : 2.5 km
- Establishment of 400kV Switching Station at Baharampur

Bangladesh portion

- Indian Border -Bheramara (Bangladesh) 400kV D/C line : 27 km
- LILO of Ishurdi-Khulna South 230kV D/C line at Bheramara: 4 km
- Establishment of 500MW HVDC back-to-back Station and 230kV Switching Station at Bheramara

A2. Interconnection by 13 Plan

The following schemes are under discussion as a part of new Interconnection to facilitate power exchange between India and Bangladesh

A2a. Power exchange between Bangladesh and India through the Interconnection between eastern side of Bangladesh and Tripura, India

During the 7th Joint Steering Committee (JSC) meeting on Cooperation in Power Sector between India and Bangladesh held on 3rd April 2014 in Dhaka, a Joint Technical Committee (JTC) was constituted in regard to the proposal of Bangladesh for import of about 100 MW power from Palatana project (726.6 MW) in Tripura/NER to eastern side of Bangladesh through radial interconnection. After detailed study by the JTC it was decided that in Indian side Surajmaninagar S/S would be technically most suitable grid point to provide radial interconnection to South Comilla in the eastern part of Bangladesh. Accordingly following scheme has been identified for radial supply of 100MW power from Tripura to eastern part of Bangladesh:

- Surjyamaninagar(Tripura) - South Comilla D/c line routed via North Comilla-58 km

The Surjyamaninagar-North Comilla section (Indian side-27km, Bangladesh side-15km,Total-42km) to be constructed as 400kV D/c line to be operated as 132kV while North Comilia-South Comilla portion(16km) to be constructed as 132kV D/c line.

A2b. Import of additional 500MW power by Bangladesh from India through capacity upgradation of the existing Baharampur(India) - Bheramara(Bangladesh) interconnection

The import of additional 500MW of power by Bangladesh from India through capacity upgradation of the existing Baharampur(India) – Bheramara (Bangladesh) interconnection was discussed in the Joint Working Group (JWG) and Joint Steering Committee (JSC) meetings held on April 2-3, 2014 at Dhaka, Bangladesh. It was decided that both the sides would jointly assess the requirement of strengthening the system for this additional power. After joint study of Indian and Bangladesh team the following strengthening scheme is proposed:

Interconnection

- 500 MW HVDC back-to-back converter unit (2^{nd} module) at Bheramara (Bangladesh)

Indian System:

- Farakka - Behrampur 400kV D/c (HTLS) line - about 70-80km.

- Removal of LILO of Farakka - Jeerat 400kV line at Behrampur to make Farakka-Jeerat direct S/c line.
- LILO of Farakka-Jeerat 400kV S/c line at Sagardighi (subject to availability of bay space at Sagardighi).
- LILO of Sagardighi-Subhasgram 400kV S/c line at Jeerat.

Bangladesh System:

- Bheramara - Ishurdi 230kV D/c line - 12km

A2c. High Capacity multi-terminal HVDC bipole line from NER (India) to NR/WR India) through Bangladesh

The Joint Technical Team (JTT) of India and Bangladesh formed to explore the opportunity of power exchange between eastern side of Bangladesh and India submitted its report to the Joint Working Group(JWG) in the Meeting held on 2nd April, 2014 at Dhaka. On recommendation of JWG, the JSC decided to proceed with the ±800 KV, 6500MW HVDC multi-terminal bipole line from NER(India) to NR/WR(India) through Bangladesh with 500/1000 MW HVDC terminal in Bangladesh. It was decided to prepare the detailed feasibility and project report jointly by PGCIL/CEA and PGCB/BPDB in six months. The studies are under progress for following major transmission scheme:

- Rangia/Rowta (NER-Assam) – Gurudaspur (NR - Punjab) ±800kV 6000/6500 MW HVDC bipole with 3000 MW terminal Capacity

This inter-regional corridor has been planned for transfer of hydro power from NER to load centre in Gurudaspur of Punjab in NR. This would be a multi-terminal HVDC corridor which would pass through Bangladesh with one 500/1000 MW HVDC terminal in Bangladesh for delivery of power.

B. India and Nepal

Nepal is radially connected with India at various places through 11kV, 33kV and 132kV lines. About 150 MW of power is being exchanged through these interconnections in radial mode.

Further, Muzaffarpur(India) - Dhalkebar(Nepal) 400kV D/c (to be initially operated at 220kV) link has been planned for enhancement of quantum of power exchange between India and Nepal. Implementation of this link is being taken up by separate joint venture companies for Indian and Nepalese portion and link is expected to be commissioned by 2015-16.

C. India and Bhutan

India and Bhutan already have existing arrangements for exchange of power. Bulk power generated at Tala HEP(1020 MW), Chukha HEP (336 MW) and Kurichu HEP(60 MW) in Bhutan is exported to India through 400kV, 220kV and 132kV lines, respectively. The basin-wise installed capacity of various hydro projects in Bhutan at present and envisaged to come up by the end of 13th plan is given below:

Table 4.7 : Generating Station in Bhutan upto 2021-22

Sl.	Name of the Generating Station	Existing	by 2021-22
Wangchhu Basin			
1	Tala	1020	1020
2	Chukha	336	336
3	Bunakha-RS		180
4	Wangchhu		570
	Sub Total (Wangchhu basin)	1356	2106
Punatsangchhu basin			
5	Dagachhu		126
6	Punatsangchu-I		1200
7	Punatsangchu-II		1020
	Sub Total (Punatsangchhu basin)	-	2346
Mangdechhu basin			
8	Chamkharchu-1		770
9	Mangdechu		720
	Sub Total (Mangdechhu basin)	-	1490
Drangmechhu basin			
10	Kuruchu	60	60
11	Kholongchu		600
	Sub Total (Drangmechhu basin)	60	660
	TOTAL	**1416**	**6602**

Accordingly, about 6602MW hydro projects are envisaged to come up in Bhutan by 2021-22. The following interconnection has been planned for exchange of power with Bhutan :

Existing Interconnection

- Chukha HEP (Bhutan) – Birpara (ER) 220kV 3 circuits
- Kurichu HEP (Bhutan) - Geylegphug (Bhutan) - Salakati (ER) 132kV S/c
- Tala HEP (Bhutan) - Siliguri (ER) 400kV 2xD/c

Interconnection by end of 13th plan

- Rangia/Rowta (NER) – Yangbari (Bhutan) 400KV 2x D/c line (quad)
- Alipurduar (ER) – Jigmelling (Bhutan) 400kV D/c line (quad)

Following strengthening has been identified for dispersal of power in the Indian grid from Alipurduar (ER) and Rangia/Powta pooling station (NER) :

- Alipurduar – Siliguri 400kV D/c line (quad)
- Kishanganj – Darbhanga 400kV D/c line (quad)
- Rangia/Rowta (NER-Assam) – Gurudaspur (NR - Punjab) $\pm$800kV, 6000/6500 MW HVDC bipole with 3000MW terminal Capacity

D. India and Pakistan

Discussions are being held between Govt of India and Govt of Pakistan to establish a cross border interconnection between the two countries. It has been proposed that Pakistan may procure up to 500 MW power from Indian power market on commercial terms. The cross border interconnection may be through 400 KV double circuit line with HVDC back to back terminal of 500 MW capacity to be located in Pakistan. The proposed location of interconnection in India is Amritsar and in Pakistan Ghazi Road in Lahore as point of interconnection. HVDC back to back station shall have longer gestation period of about 36 months, while the transmission line can be completed in about 24 months. As such, if agreed, after the completion of 400 kV line about 150-200 MW power can be supplied in radial mode at 220 kV level in the interim period till commissioning of HVDC link. Under radial mode of operation, a portion of Lahore Grid with shall have to be disconnected from Lahore Grid and the same shall be connected to Indian Grid. There are certain technical issues which need to be addressed before finalizing the power supply in radial operation.

Annex-4.1

Inter- Regional Transmission Capacity up to 13th Plan

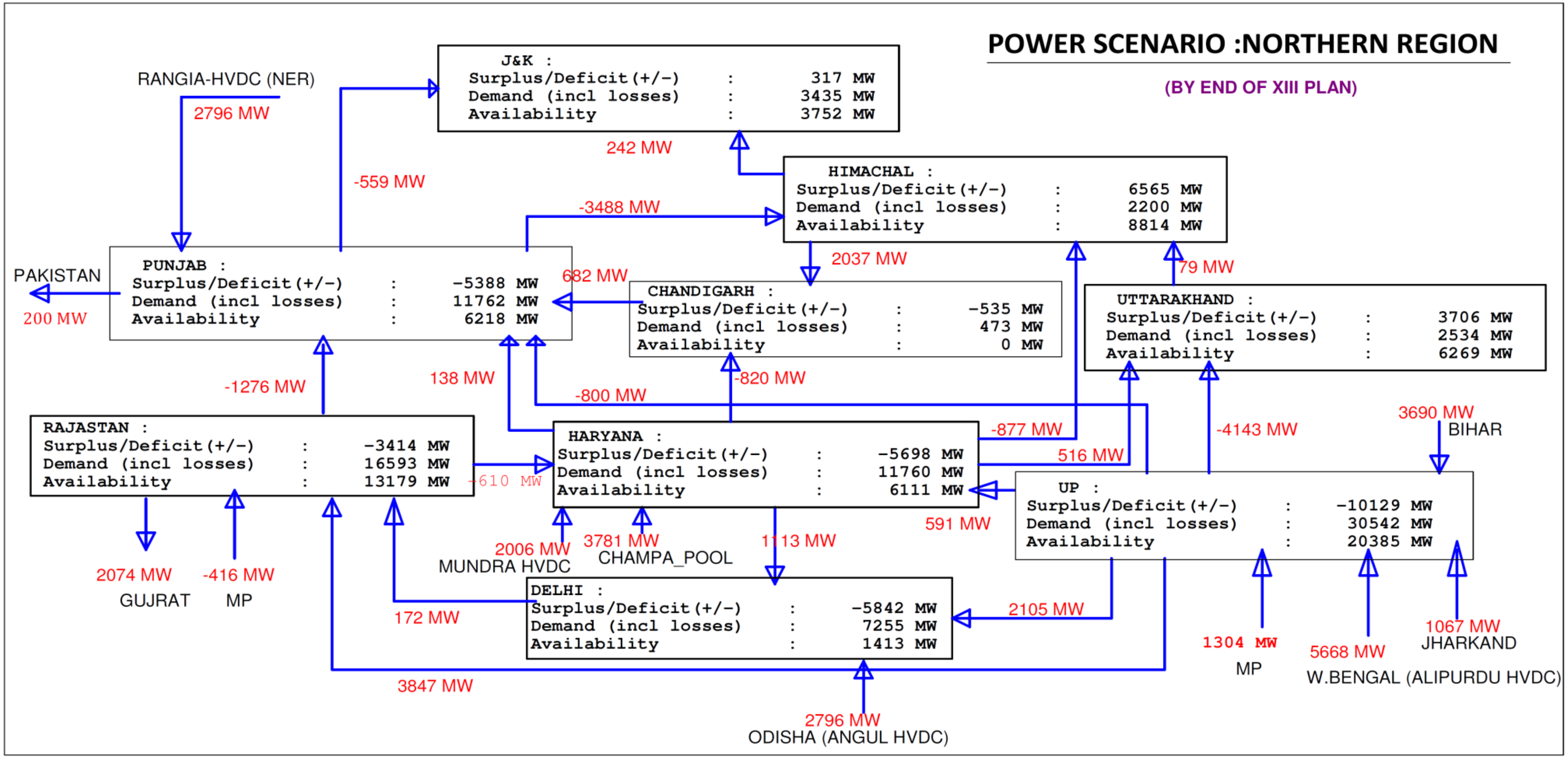
	Present	Balance by 12th Plan	End of 12th Plan	During 13th Plan	End of 13th Plan
EAST-NORTH					
Dehri-Sahupuri 220 kV S/c	130		130		130
Sasaram HVDC back-to-back	500		500		500
Muzaffarpur-Gorakhpur 400 kV D/c (with Series Cap+TCSC)	2000		2000		2000
Patna – Balia 400kV D/c (Quad)	1600		1600		1600
Biharshariff – Balia 400kV D/c(Quad)	1600		1600		1600
Barh – Balia 400kV D/c (Quad)	1600		1600		1600
Gaya - Balia 765kV S/c	2100		2100		2100
Sasaram bypassing(additional capacity)	500		500		500
Sasaram - Fatehpur 765kV2x S/c	4200		4200		4200
Barh-II-Gorakhpur 400kV D/c (Quad) line		1600	1600		1600
Gaya-Varanasi 765 kV S/c line		2100	2100		2100
Biharsharif - Varanasi 400kV D/c line with quad conductor		1600	1600		1600
Tillaiyya – Balia 765kV D/c line, one ckt via Gaya				4200	4200
Angul (ER- Orissa) – Badarpur (NR-Delhi) ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity				3000*	3000
Sub-total	**14230**	**5300**	**19530**	**7200**	**26730**
EAST-WEST					
Budhipadar-Korba 220 kV 3 ckts.	390		390		390
Rourkela-Raipur 400 kV D/c with series comp.+TCSC	1400		1400		1400
Ranchi –Sipat 400 kV D/c with series comp.	1200		1200		1200
Rourkela-Raipur 400 kV D/c (2nd) with series comp.	1400		1400		1400
Ranchi - Dharamjayagarh - WR Pooling Station 765kV S/c line	2100		2100		2100
Ranchi - Dharamjaygarh 765kV 2nd S/c		2100	2100		2100
Jharsuguda-Dharamjaygarh 765kV D/c line		4200	4200		4200
Jharsuguda - Dharamjaygarh (to be LILOed at Raigarh Tamnar) 765kV D/c line (2nd)				4200	4200
Jharsuguda - Raipur Pool 765kV D/c line				4200	4200
Sub-total	**6490**	**6300**	**12790**	**8400**	**21190**
WEST- NORTH					
Auriya-Malanpur 220 KV D/c	260		260		260
Kota - Ujjain 220 KV D/c	260		260		260
Vindhyachal HVDC back-to-back	500		500		500
Gwalior-Agra 765 kV 2 x S/c	4200		4200		4200
Zerda-Kankroli 400kV D/c	1000		1000		1000
Champa Pool- Kurukshetra HVDC Bipole		3000	3000		3000
Gwalior-Jaipur 765kV 2xS/c lines		4200	4200		4200
RAPP-Sujalpur 400kV D/c		1000	1000		1000
Adani(Mundra) - Mahendranagar HVDC bipole	2500		2500		2500
Upgradation of Champa – Kurukshetra ±800kV, 6000MW HVDC bipole with 3000MW terminal Capacity				3000	3000

	Present	Balance by 12th Plan	End of 12th Plan	During 13th Plan	End of 13th Plan
Jabalpur – Orai 765kV D/c line				4200	4200
Banaskanta – Chittorgarh 765kV D/c line				4200	4200
Dhanvahi – Fatehpur 765kV D/c line				4200	4200
Sub-total	**8720**	**8200**	**16920**	**15600**	**32520**
EAST- SOUTH					
Balimela-Upper Sileru 220kV S/c	130		130		130
Gazuwaka HVDC back-to-back	1000		1000		1000
Talcher-Kolar HVDC bipole	2000		2000		2000
Upgradation of Talcher-Kolar HVDC Bipole	500		500		500
Angul - Srikakulum 765kV D/c line		4200	4200		4200
Angul - Srikakulum 765kV D/c line (2nd)				4200	4200
Sub-total	**3630**	**4200**	**7830**	**4200**	**12030**
WEST- SOUTH					
Chandrapur HVDC back-to-back	1000		1000		1000
Kolhapur-Belgaum 220kV D/c	260		260		260
Ponda – Nagajhari 220kV D/c	260		260		260
Raichur - Sholapur 765kV S/c line (PG)	2100		2100		2100
Raichur - Sholapur 765kV S/c line (Pvt. Sector)	2100		2100		2100
Narendra - Kolhapur 765kV D/c (ch at 400kV)		2200	2200		2200
Wardha - Nizamabad 765kV D/c line				4200	4200
Raigarh - Pugalur +/- 800kV, 6000 Bi-pole				6000	6000
Warora Pool - Warangal 765kV D/c line				4200	4200
Sub-total	**5720**	**2200**	**7920**	**14400**	**22320**
EAST- NORTH EAST					
Birpara-Salakati 220kV D/c	260		260		260
Siliguri - Bongaigaon 400 kV D/c	1000		1000		1000
Siliguri - Bongaigaon 400 kV D/c (Quad) line		1600	1600		1600
Sub-total	**1260**	**1600**	**2860**	**-**	**2860**
NORTH EAST-NORTH					
Biswanath Chariali - Agra +/- 800 kV, 3000 MW HVDC Bi-pole		3000	3000		3000
LILO of Biswanath Chariali - Agra +/- 800 kV, 3000 MW HVDC Bi-pole at new pooling station in Alipurduar and addition of second 3000 MW module		3000	3000		3000
Rangia/Rowta – Gurudaspur ±800kV, 6000/6500 MW HVDC bipole with 3000MW terminal Capacity				3000*	3000
Sub-total		**6000**	**6000**	**3000**	**9000**
TOTAL	**40,050**	**33,800**	**73,850**	**52,800***	**1,26,650**
TOTAL (CUMULATIVE)	**40,050**	**73,850**	**73,850**	**1,26,650**	**1,26,650**

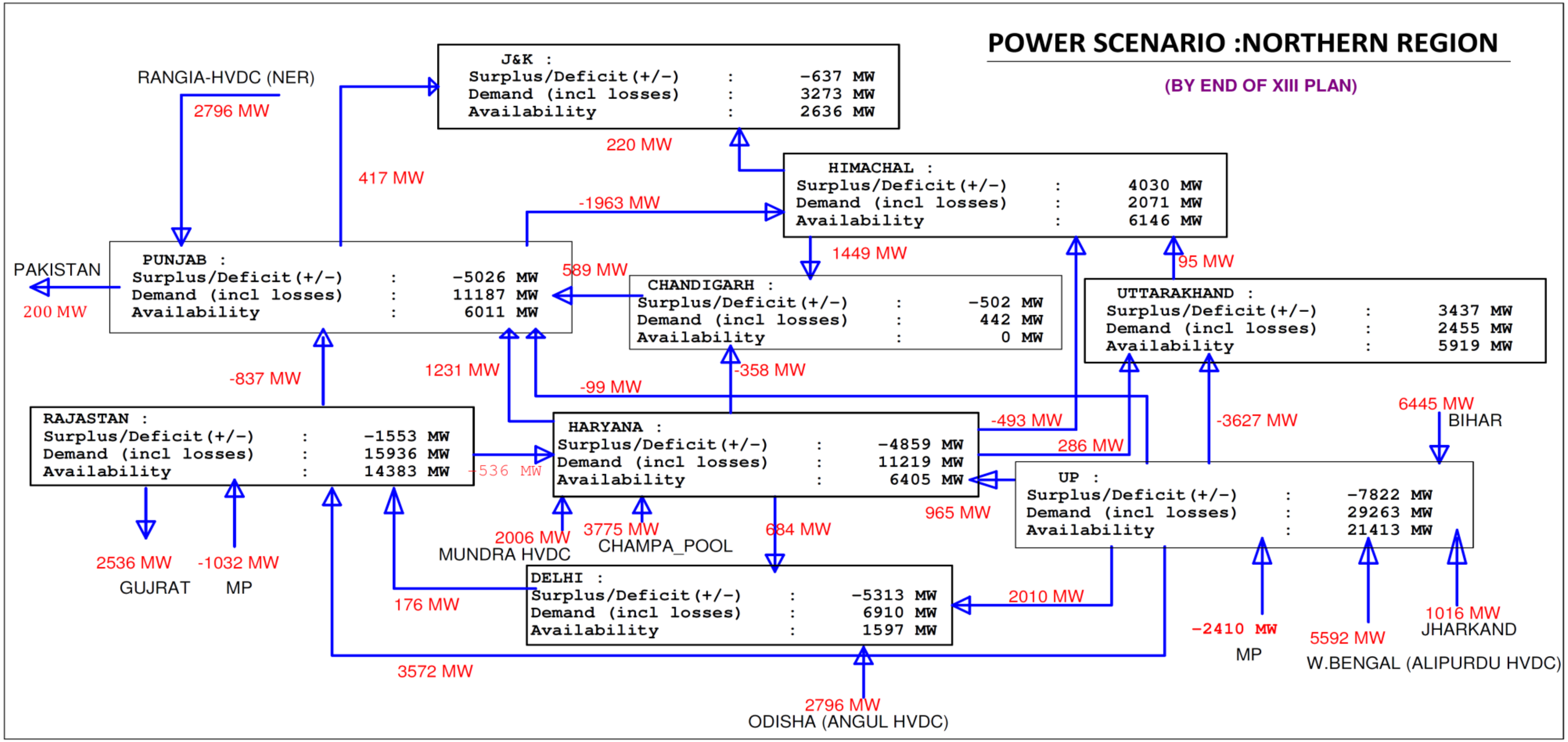
*** - Tentative, may be required in 13th or 14th Plan, in which case 13th plan I-R capacity addition would be 46800 MW. One of these HVDC bipoles if needed may be planned towards Southern Region instead of towards Northern region.**

