

## **Agenda note for 36<sup>th</sup> Standing Committee Meeting on Power System Planning in Northern Region.**

### **1. Confirmation of the minutes of 35<sup>th</sup> Meeting of the Standing Committee on Power System Planning in Northern Region held on 3/11/2014**

- 1.1 The minutes of the 35<sup>th</sup> meeting of Standing Committee on Power System Planning in Northern Region held on 3<sup>rd</sup> November 2014 at Dehradun, Uttarakhand were circulated vide CEA letter No. 1/9/SP&PA-2013 / 648-666 Dated: 17.12.2014.
- 1.2 CTU has suggested some modification in the minutes of the 35<sup>th</sup> Standing Committee Meeting on Power System Planning in Northern region, accordingly, a corrigendum for Minutes of the 35<sup>th</sup> meeting were circulated vide CEA letter No. 1/9/SP&PA-2013 / 93-111 Dated: 13.02.2015.
- 1.3 The scheme "Creation of 400/220kV substations in NCT of Delhi during 12<sup>th</sup> Plan period" had been discussed and agreed in the 34<sup>th</sup> SCM of NR held on 8/8/2014. Further, there were some minor modifications in the original scheme informed in the 34<sup>th</sup> SCM.
  - a) The establishment of Papankalan substation was earlier envisaged at Papankalan-I existing substation by replacing existing 220/66 kV substation of DTL. While working out the details it was observed that accommodating 400/220 kV S/s in existing Papankalan-I substation will be difficult without disturbing the present set up in the compressed time schedule. Accordingly, after considering other constraints, an alternate site in Sector-5, Dwarka, close to Papankalan-I was identified which would be named as Dwarka-I 400/220kV ISTS substation. Further, sufficient line corridor for LILO of one circuit of Bamnauli – Jhatikara D/c line at Dwarka-I is available and dismantling of existing 220kV D/c line would not be required. Accordingly, for LILO of one ckt. of Bamnauli – Jhatikara 400 kV D/c line, a new corridor with 400 kV D/c (Quad/HTLS) shall be constructed.
  - b) Provision of 1\*125MVAR Bus Reactor at each of the Rajghat, Tughlakabad, Karampura & Dwarka-I (earlier Papankalan-I) Substations,

- c) Deletion of Dwarka-I (earlier Papankalan-I) to Jhatikalan D/c line,
- d) LILO of both circuits of Bawana -Mandola at Rajghat & construction of complete LILO as M/c line.

Further, the scheme "Creation of 400/220kV substations in NCT of Delhi during 12<sup>th</sup> Plan period-Part B1" is again put up for consideration to the committee at agenda item no. for subsequent modifications for Karampura.

1.4 Implementation of 220/66kV substation in Chandigarh along with Chandigarh–Panchkula(PG) 220kV D/c line has been entrusted to POWERGRID under compressed time schedule. During the 33<sup>rd</sup> NRPC meeting held on 11/11/14, HVPNL have informed that they intend to construct a 220kV substation in Haryana en-route Chandigarh-Panchkula (PG) 220kV D/c line. Anticipating severe R-o-W in the proposed route, it was proposed by HVPNL that provision of M/c towers to be kept in line traversing through Haryana portion for approx. 4km from 400/220kV Panchkula Substation.

The route of the line involves Chandigarh, Punjab & Panchkula Municipal Area and severe RoW due to residential area, some portion of the line shall be through underground cable. The use of cable had already been informed in the 33<sup>rd</sup> NRPC meeting held on 11/11/14. Now, the location of the substation site is being proposed at Hallo Majra/ Raipur Kalan instead of Sector 47 as recorded in the Standing Committee. Therefore, **it is proposed that the name of substation be recorded as Chandigarh substation instead of Sector 47, Chandigarh.**

1.5 In the 35<sup>th</sup> Standing Committee of NR held on 3/11/2014, it was proposed to construct Koteshwar Pooling Station- Rishikesh 400kV D/c line. Since the 400kV D/c with quad conductor the tower weight is heavy and as such difficult in the hilly area so POWERGRID proposed to construct the Koteshwar Pooling Station- Rishikesh 400kV D/c line with HTLS (High temperature and low Sag) conductor. Accordingly, Koteshwar Pooling Station - Rishikesh 400kV D/c (HTLS) line was agreed as strengthening scheme. However, the same has been inadvertently

recorded as Quad line in the scope given in the corrigendum to minutes. The same may be corrected as HTLS conductor.