Annex – 4.2

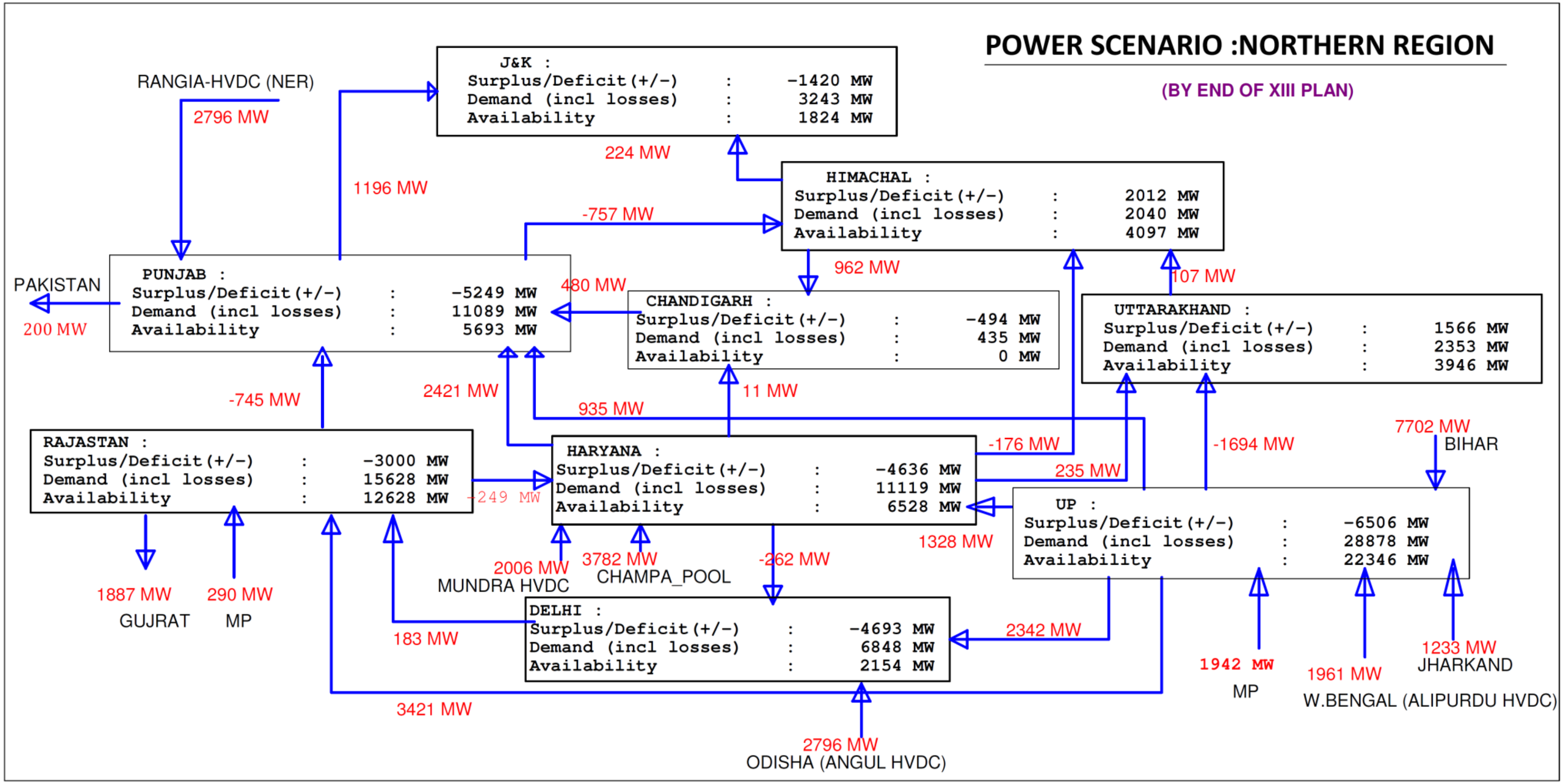
SUMMER PEAK (NR) ANNEXURE 4.2a



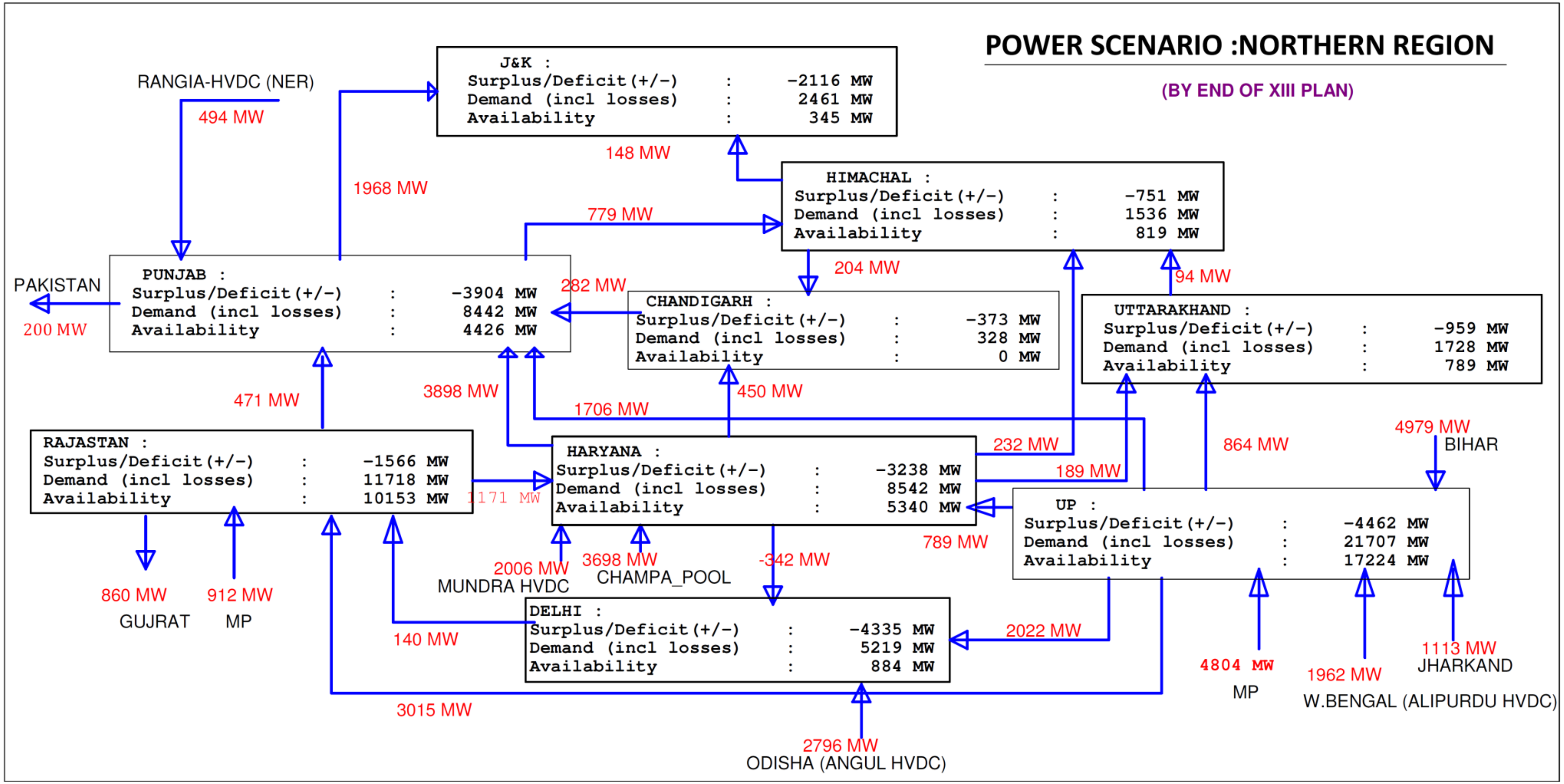
MONSOON PEAK (NR) ANNEXURE 4.2a



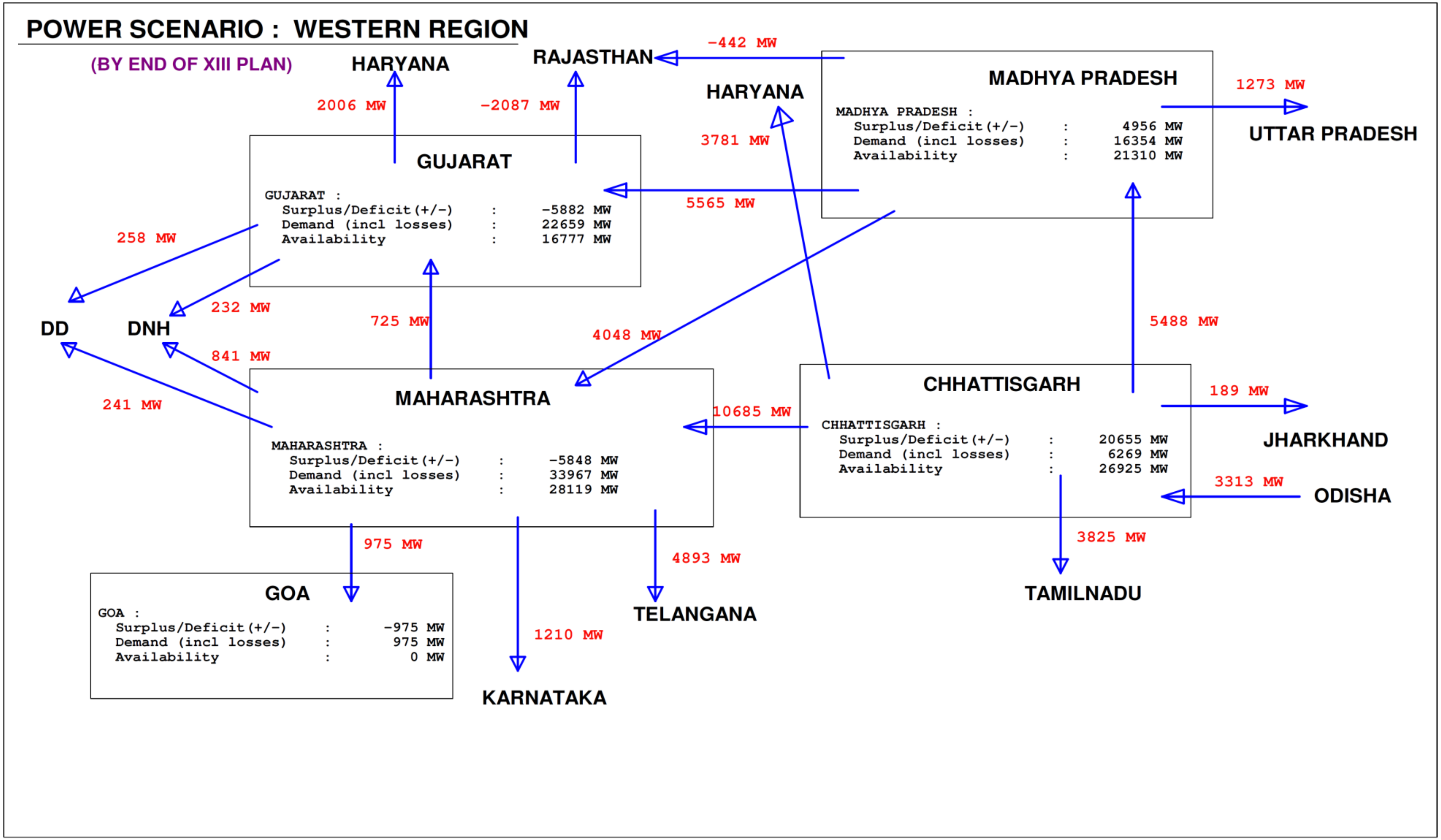
WINTER PEAK (NR) **ANNEXURE 4.2a**



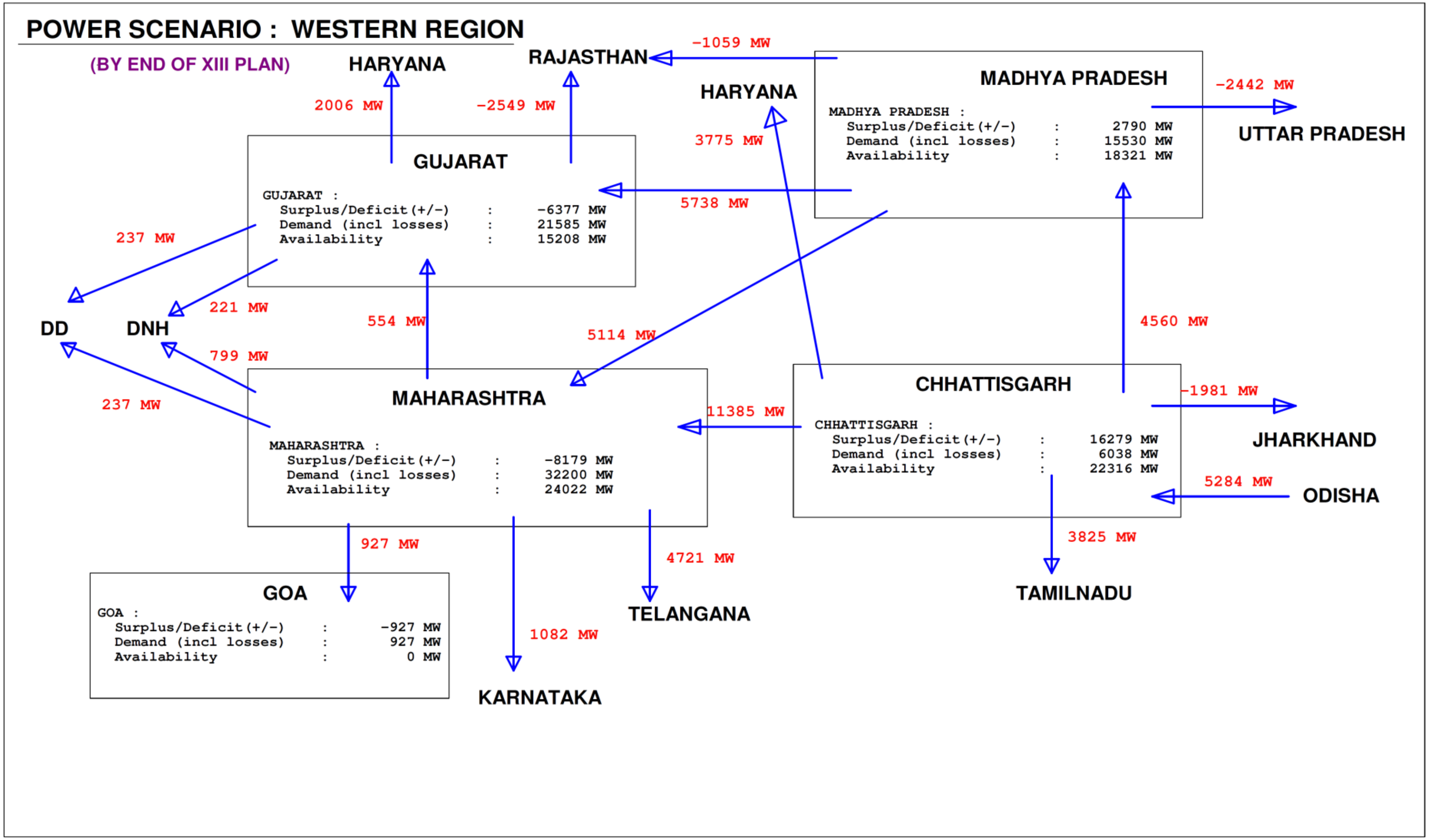
WINTER OFF-PEAK (NR) ANNEXURE 4.2a



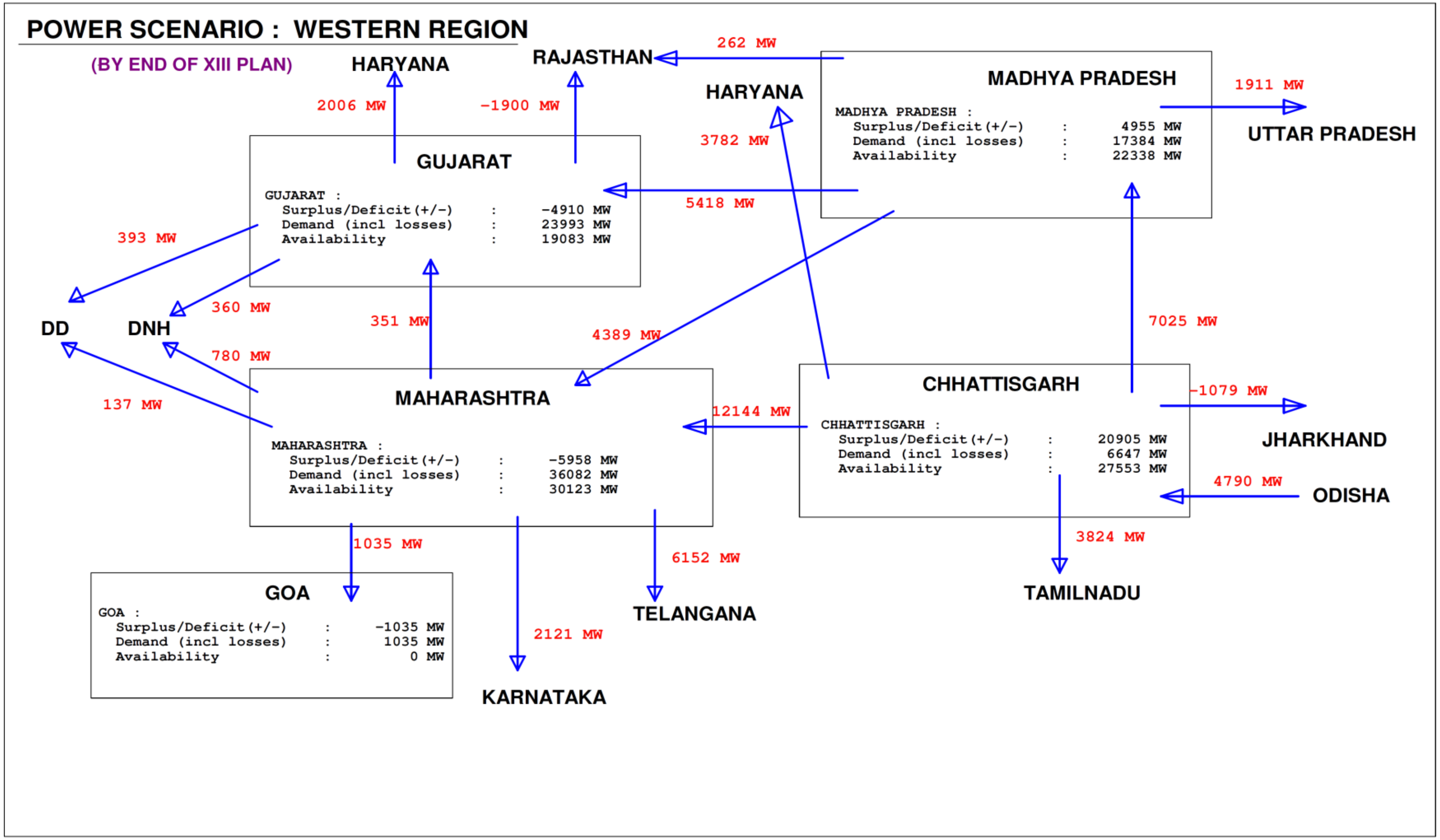
SUMMER PEAK (WR) ANNEXURE 4.2b



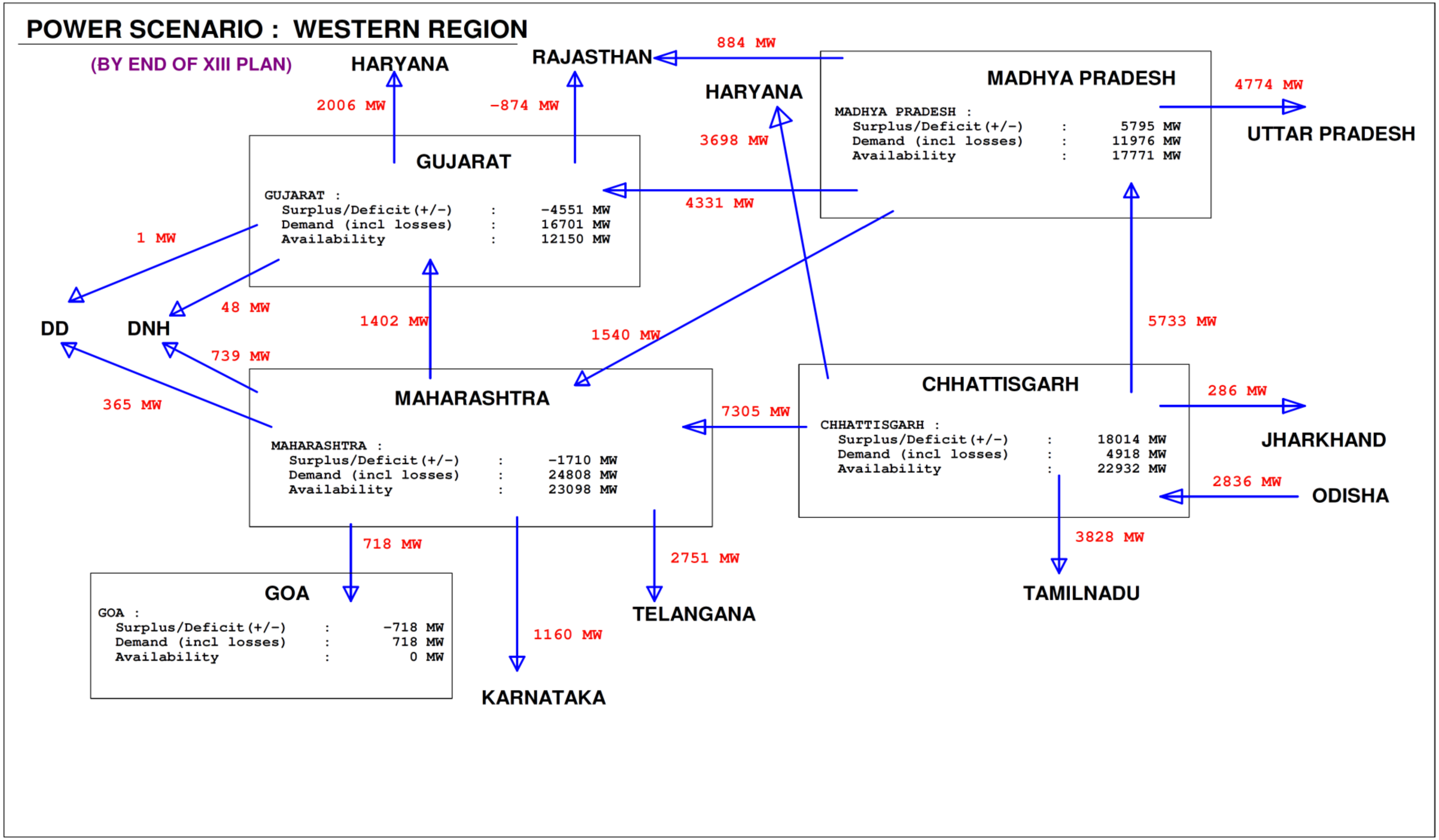
MONSOON PEAK (WR) ANNEXURE 4.2b



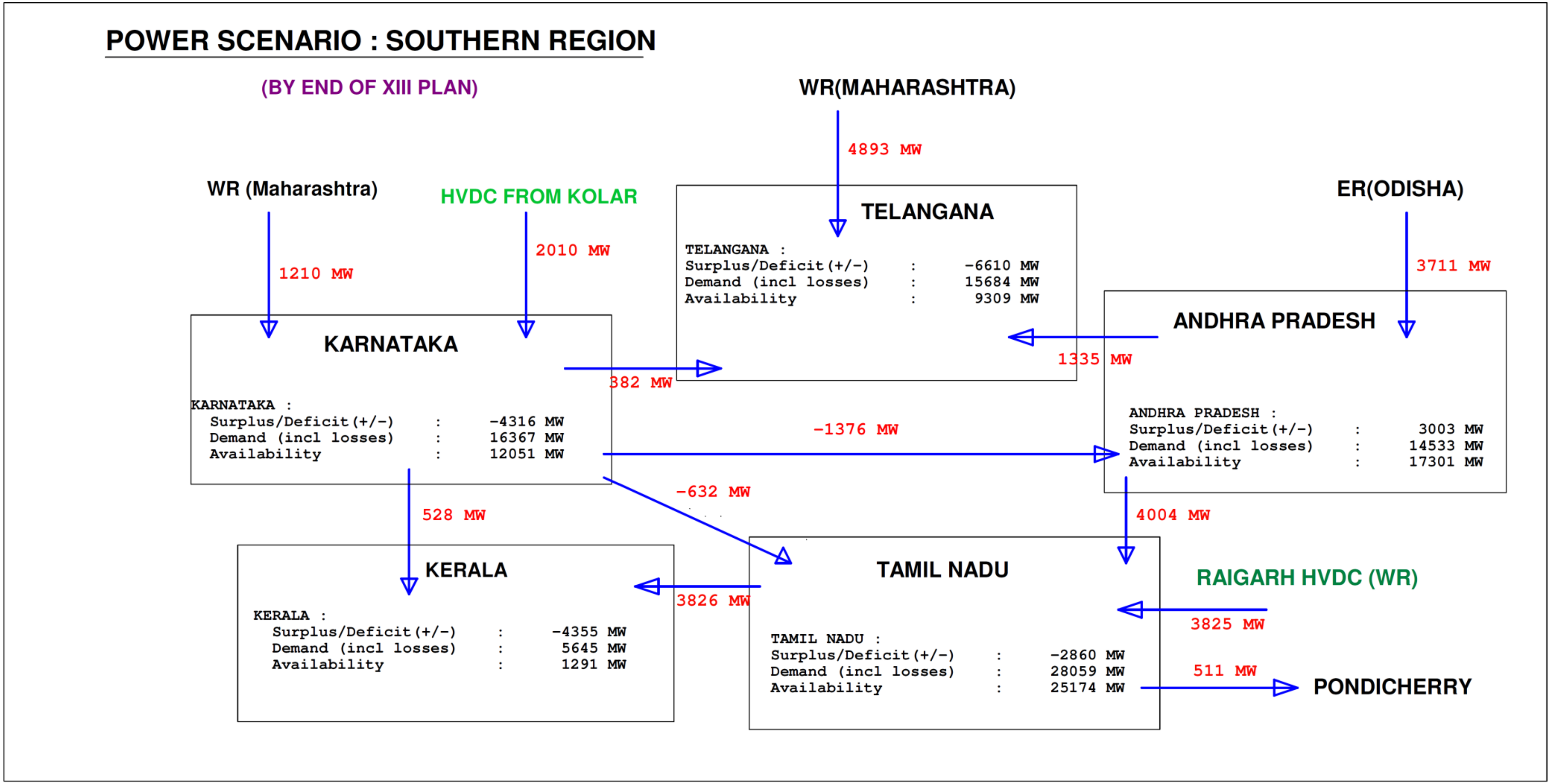
WINTER PEAK (WR) ANNEXURE 4.2b



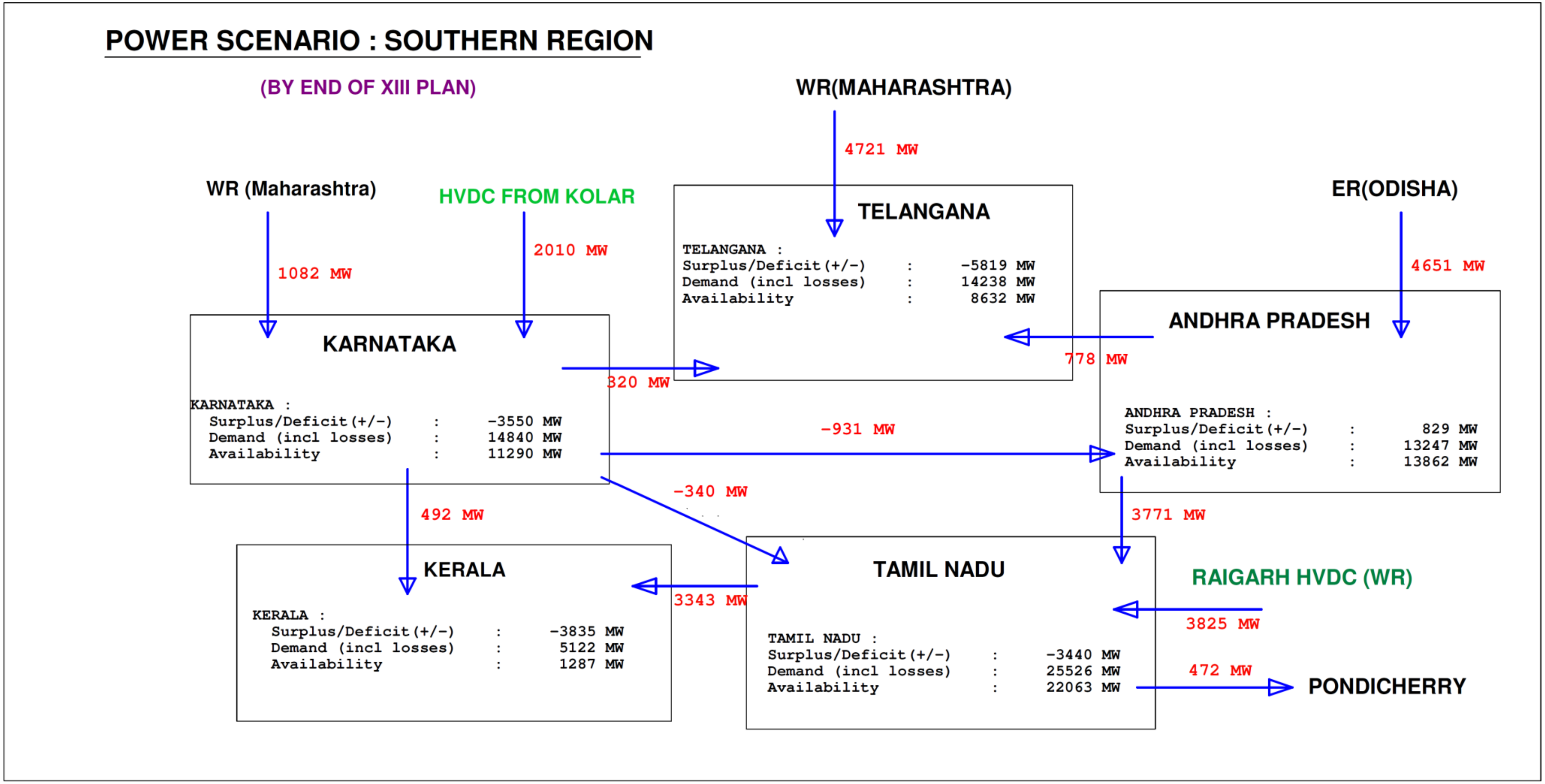
WINTER OFF-PEAK (WR) ANNEXURE 4.2b



SUMMER PEAK (SR) **ANNEXURE 4.2c**



MONSOON PEAK (SR) ANNEXURE 4.2c



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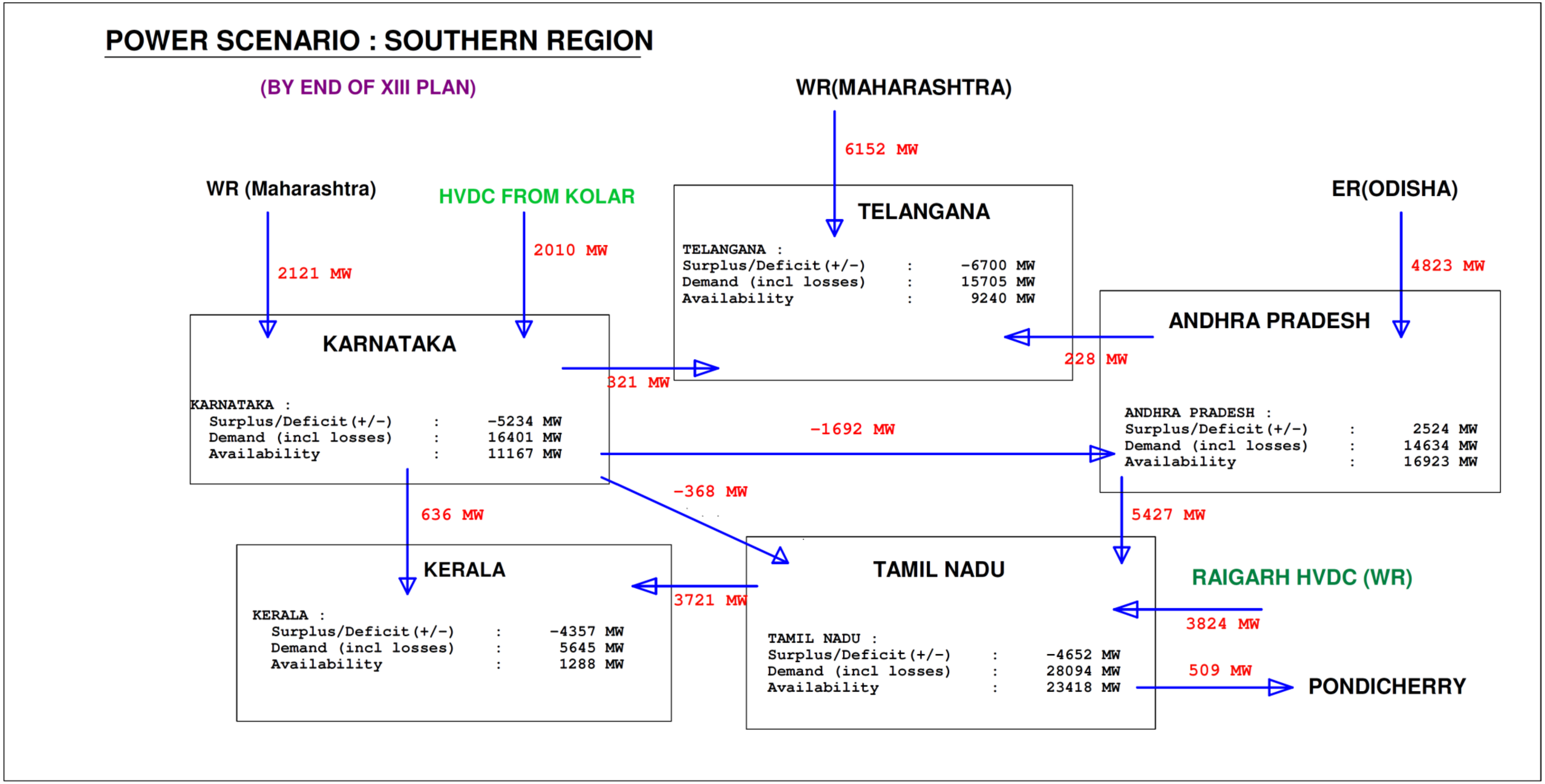
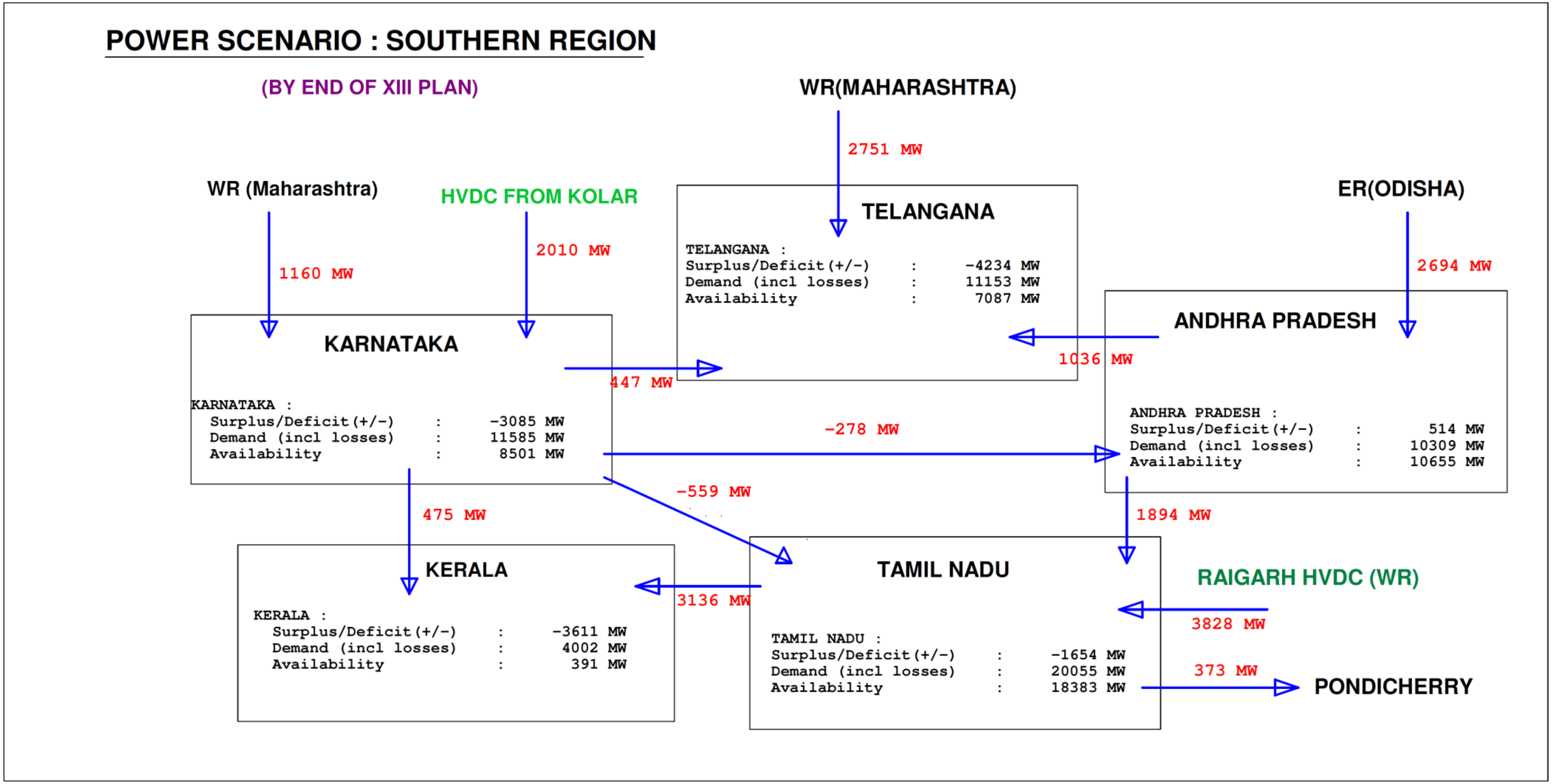
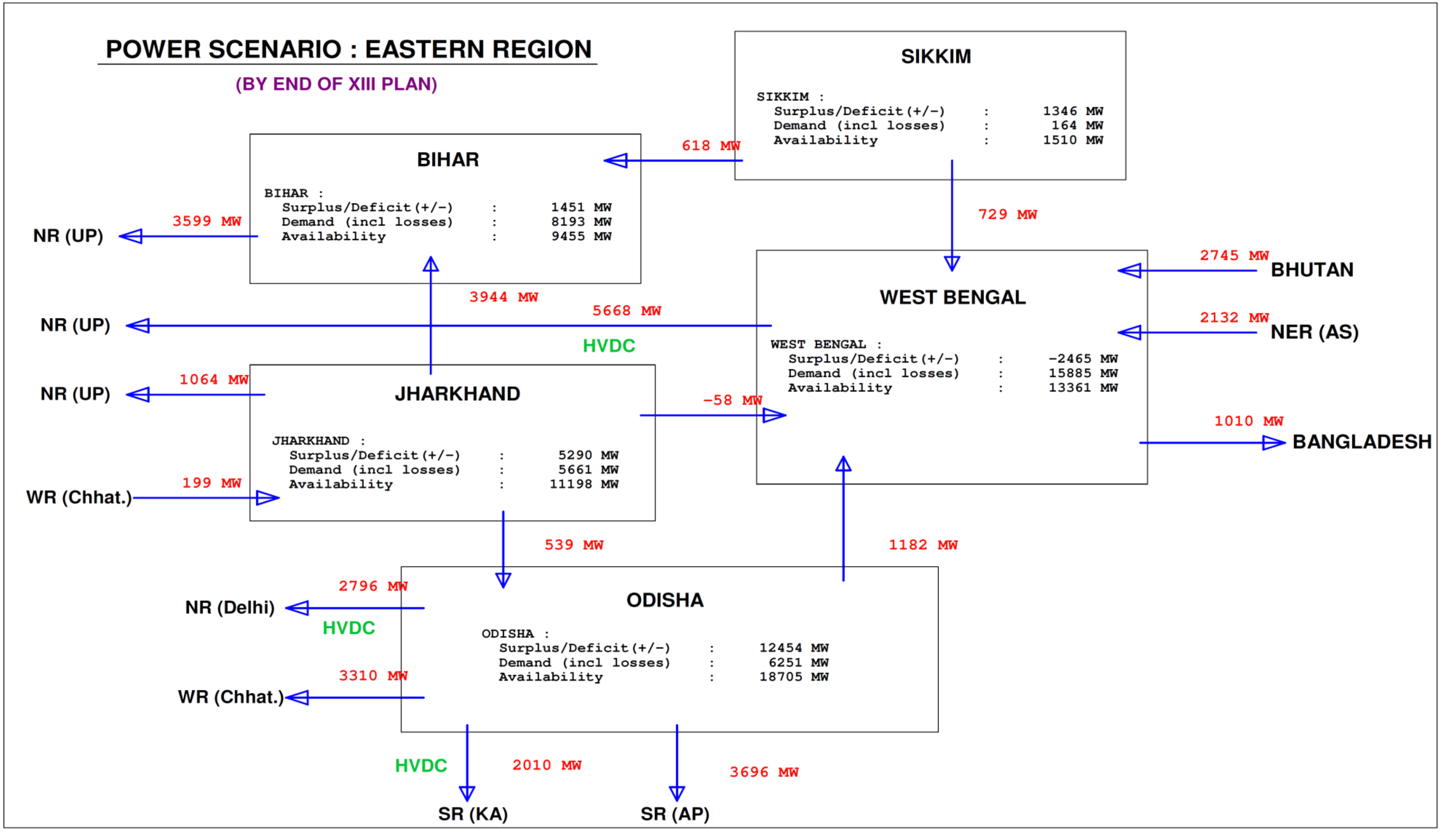


WINTER OFF-PEAK (SR) ANNEXURE 4.2c



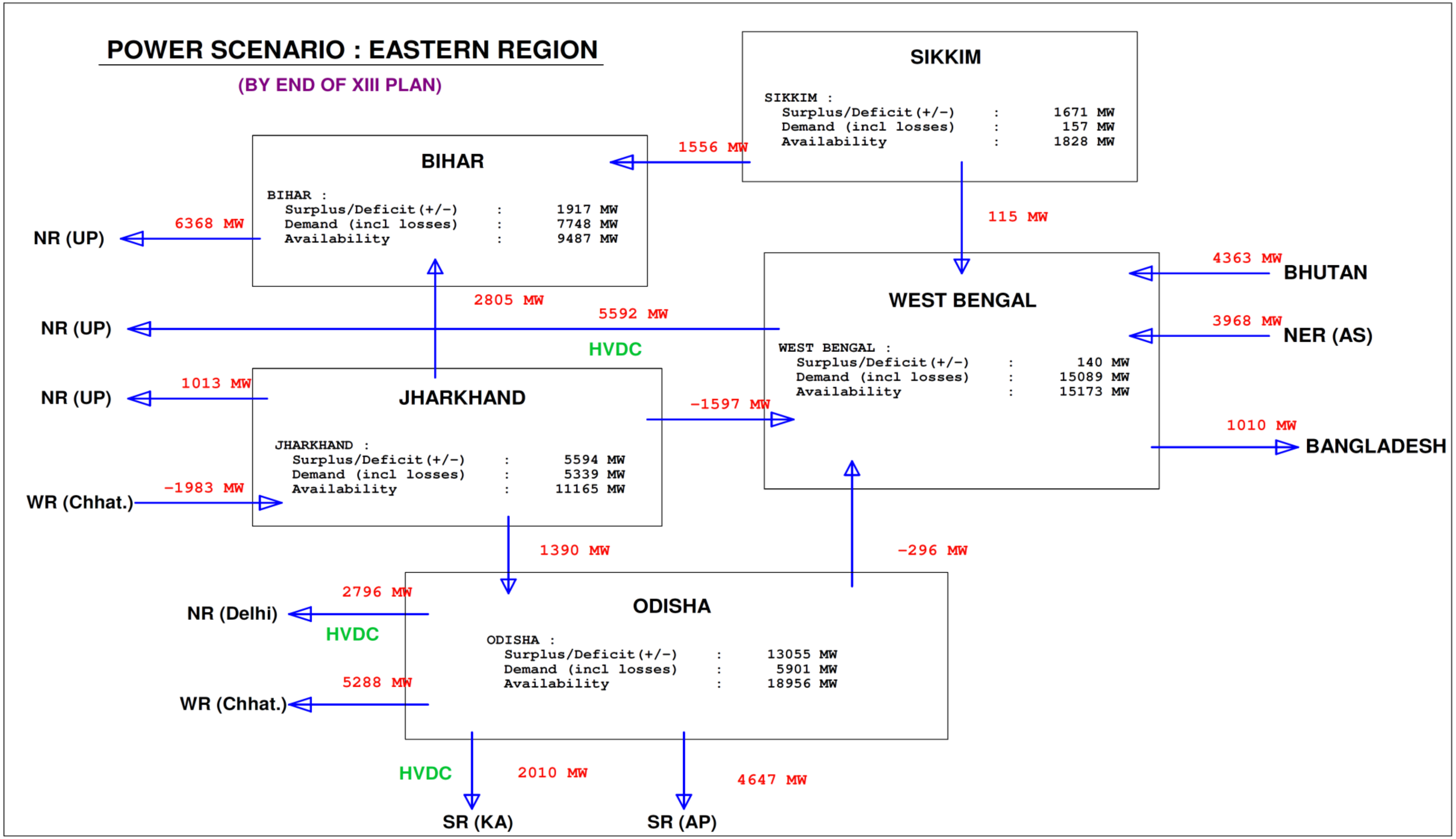
SUMMER PEAK (ER)

ANNEXURE 4.2d

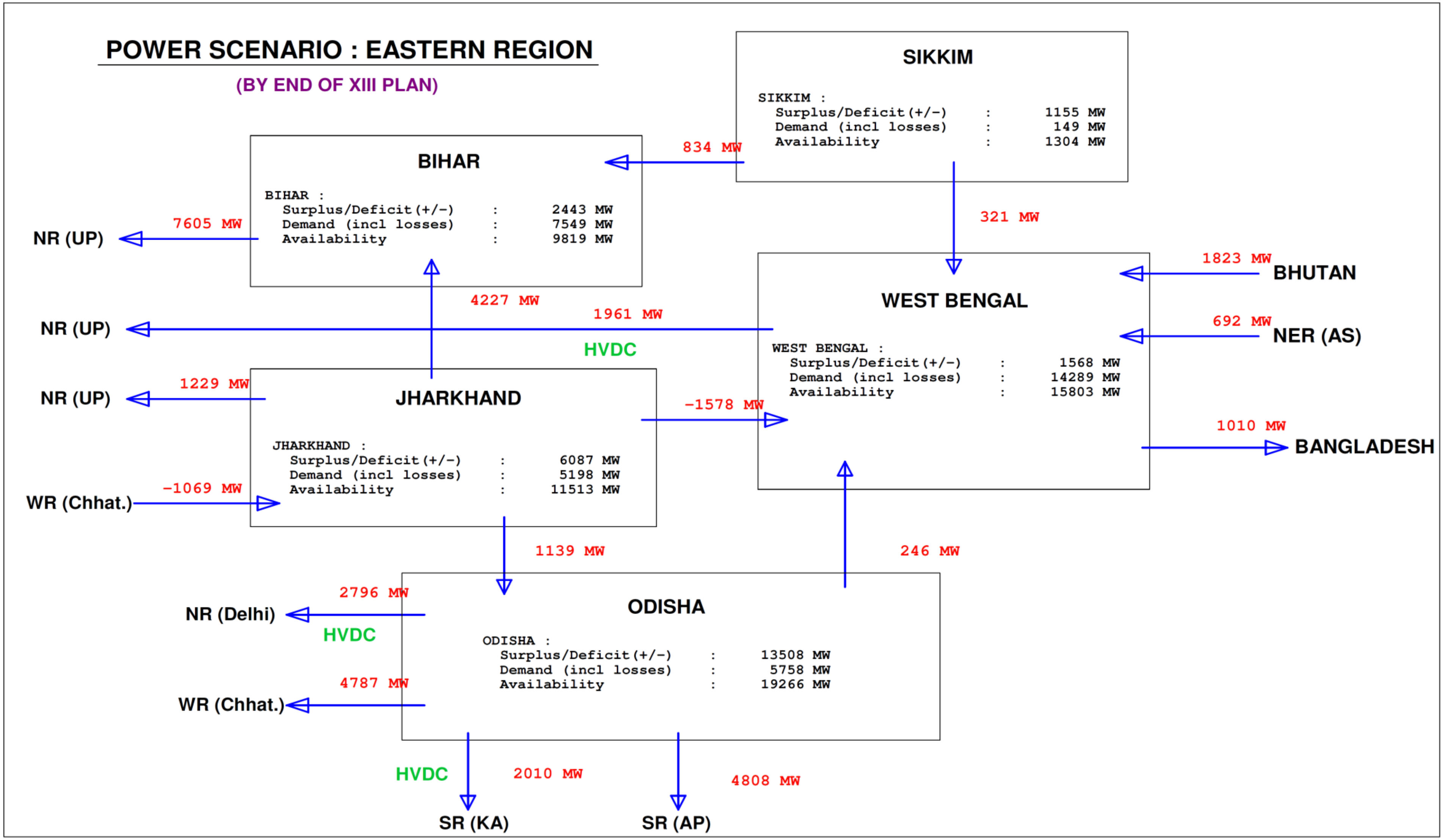


MONSOON PEAK (ER)

ANNEXURE 4.2d

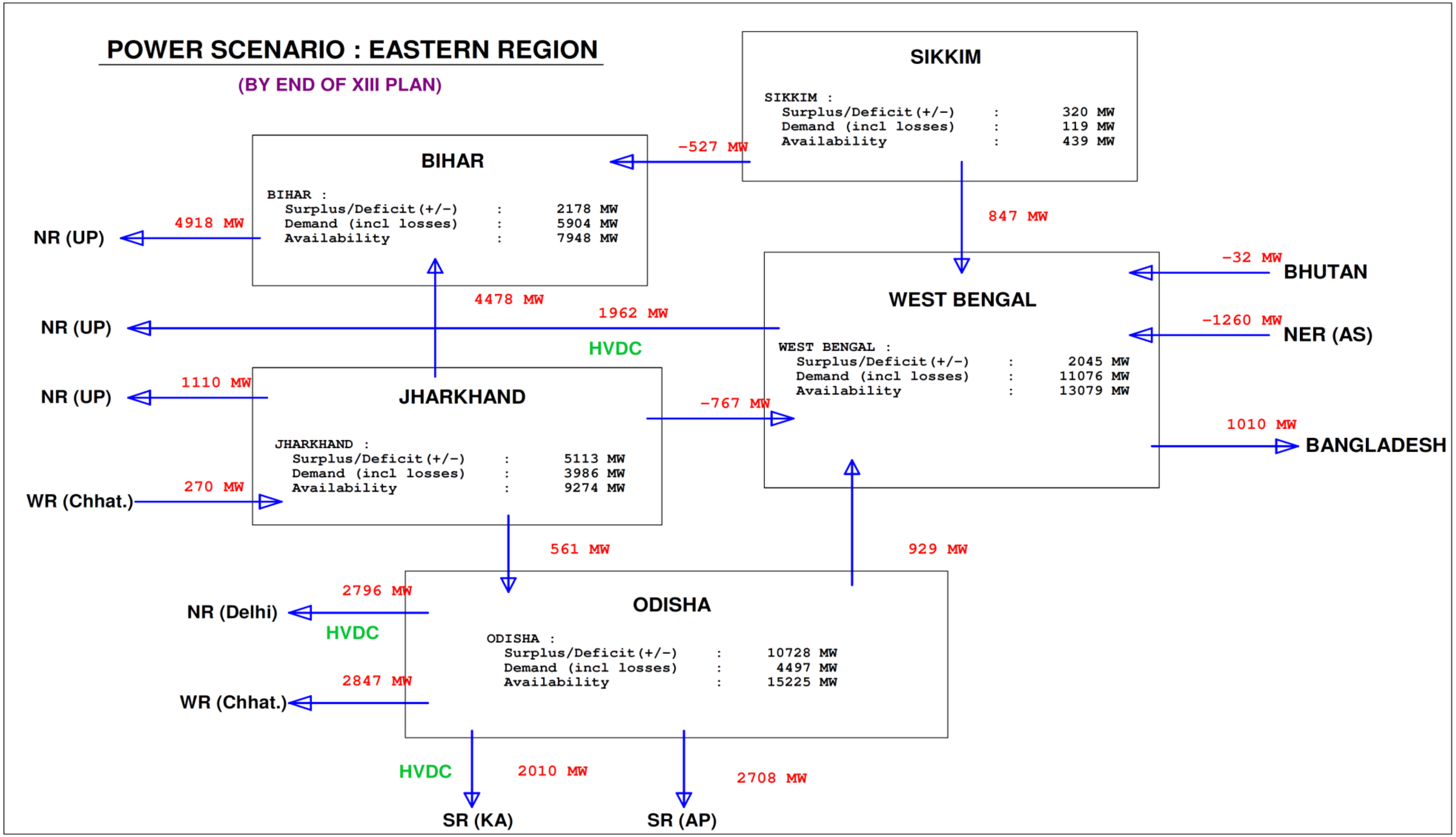


WINTER PEAK (ER) ANNEXURE 4.2d

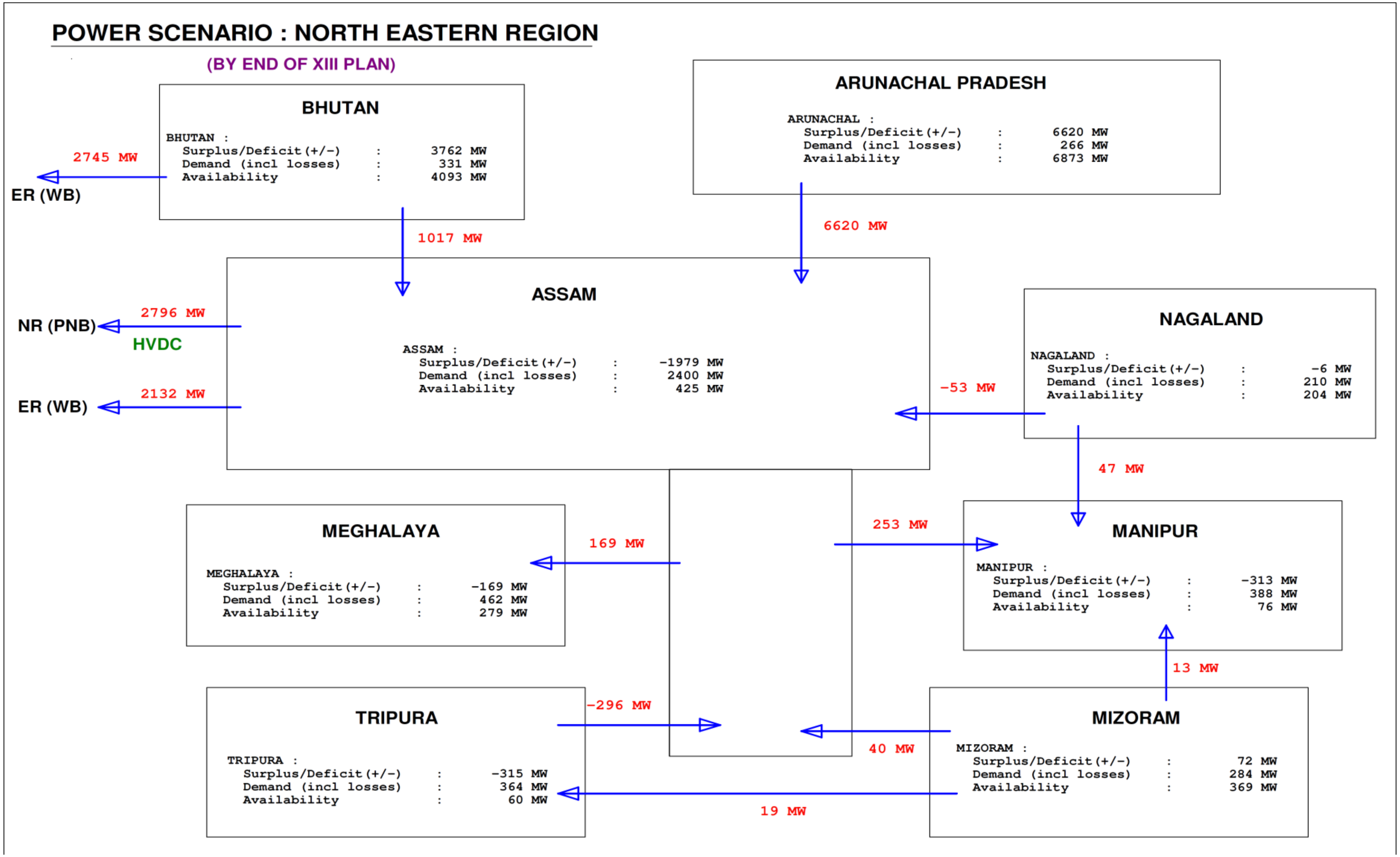


WINTER OFF-PEAK (ER)

ANNEXURE 4.2d

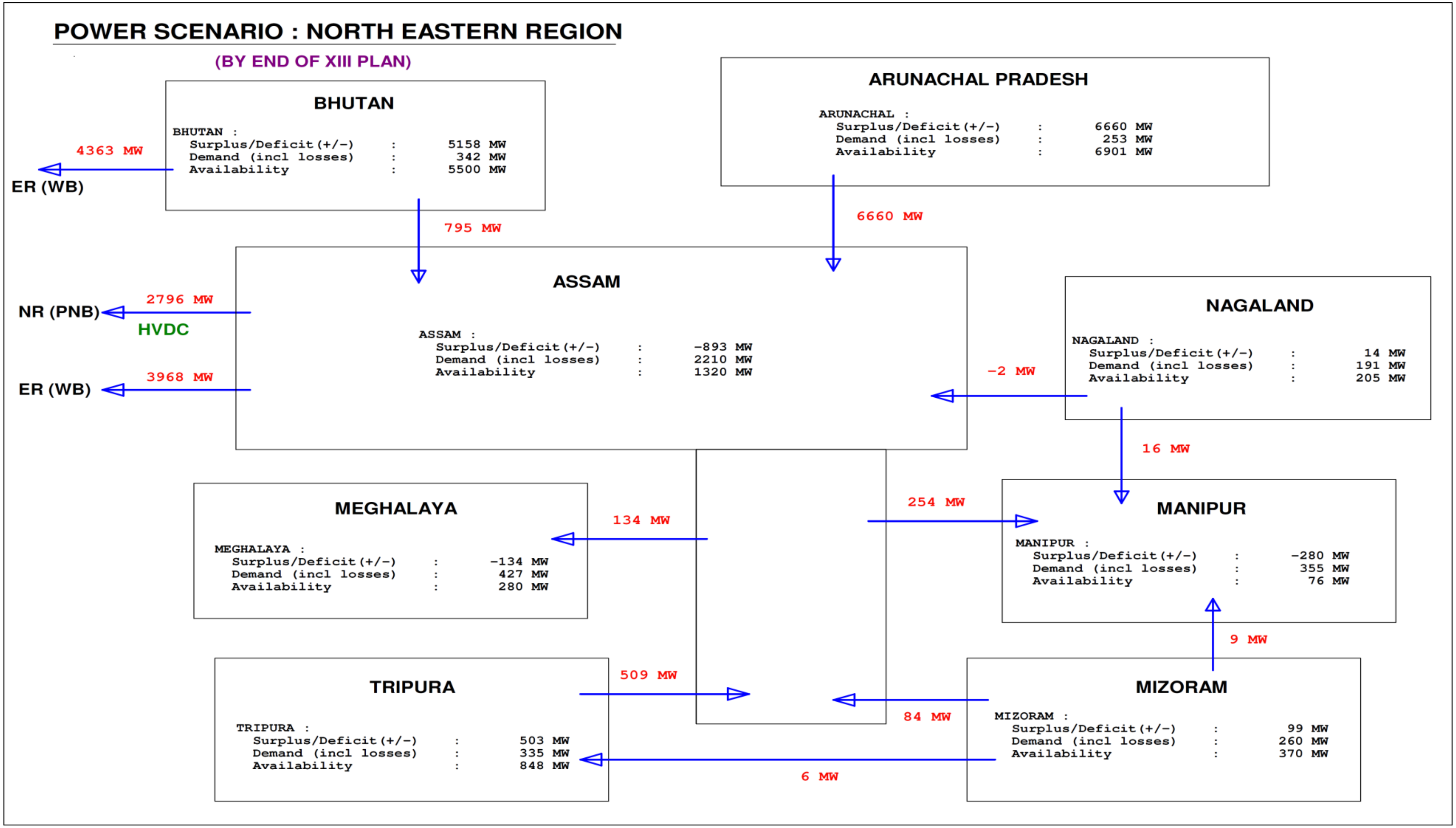


SUMMER PEAK (NER) ANNEXURE 4.2e

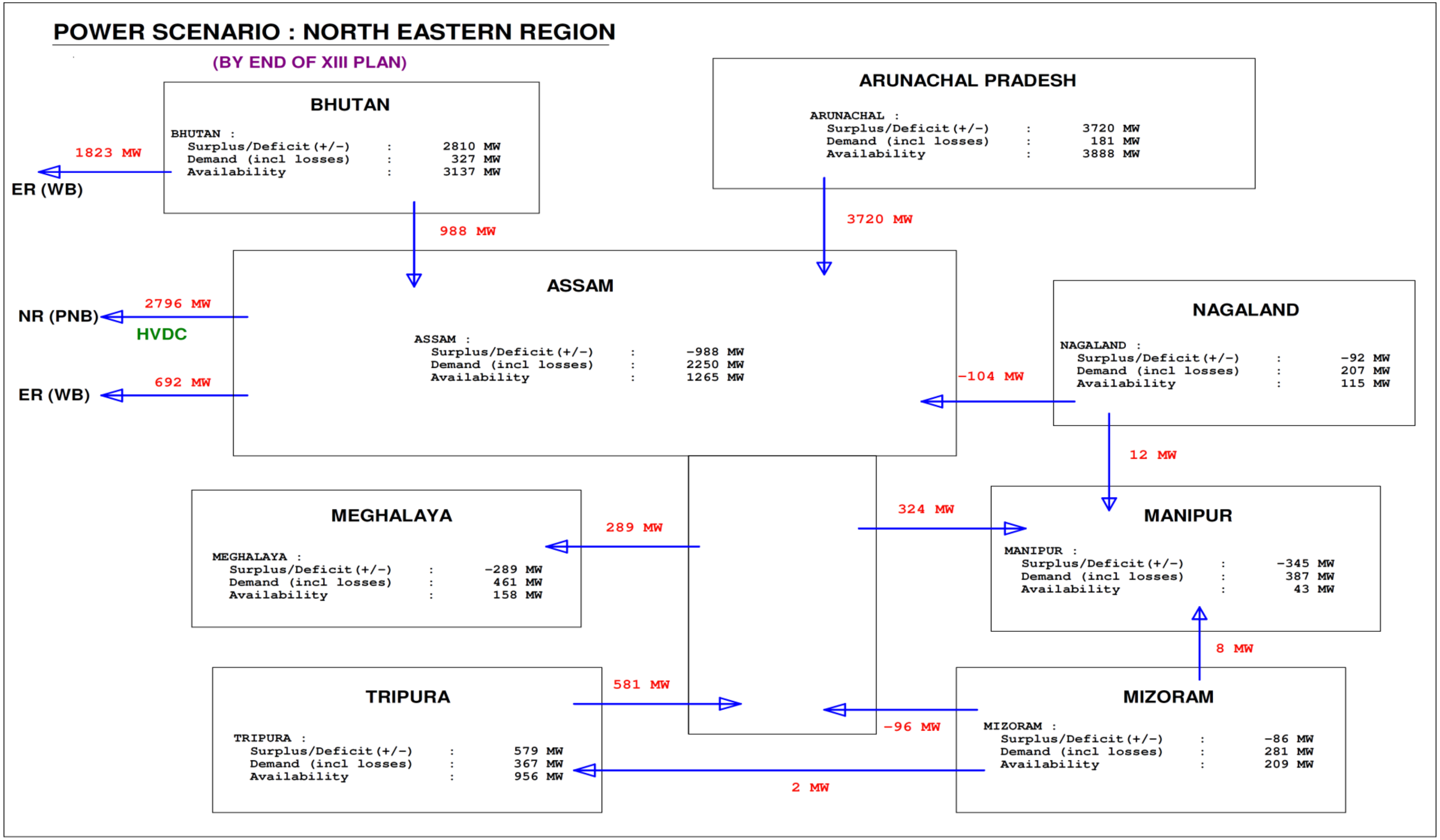


MONSOON PEAK (NER)