1.6 Following transmission scheme has been approved in the 35<sup>th</sup> Standing Committee on Power System Planning in Northern Region held on 3/11/2014 under NRSS XXXVII:

The scope of the transmission scheme under ISTS is as under:

- Creation of 400/220kV, 2X315MVA GIS Substation in Jauljivi area under ISTS by LILO of both ckt. of 400 kV Dhauliganga-Bareilly (POWERGRID) line (presently charged at 220 kV) at 400kV Jauljivi (ISTS).
- Charging of Baram(Jauljivi)–Bareilly D/C line at 400kV level
- Diversion of Dhauliganga-Bareilly 400kV D/c line(operated at 220kV) at Bareilly end from CB Ganj to Bareilly(POWERGRID)
- Shifting of 25 MVAR line reactor already available in 220kV Dhauliganga – Bareilly line at Dhauliganga end, to Baram(Jauljivi) S/s as a bus reactor

**Under the above scope, the disconnection of 220kV LILO arrangement of Dhauliganga -Bareilly at Pithoragarh and connection of Pithoragarh to Baram(Jauljivi) 400/220kV S/s is also to be included.**

Further, some minor modifications are being proposed to be included the scope of scheme:

- 1) Due to transportation limitations in the hilly terrain in Uttarakhand, it is proposed that in place of 2X315MVA 400/220kV 3 phase ICTs, 7X105MVA single phase ICTs may be considered at 400/220kV Baram(Jauljivi) substation.
- 2) 2\*63MVAR switchable line reactors in Bareilly - Baram (Jauljivi) 400kV D/c at Baram (Jauljivi) 400/220kV end is proposed for providing voltage control at Jauljivi end under various operating conditions. These 63MVAR line reactors shall be taken up as single phase units, if required.

- 3) 2 Nos. of 400kV bays at Bareilly(PG) to be included in the scope for Bareilly-Baram(Jauljivi) 400kV D/c line
- 4) One no. of 220kV sectionaliser alongwith an associated bay at 400/220kV Baram Substation is proposed for reliability in accordance to the Transmission Planning Criteria of CEA.

Considering the above, the total scope for **NRSS XXXVII** is as given below:

- Establishment of 400/220kV, 7X105MVA GIS S/s at Baram( Jauljivi) with 220kV bus sectionalized
- LILO of both circuits of 400 kV Dhauliganga-Bareilly (PG) line (presently charged at 220 kV) at 400/220kV Baram(Jauljivi) substation
- Charging of Baram(Jauljivi)–Bareilly D/c line at 400kV level
- Diversion of Dhauliganga-Bareilly 400kV D/c line(operated at 220kV) at Bareilly end from CB Ganj to Bareilly(POWERGRID) alongwith 2 nos. of 400 kV bays at Bareilly
- Disconnection of 220kV LILO arrangement of Dhauliganga-Bareilly at Pithoragarh and connecting Pithoragarh S/S to Baram(Jauljivi) 400/220kV S/s at 220kV level
- Shifting of 25 MVAR line reactor already available in 220kV Dhauliganga –Bareilly line at Dhauliganga end, to 400/220kV Baram(Jauljivi) S/s as a bus reactor at 220kV
- 2\*63MVAR switchable line reactors in Bareilly - Baram (Jauljivi) 400kV D/c at Baram (Jauljivi) 400/220kV end. These 63MVAR line reactors shall be taken up as single phase units, if required.

- 1.7 As no other suggestion for the modification to the minutes of meeting has been received thereafter, so the Minutes of the 35<sup>th</sup> Standing Committee Meeting on Power System Planning in Northern along with the above modifications suggested by CTU is taken as confirmed.