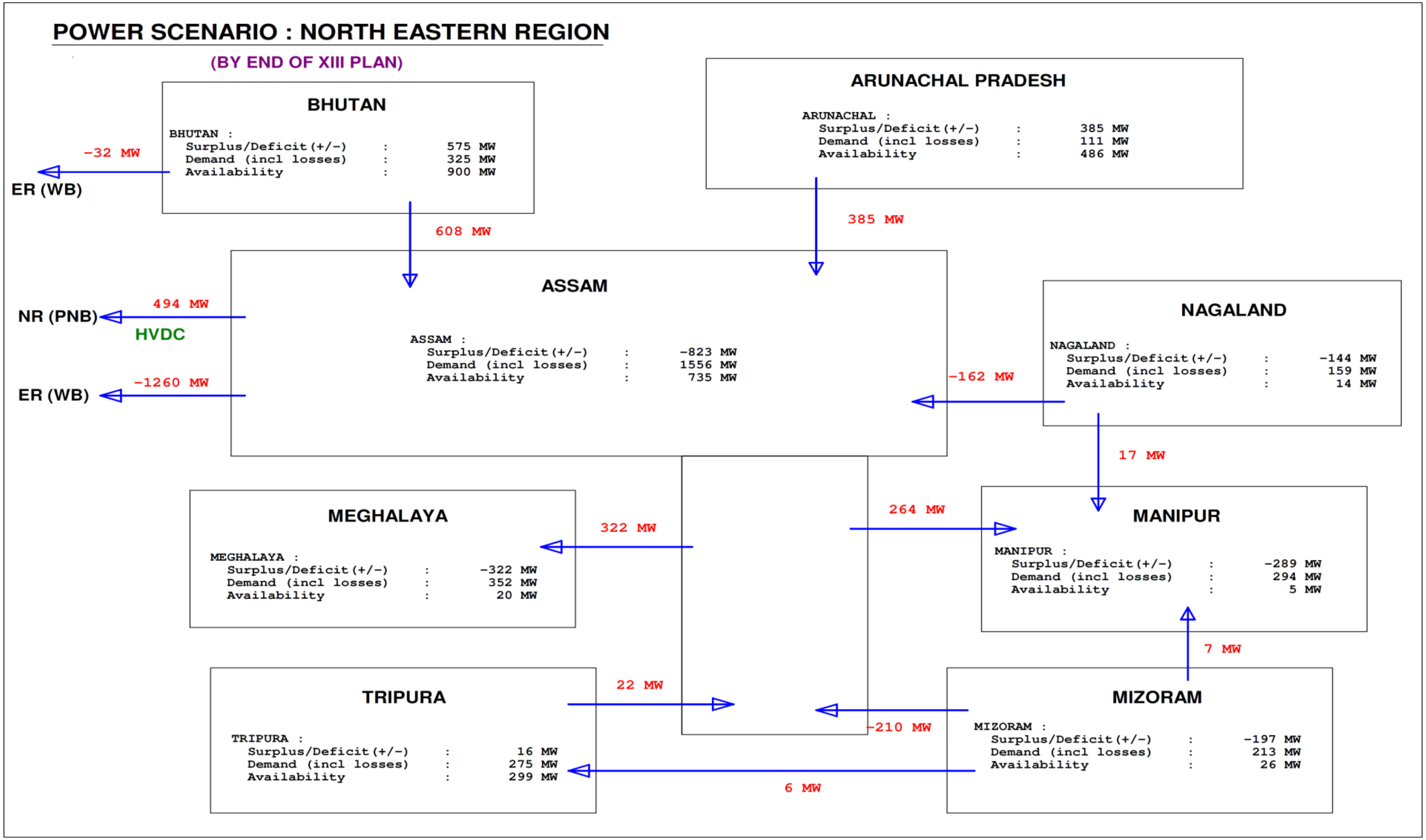
ANNEXURE 4.2e



WINTER PEAK (NER) ANNEXURE 4.2e



WINTER OFF-PEAK (NER) ANNEXURE 4.2e



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Annexure – 4.3

Transmission System for 12th and 13th Plan

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
ER - 01	**Eastern Region Strengthening Scheme-III**			
	1. Sasaram-Daltonganj 400kV D/C line	400kV	D/C	Comm.
	2. Mandhasal-Pattanaiakya 400kV D/C line	400kV	D/C	Comm.
	3. LILO of Kahalgaon-Biharsharif 400kV D/C line (1st line) at Lakhisarai	400kV	2xD/C	Comm.
	4. LILO of Kahalgaon-Biharsharif 400kV D/C line (2st line) at Banka	400kV	2xD/C	Comm.
	5. LILO of Meramundali-Jeypore 400kV S/C line at Bolangir	400kV	D/C	Comm.
	6. LILO of Rangali-Baripada 400kV S/C line at Keonjhar	400kV	D/C	Comm.
	7. LILO of one Ckt. of Baripada-Mendhasal 400kV D/C line at Dubri(OPTCL)	400kV	D/C	Comm.
	8. LILO of Jamshedpur-Rourkela 400kV D/C line at Chaibasa	400kV	D/C	Comm.
	9. Daltonganj(New)) 2x315 MVA, 400/220 kV sub-station.	400/220kV	trf	Comm.
	10. Lakhisarai(New) 2x200 MVA, 400/132 kV sub-station.	400/220kV	trf	Comm.
	11. Banka(New) 2x200 MVA, 400/132 kV sub-station.	400/220kV	trf	Comm.
	12. Bolangir(New) 2x315 MVA, 400/220 kV sub-station.	400/220kV	trf	Comm.
	13. Keonjhar(New) 2x315 MVA, 400/220 kV sub-station.	400/220kV	trf	Comm.
	14. Chaibasa(New) 2x315 MVA, 400/220 kV sub-station.	400/220kV	trf	Comm.
	15. Pattanaiakya (New) 2x315 MVA, 400 / 220 kV sub-station	400/220kV	trf	Comm.
ER - 02	**Eastern Region Strengthening Scheme-IV**			
	1. Additional 1X160MVA, 220/132kV Transformer with associated bays at 220/132kV Siliguri Substation	220/132kV	trf	Comm.
	2. Replacement of 1X50MVA, 220/132kV Transformer by 1X160MVA, 220/132kV Transformer with associated bays at 220/132kV Birpara Substation	220/132kV	trf	Comm.
	3. Installation of additional Bay/Breaker against 400kV Malda-Farakka-I feeder at Malda Substation	400kV	bay	Comm.
	4. Replacement of 2X50MVA, 220/132kV Transformers by 2X160MVA, 220/132kV Transformers with associated bays at 400/220/132kV Malda Substation	220/132kV	trf	Comm.
ER - 03	**Eastern Region Strengthening Scheme-V**			
	1. Establishment of 400/220 kV, 2X500 MVA Rajarhat substation	400/220kV	trf	UC
	2. LILO of Subhashgram- Jeerat 400kV S/C line at Rajarhat	400kV	D/C	UC
	3. Rajarhat-Purnea 400 kV D/c line (triple snowbird), with LILO of one circuit at Gokarna and other circuit at Farakka	400kV	D/C	UC
ER - 04	**Eastern Region System Strengening Scheme - VII**			
	1. Kharagpur - Chaibasa 400 kV D/c line	400kV	D/C	UC
	2. Purulia PSS - Ranchi 400 kV D/c line	400kV	D/C	UC
ER - 05	**Eastern Region System Strengening Scheme - VI**			
	1. LILO of Barh - Gorakhpur 400 kV D/c line at Motihari (2xD/c) (quad)	400kV	2xD/C	UC
	2. Mujaffarpur - Darbhanga 400 kV D/c line with triple snow bird conductor	400kV	D/C	UC
	3. 2x500 MVA 400 / 220 kV S/s at Darbhanga (GIS) with space for future extension	400/220kV	trf	UC
	4. 2x200 MVA 400 / 132 kV S/s at Motihari (GIS) with space for future extension	400/132kV	trf	UC
	5. 2x80 MVAR Line reactors (switchable) at Motihari end (with 600 ohm NGR) for Barh-Mothihari section		reactor	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	6. 2x50 MVAR Line reactors (fixed) at Mothihari end (with 400 ohm NGR) for Mothihari - Gorakhpur section		reactor	UC
ER - 06	**ATS for Barh-II U 1,2 (1320 MW)**			
	Barh-II - Gorakhpur 400kV D/c line (quad)	400kV	D/C	UC
ER - 07	**ATS for Nabi Nagar JV (Rly+NTPC) (1000MW)**			
	Nabinagar-Sasaram 400kV D/C line with twin lapwing	400kV	D/C	Comm.
ER - 08	**ATS for New Nabi Nagar JV (Bihar+NTPC) (1980MW)**			
	1. Nabinagar-Gaya 400kV D/C (Quad) line	400kV	D/C	UC
	2. Nabinagar-Patna 400kV D/C (Quad) line	400kV	D/C	UC
	3. Augumentation of Gaya 765/400kV 1x1500 MVA Transformer.	765/400kV	trf	UC
ER - 09	**ATS for Muzzafarpur ext JV (390 MW)**			
	Existing System will be adequate			Comm.
ER - 10	**Combined system for Bokaro Expansion(500 MW) & Koderma(2x500 MW)**			
	1. Bokaro Extn. - Kodarma 400kV D/C line	400kV	D/C	Comm.
	2. Kodarma - Gaya 400kV quad D/C line	400kV	D/C	Comm.
	3. Koderma- Biharsharif 400kV D/C (Quad) line	400kV	D/C	Comm.
ER - 11	**Dedicated Transmission Sysytem for [Adhunik Power(540 MW), Corporate Power (Phase-I (540 MW) & Phase II (540MW)), Essar Power (1200 MW)]**			
	Dedicated Transmission line for Adhunik Power (540 MW)			
	Adhunik TPS- Jamshedpur 400kV D/C line	400kV	D/C	Comm.
	Dedicated Transmission line for Corporate power- Phase I ((Mata Shri Usha TPP) (540MW)			
	Corporate phase-I TPS-Ranchi 400kV D/C line	400kV	D/C	UC
	Dedicated Transmission line for Corporate power- Phase II (540MW)			
	Corporate phase-II TPS-Jharkhand Pooling station 400kV D/C line	400kV	D/C	UC
	Dedicated Transmission line for Essar Power (1200 MW).			
	Essar Power - Jharkhand Pooling station 400kV Quad D/C line	400kV	D/C	UC
ER - 12	**Common Sytem Strengthening for Phase-I Generation Projects in Jharkhand[(Adhunik Power(540 MW), Corporate (540MW), Essar Power(1200 MW)]-Part-A**			
	1. Ranchi – Gaya 400 kV (Quad) line via pooling station proposed near Essar / Corporate generation project (Jharkhand Pool)	400kV	D/C	UC
	2. Ranchi New (765/400kV S/s) - Dharamjaygarh / near Korba 765kV S/c	765kV	S/C	Comm.
	3. Establishment of 400kV Pooling Station (Jharkhand Pool) near Essar and Corporate generation projects. This will be a switching station without ICTs	400kV		UC
	4. New 2x1500 MVA, 765/400 kV substation at Varanasi	765/400kV	trf	UC
	5. Gaya – Varanasi 765 kV S/c line	765kV	S/C	UC
	6. Varanasi - Balia 765 kV S/c line	765kV	S/C	UC
ER - 13	**Common System Strengthening for Phase-I Generation Projects in Jharkhand[(Adhunik Power(540 MW), Corporate (540MW), Essar Power(1200 MW)]-Part-B**			
	1. New 2x1500 MVA, 765/400 kV substation at Kanpur	765/400kV	trf	UC
	2. Varanasi – Kanpur 765 kV D/c	765kV	D/C	UC
	3. Kanpur – Jhatikra 765 kV S/c	765kV	S/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	4. Kanpur (765/400kV) - Kanpur (Existing) 400kV D/C (Quad)	400kV	D/C	UC
	5. Varanasi - Sarnath (UPPCL) 400kV D/c (quad)	400kV	D/C	UC
	6. LILO of Sasaram - Allahabad 400kV line at Varanasi	400kV	D/C	UC
	7. Private Sector line: Dharamjaygarh – Jabalpur 765kV D/C line (2nd line) would be under the scope of private sector.	765kV	D/C	UC
ER - 14	**Dedicated Transmission System for Phase-I Generation Projects in Orissa[Sterlite TPP U 1&2, 3&4 (2400 MW), Monet Power (1050 MW), GMR(1050 MW), Nav Bharat (1050 MW), Ind Barat(700 MW), Jindal (1200MW), Lanco Babandh(4x660), Derang TPP (2x600 MW)]**			
	Dedicated Transmission line for Sterlite TPP U 1&2, 3&4(2400MW)			
	Sterlite TPP - Jhasuguda 765/400kV Pooling station 2XD/c 400kV line	400kV	2xD/C	UC
	Dedicated Transmission line for Monet Power (1050 MW)			
	Monnet-Angul Pooling point 400 kV D/c line	400kV	D/C	UC
	Dedicated Transmission line for GMR(1050 MW)			
	GMR-Angul Pooling point 400 kV D/c line	400kV	D/C	UC
	Dedicated Transmission line for Nav Bharat (1050 MW)			
	Navbharat TPP - Angul Pooling point 400 kV D/C(Quad) line	400kV	D/C	UC
	Dedicated Transmission line for Ind Barat(700 MW)			
	Ind-Barath TPS-Jharsuguda 400 kV D/C line	400kV	D/C	UC
	Dedicated Transmission line for Jindal (1200MW)			
	Jindal TPP - Angul Pooling point 400 kV D/C line	400kV	D/C	Comm.
	Dedicated Transmission line for Lanco Babandh(4x660MW)			
	Lanco-Angul Pooling point 400 kV 2xD/c line	400kV	2xD/C	UC
	Derang TPP (2x600 MW) (Private Sector)			
	Derang - Angul Pooling Point 400 kV D/c line	400kV	D/C	UC
ER - 15	**ATS for Phase-I Generation Projects in Orissa[Sterlite TPP U 1&2, 3&4 (2400 MW), Monet Power (1050 MW), GMR(1050 MW), Nav Bharat (1050 MW), Ind Barat(700 MW), Jindal (1200MW), Lanco(2640MW)]-Part-A**			
	1. Angul Pooling Station – Jharsuguda Pooling Station 765kV 2xS/c	765kV	2xS/C	UC
	2. LILO of Rourkela – Raigarh 400kV D/c at Jharsuguda Pooling station	400kV	2xD/C	Comm.
	3. **LILO of Meramundali – Jeypore 400kV S/c line at Angul pooling station	400kV	D/C	Comm.
	4. **LILO of one ckt of Talcher - Meramundali 400kV D/c line at Angul pooling station	400kV	D/C	Comm.
	5. Establishment of 2x1500 MVA, 765/400kV Pooling Station at Jharsuguda	765/400kV	trf	Comm.
	6. Establishment of 4x1500MVA, 765/400kV Pooling Station at Angul	765/400kV	trf	UC
	** These LILO would be later disconencted when Angul PS is developed			
ER - 16	**ATS for Phase-I Generation Projects in Orissa[Sterlite TPP U 1&2, 3&4 (2400 MW), Monet Power (1050 MW), GMR(1050 MW), Nav Bharat (1050 MW), Ind Barat(700 MW), Jindal (1200MW), Lanco(2640MW)]-Part-B**			
	1. Establishment of 765kV switching station at Dharamjaygarh / near Korba	765kV		Comm.
	2. Establishment of 765/400kV Pooling Station at Jabalpur	765/400kV	trf	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	3. Jharsuguda Pooling Station – Dharamjaygarh / near Korba (WR) 765kV D/c	765kV	D/C	Comm.
	4. LILO of Ranchi – WR Pooling near Sipat 765kV S/c line at Dharamjaygarh / near Korba	765kV	D/C	Comm.
	5. Dharamjaygarh / near Korba – Jabalpur Pooling Station 765kV D/c line	765kV	D/C	UC
	6. Jabalpur Pooling Station – Jabalpur 400 kV D/c Quad line	400kV	D/C	Comm.
ER - 17	**ATS for Phase-I Generation Projects in Orissa[Sterlite TPP U 1&2, 3&4 (2400 MW), Monet Power (1050 MW), GMR(1050 MW), Nav Bharat (1050 MW), Ind Barat(700 MW), Jindal (1200MW), Lanco(2640MW)]-Part-C**			
	1. Jabalpur Pooling Station – Bina 765kV D/c line	765kV	D/C	Comm.
	2. Bina – Gwalior 765kV S/c (3rd circuit)	765kV	S/C	Comm.
	3. Gwalior - Jaipur 765kV S/c line (2nd circuit)	765kV	S/C	UC
	4. Jaipur - Bhiwani 765kV S/c line	765kV	S/C	UC
ER - 18	**ATS for Phase-I Generation Projects in Orissa[Sterlite TPP U 1&2, 3&4 (2400 MW), Monet Power (1050 MW), GMR(1050 MW), Nav Bharat (1050 MW), Ind Barat(700 MW), Jindal (1200MW), Lanco(2640MW)]-Part-D**			
	1. Establishment of 2x1500MVA, 765/400kV Bhopal Pooling Station	765/400kV	trf	UC
	2. Jabalpur Pool – Bhopal – Indore 765kV S/c	765kV	S/C	UC
	3. Bhopal New substation – Bhopal (M.P.) 400kV D/c (high capacity)	400kV	D/C	UC
ER - 19	**Dedicated Transmission System for Phase-I Generation Projects in Sikkim[Teesta – III HEP(1200MW), Teesta-VI(500 MW), Rangit-IV (120 MW), Chujachen (99MW), Bhasmey (51 MW), Jorethang Loop(96 MW), Rongnichu(96 MW)]**			
	Dedicated Transmission line for Teesta – III HEP(1200MW)			
	Teesta-III – Kishanganj 400kV D/c line with Quad Moose conductor	400kV	D/C	UC
	Dedicated Transmission line for Teesta-VI(500 MW)			
	Teesta-VI-Rangpo 220kV D/C(twin moose)	220kV	D/C	Comm.
	Dedicated Transmission line for Rangit-IV (120 MW)			
	Rangit-IV-New Melli 220kV D/C line	220kV	D/C	Comm.
	Dedicated Transmission line for Chujachen HEP (99MW) (Gati)			
	LILO of Melli - Gangtok at Chujachen D/c (LILO point at Namthang)	132kV	D/C	Comm.
	Dedicated Transmission line for Bhasmey (51 MW)			
	LILO of one ckt. Chujachan-Rangpo 132kV D/c at Bhasmey	132kV	D/C	Comm.
	Dedicated Transmission line for Jorethang Loop(96 MW)			
	Jorrethang-New Melli 220kV D/Cline	220kV	D/C	UC
	Dedicated Transmission line for Rongnichu(96 MW)			
	Rongnichu-Rangpo 220 kV D/c line	220kV	D/C	UC
ER - 20	**ATS for Phase-I Generation Projects in Sikkim[Teesta – III HEP(1200MW), Teesta-VI(500 MW), Rangit-IV (120 MW), Chujachen (99MW), Bhasmey (51 MW), Jorethang Loop(96 MW), Rongnichu(96 MW)]-Part-A**			
	1. Establishment of New 2x315 MVA, 400kV sub-station at Kishenganj	400/220kV	trf	Comm.
	2. LILO of Siliguri (Existing) – Purnea 400kV D/c line(quad) at new pooling station at Kishenganj	400kV	2xD/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	3. LILO of Siliguri – Dalkhola 220kV D/c line at new pooling station at Karandighi	220kV	2xD/C	UC
ER - 21	**ATS for Phase-I Generation Projects in Sikkim[Teesta – III HEP(1200MW), Teesta-VI(500 MW), Rangit-IV (120 MW), Chujachen (99MW), Bhasmey (51 MW), Jorethang Loop(96 MW), Rongnichu(96 MW)]-Part-B**			
	1(a). Establishment of 16x105MVA, 1 ph, 400/220kV and 3x100MVA 220/132kV, Gas Insulated Substation at Rangpo	400/220kV	trf	Comm.
	1(b). Establishment of 3x100MVA 220/132kV trf at Rangpo GIS	220/132kV	trf	UC
	2. Establishment of 220kV Switching station at New Melli	220kV		UC
	3. LILO of Teesta III – Kishenganj 400kV Quad D/c line (to be constructed through JV route) at Rangpo	400kV	D/C	UC
	4. New Melli - Rangpo 220kV D/c line (with twin Moose conductor)	220kV	D/C	UC
	5. LILO of Gangtok-Rangit 132kV S/c line at Rangpo and termination of Gangtok-Rangpo/Chujachen and Melli–Rangpo/Chujachen 132kV lines (constructed under part-A through LILO of Gangtok-Melli 132kV S/c line up to Rangpo) at Rangpo sub-station	132kV	D/C	UC
	6. LILO of Existing Teesta V – Siliguri 400kV D/c line at Rangpo	400kV	2xD/C	Comm.
	7. Kishenganj- Patna (PG) 400kV D/c (quad) line	400kV	D/C	UC
ER - 22	**ATS for Raghunathpur (1200MW)**			
	1.LILO of one ckt of Maithon(PG)-Ranchi 400kV line at Ragunathpu(400kV D/C Lilo line)	400kV	D/C	UC
	2. Raghunathpur-Ranchi 400kV quad D/C line	400kV	D/C	UC
ER - 23	**Common Transmission System for import of power from DVC by NR**			
	1. Maithon - Gaya 400kV quad D/C line	400kV	D/C	Comm.
	2. Gaya - Sasaram 765kV S/C line	765kV	S/C	Comm.
	3. Gaya-Balia 765kV S/C	765kV	S/C	Comm.
	4. Balia-Lucknow 765kV S/C	765kV	S/C	Comm.
	5. LILO of both circuits of Allahabad - Mainpuri 400kV D/C line at Fatehpur 765/400kV sub-station of POWERGRID	400kV	2xD/C	Comm.
	6. Ranchi-WR Pooling 765kV S/C	765kV	S/C	Comm.
	7. Sasaram-Fatehpur(PG 765kV s/s) 765kV S/C line	765kV	S/C	Comm.
	8. Fatehpur(PG 765kV s/s) - Agra 765kV S/C line	765kV	S/C	Comm.
	9. Biharsharif – Sasaram(PG 765kV s/s) 400kV quad D/C line	400kV	D/C	Comm.
	10. 40% Series compensation of Barh-Balia 400kV quad D/C line at Balia end	400kV		Comm.
	11. 40% Series compensation of Biharsharif-Balia 400kV quad D/C line at Biharsharif	400kV		Comm.
	12. Lucknow 765/400kV new sub-station – Lucknow 400/220kV existing sub-station 400 kV quad 2xD/c line	400kV	2xD/C	Comm.
	13. Bareilly 765/400kV new sub-station – Bareilly 400/220kV existing sub-station 400 kV quad 2xD/c line (to match with NKSTPP System)	400kV	2xD/C	Comm.
	14. Ranchi new sub-station – Ranchi 400/220kV existing sub-station 400 kV quad 2xD/c	400kV	2xD/C	Comm.
	15. LILO of both circuits of Barh - Balia 400kV D/C quad line at Patna	400kV	2xD/C	Comm.
	16 Establishment of Gaya 765/400kV Substation with	765/400kV	trf	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	3X1500 MVA transformers			
	17 Establishment of Sasaram 765/400kV Substation with 2X1500 MVA transformers	765/400kV	trf	Comm.
	18 Establishment of Ranchi 765/400kV Substation with 2X1500 MVA transformers	765/400kV	trf	Comm.
	19 Establishment of Fathepur 765/400kV Substation with 2X1500 MVA transformers	765/400kV	trf	Comm.
	20 Establishment of Agra 765/400kV Substation with 2X1500 MVA transformers	765/400kV	trf	Comm.
	21 Establishment of Balia 765/400kV Substation with 2X1500 MVA transformers	765/400kV	trf	Comm.
	22 Establishment of Lucknow 765/400kV Substation with 2X1500 MVA transformers	765/400kV	trf	Comm.
ER - 24	**Transmission system for Pooling Station in ER and transfer of power to NR/WR from projects in Bhutan**			
	1. New 2x315MVA, 400/220kV AC Pooling Station at Alipurduar	400/220kV	trf	UC
	2. Extension of ±800 kV HVDC station with 3000 MW inverter module at Agra			UC
	3. LILO of Bishwanath Chariyali – Agra HVDC line at new pooling station in Alipurduar for parallel operation of the HVDC station	±800kV	HVDC	UC
	4. LILO of Bongaigaon – Siliguri 400kV D/c line(quad) (under Pvt. Sector) at new pooling station in Alipurduar	400kV	D/C	UC
	6. LILO of Birpara-Salakati 220kV D/c line at new pooling station in Alipurduar	220kV	D/C	UC
	7. Earth Electrode line at Agra HVDC Terminal			UC
	8. Earth Electrode line at new pooling station at Alipurduar			UC
	9. HVDC sub-station with ± 800 kV, 3000MW converter module at new pooling station at Alipurduar.	±800kV	HVDC	UC
ER - 25	**ATS for CESC Haldia (600 MW) (Private Sector)**			
	CESC Haldia-Subhasgram 400 kV D/C line	400kV	D/C	UC
ER - 26	**ATS for Durgapur DPL New (U-8) (250 MW)**			
	DPL - Bidhannagar 400 kV D/c line	400kV	D/C	UC
ER - 27	**System Strengthening Scheme in West Bengal**			
	1. LILO of Kolaghat-Baripada 400kV S/C line at Kharagpur	400kV	D/C	Comm.
	2. Chanditala - Kharagpur 400 kV D/c line	400kV	D/C	UC
ER - 28	**Eastern Region System Strengening Scheme - VIII**			
	1. 2x125 MVAR bus reactor at Muzaffarpur (one 125MVAR reactor would be installed by replacing the existing 63MVAR bus reactor at Muzaffarpur, which shall be used as spare)	400kV	reactor	Comm.
	2. 1x125 MVAR bus reactor at Rourkela	400kV	reactor	Comm.
	3. 1x125 MVAR bus reactor at Indravati	400kV	reactor	Comm.
	4. Replacement of existing 1x63MVAR bus reactor with 1x125 MVAR bus reactor at Jeypore (63 MVAR reactor thus released shall be used as spare reactor)	400kV	reactor	Comm.
	5.Shifting of 2x50 MVAR line reactor from Patna end of 400kV Kahalgaon/Barh – Patna D/c line to Balia end of 400kV Patna-Balia D/c line.	400kV	reactor	Comm.
	6. Addition of 1x500 MVA, 400/220kV ICT with associated bays at Subhashgram along with 2 nos. of 220kV equipped line bays	400/220kV	trf	Comm.
ER - 29	**Spare ICT /Reactors in ER**			
	1. 1x315 MVA spare ICT at Biharshariff (Bihar)	400/220kV	trf	UC
	2. 1x315 MVA spare ICT at Durgapur(WB)	400/220kV	trf	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	3. 1x315 MVA spare ICT at Jamshedpur(Jharkhand)	400/220kV	trf	UC
	4. 1x315 MVA spare ICT at Rourkela(Orissa)	400/220kV	trf	UC
	5. 1x160 MVA Spare ICT at Baripada 02	220/132kV	trf	UC
	6 1x160 MVA Spare ICT at Siliguri	220/132kV	trf	UC
	7. 1x50 MVA Spare ICT at Gangtok (Sikkim)	132/66kV	trf	UC
	8. 1x80 MVAR Bus Reactor at Rourkela	400kV	reactor	UC
ER - 30	**Eastern Region System Strengening Scheme - IX**	400kV	reactor	
	1. Installation of 1X125 MVAR Bus Reactor at Gazuwaka 400 kV (East) bus.	400kV	reactor	UC
	2. Installation of 2X125 MVAR Bus Reactor at Rengali.	400kV	reactor	UC
	3. Installation of 1X125 MVAR Bus Reactor at Maithon.	400kV	reactor	UC
	4. Installation of 1X125 MVAR Bus Reactor in parallel with existing 50 MVAR (3X16.67) Bus Reactor at Biharsharif, using existing Reactor bay.	400kV	reactor	UC
	5. Installation of 2X125 MVAR Bus Reactor in parallel with existing 2X50 MVAR Bus Reactor at Jamshedpur.	400kV	reactor	UC
	6. Installation of 1X125 MVAR Bus Reactor in parallel with existing 1X50 MVAR Bus Reactor at Rourkela.	400kV	reactor	UC
	7. Installation of 2X125 MVAR Bus Reactor at Durgapur (Parulia). Out of 2X125 MVAR Bus Reactor, 1X125 MVAR Bus Reactor would be in parallel with existing 1X50 MVAR Bus Reactor, using existing Reactor bay.	400kV	reactor	UC
	8. Addition of 1X500 MVA, 400/220 kV ICT along with associated bays at Muzaffarpur 400/220 kV Substation	400/220kV	trf	UC
	9. Addition of 1X160 MVA, 220/132 kV ICT along with associated bays at Ara 220/132 kV Substation.	220/132kV	trf	UC
	10. Replacement of 2X315 MVA, 400/220 kV ICTs with 2X500 MVA, 400/220 kV ICTs at Maithon	400/220kV	trf	UC
	10. Procurement of one 500 MVA, Single Phase unit of 765/400 kV ICT for Eastern Region to be stationed at Gaya sub-station	765/400kV	trf	UC
	11. Converting 2X80 MVAR Line Reactors at Gorakhpur end of Barh-II – Gorakhpur 400 kV Quad D/c line to 2X80 MVAR (Switchable) Line Reactors	400kV	reactor	UC
ER - 31	**Eastern Region System Strengening Scheme - X**			
	Sagardighi TPS (West Bengal) – Berhampur (POWERGRID) 400kV D/c Line with high capacity HTLS conductor	400kV	D/C	UC
ER - 32	**Eastern Region System Strengening Scheme - XII**			
	1. Installation of 1X125 MVAR Bus Reactor at Baripada with GIS bay.	400kV	Reactor	UC
	2. Installation of 1X125 MVAR Bus Reactor at Maithon with GIS bay	400kV	Reactor	UC
	3. Replacement of 2X315 MVA, 400/220 kV ICTs with 2X500 MVA, 400/220 kV ICTs at Purnea #	400/220kV	trf	UC
	4. Replacement of 2X315 MVA, 400/220 kV ICTs with 2X500 MVA, 400/220 kV ICTs at Patna #	400/220kV	trf	UC
	5. Replacement of 2X315 MVA, 400/220 kV ICTs with 2X500 MVA, 400/220 kV ICTs at Pusauli #	400/220kV	trf	UC
	6. Shifting of 1X315 MVA, 400/220 kV ICT from any suitable location (after replacement by 1x500MVA ICT) and install it at Jamshedpur 400/220 kV Substation as 3rd ICT along with associated bays.	400/220kV	Replace ment	UC
	7. Procurement of two 500 MVA, Single Phase unit of 765/400 kV ICT for Eastern Region to be stationed at Angul and Jharsuguda sub-station	765/400kV	trf	UC
	8. Spare 1 unit of 765kV, 110 MVAR Single Phase Reactor	765kV	Reactor	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	to be stationed at Sasaram			
	9. Modification of 132kV bus arrangement at 220/132kV Siliguri Substation with GIS	132kV		UC
	# Out of the 6 nos. 315 MVA ICTs released from Purnea, Patna & Pusauli substations, one each would be kept as spare at Patna and Pusauli substation, one each would be diverted to Jamshedpur and Farakka substation and remaining 2x315 MVA, 400/220kV ICTs would be utilized as Regional Spare			UC
ER - 33	**Eastern Region System Strengening Scheme - XIII**			
	1. Reconductoring of Farakka-Malda 400kV D/c with high capacity HTLS conductor	400kV	D/C	UC
ER - 34	**Transmission System assocoiated with Darlipalli TPS**			
	1. Darlipalli TPS – Jharsuguda P.S. 765kV D/c line	765kV	D/C	Planned
ER - 35	**Interconnection Link between India and Bangladesh (India portion)**			
	LILO of Farakka-Jeerat 400kV S/c line at Behrampur Switching station	400kV	D/C	Comm.
	Establishment of Behrampur Switching Station	400/220kV	sw	Comm.
	Behrampur-Bheramara 400kV D/c line (Indian Portion)	400kV	D/C	Comm.
ER - 36	**Interconnection Link between India and Nepal (India portion)**			
	400 kV Muzaffarpur (India) - Dhalkebar (Nepal) D/c lnik [Indian portion - 87 km by CPTC (JV); Nepal Portion - 39 km]	400kV	D/C	UC
ER - 37	**ATS for Phunatsangchu St-I (1200 MW)**			
	1. Punatsangchu I - Lhamoizingkha (Bhutan Border) 400 kV 2xD/c line	400kV	2xD/C	UC
	2. Lhamoizingkha (Bhutan Border) – Alipurduar 400kV D/C with Quad Moose Conductor	400kV	D/C	UC
	3. LILO of 220 kV Bosochhu-II-Tsirang S/c line at Punatsangchu-I	220kV	D/C	UC
	4. 3x105 MVA ICT at Punatsangchu		trf	UC
	5. 1x80 MVAR Bus reactor at Punatsangchu		reactor	UC
ER - 38	**ATS for Phunatsangchu St-II (990 MW)**			
	1. LILO of Punatsangchu I - Lhamoizingkha (Bhutan Border) 400 kV D/c line at Punatsangchu-II	400kV	D/C	Planned
ER - 39	**Indian Grid Strengthening for import of Bhutan surplus**			
	1. New 2x315 MVA ,400/220kV AC & HVDC S/S with ±800kV, 3000MW converter module at Alipurduar.	400/220kV	trf	UC
	2. Extension of ±800 kV HVDC station with 3000 MW inverter module at Agra	±800kV	HVDC	UC
	3. LILO of ±800kV,6000MW Bishwanath Chariyali – Agra HVDC Bi-pole line at Alipurduar for parallel operation HVDC terminal with 400/220kV at Alipurduar	±800kV	HVDC	UC
	4. LILO of Bongaigaon – Siliguri 400kV D/C Quad Moose line at Alipurduar	400kV	2xD/C	UC
	5. Lhamoizingha/Sunkosh –Alipurduar 400kV D/C (1st) Quad moose line (Indian portion)	400kV	2xD/C	UC
	7. LILO of Birpara-Salakati 220kV D/C line at Alipurduar	220kV	D/C	UC
	8. Earth electrode line at Alipurduar HVDC terminal			UC
	9. Earth electrode line at Agra HVDC terminal			UC
ER - 40	**Indian Grid Strengthening for import of Bhutan surplus**			
	Jigmeling (Bhutan) - Alipurduar 400kV D/c (Quad/HTLS)	400kV	D/c	Planned
	Alipurduar – Siliguri 400kV D/c line with Quad moose conductor	400kV	D/c	Planned
	Kishanganj – Darbhanga 400kV D/c line with Quad moose	400kV	D/c	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	conductor			
ER - 41	**Dynamic Reactive Compenstion in Eastern Region - XI**			
	1. At Rourkela. 2x125 MVAR MSR & +/- 300 MVAR STATCOM	400kV	statcom	Planned
	2. At Ranchi. 2x125 MVAR MSR & +/- 300 MVAR STATCOM	400kV	statcom	Planned
	3. At Kishanganj. 2x125 MVAR MSR & +/- 300 MVAR STATCOM	400kV	statcom	Planned
	4. At Jeypore. 2x125 MVAR MSR, 1x125 MVAR MSC & +/- 300 MVAR STATCOM	400kV	statcom	Planned
ER - 42	**Additional Reactive Compensation in Eastern Region: Addition of additional 1x125MVAr Bus reactors at Banka, Bolangir, Baripada, Keonjhar, Durgapur, Chaibasa and Lakhisarai (ERSS-XIV)**	**400kV**	**reactor**	
	Installation of 3rd 400/220 kV ICT (500 MVA) at Kishanganj	400/220kV	trf	Planned
ER - 43	**Transformer Augmentation/Replacements in Eastern Region**			
	Augmentation of Transformation capacity at 400/220kV Baripada S/S (PG): Addition of 1x500MVA Transformer	400/220kV	trf	UC
	Replacement of 1X100 MVA 220/132kV, 3rd ICT with 1X160 MVA, 220/132 kV ICT at Purnea 220/132 kV sub-station	220/132kV	trf	UC
	Replacement of existing 100 MVA, 220/132kV ICTs with 1X160 MVA, 220/132 kV ICT at Siliguri 220/132 kV sub-station	220/132kV	trf	UC
	Replacement of existing 100 MVA, 220/132kV ICTs with 1X160 MVA, 220/132 kV ICT at Birpara 220/132 kV sub-station	220/132kV	trf	UC
ER - 44	**765kV strengthening system in Eastern Region**			
	1. Establishment of 765/400 kV new substations at Banka (New), Gokarna(New), Medinipur, Jeerat (New) and Jajpur Road.	765/400kV	trf	Planned
	2. Angul – Jajpur Road 765kV D/c line	765kV	D/C	Planned
	3. Jajpur Road – Medinipur 765kV D/c line	765kV	D/C	Planned
	4. Ranchi (New) – Medinipur 765kV D/c line	765kV	D/C	Planned
	5. Medinipur – Jeerat (New) 765kV D/c line	765kV	D/C	Planned
	6. Jeerat (New) – Gokarna (New) 765kV D/c line	765kV	D/C	Planned
	7. Gokarna(New) – Banka(New) 765kV D/c line	765kV	D/C	Planned
	8. Gaya – Banka (New) 765kV D/c line	765kV	D/C	Planned
	9. Gaya – Ranchi (New) 765kV D/c line	765kV	D/C	Planned
	10. Jajpur Road – Duburi 400kV D/c line (quad/HTLS)	400kV	D/C	Planned
	11. Medinipur – Haldia New (NIZ) (WBSETCL) 400kV D/c line (quad/HTLS)	400kV	D/C	Planned
	12. LILO of Chandithala – Kharagpur 400kV D/c line at Medinipur	400kV	D/C	Planned
	13. Jeerat (New) – Subhasgram 400kV D/c line(quad/HTLS)	400kV	D/C	Planned
	14. Jeerat (New) – Jeerat 400kV D/c line (quad/HTLS)	400kV	D/C	Planned
	15. LILO of Sagardighi – Subhasgram 400kV S/c line at Rajarhat	400kV	S/C	Planned
	16. LILO of Sagardighi – Rajarhat 400kV S/cline at Jeerat	400kV	S/C	Planned
	17. Gokarna (New) – Gokarna 400kV D/c line (quad/HTLS)	400kV	D/C	Planned
	18. Gokarna (New) – Durgapur (PG) 400kV D/c line (quad/HTLS)	400kV	D/C	Planned
	19. Banka (New) – Banka 400kV D/c line (quad/HTLS)	400kV	D/C	Planned
ER - 45	**ATS for Tillaiyya UMPP (4000MW)**			

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. Tilaiyya UMPP - Balia 765 kV S/C line	765kV	S/C	Planned
	2. Tilaiyya UMPP - Gaya 765 kV D/C line	765kV	D/C	Planned
	3. LILO of one Ckt.of Tilaiyya UMPP - Balia 765 kV D/C line at Gaya	765kV	D/C	Planned
ER - 46	**ATS for Odisha UMPP Project (Immediate Evacuation System and Associated Strengthening in ER)**			
	1 Odisha UMPP – Sundergarh (Jharsuguda) 765kV 2xD/c line	765kV	2xD/c	Planned
	2 Odisha UMPP – Lapanga 400kV D/c line (quad/HTLS)	400kV	D/c	Planned
	3 Odisha UMPP – Kesinga 400kV D/c line (quad/HTLS)	400kV	D/c	Planned
	Associated System Strengthening: ± 800kV, 6000MW HVDC bipole line from Angul to Badarpur (NR)	±800kV	HVDC	New
ER - 47	**Dedicated Transmission System for Phase-II Generation Projects in Sikkim[Dikchu(96 MW), Panan(300 MW), Ting Ting(99 MW), Tashiding(97 MW)]**			
	Dedicated Transmission line for Dikchu(96 MW)			
	1. Dikchu HEP - Gangtok 132 kV D/c with Zebra conductor	132kV	D/C	Planned
	2. Dikchu HEP - Mangan (PG) 132 kV D/c line with Zebra conductor	132kV	D/C	Planned
	Dedicated Transmission line for Panan(300 MW)			
	Panan-Mangan 400kV D/C line	400kV	D/C	Planned
	Dedicated Transmission line for Ting Ting(99 MW)			
	Tingting- Tashiding PS 220kV D/C line	220kV	D/C	Planned
	Dedicated Transmission line for Tashiding(97 MW)			
	Tashiding- Tashiding PS 220kV D/C line	220kV	D/C	Planned
ER - 48	**ATS for Phase-II Generation Projects in Sikkim[Dikchu(96 MW), Panan(300 MW), Ting Ting(99 MW), Tashiding(97 MW)]-Part-A**			
	1. Establishment of 4x105MVA, Single Phase, 400/132kV pooling station at Mangan.	400/132kV	trf	Planned
	2. LILO of Teesta-III – Kishenganj 400kV D/c line at Mangan	400kV	2xD/C	Planned
	3. Mangan – Kishenganj 400kV D/c line with quad moose conductor	400kV	D/C	Planned
	4. New Melli – Rangpo 220kV D/c with twin moose conductor (2nd line)	220kV	D/C	Planned
ER - 49	**ATS for Phase-II Generation Projects in Sikkim[Dikchu(96 MW), Panan(300 MW), Ting Ting(99 MW), Tashiding(97 MW)]-Part-B**			
	1. Establishment of 220kV Gas Insulated Pooling/Switching Station at Legship	220kV	sw	Planned
	2. Legship Pooling station – New Melli 220kV D/c with twin moose conductor	220kV	D/C	Planned
ER - 50	**Reconductoring of Overloaded Lines in Eastern Region**			
	1. Jeypore - Jaynagar 220kV D/c line	220kV	D/C	New
	2. Maithon RB - Maithon 400kV D/c line	400kV	D/C	New
	3. Maithon - Raghunathpur 400kV S/c line (LILOed portion)	400kV	S/C	New
ER - 51	**ATS for JAS Infra (4x660 MW)**			
	JAS - Banka New 400kV 2xD/c	400kV	2xD/C	New
ER - 52	**ATS for Katwa TPS (2x660 MW)**			
	Katwa TPS - Katwa New 400kV D/c Quad	400kV	D/C	New
ER - 53	**ATS for Turga PSS (2x500 MW)**			
	Turga PSS - Purulia New 400kV D/c Quad	400kV	D/C	New
ER - 54	**Transmission System for Phase-II IPPs in Odisha**			

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	NSL Nagapatnam - Angul 400 kV D/c (Triple snowbird)	400kV	D/C	Planned
	OPGC – Jharsuguda 400 kV D/c (Triple Snowbird)	400kV	D/C	Planned
	Jharsuguda – Raipur Pool 765 kV D/c line	765kV	D/C	Planned
	Addition of 2x1500MVA, 765/400kV ICT at Jharsuguda	765/400kV	trf	Planned
	Addition of 2x1500MVA, 765/400kV ICT at Angul	765/400kV	trf	Planned
	Split bus arrangement at 400kV and 765kV bus in both Angul and Jharsuguda substations			Planned
ER - 55	**System Strengthening in West Bengal**			
	New Substation at Katwa New	400/220kV	trf	Planned
	Chanditala-Bakreswar 400kV D/c line	400kV	D/C	Planned
	Chanditala-Katwa New 400kV D/c line	400kV	D/C	Planned
	New Substation at Mayureswar	400/132kV	trf	Planned
	New Substation at Burdwan	400/132kV	trf	Planned
	LILO of Arambagh - Bidhannagar S/c line at Burdwan	400kV	S/C	Planned
NER - 01	**Strengthening of Transmission in NER Phase-II**			
	1. LILO of one ckt (2nd) of Silchar - Bongaigaon 400kV D/c at Byrnihat	400kV	D/C	Comm.
	2. LILO of Balipara-Khupi at Bhalukpong	132kV	D/C	UC
	3. NER PP (Biswanath Chariali) - Itanagar (Zebra conductor)	132kV	D/C	UC
	4. LILO of one ckt of Pallatana-Silchar 400kV D/c at P. K. Bari	400kV	D/C	UC
	5. Bhalukpong PG 132/33 kV S/s (2x25 MVA)	132/33kV	trf	UC
	6. P. K. Bari (4 single phase units of 50 MVA)	400/132kV	trf	UC
NER - 02	**ATS for Pare Dikrong HEP (110MW)**			
	1. LILO of RHEP-Nirjouli 132kV S/c line at Dikrong HEP	132kV	D/C	UC
	2. LILO of one ckt of RHEP-Edavger 132kV D/c line at Dikrong HEP	132kV	D/C	UC
	3. 2nd 315 MVA, 400/ 220 kV ICT at Misa	400/220kV	trf	Comm.
NER - 03	**ATS for Kameng HEP (600MW)**			
	1. Kameng-Balipara 400kV D/c line	400kV	D/C	UC
	2. Balipara-Bongaigaon (Quad) 400kV D/c line with 30 % FSC	400kV	D/C	Comm.
NER - 04	**ATS for Lower Subansiri HEP (2000MW)**			
	1. Lower-Subansiri-Biswanath Chariyali(PP) 400 kV 2xD/C (Twin Lapwing) line	400kV	2xD/C	UC
NER - 05	**Combined Transmission system for Transfer of Power from NER to NR/WR**			
	1. Biswanath Chariyali – Agra ±800 kV, 6000 MW HVDC bi-pole line	±800kV	HVDC	UC
	2. LILO of Ranganadi – Balipara 400kV D/C line at Biswanath Chariyali (Pooling Point)	400kV	2xD/C	UC
	3. Biswanath Chariyali – Biswanath Chariyali (AEGCL) 132 kV D/c	132kV	D/C	UC
	4. Establishment of 400/132 kV Pooling Station at Biswanath Chariyali with 2x200MVA, 400/132/33 kV transformers along with associated bays.	400/132kV	trf	UC
	5. HVDC rectifier module of 3,000 MW at Biswanath Chariyali and inverter module of 3,000 MW capacity at Agra.	±800kV	HVDC	UC
	6. Balipara-Biswanath Chariyali(PP) D/C	400kV	D/C	UC
	7. Agra 400/ 220 kV S/s (1x315 MVA)	400/220kV	trf	UC
NER - 06	**Dedicated system for Bongaigaon TPP (3x250 MW) (Central Sector)**			
	Bongaigaon TPP - Bongaigaon (PG) 400 kV D/c line	400kV	D/C	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NER - 07	**Combined ATS for Pallatana (726 MW) & Bongaigaon TPP(750MW)**			
	1. Silchar-Badarpur (PG) Switching Satation 132kV D/c line	132kV	D/C	Comm.
	2. Silchar-P. K. Bari (TSECL) 400kV D/c line (charged at 132 kV)	400kV	D/C	Comm.
	3. Silchar - Melriat New PG 400kV D/c line (charged at 132kV)	400kV	D/C	Comm.
	4. Silchar - Imphal 400kV D/c line (charged at 132kV)	400kV	D/C	Comm.
	5. Melriat (New)-Melriat (Mizoram) 132kV D/c line	132kV	D/C	UC
	6. Silchar-Srikona (AEGCL) 132kV D/c line	132kV	D/C	Comm.
	7. Silchar-Hailakandi (AEGCL) 132kV D/c line	132kV	D/C	UC
	8. LILO of Loktak-Imphal (PG) 132kV D/c line at Imphal (New)	132kV	2xD/C	Comm.
	9. LILO of one ckt of Kathalguri-Misa 400 kV D/C line at Mariani (New) (chg at 220 kV)	400kV	D/C	Comm.
	10. Mariani (New)-Mokokchung (PG) 220kV D/c line	220kV	D/C	Comm.
	11. Mokokchung (PG)-Mokokchung (Nagaland) 132kV D/c line with Zebra conductor	132kV	D/C	UC
	12. Passighat-Roing 132kV S/c on D/c line	132kV	S/C on D/C	Comm.
	13. Roing-Tezu 132kV S/c on D/c line	132kV	S/C on D/C	Comm.
	14. Tezu-Namsai 132 kV S/c on D/c line	132kV	S/C on D/C	Comm.
	15. Establishment of 400/132kV Silchar S/S (2x200 MVA)	400/132kV	trf	Comm.
	16. Establishment of Melriat 132/33kV S/S (upgradable to 400 kV) (2x50 MVA)	132/33kV	trf	UC
	17. Establishment of 132/33kV Imphal (New) S/S (upgradable to 400 kV) (2x50 MVA)	220/132kV	trf	Comm.
	18. Establishment of Mariani 220 kV Switching Station (upgradable to 400 kV)	220kV		Comm.
	19. Establishment of Mokokchung 220/132kV S/S (7x10 MVA one spare)	220/132kV	trf	UC
	20. Establishment of Roing 132/33kV S/S (single phase 7x5 MVA one spare)	132/33kV	trf	UC
	21. Establishment of Tezu 132/33 S/S (single phase 7x5 MVA one spare)	132/33kV	trf	UC
	22. Establishment of Namsai 132kV S/S (2x15 MVA)	132/33kV	trf	UC
	23. Bus Reactor at Silchar (2x63 MVAR)	400kV	reactor	Comm.
	24. Bus Reactor at Bongaigaon (1x80 MVAR)	400kV	reactor	Comm.
	25. 50 MVAR line reactors in each ckt of Pallatana-Silchar 400 kV D/C line at Silchar end	400kV	reactor	UC
	26. 63 MVAR line reactors in each ckt of Silchar-Bongaigaon 400 kV D/C line at Silchar and Bongaigaon ends	400kV	reactor	UC
	27. 400/ 220kV (2x315 MVA transformers) at BTPS (NTPC)	400/220kV	trf	Comm.
	28. 400/ 132kV (2x200 MVA transformers) at Palatana	400/132kV	trf	Comm.
	29. 50 MVAR line reactors in each ckt of Pallatana-Silchar 400 kV D/C line at Pallatana end	400kV	reactor	Comm.
	30. 80 MVAR bus reactor at Pallatana GBPP	400kV	reactor	Comm.
	31. LILO of both ckts of Silchar - Bongaigaon 400kV D/C line at Guwahati New (Azara)	400kV	2xD/C	UC
	32. Establishment of New Guwahati (Azara) 400/220kV substation (2x315 MVA)	400/220kV	trf	UC
	33. 63 MVAR line reactors in each ckt of Azara-Bongaigaon 400 kV D/C line at Azara end	400kV	reactor	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	34. 63 MVAR bus reactor at Azara end	400kV	reactor	UC
	35. LILO of both ckt of Agia - Guwahati 220 kV D/C at Guwahati New (Azara) PG	220kV	2xD/C	UC
	36. LILO of one ckt of Silchar-Bongaigaon 400 kV D/C line at Byrnihat	400kV	D/C	Comm.
	37. Establishment of Byrnihat 400/220kV S/S (2x315 MVA)	400/220kV	trf	Comm.
	38. 63 MVAR line reactor at Byrnihat for Silchar-Byrnihat line	400kV	reactor	Comm.
	39. 63 MVAR bus reactor at Byrnihat	400kV	reactor	Comm.
	40. BTPS-(NTPC)-Bongaigaon S/S(PG) 400kV D/c line	400kV	D/C	UC
	41. Pallatana-silchar 400kV D/c line	400kV	D/C	Comm.
	42. Silchar-Bongaigaon 400kV D/c line	400kV	D/C	UC
	43. Pallatana - Surajmani Nagar 400kV D/c line (charged at 132kV)	400kV	D/C	UC
NER - 08	**ATS for New Umtru (40 MW)**			
	1. New Umtru HEP - Norbong 132 kV D/c line	132kV	D/C	UC
NER - 09	**ATS for Monarchak (105 MW)**			
	1. Monarchak-Badarghat-Kumarghat-Badarpur Sw. Stn 132kV D/c line	132kV	D/C	UC
	2. Monarchak-Rabindra nagar 132kV D/c line	132kV	D/C	UC
	3. Establishment of Rabindra Nagar 132/33kV Substation 2x25 MVA)	132/33kV	trf	UC
	4. Establishment of Badarghat (Agartala New) 132/33kV Substation (2x25 MVA)	132/33kV	trf	UC
NER - 10	**System Strengthening Scheme in Arunachal Pradesh (Phase-I)**			
	1. Khupi - Seppa 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	2. Seppa-Sagali 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	3. Sagali-Naharlagun 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	4. Naharlagun-Gerukamukh 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	5. Gerukamukh – Likabali 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	6. Likabali – Niglok 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	7. Niglok-Pasighat 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	8. Deomali – Khonsa 132kV S/c line	132kV	S/C	Planned
	9. Khonsa – Changlong 132kV S/c line	132kV	S/C	Planned
	10. Changlang – Jairampur 132kV S/c line	132kV	S/C	Planned
	11. Jairampur - Miao 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	12. Miao - Namsai (PG) 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	13. Teju-Halaipani 132kV S/c on D/C line	132kV	S/C on D/C	Planned
	14. Naharlagun-Banderdewa132kV S/c on D/C line	132kV	S/C on D/C	Planned
	15. Seppa 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	16. Sagali 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	17. Naharlagun 132/33 kV S/s, 2x31.5 MVA	132/33kV	trf	Planned
	18. Gerukamukh 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	19. Likabali 132/33 kV S/s, 7x5 MVA (single phase-one	132/33kV	trf	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	spare)			
	20. Niglok 132/33 kV S/s, 2x31.5 MVA	132/33kV	trf	Planned
	21. Pasighat 132/33 kV (2nd S/s), 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	22. Khonsa 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	23. Changlang 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	24. Jairampur 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	25. Miao 132/33 kV S/s, 7x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	26. Halaipani 132/33 kV S/s, 4x5 MVA (single phase-one spare)	132/33kV	trf	Planned
	27. Banderdewa 132/33 kV S/s, 2x25 MVA (single phase-one spare)	132/33kV	trf	Planned
NER - 11	**System Strengthening Scheme in Arunachal Pradesh (Phase-II)**			
	1. Palin-Koloriang 132kV S/c line	132kV	S/C	Planned
	2. LILO of Ziro-Daporijo 132 kV D/C at Basar	132kV	D/C	Planned
	3. Roing - Anini 132kV S/c line on D/C	132kV	S/C on D/C	Planned
	4. Along - Reying 132kV S/c line on D/C	132kV	S/C on D/C	Planned
	5. Along - Yingkiong 132kV S/c line on D/C	132kV	S/C on D/C	Planned
	6. Establishment of Palin 132/33kV substation (7x5 MVA single Phase)	132/33kV	trf	Planned
	7. Establishment of Koloriang 132/33kV Substation (7x5 MVA single Phase)	132/33kV	trf	Planned
	8. Establishment of Basar 132/33kV Substation (7x5 MVAsingle Phase)	132/33kV	trf	Planned
	9. Establishment of Yingkiong 132/33kV Substation (7x5 MVA single Phase)	132/33kV	trf	Planned
	10. Establishment of Roing 132/33kV Substation (7x5 MVA single Phase)	132/33kV	trf	Planned
	11. Establishment of Reying 132/33kV Substation (7x5 MVA single Phase)	132/33kV	trf	Planned
	12. Establishment of Anini 132/33kV Substation (4x5 MVA single Phase)	132/33kV	trf	Planned
	13. Ziro 132/33kV Substation (Aug.) (4x8 MVA)	132/33kV	trf	Planned
	14. Daporijo 132/33kV Substation (Aug.) (2x12.5 MVA)	132/33kV	trf	Planned
	15. Along 132/33kV Substation (Aug.) (7x5 MVA)	132/33kV	trf	Planned
	16. Ziro - Palin 132kV S/c line	132kV	S/C	Planned
NER - 12	**System Strengthening Scheme (World Bank) in Assam (Tranche-I)**			
	Rangia – Amingaon	220kV	D/C	Planned
	Tinsukia – Behiating (New Dibrugarh)	220kV	D/C	Planned
	Kahilipara – Guwahati Medical College	132kV	D/C	Planned
	Rupai-Chapakhowa (with 4KM river crossing via Dhola)	132kV	S/C on D/D	Planned
	Dhemaji – Silapathar	132kV	S/C on D/D	Planned
	Amingaon - Hazo	132kV	D/C	Planned
	KAMAKHYA-PALTANBAZAR (UG CABLE)	132kV	S/C	Planned
	LILO of 132kV S/c Rangia - Rowta at Tangla	132kV	D/C	Planned
	LILO OF 132KV D/C GOLAGHAT-BOKAJAN AT SARUPATHAR	132kV	D/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	Sonabil - Tezpur New	132kV	D/C	Planned
	LILO OF 132KV S/C JORHAT-NAZIRA LINE AT TEOK	132kV	D/C	Planned
	New S/S			
	Amingaon	220/132kV	trf	Planned
	Behiating (New Dibrugarh)	220/132kV	trf	Planned
	Guwahati Medical College	132/33kV	trf	Planned
	Chapakhowa	132/33kV	trf	Planned
	Silapathar	132/33kV	trf	Planned
	Hazo	132/33kV	trf	Planned
	Paltanbazar	132/33kV	trf	Planned
	Tangla	132/33kV	trf	Planned
	Sarupathar	132/33kV	trf	Planned
	Tezpur New	132/33kV	trf	Planned
	Teok	132/33kV	trf	Planned
	S/S Augmentation			
	Samaguri	220/132kV	trf	Planned
	Dhaligaon	132/33kV	trf	Planned
	Samaguri	132/33kV	trf	Planned
NER - 13	**System Strengthening Scheme (World Bank) in Manipur (Tranche-I)**			
	Imphal - Ningthoukhong	132kV	D/c	Planned
	LILO of Yurembam(Imphal-State) - Karong at Gamphajol	132kV	D/C	Planned
	Kakching - Thoubal	132kV	S/C on D/C	Planned
	Stringing of Yaingangpokpi - Kongba 132kV 2nd ckt	132kV	S/C	Planned
	Stringing of Kakching - Kongba 132kV 2nd ckt	132kV	S/C	Planned
	Stringing of Kakching - Churachandpur 132kV 2nd ckt	132kV	S/C	Planned
	Renovation of Yurembum – Karong - Mao(Manipur-Nagaland border) section of Yurembum-Karong-Kohima 132kV S/c line	132kV	S/C	Planned
	New Sub-Station			
	Thoubal	132/33kV	trf	Planned
	Gamphajol	132/33kV	trf	Planned
	S/S Augmentation			
	Ningthoukhong (2nd tfr)	132/33kV	trf	Planned
	Rengpang (2nd tfr)	132/33kV	trf	Planned
	Jiribam (2nd tfr)	132/33kV	trf	Planned
	Kongba (2nd tfr)	132/33kV	trf	Planned
NER - 14	**System Strengthening Scheme (World Bank) in Mizoram (Tranche-I)**			
	Lungsen - Chawngte (charged at 33kV)	132kV	S/C	Planned
	Chawngte - S. Bungtlang(charged at 33kV)	132kV	S/C	Planned
	W. Phaileng - Marpara	132kV	S/C on D/C	Planned
	New S/S			
	Lungsen New SUBSTATION	132/33kV	trf	Planned
	W. Phaileng	132/33kV	trf	Planned
	Marpara	132/33kV	trf	Planned
	S/S Augmentation			
	Serchip	132/33kV	trf	Planned
	Lunglei Bay Extn	33kV	extn	Planned
	Lungsen Extn Bay Extn	33kV	extn	Planned
	CHAWNGTE Extn Bay Extn	33kV	extn	Planned
	CHAWNGTE Extn Bay Extn	33kV	extn	Planned
	S.BUNGTLANG Extn Bay Extn	33kV	extn	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NER - 15	**System Strengthening Scheme (World Bank) in Tripura (Tranche-I)**			
	Rokhia-Rabindranagar	132kV	D/C	Planned
	Suryamani Nagar - Gokul Nagar	132kV	D/C	Planned
	LILO of PK Bari-Ambasa at Monu	132kV	D/C	Planned
	Kailasahar - Dharamnagar	132kV	D/C	Planned
	Rabindranagar - Belonia	132kV	D/C	Planned
	Udaipur - Bagafa	132kV	D/C	Planned
	Bagafa - Belonia	132kV	D/C	Planned
	Belonia - Sabroom	132kV	D/C	Planned
	LILO of Agartala 79 Tilla - Dhalabil (Khowai) 132KV S/C LINE	132kV	D/C	Planned
	Bagafa - Satchand	132kV	S/C ON D/C	Planned
	New S/S			
	Rabindra Nagar	132/33kV	trf	Planned
	Gokul Nagar	132/33kV	trf	Planned
	Monu	132/33kV	trf	Planned
	Belonia	132/33kV	trf	Planned
	Bagafa	132/33kV	trf	Planned
	SABROOM	132/33kV	trf	Planned
	MOHANPUR (HEZAMARA)	132/33kV	trf	Planned
	SATCHAND	132/33kV	trf	Planned
	S/S Augmentation & transformer replacement			
	Kailashahar (Gournagar)	132/33kV		Planned
	UDAIPUR	132/33kV		Planned
	Ambasa	132/33kV		Planned
	Dhalabil(Khowai)	132/33kV		Planned
	JIRANIA	132/33kV		Planned
NER - 16	**System Strengthening Scheme (World Bank) in Meghalaya (Tranche-I)**			
	Killing (byrnihat) - Mawngap - New Shillong 220kV D/C line	220kV	D/C	Planned
	LILO of both ckt of MLHEP-Khleriat 132kV D/c line at Mynkre	132kV	D/C	Planned
	Phulbari - Ampati	132kV	D/C	Planned
	New S/S			
	Mynkre	132/33kV	trf	Planned
	Phulbari	132/33kV	trf	Planned
	Mawngap (upgrading U/C 132 kV S/S to 220 kV GIS)	220/132kV	trf	Planned
	New Shillong	220/132kV	trf	Planned
	New Shillong	132/33kV	trf	Planned
NER - 17	**System Strengthening Scheme (World Bank) in Nagaland (Tranche-I)**			
	LILO of Mokokchung (Nagaland) - Mariani (Assam) 132kV D/c line at Longnak	132kV	D/C	Planned
	New Kohima – Mon (Naginimora) routed via Wokha and Mokokchung (to be charged at 132kV)	220kV	S/C on D/C	Planned
	Tuensang - Longleng	132kV	S/C on D/C	Planned
	New Kohima (Zadima) - New Secretariat Complex	132kV	D/C	Planned
	LILO of Kohima-Wokha Line at new Kohima	132kV	D/C	Planned
	LILO of Kohima – Meluri(Kiphire) 132kV D/c line at Pfutsero	132kV	2xD/C	Planned
	Wokha – Mokokchung(Nagaland) routed via Zunheboto	132kV	S/C on	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
			D/C	
	New S/S			
	LONGNAK	132/33kV	trf	Planned
	LONGLENG	132/33kV	trf	Planned
	NEW SECRETARIAT COMPLEX KOHIMA (NEW) SUBSTATION	132/33kV	trf	Planned
	Pfutsero	132/33kV	trf	Planned
	ZUNHEBOTO	132/33kV	trf	Planned
	S/S Augmentation & transformer replacement			
	Wokha	132/33kV	trf	Planned
NER - 18	**Manhdhechu (720 MW)**			
	1. Mangdechu HEP-Goling 400kV 2XS/c line	400kV	2xS/c	Planned
	2. Goling-Jigmeling 400kV D/c line	400kV	D/c	Planned
	3. Jigmeling-Alipurduar 400kV D/c line(Quad)	400kV	D/c	Planned
NER - 19	**NER System Strengthening-II**			
	1. LILO of 2nd ckt of Silchar – Bongaigaon 400 kV D/c line at Byrnihat (MeECL)	400kV	D/C	Planned
	2. Biswanath Chariyali – Itanagar (Ar. Pradesh) 132 kV D/c line (Zebra Conductor)	132kV	D/C	Planned
	3. Silchar – Misa 400 kV D/c (quad) line.	400kV	D/C	Planned
	4. Ranganadi HEP – Nirjuli(PG) 132 kV D/c line with one ckt to be LILOed at Itanagar (Ar. Pradesh) or Via Itanagar (Ar. Pradesh)	132kV	D/C	Planned
	5. Imphal (PG) – New Kohima (Nagaland) 400 kV D/c line (initially charged at 132 kV).	400kV	D/C	Planned
	6. 2nd 400/220 kV, 315 MVA ICT at Balipara substation of POWERGRID	400/220kV	trf	Planned
	7. Replacement of existing 132/33 kV, 2X10 MVA ICT by 132/33 kV, 2X50 MVA ICT at Nirjuli sub-station of POWERGRID	132/33kV	trf	Planned
NER - 20	**ATS for Khuitam(33 MW)**			
	Khuitam - Dinchang 132 kV D/c line	132kV	D/C	Planned
NER - 21	**Dedicated sysyem for KSK Dibbin, Patel Hydro, Nafra, Khuitam**			
	Dedicated System for KSK Dibbin			
	KSK Dibbin - Dinchang PP 220kV D/C line	220kV	D/C	Planned
	Dedicated System for Patel Hydro (Gongri+Sasankrong)			
	Saskngrong - Goongri 132kV D/c lline	132kV	D/C	Planned
	Goongri - Dinchang PP 220kV D/C line		D/C	Planned
	Dedicated System for SEW Nafra			
	Nafra - Dinchang PP 220kV D/C line	220kV	D/C	Planned
	Dedicated System for Adishankar Khuitam			
	Kuitam - Dinchang PP 220kV D/C line	220kV	D/C	Planned
	Dedicated sysyem for KSK Dibbin, Patel Hydro, Nafra, Khuitam			
	1. 440/220kV ,2x315 MVA Pooling station at Rangia/ Rowta	400/220kV		Planned
	2. 440/220kV ,2x315 MVA Pooling station at Dinchang	400/220kV		Planned
	3. LILO of Bongaigaon – Balipara 400kV D/C line at rangia/Rowta	400kV	2xD/C	Planned
	4. Dinchang PP –Rangia/ Rowta 400kV D/C (quad) line	400kV	D/C	Planned
NER - 22	**Namrup +Ext (100 MW) (state sector)**			
	1. LILO of Namrup –Tinsukia 220kV S/C line at Bodubi	220kV	D/C	UC
	2. Namrup – Tinsukia 220kV D/C line (existing)	220kV	D/C	Comm.
	3. Namrup – Lakwa 132kV D/c line (existing)	220kV	D/C	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NER - 23	**Evacuation System for Demwe (1750MW), Tato-II (700MW), Kalai-II (1200MW) and GMR Londa**			
	1. 400kV pooling substation at Silapathar (Assam)	400kV	Sw	New
	2. Demwe – Silapathar 400kV 2xD/c with High Capacity / HTLS conductor	400kV	2xD/C	New
	3. Tato-II – Silapathar 400kV D/c line (High Capacity / HTLS)	400kV	D/C	New
	4. Kalai-II – Silapathar 400kV D/c line (High Capacity / HTLS)	400kV	D/C	New
	5. Silapathar – Bishwanath Chariali 400kV 2x D/c line (High Capacity / HTLS)	400kV	2xD/C	New
	6. GMR Londa(225 MW) – Biswanath Chariali 400kV D/c line (High Capacity / HTLS)	400kV	D/C	New
	7. Reconductoring of Biswanath Chariali – Balipara 400kV 2x D/c (twin moose) to high capacity / HTLS	400kV	2xD/C	New
	8. LILO of Balipara - Bongaigaon 400kV D/c (quad) at Rangia (with removal of FSC at Balipara)	400kV	D/C	New
	9. Reconductoring of Balipara - Bongaigaon 400kV D/c (twin moose) to high capacity / HTLS	400kV	D/C	New
NER - 24	**Interconnection of NER with Bhutan**			
	Rangia/Rowta – Yangbari(Bhutan) 400KV 2x D/c line (quad)	400kV	2xD/C	New
NER - 25	**ATS for Tuirial HEP (2x30 MW)**			
	1.Tuirial-Kolasib 132 kV S/c (operated at 33 kV) - (existing)	132kV	S/C	Planned
	2. LILO of Jiribam-Aizwal 132 kV S/c at Tuirial HEP	132kV	D/C	Planned
NER - 26	**Evacuation of power pooled from Bhutan and ArP at Rangia/Rowta to NR**			
	±800kV HVDC from Rangia/Rowta to Gurdaspur (NR) (3000MW)	±800kV	HVDC	New
NER - 27	**NER System Strengthening-III**			
	Installation of 2nd 400/220 kV, 315 MVA ICT at Bongaigaon substation	400/220kV	trf	Planned
	Replacement of existing 60MVA, 220/132kV ICT by 1x160 MVA 220/132 kV ICT at Kopili HEP	220/132kV	trf	Planned
	Replacement of existing 2x50MVA, 220/132kV ICTs by 2x160MVA, 220/132kV ICTs at Balipara sub-station	220/132kV	trf	Planned
SR - 01	**Transmission system associated with Krishnapatnam UMPP (5x800 MW)-Part-A & Part C (Delinked with Krishnapatnam UMPP, being implemented as System Strengthening scheme) Part A**			Comm.
	1. TPCIL –Nellore Pooling Point (earlier as Krishnapattnam UMPP – Nellore) 400 kV, Quad D/C line	400kV	D/C	Comm.
	2. Nellore Pooling Point - Gooty (earlier as Krishnapattnam UMPP –Gooty) 400 kV, Quad D/C line with 63MVAR line reactors at each end on both circuits.	400kV	D/C	Comm.
SR - 02	**Transmission system associated with Krishnapatnam – Part B (Delinked with Krishnapatnam UMPP, being implemented as System Strengthening scheme)**			Comm.
	1. Establishment of new 765/400 kV substation at , Raichur and Sholapur with 2x 1500 MVA ICTs and 1x 240 MVAR bus reactors at each S/S	765/400kV	trf	Comm.
	2. Establishment of new 765/400 kV substation (GIS) at Pune with 2x1500 MVA transformation capacity	765/400kV	trf	UC
	3. LILO of existing Raichur-Gooty 400kV Quad D/C line at Raichur(New) substations	400kV	D/C	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	4. Raichur – Sholapur 765 kV S/c with 240 MVAR switchable line reactors at each end	765kV	S/C	Comm.
	5. Sholapur – Pune 765 kV S/c with 240 MVAR switchable line reactors at each end	765kV	S/C	UC
	6. LILO of Aurangabad- Pune 400 kV D/C at Pune(GIS) with 50 MVAR line reactor at Pune (GIS)	400kV	D/C	UC
	7. LILO of Parli-Pune 400 kV D/C at Pune (GIS) with 50 MVAR line reactor at Pune (GIS).	400kV	D/C	UC
SR - 03	**Transmission System associated with KUMPP Part-C**			Comm.
	1. Establishment of new 765/400 kV substation at Kurnool with 2x 1500 MVA ICTs and 1x 240 MVAR bus reactors .	765/400kV	trf	Comm.
	2. LILO of Nagarjuna Sagar – Gooty 400 kV S/C line at Kurnool (New) substation.	400kV	D/C	Comm.
	3. Kurnool(new)-Kurnool (APTRANSCO) 400 KV D/C QUAD line.	400kV	D/C	Comm.
	4. Krishnapattnam UMPP – Kurnool (New) 400kV, Quad D/C line with 50MVAR line reactor at each end on both circuits. (DEFFERED)	400kV	D/C	Comm.
	5. Kurnool (New) – Raichur 765kV S/C line (DEFFERED)	765kV	S/C	Comm.
SR - 04	**ATS for Pulichintala(2x30MW)**			Comm.
	1. 132Kv Pulichintala HEP-Chillakallu DC line	132kV	D/C	Comm.
	2. 132Kv bay extensions at Chillakallu	132kV	bay	Comm.
SR - 05	**ATS for Lower Jurala U1-6(6X40MW)**			UC
	1. 220Kv Lower Jurala HEP switchyard-220/132Kv Jurala S/S D/C line	220kV	D/C	UC
	2. 400Kv Veltoor -220Kv Jurala S/S ,220Kv D/C line	220kV	D/C	UC
SR - 06	**Sri Damodaram Sanjeevaiah TPP (Krishnapatnam TPP) (2X800MW) (State Sector)**			Comm.
	1. Krishnapattnam - Nellore 400kV Quad D/C line	400kV	D/C	Comm.
	2. Krishnapattnam - Chittoor 400kV Quad D/C line	400kV	D/C	Comm.
SR - 07	**ATS for Tuticorin JV(500 MW) (Central Sector)**			Comm.
	Tuticorin – Madurai 400kV D/c line (Quad conductor)	400kV	D/C	Comm.
SR - 08	**System Strengthening in SR-XII**			UC
	1. Establishment of new 400/220 kV substation at Yelahanka with 2x500 MVA transformers and 1x63 MVAR bus reactor	400/220kV	trf	UC
	2. LILO of Nelamangla-Hoody 400kV S/c line at Yelahanka 400kV S/S	400kV	D/C	UC
	3. LILO of Somanahalli -Hoody 400kV S/c line at Yelahanka 400kV S/S	400kV	D/C	UC
SR - 09	**System Strengthening in SR-XIII**			UC
	1. 400/220kV 2X500MVA substation at Madhugiri with upgrading this S/S to 765kV level in future and 1X63 MVAR bus reactor	400/220kV	trf	UC
	2. Gooty – Madhugiri 400kV D/C line	400kV	D/C	UC
	3. Madhugiri – Yelahanka 400kV D/C Quad line	400kV	D/C	UC
SR - 10	**System Strengthening in SR-XIV**			UC
	1. Salem (New) – Somanahalli 400kV Quad D/C line.	400kV	D/C	UC
	2. 1x315 MVA 400/220kV Transformer Augmentation at Hosur 400/230 kV S/S	400/220kV	trf	Comm.
SR - 11	**System Strengthening in SR-XV**			UC
	Mysore – Kozhikode 400kV Quad D/C line	400kV	D/C	UC
SR - 12	**System Strengthening in SR-XVII**			UC
	1. New 400kV substation at Narendra (GIS) (GIS) (which shall be later upgraded to 765kV) (2x1500 MVA)	400/220kV		UC
	2. Narendra (GIS)-Kolhapur (GIS) 765kV D/C line	765kV	D/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	(initially charged at 400kV)			
	3. LILO of both circuits of existing Kolhapur –Mapusa 400kV D/C line at Kolhapur(GIS)	400kV	D/C	UC
	4. Narendra (GIS)- Narendra (existing) 400kV D/C Quad line. -- about 20 km.	400kV	D/C	UC
SR - 13	**System Strengthening in SR-XVIII (Vijaywada Nellore-Thiruvalam-Sholinganallur Corridor)**			UC
	1. Vijayawada – Nellore (AP) 400 kV D/C line with 63 MVAR line reactors at both ends of each ciruit	400kV	D/C	UC
	2. Nellore - Thiruvalam 400 kV D/C Quad line with 1x50 MVAR line reactors at both ends of each circuit.	400kV	D/C	Comm.
	3. Thiruvalam – Melakottaiyur 400 kV D/C line	400kV	D/C	Comm.
	4. LILO of existing Bangalore – Salem 400 kV S/C line at Hosur	400kV	D/C	Comm.
SR - 14	**System Strengthening in SR-XIX (Kurnool-Thiruvalam Corridor)**			UC
	1. Kurnool – Thiruvalam 765 kV D/c line line with 1x240 MVAR line reactors at both ends of each circuit.	765kV	D/C	UC
	2. Provision of 2x1500 MVA, 765/400kV transformers at Thiruvalam.	765/400kV	trf	UC
	3. LILO of Kolar – Sriperumbudur 400 kV S/c line at Thiruvalam.	400kV	D/C	Comm.
SR - 15	**System Strengthening in SR for import of power from ER**			UC
	1. Srikakulam PP- Vemagiri –II Pooling Station 765kV D/C line	765kV	D/C	UC
	2. Khammam (new)- Nagarjunr Sagar 400kV D/C line	400kV	D/C	UC
SR - 16	**Dedicated Transmission line for Simhapuri(570MW)/ Meenakshi(900MW)**			
	Simhapuri/Meenakshi –Nellore 400 kV D/C (quad) line alongwith associated bays	400kV	D/C	Comm.
SR - 17	**ATS for Krishnapattanam LTA Power Projects**			
	1. Establishment of 765/400 kV Nellore Pooling Station with 2X1500MVA transformer capacity	765/400kV	trf	UC
	2 LILO of Simhapuri-Nellore 400 kV D/C quad line at Nellore Pooling station	400kV	D/C	Comm.
	3. Nellore Pooling Station – Kurnool 765 kV D/c line.	765kV	D/C	UC
SR - 18	**Dedicated Transmission System for East Coast Energy Pvt. Ltd. project(1320 MW)[Srikakulam area]**			UC
	1. Generation would be stepped up at 400kV.	400kV		UC
	2. Bus reactor of 1x125MVAR	400kV	reactor	UC
	3. East Coast Energy generation switchyard – Srikakulam Pooling Station 400kV D/C Quad line alongwith associated bays	400kV	D/C	UC
SR - 19	**ATS for LTOA Projects in Srikakulam area[East Coast Energy Pvt. Ltd. project(1320 MW)]**			
	1. Establishment of 765/400kV Pooling Station in Srikakulam area with 2x1500 MVA 765/400kV transformer capacity	765/400kV	trf	UC
	2. Srikakulam Pooling station – Angul 765 kV D/C line(Initially Charged at 400kV)	765kV	D/C	UC
	3. 765/400kV 1x1500 MVA transformer at Angul	765/400kV	trf	UC
	4. Angul – Jharsuguda 765 kV D/C line	765kV	D/C	UC
	5. Jharsuguda - Dharamjaigarh 765 kV D/C line	765kV	D/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	6. Associated 400 kV and 765kV bays at Srikakulam Pooling station, Angul, Jharsuguda and Dharamjaigarh 765/400kV S/Ss.	765/400kV	bay	UC
SR - 20	**ATS for Rayalseema St -III (U-6)**			UC
	1. RSTPP Generation Switchyard- Chittoor 4ookV D/C line	400kV	D/C	UC
SR - 21	**ATS for Torangallu Jindal U3(300MW) (Private Sector)**			UC
	1. Torangallu JSW -Gooty 400kV D/C line	400kV	D/C	UC
	2. LILO of RTPS- Guttur at Thorangallu JSW S/S	400kV	D/C	UC
SR - 22	**Kudgi Phase-I (3x800 MW) (Central Sector)**			UC
	1. Kudgi TPS – Narendra (New) 400 kV 2xD/C quad lines	400kV	2xD/C	
	2. Narendra (New) – Madhugiri 765 kV D/c line	765kV	D/C	
	3. Madhugiri – Bidadi 400 kV D/c (quad) line.	400kV	D/C	
SR - 23	**ATS for Thottiar HEP (2X80MW)**			UC
	1. Generation to be stepped up to 220kV for evacuation	220kV		UC
	2. upgrading the existing 110kV Kodakara S/S to 220kV	220kV		UC
	3. 220kV D/C line from switchyard to Kodakara S/S	220kV	D/C	UC
	4. LILO of Idukki-Kozikode 220kVS/C line Kodakara	220kV	D/C	UC
SR - 24	**ATS for Pallivasal HEP (60 MW)**			UC
	Evacuation at lower level			UC
SR - 25	**Dedicated Transmission System for Coastal Energen Pvt. Ltd. Project (Melamuruthur TPP) (2x600MW)**			UC
	1. Generation would be stepped up at 400kV	400kV		UC
	2. Coastal Energen generation switchyard –Tuticorin Pooling Station 400kV D/C Quad line alongwith associated bays	400kV	D/C	UC
SR - 26	**Dedicated Transmission System for Ind-Barath Power (Madras) Ltd. Project(1320MW)**			UC
	1. Generation would be stepped up at 400kV	400kV		UC
	2. Ind-Barath Power generation switchyard –Tuticorin Pooling Station 400kV D/C Quad line alongwith associated bays	400kV	D/C	UC
SR - 27	**ATS for Tuticorin LTA Power Projects in Tuticorin Area**			UC
	1. Establishment of 765 kV Pooling station in Tuticorin (initially charged at 400 kV)	765kV-op-400kV		UC
	2. LILO of both circuits of Tuticorin JV – Madurai 400 kV D/C Quad line at Tuticorin Pooling Station	400kV	D/C	UC
	3. Salem Pooling Station – Salem 400 kV D/C (quad) line.	400kV	D/C	UC
	4. (iv) Tuticorin Pooling station – Salem Pooling station 765 kV D/C line (initially charged at 400 kV)	765kV-op-400kV	D/C	UC
	5. Salem Pooling Station – Madhugiri Pooling Station 765 kV S/C line (initially charged at 400 kV)	765kV-op-400kV	S/C	UC
	6. Associated 400 kV bays at Tuticorin Pooling station, Salem Pooling Station, Salem and Madhugiri.	400kV	bay	UC
	7 Establishment of 765 kV Pooling station in Salem (initially charged at 400 kV)	765kV-op-400kV		UC
SR - 28	**Immediate Evacuation for IL&FS Tamil Nadu power company Ltd (1200 MW)**			
	1. Generation-Switchyard-Nagapattinam Pooling station 400kV D/c quad line	400kV	D/C	UC
	2. 125 MVAR bus reactor at generation switchyard.		reactor	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
SR - 29	**ATS for ISGS Projects in Nagapattinam and Cuddalore Area of Tamilnadu**			UC
	1. New 765/400kV Pooling Station at Nagapattinam (GIS)with sectionalisation arrangement to control short circuit MVA (initially charged at 400kV)	765/400kV		UC
	2. LILO of Neyveli – Trichy 400kV S/c line at Nagapattinam Pooling Station for initial arrangement which later shall be bypassed –about 20kms	400kV	D/C	UC
	3. 2 nos. 400kV bays each at Nagapattinam Pooling Station and Salem for terminating Nagapattinam Pooling Station –Salem 765kV D/C line (initially charged at 400kV)being implemented under Tariff based bidding	765kV-op-400kV	bay	UC
	4. 1 no. 400kV bay each at Salem and Madhugiri for terminating Salem- Madhugiri 765 kV S/C line -2(initially charged at 400kV) being implemented under Tariff based bidding	765kV-op-400kV	bay	UC
	5. 2 nos. 400kV bays each at Madhugiri and Narendra for terminating Madhugiri – Narendra 765kV D/C line (initially charged at 400kV) being implemented under Tariff based bidding	765kV-op-400kV	bay	UC
	6. 2 nos. 400kV bays each at Kohlapur ,Padghe & Pune for terminating Kohlapur- Padghe 765kV D/C line (one circuit via Pune) (initially charged at 400kV) being implemented	765kV-op-400kV	bay	UC
	7. Nagapattanam Pooling Station- Salem 765kV D/c line	765kV-op-400kV	D/C	UC
	8. Salem - Madhugiri 765kV S/c line	765kV-op-400kV	S/C	UC
SR - 30	**Kalapakkam PFBR (500MW) (Central Sector)**			UC
	1. Kakapakkam – Arni 230 kV D/C line	230kV	D/C	UC
	2. Kakapakkam PFBR– Kanchepuram 230 kV D/C line	230kV	D/C	UC
	3. Kakapakkam PFBR –Siruchri 230 kV D/C line	230kV	D/C	UC
	4. Kakapakkam – MAPS 230 kV S/C cable	230kV	S/C	UC
SR - 31	**Wind projects in Tamil Nadu Phase I**			UC
	1. Kanaraptty (TN Wind) - Kayathar 400 KV, 400 kV D/C Twin Moose line.	400kV	D/C	UC
	2. Kayathar - Karaikudi 400 kV D/C Quad line	400kV	D/C	UC
	3. Karaikudi - Pugalur 400 kV D/C Quad line	400kV	D/C	UC
	4. Establishment of Kayathar S/s with (a) 2x315 MVA 400/230 kV ICT	400/230kV	trf	UC
	4. (b) 2x200 MVA 400/110kV ICT	400/110kV	trf	UC
	5. Pugalur – Malekottayur 400 kV D/C Quad line	400kV	D/C	UC
	6. Tirunelveli (TNEB) (TN wind/Kanarapatty) 400/230 kV S/S (3x315 MVA)	400/230kV	trf	UC
	7. Tirunelveli (TNEB) - Tirunelveli (PG) 400kV D/c quad line	400kV	D/C	UC
	8. Five numbers of 230/33 kV wind energy substations at Marandai, Sayamalai, Vagaikulam, Kumarapuram, Sankaralingapuram and one 230/110 kV Samugarangapuram substation with associated 230 kV lines connecting with the Kanarpatti 400 kV S/S. [**This system was planned in 2007 for completion in 11th Plan. The system is yet to be completed.]	230/33kV	trf	UC
SR - 32	**Wind projects in Tamil Nadu Phase-II**			UC
	1. Thappagundu 400/110 KV (5x200MVA) S/s in Theni area	400/110kV	trf	UC
	2. Anaikadavu S/s in Udumpet area with 400/230 kV, 2x315 MVA	400/230kV	trf	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	2. (b) 400/110 kV, 2x200 MVA ICT	400/110kV	trf	UC
	3. Rasipalayam S/s in Udumalpet area with (a) 400/230 kV, 2x315 MVA ICT	400/230kV	trf	UC
	3. (b) 400/110 kV, 2x200 MVA ICT	400/110kV	trf	UC
	4. Anaikadavu- Rasipalayam 400kV D/c line.	400kV	D/C	UC
	5. Thappagundu- Anaikadavu 400kV D/c with one ckt LILO at Udumalpet 400/220 kV (PGCIL) substation.	400kV	D/C	UC
	6. Rasipalayam -Singarapet 400kV 2xD/c line	400kV	2xD/C	UC
	7. Vagrai S/s with 400/230 kV, MVA ICT	400/230kV	trf	UC
	7. (b) 400/110 kV, MVA ICT	400/110kV	trf	UC
	8. Vagrai-Rasipalayam 400 kV D/c line	400kV	D/C	UC
	9. (a) Thennampatti 400/230 kV substation	400/230kV	trf	UC
	9 (b) 400/110 kV, MVA ICT	400/110kV	trf	UC
	10. Thennampatti - Kayathar 400kV D/C line	400kV	D/C	UC
SR - 33	**System for additional inter-connection with ISTS and increased reliability**			UC
	1. LILO of one Rasipalayam -Singarapet 400kV D/c line at Salem 765/400kV (POWERGRID) substation	400kV	D/C	UC
SR - 34	**Wind projects in Andhra Pradesh (3150 MW)**			UC
	1. 400/220 kV Substation at Hindupur (3x315MVA)	400/220kV	trf	UC
	2. 400/220 kV Substation at Kondapuram (4x315MVA)	400/220kV	trf	UC
	3. 400/220 kV Substation at Uravakonda (4x315MVA)	400/220kV	trf	UC
	4. Uravakonda-Mahbubnagar 400 kV Quad DC Line	400kV	D/C	UC
	5. Uravakonda-Hindupur 400 kV DC Line	400kV	D/C	UC
	6. Uravakonda-Kondapur 400 kV DC Line	400kV	D/C	UC
	7. Kondapur – Kurnool 400kV quad DC line	400kV	D/C	UC
	8. Hindupur (400kV) S/S -Hindupur/ Gollapuram(existing) 220kV DC line	220kV	D/C	UC
	9. Urvakonda (400kV) S/S - Kalyandurg(existing) 220kV D/C line	220kV	D/C	UC
	10. Kondapur (400kV) S/S - Tadipatri(existing) 220kV D/C line	220kV	D/C	UC
	11. 220/132 kV, 2x100 MVA Substation at Jammalamadugu	220/132kV	trf	UC
	12. 220/132 kV, 2x100 MVA Substation at Penukonda	220/132kV	trf	UC
	13. 220/132 kV, 2x100 MVA Substation at Porumamilla	220/132kV	trf	UC
	14. Connectivity of Jammalamadugu, Penukonda and Porumamilla 220/1323kv S/s with existing 132/33kV S/Ss	220/132kV		UC
SR - 35	**Wind projects in Karnataka (400 MW)**			UC
	1. LILO of Munirabad - Davangere (Guttur) 400 kV S/C line at Doni	400kV	D/C	UC
SR - 36	**System Strengthening in SR - XX**			UC
	1. Augmentation of 1x500 MVA 400/220kV Transformer with associated 400kV & 220kV bays at each substations of (1) Hyderabad (Ghanapur), (2) Warangal, (3) Khammam, (4) Vijayawada, (5) Gooty, (6) Cuddapah, (7) Malekuttaiayur, (8) Somanahalli, (9) Mysore, (10) Pugalur and (11) Trichy.	400/220kV	trf	UC
	2.Replacement of 2x315 MVA 400/220kV transformers at Narendra with 2x500 MVA transformers and utilize the replaced 2x315 MVA transformers as regional spare, location to keep the spare shall be decided later.	400/220kV	trf	UC
	3. Conversion of 50 MVAR line reactors at Madakathara end on both circuits of Ellapally (Palakkad) – Madakathara (North Trissur) 400kV D/c line into switchable reactors by providing necessary switching arrangement.	400kV	Reactor	UC
	4. 2x125 MVAR Bus Reactor at Vijayawada 400kV substation.	400kV	Reactor	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
SR - 37	**System Strengthening in SR - XXI (Dynamic Recative Compensation in SR**			
	1. At Hyderabad. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 200 MVAR STATCOM	400kV	Statcom	UC
	2. At Udumulpeta. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 200 MVAR STATCOM	400kV	Statcom	UC
	3. At Trichy. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 200 MVAR STATCOM	400kV	Statcom	UC
SR - 38	**System Strengthening in SR - XXII**			UC
	1. Kurnool - Raichur 765 kV S/c line (2nd)	765kV	S/C	UC
SR - 39	**System Strengthening in SR - XXIII**			UC
	1. Installation of 1x125 MVAR 400kV bus reactor at Gooty, Hassan, Khammam, Trivendrum, Nellore (existing), Narendra (New) and Nagarjunasagar 400/220 kV substation.	400kV	Reactor	UC
	2. Installation of 2x63 MVAR bus reactors at Yelahanka substation.	400kV	Reactor	UC
	3. Replacement of 63 MVAR bus reactor with 125 MVAR bus reactor at Narendra 400/220 kV substation.	400kV	Reactor	UC
	4. Provision of 1x80 MVAR switchable line reactors at Nellore pooling station on each ckt of Nellore pooling station – Gooty 400 kV Qaud d/c line.	400kV	Reactor	UC
	5. Provision of 400/220 kV, 1x500 MVA ICT at Madurai 400/200 kV substation	400/220kV	trf	UC
	6. Procurement of 1 Nos. 500 MVA, 765/400 kV spare ICT.	765/400kV	trf	UC
SR - 40	**Wardha – Hyderabad 765 kV Link**			UC
	1. Wardha – Hyderabad (Maheshwaram) 765kV D/c line with anchoring at Nizamabad 765/400kV substation	765kV	D/C	UC
	2. Establishment of Nizamabad 765/400 kV GIS Pooling Station with 2x1500 MVA transformers	765/400kV	trf	UC
	3. 1 no. 240 MVAR, 765 kV Bus Reactors at Nizamabad	765kV	Recator	UC
	4. Nizamabad – Dichpalli 400 kV D/c line.	400kV	D/C	UC
	5. 2 nos. 765kV bays each at Maheshwaram and Wardha for terminating Wardha – Hyderabad (Maheshwaram) 765kV D/c line with anchoring at Nizamabad	765kV	Bays	UC
	6. 1 no. 240 MVAR switchable line reactor at Maheshwaram and Wardha for both circuits of Wardha – Hyderabad (Maheshwaram) 765kV D/c line with anchoring at Nizamabad	765kV	Reactor	UC
	7. 4 nos. 765kV bays at Nizamabad for anchoring of Wardha – Hyderabad (Maheshwaram) 765kV D/c line	765kV	Bays	UC
	8. 1 no. 240 MVAR switchable line reactor at Nizamabad for both circuits of Wardha – Nizamabad 765kV D/c line and Nizamabad – Hyderabad (Maheshwaram) 765kV D/c line	765kV	Reactor	UC
SR - 41	**Sub-station Works associated with Hyderabad (Maheshwaram) Pooling Station**			UC
	1. Establishment of Maheshwaram (PG) 765/400 kV GIS substation with 2x1500 MVA transformers	765/400kV	trf	UC
	2. LILO of Hyderabad – Kurnool 400 kV s/c line at Maheshwaram (PG) substation.	400kV	D/C	UC
	3. 2 nos. 240 MVAR, 765 kV Bus Reactors at Maheshwaram Pooling Station	765kV	Reactor	UC
SR - 42	**Evacuation for Yeramaras(2x660 MW) and Edalapur (1X800 MW) Stg-I**			UC
	1. Establishment of Bellary 400kV pooling station near 'BTPS'	400kV		UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	2. Establishment of Gulbarga 400/220 kV substation 7x167 MVA(single phase) or 2x500 MVA.	400/220kV	trf	UC
	3. Yermarus TPS - Gulbarga 400 kV D/C line with quad moose conductor	400kV	D/C	UC
	4. Establishment of Establish 400 KV switching station at Chikkanayakanahalli (C.N Halli) near “Loop in Loop Out” (LILO) point on the Nelamangala – Talaguppa 400kV lines to Hassan	400kV	D/C	UC
	5. LILO of both the circuits of Nelamangala – Talaguppa 400kV lines to the proposed pooling station near CN Halli	400kV	D/C	UC
	6. Terminate 400kV D/C line feeding 400/220 KV station at Hassan from Nelamangala – Talaguppa line at CN Halli 400kV pooling station	400kV	D/C	UC
	7. Yermarus TPS - Bellary Pooling Station 400kV D/C line with quad moose conductor	400kV	D/C	UC
	8. Bellary Pooling Station - C.N.Hally 400kV D/C line with quad moose conductor	400kV	D/C	UC
	9. Bellary Pooling Station - New Madhugiri (near Tumakur) 765/400kV station, 400kV D/C line with quad moose conductor	400kV	D/C	UC
	10. Bellary TPS – Bellary Pooling Station 400kV D/C line with quad moose conductor	400kV	D/C	UC
	11. De-link 400kV S/C line running between RTPS-BTPS-JSW-Guttur with ‘BTPS’ and JSW Bus so as to retain direct connectivity between RTPS and Guttur	400kV	D/C	UC
	12.JSW TPS – Bellary Pooling Station 400kV D/C line with quad moose conductor	400kV	D/C	UC
SR - 43	**Evacuation for Yeramaras(2x660 MW) and Edalapur (1X800 MW) Stg-II**			UC
	1. Edlapur TPS - Bellary Pooling Station 400kV D/C line with quad moose conductor	400kV	D/C	UC
	2. Edlapur TPS - Yermarus TPS 400kV D/C line with quad moose conductor	400kV	D/C	UC
	3. Tumakur (New Madhugiri) - Bastipura (Mysore) 400kV D/C line with quad moose conductor	400kV	D/C	UC
SR - 44	**Transmission System for Connectivity for NCC Power Projects Ltd. (1320 MW)**			UC
	1. NCC Generation Switchyard-Nellore Pooling Station 400 kV (quad) D/c line	400kV	D/C	UC
	2. 2 nos. 400 kV line bays at Nellore Pooling Station for termination of the line	400kV	Bays	UC
SR - 45	**Contingency Arrangement for Transmission of Power from IL&FS Generation Project**			UC
	1. LILO of 2nd circuit of Neyveli – Trichy 400kV line at Nagapattinam Pooling Station.	400kV	D/C	UC
	2. Strengthening of Neyveli TS-II to Neyveli TS-I expansion 400kV link with higher capacity conductor	400kV	D/C	UC
SR - 46	**Connectivity to Garividi SS**			
	1. Establishment of Grivid 400/ 220 kV SS	400/220 kV	trf	UC
	2. Kalapaka - Garividi 400 kV D/c (Quad) Line	400kV	D/C	UC
SR - 47	**Evacuation Sysytem for Hinduja**			
	1. 400kV twin moose D/c line from Kalpaka S/s to Hinduja (HNPCL) Switchyard.	400kV	D/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	2. A new 400/220kV KVKota S/s with 2x315MVA capacity	400/220kV	trf	UC
	3. 400kV twin moose D/c line from HNPCL switchyard to the proposed KVKota S/s.	400kV	D/C	UC
	4. 400/220kV Suryapet S/s with 2x315MVA capacity	400/220kV	trf	UC
	5. 400kV quad moose D/c line from proposed KVKota S/s to proposed Suryapet S/s.	400kV	D/C	UC
	6. 400kV quad moose D/c line from proposed Suryapet S/s to 400/220kV Yeddumailaram(Shankarapally).	400kV	D/C	UC
	7. 400kV twin moose D/c line from proposed KVKota S/s to Vemagiri S/s.	400kV	D/C	UC
SR - 48	**Transmission Requirement for A.P**			
	1. 400/220kV Manikonda S/s (2x315MVA)	400/220kV	trf	UC
	2. LILO of both circuits of proposed 400kV Suryapet - Yeddumailaram quad moose D/c line	400kV	D/C	UC
	3. 400/220kV Maheswaram S/s(APTRANSCO) (2x315MVA)	400/220kV	trf	UC
	4. 400/220kV Podili S/s (3x315MVA)	400/220kV	trf	UC
	5. 400kV twin moose D/c line to 400/220kV Narsaraopeta/Sattenpalli S/S(APTRANSCO)	400kV	D/C	UC
	6. 400/220kV Kalikiri S/s (2x315MVA)	400/220kV	trf	UC
	7. LILO of both circuits of 400kV RayalseemaTPP-IV - Chitoor D/C line.	400kV	D/C	UC
SR - 49	**ATS FOR ETPS EXPANSION – 1X660MW**			Planned
	1. 400kV DC Quad connectivity from ETPS Expansion switchyard to the 765/400kV Pooling station at North Chennai. (Generation at 400kV level)	400kV	D/C	Planned
	2. 1X125 MVAR,420kV Bus Reactor at generation switchyard.	400kV	reactor	Planned
SR - 50	**ATS FOR ENNORE SEZ (NCTPS Stage-IV) – 2X660MW**			Planned
	1. 400kV DC Quad connectivity from Ennore SEZ switchyard to the 765/400kV Pooling station at North Chennai. (Generation at 400kV level)	400kV	D/C	Planned
	2. 400kV DC Quad inter link between the ETPS Expansion and Ennore SEZ switchyard for reliability.	400kV		Planned
	3. 2X125MVAR, 420kV Bus Reactors at generation switchyard	400kV	reactor	Planned
SR - 51	**ATS FOR NCTPS Stage III – 1X800MW**			Planned
	1.765kV DC line from NCTPS Stage III switchyard to the North Chennai Pooling station. (Generation at 765kV level)	765kV	D/C	Planned
	2. 1X240MVAR,765kV Bus Reactor at generation switchyard	765kV	reactor	Planned
SR - 52	**ATS FOR ETPS Replacement – 1X660MW**			Planned
	1.765kV DC line from ETPS Replacement switchyard to North Chennai Pooling station. (Generation at 765kV level)	765kV	D/C	Planned
	2.765kV DC inter link to NCTPS Stage-III for reliability.	765kV		Planned
	3.1X240MVAR, 765kV Bus Reactor at generation switchyard.	765kV	recator	Planned
SR - 53	**ATS for M/S.OPG Power generation Ltd.- 2X360MW : (By OPG)**			Planned
	1. 400kV DC line to the North Chennai Pooling station.	400kV	D/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	2. 2X80 MVAR ,420kV Bus Reactor at the generation switchyard.	400kV	reactor	Planned
SR - 54	**Common Transmission system for above generation projects in Chennai area**			Planned
	Establishment of 765/400kV Pooling Station in North Chennai area			Planned
	1. 765kV DC line from North Chennai 765kV pooling station to Ariyalur 765/400kV SS	765kV	D/C	Planned
	2. Second 765kV DC line from North Chennai 765kV pooling station to Ariyalur 765/400kV SS	765kV	D/C	Planned
	3. 1x240 MVAR, 765kV switchable line reactors in each line at both ends	765kV	Reactor	Planned
	4. 400kV DC line from North Chennai Pooling station to Pulianthope 400/230kV SS	400kV	D/C	Planned
	5. 500MVA, 400/400kV Phase Shifting transformer (PST) at the Pooling station to control the power flow on the Pooling station – Pulianthope 400kV DC line	400kV	PST	Planned
SR- 55-A	**Establishment of 765/400kV Sub Station in Ariyalur (near Villupuram)**			Planned
	1. 2X1500MVA, 765/400kV ICTs	765/400kV	trf	Planned
	2. 765kV DC line from Ariyalur 765/400kV SS to the Thiruvalam PGCIL 765/400kV SS.	765kV	D/C	Planned
	3. 1x240 MVAR, 765kV switchable line reactors in each line at both ends	765kV	Reactor	Planned
	4. LILO of both the circuits of Pugalur – Kalivantapattu 400kV DC Quad line at Ariyalur	400kV	D/C	Planned
	5. 2X240MVAR, 765kV Bus Reactor at 765kV bus of Ariyalur 765/400kV SS	765kV	Reactor	Planned
	6. Provision for 420kV bus reactor at 400kV bus	400kV	Reactor	Planned
SR -55-B	**Establishment of 765/400kV SS in Coimbatore Region**			Planned
	1. 2X1500MVA, 765/400kV ICTs	765/400kV	trf	Planned
	2. 765kV DC line to Ariyalur 765/400kV SS	765kV	D/C	Planned
	3. 240 MVAR, 765kV switchable line reactors in each line at both ends	765kV	Reactor	Planned
	4. Provision for bus reactor at 400kV bus for future requirement	400kV	Reactor	Planned
SR -55-C	**ATS for proposed power plants at Udangudi (2x660 MW + 1x 800MW)**			Planned
	1. 400kV DC Quad line from Udangudi to the Kayathar 400kV SS	400kV	D/C	Planned
	2. 400kV DC line from Udangudi to Samugarengapuram 400/230-110 kV SS	400kV	D/C	Planned
	3. 400kV Quad DC line from Udangudi to Ottapidaram 400/230-110kV SS	400kV	D/C	Planned
	4. Ottapidaram 400/230-110 kV Substation with 2x 315MVA, 400/230kV ICTs	400/220kV	trf	Planned
	5. 2x200 MVA, 400/110 kV ICTs.	400/110kV	trf	Planned
	6. 400 kV DC Quad line from Ottapidaram to Udangudi Switchyard	400kV	D/C	Planned
	7. 400 kV D/C Quad line from Ottapidaram to Kamuthi 400/230-110 kV Substation	400kV	D/C	Planned
	8. LILO of TSipcot – Kavanoor 230kV SC line at Ottapidaram	230kV	S/C	Planned
	9. 230kV DC line from Udangudi to Indbharath generation switchyard (2x150 MW)	230kV	D/C	Planned
	10. LILO of TSipcot – Savasapuram 230kV SC feeder at Ottapidaram	230kV	S/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	11. Kamuthi 400/230-110 kV Substation for Solar Power injection with 3x 315MVA 400/230kV ICTs	400/220kV	trf	Planned
	12. 2x200 MVA, 400/110kV ICTs	400/110kV	trf	Planned
	13. 400 kV DC Quad line from Kamudhi SS to Karaikudi 400kV PGCIL SS	400kV	D/C	Planned
	14. 230kV DC line from Kamudhi SS to Muthuramalingapuram 230kV SS.	230kV	D/C	Planned
	15. 230kV DC line from Kamudhi SS to Kavanoor 230kV SS	230kV	D/C	Planned
SR - 56	**TANTRANSCO Proposals for 400 KV Substations, as System Strengthening.**			Planned
SR- 56-A	**A.Establishment of Samugarengapuram 400/230-110 KV Substation**			
	1. Samugarengapuram 400/230-110 KV wind Substation with 2x 315MVA,400/230kV ICTs	400/230kV	trf	Planned
	2. 2x200 MVA, 400/110kV ICTs	400/110kV	trf	Planned
	3. 400 kV D/C line from Udangudi Switchyard	400kV	D/C	Planned
	4. LILO of Kudankulam – SRPudur 230kV SC line	230kV	S/C	Planned
	5. LILO of Udayathur – Sankaneri 230kV SC line	230kV	S/C	Planned
	6. 230kV DC line to proposed Muppandal 230kV SS	230kV	S/C	Planned
SR -56-B	**B.Establishment of Padukottai 400/230-110 KV Substation**			
	1. Pudukottai 400/230-110 kV Substation with 2x 315MVA,400/230kV ICTs	400/230kV	trf	Planned
	2. 2x200 MVA, 400/110kV ICTs	400/110kV	trf	Planned
	3. LILO of both 400kV Karaikudi – Pugalur TANTRANSCO DC Quad line	400kV	D/C	Planned
	4. 230kV SC line to Karambium 230kV SS	230kV	S/C	Planned
	5. 230kV SC line to Pudukottai 230kV SS	230kV	S/C	Planned
	6. 230kV SC line to Tuvakudi (BHEL) 230kV SS	230kV	S/C	Planned
SR- 56-C	**C.Establishment of Turaiyur 400/230-110 KV Substation**			
	1. Turaiyur 400/230 kV Substation with 2x 315MVA, 400/230kV ICTs	400/230kV	trf	Planned
	2. LILO of one of the NLC – Pugalur 400 kV PGCIL line at Turaiyur	400kV	S/C	Planned
	3. 400 kV D/C line from Turaiyur to Mangalapuram 400 kV Substation	400kV	D/C	Planned
	4. 230kV SC line to Perambalur 230kV SS	230kV	S/C	Planned
	5. 230kV SC line to Samayapuram 230kV SS	230kV	S/C	Planned
	6. 230kV SC line to sanctioned Jambunathapuram 230kV SS	230kV	S/C	Planned
	7. 230kV SC line to the sanctioned Poyyur 230kV SS	230kV	S/C	Planned
SR- 56-D	**D.Establishment of Kolapalur 400/230-110 KV Substation**			
	1. Kolapalur 400/230-110 kV Substation with 2x 315MVA,400/230kV ICTs	400/230kV	trf	Planned
	2. 2x200 MVA, 400/110kV ICTs	400/110kV	trf	Planned
	3. LILO of one of the 400 kV MTPS Stage III – Karamadai TANTRANSCO line at Kolapalur	400kV	S/C	Planned
	4. 400 kV D/C line from Kolapalur to Rasipalayam 400 kV Substation	400kV	D/C	Planned
	5. 230kV SC line from Karmadai to Thingalur 230kV SS	230kV	S/C	Planned
	6. 230kV SC line from Karmadai to Anthiyur 230kV SS	230kV	S/C	Planned
	7. 230kV SC line from Karmadai to Shenbagapudur 230kV SS	230kV	S/C	Planned
	8. LILO of Gobi – Pallakapalayam 230kV feeder	230kV	S/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	9. LILO of Karamadai – Ingur 230kV line at Karmadai	230kV	S/C	Planned
SR -56-E	**E.Establishment of Managalapuram 400/230-110 KV Substation**			
	1. Mangalapuram 400/230 KV Substation with 2x 315 MVA, 400/230 kV ICTs	400/230kV	trf	Planned
	2. LILO of both the Ariyalur – Pugalur 400 kV D/C Quad line at Mangalapuram	400kV	D/C	Planned
	3. LILO of Salem – Singapuram 230kV SC line at Mangalapuram	230kV	D/C	Planned
	4. LILO of Deviakurichi – Valayapatty 230 kV feeder at Mangalapuram	230kV	D/C	Planned
	5. 230 kV SC line from Mangalapuram to Thammampatty 230 kV SS	230kV	S/C	Planned
	6. 230 kV SC line from Mangalapuram to Udayapatty 230 kV SS	230kV	S/C	Planned
SR -56-F	**F.Establishment of Sholingur 400/230-110 KV Substation**			
	1. Sholingur 400/230-110 KV Substation with 2x 315MVA, 400/230 kV ICTs	400/230kV	trf	Planned
	2. 2x200 MVA, 400/110kV ICTs	400/110kV	trf	Planned
	3. LILO of Sriperumbudur- Tiruvalam - Kolar 400 kV S/C PGCIL line. (In between Sriperumbudur & Tiruvalam 400kV Substation)	400kV	D/C	Planned
	4. LILO of Thiruvalam – Mosur 230 kV feeder at Sholingur	230kV	S/C	Planned
	5. LILO of SVChatram – Arni 230 kV feeder at Sholingur	230kV	S/C	Planned
	6. 230 kV DC line from Sholingur to Pattaraiperumbudur 230 kV SS	230kV	D/C	Planned
SR- 56-G	**G.Establishment of Pulianthope 400/230-110 KV Substation**			
	1. Pulianthope 400/230 kV Substation with 3x 315MVA, 400/230kV ICTs	400/230kV	trf	Planned
	2. 400 kV DC Quad line from Pulianthope to North Chennai Pooling Station	400kV	D/C	Planned
	3. 400 kV DC line from Pulianthope to Manali 400/230-110 kV Substation	400kV	D/C	Planned
	4. 230 kv SC cable link to Tondiarpet 230 kV SS	230kV	S/C	Planned
	5. 230 kv SC cable link to Basinbridge 230 kV SS	230kV	S/C	Planned
	6. 230 kv SC cable link to Vysarpadi 230 kV SS	230kV	S/C	Planned
	7. 230 kv SC cable link to CMRL Central 230kV SS	230kV	S/C	Planned
SR- 56-H	**H.Establishment of Mylapore 400/230-110 KV Substation**			
	1. Mylapore 400/230 kV Substation with 2x 315MVA, 400/230 kV ICTs	400/230kV	trf	Planned
	2. 400 kV SC cable from Mylapore to Pulianthope 400/230 kV SS	400kV	S/C	Planned
	3. 400 kV SC cable from Mylapore to Guindy 400 kV SS	400kV	S/C	Planned
SR- 56-I	**I.Establishment of Palavadi 400/230-110 KV Substation**			
	1. Palavadi (Singarapet) 400/230-110 KV Substation	400kV		Planned
	2. 400 kV DC quad line from Singarapet to MTPS Stage III	400kV	D/C	Planned
	3. 400 kV DC quad line from Singarapet to Tiruvalam 400 KV SS	400kV	D/C	Planned
	4. 400 kV quad 2XDC line from Singarapet to Rasipalayam 400 kV Substation	400kV	2xD/C	Planned
	5. LILO of Karimangalam - MALCO 230kV SC line at Singarapet	230kV	S/C	Planned
	6. 230kV line from Singarapet to Gurubarahally 230kV SS.	230kV	S/C	Planned
	7. 230kV DC line from Singarapet to Udanapally 230kV SS	230kV	D/C	Planned
SR - 56-J	**Kayathar – Koilpatty (Tuticorin Pooling point) 400kV DC Quad line**		D/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. Kayathar – Koilpatty (Tuticorin Pooling point) 400kV DC Quad line	400kV	D/C	Planned
SR -56-K	**Pavoorchatram 400kV SS (Tennampatty 400kV SS)**			Planned
	1. LILO of Kodikurichi – Veeranam 230kV line at Pavoorchatram	230kV	D/C	Planned
	2. Establishment of Pavoorchatram 400kV S/s	400/230kV	trf	Planned
SR - 57	**Transmission System for evacuation of power from 2x500 MW Neyveli Lignite Corp. Ltd. TS-I (Replacement) (NNTPS) in Neyveli**			Planned
SR-57-A	**Transmission System for Connectivity**			Planned
	1. 7x167 MVA (single phase), 400/220 kV transformers at generation switchyard (by NLC)	400/220kV	trf	Planned
	2. 1x80 MVAR Bus Reactor at generation switchyard (by NLC)	400kV	Reactor	Planned
	3. LILO of existing Neyveli TS-II – Pondycherry 400 kV SC at NNTPS	400kV	S/C	Planned
SR -57-B	**Transmission System for LTA (as an ISTS)**			Planned
	1. NNTPS switchyard – Villupuram (Ginjee) 400kV D/c line	400kV	D/C	Planned
	2. 2x500 MVA ICTs at Villupuram (Ginjee) 400kV S/S	400/220kV	trf	Planned
SR -57-C	**System Strengthening in Tamil Nadu**			Planned
	1. Establishment of new 230/110kV, 3x160 MVA or 4x100 MVA S/S at Neyveli (by TNEB)	230/110kV	trf	Planned
	2. Shifting of the 230kV (3 nos) and 110kV(7 nos) lines owned by TNEB emanating from the existing Neyveli TS-I switchyard to Neyveli 230kV SS (by TNEB)	230kV		Planned
	3. LILO of both circuits of Neyveli TS-I – Neyveli TS-II 230kV DC line at NNTPS Switchyard (by NLC)	230kV	D/C	Planned
	4. NNTPS switchyard – Neyveli(TANTRANSCO 230kV S/S), 230kV DC line with HTLS conductor (by TNEB)	230kV	D/C	Planned
	5. Neyveli TPS-II - Neyveli(TANTRANSCO 230kV S/S), 230kV D/C line with HTLS conductor (by TNEB)	230kV	D/C	Planned
SR - 58	**System for increasing capacity of Inter-State Transmission system for import of power into SR**			Planned
SR -58-A	**Scheme-1: Inter-Regional AC link Warora-Warangal - Hyderabad- Kurnool 765kV link for import into Southern Region**			Planned
	1. Establishment of 765/400kV substation at Warangal (New) with 2x1500 MVA transformer	765/400kV	trf	Planned
	2. 2x240 MVAR bus reactors at Warangal (New) 765/400 kV SS	765kV	Reactor	Planned
	3. Warora Pool -Warangal (New) 765 kV DC line	765kV	D/C	Planned
	4. 240 MVAR switchable line reactor at both ends.	765kV	Reactor	Planned
	5. Warangal (New) –Hyderabad 765 kV DC line	765kV	D/C	Planned
	6. 330 MVAR switchable line reactor at Warangal end	765kV	Reactor	Planned
	7. Warangal (New) – Warangal (existing) 400 kV (quad) DC line.	400kV	D/C	Planned
	8. Hyderabad– Kurnool 765 kV D/c line	765kV	D/C	Planned
	9. 240 MVAR switchable line reactor at Kurnool end	765kV	Reactor	Planned
	10. Warangal (New) – Chilakaluripeta 765kV DC line	765kV	D/C	Planned
	11. 240 MVAR switchable line reactor at both ends.	765kV	Reactor	Planned
	12. LILO of Kurnool-Thiruvelam 765 kV DC at Cuddapah	765kV	D/C	Planned
	13. Cuddapah- Hoodi 400kV (quad) DC line	400kV	D/C	Planned
	14. 63 MVAR switchable line reactor at both ends	400kV	Reactor	Planned
SR - 58-B	**Scheme-II: HVDC Bipole link between Western region (Chhattisgarh) and Southern region (Tamil Nadu)**			Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. Raigarh(HVDC Stn) – Pugalur (HVDC Stn) 6000 MW HVDC bipole	±800kV	HVDC	Planned
	2. Establishment of Raigarh HVDC Stn and Pugalur HVDC Stn with 6000 MW HVDC terminals	±800kV	HVDC	Planned
	3. Raigarh HVDC Station – Raigarh(Existing) 400kV (quad) 2xDC lines	400kV	2xD/C	Planned
	4. Pugalur HVDC Station – Pugalur (Existing) 400kV (quad) DC line.	400kV	D/C	Planned
	5. Pugalur HVDC Station – Arasur 400kV (quad) DC line	400kV	D/C	Planned
	6. 80 MVAR switchable line reactor at Arasur end.	400kV	Reactor	Planned
	7. Pugalur HVDC Station – Thiruvalam 400kV (quad) DC line	400kV	D/C	Planned
	8. 1x80MVAR switchable line reactor at both ends.	400kV	Reactor	Planned
	9. Pugalur HVDC Station – Edayarpalayam 400 kV (quad) DC	400kV	D/C	Planned
	10. 1x63MVAR switchable line reactor at Edayarpalayam end.	400kV	Reactor	Planned
	11. Edayarpalayam – Udumulpeta 400 kV (quad) DC line.	400kV	D/C	Planned
	12. Establishment of 400/220kV substation with 2x500 MVA transformers at Edayarpalayam	400/220kV	trf	Planned
	13. 2x125 MVAR bus reactors at Edayarpalayam	400kV	Reactor	Planned
SR - 58-C	**Scheme-III: Strengthening of transmission system beyond Vemagiri**			Planned
	1. Vemagiri-II – Chilakaluripeta 765kV DC line	765kV	D/C	Planned
	2. 240 MVAR switchable line reactor at both ends.	765kV	Reactor	Planned
	3. Chilakaluripeta – Cuddapah 765kV DC line	765kV	D/C	Planned
	4. 240 MVAR switchable line reactor at both ends.	765kV	Reactor	Planned
	5. Chilakaluripeta – Narsaraopeta 400kV (quad) DC line	400kV	D/C	Planned
	6. Cuddapah – Madhugiri 400kV (quad) DC line	400kV	D/C	Planned
	7. 80 MVAR switchableline reactor at both ends.	400kV		Planned
	8. Cuddapah-Hindupur 400kV (quad) D/c line	400kV	D/C	Planned
	9. 80 MVAR switchable line reactor at Hindupur end.	400kV		Planned
	10. Srikaukulam Pooling Station – Garividi 400 kV (Quad) D/c line	400kV	D/C	Planned
	11. 80MVAR switchable line reactor at Garividi end.	400kV	Reactor	Planned
	12. Establishment of 765/400kV substation at Chilakaluripeta with 2x1500 MVA transformers	765/400kV	trf	Planned
	13. 2x240 MVAR bus reactor at Chilakaluripeta 765/400kV SS	765kV	Reactor	Planned
	14. Establishment of 765/400kV substation at Cuddapah with 2x1500 MVA transformers	765/400kV	trf	Planned
	15. 2x240 MVAR bus reactor at Cuddapah 765/400kV SS	765kV	Reactor	Planned
	16. Establishment of 400/220kV substation at Podli with 2x315 MVA transformers	400/220kV	trf	Planned
	17. 2x125 MVAR bus reactors at 400/220kV Podli SS	400kV	Reactor	Planned
SR - 59	**Mangalore (UPCL)–Kasargode-Kozhikode 400 kV link**			Planned
	1. Mangalore (UPCL)–Kasargode 400 kV D/c Quad line	400kV	D/C	Planned
	2. Kasargode - Kozhokode, 400kV quad D/c line,	400kV	D/C	Planned
	3. Establishment of 2x500 MVA, 400/220 kV GIS substation at Kasargode	400/220kV	trf	Planned
SR - 60	**Connectivity lines for Maheshwaram (Hyderabad) 765/400kV Pooling S/s.**			Planned
	1 Maheshwaram (PG) – Mahboob Nagar 400 kV D/C line	400kV	D/C	Planned
	2. Nizamabad – Yeddumailaram (Shankarapalli) 400 kV D/C line	400kV	D/C	Planned
SR - 61	**Additional System for import of Power from Eastern**			New