**Members may concur the minutes.**

## **2. 220kV interconnection from Samba & New Wanpoh 2x315 MVA, 400/220kV substations of POWERGRID in J & K.**

2.1 The 2x315 MVA, 400/220kV substations at Samba & New Wanpoh have been commissioned by POWERGRID under ISTS and for drawl of power from these substations, the underlying 220 kV network have not been constructed by PDD, J&K.

2.2 PDD, J&K has intimated that due to fund constraints they are not in position to construct the above 220kV interconnection works in time resulting in under utilization of transformation capacity available at both 400kV substations of POWERGRID at Samba & New Wanpoh.

2.3 PDD, J&K vide their letter dated 14/10/2014 had requested that the following 220 kV transmission network for utilizing Samba and New Wanpoh 400/220 kV substations may be taken up as ISTS works (copy of the letter enclosed).

2.4 The works are as given below:

- LILO of both circuits of 220kV Hiranagar- Bishnah at 400/220kV Samba
- LILO of 220kV Gladini- Hiranagar S/c at 400kV Samba(PG) S/s
- 220kV interconnection between 400/220kV New Wanpoh and 220/132kV Mirbazar
- Re-orientation of 220kV bays for crisscrossing of transmission lines and utilization of bays reserved for Alusteng- Mirbazar lines for 220kV interconnection between New Wanpoh & Mirbazar.

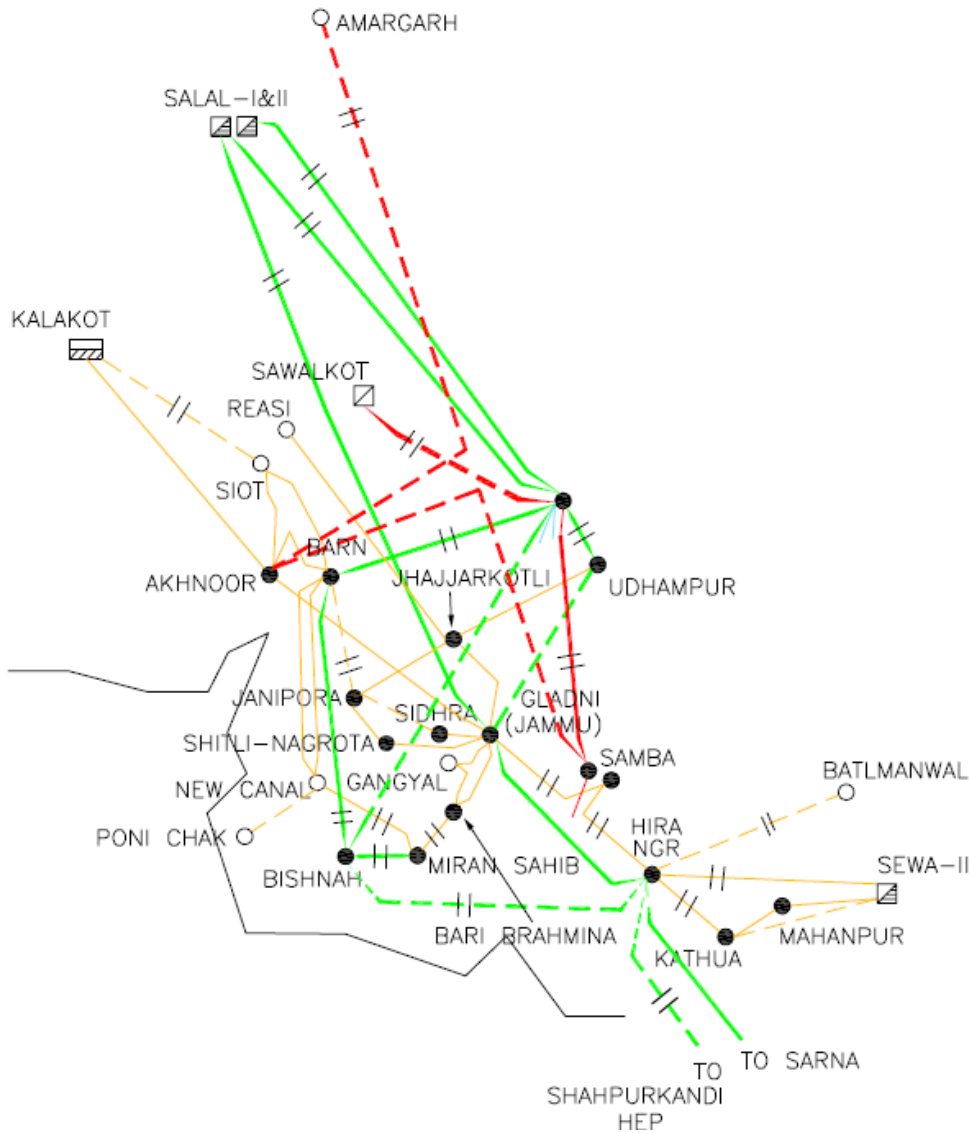
**Members may discuss and concur the proposal.**