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	Region			
	1. Angul - Srijkakulam 765 kV 2nd D/c line	765kV	D/C	New
	2. Srikakulam - Vemagiri 765 kV 2nd D/c line	765kV	D/C	New
	3. Vemagiri - C'Peta 765 kV D/c line	765kV	D/C	New
WR - 01	**Establishment of 400/220kV GIS substation at Kala in UT of Dadra and Nagar Haveli**			
	1. LILO of both circuits of Vapi –Navi Mumbai 400 kV D/c at proposed Kala S/s in UT DNH	400kV	D/C	Comm.
	2. Establishment of 400/220kV, 2x315 MVA S/s at proposed Kala S/s in UT DNH (GIS)	400/220kV	trf	Comm.
WR - 02	**Establishment of 400/220kV S/s at GIS substation at Magarwada in UT of Daman and Diu**			
	1. LILO of both ckts of Navsari - Boisari 400 kV D/c line at Magarwada S/s	400kV	D/C	UC
	2. Establishment of 400/220kV, 2x315 MVA S/s at Magarwada S/s (GIS)	400/220kV	trf	UC
WR - 03	**Split Bus arrangement and reconfiguration/shifting of terminating lines at Raipur 400kV S/s**			
	1. Splitting 400kV Raipur bus into two sections between existing line bays of Chandrapur-1 & Chandrapur-2 through bus sectionaliser.	400kV	bay	UC
	2. Bypass 400kV Bhatapara-Raipur-Bhilai line at Raipur and restore the line as 400kV Bhatapara-Bhilai S/c	400kV		Comm.
	3. Shifting of Chandrapur-2 and Chandrapur-3 line bays from Section Raipur-B to Raipur-A.	400kV	bay	UC
WR - 04	**Installation of Transformers at Vapi Substation**			
	1. Installation of 400/220kV, 1x315MVA transformer (3rd) each at Vapi(PG) S/stn.	400/220kV	trf	Comm.
WR - 05	**Western Region Stregthening Scheme - III**			
	1. Bachau(PG) – Versansa (GETCO) 400kV D/c	400kV	D/C	UC
WR - 06	**Augmentation of transformers & bays in WR**			
	1. Installation of 400/220KV, 1x315MVA transformer each at Mapusa & Navsari	400/220kV	trf	Comm.
	2. Bays Extension at 400kV Indore – 2 nos for Indore – Pithampur 400kV D/c line (MPPTCL)	400kV	bays	UC
	3. Bays Extension at Pirana 220kV bus- 2 nos	220kV	bays	UC
WR - 07	**Spare transformers/reactors in WR**			
	1.2 nos. 315 MVA ICTs AT Dehgam & Raipur	400/220kV	trf	Comm.
	2. 2 nos. 315 MVA ICTs AT Jabalpur & Pune	400/220kV	trf	UC
	3. 1 nos. 80 MVAR shunt reactors at Itarsi	400kV	reactor	Comm.
	4. 1 nos. 125 MVAR shunt reactors at Wardha	400kV	reactor	Comm.
WR - 08	**Installation of Reactors in Western Region**			
	1. Installation of 1X125 MVAR Bus Reactor at Jabalpur (PG), Khandwa (PG), Shujalpur (PG), Bhatapara (PG), Aurangabad (PG)	400kV	Reactor	UC
	2. Installation of 1X125 MVAR Line Reactor at Solapur (PG) for 400 kV Solapur (PG) –Karad S/c line	400kV	Reactor	Comm.
WR - 09	**Transformers for HVDC back-to-back (BTB) station at Bhadrawati**			
	1. 3 nos. of spare converter transformers.	400kV	Conever ter Trf	UC
	2. 1×315 MVA ICT (along with 2 nos. 220 kV GIS line bays)	400/220kV	trf	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
WR - 10	**Installation of Reactors (Part-II) in Western Region**			
	1. Gwalior (PG) – 1x125MVAR	400kV	reactor	UC
	2. Itarsi (PG)-2x125MVAR	400kV	reactor	UC
	3. Raipur (PG) – 1x125MVAR	400kV	reactor	UC
	4. Parli (PG) – 1x125MVAR	400kV	reactor	UC
	5. Seoni (PG) – 1x125MVAR	400kV	reactor	UC
	6. Pirana (PG) – 1x125MVAR	400kV	reactor	UC
	7. Line Reactor at Raipur (PG) for 400 kV Raipur(PG) – Bhadrawati S/c line) – 1x63MVAR	400kV	reactor	UC
WR - 11	**Dynamic Recative Compensation in Western Region**			
	1. At Aurangabad. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 300 MVAR STATCOM	400kV	Statcom	UC
	2. At Gwalior 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 200 MVAR STATCOM	400kV	Statcom	UC
	3. At Satna. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 300 MVAR STATCOM	400kV	statcom	UC
	4 At Solpaur. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 300 MVAR STATCOM	400kV	statcom	UC
WR - 12	**Installation of Bus Rector and ICT in Western Region**			
	1. 1x125MVAR Bus Reactor at Bina substation	400kV	reactor	UC
	2. 1x1500MVA (4th), 765/400kV transformer at Raigarh Pooling Station (near Tamnar)	765/400kV	trf	UC
	3. 1x500 MVA (3rd), 400/220 kV transformer at Damoh alongwith 2 nos. 220 kV bays	400/220kV	trf	UC
	4. 1x1500MVA (2nd), 765/400kV transformer at Raipur Pooling Station	765/400kV	trf	UC
	5. 2x500 MVA, 400/220 kV transformer at Vadodara alongwith 4 nos. 220 kV GIS bays	400/220kV	trf	UC
	6. 2 nos. 63 MVAR switchable line reactors at Rajgarh for Rajgarh-Sardar Sarovar 400 kV D/c line.	400kV	reactor	UC
WR - 13	**Inter-regional System Strengthening Scheme for WR and NR – Part-A**			
	Solapur - Aurangabad 765 kV D/c line	765kV	D/C	UC
	1x240 MVAR line reactors at both ends of Solapur - Aurangabad 765kV D/c line	765kV	reactor	UC
WR - 14	**ATS for KAPP Extn U-3,4,(1400MW)(Central sector)**			
	1. Kakrapar NPP-Navsari 400kV D/C line	400kV	D/C	UC
	2. Kakrapar NPP-Vapi 400kV D/C line	400kV	D/C	UC
WR - 15	**ATS for Mundra UMPP(4000MW)-Part B (Streghtening in WR)**			
	1. Gandhar-Navsari 400 kV D/C line	400kV	D/C	Comm.
	2. Navsari-Boisar 400 kV D/C line	400kV	D/C	UC
	3. Wardha-Aurangabad 400 kV (Quad) D/c (with provision to upgrade at 1200 kV at later date)	400kV	D/C	UC
	4. Aurangabad-Aurangabad (MSETCL) 400 kV D/C quad	400kV	D/C	Comm.
	5. LILO of both circuit of Kawas-Navsari 220 kV D/C at Navsari (PG)	220kV	D/C	Comm.
	6. Bachchau 400/220 kV, 2x315 MVA substation	400/220kV	trf	Comm.
	7. Navsari GIS 400/220 kV , 2x315 MVA	400/220kV	trf	Comm.
	8. Wardha 765/400 kV , 3x1500 MVA substation	765/400kV	trf	Comm.
	9. Aurangabad(PG) 400/220 kV 2x315 MVA	400/220kV	trf	Comm.
	10. Extn. 765 kV at Seoni and Wardha S/s	765/400kV	bay	Comm.
	11. Extn. 400 kV at Limbdi,Ranchodpur,Jetpur S/s	400/220kV	bay	Comm.
	12. 40% Fixed Series compensation each on Wardha - Aurangabad 400 kV D/c at Wardha end.	400kV		UC
WR - 16	**ATS for Bhavnagar (2X250 MW)**			

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. BECL - Botad 220 kV D/C line	220kV	D/C	UC
	2. BECL - Sagapara 220 kv D/C line	220kV	D/C	UC
	3. LILO of Sarvakundla - Vartej 220 kV line at BECL	220kV	S/C	UC
WR - 17	**ATS for Sikka Ext. (2X250MW)**			UC
	Sikka - Moti Paneli 220 kV D/C line with Al 59 cond.	220kV	D/C	UC
	LILO of bot ckt. of Jamnagar - Jetpur 220 kV D/C line at Sikka	220kV	D/C	UC
WR - 18	**Pipavav CCPP(2x351 MW) GSECL**			
	1. PipavavTPS- Dhokadva 220kV D/c line	220kV	D/C	UC
	2. LiLO of both Savarkundla – Mahva220kV lines at Pipavav(GPPC)	220kV	2xD/C	Comm.
	3. Mahuva – Sagapara 220kV D/C line	220kV	D/C	Comm.
WR - 19	**Ukai Extn. (GSECL) 500 MW**			
	1. LILO of 400 kV Asoj- Ukai at Kosamba D/C	400kV	D/C	Comm.
	2. Ukai –Kosamba 400kV D/C line	400kV	D/C	Comm.
	3. Kosamba – Chornia 400kv D/C line	400kV	D/C	UC
	4. Kosamba – Jagadia 220kV D/C line	220kV	D/C	UC
WR - 20	**Wanakbori TPS (GSECL) 500 MW**			
	1. LILO of one ckt of 400 kV Wanakbori – Soja line at Dehgam(PG)	400kV	D/C	Comm.
	2. Soja- Zerda 400kV D/C line	400kV	D/C	Comm.
	3. Wanakbori Sw. Yard- Wanakbori(existing) 400kV D/C line	400kV	D/C	Comm.
	4. Wanakbori- Soja 400kV D/c line	400kV	D/C	Comm.
WR - 21	**Shapoorji Pallonji Energy Ltd. (SPEL) (1320 MW)**			
	1. SPEL – Pirana 400kV D/c line	400kV	D/C	UC
	2. SPEL- Amreli 400kV D/c line	400kV	D/C	UC
WR - 22	**DGEN TPS -Torrent Power Ltd. (1200 MW)**			
	1. DGEN TPS – Navsari 400kV D/c (triple snowbird)	400kV	D/C	Comm.
	2. DGEN TPS-Vadodara 400 kV D/C (twin Moose)	400kV	D/C	UC
	3. Navsari-Bhestan 220 kV D/C line	400kV	D/C	UC
WR - 23	**Vindhyachal STPP -IV (2X500 MW), Rihand STPP-III (2X500 MW) of NR**			
	1. Rihand-III- Vindhyachal Pool 765 kV D/c line (initially to be operated at 400 kV)	765kV	D/C	Comm.
	2. Vindhyachal-IV - Vindhyachal Pool 400 kV D/c (Quad)	400kV	D/C	Comm.
	3. Vindhyachal Pool-Satna 765 kV 2xS/c	765kV	2xS/C	Comm.
	4. Satna - Gwalior 765 kV 2xS/c	765kV	2xS/C	Comm.
	5. Gwalior - Jaipur(South) 765 kV S/c	765kV	S/C	UC
	6. Vindhyachal Pool-Sasan 765 KV S/c	765kV	S/C	Comm.
	7. Vindhyachal Pool-Sasan 400 KV D/c	400kV	D/C	Comm.
	8. Establishment of 765/400kV, 2x1500 MVA S/s at Vindhyachal Pool	765/400kV	trf	UC
WR - 24	**ATS for Sasan UMPP (3960MW) -Part A**			
	1. 765 kV Sasan – Satna line-I	765kV	S/C	Comm.
	2. 765 kV Sasan – Satna line-II	765kV	S/C	Comm.
	3. 765 kV Satna - Bina(PG) line-I	765kV	S/C	Comm.
	4. 765 kV Satna - Bina(PG) line-II	765kV	S/C	Comm.
	5. 765 kV Sasaram - Fatehpur line-II	765kV	S/C	Comm.
	6. 765 kV Fatehpur - Agra line	765kV	S/C	Comm.
	7. 400 kV Bina(PG)-Bina(MPPTCL) line	400kV	S/C	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	8. LILO of both ckts of Vindhyachal-Jabalpur 400 kV D/c at Sasan (LILO of one ckt to be retained with switching arrangement and other LILO to be bypassed subsequent to development of Sasan 765kV SS)	400kV	D/C	Comm.
WR - 25	**ATS for Sasan UMPP(3960MW) -Part B (Strengthening in WR)**			
	1.Bina(PG)-Indore(PG) 765 kV S/C	765kV	S/C	Comm.
	2. Indore(PG)-Indore (MPPTCL) 400 kV D/C quad	400kV	D/C	Comm.
	3. Indore S/S 765/400 kV, 2x1500 MVA	765/400kV	trf	Comm.
	4. Establishment of new 765/400 kV, 2x1500 MVA S/s at Gwalior	765/400kV	trf	Comm.
	5. Extn. 765/400 kV, 2x1000 MVA S/s at Bina (PG)	765/400kV	trf	Comm.
	6. Establishment of new 765/400 kV, 2x1000 MVA S/s at Satna	765/400kV	trf	Comm.
	7. Extn. 765 kV at Agra, Gwalior, , Bina & Seoni S/s	765kV	bay	Comm.
	8. Provision of 765 kV Bays for charging of Seoni - Bina S/c line at 765 kV level	765kV	bay	Comm.
WR - 26	**ATS for Bina Power (2x250 MW)**			
	1. 400kV D/C line up to common point on D/c tower from Bina TPS	400kV	D/C	Comm.
	2. Termination of one ckt. Of above at Bina (PG) and other ckt at Bina (MPTCL)	400kV	D/C	Comm.
WR - 27	**ATS for Mahan Power (1200MW)**			
	1. Gandhar – Hazira 400kV D/c line	400kV	D/C	Comm.
	2. LILO of 400kV Vindhyachal – Korba line at Mahan S/S	400kV	D/C	Comm.
	3. Mahan- Bilaspur 400kV D/C line	400kV	D/C	
	4. Hazira S/s 400/220kV (2x500MVA) S/S	400/220kV	trf	Comm.
WR - 28	**Dedicated Transmission line for [Aryan Coal Benefication (2X600MW), DB Power (MP) Ltd., U-1, 2 (1320 MW), Vindhyachal-V (500 MW), Chitrangi Power (5940 MW)]**			13-12-117
	DTL for Aryan Coal Benefication (2X600MW)			
	1. Aryan Coal – Vindhyachal Pooling Station 400kV D/c (high capacity)	400kV	D/C	UC
	2. Two nos of 400kV bays at Vindhyachal Pooling Station	400kV	bay	UC
	DTL for DB Power (MP) ltd., U-1, 2 (1320 MW)			UC
	1. DB Power – Vindhyachal Pooling Station 400kV D/c (quad) line	400kV	D/C	UC
	2. Two nos of 400kV bays at Vindhyachal Pooling Station	400kV	bay	UC
	Vindhyachal –V (500 MW) (Central Sector)			
	1. Vindhyachal - Vindhyachal Pooling Station 400kV D/c (quad) line	400kV	D/C	UC
WR - 29	**Jaiprakash Power Ventures Ltd.- Nigri TPP(2x660 MW)**			
	1. Jaiprakash – Satna 400kV D/c (high capacity)	400kV	D/c	UC
	2. Two nos of 400kV bays at Satna(POWERGRID)	400kV	bay	UC
WR - 30	**Dedicated Transmission System for Generaion projects in MP connecting to Jabalpur Pooling Point [Moserbear Power]**			13-12-117
	Moserbear Power (Annupur TPP) (1200 MW)			
	1. MB Power- Jabalpur PS 400 kV D/c line(Triple)	400kV	D/C	UC
	2. Jabalpur Pooling station- Jabalpur (existing)	400kV	D/C	Comm.
WR - 31	**ATS for Malwa (Shree Singaji) TPP (1200MW)**			
	1. Malwa TPH - Pithampur 400 kV D/c line	400kV	D/C	Comm.
	2. Malwa TPH - Julwania 400 kV D/c lineone ckt via Chhegaon	400kV	D/C	Comm.
	3. Chhegaon - Julwania 400 kV D/c line	400kV	D/C	

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	4. Malwa TPH - Chhegaon 220 kV D/c line	220kV	D/C	
	5. Pitampur(400kV)- Pitampur(220kV) inter-connection	220kV	D/C	
	6. LILO of both ckts of 220kV Nimrani – Julwanai at Julwania400kV S/S	220kV	2xD/C	
WR - 32	**Satpura Ext TPP U-10,11 (500MW**			
	1. Satpura TPH - Ashta 400 kV D/c line	400kV	D/C	
	2. Astha – Indore-II(Jetpura) 220kV S/c on D/c	220kV	S/C on D/C	
	3. Astha New 400/220kv S/s (630MVA)	400/220kV	trf	Comm.
	4. Astha (add transformer) 220/132kV	220/132kV	trf	Comm.
WR - 33	**ATS for Mauda STPS- I (2X500) MW**			
	1. Mauda STPS– Wardha 400 kV D/c (Quad)	400kV	D/C	Comm.
	2. Extn. Of 400/220 kV Wardha S/s	400/220kV	bay	Comm.
WR - 34	**ATS for Mauda STPS- II (2X660) MW**			
	1. Mauda II - Betul 400kV D/C (Quad)	400kV	D/C	UC
	2. Betul -Khandwa 400kV D/C(Quad)	400kV	D/C	UC
	3. Khandwa-Indore 400kV D/C(second circuit)	400kV	D/C	UC
	4. 400/220kV, 2X315 MVA S/S at Betul	400/220kV	trf	UC
WR - 35	**ATS for Tiroda Adani Ph-1,Ph –II(1320MW+1320MW)**			
	1.Tiroda (Gondia) - Warora 400 kV D/c line (quad)	400kV	D/C	Comm.
	2.Tiroda-Koradi III 765 kV 2xS/c line	765kV	2xS/C	UC
	3. Koradi-III - Akola-II 765 kV 2xS/c line	765kV	2xS/C	UC
	4. Akola-II - Aurangabad II 765 kV 2xS/c line	765kV	2xS/C	UC
	5. 2x1500 MVA, 765/400 kV ICT at Tiroda (Gondia)	765/400kV	trf	Comm.
	6. Aurangabad II-Aurangabad (PG) 765kV S/C(with D/C towers)	765kV	S/C	UC
	7. Aurangabad(II)765/400kV,2X1500MVA substation	765/400kV	trf	UC
WR - 36	**ATS for IndiaBulls Realtech Ltd (Nasik) Phase I & II (5x270 + 2x270 MW)**			
	1. Sinnar – Nasik 400kV D/C	400kV	D/C	Comm.
	2. Sinnar – Bableshwar 400kV quad D/C line	400kV	D/C	UC
WR - 37	**ATS for India Bulls- Amaravati-Nandagaonpet(4X660 MW)**			
	1. Nandagaonpet-Akola-I 400 KV D/c Line (Quad)	400kV	D/C	UC
	2. LILO of Akola-I- Koradi-I 400kV S/c line at Nandgaonpet	400kV	D/C	Comm.
WR - 38	**ATS for Ideal Power (Bela TPP)(540MW)**			
	1. LILO of one ckt of 400 kV Koradi-II - Wardha (PG) at M/s Ideal Energy	400kV	D/C	UC
WR - 39	**ATS for Dhariwal Infrastructure(600 MW)**			
	1. LILO of one ckt of Bhadrawathi(PG)-Parli 400 KV D/c line at Dhariwal TPS	400kV	D/C	Comm.
WR - 40	**ATS for EMCO-Maharashtra**			
	EMCO-Bhadrawathi(PG) 400 kV D/c line	400kV	D/C	Comm.
WR - 41	**ATS for Parli (Replacement) U-8 (250MW)**			
	1. Parli-Nanded 220kV D/C line	220kV	D/C	
	2. LILO of 220kV Parlib GCR-Beed at Parli D/C line	220kV	D/C	
WR - 42	**ATS for Koradi((1980 MW)**			
	Koradi-II – Koradi–III 400 kV quad D/C line	400kV	D/C	
	7X167 MVA, 400/220 kV S/s at Koradi-II	400/220kV	trf	
WR - 43	**ATS for Chandrapur II TPS (1000MW)**			

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. LILO of both circuits of Chandrapur - Parli 400kV D/C at Chandrapur-II (that is LILO of 2 circuits out of 3)	400kV	D/C	Comm.
	2. Chandrapur-II – Warora – Wardha PG 400kV quad D/C	400kV	D/C	Comm.
	3. 2x500 MVA, 400/220 kV S/s at Chandrapur-II	400/220kV	trf	Comm.
WR - 44	**GEPL TPP U-1&2 (2x60) MW**			
	1. GEPL – MIDC 220kV D/C line	220kV	D/C	UC
WR - 45	**Dedicated Transmission System for Generaion projects in Raigarh complex near Kotra [RKM Powergen Ltd, SKS Ispat & Power Ltd, DB Power Ltd, Avanta BhandarTPP, Athena Chhattisgarh Power Ltd. (2x600MW)]**			
	Dedicated Transmission line for RKM Powergen Ltd (Uchpanda TPP) (4x360MW)			
	RKM Powergen – Raigarh Pooling Station(near Kotra) 400kV D/c(Quad)	400kV	D/C	UC
	Dedicated Transmission line for SKS Ispat & Power Ltd (4x300MW) (Darrampura TPP)			UC
	SKS Ispat - Raigarh Pooling Station (near Kotra) 400kV D/c(Quad)	400kV	D/C	UC
	Dedicated Transmission line for DB Power Ltd (2X600MW)			UC
	DB Power – Raigarh Pooling Station (near Kotra) 400kV D/c (Quad)	400kV	D/C	UC
	Dedicated Transmission line for Avantha Bhandar (Korba West) TPP(1X600MW)			
	Korba West – Raigarh Pooling Station 400kV D/c line	400kV	D/C	Comm.
	Dedicated Transmission line for Athena Chhattisgarh Power Ltd. (2x600MW)			UC
	Athena Chhattisgarh – Raigarh Pooling Station(near Kotra) 400kV D/c(Quad)	400kV	D/C	UC
WR - 46	**Dedicated Transmission System for Generaion projects in Champa complex [Akaltara(KSK Mahanadi) Power Ltd (2400MW), Karnataka Power Corp Ltd.(KPCL) (1600MW), Lanco Amarkantak Power(1320MW), MB Power (Chhattisgarh) Ltd. (2x660 MW)]**			
	Dedicated Transmission line for Akaltara (KSK Mahanadi) Power Ltd (6X600MW)			UC
	Wardha Power (KSK Mahanadi) – Champa Pooling Station 400kV 2xD/c (Quad)	400kV	2xD/C	UC
	Dedicated Transmission line for Lanco Amarkantak Power(2X660MW)			UC
	Lanco - Champa Pooling Station 400kV D/c (Quad)	400kV	D/C	UC
WR - 47	**Dedicated Transmission System for Aryan Coal Beneficiaries Ltd., Dheeru Powergen and PTC India ,Spectrum Power, Maruti Clean Coal & Power Ltd. at WR Pooling Point (Bilaspur)**			
	Dedicated Transmission System for Maruti Clean Coal and Power Ltd(300MW)			
	1. Maruti-WR Pooling Station(Bilaspur) 400kV D/C	400kV	D/C	Comm.
	Aryan Coal Benefications Pvt. Ltd. (1200MW)			
	1. Aryan Coal – WR Pooling Point (Bilaspur) 400kV D/C	400kV	D/C	Comm.
	Spectrum Power (100MW) (Private Sector)			

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. Interconnecton of Spectrum Generation with Aryan Coal Benefications Pvt. Ltd.	400kV	D/C	Comm.
WR - 48	**Dedicated Transmission System for Jindal Power Ltd., TRN Energy Ltd (600MW), Sarda Energy & minerals(SEML) (350 MW), Jayaswal New Urja Ltd(JNUL) (600MW)**			
	Dedicated Transmission System for Raigarh Ph-III(4x600MW) (Jindal Power Ltd)			13-12-117
	Jindal Power – Raigarh Pooling Station (near Tamnar) 400kV 2xD/c (Quad)	400kV	2xD/C	Comm.
	Dedicated Transmission System for TRN Energy (2x300MW)			
	TRN Energy – Raigarh Pooling Station (near Tamnar) 400kVD/c (Quad)	400kV	2xD/C	UC
WR - 49	**Dedicated Transmission System for Balco Ltd (600MW),Vandana Vidhyut Ltd. (540 MW)**			
	Balco Ltd (2x300MW) (Private Sector)			
	Balco – Dharamjaygarh Pooling Station 400kV D/c	400kV	D/C	UC
	Vandana Vidyut Ltd. (4x135MW) (Private Sector)			
	Vandana Vidyut – Daramjaygarh Pooling Station 400 kV D/C line	400kV	D/C	UC
WR - 50	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-A**			
	1. Raigarh Pooling Station (near Kotra) - Raipur Pooling station 765 kV D/C line.	765kV	D/C	Comm.
	2. Raigarh Pooling Station (near Kotra) - Raigarh (existing) 400 kV D/C (to be kept open at a later date).	400kV	D/C	Comm.
	3. Raipur Pooling Station – Raipur (existing) 400 kV D/C line (to be kept open at a later date).	400kV	D/C	Comm.
	4. Establishment of 765/400kV 4x1500MVA Raigarh Pooling Station (near Kotra).	765/400kV	trf	Comm.
	5. Establishment of 765/400kV 1x1500MVA Raipur Pooling Station	765/400kV	trf	Comm.
WR - 51	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complexand Raipur complex of Chhattisgarh-Part-B**			
	1. Champa Pooling station- Raipur Pooling station 765 kV D/C line.	765kV	D/C	Comm.
	2. Raigarh Pooling station (near Kotra) - Raigarh Pooling station (near Tamnar) 765 kV D/C line.	765kV	D/C	Comm.
	3. Champa Pooling Station – Dharamjaygarh/Korba 765kV S/c line.	765kV	S/C	Comm.
	4. Raigarh Pooling Station (near Kotra) – Champa Pooling Station 765kV S/c line.	765kV	S/C	UC
	5. Establishment of 765/400kV 6x1500MVA Champa Pooling Station	765/400kV	trf	UC
	6. Establishment of 765/400kV 3x1500MVA Raigarh Pooling Station(near Tamnar)	765/400kV	trf	Comm.

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
WR - 52	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-C**			
	Raipur Pooling Station – Wardha 765kV D/c line	765kV	D/C	UC
WR - 53	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-D**			
	1. Wardha – Aurangabad (PG) 765kV D/c line.	765kV	D/C	Comm.
	2. Aurangabad(PG) – Boisar / Kharghar 400kV D/c (Quad) line.	400kV	D/C	UC
	3. Augmentation of transformation capacity by 400/220kV, 1x500 MVA transformer at Boisar	400/220kV	trf	Comm.
	4. Establishment of 765/400kV 2x1500MVA Aurangabad (PG) S/s	765/400kV	trf	Comm.
WR - 54	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-E**			
	1. Aurangabad (PG) – Padghe(PG) 765kV D/c line	765kV	D/C	UC
	2. Padghe (PG) – Padghe(MSETCL) 400kV D/c (Quad) line.	400kV	D/C	UC
	3. Vadodara – Asoj 400kV D/c(Quad) line.	400kV	D/C	Comm.
	4. Establishment of 765/400kV, 2x1500MVA Padghe(PG) S/s [GIS Substation]	765/400kV	trf	UC
WR - 55	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-F**			
	Raipur Pooling Station – Wardha 765kV 2nd D/c line	765kV	S/C	UC
WR - 56	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-G**			
	Wardha – Aurangabad (PG) 765kV 2nd D/c line	765kV	S/C	UC
WR - 57	**Combined ATS for Generation Projects located in Raigarh Complex near Kotra, Raigarh complex near Tamnar, Champa complex and Raipur complex of Chhattisgarh-Part-I**			
	1. A ±800kV, 6000 MW HVDC bipole between Champa Pooling Station (WR) – near Kurushetra (NR) in Haryana with metallic return (initially to be operated at 3000 MW).	±800kV	hvdc	UC
	2. Establishment of 3000 MW, ±800 kV HVDC bipole terminal each at Champa pooling station and near Kurushetra in Haryana with provision to upgrade the terminals to 6000 MW.	±800kV	HVDC	UC
	3. Kurukshetra(NR) - Jallandhar 400kV D/c(Quad) line (one ckt. via 400/220kV Nakodar S/s).	400kV	D/C	UC
	4. LILO of Abdullapur – Sonepat 400kV D/c(triple) at Kurukshetra	400kV	2xD/C	UC
	5. Establishment of 400/220kV, 2x500 MVA S/s at Kurukshetra	400/220kV	trf	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	6. Establishment of 400/132kV, 2x200 MVA S/s at Champa Pooling Point	400/132kV	trf	UC
WR - 58	**System Strengthening in WR for Generation Projects in MP and Chhattisgarh (being pooled at Bilaspur Pooling Station)**			
	1. Indore - Vadodara 765kV S/c	765kV	S/C	Comm.
	2. Vadodara – Pirana 400kV D/c(Quad)	400kV	D/C	Comm.
	3. Establishment of 765/400kV 2x1500MVA Vadodara substation	765/400kV	trf	UC
WR - 59	**System Strengthening in WR for Generation Projects in Western Region**			
	1. Jabalpur – Bhopal -Indore 765kV S/c (quad bersimis)	765kV	S/C	UC
	2. Aurangabad – Dhule- Vadodara 765kV S/c (quad bersimis)	765kV	S/C	UC
	3. Bhopal (PG) –Bhopal (MPTCL) 400kV D/C quad line	400kV	D/C	Comm.
	4. Dhule (PG) – Dhule (MSETCL) 400kV D/C quad line	400kV	D/C	UC
WR - 60	**Swastik TPP U-1(25 MW) (Private Sector)**			
	1. LILO of Korba – Mopaka 132KV line at Swastik TPP	132kV	D/C	
WR - 61	**Ratija TPP (50 MW) (Private Sector)**			
	1. Ratija – Kasaipalli 132KV D/C line	132kV	D/C	
WR - 62	**MARWA CSEB (2x500 MW)**			
	1. Marwa-Raipur(Raita) 400 kV D/c line	400kV	D/C	Comm.
	2. LILO of One ckt of Korba(W) – Khedamara 400 kV D/c line at Marwa	400kV	D/C	
	3. Establishment of 400/220kV, S/s at Raipur(Raita) (2x315 MVA) and Marwah Switchyard (1x315 MVA)	765/400kV	trf	Comm.
WR - 63	**ATS for Korba(W)St-III(500MW)**			
	1. LILO of 400 kV Korba(West)- Bhilai at Raipur DCDS	400kV	D/C	Comm.
	2. Korba (West) - Khedamara DCDS 400 kV D/C line	400kV	D/C	Comm.
	3. Raipur 400/220 kV S/s (2x315 MVA)	400/220kV	trf	Comm.
WR - 64	**System Strengthening in WR common for Western Region and Northern Region**			
	1. Jabalpur -Bina 765kV S/c	765kV	S/C	Comm.
	2. Jabalpur - Dharamjaygah765kV D/c	765kV	D/C	UC
WR - 65	**Chhattisgarh Supplementary Scheme**			
	1. Installation of 765/400KV, 2x1500MVA transformer at Dharamjaygarh.	765/400kV	trf	Comm.
WR - 66	**Transmission system for Solar projects in Charanka Solar Park (950.5 MW)**			
	1. (a) Charanka –Sankhari 400kV D/C line (ACSR Twin Moose)	400kV	D/C	
	1. (b) Charanaka 400/220 kV S/s (2x315 MVA)	400/220kV	trf	
	1. (c) 400 kV, 125 MVAR bus reactor at Charanka S/s	400kV	reactor	
	2. 220/66 kV ,8X100 MVA Charanka Pooling Station	220/66kV	trf	
	3. Charanka-Jangral 220kV D/C line (AI-59).	220kV	D/C	
	4. Around 452kms 1Cx630 sq mm of 66 kV cable for interconnection of Solar Projects in each plot of the Solar Park with Pooling Station	66kV		

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
WR - 67	**Transmission system for wind projects in Gujarat (4500 MW)**			
	1. Jamanwada W/F S/S-Versana 220 kV D/C –(AAAC Moose conductor)	220kV	D/C	
	2. Nakhatarana W/F S/S-Versana 220 kV D/C (AAAC Moose conductor)	220kV	D/C	
	3. Vandiya W/F SS – Halvad (400 kV SS) 220 kV D/C line (Zebra conductor	220kV	D/C	
	4. Kanmer W/F SS – Halvad (400 kV SS) 220 kV D/C line (Zebra conductor)	220kV	D/C	
	5. Chotila W/F SS – Jasdan 220 kV D/C line (Zebra conductor	220kV	D/C	
	6. Malvan W/F SS – Chorania 220 kV D/C line (Zebra conductor)	220kV	D/C	
	7. Dhanki W/F SS – Bhatia 220 kV D/C line (Zebra conductor)	220kV	D/C	
	8. Bhanvad W/F SS- Bhomiyavadar 132 kV D/C line.	132kV	D/C	
	9. Tebhada W/F SS Nyara (Rajkot) 220 kV D/C line (AAAC Moose conductor)	220kV	D/C	
	10. Maliya W/F SS – Tankara 220 kV D/C line (Zebra conductor)	220kV	D/C	
	11. Rojmal W/F SS – Amreli 220 kV D/C line (AAAC Moose conductor)	220kV	D/C	
	12. Shapur W/F SS – Halvad (400 kV SS) 220 kV D/C line (AAAC Moose conductor)	220kV	D/C	
	13. Kodadha W/F SS – Tharad 220 kV D/C line (AAAC Moose conductor)	220kV	D/C	
	14. Patan W/F SS – Radhanpur 220 kV D/C line (Zebra conductor)	220kV	D/C	
WR - 68	**System Strengthening for wind projects in Gujarat (4500 MW)**			
	1. Varsana-Halvad 400kV D/C Quad line along with 400/220kV, 2x315MVA Halvad substation.	400kV	D/C	
	2. 220/66 kV, 100 MVA Tankara substation,	220/66kV	trf	
	3. 220/132 kV, 200MVA Bhatia substation	220/132kV	trf	
	4. 220/66 kV, 100MVA Jasdan substation.	220/66kV	trf	
	5. 220/132kV, 100MVA Jasdan substation.	220/132kV	trf	
	6. Bhatia-Kalavad-Kangasiyali 220kV D/C line (AAAC Moose).	220kV	D/C	
	7. Morbi-Tankara-Chorania 220kV D/C line (AAAC Moose).	220kV	D/C	
	8. Amreli-Jasdan 220kV D/C line(AAAC Moose).	220kV	D/C	
	9. Varsana- Bhachau- Radhanpur 220kV D/C line (AAAC Moose).	220kV	D/C	
	10. Nakhatrana-Varsana 220kV D/C line (ACSR Zebra).	220kV	D/C	
	11. Bhatia(220kV)-Bhatia(132kV) 132 kV D/C line(ACSR Panther).	132kV	D/C	
WR - 69	**Transmission System for Essar Power Gujarat Limited (EPGL)**			UC
	1. Essar Power TPS –Bachau 400 kV D/c (triple) line	400kV	D/C	UC
	2. 1x63 MVAR line reactor at Bachau end on both circuits of above line	400kV	Reactor	UC
WR - 70	**Dedicated Transmission System for Generaion projects in MP connecting to Jabalpur Pooling Point [Moserbear Power, Today Energy, Jhabua Power, SKJ Powergen Ltd. (1320 MW)]**			

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	Jhabua Power (2x600MW)			UC
	1. Jhabua Power- Jabalpur pooling Station (high capacity line)	400kV	D/C	UC
WR - 72	**Transmission System Associated with Gadarwara STPS (2x800MW) of NTPC (Part-A)**			
	1.Gadarwara - Jabalpur Pool 765kV D/c line,	765kV	D/C	UC
	2. Gadarwara - Warora Pool 765kV D/c line	765kV	D/C	UC
	3. LILO of all both circuits of Wardha - Parli (new) 400kV D/c line at Warora Pool,	400kV	2xD/C	UC
	4.Establishment of 2x1500MVA, 765/400kV substation at Warora.	765/400kV	trf	UC
WR - 73	**Transmission System Associated with Gadarwara STPS (2x800MW) of NTPC (Part-B)**			
	1. Warora Pool - Parli 765kV D/c line	765kV	D/C	UC
	2.Parli - Solapur 765kV D/c line	765kV	D/C	UC
	3.Parli(new) - Parli (PG) 400kV D/c (quad) line,	400kV	D/C	UC
	4. Establishment of 2x1500MVA, 765/400kV substation at Parli (new).	765/400kV	trf	UC
WR - 74	**Solapur STPP(2x660MW) transmission system**			UC
	1. Solapur STPP – Solapur (PG) 400kV 2 x D/c (Quad).	400kV	D/C	UC
	2. Augmentation of 400/220kV ICT by 1x500 MVA transformer at Solapur (PG).	400/220kV	trf	UC
WR - 75	**Dedicated Transmission System for GMR Chattishgarh Energy Pvt. Ltd (Raipur complex) (2X685MW)**			
	GMR Chattishgarh - Raipur Pooling station 400 kV D/C line (quad)	400kV	D/C	Comm.
	Transmission System Associated with Lara STPS-I (2x800MW)			UC
	1. Lara STPS-I – Raigarh (Kotra) Pooling Station 400 kV D/c line	765kV	D/C	UC
	2. Lara STPS-I – Champa Pooling Station 400 kV D/c (quad) line.	765kV	D/C	UC
WR - 77	**Transmission System for Transfer of power from IPPs in SR to NR/WR - WR**			
	1. Establishment of 2x1000MVA 765/400 kV station at Orai	765/400kV	trf	Planned
	2. LILO of one circuit of Satna – Gwalior 765 kV line at Orai	765kV	D/C	Planned
	3. Establishment of 2x1500MVA 765/400 kV station at Aligarh	765/400kV	trf	Planned
	3a. LILO of Agra – Meerut 765 kV line at Aligarh	765kV	D/C	Planned
	4. Jabalpur Pooling Station – Orai 765kV D/c line	765kV	D/C	Planned
	5. LILO of Kanpur – Jhatikara 765kV S/c line at Aligarh S/s	765kV	D/C	Planned
	6. Orai – Aligarh 765 kV D/c line	765kV	D/C	Planned
	7. Orai-Orai (UPPCL) 400kV D/c Quad – 20 km	400kV	D/C	Planned
WR - 78	**Comprehensive Strgethening in ISTS (NR) related to Wind Projects**			Planned
	1. Bhuj Pool–Banaskanta 765 kV D/c	765kV	D/C	Planned
	2. Banaskanta -Chittorgarh 765 kV D/c	765kV	D/C	Planned
	3. Banaskanta-Sankhari 400 kV D/c	765kV	D/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	4.765/400/220kV (765/400 kV-2x1500 MVA & 400/220kV-2x500MVA) substation each at Bhuj Pool	765/400kV	trf	Planned
		400/220kV	trf	Planned
	4.765/400/220kV (765/400 kV-2x1500 MVA & 400/220kV-2x500MVA) substation each at Banaskanta	765/400kV	trf	Planned
		400/220kV	trf	Planned
	5. Associated reactive compensation (Bus reactors & line reactors)	765kV,400kV, 220kV	recator	Planned
WR - 79	**Additional System Strengthening for Sipat STPS**			Planned
	1. Sipat - Bilaspur Pooling Station 765kV 3rd S/c line,	765kV	S/C	Planned
	2. Bilaspur Pooling Station - Dhanwahi Pooling Station 765kV D/c line,	765kV	D/C	Planned
	3. LILO of both circuits of Jabalpur - Orai 765kV D/c line at Dhanwahi Pooling Station (2xD/c),	765kV	2XD/C	Planned
	4. LILO of all circuits of Vindhyachal - Jabalpur 400kV 2xD/c lines at Dhanwahi Pooling Station (4xD/c).	400kV	4xD/C	Planned
	5. Establishment of Dhanwahi Pooling Station with 2x1500 MVA, 765/400kV ICTs	765/400kV	trf	Planned
WR - 80	**System Strengthening for IPPs in Chhattisgarh and other generation projects in WR**			Planned
	1. Gwalior - Morena 400kV D/c line.	400kV	D/C	Planned
	2. Establishment of 2x315MVA, 400/220kV substation at Morena,	400/220kV	trf	Planned
	3. Vindhyachal-IV & V STPP - Vindhyachal Pooling Station 400kV D/c (Quad) 2nd line	400kV	D/C	Planned
	4. Sasan UMPP - Vindhyachal Pooling Station 2nd 765kV S/c line,	765kV	S/C	Planned
	5. LILO of one circuit of Aurnagabad - Padghe 765kV D/c line at Pune,	765kV	D/C	Planned
	6. Raigarh (Kotra) - Champa Pool 765kV 2nd S/c line	765kV	S/C	Planned
	7.Champa Pool - Dharamjaigarh 765kV 2nd S/c line.	765kV	S/C	Planned
WR - 81	**Additional System Strengthening for Chhattisgarh IPPs**			Planned
	1. Raipur Pool - Rajnandgaon 765kV D/c line	765kV	D/C	Planned
	2.Rajnandgaon - Warora Pool 765kV D/c line	765kV	D/C	Planned
	3. LILO of all 4 circuits of Raipur/Bhilai - Bhadrawati at Rajnandgaon,	400kV	4xD/C	Planned
	4.Establishment of 2x1500MVA, 765/400kV substation at Rajnandgaon.	765/400kV	trf	Planned
WR - 82	**ATS for Pipavav Energy (1200 MW)**			Planned
	1. PipavavTPS- Pirana 400 kV D/c line(Triple) along with 1X125 MVA bus reactor at Pipavav	400kV	D/C	Planned
	2. Pirana –Dehgam 400 kV D/c line (2nd)	400kV	D/C	Planned
	3. Installation of 1X315 MVA , 400/220 kV ICT(3rd) at Pirana	400/220kV	trf	Planned
WR - 83	**ATS for Dhuvarn (Ext.(360MW)**			Planned
	1. LILO of kasor-Vartej 220 kV S/c line at Dhuvarn	220kV	D/C	Planned
	2. LILO of Karamsad-Vartej 220 kV S/c line at Dhuvarn	220kV	D/C	Planned
WR - 84	**Essar Power MP Ltd. (Mahan Phase II) (600 MW) (Private Sector)**			Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. Bus extension of Mahan TPS phase-1 generation project to proposed generation project switchyard along with 1x125MVAR bus rector (connectivity)	400kV		Planned
WR - 85	**Transmission System Associated with Vindhyachal –V**			UC
	1. 2 nos. 765kV bays at Vindhyachal Pooling station & Jabalpur Pooling station	765kV	bays	UC
	2. 1x330 MVAR, 765kV line Reactor alongwith 850 Ohm NGR on both circuit at both ends	765kV	reactor	UC
	3. 1x1500MVA, 765/400kV ICT Vindhyachal Pooling Station	765/400kV	trf	UC
	4. Vindhyachal Pooling station - Jabalpur Pooling Station 765kV D/c line	765kV	D/C	UC
WR - 86	**NPCIL Jaitapur (3480MW) (Central Sector)**			
	1. Jaitapur - Kolhapur 765 kV D/C line. (connectivity)	765kV	D/C	Planned
	2. Aurangabad - Dhule - Vadodara 765kV 2nd S/c line			New
WR - 87	**Dedicated Transmission System for Generaion projects in Champa complex [Akaltara(KSK Mahanadi) Power Ltd (2400MW), Karnataka Power Corp Ltd.(KPCL) (1600MW), Lanco Amarkantak Power(1320MW), MB Power (Chhattisgarh) Ltd. (2x660 MW)]**			
	Dedicated Transmission line for Karnataka Power Corp Ltd.(KPCL) 1600MW)			Planned
	KPCL – Champa Pooling Station 400 kV D/C	400kV	D/C	Planned
	M B Power (Chattisgarh) Ltd(2x660 MW)			Planned
	M B Power - Champa Pooling Station 400kV D/c (Quad)	400kV	D/C	Planned
WR - 88	**Dedicated Transmission System for Jindal Power Ltd., TRN Energy Ltd (600MW), Sarda Energy & minerals(SEML) (350 MW), Jayaswal New Urja Ltd(JNUL) (600MW)**			
	Sarda Energy & minerals(SEML) (350 MW)			
	Sarda Energy– Raigarh Pooling Station (near Tamnar) 400kV D/c line	400kV	D/C	Planned
WR - 89	**Additional Strengthening at Raipur & Raigarh (Tamnar) 765/400kV Substation**			Planned
	1. LILO of both ckts for Jharsuguda- Dharmjaygarh 765kV 1xD/c line at Raigarh (Tamnar)	765kV	D/C	Planned
WR - 90	**Strengthening of ISTS system in Gujarat**			Planned
	Establishement of 765/400kV, 1x1500MVA Pooling Station in Saurashtra Area			Planned
	Saurashtra Pooling Station - Vadodara 765kV D/c	765kV	D/C	Planned
	Saurashtra Pooling Station - Halvad 400kV D/c	400kV	D/C	Planned
	LILO of both ckts of Mundra UMPP - Jetpur 400kV D/c (tripple conductor) at Saurashtra pooling Station	400kV	D/C	Planned
WR - 91	**Evacuation of Power from Adani Mundra Generation Project**			
	1. Adani Mundra - Bhuj Pool 400 kV D/c (quad) line	400kV	D/c	New
WR - 92	**Transmission System Associated with Barethi TPP (NTPC Ltd) (2640MW)**			New

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	1. Barethi TPP - Jabalpur Pooling Station 765kV D/c		D/C	New
	2. Jabalpur Pool - Bhopal - Indore 765kV 2nd S/c		S/c	New
WR - 93	**Transmission System Associated with Khargone TPP (NTPC Ltd) (1600MW)**			New
	1. Khargone TPP - Indore 400kV D/c (High Capacity)		D/C	New
	2. Indore- Vadodara 765kV 2nd S/c		S/c	New
	3. Indore- Bina 765kV 2nd S/c		S/c	New
WR - 94	**Transmission System Strengthening in WR-NR Transmission Corridor**			New
	Up-gradation of ±800kV, 3000MW HVDC Bipole terminal Capacity between Champa Pooling Station & Kurukshetra (NR) to 6000MW	±800kV	HVDC	New
	Kurukshetra - Jind 400kV D/c Quad		D/C	New
	Kurukshetra (NR) - Suitable location near Ambala 400kV d/c (Quad)		D/C	New
WR - 95	**System Strengthening in Saurashtra Area of Gujarat**			New
	1. Saurashtra Pool - Banaskantha 765kV D/c		D/C	New
	2. Saurashtra Pool - Vadodara 765kV D/c 2nd		D/C	New
NR-01	**765kV system for Central Part of Northern Grid-Part-I**			
	1. Agra - Meerut 765 kV S/c	765kV	S/C	Comm.
	2. Agra - Jhatikra 765 kV S/c	765kV	S/C	Comm.
	3. Jhatikra - Bhiwani 765 kV S/c	765kV	S/C	Comm.
	4. Bhiwani – Moga 765 kV S/c	765kV	S/C	Comm.
	5. LILO of both circuits of Mundka/Bawana – Bamnouli at Jhatikra	400kV	2xD/C	Comm.
NR-02	**765kV system for Central Part of Northern Grid-Part-II**			
	1. Agra Substation extension Bay extension	765/400kV	bay	Comm.
	2. Establishment of 765/400/220 kV substation at Jhatikra with 4x1500MVA 765/400 kV	765/400kV	trf	Comm.
	3. Augmentation of Moga & Meerut 400/220 kV substation to 765/400/220 kV susbtation with 2x1500MVA transformation capacity	765/400kV	trf	Comm.
	4. 240 MVAR Bus reactor at Jhatikra	765kV	reactor	Comm.
NR-03	**765kV system for Central Part of Northern Grid-Part-III**			
	1. Meerut – Bhiwani 765 kV S/c	765kV	S/C	Comm.
	2(a). Establishment of 765/400/220 kV substation at Bhiwani with 2x1000MVA 765/400 kV ICT	765/400kV	trf	Comm.
	2(b). Establishment of 2x315 MVA 400/220 kV ICT at Bhiwani	400/220kV	trf	Comm.
	3. LILO of both circuits of Bawana/Bahadurgarh-Hissar 400 kV D/c at Bhiwani	400kV	2xD/C	Comm.
	4. LILO of both circuits of Bareilly-Mandaula 400 kV D/c at Meerut	400kV	2xD/C	Comm.
	5. Mandaula Bus split	400kV	bay	Comm.
	6. Ballabhgarh Bus split	400kV	bay	Comm.
NR-04	**NR System Strengthening Scheme-XIX**			
	1. LILO of both circuits of Meerut – Kaithal 400 kV D/c (Quad HSIL) to create new 400/220 kV S/s at Bagpat	400kV	2xD/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	2. Bagpat 400/220 kV GIS s/s with 2x500 MVA transformation capacity	400/220kV	trf	UC
	3. 80 MVAR Bus Reactor at Kaithal	400kV	reactor	Comm.
	4. 125 MVAR Bus Reactor at Bagpat	400kV	reactor	UC
NR-05	**NR System Strengthening Scheme-XX**			
	1. LILO of one circuit of Parbati PS – Amritsar 400 kV D/c to create new 400/220 kV S/s at Hamirpur	400kV	D/C	Comm.
	2. Hamirpur 400/220 kV s/s with 2x315 MVA transformation capacity	400/220kV	trf	Comm.
NR-06	**NR System Strengthening Scheme-XXI**			
	1. Lucknow – Bareilly 765 kV S/c (Ckt. No. 1)	765kV	S/C	Comm.
	2. Bareilly–Kashipur 400 kV D/c (quad)	400kV	D/C	UC
	3. Kashipur–Roorkee 400 kV D/c (quad)	400kV	D/C	UC
	4. Roorkee–Saharanpur 400 kV D/c (quad)	400kV	D/C	UC
	5. Establishment of new 765/400 kV, 2x1500 MVA substation at Bareilly	765/400kV	trf	UC
	6. Bareilly – Bareilly 400 kV 2xD/c (quad)	400kV	2xD/C	Comm.
NR-07	**NR System Strengthening Scheme-XXII**			
	1. Kishenpur – Samba 400 kV D/c	400kV	D/C	Comm.
	3. Establishment of new 400/220 kV, 2x315 MVA substation at Samba	400/220kV	trf	Comm.
NR-08	**NR System Strengthening Scheme-XXIII**			
	1. Augmentation of 400/220 kV transformation capacity by 2x500 MVA at Maharanibagh	400/220kV	trf	Comm.
	2. Augmentation of 400/220 kV transformation capacity by 1x500 MVA at Lucknow	400/220kV	trf	Comm.
	3. Augmentation of 400/220 kV transformation capacity by 1x500 MVA at Bahadurgarh	400/220kV	trf	Comm.
NR-09	**NR System Strengthening Scheme-XXIV**			
	1. Dehradun – Abdullapur 400 kV D/c (Quad)	400kV	D/C	UC
	2. Dulhasti – Kishenpur 400 kV D/c (Quad) – Single Circuit Strung	400kV	S/C	Comm.
	3. 2 nos. of 63 MVAR line Reactors (one on each ckt) on Barh – Balia 400 kV D/c line at Balia end	400kV	reactor	Comm.
NR-10	**NR System Strengthening Scheme-XXV**			
	1. Jaipur-Bhiwani 765kV S/c (2nd Ckt)	765kV	S/C	UC
	2. Bhiwani(PG)-Hissar 400kV D/c line	400kV	D/C	UC
	3. LILO of 400kV D/c Moga-Bhiwadi line at Hissar	400kV	D/C	UC
NR-11	**NR System Strengthening Scheme-XXVI**			
	Meerut-Moga 765kV S/c line	765kV	S/C	UC
NR-12	**NR System Strengthening Scheme-XXVII**			UC
	1 LILO of 400kV Dehar-Panipat S/c line at Panchkula	400kV	D/C	UC
	2 LILO of 400kV Dehar-Bhiwani S/c line at Rajpura	400kV	D/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	3. TehriPP-Srinagar 400kV D/c line (Quad)	400kV	D/C	UC
	4. one 400kV line bay at kota(PG) for terminating Anta-Kota 400kV S/c line	400kV	bay	UC
	5. Two 220kV line bays at Chamera pooling point	220kV	bay	UC
NR-13	**NR System Strengthening Scheme-XXVIII**			
	1. Extend one 400kV D/c (Quad) Biharsharif-Sasaram line to Varanasi,Bypassing Sasaram	400kV	D/C	UC
	2. LILO of Gaya-Fathepur76kV S/c line at Varanasi	765kV	D/C	UC
	3. Sasaram-Allahabad Circuit may be from ER bus	400kV		Comm.
	4. Sasaram-Saranath 400kV S/c may be through HVDC back to Back	400kV	HVDC	Comm.
NR-14	**NR Bus Reactor Schemes**			
	1. 125 MVAR bus reactor at Gorakhpur	400kV	reactor	Comm.
	2. 125 MVAR bus reactor at Allahabad	400kV	reactor	Comm.
	3. 125 MVAR bus reactor at Mainpuri	400kV	reactor	Comm.
	4. 125 MVAR bus reactor at Hissar	400kV	reactor	Comm.
	5. 125 MVAR bus reactor at Jullandhar	400kV	reactor	Comm.
	6. 125 MVAR bus reactor at Kankroli	400kV	reactor	Comm.
	7. 125 MVAR bus reactor at Nallagarh	400kV	reactor	Comm.
	8. 2X125 MVAR bus reactor at Vindhyachal(NR Bus)	400kV	reactor	Comm.
	9. 80 MVAR bus reactor at Amritsar	400kV	reactor	Comm.
NR-15	**System Strengthening in NR (after delinking the scheme with North Karanpura Project)**			
	1. Lucknow - Bareilly 765 kV S/c line (Ckt. No. 2)	765kV	S/C	Planned
	2. Bareillly - Meerut 765 kV S/C line	765kV	S/C	Planned
	3. Agra - Gurgaon 400 kV D/c line (quad)	400kV	D/C	Planned
	4. 2x500 MVA, 400/ 220 kV S/S Gurgaon	400/220kV	trf	Planned
NR-16	**ATS for Kishen Ganga (330MW)**			
	1. Kishenganga – Wagoora 220kV 2XD/c line	220kV	D/C	Planned
	3. Kishenganga- Amargarh 220kV D/c line	220kV	D/C	Planned
NR-17	**ATS for Baghalihar II (450 MW)**			
	LILO of one ckt of 400kV Kishenpur-New Wanpoh D/c line at Baghlihar HEP	400kV	D/C	Planned
NR-18	**ATS for Parbati-II (800MW)**			
	1 Parbati II-Koldam (Quad) 1st ckt	400kV	S/C	UC
	2 Parbati II-Koldam (Quad) 2nd ckt	400kV	S/C	UC
	3 Parbati II- Koldam (Quad) D/c portion	400kV	D/C	UC
NR-19	**ATS for Rampur (412MW)**			
	1) LILO of 400 kV D/c Nathpa Jhakri - Nalagarh at Rampur	400kV	2xD/C	Comm.
	2) Ludhiana - Patiala 400kV D/c line	400kV	D/C	Comm.
	3) LILO of 400kV D/c Patiala -Hissar line at Kaithal	400kV	D/C	Comm.
NR-20	**ATS for Koldam (800MW)**			
	1) Koldam-Ludhiana 400kV D/c	400kV	D/C	UC
	2) Koldam-Nalagarh (Quad) 400kV D/c line	400kV	D/C	Comm.
NR-21	**ATS for Tidong-I (100 MW)**			
	Tidong-I HEP- kashang 220kV D/c line	220kV	D/C	

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NR-22	**ATS for Sorang(100 MW)**			
	LILO of S/c Karcham Wangtoo - Abdullapur 400kV line at Sorang	400kV	D/C	
NR-23	**ATS for UHL-III(100MW)**			
	Evacuation at lower voltage			
NR-24	**ATS for Kashang I, II, III (3x65 MW)**			
	Kashang-Boghtu 220kV D/c line	220kV	D/C	Planned
NR-25	**ATS for Sawara Kuddu (110 MW)**			
	LILO of NathpaJhakri-Abdullapur 400kV D/c line at Sawara kuddu	400kV	2xD/C	UC
NR-26	**ATS for Sainj(100 MW)**			
	1. Sainj-Sainj Village(HPPTCL) 132kV D/c line	132kV	D/C	UC
	2. LILO of 400kV Parbathi-II- Parbathi pooling point S/c line	400kV	D/C	UC
	3. Establishment of Sainj 400 / 132 kV S/s (150 MVA)	400/132kV	trf	UC
NR-27	**ATS for Nabha - Rajpura TPS (2x700 MW)**			
	1. Creation of 400/220 kV S/S near Nabha/Patiala with 2X315 MVA Transformers	400/220kV	trf	UC
	2. Muktsar - substation near Jullundhur 400 kV D/C via Tarantaran	400kV	D/C	UC
	3. Creation of 400/220 kV S/S near Tarantaran	400/220kV	trf	UC
	4. Nabha/Patiala - S/S near Jullundhur 400 kV D/C via Mohali	400kV	D/C	UC
	5. Creation of 400/220 kV S/S near Mohali	400/220kV	trf	UC
	6. Interconnection between 400 kV S/S near Jullundhur to Jullundhur S/S (PG)	400kV	D/C	UC
	7. Interconnection between 400 kV S/S near Taran Taran to Amritsar S/S (PG)	400kV	D/C	UC
NR-28	**ATS for Talwandi Sabo (3x660 MW)**			
	1. Talwandi Sabo - Muktsar 400kV D/c line	400kV	D/C	UC
	2. Muktsar - Patti – Nakodar 400kV D/c line	400kV	D/C	UC
	3. Talwandi Sabo - Dhuri 400kV D/c line	400kV	D/C	Comm.
	4. Talwandi Sabo - Nakodar 400 kV D/C (one ckt to be LILOed at Moga 400kV PGCIL s/s)	400kV	D/C	Comm.
	5. Establishment of 2X315 MVA Muktsar S/s	400/220kV	trf	UC
	6. Establishment of 2X315 MVA Patti S/s	400/220kV	trf	UC
	7. Establishmnet of 2X315 MVA Nakodar S/s	400/220kV	trf	Comm.
NR-29	**ATS for Govindwal Saheb (2x270 MW)**			
	1. Gowindwal sahib - Ferozpur 220 kV D/c	220kV	D/C	UC
	2. Gowindwal sahib - Khasa (Amritsar) 220 kV D/c	220kV	D/C	UC
	3. Gowindwal sahib - Sultanpur Lodhi 220 kV D/c	220kV	D/C	UC
	4. Gowindwal sahib - Kapurthalahasa 220 kV D/c	220kV	D/C	UC
NR-30	**ATS for RAPP D(2X700MW)**			UC
	1. RAPP–Jaipur (South) 400kV D/c line of which one ckt. to be LILOed at Kota	400kV	D/C	UC
	2. RAPP – Shujalpur (WR) 400kV D/c line	400kV	D/C	UC
	3. 1x63MVAR at RAPP end of RAPP-Jaipur S/c line	400kV	reactor	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	4. 1X50 MVAR at RAPP end of RAPP-Shujalpur D/ c line(each Ckt)	400kV	reactor	UC
	5. 125 MVAR bus reactor at RAPP-D Generation	400kV	reactor	UC
NR-31	**ATS for Ramgarh-II (160 MW)**			
	1. Ramgarh- Dechu 220kV D/c line (Comm.)	220kV	D/C	Comm.
	2. Dechu – Tinwari 220kV S/c line	220kV	S/C	Comm.
	3. Dechu – Phalodi 220kv S/c line	220kV	S/C	Comm.
	4. 220/132kV S/S at Dechu(new) (2x100MVA)	220kV		Comm.
NR-32	**Composite System for ATS for Chhabra TPSSt-2 (500 MW) &Kalisindh (1200 MW)**			
	1. Phagi (Jaipur South) 3000 MVA, 765/400kV S/S along with two sets of 765kV, 3x80 MVAR line reactors and 400kV 1x125 MVAR bus reactor	765kV		UC
	2. 400/765 kV GSS at Anta (Baran) pooling Station with with two sets of 765kV, 3x80 MVAR line reactors	765kV		UC
	3. Anta – Phagi (Jaipur South) 765kV 2xS/c line	765kV	2xS/C	Comm.
	4. 400/220kV S/S GSS at Ajmer	400kV		
	5. Kalisindh – Anta Pooling Point at 400kV D/C (quad) line (for Kalisindh TPS)	400kV	D/C	Comm.
	6. Chhabra – Anta Pooling Point at 400kV D/C (quad) line(for Chhabra TPS)	400kV	D/C	UC
	7. Phagi (Jaipur south) – Ajmer 400kV D/C line	400kV	D/C	UC
	8. Phagi (Jaipur south) –Heerapura 400kV D/C line	400kV	D/C	UC
	9. LILO of 220kV Ajmer – Beawer line at Ajmer(400/220kV) GSS.	220kV	D/C	UC
	10. LILO of 220kV Ajmer – Kishangarh line at Ajmer(400/220kV) GSS.	220kV	D/C	UC
	11. Kalisindh – Jhalawar 220kV D/C line (for Kalisindh TPS)	220kV	D/C	UC
NR-33	**ATS for Tapovan Vishnugarh(520MW)**			
	1. Tapovan Vishnugarh HEP- Kunwaripaas 400kV D/c line	400kV	D/C	UC
	2. LILO one ckt of Vishnu Prayag – Muzaffarnagar 400 kV D/c line at Kuwanri Pass	400kV	D/C	UC
	3. Kunwari Pass - Karanprayag 400kV D/c line	400kV	D/C	UC
	4. Karanprayag - Srinagar line 400kV D/c line	400kV	D/C	UC
	5. LILO of Kunwari Pass – Srinagar 400kV D/c line at Karanprayag	400kV	D/C	UC
NR-34	**ATS for Singoli Bhatwari (99 MW)**			
	LILO of Baramwari – Srinagar 220kV D/c line at Singoli Bhatwari	220kV	D/C	
NR-35	**ATS for Phata Byong (76 MW)**			
	LILO of Gaurikund Rambara -Barambari 132kV S/c at Phata Byong	132kV	D/C	UC
	Baramwari-Srinagar 220kV D/c line	220kV	D/C	UC
NR-36	**Srinagar (330 MW) (Private Sevtor)**			
	1. Srinagar - Kashipur 400kV D/c line	400kV	D/C	UC
	2. Srinagar-HEP - Srinagar 400kV D/c line	400kV	D/C	UC
	3. LILO of visgnuprayag-Muzaffarnagar 400kV line at srinagar	400kV	D/C	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NR-37	**Combined ATS for Rihand STPP-III (2X500 MW) & Vindhyachal STPP -IV (2X500 MW) of WR**			
	1. Rihand-III- Vindhyachal Pool 765 kVD/c(initially to be operated at 400 kV)	765kV	D/C	UC
	2. Vindhyachal-IV - Vindhyachal Pool 400 kV D/c (Quad)	400kV	D/C	UC
	3. Vindhyachal Pool-Satna 765 kV 2xS/c	765kV	2xS/C	UC
	4. Satna - Gwalior 765 kV 2xS/c	765kV	2xS/C	UC
	5. Gwalior - Jaipur(South) 765 kV S/c	765kV	S/C	UC
	6. Vindhyachal Pool-Sasan 765 KV S/c	765kV	S/C	UC
	7. Establishment of 765/400kV, 2x1500 MVA S/s at Vindhyachal Pool	765/400kV	trf	UC
NR-38	**Combined ATS for Bara TPS(1980MW), Karchana (1320MW) & Meja JV(1320MW)**			
	1. Step-up of Bara generation to 765kV	765kV	bay	UC
	2. Bara switchyards to have 765kV and 400kV levels with 2x1500MVA (7x500 MVA, 1 phase units) 765/400 ICTs.	765/400kV	trf	UC
	3. Establishment of 400kV substation at Reewa Road Allahabad with 400/220kV 2x315 MVA ICTs	400/220kV	trf	UC
	4. Step-up of Karchana and Meja generation to 400kV	400kV	bay	UC
	5. LILO of 400kV Obra-Panki line at Reewa Road Allahabad	400kV	D/C	UC
	6. Meja – Bara 400kV quad D/C line	400kV	D/C	UC
	7. Meja – Reewa Road (Allahabad) 400kV quad D/C line	400kV	D/C	UC
	8. Karchana – Bara 400kV quad D/C line	400kV	D/C	UC
	9. Karchana – Reewa Road Allahabad 400kV quad D/C line	400kV	D/C	UC
	10. Bara-Mainpuri 765kV 2xS/C lines	765kV	2xS/C	UC
	11. Mainpuri –G. Noida 765kV S/C	765kV	S/C	UC
	12. LILO of Agra - Meerut 765 kV S/C line of PGCIL at G. NOIDA	765kV	S/C	UC
	13. Hapur – G.Noida 765kV S/C line	765kV	S/C	UC
	14. New 765/400kV substation at Maipuri with 2x1000MVA (7x333 MVA, 1 phase units) ICTs	765/400kV	trf	UC
	15. Mainpuri 765kV UPPCL – Mainpuri 400kV PGCIL 400kV quad D/C line	400kV	D/C	UC
	16. New 765/400 substation at G.Noida with 2x1500MVA (7x500MVA, 1 phase units) 765/400kV	765/400kV	trf	UC
	17. 2x315MVA 400/220kV ICTs at New 765/400kV substation at G.Noida	400/220kV	trf	UC
	18. Reewa Road Allahabad – Banda 400kV quad D/C line	400kV	D/C	UC
	19. Banda – Orai 400kV quad D/C line	400kV	D/C	UC
	20. Orai – Mainpuri 765kV UPPCL 400kV quad D/C line	400kV	D/C	UC
	21. Establishment of 400kV substation at Banda with 400/220kV 2x315 MVA ICTs	400/220kV	trf	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	22. Establishment of 400kV substation at Orai with 400/220kV 2x315 MVA ICTs	400/220kV	trf	UC
	23. Meja-Allahabad(PG) 400kV D/c line	400kV	D/C	UC
	24. Unnao-Mainpuri 765kV S/c line	400kV	D/C	UC
	25. Mainpuri-Hapur 765kV S/c line	400kV	D/C	UC
	26. Mainpuri – Aligarh 400 kV Quad D/c line	400 kV	D/C	UC
	27.Tanda-Gonda 400 kV Quad D/c line	400 kV	D/C	UC
	28. Gonda-Shahjahanpur 400 kV Quad D/c line	400 kV	D/C	UC
	29. LILO of Sarojininagar-Kursi Road line at Sultanpur Road 400kV Twin Moose	400 kV	D/C	UC
	30. LILO of Obra-Sultanpur line at Aurai 400 kV Twin Moose	400 kV	D/C	UC
	31.G.Noida - Sikanderabad line 400kV D/c Quad	400 kV	D/C	UC
	32.G.Noida - Noida (Sector-148) line 400kV D/c Quad	400 kV	D/C	UC
	33.Hapur - Dasna 400 kV D/c Quad Moose line	400 kV	D/C	UC
	34.Hapur - Ataur 400 kV D/c Quad Moose line	400 kV	D/C	UC
	35.LILO of Muradabad (PG)-Muradnagar(PG) 400 kV D/c Quad Moose line at Hapur	400 kV	D/C	UC
	36.LILO of Muradnagar-Muzzafarnagar 400 kV D/c Quad Moose line at Atuar	400 kV	D/C	UC
	37.LILO of Rishikesh-Kashipur 400 kV D/c Quad Moose line (PTCUL) at Nehtur	400 kV	D/C	UC
	38.Establishment of 400kV substation at Gonda with 400/220kV 2x315 MVA ICTs	400/220kV	trf	UC
	39.Establishment of 400kV substation at Gonda with 220/132 kV 2x100 MVA ICTs	220/132kV	trf	UC
	38.Establishment of 400kV substation at Sultanpur road, Lucknow with 400/220kV 2x500 MVA ICTs	400/220kV	trf	UC
	39.Establishment of 400kV substation at Sultanpur road,Lucknow with 220/132 kV 2x160 MVA ICTs	220/132kV	trf	UC
	40.Establishment of 400kV substation at Aurai with 400/132 kV 2x200 MVA ICTs	400/132kV	trf	UC
	41.Establishment of 765kV substation at Hapur with 765/400 kV 2x1500 MVA ICTs	765/400kV	trf	UC
	42.Establishment of 400kV substation at Hapur with 400/220 kV 2x 500 MVA ICTs	400/220kV	trf	UC
	43.Establishment of 400kV substation at Ataur with 400/220 kV 2x500 MVA ICTs	400/220kV	trf	UC
	44.Establishment of 400kV substation at Ataur with 220/33 kV 3x60 MVA ICTs	220/33 kV	trf	UC
	45.Establishment of 400kV substation at Sikandrabad with 400/220 kV 2x500 MVA ICTs	400/220kV	trf	UC

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	46.Establishment of 400kV substation at Nehtur with 400/132 kV 2x200 MVA ICTs	400/132kV	trf	UC
	47.Establishment of 400kV substation at Dasna with 400/132 kV 2x315 MVA ICTs	400/220kV	trf	UC
	48.Establishment of 400kV substation at Dasna with 220/132kV 2x100 MVA ICTs	220/132kV	trf	UC
	49.Establishment of 400kV substation at Indirapuram with 400/220 kV 2x500 MVA ICTs	400/220kV	trf	UC
	50.Establishment of 400kV substation at Indirapuram with 220/33kV 3x60 MVA ICTs	220/33kV	trf	UC
NR-39	**Lalitpur TPS (3x660 MW) (State Sector) (tentative)**			
	1. Lalitpur – Agra –I 765kV S/C line (385km)	765kV	S/C	UC
	1. Lalitpur – Agra –I 765kV S/C line (385km)	765kV	S/C	UC
	3. Agra (UP)- agra(PG) 765kV S/C line (50km)	765kV	S/C	UC
	4. Lalitpur 765/220kV S/S (2x300) MVA	765/220kV	trf	UC
	5. Establishment of 765/400 kV, 2x1500 MVA, Agra (UP) substation	765/400 kV		UC
	6. Establishment of 400/132 kV, 2x300 MVA Agra (South) substation	400/132kV		UC
	7. LILO of one circuit of existing 400kV Agra (UP) – Agra (PG) 2xS/C line at 765/400 kV Agra (UP) (10 Km)			UC
	8.LILO of existing 400 kV Agra (UP) – Muradnagar S/C line at Agra (UP) 765/400 kV substation			UC
	9. Jhasi- Lalitpur – lalitpur switchyard 220kV D/C line (2x50 km)	220kV	D/C	UC
NR-40	**Strengthening of Transmission Network of Delhi for 12th Plan**			
	1. Establishment of 400/220 kV, 4x500 MVA substation at Rajghat	400/220kV		New
	LILO of 400 kV line Bawana –Mandola at Rajghat	400 kV		New
	2. Establishment of 400/220 kV, 4x500 MVA substation at Tughlakabad	400/220kV		New
	3.LILO of one circuit of Bamanuli-Samaypur 400 kV D/c line and balance two circuits shall be utilised later.	400 kV		New
	4. Establishment of 400/220 kV, 4x500 MVA substation at Karmapura	400/220kV		New
	5. Jhatikalan-Karmapura 400 kV D/c line	400 kV		New
	6. Up-gradation of existing 220/66KV AIS substation to 400/220 kV, 4x500 MVA GIS substation at Papankalan-I	22/66kV		New
	7. LILO of Bamanuli-Jhatikalan 400 kV S/c line	400 kV		New
NR-41	**Inter-Regional Transmission system Between NR & WR**			
	Dhanvahi-Fatehpur 765kV D/c	765kV		New
	Fatehpur-Lucknow -765kV D/c	765kV		New
	Lucknow-Aligarh -765kV D/c	765kV		New
	Aligarh-Muzzafar nagar 765kV D/c	765kV		New
	Muzzafar nagar-Mohali 765kV D/c	765kV		New

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	Mohali-Gurdaspur 765kV D/c	765kV		New
	LILO of Kishenpur-Moga 765kV line at Gurdaspur	765kV		New
	Gurdaspur-Amritsar 400kV D/c	400kV		New
	Gurdaspur-Jallandhar 400kV D/c	400kV		New
	LILO of Patiala-Ludhiana 400kV D/c	400kV		New
	Mohali-Panchkula 400kV D/c	400kV		New
	Muzaffarnagar 765/400kV –Muzaffar nagar existing	400kV		New
	Establishment of 2x1500MVA, 765/400kV substation at Muzaffarnagar	765kV		New
	Establishment of 2x1500MVA, 765/400kV substation at Mohali	765kV		New
	Establishment of 2x1500MVA, 765/400kV substation at Gurdaspur	765kV		New
NR-42	**Inter-Regional Transmission system Between NR & ER**			
	±800kV, 6000MW HVDC bipole line from Angul to Badarpur in NR with 3000MW terminal at either end.	HVDC		New
	3x500MVA, 400/220kV transformers at Badarpur	400kV		New
	Badarpur-Ballabgarh 400kV D/c (Quad) – 40ckm	400kV		New
	Badarpur-Tuglqabad 400kV D/c (Quad) – 40ckm	400kV		New
NR-43	**ATS for Miyar HEP (120 MW)**	400kV		
	400kv D/c line from Miyar to the site of 400kV pooling station near sisu/Gramphu pooling station	400kV		Planned
	From site of 400kV pooling station near sisu/Gramphu pooling station-Hamirpur 400kV D/c line	400kV		Planned
				Planned
	ATS for Seli HEP (400 MW)			
	LILO of Miyar-Hamirpur 400 kV D/c line at Seli	400kV		Planned
NR-44	**Anpara D (1000 MW) (State Sector)**			UC
	1. Anpara B - Anpara D 400 kV D/c line	400kV	D/C	UC
	2. Anpara C - Anpara D 765 kV S/c line	765kV	S/C	UC
	3. Anpara D - Unnao 765 kV S/c line	765kV	S/C	UC
	4. Anpara D 765 / 40o kV S/S (2x600 + 1000) MVA	765/400kV	trf	UC
NR-45	**Solar & New Wind Power Projects in Rajsthan(2650 MW) [Solar - 1400 MW; Wind - 1250 MW)**			
	1. 400/220 kV, 3 X 500 MVA and 220/132kV, 3x160 MVA with 132/33kV, 2x40/50 MVA Pooling Sub-Station GSS at Ramgarh (Jaisalmer) alongwith 400kV, 1x125 MVAR, Bus Reactor and 2x50 MVAR line Reactor for 400kV D/C Ramgarh-Bhadla line	400/220kV	trf	Planned
	2. 400/220 kV, 3 X 315 MVA and 220/132kV, 3x160 MVA with 132/33kV, 2x40/50 MVA Pooling Sub-Station GSS at Bhadla (Jodhpur) alongwith 400kV, 1x125 MVAR Bus Reactor and 4x50 MVAR, 400kV Line Reactors for Bhadla ends of 400kV D/C Bhadla-Bikaner line, 400kV LILO Jodhpur-Merta at Bhadla.	400/220kV	trf	Planned
	3. Augmentation of 400kV GSS Akal by installation of 400/220 kV, 1 X 500 MVA Transformer alongwith 400kV, 2x50 MVAR Shunt Reactor (line type) for proposed 400kV Akal-Jodhpur (New) D/c line, and 1x125 MVAR 400 kV Bus Reactor.	400/220kV	trf	Planned
	4. Augmentation of 400kV GSS Jodhpur (New)			Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	(i) 2x50 MVAR, 400kV Shunt Reactor (line type) at 400kV GSS Jodhpur (New) for 400kV D/C Akal-Jodhpur(New) line	400kV	reactor	Planned
	(ii) 400kV bays at Jodhpur (New) for LILO of both ckt. of 400kV D/C Raj West LTPS-Jodhpur line.	400kV	bay	Planned
	5. Augmentation at 400kV GSS Barmer			Planned
	(i) 1x125 MVAR, 400kV Shunt Reactor (Bus type) at 400kV GSS Barmer	400kV	reactor	Planned
	(ii) 400kV bays for 400kV D/C Barmer-Bhinmal (PG) line	400kV	bay	Planned
	6. Augmentation at 400kV GSS Bikaner			Planned
	(i) 400kV Bays for 400kV D/C Bhadla-Bikaner line and 400kV D/C Bikaner-Sikar (PGCIL) line at Bikaner end of the lines	400kV	bay	Planned
	(ii) 1x125 MVAR, 400kV Shunt Reactor (Bus type) at 400kV GSS Bikaner	400kV	reactor	Planned
	7. 400kV Interconnecting Lines :	400kV		Planned
	(i) 400 kV D/C Ramgarh(Jaisalmer)-Akal (Jaisalmer) line (Twin Moose)	400kV	D/C	Planned
	(ii) 400 kV D/C Ramgarh-Bhadla line (Twin Moose)	400kV	D/C	Planned
	(iii) 400 kV D/C Bhadla-Bikaner line (Quad Moose)	400kV	D/C	Planned
	(iv) 400 kV D/C line from 400/220kV Pooling Station Bhadla to LILO point at 400kV S/C Jodhpur-Merta line (Twin Moose)	400kV	D/C	Planned
	(v) 400 kV D/C Bikaner-Sikar (PGCIL) line (Twin Moose)	400kV	D/C	Planned
	(vi) 400 kV D/C Barmer-Bhinmal (PGCIL) line (Twin Moose)	400kV	D/C	Planned
	(vii) LILO of both circuits of 400kV D/C Raj West-Jodhpur line at 400kV GSS Jodhpur (New) (Twin Moose)	400kV	D/C	Planned
	(viii) 400kV D/C Akal-Jodhpur (New) line (Quad Moose	400kV	D/C	Planned
	8. 220kV GSS at Bap and associated lines:			Planned
	(i) 220/132kV, 2x160 MVA	220/132kV	trf	Planned
	(ii) 132/33kV, 2x40/50 MVA ICT	132/33kV	trf	Planned
	(iii) LILO of 220kV Barsingsar LTPS-Phalodi line at at Bap	220kV	D/C	Planned
	(iv) 220kV D/C Bap-Bhadla line	220kV	D/C	Planned
	9. 220kV GSS at Kanasar and associated lines:			Planned
	(i) 220/132kV, 2x160 MVA ICT	220/132kV	trf	Planned
	(ii) 132/33kV, 2x40/50 MVA ICT	132/33kV	trf	Planned
	(ii) 220kV D/C Bhadla- Kanasar line	132kV	D/C	Planned
	(iii) LILO of 132kV PS1-PS2 line at proposed 220kV GSS at Kanasar	132kV	D/C	Planned
	(iv) LILO of 132kV PS2-PS3 line at proposed 220kV GSS at Kansar	132kV	D/C	Planned
	10. Up-gradation of PS No. 2 to 132kV Grid Substation with 132/33kV, 2x20/25 MVA Transformers with associated 132kV line	132/33kV	trf	Planned
	11. Up-gradation of PS No. 3 to 132kV Grid Substation with 132/33kV, 2x20/25 MVA Transformers	132/33kV	trf	Planned
	12. Charging of 132 kV line from PS_No.5 to PS_No.1 on 132 kV voltage level via 132 kV PS_No.2 GSS , 132 kV PS_No.3 GSS and 132kV PS_No.4 GSS	132kV		Planned
	14. Up-gradation of PS No. 4 to 132kV Grid Substation with 132/33kV, 2x20/25 MVA Transformers	132/33kV	trf	Planned
NR-46	**SVCs in Northern Region**			
	1. Ludhiana S/s - (+) 600 MVAR / (-) 400 MVAR	400kV	SVC	Planned
	2. Kankroli S/s - (+) 400 MVAR / (-)300 MVAR	400kV	SVC	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	3. New Wanpoh S/s - (+) 300 MVAR / (-) 200 MVAR	400kV	SVC	Planned
NR-47	**Inter-connection between Srinagar (Uttarakhand) and Tehri**			
	Srinagar - Tehri Pooling station 400 kV D/c (quad)	400kV	D/C	Planned
NR-48	**ATS for Kutehr (260MW)**			
	1) Establishment of 400/220 kV ,2x315 MVA S/S at Lahal	400/220kV	trf	Planned
	2) Kutehar -Lahal 220 kV D/C line	220kV	D/C	Planned
	3) Lahal PS - Chamera PS 400 kV D/C line	400kV	D/C	Planned
NR-49	**ATS for Bajoli Holi HEP (180 MW)**			
	1. HPPTCL system upto Chemera Pooling point (connectivity)	220kV	D/C	Planned
NR-50	**ATS for Kunihar (Andhra+Nogli+Micro) (196 MW)**			
	Evacuation at lower voltage			
NR-51	**ATS for Barsingsar Ext(250MW)**			
	1. Barsingsar- Nagaur220kV S/c line	220kV	S/C	Planned
	2. Barsingsar-Khinvsar- Bhopalgarh 220kVS/c line with S/S at Khinvsar (Nagaur)	220kV	S/C	Planned
	3.Establishment of Khinvsar 220/132kV substation	220/132kV		Planned
NR-52	**ATS for Shree Cement Ltd (300 MW) (IPP)**			
	1. LILO of one ckt of Kota – Meria 400kV D/c line at generation switchyard with 80 MVAR bus reactor	400kV	D/C	Comm.
NR-53	**ATS for Kotlibhel St-1A & B (515 MW), Kotlibhel St-II (530 MW)**			
	1. Kotli Bhel IA – Dehradun (PTCUL) 220 kV D/C twin/quard line [Twin up to Kotli Bhel II and quad between Kotli Bhel II – Dehradun (PTCUL)]	220kV	D/C	Planned
	2. LILO of one circuit of Kotli Bhel IA – Dehradun (PTCUL) 220 kV D/C line at Kotlibhel 1B	220kV	D/C	Planned
	3. Connectivity between 220kV Dehradun s/s of PTCUL and 400/220kV Dehradun s/s of regional grid. This would be either through extended bus or through 220kV quad D/C line depending on location of the two s/s being contiguous or otherwise	220kV	D/C	Planned
	4. Dehradun-Abdullapur 400 kV D/C line as regional scheme for Kotlibhel HEP	400kV	D/C	Planned
NR-54	**ATS for Tehri-II (1000MW)**			
	1. Tehri PSP – Tehri Pooling Point (quad) 400kV S/c line	400kV	S/C	Planned
	2. Charging Tehri Pooling Point – Meerut line at 765kVS/c line	765kV	S/C	Planned
	3. Establishment of 765/400 kV, 3x1500 MVA S/S at Tehri Pool (Due to Space constraints, Tehri Pooling stn. would be GIS)	765/400kV	trf	Planned
	4. 765/400 kV, 1x1500 MVA substations at Meerut	765/400kV	trf	Planned
	5. Modification of Series Capacitors for operation at 765 kV level at meerut	765kV		Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NR-55	**ATS for Lata Tapovan (171 MW)**			
	1. Lata Tapovan - Joshi Math 220kV D/c line	220kV	D/C	New
NR-56	**ATS for Pala Maneri (480 MW)**			
	1. LILO of Lohari Nagpala – Koteshwar 400kV D/c line at Pala Maneri	400kV	2xD/C	New
NR-57	**Sravanthi Energy Private Litd. (450 MW)**			
	1. LILO of one circuit of Kashipur - Roorkee 400 kV D/c line at Generation Switchyard	400kV	D/C	Planned
NR-58	**Northern Region System Strengthening Scheme- NRSS XXX**			
	1. Singrauli – Allahabad 400 kV S/c (due to ROW constraints, about 50 km section of Singrauli-Allahabad line to be strung on existing 400 kV D/c tower from Singrauli end).	400kV	S/C	Planned
	2. Allahabad - Kanpur 400 kV D/c line	400kV	D/C	Planned
NR-59	**Dynamic Compensation (STATCOM) at Lucknow and Nalagarh**			
	1. At Lucknow. 2x125 MVAR MSR, 1X125 MVAR MSC & +/- 300 MVAR STATCOM	400kV	STATCOM	UC
	2. At Nalagarh 2x125 MVAR MSR, 2X125 MVAR MSC & +/- 200 MVAR STATCOM	400kV	STATCOM	UC
NR-60	**NR System Strengthening Scheme-XXIX**			
	1. LILO of both circuits of Uri - Wagoora 400 kV D/c line at Amargarh (on multi-circuit towers)	400kV	2xD/C	UC
	2. Establishment of 7x105 MVA (1ph units.), with 400/220 kV GIS substation at Amargarh	400/220kV	trf	UC
	3. Jullandhar – Samba 400 kV D/c line	400kV	D/C	UC
	4. Samba -Amargarh 400 kV D/c line	400kV	D/C	UC
NR-61	**NR System Strengthening Scheme-XXXI (Part-A)**			
	1. Establishment of a 7Xl05MVA, 400/220 kV GIS substation at Kala Amb	400/220kV	trf	UC
	2. LILO of both circuits of Karcham Wangtoo – Abdullapur 400 kV D/c at Kala Amb	400kV	2XD/C	UC
	3. 40% Series Compensation on 400kV Karcham Wangtoo - Kala Amb quad D/c line at Kala Amb end	400kV	Series Capacitor	UC
NR-62	**NR System Strengthening Scheme-XXXI (Part-B)**			
	1. Kurukshetra - Malerkotla 400 kV D/c line	400kV	D/C	Planned
	2. Malerkotla - Amritsar 400 kV D/c line	400kV	D/C	Planned
NR-63	**NR System Strengthening Scheme-XXXII**			
	1. 400 kV Panchkula – Patiala D/c line (with 10 km on multi-circuits towers in forest area near Panchkula for accommodating 220 kV D/c line for power supply to Chandigarh)	400kV	D/C	Planned
	2. 400 kV Lucknow (PG) – Kanpur (New)(PG) D/c line	400kV	D/C	Planned
	3. LILO Dadri-Malerkotla line at Kaithal S/s (PG)	400kV	D/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
	4. LILO of both circuits of RAPP – Kankroli 400 kV D/c line at Chittorgarh 400/220 kV substation of RRVPNL	400kV	2XD/C	Planned
	5. Conversion of 50MVAR line reactors at Kankroli end of RAPP-Kankroli 400kV line into bus reactor at Kankroli (depending on layout these reactors may be controlled through single bay)	400kV	reactor	Planned
	6. Augmentation of transformation capacity at 400/220 kV Ballabhgarh substation by replacing existing 4x315 MVA ICTs with 4x500 MVA ICTs. The 4x315 MVA ICTs were agreed be kept as regional spares after refurbishment.	400/220kV	trf	Planned
	7. Augmentation of Transformation capacity at Mandola by replacing 4x315 MVA ICTs with 4x500 MVA ICTs. The dismantled 315 MVA ICTs were agreed to be maintained as regional spares after refurbishment.	400/220kV	trf	Planned
	8. Provision of 7x105 MVA, 400/220 kV ICT at Parbati Pooling station along with associated bays and two nos. of 220 kV line bays.	400/220kV	trf	Planned
	9. Augmentation of 400/220kV, transformation capacity by 500MVA ICT(4th)at Sector-72 Gurgaon (PG) Substation	400/220kV	trf	Planned
NR-64	**Tr. system for Patran 400kV S/s**			
	1. Establishment of new 400/220 kV GIS substation with 2x500 MVA ICTs at Patran	400/220kV	trf	UC
	2. LILO of both circuits of Patiala-Kaithal 400kV D/c line	400kV	2XD/C	UC
NR-65	**NR System Strengthening Scheme-XXXIII**			
	1. Ballabhgarh – Greater Noida (New) 400 kV D/c employing multi-circuit towers in 5 km stretch of the above line from Ballabgarh end	400kV	D/C	New
	2. Estb. of 2x500 MVA, 400/220 kV GIS substation at Greater Noida (New)	400/220kV	trf	New
NR-66	**NR System Strengthening Scheme-XXXIV**			
	1. LILO of Agra – Bharatpur 220 kV S/c line at Agra (PG) alongwith 2 nos of 220kV line bays at Agra (PG) for termination of these lines.	220kV	D/C	Planned
	2. 1X315 MVA, 400/220 kV ICT at Agra (PG) along with associated bay 400kV and 220kV bay for termination of ICT (ICT shall be from the spared ICTs available after replacement of ICTs at Ballabhgarh / Mandaula)	400/220kV	trf	Planned
	3. 1x315 MVA, 400/220 kV transformer at 400kV substation Kaithal along with associated bay 400kV and 220kV bay for termination of ICT (spared ICT available after replacement of ICTs at Ballabhgarh / Mandaula S/s shall be installed)	400/220kV	trf	Planned
	4. 2 nos., 220kV line bays at Kaithal S/s	220kV	bays	Planned
	5. 2 nos. 220 kV line bays at 400/220 kV Bhinmal S/s (POWERGRID)	220kV	bays	Planned
	6. LILO of Sarna- Hiranagar 220kV S/c at 400/220kV Samba S/s. The lines are to be terminated at existing 220kV line bays at Samba under present project)	220kV	D/C	Planned
	7. LILO of one circuit of 400 kV Parbati Pooling Station – Amritsar D/c line at Jalandhar S/s (PG) along with 2 nos of 400kV line bays at Jallandhar(PG) for termination of these lines	400kV	D/C	Planned

Sl. No.	Scheme /details	Voltage (kV)	Type	Present Status
NR-67	**NR System Strengthening Scheme-XXXV**			
	Mohindergarh – Bhiwani 400 kV D/c line	400kV	D/C	Planned
NR-68	**Comprehensive Strgethening in ISTS (NR) related to Wind Projects**			
	1. Chittorgarh-Ajmer (New) 765 kV D/c	765kV	D/C	Planned
	2. Ajmer (New)-Suratgarh (New) 765 kV D/c	765kV	D/C	Planned
	3. Suratgarh (New)-Moga (PG) 765 kV D/c	765kV	D/C	Planned
	4. Chittorgarh-Chittorgarh (RVPN) 400 kV D/c (Quad)	400kV	D/C	Planned
	5. Ajmer (New)- Ajmer (RVPN) 400 kV D/c (Quad)	400kV	D/C	Planned
	6. Suratgarh (New)- Suratgarh 400 kV D/c (Quad)	400kV	D/C	Planned
	7. 2x1500 MVA, 765/400 kV sub-station each at Chittorgarh	765/400kV	trf	Planned
	8. 2x1500 MVA, 765/400 kV sub-station each at Ajmer (New)	765/400kV	trf	Planned
	9. 2x1500 MVA, 765/400 kV sub-station each at Suratgarh (New)	765/400kV	trf	Planned
	Associated reactive compensation (Bus reactors & line reactors)	765kV	reactors	Planned
NR-69	**ATS for Tanda (2x660MW)**			
	1. Tanda - Sohawal 400kV D/c (Twin Moose) -90km	400kV	D/C	New
	2. Sohawal - Lucknow (New) (PG) 400kV D/c - (Twin Moose) - 165km	400kV	D/C	New
NR-70	**ATS for Unchahar TPS(1x500MW)**			
	1. Unchahar – Fatehpur 400kV D/C line	400kV	D/C	UC
NR-71	**ATS for Ratle HEP (850 MW)**			
	1. LILO of Dulhasti-Kishenpur 400 kV D/c (Quad) line at Ratle	400kV	D/C	Planned
	2. Kishenpur-Ratle 400 kv S/c Quad line	400kV	S/C	Planned
NR-72	**ATS for Mansa TPS (1320MW)**			
	1. LILO of Talwandi-Mansa S/s 400kV D/c at Mansa TPS	400kV	D/C	Planned
	2. Mansa TPS- Mansa S/s 400 kV D/c	400kV	D/C	Planned
	3.Mansa-Barnala-Amloh 400kV D/c	400kV	D/C	Planned
	4.LILO of one circuit of Rajpura TPS -Nakodar at Amloh	400kV	S/C	Planned
	5.2x500 MVA, 400/220 kV new substations at Barnala	400kV	trf	Planned
	6.2x315 MVA, 400/220 kV new substations at Amloh	400kV	trf	Planned
NR-73	**ATS for Bilhaur STPP (1320 MW)**			
	1.Bilhaur TPP- Kanpur (PG) 400 kV D/c line	400kV	D/C	New

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Perspective Transmission Plan

PART - II

Evolving Broad Transmission Corridors

for period 2022-34

i.e. 14th, 15th Plans and beyond

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Chapter – 5

Load and Generation Assumptions for 14th and 15th Plans and up to 2033-34

5.1 Introduction

5.1.1 This part of the report covers broad transmission corridors that may be required between 2022 to 2034 i.e. 9th year onwards and up to 20 years ahead. The generation plants that may come up in these 12 years (2022-2034) is not known. The all-India peak demand is expected to rise from the current level of 140 GW to about 600 GW i.e. about 4.2 times by 2034. This implies roughly quadrupling the generation installed capacity as well as transmission systems of about 4 to 5 times the present capacities. The perspective plan for this period i.e. 2022-34 which includes 14th Plan, 15th Plan and first two years of 16th Plan, therefore, can at best be an indicative plan giving broad transmission corridors across various regions and possible international exchange corridors.

5.1.2 This assessment of indicative corridors requires an assessment of state-wise load growth and state-wise generation capacity additions of various fuel types i.e. coal, Gas nuclear, hydro, etc. The following paragraphs in this chapter give details of assessment of demand for the perspective plan period up to 2034 including methodology for assessment. As described earlier in chapter 1, the assessment of generation capacity addition during 2022-34 has been carried out in the "Report of the Working on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India – 2013 of National Transport Development Policy Committee (NTDPC). The assessment made in the NTDPC report has been supplemented with additional information as available with regard to nuclear, hydro projects in SAARC, gas resources.

5.1.3 Accordingly, two generation addition scenarios have been identified for 14th and 15th Plan Periods and one generation scenario has been identified for 2022-34 period. The details of these demands and generation assessments are given in subsequent paragraph of this chapter. The next chapter would give a detailed analysis carried out using these demands and generation addition assessments to identify broad transmission corridors for 14th, 15th and early 16th Plan periods.