## **3. Creation of 400/220 kV, 2x315 MVA S/S at Akhnoor and Kistwar**

3.1 CE system operation wing Jammu has requested for creation of two nos. of 400 kV Substation in Jammu Area. One at Akhnoor by LILO of the under construction 400 kV Jullandhar – Samba -Amargarh D/c line of M/s Sterlite Ltd. and another at Kishtwar by LILO of the Dulhasti – Rattle- Kishenpur 400 kV line at Kishtwar.

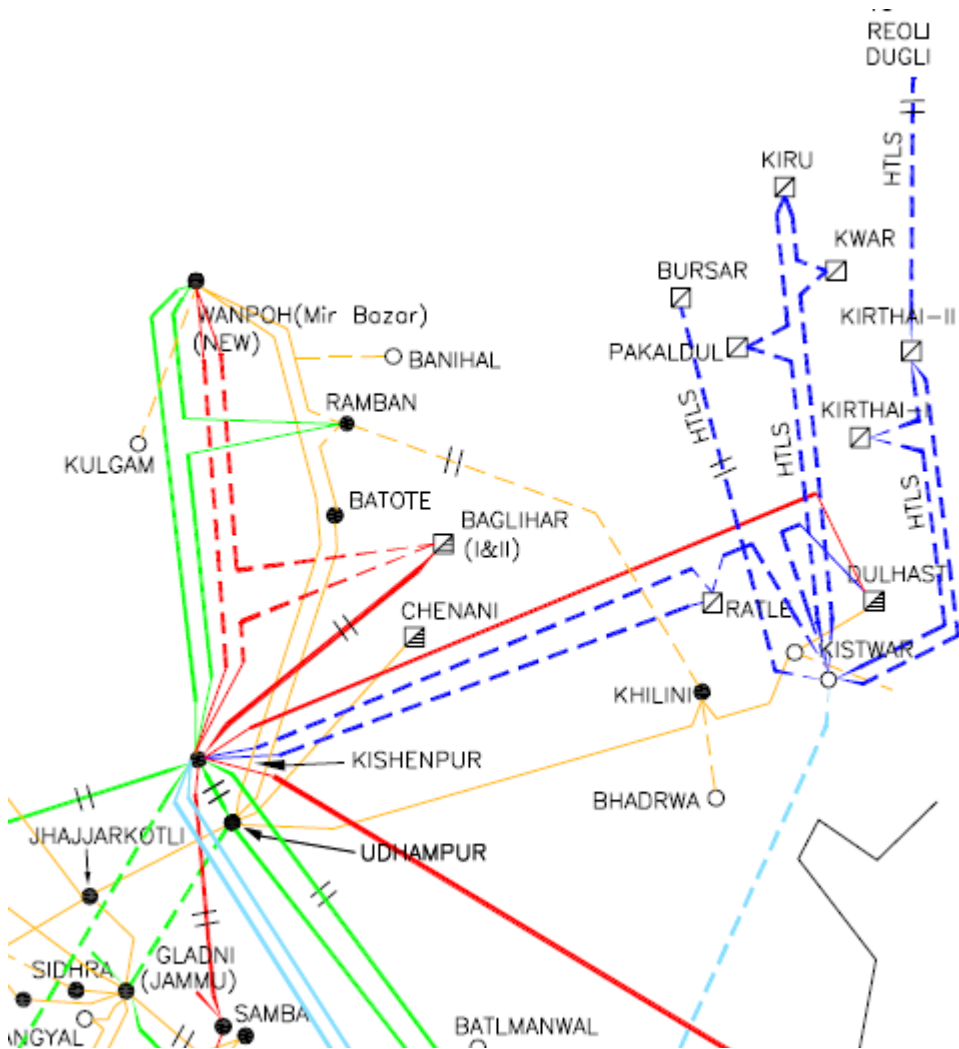
### 3.2 400/220 kV, 2x315 MVA S/S at Akhnoor