5.2 Assessment of electricity demand

5.2.1 Demand assessment is an essential prerequisite for planning of generation capacity addition and associated transmission infrastructure required to meet the future power requirement of various sectors of our economy. The type and location of power projects to be planned in the system is largely dependent on the magnitude, spatial distribution as well as the variation of demand during the day, seasons and on a yearly basis. Therefore, reliable planning for generation and transmission capacity addition for future is largely dependent on an accurate assessment of the future demand.

5.2.2 The Electricity Power Survey Committee is constituted by CEA, with wide representation from the Stake-holders in the Power Sector, to forecast the demand for electricity both in terms of peak electric load and electrical energy requirement. CEA has been regularly bringing out the Electric Power Survey Reports. The latest Report by this Committee is the 18th Electric Power Survey (EPS) Report. This Report forecasted year-wise electricity demand for each State, Union Territory, Region and All India in detail up to the end of 12th and 13th Five Year Plans i.e. till the year 2016-17 and 2021-22. The report also projected the perspective electricity demand for the terminal years of 14th and 15th Five Year Plans i.e. for the year 2026-27 and 2031-32 respectively for the Utility systems.

5.2.3 The 18th EPS Report encompasses various features for fulfilling the Aims and Objectives of the National/ State Policies framed by the Government(s). Due consideration has been given to the promotion of high efficiency and DSM measures in the Agriculture, Industrial, Commercial sectors as well as in domestic establishments while formulating the electricity demand forecasts. Future projections of the demand have also been worked out based on the T & D loss reduction targets assessed in consultation with various States/UTs. The all-India demand forecast as per 18th EPS for the terminal year of 12th, 13th, 14th and 15th Five Year Plan is given in Table 5.1

Table - 5.1: Projected All India Peak Demand and Energy Requirement (As per 18th EPS Report)

Year	Energy Requirement (MU)	Peak Demand (MW)
12th plan end (2016-17)	13,54,874	1,99,540
13th plan end (2021-22)	19,04,861	2,83,470
14th plan end (2026-27)	27,10,058	4,00,705
15th plan end (2031-32)	37,10,083	5,41,823

5.3 Methodology for Demand Assessment

5.3.1 Partial End Use Methodology (PEUM), which is a proven method for demand forecasting and is a combination of time series analysis and End Use Method, has been used for earlier EPS by CEA. In line with directions of EPSC, PEUM has been adopted to forecast electricity demand for 18th EPS as well. The time series method has been used to derive growth indicators giving higher weightage to recent trend so as to incorporate benefits of energy conservation initiatives and impact of technological changes. The input data for the period 2003-04 to 2009-10 was scrutinized for the purpose of studies and the year-wise EER for all States/UTs has been worked out up to end of 13th Plan (2021-22) with the year 2009-10 being taken as base year. Unlike earlier power survey the 18th EPS has carried out short/medium term year wise forecast for two five year plans viz. 12th Plan and 13th Plan period so as to reflect the achievement of state utilities of their programme for growth of demand, augmentation of T&D system thereby reducing the T&D losses. The short-term/medium term forecast of electricity demand for each State/UT, Region and All India has been made for various categories of consumption viz. Domestic, Commercial, Public Lighting, Public Water Works, Irrigation, Industrial (LT, HT < 1 MW, HT >1 MW), Railway Traction & Bulk Non-Industrial HT Supply. The long term projections cover the load forecast for terminal years of 14th Plan (2026-27) and 15th Plan (2031-32).

5.3.2 The shortage in electrical energy has been worked out after accounting for the restrictions, scheduled cuts and under frequency compensation as reported by the States/UTs to CEA. The projections for the intervening period of 12th Plan (2011-12 to 2015-16), in terms of APEL and EER have been arrived at by applying compounded annual growth rates after adding the actual shortage in the energy and demand met during the year 2010-11.

5.3.3 **All India Pattern of Compound Annual Growth Rate (CAGR**): The18th EPS has broadly considered the GDP growth between 8 to 10% during 12th plan period and slightly lower during 13th plan period. According to 18th EPS, the All India CAGR of AEPL from base year (2009-10) to end of 12th plan (2016-17) works out to 9.58% whereas during the period 2016-17 to 2021-22 CAGR is of the order of 7.27%. As regards EER, the CAGR during the period 2009-10 to 2016-17 is 8.55% and during 2016-17 to 2021-22 is 7.05%. The CAGR for all India electricity consumption during 2009-10 to 2016-17 is 9.85% whereas the CAGR is expected to reduce to 7.96% during the period 2016-17 to 2021-22.

5.3.4 **The System Load Factor:** The All India Annual Electric Load Factor (AELF) in the base year 2009-10 is around 82.7%. According to the 18th EPS, the All India AELF by 2011-12 would be 81.28% which is expected to gradually reduce to 77.51% by the end of 2016-17, and by 2021-22 load factor is anticipated to be 76.71%. The Region wise breakup of the anticipated AELF during 2011-12 and for terminal years of 12th plan (2016-17), 13th plan (2021-22), 14th plan (2026-27) and 15th plan (2031-32) is given below in **Table 5.2**:

Table – 5.2 : Region-wise AELF (%)

Region/Year	2016-17	2021-22	2026-27	2031-32
Northern	79.15	78.43	78.19	77.69
Western	72.56	71.54	71.04	70.54
Southern	71.39	70.94	70.85	70.35
Eastern	76.94	75.29	74.86	74.36
North E.	62.16	65.42	64.92	64.42
A&N	62.50	65.00	64.50	64.00
Lakshadweep	52.00	42.00	42.00	42.00
All India	**77.51**	**76.71**	**76.43**	**75.93**

5.4 Long Term Forecast for 14th & 15th Plans and beyond up to 2033-34

5.4.1 The long term EER for the terminal years of 14th plan (2026-27) and 15th plan (2031-32) have been made by extrapolating the forecast of electrical energy consumption of the States/UTs and by adding T&D losses. The peak electric load have been worked out after applying suitable annual load factors in the case of States/UTs and suitable diversity factors in case of regions According to 18th EPS, the All India EER by end of 14th Plan (2026-27) and 15th Plan (2031-32) is assessed to be 2710 BU and 3710 BU respectively. The All India APEL by end of 14th Plan (2026-27) & 15th Plan 2031-32 is estimated to be 400.7 GW and 541.8 GW respectively. The region-wise break up of EER and APEL by end of 14th plan (2026-27) and 15th plan (2031-32) are given below in **Table- 5.3**.

Table -5.3 : Summary of Region wise Long Term Forecast of APEL & EER for terminal years of 14th and 15th Plans (as per 18th EPS)

Region	EER (BU)		APEL (GW)	
	2026-27	2031-32	2026-27	2031-32
Northern	840.67	1135.55	121.98	164.24
Western	757.32	1028.98	120.62	163.23
Southern	727.92	1017.53	118.77	165.34
Eastern	349.42	480.05	53.06	72.88
North E.	33.96	46.93	6.17	8.46
A&N	125	172	709	963
Lakshadweep	23	30	84	110
All India	**2710.06**	**3710.09**	**400.71**	**541.83**

5.4.2 State-wise EPS forecast for the terminal years of 14th plan (2026-27) and 15th plan (2031-32) both Annual Peak Demand and Energy requirement are given below:

Table- 5.4 : ALL INDIA & STATE WISE / UT WISE FORECAST
Peak Electric Load at Power Station Bus Bars (Utilities Only)

(Fig. in MW)

State/UTs	12th Plan End (2016-17)	13th Plan End (2021-22)	14th Plan End (2026-27)	15th Plan End (2031-32)
Delhi	6398	9024	12681	17246
Haryana	10273	14244	20103	27202
Himachal Pradesh	1900	2589	3424	4476
Jammu & Kashmir	2687	4217	5996	8302
Punjab	12342	14552	18352	23144
Rajasthan	13886	19692	28828	40284

State/UTs	12th Plan End (2016-17)	13th Plan End (2021-22)	14th Plan End (2026-27)	15th Plan End (2031-32)
Uttar Pradesh	23081	36061	53690	73708
Uttarakhand	2189	2901	3911	5222
Chandigarh	426	559	732	948
Northern Region	**60934**	**86461**	**121979**	**164236**
Goa	815	1192	1658	2216
Gujarat	19091	26973	38691	53301
Chhattisgarh	4687	6599	9090	12116
Madhya Pradesh	13904	18802	27519	38088
Maharashtra	28645	39622	54982	74528
D. & N. Haveli	944	1297	1733	2294
Daman & Diu	441	605	818	1082
Western Region	**62015**	**86054**	**120620**	**163222**
Andhra Pradesh	22445	33194	51601	74818
Karnataka	13010	18403	25396	34720
Kerala	4669	6093	8150	10903
Tamil Nadu	20816	29975	43044	59827
Puducherry	630	782	787	940
Southern Region	**57221**	**82199**	**118764**	**165336**
Bihar	5018	9306	16239	23411
Jharkhand	4616	6341	8780	11930
Odisha	5672	6749	8712	11280
West Bengal	11793	17703	26027	36187
Sikkim	144	176	245	341
Eastern Region	**24303**	**35928**	**53053**	**72874**
Assam	1817	2534	3613	5033
Manipur	346	497	869	1212
Meghalaya	445	596	828	1112
Nagaland	185	271	403	554
Tripura	340	472	674	913
Arunachal Pradesh	135	177	266	365
Mizoram	285	352	521	723
North Eastern Region	**2966**	**4056**	**6169**	**8450**

State/UTs	12th Plan End (2016-17)	13th Plan End (2021-22)	14th Plan End (2026-27)	15th Plan End (2031-32)
Andaman & Nicobar	67	89	125	172
Lakshadweep	11	18	23	30
All India	**1,99,540**	**2,83,470**	**4,00,705**	**5,41,823**

Table – 5.5 : ALL INDIA & STATE WISE / UT WISE FORECAST - Electrical Energy Requirement at Power Station Bus Bars (Utilities Only)

(Fig. in Million Units)

State/UTs	12th Plan End (2016-17)	13th Plan End (2021-22)	14th Plan End (2026-27)	15th Plan End (2031-32)
Delhi	37529	52930	73827	99649
Haryana	56681	78586	110915	150083
Himachal Pradesh	10901	14514	19198	25096
Jammu & Kashmir	16298	21884	31110	43075
Punjab	69410	86941	108835	136243
Rajasthan	77907	110483	161741	226014
Uttar Pradesh	138854	209046	308887	420829
Uttarakhand	12751	16774	22438	29733
Chandigarh	2165	2842	3719	4821
Northern Region	**422498**	**594000**	**840670**	**1135543**
Goa	4853	6837	9442	12617
Gujarat	108704	153582	218610	301160
Chhattisgarh	24222	34106	46979	62620
Madhya Pradesh	77953	107060	155489	213539
Maharashtra	169353	225606	310654	417826
D. & N. Haveli	6286	8413	11164	14676
Daman & Diu	2817	3706	4980	6536
Western Region	**394188**	**539310**	**757318**	**1028974**
Andhra Pradesh	129767	191912	284776	412903

State/UTs	12th Plan End (2016-17)	13th Plan End (2021-22)	14th Plan End (2026-27)	15th Plan End (2031-32)
Karnataka	78637	108012	147941	200736
Kerala	26584	34691	46049	61125
Tamil Nadu	119251	171718	244703	337491
Puducherry	3586	4452	4444	5271
Southern Region	**357826**	**510786**	**727913**	**1017526**
Bihar	29447	52975	91733	131219
Jharkhand	27691	37482	51512	69475
Odisha	35772	42566	54565	70154
West Bengal	70352	103283	150704	207948
Sikkim	528	645	898	1250
Eastern Region	**163790**	**236952**	**349412**	**480046**
Assam	8947	12699	18107	25224
Manipur	1241	2219	3881	5416
Meghalaya	2243	3029	4206	5651
Nagaland	834	1163	1728	2373
Tripura	1402	2026	2892	3921
Arunachal Pradesh	552	721	1085	1489
Mizoram	936	1388	2053	2847
North Eastern Region	**16154**	**23244**	**33952**	**46921**
Andaman & Nicobar	366	505	709	963
Lakshadweep	52	65	84	110
All India	**13,54,874**	**19,04,861**	**27,10,058**	**37,10,083**

5.4.3 The 18th EPS does not provide forecast for the year 2033-34. A forecast for 2034, by extrapolating the EPS figures has been made for the purpose of perspective transmission planning. The state-wise and region-wise annual peak load forecast are given below. The table below also gives corresponding figures for 14th and 15th plans for comparison purpose.

Table – 5.6 : ALL INDIA & STATE WISE / UT WISE Annual Peak Demand

(in MW)

State/UTs	14th Plan (as per 18th EPS) **2026-27**	15th Plan (as per 18th EPS **2031-32**	**Estimates for 2033-34**
Delhi	12681	17246	19503
Haryana	20103	27202	30700
Himachal Pradesh	3424	4476	4982
Jammu & Kashmir	5996	8302	9456
Punjab	18352	23144	25395
Rajasthan	28828	40284	46053
Uttar Pradesh	53690	73708	83669
Uttrakhand	3911	5222	5862
Chandigarh	732	948	1051
Northern Region	**121979**	**164236**	**184987**
Goa	1658	2216	2489
Gujarat	38691	53301	60588
Chhattisgarh	9090	12116	13592
Madhya Pradesh	27519	38088	43376
Maharashtra	54982	74528	84170
D. & N. Haveli	1733	2294	2566
Daman & Diu	818	1082	1210
Western Region	**120620**	**163222**	**184214**
Andhra Pradesh	51601	74818	86805
Karnataka	25396	34720	39346
Kerala	8150	10903	12249
Tamil Nadu	43044	59827	68248
Pudducherry	787	940	1009
Southern Region	**118764**	**165336**	**188730**
Bihar	16239	23411	27100
Jharkhand	8780	11930	13486
Orissa	8712	11280	12508
West Bengal	26027	36187	41286
Sikkim	245	341	389
Eastern Region	**53053**	**72874**	**82740**
Assam	3613	5033	5747
Manipur	869	1212	1385

(in MW)

State/UTs	14th Plan (as per 18th EPS) **2026-27**	15th Plan (as per 18th EPS **2031-32**	**Estimates for 2033-34**
Meghalaya	828	1112	1251
Nagaland	403	554	629
Tripura	674	913	1031
Arunachal Pradesh	266	365	414
Mizoram	521	723	824
North Eastern Region	**6169**	**8450**	**9583**
Andman & Nicobar Islands	125	172	195
Lakshadweep	23	30	33
All India	**400705**	**541823**	**611323**

5.4.4 In addition to above, following peak export demand has also been assumed for neighbouring countries of SAARC region.

Table – 5.7 : Expected Export Peak Demand for SAARC countries

(in MW)

State/UTs	**14th Plan (as per 18th EPS) 2026-27**	**15th Plan (as per 18th EPS 2031-32**	**Estimates for 2033-34**
SAARC Exports			
Bangladesh	1500	2000	2000
Nepal	400	500	500
SriLanka	500	800	1000
Pakistan	800	1000	1000
SAARC Exports	**3200**	**4300**	**4500**
Total All India + SAARC	**403800**	**546000**	**615700**

5.5 Possible generation resources:

The following aspects are broadly taken into consideration to assess the possible generation capacity from different modes to ensure planning of matching transmission network and meet demand.

- Untapped hydro potential, particularly in the Himalayan belt covering North and North Eastern regions of the country, Bhutan and Nepal.

- Location of capacity of coal reserves, location of Gas fields, proposed gas pipelines and plans for LNG terminals and re-gasification capacities.
- Projected port traffic for coal.
- State-wise potential for Renewable Energy Sources.
- Retirement of old and inefficient plants to be taken into consideration, which may be replaced by plants with latest technologies having lesser variable cost.

The above aspects were taken into consideration in the report of the Working Group on Integrated Strategy for bulk transport of energy of NTDPC.

5.6 Assessment of Generation Capacity requirement made during working of the NTDPC report

National Transport Development Committee (NTDPC), was established by the Cabinet Secretariat as a high level committee, to assess the transport requirements of India over the next two decades. "Working Group on Integrated Strategy for Bulk Transport of Energy & Related Commodities in India" was constituted under NTDPC. This working Group prepared a report in June, 2013. The broad assumptions to arrive at the above capacities are as given below:

- The installed capacity by the end of 12th Plan(2016-17) are based on planned addition during 12th Plan. Renewable capacity is over and above the conventional capacity. The candidate projects likely to be materialized during 13th to 15th Plans have been considered and State level constraints for capacity additions have been modeled for the plans beyond 12th plan.
- Likely projected availability of domestic coal from CIL and SCCL to power by 2031-32 has been considered.
- Coal prices from various subsidiaries are taken as per CIL's notified prices. Imported coal price forecast as per the World Energy Outlook 2011 global coal price forecast and analysis shared by ICF International. Domestic gas prices are as per the prevailing market prices for the various sources (APM, NELP, JVs). LNG prices are based on IEA's WEO forecast for Asian deliveries after adjustment applied corresponding to the actual contractual arrangements available for Indian buyers

- The basis for gas production is the DGH approved gas production plans for various existing and upcoming gas fields. It reflects discussions with and other analyses commissioned for various stake holders including Petroleum Planning and Analysis Cell (PPAC), Ministry of Petroleum and Natural Gas (MoPNG), DGH, GAIL and others.
- For wind potential, latest estimates of 109 GW made by Centre for Wind Energy Technology (CWET) for a hub height of 80 meters have been taken.
- Average levelised parameters have been used for costs of electricity generation, coal mining, commodity transport and power transmission.

5.7 Hydro Power Resources

Hydro potential (25 MW & above) in the country has been estimated as 1,45,320 MW. Out of this potential, 35,944 MW hydro capacity is under operation (as on 30.06.2014) and 13,131 MW hydro capacity is under construction. In addition, nine Pumped Storage Schemes (PSS) of about 4,786 MW are under operation and two PSS of 1,080 MW are under construction. Hydro Capacity of 96,244 MW (66%) is yet to be developed.

The likely installed capacity of hydro electric power plants is expected to be about 1,10,000 MW by the year 2031-32.

5.8 Nuclear Power Resources

Nuclear Power Plants in India are implemented by NPCL. At present, NPCIL operates 20 nuclear power reactors with a capacity of 4780 MW. One reactor namely RAPS-1 (100 MW) operated by NPCIL is owned by the Government of India while the remaining 4680 MW capacity is owned by NPCIL. NPCIL also has six nuclear power reactors with a capacity of 4,800 MW presently under construction which are likely to be commissioned during 12th Plan period.

Beyond the reactors presently in operation and under construction, sites for setting up additional 16 PHWRs of 700 MW each and 28 LWRs each of 1000 MW and higher capacity have been accorded ‘in principle’ approval of the Government. The LWR sites have been approved for locating six reactors each and PHWR sites for two/four reactors. The plan is to set up reactors in phases of twin reactors at each site, with a gap of about four years between phases.

In addition to the above mention programme of NPCIL, Bhartiya Nabhikiya Vidyut Nigam Ltd (BHAVINI) has planned to commissioned FBRs of 500 MWe capacity. First Prototype Fast Breeder Reactor (PFBR) of 500 MW capacity is under advanced stage of construction and is likely to start power generation during the year 2015-16. According to BHAVINI, capacity addition of 1500 MW is to be achieved by 2022-23 and between 2023- 2032 it is planned to commission 4 FBRs of 500 MW each and 2 FBRs of 1000 MW each. With these capacity additions the total capacity of BHAVINI is likely to be 5500 MW by 2032.

As per NPCIL, start of work on 19 new reactors with a total capacity of 17,400 MW is envisaged during 12th Five Year Plan as detailed below:

Table – 5.8 : Nuclear capacity up to 15th Plan

Projects	Location	Capacity (MW)
Indigenous Reactors		
GHAVP U 1&2*	Gorakhpur, Haryana	2 x 700
CMAPP U 1&2	Chutka, Madhya Pradesh	2 x 700
Mahi Banswara U 1&2	Mahi Banswara, Rajasthan	2 x 700
Kaiga U 5&6	Kaiga, Mamataka	2 x 700
FBR U 1&2	Kalpakkam, Tamil Nadu	2 x 500
AHWR	Under identification	300
Reactors with Foreign Cooperation		
KKNPP U 3&4*	Kudankulam, Tamil Nadu	2 x 1000
JNPP U 1&2	Jaitapur, Maharashtra	2 x 1650
Kovvada U 1&2	Kovvada, Andhra Pradesh	2 x 1500
Chhaya Mithi Virdi U 1&2	Chhaya Mithi Virdi, Gujarat	2 x 1100

*Projects accorded Financial Sanction

These twelve reactors are planned to be added progressively during the 13th and 14th Plans. The actual realization during 13th Plan would however depend on the actual start of work on the projects. This in turn would depend on factors like acquisition of land, obtaining statutory clearances and resolution of issues, finalization of contracts etc. The likely installed capacity of nuclear power plants is expected to be about 35500 MW.

5.9 Coal Reserves

Exploration for coal in India is carried out in stages. During preliminary exploration, geological surveys are undertaken to identify potential coal-bearing areas. In the next stage there is regional or promotional exploration where widespread drilling is carried out to establish the broad framework of the deposits. Progressively more intensive exploration is carried out before mining actually begins. The estimates of coal resources are placed in three categories: proven, indicated and inferred with proven being the most detailed exploration of the three.

India's total geological resource of coal has been estimated to be about 286 Billion Tonnes (BT). Of this, 114 BT is proven resource, while 137 BT and 34 BT fall in the indicated and inferred categories respectively. Only about 12 per cent of the geological resource contains coking coal; the bulk is non-coking coal. Indian coal is classified into grades, A through G, based on its gross calorific value (GCV) with grade 'A' coal having the highest GCV. Coal India Limited (CIL) is the major indigenous coal producer and has seven production subsidiaries and an eighth subsidiary (CMPDI) that provides technical support to the seven production subsidiaries. Singareni Colleries Co. Ltd, jointly owned by the Governments of India and Andhra Pradesh, is also into coal production and supply.

The major reserves of coal in the country is given in Table- 5.9. These coalfields have a geological resource of about 232 BT, more than 80 per cent of the national resource and almost all of it is in the eastern part of the country. The bulk of the reserves are in three states – Odisha, Jharkhand and Chhattisgarh - which together have about 70 per cent of the country's reserves of coal. However, it should be noted that much of this coal is of the poor quality (mostly grade F, & some D or E).

Table – 5.9 : Major Reserves of Coal (Figure in BT)

Sl.No.	Name of the Coalfield	State	Type of Coal	Gross Geological reserves	Remarks
1	Talcher	Orissa	F	46.64	Thermal coal
2	Ib valley	Orissa	F	22.52	- do -
3	North karanpura	Jharkhand	F	13.35	- do -
4	South karanpura	Jharkhand	F	6.3	- do -
5	Rajmahal	Jharkhand	D-E	16.2	- do -

Sl.No.	Name of the Coalfield	State	Type of Coal	Gross Geological reserves	Remarks
6	Korba	Chhatisgarh	D-E	11.76	- do -
7	Hasdeo-Arand	Chhatisgarh	D-E	5.18	- do -
8	Mand-raigarh	M.P	D-E	23.77	- do -
9	Singrauli	M.P	C-E	12.76	- do -
10	Wardha valley	Maharashtra	D-E	6.26	- do -
11	Godavari Valley	A. P	D-E	22.05	- do -
12	Raniganj	W.B	B-E	25.83	Thermal & Semi Coking
13	Jharia	Bihar	LVM , C - E	19.43	Coking
	TOTAL			**232.05**	

Average ash content: 38-40%, Average heat rate 4000Kcal/Kg

Source: *Report of Sub-Group 2 of the 'Working Group on Integrated Strategy for Bulk Transport of Energy and Related Commodities in India', as part of the NTDPC*

5.10 Estimated Renewable Energy Potential

The estimated medium-term (up to 2032) potential for power generation in the country from wind, small hydro, solar and biomass resources has been estimated at around 200 -250 GW, a part of which may become grid connected. Details of the same are as given below:

Table – 5.10 : Renewable Energy Source Potential

Sl. No.	Resource	Estimated Potential
i	Solar Energy	about 100,000 MW (depending upon technological advancement to make solar power cost effective)
ii	Wind Power	about 100,000 MW
iii	Small Hydro Power (up to 25 MW)	about 15,000 MW
iv	Bio-Power (Agro-Residues 16000 MW Cogeneration Bagasse 6000 MW, , & Waste to Energy 3000 MW)	about 25,000 MW
	Total	**about 2,40,000 MW**

5.11 Generation Import Potential from Bhutan and Nepal

Following hydro generation capacity for import in India has been considered from Bhutan and Nepal during 2026-34.

Table – 5.11 : Hydro Potential (capacities in MW) for Import from SAARC by 2034

Import From	By 2026-27	By 2031-32	By 2033-34
Bhutan	13986	26534	26534
Nepal	10000	20000	25000
Total SAARC Import	23986	46534	51534

5.12 Generation Addition Scenarios

The capacity addition figures in case of hydro, renewable and nuclear in the NTDPC report (the working Group report) appear to be reasonable and the same has been adopted for the purpose of present report on perspective transmission plan, which has been considered as **'Generation Scenario-I'** for 14th and 15th Plans. However in view of drastic change in likely gas scenario, it is felt that capacity addition from gas based power plants may be considerably lower and as such another scenario i.e. 'Generation Scenario-II' has also been considered. In this scenario, it is assumed that additional imported coal would fill the load-generation gap. The details are given in following paragraphs.

5.13 Generation Scenario – (more gas) for 14th and 15th Plans

As described above, following Tables give the state-wise and fuel-wise generation capacity at the end of 14th and 15th plans under '**Generation Scenario-I'**.

Table – 5.12 : Generation Scenario – I for 14th Plan

Scenario: I for end of 14th Plan i.e. by 2026-27

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
ER	BI	16769	0	143	0	323	17235
ER	JH	16159	0	134	90	612	16995
ER	OR	33546	0	2118	0	453	36117

Scenario: I for end of 14th Plan i.e. by 2026-27

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
ER	SI	0	0	4213	5	139	4357
ER	WB	21012	0	2457	1684	1767	26920
Total ER		**87486**	**0**	**9064**	**1779**	**3294**	**101623**
NER	AR	0	0	15282	0	242	15524
NER	AS	810	0	300	1629	430	3169
NER	MG	0	0	397	138	501	1036
NER	MN	0	0	1097	45	220	1362
NER	MZ	0	0	647	52	157	856
NER	NG	0	0	283	62	153	498
NER	TR	0	0	0	1117	137	1254
Total NER		**810**	**0**	**18006**	**3043**	**1840**	**23699**
NR	DL	420	0	0	6587	685	7692
NR	HP	0	0	18714	0	5501	24215
NR	HY	9795	1400	62	1463	1972	14692
NR	JK	0	0	7374	184	2801	10359
NR	PB	9220	0	1411	0	4772	15403
NR	RJ	15776	5380	526	1339	15448	38469
NR	UP	28748	440	502	4473	4637	38800
NR	UT	0	0	10356	900	3903	15159
Total NR		**63959**	**7220**	**38945**	**14946**	**39719**	**164789**
SR	AP	19520	0	4630	12576	7021	43747
SR	KE	0	0	2424	2376	1860	6660
SR	KT	10880	2280	3698	5597	15905	38360
SR	TN	28178	3940	2160	8665	16577	59520

Scenario: I for end of 14th Plan i.e. by 2026-27

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
SR	TS	14329	0	524	0	6300	21153
Total SR		**72907**	**6220**	**13436**	**29214**	**47663**	**169440**
WR	CH	31696	0	120	0	585	32401
WR	GO	0	0	0	598	591	1189
WR	GU	24214	3140	1990	10416	31127	70887
WR	MH	42978	4400	2975	6353	8832	65538
WR	MP	29959	700	2794	1850	2267	37570
Total WR		**128847**	**8240**	**7879**	**19217**	**43402**	**207585**
Bhutan		0	0	13986	0	0	13986
Nepal		0	0	10000	0	0	10000
Total SAARC		**0**	**0**	**23986**	**0**	**0**	**23986**
Total All-India + SAARC Imports)		**354009**	**21680**	**111316**	**68199**	**135918**	**691122**

Table – 5.13 : Generation Scenario – I for 15th Plan

Scenario: I for end of 15th Plan i.e. by 2031-32

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
ER	BI	17729	0	143	0	456	18328
ER	JH	17948	0	134	90	739	18911
ER	OR	44052	0	2118	0	1529	47699
ER	SI	0	0	4960	5	226	5191
ER	WB	32091	0	2457	1684	2456	38688
Total ER		**111820**	**0**	**9811**	**1779**	**5406**	**128816**

Scenario: I for end of 15th Plan i.e. by 2031-32

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
NER	AR	0	0	32349	0	343	32692
NER	AS	810	0	300	1189	519	2818
NER	MG	0	0	694	171	683	1548
NER	MN	0	0	1097	0	544	1641
NER	MZ	0	0	647	0	236	883
NER	NG	0	0	283	24	281	588
NER	TR	0	0	0	1079	284	1363
Total NER		**810**	**0**	**35370**	**2463**	**2890**	**41533**
NR	DL	0	0	0	11389	1078	12467
NR	HP	0	0	18714	0	5913	24627
NR	HY	11115	2100	62	6563	2853	22693
NR	JK	0	0	7374	184	3798	11356
NR	PB	9731	0	1411	2528	8948	22618
NR	RJ	17542	7480	526	4316	32478	62342
NR	UP	33458	440	502	15196	5636	55232
NR	UT	0	0	14728	882	4228	19838
Total NR		**71846**	**10020**	**43317**	**41058**	**64932**	**231173**
SR	AP	23609	0	4630	15918	10000	54157
SR	KE	0	0	2424	3958	3157	9539
SR	KT	13996	2280	3698	8121	25128	53223
SR	TN	31400	8191	2160	12794	20634	75179
SR	TS	17829	0	524	0	7106	25459

Scenario: I for end of 15th Plan i.e. by 2031-32

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
Total SR		**86834**	**10471**	**13436**	**40791**	**66025**	**217557**
WR	CH	37480	0	120	0	719	38319
WR	GO	0	0	0	1259	998	2257
WR	GU	30068	4989	1990	18005	50114	105166
WR	MH	50963	8000	2975	9587	15195	86720
WR	MP	36926	2100	2926	3940	4542	50434
Total WR		**155437**	**15089**	**8011**	**32791**	**71568**	**282896**
Bhutan		0	0	26534	0	0	26534
Nepal		0	0	20000	0	0	20000
Total SAARC		**0**	**0**	**46534**	**0**	**0**	**46534**
Total All-India + SAARC Imports)		**426747**	**35580**	**156479**	**118882**	**210821**	**948509**

5.14 Generation Scenario – II (less gas) for 14th and 15th Plans

As given in earlier paragraphs, capacity addition from gas based power plants may be considerably lower as compared to the first scenario. Presently gas based capacity in the country of about 21,000 MW is operating at an average PLF of about 23%. Besides this, a capacity of about 6,000 MW is ready for commissioning. By the end of 12th plan the gas based capacity would be of the order of 27,000 MW, which is close to the estimated capacity in the Report. However, for the 13th Plan onwards, gas based capacity addition as estimated in the Report seems to be on the higher side due to the proposed changes in gas allocation priority wherein, Power sector has been given lower priority. Besides, due to proposed revision of gas prices, gas based capacity will be costlier and competing with coal becomes questionable.

However, in view of the increasing capacity addition from the Renewable sources, quick responding gas based capacity is necessary for the Grid security and stability. Gas based capacity is also needed as peaking capacity as the addition of hydro capacity is relatively slow. Gas being cleaner fuel, needs to be promoted in accordance with Low Carbon Growth Strategy adopted by the Country due to Global environmental compulsions. Even though, the current availability of gas is very low for Power Sector, considering all of these factors, the capacity addition from gas based power plants has been taken about 50% of the capacity proposed in the NTDPC Report during 13th, 14th and 15th Plan periods & the corresponding capacity has been added from the coal based power plants. This results in a second generation scenario. Following Tables give the state-wise and fuel-wise generation capacity at the end of 14th and 15th plans under **'Generation Scenario-II'**

Table – 5.14 : Generation Scenario –II for 14th Plan

Scenario: II for end of 14th Plan i.e. by 2026-27

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
ER	BI	16769	0	143	0	323	17235
ER	JH	16159	0	134	90	612	16995
ER	OR	33546	0	2118	0	453	36117
ER	SI	0	0	4213	5	139	4357
ER	WB	21798	0	2457	898	1767	26920
Total ER		**88272**	**0**	**9064**	**993**	**3294**	**101623**
NER	AR	0	0	15282	0	242	15524
NER	AS	1332	0	300	1107	430	3169
NER	MG	68	0	397	70	501	1036
NER	MN	0	0	1097	45	220	1362
NER	MZ	0	0	647	52	157	856
NER	NG	30	0	283	32	153	498
NER	TR	0	0	0	1117	137	1254
Total NER		**1430**	**0**	**18006**	**2423**	**1840**	**23699**

Scenario: II for end of 14th Plan i.e. by 2026-27

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
NR	DL	2374	0	0	4634	685	7692
NR	HP	0	0	18714	0	5501	24215
NR	HY	10309	1400	62	950	1972	14692
NR	JK	0	0	7374	184	2801	10359
NR	PB	9220	0	1411	0	4772	15403
NR	RJ	15936	5380	526	1180	15448	38469
NR	UP	30238	440	502	2983	4637	38800
NR	UT	0	0	10356	900	3903	15159
Total NR		**68076**	**7220**	**38945**	**10830**	**39719**	**164789**
SR	AP	21242	0	4630	9904	7021	42797
SR	KE	804	0	2424	1573	1860	6660
SR	KT	13562	2280	3698	2916	15905	38360
SR	TN	31791	3940	2160	5052	16577	59520
SR	TS	15280	0	524	0	6300	22104
Total SR		**82678**	**6220**	**13436**	**19444**	**47663**	**169441**
WR	CH	31696	0	120	0	585	32401
WR	GO	275	0	0	323	591	1189
WR	GU	25229	3140	1990	9401	31127	70887
WR	MH	44470	4400	2975	4862	8832	65538
WR	MP	30884	700	2794	925	2267	37570
Total WR		**132554**	**8240**	**7879**	**15511**	**43402**	**207585**
Bhutan		0	0	13986	0		13986
Nepal		0	0	10000	0	0	10000
Total SAARC		**0**	**0**	**23986**	**0**	**0**	**23986**
Total All-India + SAARC Imports)		**373009**	**21680**	**111316**	**49200**	**135918**	**691123**

Table – 5.15 : Generation Scenario –II for 15th Plan

Scenario: II for end of 15th Plan i.e. by 2031-32

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
ER	BI	17729	0	143	0	456	18328
ER	JH	17948	0	134	90	739	18911
ER	OR	44052	0	2118	0	1529	47699
ER	SI	0	0	4960	5	226	5191
ER	WB	32877	0	2457	898	2456	38688
Total ER		**112606**	**0**	**9811**	**993**	**5406**	**128816**
NER	AR	0	0	32349	0	343	32692
NER	AS	1112	0	300	887	519	2818
NER	MG	85	0	694	87	683	1548
NER	MN	0	0	1097	8	544	1649
NER	MZ	0	0	647	16	236	899
NER	NG	11	0	283	13	281	588
NER	TR	0	0	0	1098	284	1382
Total NER		**1208**	**0**	**35370**	**2108**	**2890**	**41576**
NR	DL	4070	0	0	7035	1078	12182
NR	HP	0	0	18714	0	5913	24627
NR	HY	14179	2100	62	3500	2853	22693
NR	JK	0	0	7374	184	3798	11356
NR	PB	10995	0	1411	1264	8948	22618
NR	RJ	19190	7480	526	2668	32478	62342
NR	UP	40310	440	502	8345	5636	55232

Scenario: II for end of 15th Plan i.e. by 2031-32

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
NR	UT	0	0	14728	891	4228	19847
Total NR		**88743**	**10020**	**43317**	**23886**	**64932**	**230897**
SR	AP	26242	0	4630	11575	10000	52447
SR	KE	1595	0	2424	2364	3157	9539
SR	KT	17940	2280	3698	4178	25128	53223
SR	TN	37078	8191	2160	7117	20634	75179
SR	TS	19540	0	524	0	7106	27170
Total SR		**102394**	**10471**	**13436**	**25232**	**66025**	**217558**
WR	CH	37480	0	120	0	719	38319
WR	GO	606	0	0	654	998	2257
WR	GU	34878	4989	1990	13196	50114	105166
WR	MH	54072	8000	2975	6479	15195	86720
WR	MP	38896	2100	2926	1970	4542	50434
Total WR		**165931**	**15089**	**8011**	**22298**	**71568**	**282896**
Bhutan		0	0	26534	0		26534
Nepal		0	0	20000	0	0	20000
Total SAARC		**0**	**0**	**46534**	**0**	**0**	**46534**
Total All-India + SAARC Imports)		**470880**	**35580**	**156479**	**74516**	**210821**	**948276**

5.15 It may be mentioned that although, total capacity addition by the end of 15th Plan(2031-32) remains same in two scenarios, however, due to change in fuel mix (due to shift of about 44000 MW from gas to coal) transmission requirement may change. In view of limited availability of domestic coal, additional capacity of

44000 MW from coal would mainly be on imported coal and based on coastal locations in the States of Andhra Pradesh, Gujarat, Maharastra, Karnataka, Tamil Nadu & West Bengal, as such transmission system needs to be planned accordingly.

5.16 Generation Addition Scenario for 2033-34

The above capacity is not sufficient to meet the additional peak demand for the period of 2033-34. The All-India annual peak demand increases by about 70, 000 MW from 541823 MW to 611323 MW to meet this increased demand at least about 80, 000 MW of additional capacity would be needed. A generation capacity scenario for 2033-34 has been considered by scaling up the coal based and gas based capacities of scenario-I. An additional 5000 MW of hydro capacity has also been considered in Nepal for import to India. Following Table gives the state-wise and fuel-wise generation capacity at the end of 2033-34.

Table – 5.16 : Generation Scenario for 2033-34

Generation Scenario for 2033-34

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
ER	BI	20388	0	143	0	456	20988
ER	JH	20640	0	134	99	739	21612
ER	OR	50660	0	2118	0	1529	54306
ER	SI	0	0	4960	6	226	5192
ER	WB	36905	0	2457	1852	2456	43670
Total ER		**128593**	**0**	**9811**	**1957**	**5406**	**145767**
NER	AR	0	0	32349	0	343	32692
NER	AS	932	0	300	1308	519	3058
NER	MG	0	0	694	188	683	1565
NER	MN	0	0	1097	0	544	1641

Generation Scenario for 2033-34

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
NER	MZ	0	0	647	0	236	883
NER	NG	0	0	283	26	281	590
NER	TR	0	0	0	1187	284	1471
Total NER		**932**	**0**	**35370**	**2709**	**2890**	**41901**
NR	DL	0	0	0	12528	1078	13606
NR	HP	0	0	18714	0	5913	24627
NR	HY	12782	2100	62	7219	2853	25017
NR	JK	0	0	7374	202	3798	11374
NR	PB	11191	0	1411	2781	8948	24330
NR	RJ	20173	7480	526	4748	32478	65405
NR	UP	38477	440	502	16716	5636	61770
NR	UT	0	0	14728	970	4228	19926
Total NR		**82623**	**10020**	**43317**	**45164**	**64932**	**246056**
SR	AP	27150	0	4630	17510	10000	59290
SR	KE	0	0	2424	4354	3157	9935
SR	KT	16095	2280	3698	8933	25128	56135
SR	TN	36110	8191	2160	14073	20634	81168
SR	TS	20503	0	524	0	7106	28133
Total SR		**99859**	**10471**	**13436**	**44870**	**66025**	**234661**
WR	CH	43102	0	120	0	719	43941
WR	GO	0	0	0	1385	998	2383
WR	GU	34578	4989	1990	19806	50114	111477

Generation Scenario for 2033-34

(in MW)

Region	State	Coal	Nuclear	Hydro	Gas	RES	Total
WR	MH	58607	8000	2975	10546	15195	95323
WR	MP	42465	2100	2926	4334	4542	56366
Total WR		**178753**	**15089**	**8011**	**36070**	**71568**	**309491**
Bhutan		0	0	26534	0		26534
Nepal		0	0	25000	0	0	25000
Total SAARC		**0**	**0**	**51534**	**0**	**0**	**51534**
Total All-India + SAARC Imports)		**490759**	**35580**	**161479**	**130771**	**210821**	**1029410**

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Chapter – 6

Evolving Transmission corridors for 14th and 15th Plans and up to 2033-34

6.1 Introduction

The projection of generation and demand projection under different scenarios as estimated in the earlier Chapter for 14th (2026-27), 15th (2031-32) and 2033-34 conditions are utilised in this chapter to find out the demand surplus analysis for the above conditions. On the basis of the demand supply position, the requirement of flow of power between various regions has been worked out. The transmission corridors between the regions including the SAARC countries have been indicated which may be required to meet the need of the power transfer among various regions. The analysis has been carried out for both Scenario-I and Scenario-II of future addition of generation projects as explained in the previous chapter.

6.2 Growth in Generation and Demand for Scenario-I

Under scenario-1, the installed capacity of the country is likely to grow from 462 GW by the end of 13th plan (2021-22) to 978 GW by 2033-34. The capacity of hydro projects in SAARC countries viz. Bhutan and Nepal is expected to simultaneously increase from 6.6 GW by the end of 13th plan to 51.5 GW by the end of 2033-34. Thus total installed capacity including SAARC generation would likely to enhance from 469GW by the end of 13th plan to 1029GW by 2033-34. The growth in generation projects during 14th and 15th plan up to 2033-34 is given below.

Table – 6.1 : Growth in generation projects (Installed Capacity) in the 14th and 15th plan up to 2033-34 (Scenario-I)

	End of 13th Plan (2021-22)	Addition in 14th Plan	End of 14th Plan (2026-27)	Addition in 15th Plan	End of 15th Plan (2031-32)	End of 2033-34
NR	102206	62583	164789	66384	231173	246056
WR	148818	58767	207585	75311	282896	309491
SR	118958	50482	169440	48117	217557	234661
ER	77813	23810	101623	27193	128816	145767

	End of 13th Plan (2021-22)	Addition in 14th Plan	End of 14th Plan (2026-27)	Addition in 15th Plan	End of 15th Plan (2031-32)	End of 2033-34
NER	14623	9076	23699	17834	41533	41901
SubTotal	**462418**	**204719**	**667136**	**234839**	**901975**	**977876**
Bhutan	6602	7384	13986	12548	26534	26534
Nepal	0	10000	10000	10000	20000	25000
SAARC Total	**6602**	**17384**	**23986**	**22548**	**46534**	**51534**
Total	**469020**	**222103**	**691122**	**257387**	**948509**	**1029410**

The all India peak demand is expected to grow from 283 GW in 2021-22 to 611 GW in 2033-34. The export to SAARC countries is also expected to increase from 1800 MW by the end of 13th plan to 4500 MW by 2033-34. The total requirement of power consumption is therefore about 616 GW including export to the SAARC countries. The growth of demand in 14th and 15th plan and up to 2033-34 condition is tabulated below.

Table – 6.2 : Growth in Demand in the 14th and 15th plan up to 2033-34

	13th Plan	14th Plan	15th Plan	2033-34
NR	86461	121979	164236	184987
WR	86054	120620	163222	184214
SR	82199	118764	165336	188730
ER	35928	53053	72874	82740
NER	4056	6169	8450	9583
All India	**283370**	**400600**	**541700**	**611200**
Bangladesh	1000	1500	2000	2000
Nepal	300	400	500	500
SriLanka	0	500	800	1000
Pakistan	500	800	1000	1000
SAARC Export	**1800**	**3200**	**4300**	**4500**
Total	**285170**	**403800**	**546000**	**615700**

The total Installed Capacity vis-a-vis Demand at the end of 13th, 14th, 15th and 2033-34 conditions considering SAARC exchanges are shown in the following figure.

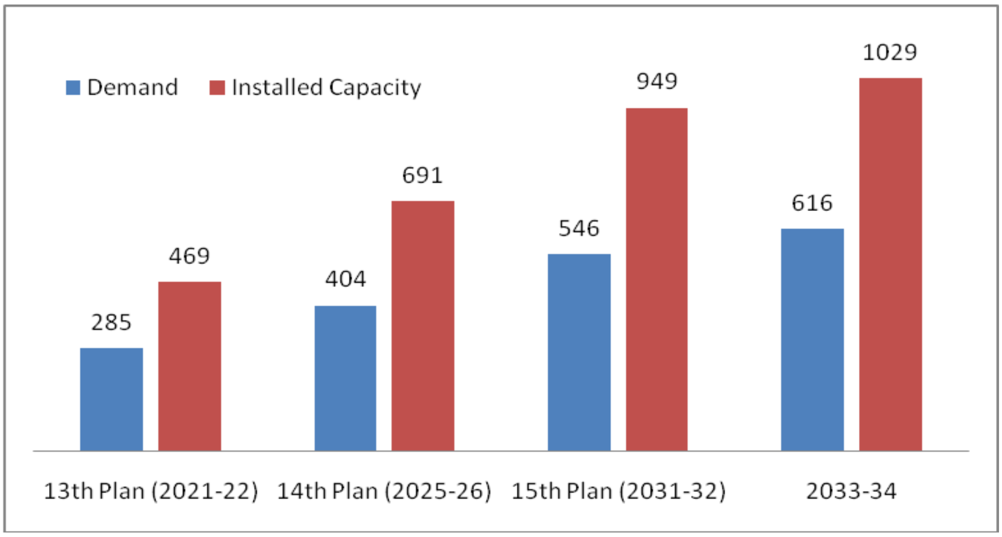


Fig 6.1 : Plan-wise Growth in Generation and Demand (GW)

From the above growth in generation and demand, the region-wise Installed Capacity and Demand at the end of 14th plan, 15th plan and 2033-34 condition is given in Table-6.3, 6.4 and 6.5 respectively.

Table – 6.3 : Region-wise Installed Capacity and Demand at the end of 14th plan (Scenario-I)

Region	Installed Capacity by the end of 14th Plan (2026-27) (Scenario - I)							Peak Demand (2026-27) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	63959	7220	71179	38945	14946	39719	164789	121979
WR	128847	8240	137087	7879	19217	43402	207585	120620
SR	72907	6220	79127	13436	29214	47663	169440	118764
ER	87486	0	87486	9064	1779	3294	101623	53053
NER	810	0	810	18006	3043	1840	23699	6169
SAARC Exchange	0	0	0	23986	0	0	23986	3200
Total	**354009**	**21680**	**375689**	**111316**	**68199**	**135918**	**691122**	**403800**

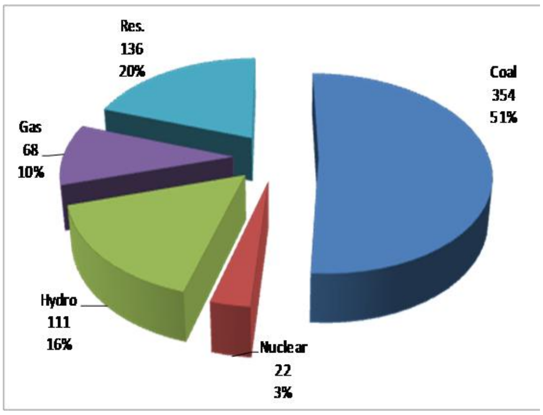
Table – 6.4 : Region-wise Installed Capacity and Demand by the end of 15th plan (Scenario-I)

Region	Installed Capacity by the end of 15th Plan (2031-32) (Scenario - I)							Peak Demand (2031-32) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	71846	10020	81866	43317	41058	64932	231173	164236
WR	155437	15089	170526	8011	32791	71568	282896	163222
SR	86834	10471	97305	13436	40791	66025	217557	165336
ER	111820	0	111820	9811	1779	5406	128816	72874
NER	810	0	810	35370	2463	2890	41533	8450
SAARC Exchange	0	0	0	46534	0	0	46534	4300
Total	**426747**	**35580**	**462327**	**156479**	**118882**	**210821**	**948509**	**546000**

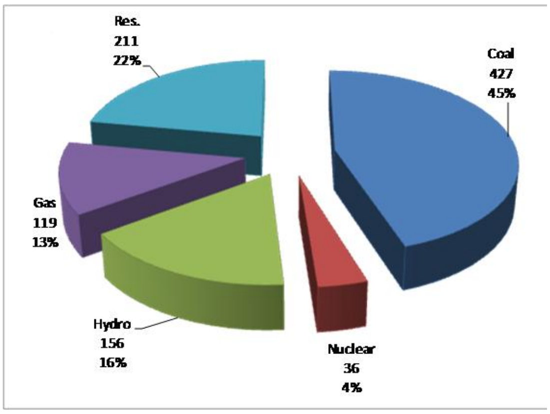
Table – 6.5 : Region-wise Installed Capacity and Demand by the end of 2033-34

Region	Installed Capacity by the end of 2033-34							Peak Demand (2033-34) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	82623	10020	92643	43317	45164	64932	246056	184987
WR	178753	15089	193842	8011	36070	71568	309491	184214
SR	99859	10471	110330	13436	44870	66025	234661	188730
ER	128593	0	128593	9811	1957	5406	145767	82740
NER	932	0	932	35370	2709	2890	41901	9583
SAARC Exchange	0	0	0	51534	0	0	51534	4500
Total	**490759**	**35580**	**526339**	**161479**	**130771**	**210821**	**1029410**	**615700**

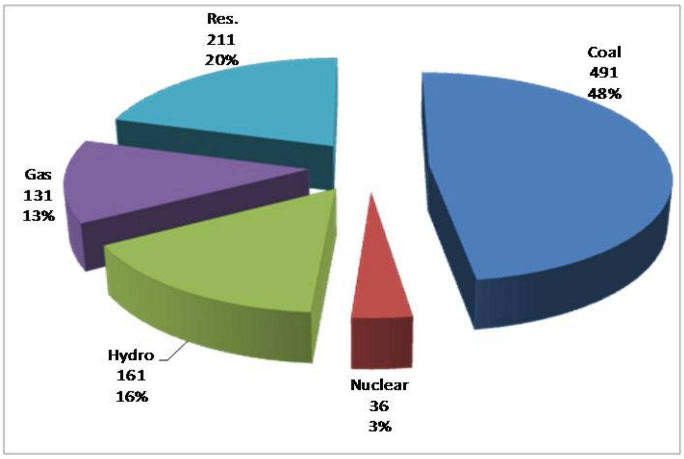
The fuel-wise installed capacity of the generation projects by the end of 14th, 15th and 2033-34 conditions is given below.