PDD Jammu has indicated that the existing 220 kV D/C line between Barn – Kishenpur is overloaded and there is no margin left on the line for taking further load growth. With the growing load at Reasi, Akhnoor, Siot and Rajouri district, there is a need for another reliable source power supply to this area. Accordingly, PDD Jammu has proposed for creation of 400 kV 2x315 MVA S/S at Akhnoor by LILO of the Samba Amargarh portion of Jullandhar – Samba –Amargarh 400 kV D/C line at Akhnoor.



### 3.3 400/220 kV, 2x315 MVA S/S at Kistwar

PDD Jammu has indicated that a 400 kV GSS at Kishtwar may be created either by tapping or by LILO of the under construction of Dulhasti – Kishenpur 400 kV line. The proposed S/s would feed the existing GSS of that area as well as for feeding construction power to upcoming power projects like Kiru, Kwar, Pakaldul, Burser etc.



**Members may discuss and concur the proposal.**

## 4. WR NR 765kV strengthening transmission corridor

4.1 A comprehensive study has been carried out for assessing the requirement of additional transmission system keeping in view the existing allocation / LTA; LTA

granted on the basis of target regions, firm PPAs & new LTA application submitted for transfer of power from various IPPs in Western Region.

4.2 The total LTA quantum granted to NR from all the generation projects in WR and ER including the central sector allocation is about 27000MW as given below:

- From WR Projects : 15200 MW
- From ER projects : 11700 MW
- **Total** : **26900 MW**

4.3 Additional requirement (other than already granted) of about 2000MW power transfer from WR to NR is being envisaged from following generation projects in WR for which UP has already signed the PPA:

SI No.	Generation Projects	Additional Allocation to NR (MW)	Commissioning Date
1	TRN Energy Ltd.	240	30-10-2016
2	Shirpur Power Pvt. Ltd.	35	01-02-2015
3	MB Power (MP) Ltd.	200	01-06-2015
4	MB Power (MP) Ltd.	98	30-10-2016
5	KSK MahanadiPower CompanyLtd	1000	30-10-2016
6	DB Power, Chhattisgarh Ltd.	235	30-11-2016
7	Maruti Clean Coal& Power Ltd	205	30-11-2016
	<b>Sub-total</b>	<b>2013</b>	

4.4 In addition to above following new projects are coming up in Western region who have applied for connectivity / LTA

SI No.	Generation Projects	Capacity (MW)	Remarks
1	KhargaonTPP(NTPC)	1320	Applied Connectivity &LTA for 1244MW to WR
2	Surguja Power Pvt Ltd. (IPP)	600	Applied for connectivity for 490MW, LTA application to be submitted
3	Dwarkesh Energy Ltd. (IPP)	1320	Applied for connectivity(for 1240.8MW, LTA application to be



submitted

**Sub-total 3240**

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Out of these new projects of 3240MW capacity, it is assumed that about 2000 MW power may be transferred to NR.