14th Plan (2026-27)



15th Plan (2031-32)



2033-34

Fig 6.2 : Fuel-wise Generation at the end of 14th, 15th and 2033-34 (Figs in GW) – Scenario-I

6.3 Demand Supply Analysis for Scenario-I

The demand-supply analysis has been carried out for both peak and off-peak condition of three seasons viz. Summer, Monsoon and Winter. The Generation and Load availability factors have been considered primarily from the planning criterion of Transmission Planning of CEA and the same has been shown in Table 6.6 and 6.7 below.

Table – 6.6 : Generation Availability Factors

	Summer Peak				Monsoon Peak				Winter Peak			
	Thermal	Hydro	Gas	Res.	Thermal	Hydro	Gas	Res.	Thermal	Hydro	Gas	Res.
NR	80%	70%	60%	15%	80%	90%	80%	10%	80%	50%	80%	10%
WR	80%	70%	60%	15%	80%	90%	80%	10%	80%	50%	80%	10%
SR	80%	70%	60%	15%	80%	90%	80%	10%	80%	50%	80%	10%
ER	80%	70%	60%	15%	80%	90%	80%	10%	80%	50%	80%	10%
NER	80%	70%	60%	15%	80%	90%	80%	10%	80%	50%	80%	10%
SAARC Exchange	80%	70%	60%	15%	80%	90%	80%	10%	80%	50%	80%	10%
	Summer Off-Peak				**Monsoon Off-Peak**				**Winter Off-Peak**			
	Thermal	**Hydro**	**Gas**	**Res.**	**Thermal**	**Hydro**	**Gas**	**Res.**	**Thermal**	**Hydro**	**Gas**	**Res.**
NR	80%	40%	0%	15%	80%	60%	0%	10%	80%	10%	10%	10%
WR	80%	40%	0%	15%	80%	60%	0%	10%	80%	10%	10%	10%
SR	80%	40%	0%	15%	80%	60%	0%	10%	80%	10%	10%	10%
ER	80%	40%	0%	15%	80%	60%	0%	10%	80%	10%	10%	10%
NER	80%	40%	0%	15%	80%	60%	0%	10%	80%	10%	10%	10%
SAARC Exchange	80%	40%	0%	15%	80%	60%	0%	10%	80%	10%	10%	10%

Table – 6.7 : Region-Wise Demand Factors for seasonal variation of Load

	Summer Peak	Summer Off-peak	Monsoon Peak	Monsoon Off-peak	Winter Peak	Winter Off-peak
NR	100%	70%	96%	70%	90%	70%
WR	90%	70%	90%	70%	100%	70%
SR	90%	70%	90%	70%	100%	70%
ER	100%	70%	95%	70%	90%	70%
NER	100%	70%	95%	70%	90%	70%
SAARC Exchange	100%	70%	100%	70%	90%	70%

With the above availability factors the load generation balance for different seasons has been calculated. Accordingly, availability, demand and surplus/deficit for 6 typical conditions i.e. peak and off-peak of Summer, Monsoon and Winter conditions have been calculated for 14^{th}, 15^{th} and 2033-34 conditions and the same is shown at Table 6.8, 6.9 and 6.10 below.

Table – 6.8 : Load-Generation Balance at the end of 14th Plan (2026-27) (Scenario-I)

	Summer Peak			Monsoon Peak			Winter Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	99130	121979	-22849	107922	117100	-9177	92344	109781	-17437
WR	133225	108558	24667	136475	108558	27917	133323	120620	12703
SR	97385	106888	-9503	103532	106888	-3356	98157	118764	-20607
ER	77895	53053	24842	79899	50400	29499	76274	47748	28526
NER	15354	6169	9185	19472	5861	13611	12270	5552	6717
SAARC Exchange	16790	3200	13590	21587	3200	18387	11993	2880	9113
All India	**439780**	**399847**	**39933**	**468887**	**392006**	**76881**	**424361**	**405345**	**19016**
	Summer Off-Peak			**Monsoon Off-Peak**			**Winter Off-Peak**		
	Availability	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**
NR	78479	85385	-6906	84282	85385	-1103	66304	85385	-19081
WR	119331	84434	34897	118737	84434	34303	116719	84434	32285
SR	75825	83135	-7309	76130	83135	-7005	72333	83135	-10802
ER	74109	37137	36971	75757	37137	38620	71403	37137	34265
NER	8126	4318	3808	11636	4318	7317	2937	4318	-1381
SAARC Exchange	9594	2240	7354	14392	2240	12152	2399	2240	159
All India	**365465**	**296650**	**68816**	**380933**	**296650**	**84283**	**332095**	**296650**	**35445**

Table – 6.9 : Load-Generation Balance at end of 15th Plan (2031-32) (Scenario-I)

	Summer Peak			Monsoon Peak			Winter Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	130189	164236	-34047	143818	157667	-13849	126491	147812	-21322
WR	172438	146900	25538	177020	146900	30121	173816	163222	10594
SR	121628	148802	-27175	129172	148802	-19631	123797	165336	-41539
ER	98202	72874	25328	100250	69230	31020	96325	65587	30739
NER	27318	8450	18868	34741	8028	26713	20593	7605	12988
SAARC Exchange	32574	4300	28274	41881	4300	37581	23267	3870	19397
All India	582350	545562	**36787**	626881	534927	**91954**	564289	553432	**10857**
	Summer Off-Peak			**Monsoon Off-Peak**			**Winter Off-Peak**		
	Availability	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**
NR	92559	114965	-22406	97976	114965	-16989	80424	114965	-34542
WR	150360	114255	36105	148384	114255	34129	147658	114255	33402
SR	93122	115735	-22613	92508	115735	-23227	89869	115735	-25866
ER	94191	51012	43180	95883	51012	44872	91156	51012	40144
NER	15230	5915	9315	22159	5915	16244	4720	5915	-1195
SAARC Exchange	18614	3010	15604	27920	3010	24910	4653	3010	1643
All India	464076	404893	**59184**	484831	404893	**79939**	418480	404893	13587

Table – 6.10 : Load-Generation Balance at the end of 2033-34

	Summer Peak			Monsoon Peak			Winter Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	141274	184987	-43713	155724	177588	-21864	138397	166488	-28091
WR	193058	165793	27266	198296	165793	32503	195092	184214	10878
SR	134495	169857	-35362	142855	169857	-27002	137481	188730	-51249
ER	111727	82740	28987	113811	78603	35208	109886	74466	35420
NER	27563	9583	17980	35035	9104	25931	20887	8625	12262
SAARC Exchange	36074	4500	31574	46381	4500	41881	25767	4050	21717
All India	644192	617460	**26733**	692101	605444	86657	627509	626573	**936**
	Summer Off-Peak			**Monsoon Off-Peak**			**Winter Off-Peak**		
	Availability	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**
NR	101181	129491	-28310	106598	129491	-22893	89456	129491	-40035
WR	169013	128950	40063	167036	128950	38087	166638	128950	37688
SR	103542	132111	-28569	102928	132111	-29183	100697	132111	-31414
ER	107610	57918	49692	109302	57918	51384	104592	57918	46674
NER	15327	6708	8619	22256	6708	15548	4842	6708	-1866
SAARC Exchange	20614	3150	17464	30920	3150	27770	5153	3150	2003
All India	517286	458328	**58958**	539041	458328	**80713**	471378	458328	**13051**

From the above analysis it is seen that NR and SR remains all through as deficit region. The maximum deficit of NR increases from 23000MW at 14th plan to 35000MW at 15th plan and 44000 MW by 2033-34. The maximum deficit of SR also enhances from 20,000MW by the end of 14th plan to 42,000MW by the end of 15th plan and 51,000MW by 2033-34. The surplus of WR increases from 35,000MW at 14th plan to 36,000MW and 40,000MW by the end of 15th plan and by 2033-34 respectively. The combined surplus of ER and NER also enhances from total 48000MW at 14th plan to 72000 at 15th plan and 77000MW by 2033-34.

The demand – supply position of the regions along with maximum surplus / deficit of various regions including SAARC countries at the end of 14th, 15th and 2033-34 conditions for Scenario-I are shown in the following figures.

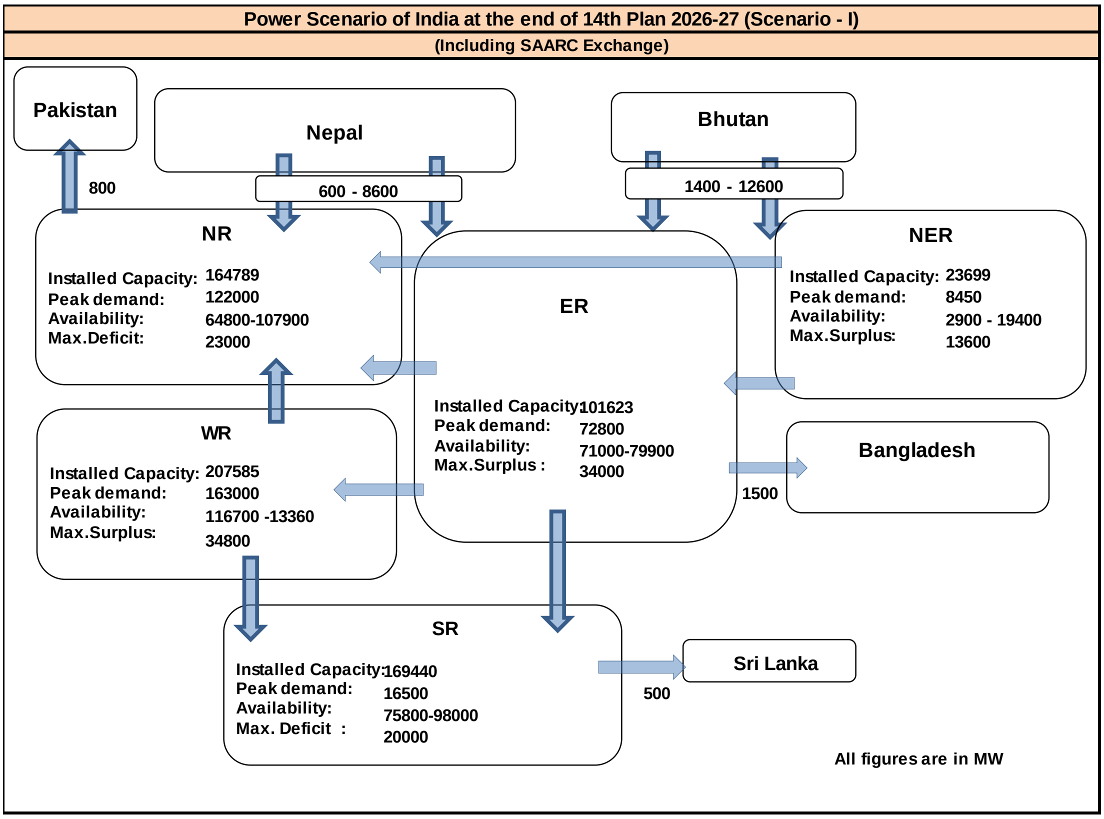


Fig 6.3 : Load Generation Scenario at the end of 14th Plan (Scenario-I)

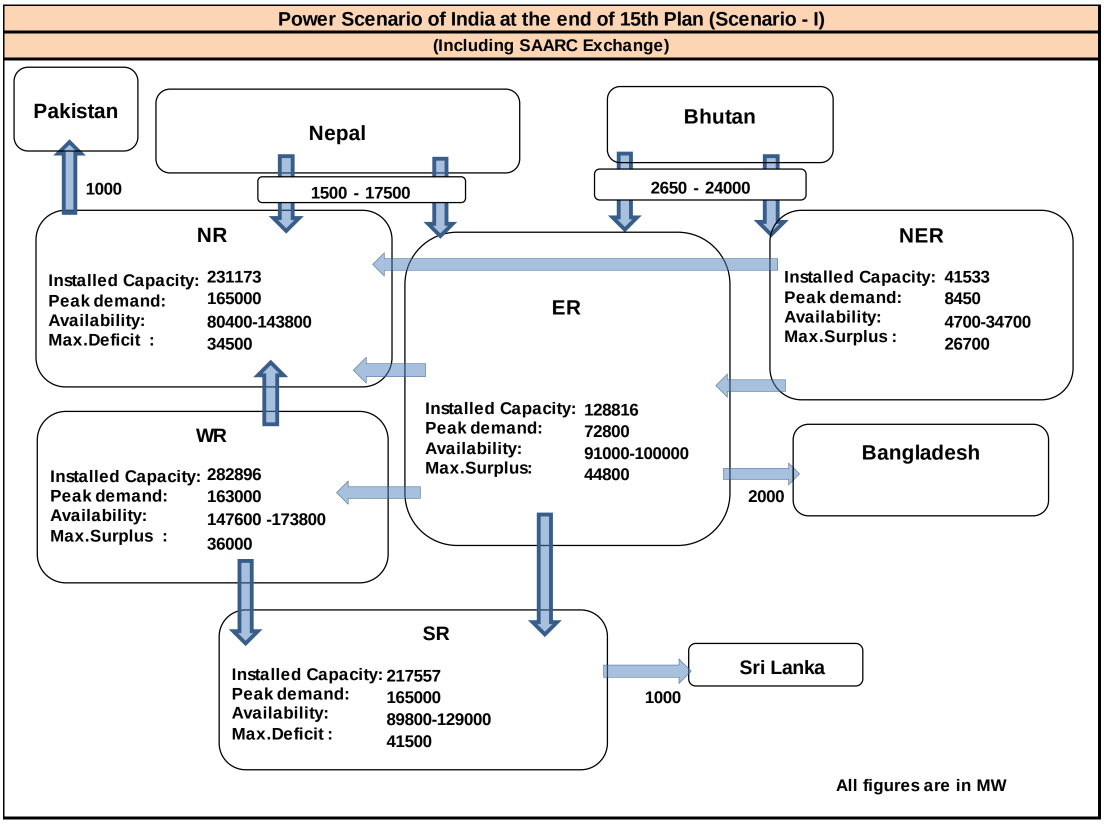


Fig 6.4 : Load Generation Scenario at the end of 15th Plan (Scenario-I)

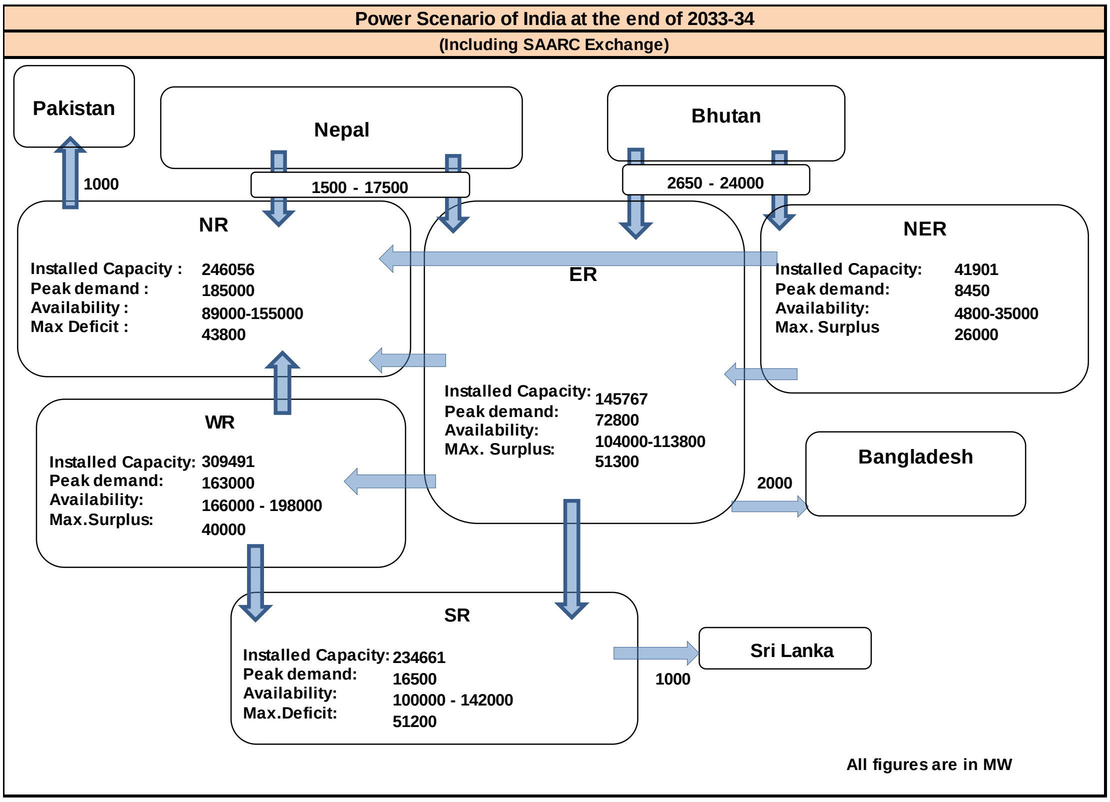


Fig 6.5 : Load Generation Scenario at the end of 2033-34 (Scenario-I)

6.4 Growth in Generation and Demand for Scenario-II

Under scenario-II, the total growth in generation project from 13th plan to 2033-34 is given below.

Table – 6.11 : Growth in generation projects (Installed Capacity) in the 14th and 15th plan up to 2033-34 (Scenario-II)

	End of 13th Plan (2021-22)	Addition in 14th Plan	End of 14th Plan (2026-27)	Addition in 15th Plan	End of 15th Plan (2031-32)	End of 2033-34
NR	102206	62583	164789	66108	230897	246056
WR	148818	58767	207585	75311	282896	309491
SR	118958	50483	169441	48117	217558	234661
ER	77813	23810	101623	27193	128816	145767
NER	14623	9076	23699	17877	41576	41901
Sub total	**462418**	**204719**	**667137**	**234606**	**901742**	**977876**
Bhutan	6602	7384	13986	12548	26534	26534
Nepal	0	10000	10000	10000	20000	25000
SAARC Total	**6602**	**17384**	**23986**	**22548**	**46534**	**51534**
Total	**469020**	**222103**	**691123**	**257154**	**948276**	**1029410**

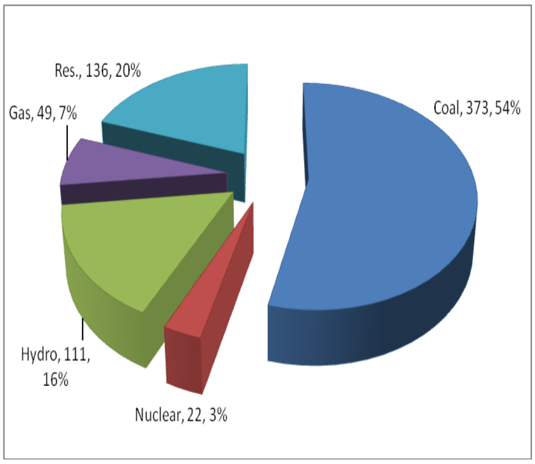
Based on the above generation growth, the region-wise installed capacity at demand for different types of fuel at the end of 14th and 15th plan as well as the corresponding demand growth is tabulated at 6.12 and 6.13 respectively. The generation data at the end of 2033-34 condition has been considered same as that of Scenario-I which has already been tabulated along with demand data at Table 6.5 above.

Table – 6.12 : Region-wise Installed Capacity and Demand at the end of 14th plan (Scenario-II)

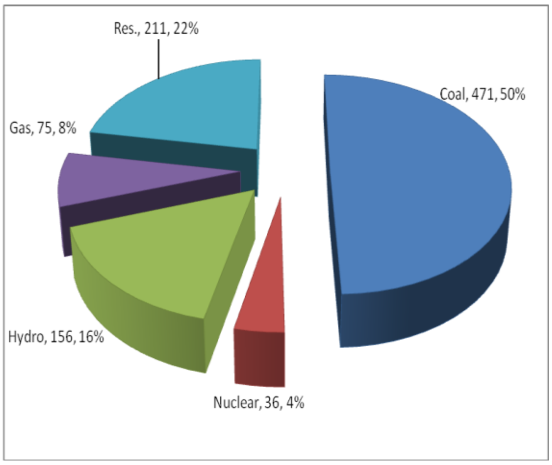
Region	Installed Capacity by the end of 14th Plan (2026-27) (Scenario - II)							Peak Demand (2026-27) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	68076	7220	75295.5	38945	10830	39719	164789	121979
WR	132554	8240	140794	7879	15511	43402	207585	120620
SR	82678	6220	88898	13436	19444	47663	169441	118764
ER	88272	0	88272	9064	993	3294	101623	53053
NER	1430	0	1430	18006	2423	1840	23699	6169
SAARC Exchange	0	0	0	23986	0	0	23986	3200
Total	**373009**	**21680**	**394689**	**111316**	**49200**	**135918**	**691123**	**403800**

Table – 6.13 : Region-wise Installed Capacity and Demand at the end of 15th plan (Scenario-II)

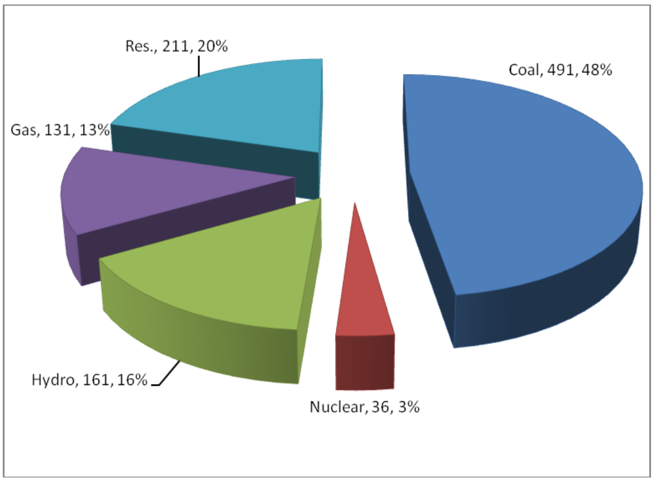
Region	Installed Capacity by the end of 15th Plan (2031-32) (Scenario - II)							Peak Demand (2031-32) MW
	Coal	Nuclear	Thermal (Coal+ Nuclear)	Hydro	Gas	Res.	Total	
NR	88743	10020	98762.5	43317	23886	64932	230897	164236
WR	165931	15089	181020	8011	22298	71568	282896	163222
SR	102394	10471	112865	13436	25232	66025	217558	165336
ER	112606	0	112606	9811	993	5406	128816	72874
NER	1208	0	1208	35370	2108	2890	41576	8450
SAARC Exchange	0	0	0	46534	0	0	46534	4300
Total	**470880**	**35580**	**506460**	**156479**	**74516**	**210821**	**948276**	**546000**



14th Plan (2026-27)



15th Plan (2031-32)



2033-34

Scenario-II : Fuel-wise Generation at the end of 14th, 15th and 2033-34 (in GW)

6.5 Demand Supply Analysis for Scenario-II

Considering the generation availability factors and demand factors as already described above in Table 6.6 and 6.7 respectively, the load generation balance has been calculated for peak and off-peak condition of 3 typical seasons viz. Summer, Monson and Winter seasons. Region-wise details of the load generation balance is shown at Table-6.14 and Table-6.15 for 14th and 15th plan conditions respectively. Load Generation Balance at the end of 2033-34 for Scenario-II is same as that of Scenario-I, which is already shown at Table 6.10.

Table – 6.14 : Load-Generation Balance by the end of 14th Plan (2026-27) (Scenario-II)

	Summer Peak			Monsoon Peak			Winter Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	99953	121979	-22026	107922	117100	-9177	92344	109781	-17437
WR	133967	108558	25409	136475	108558	27917	133323	120620	12703
SR	99339	106888	-7548	103532	106888	-3356	98158	118764	-20607
ER	78052	53053	24999	79899	50400	29499	76274	47748	28526
NER	15478	6169	9309	19472	5861	13611	12270	5552	6717
SAARC Exchange	16790	3200	13590	21587	3200	18387	11993	2880	9113
All India	**443580**	**399847**	**43733**	**468887**	**392006**	**76881**	**424361**	**405345**	**19016**
	Summer Off-Peak			**Monsoon Off-Peak**			**Winter Off-Peak**		
	Availability	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**	**Availability**	**Demand**	**Sur(+) / Def(-)**
NR	81772	85385	-3613	83603	85385	-1782	69186	85385	-16200
WR	122297	84434	37863	117362	84434	32928	119314	84434	34880
SR	83642	83135	507	79180	83135	-3955	79173	83135	-3962
ER	74737	37137	37600	76056	37137	38919	71953	37137	34816
NER	8622	4318	4304	11948	4318	7629	3371	4318	-947
SAARC Exchange	9594	2240	7354	14392	2240	12152	2399	2240	159
All India	**380665**	**296650**	**84016**	**382541**	**296650**	**85891**	**345395**	**296650**	**48745**

Table – 6.15 : Load-Generation Balance at the end of 15th Plan (2031-32) (Scenario-II)

	Summer Peak			Monsoon Peak			Winter Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	133403	164236	-30833	143597	157667	-14070	126270	147812	-21542
WR	174537	146900	27637	177020	146900	30121	173816	163222	10594
SR	124740	148802	-24063	129172	148802	-19630	123798	165336	-41538
ER	98359	72874	25485	100250	69230	31020	96325	65587	30739
NER	27423	8450	18973	34775	8028	26747	20627	7605	13022
SAARC Exchange	32574	4300	28274	41881	4300	37581	23267	3870	19397
All India	591036	545562	**45474**	626694	534927	**91768**	564103	553432	10671

	Summer Off-Peak			Monsoon Off-Peak			Winter Off-Peak		
	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)	Availability	Demand	Sur(+) / Def(-)
NR	106077	114965	-8889	111493	114965	-3472	92223	114965	-22742
WR	158755	114255	44500	156779	114255	42523	155003	114255	40748
SR	105570	115735	-10165	104956	115735	-10780	100761	115735	-14974
ER	94820	51012	43808	96512	51012	45500	91706	51012	40694
NER	15548	5915	9633	22477	5915	16562	5003	5915	-912
SAARC Exchange	18614	3010	15604	27920	3010	24910	4653	3010	1643
All India	499383	404893	**94490**	520138	404893	**115245**	449350	404893	**44457**

The region-wise demand-supply position along with maximum surplus / deficit at the end of 14th, 15th and 2033-34 condition under Scenario-II is shown in the following figures. The Scenario-II of 2033-34 is same as that of Scenario-I, however the fig is repeated here for the sake of comparison.

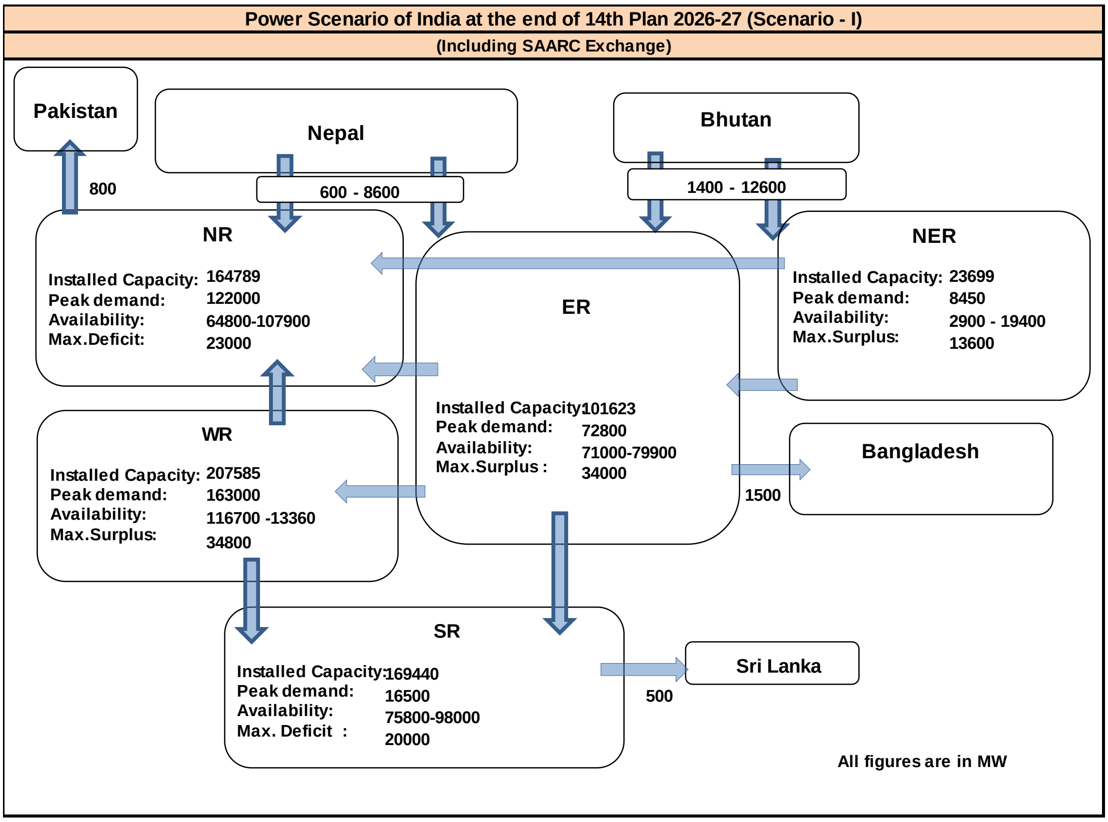


Fig 6.6 : Load Generation Scenario at the end of 14th Plan (Scenario-II)

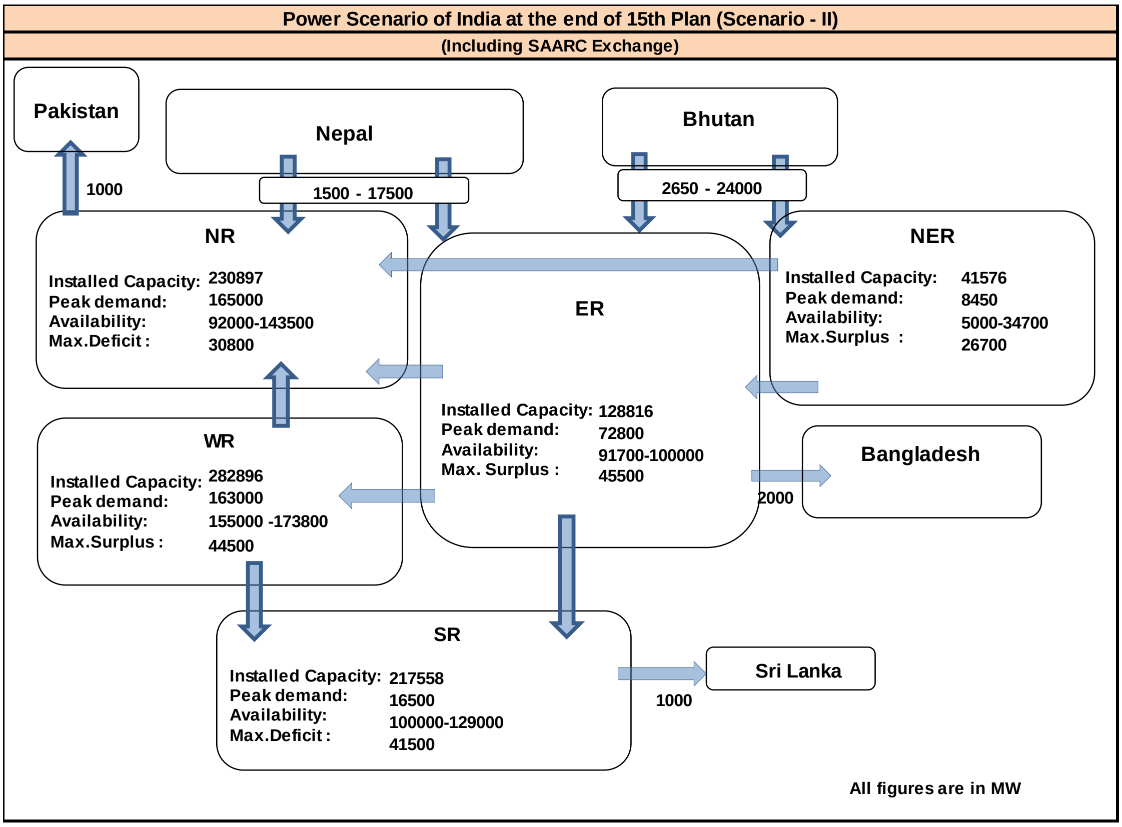


Fig 6.7 : Load Generation Scenario at the end of 15th Plan (Scenario-II)

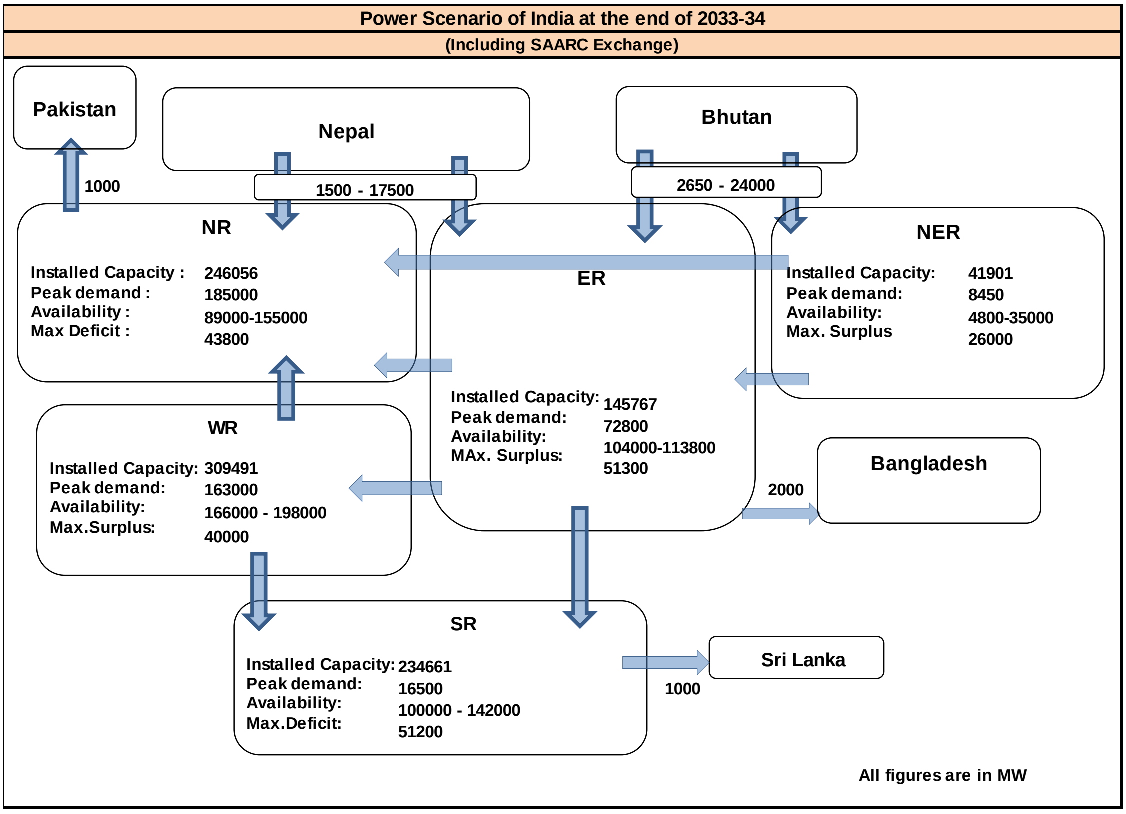


Fig 6.8 : Load Generation Scenario at the end of 2033-34 (Scenario-II)

6.6 Requirements of Major Transmission Corridors

The above exercise has been carried out for both peak and off-peak condition for 3 seasons viz. Summer, Monsoon and Winter. However, for the purpose of evolution of transmission system only peak scenarios need to be considered. Accordingly, the maximum drawal / export of different regions / SAARC countries has been tabulated below on the basis of the peak condition of Summer, Monsoon and Winter season for 14th, 15th and 2033-34 condition. The similar data evolved in the earlier chapter for the 13th plan condition is also included for comparison.

Table – 6.16 : Maximum Import/ Export of different Regions / SAARC Countries

All figures are in MW

Region	13th Plan (2021-22)	14th Plan (Scenario-I / Scenario-II)	15th Plan (Scenario-I / Scenario-II)	2033-34
NR (Import)	22000	23000/22000	34000/31000	44000
WR (Export)	16000	28000/28000	30000/30000	33000
SR (Import)	19000	21000/21000	42000/42000	51000
ER (Export)	25000	30000/30000	31000/31000	35000
NER (Export)	6000	14000/14000	27000/27000	44000
Bhutan (Export)	6600	14000	26500	26500
Nepal (Export)	0	10000	20000	25000
Sri Lanka (Import)	0	500	800	1000
Bangladesh (Import)	1000	1500	2000	2000
Pakistan (Import)	0	500	800	1000

The requirement of broad transmission corridors has been estimated in order to meet the above Import / Export requirements under various time frames. As there is not significance difference between the maximum import/export requirements under Scenario-I and II, the maximum value of the import/export of Scenario I & II has been considered to find out the capacity of the new corridors.

Based on above, the requirement of transmission capacity between various regions / SAARC countries for 14th, 15th and 2033-34 condition is tabulated below. Similar data for 13th plan condition has also been included for comparison purpose.

Table – 6.17 : Transmission Capacity between various Regions / SAARC Countries

All figures are in MW

	13th Plan (2021-22)	14th Plan (2026-27)	15th Plan (2031-32)	2033-34
Bhutan - ER/NER	8000	20000	35000	35000
Nepal - ER	-	2000	5000	8000
Nepal - NR	-	10000	20000	26000
ER/NER - NR	36000	40000	45000	45000
ER/NER - WR	21000	25000	30000	35000
ER/NER - SR	12000	15000	30000	40000
WR - SR	22000	25000	35000	40000
WR-NR	30000	35000	35000	35000
NR - Pakistan	250	500	1000	1000
ER/NER - Bangladesh	1000	1500	2000	2000
SR - Sri Lanka	-	500	1000	1000

The growth in inter -Regional capacity from IX plan to 2033-34 is shown in Fig 6.9

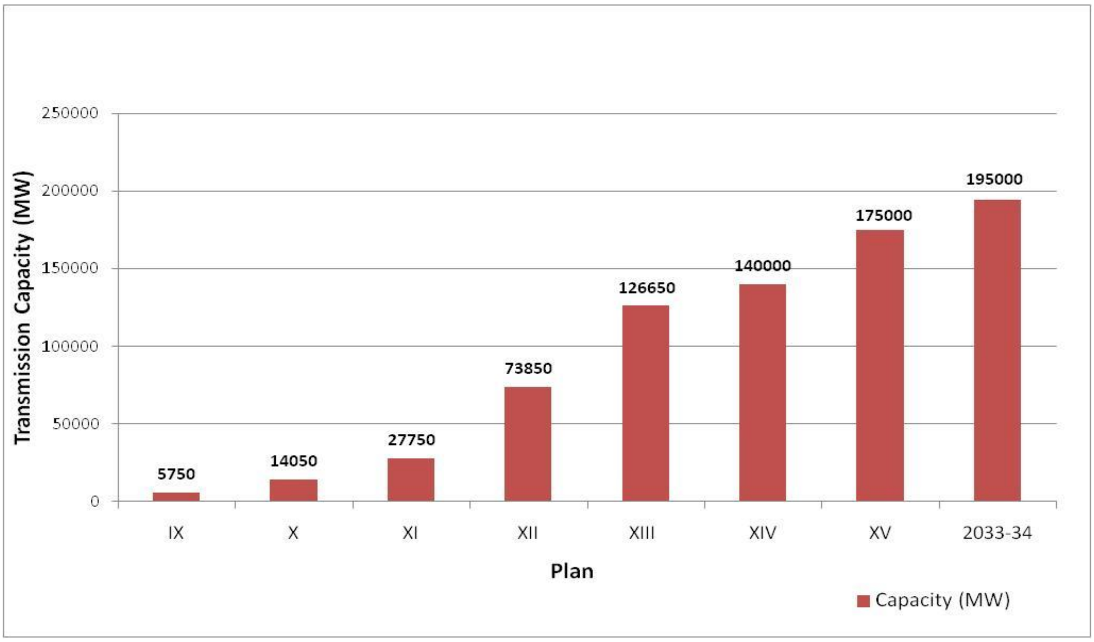


Fig 6.9 : Cumulative Growth of Inter-Regional Transmission Capacity

The plan-wise requirement of transmission corridor capacity has also been shown in the following figure.

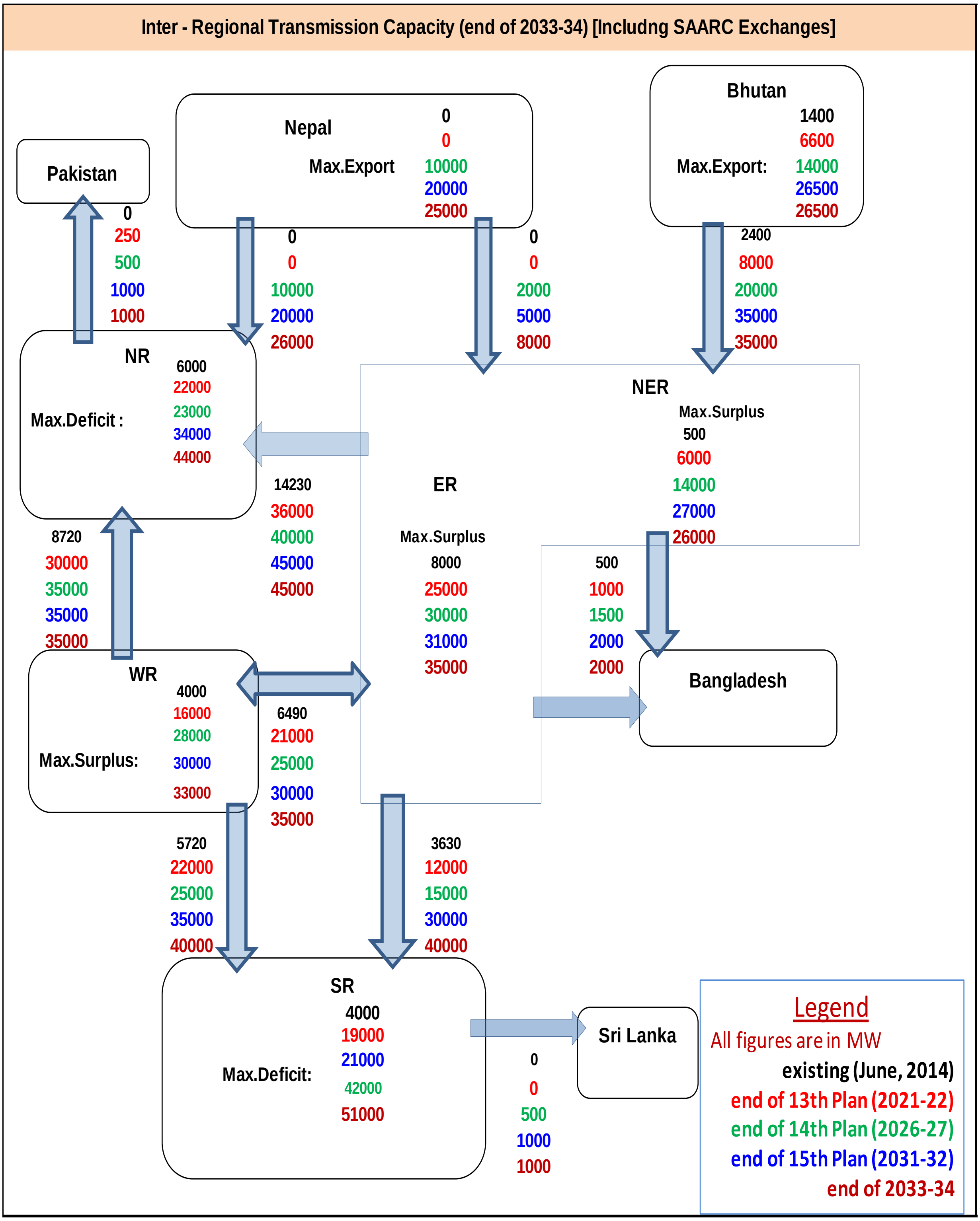


Fig 6.10 : Transmission Capacity between various Regions / SAARC Countries

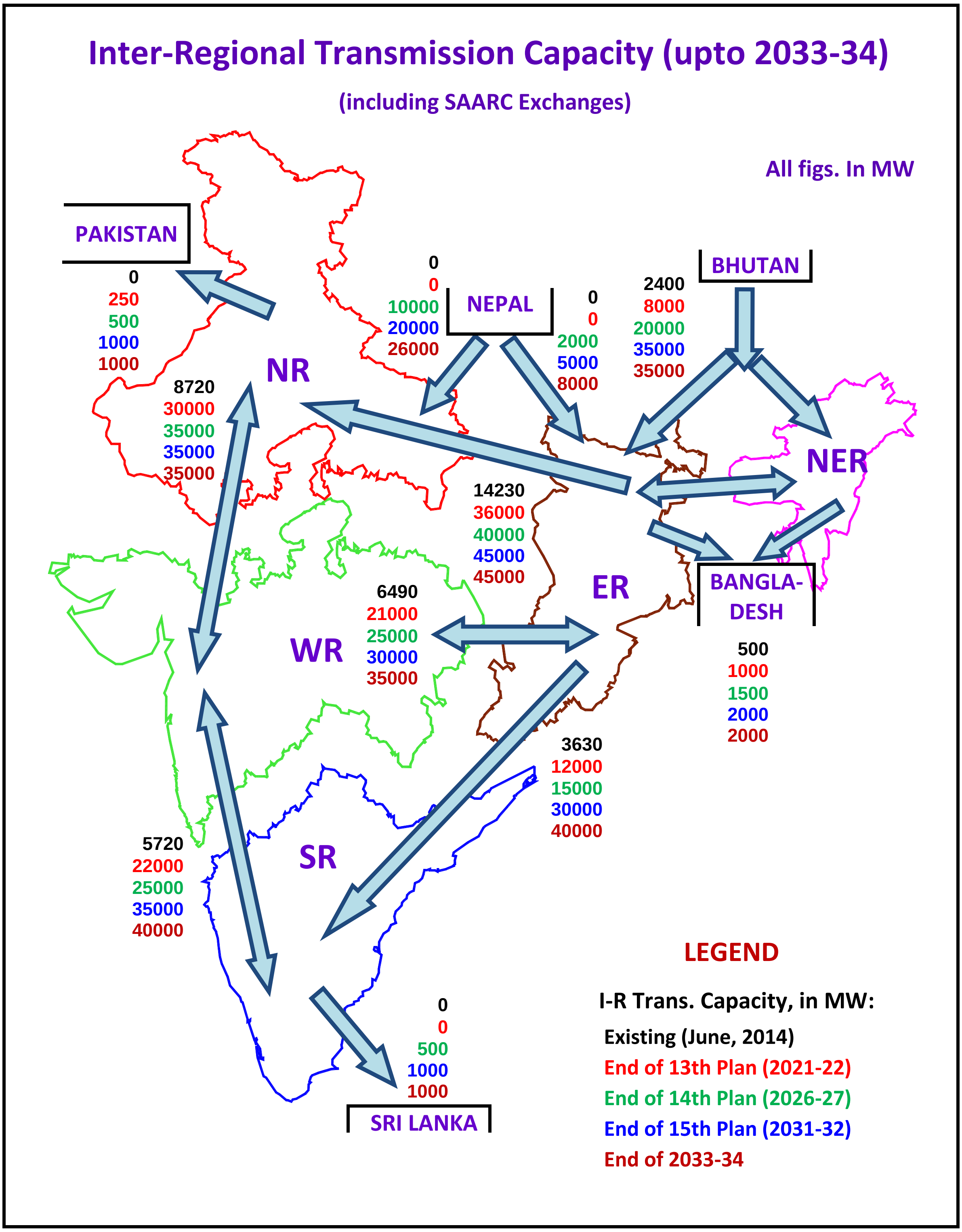


Fig 6.11 : Transmission Capacity between various Regions / SAARC Countries

6.7 Way forward

The transmission corridor identified above would be a combination of both EHV AC as well as HVDC corridors so as to have benefit like flexibility, distribution, controllability etc. of both the systems. In view of the increasing constraint in getting Right-of-Way for transmission lines, efforts need to be put to build these corridors only with high capacity transmission lines viz. HVDC, 765kV D/c line, 400kV D/c with high capacity conductor etc. The details of various corridors would be worked out depending on the status of various future generation as well as transmission projects. As the average time period to commission a transmission project is about 4-5 years, the scope of transmission system under various projects need to be finalized well in advance so that the same may be commissioned matching with associated generation / other transmission projects.

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12. Agenda and minutes of meetings of the Standing Committee on Power System Planning of Eastern Region held in 2012, 1013 and 2014
13. Agenda and minutes of 3rd meeting of the Standing Committee on Power System Planning of North Eastern Region

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The team constituted for drafting of the report:

(With reference to OM No. 14/2/2014-Trans dated 04-August-2014)

(i)	Shri Major Singh, Member (Planning)	Chairman
(ii)	Shri K. K. Arya, CE, CEA	Member
(iii)	Shri Pardeep Jindal, Director, CEA	Member **(**Convener**)**
(iv)	Shri Y.K. Sehgal, COO, CTU	Member
(v)	Shri Ashok Pal, AGM, PGCIL	Member
(vi)	Shri V. K. Agarwal, ED, NLDC/POSOCO	Member
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