4.5 Accordingly, total about 4000MW additional power need to be transferred from WR to NR. With this, the power transfer requirement from WR and ER projects to NR is as given below:

- From WR Projects : 19200 MW
- From ER projects : 11700 MW
- **Total : 30900 MW**

4.6 Studies have been carried out with varying availabilities of renewable generation:

- Low Renewables (10%)
- High Renewables (Solar: 80%, Wind: 80%)

After comprehensive studies, the following transmission system has been identified:

#### **4.7 Proposed WR-NR Strengthening System**

##### **Part-A**

- Indore(WR) – Chittorgarh(NR) 765kV D/c line

##### **Part-B**

- Vindhyachal Pool (WR) – Allahabad (NR) 765kV D/c line
- LILO of Fatehpur – Sasaram 765kV S/c line at Allahabad
- Allahabad - Lucknow 765kV D/c line
- Allahabad (New) – Allahabad (PG) 400 kV D/c (Quad)
- Bareilly – Muzaffarnagar(S/s to be located between Meerut & Muzaffarnagar) 765kV D/c line
- Muzaffarnagar –Aligarh 765kV D/c line
- Shifting of Meerut – Bhiwani 765kV S/c line from Meerut to Muzaffarnagar to form Muzaffarnagar – Bhiwani 765kV S/c line

- Muzaffarnagar – Meerut(new)(UPPTCL) 400kV D/c (Quad) line
- Muzaffarnagar – Shamli(UPPTCL) 400kV D/c (Quad) line

**List of Exhibits**

<b>Sl. No.</b>	<b>Renewable Generation</b>	<b>Case Description</b>	<b>Exhibit#</b>
1	High Renewables	Without Proposed WR-NR Corridor	1
		With Proposed WR-NR Corridor	2
		With Outage of Lucknow-Bareilly 765 kV S/c	3
2	Low Renewables	Without Proposed WR-NR Corridor	4
		With Proposed WR-NR Corridor	5
		With Outage of Lucknow-Bareilly 765 kV S/c	6

4.8 From the study results, the following may be observed:

1. Without any additional strengthening between WR and NR, Agra – Gwalior 765kV 2xS/c line remains the most loaded WR – NR interregional corridor in all the three combinations of renewable generations, with loading on it varying from 2800MW in low renewables case to over 3500MW in high renewables case.
2. In high renewables case, in case of n-1 outage of Agra – Gwalior line, loading on the parallel circuit is about 2600MW without any additional strengthening, 2400MW with Part-A of proposed strengthening and it reduces to 1850MW with both Part-A and Part-B of proposed strengthening.
3. With the commissioning of Part-A of the proposed WR – NR interregional corridor, even under low renewable condition, the RE corridor gets moderately loaded.

With the commissioning of Part-B of the proposed WR – NR interregional corridor, loading on the other WR-NR interregional transmission lines is optimal.

**Members may please discuss and concur.**

## **5. Modification of UITP scheme by PTCUL**

5.1 The issue of modification of UITP scheme was discussed in the 35<sup>th</sup> Standing Committee meeting of Transmission Planning of Northern Region held on 3/11/14, wherein PTCUL had expressed that due to extra ordinary circumstances & local resistance at Pipalkoti, they are not able to construct the Pipalkoti 400kV Substation and requested THDC to provide space for Pipalkoti Substation in the land acquired by THDC for their generation project.

5.2 During the meeting, THDC had stated that they had applied for connectivity for their Pipalkoti HEP generation project to CTU and this need to be granted. In response CTU had stated that connectivity can be given at this new Substation once the location of substation is finalized.

5.3 Keeping this in view, POWERGRID requested THDC vide letter dated 29/12/14, to intimate the status of land to PTCUL, so as the connectivity to Pipalkoti HEP is granted. THDC vide letter dated 5/1/2015, mentioned that the land, which could be spared at Pipalkoti generation project for 400/220kV substation at Pipalkoti was shown to PTCUL officials during Nov.'14 regarding its suitability for the works of PTCUL and they have not received any response for the same. In a meeting at POWERGRID Gurgaon held on 8/5/15, wherein PTCUL informed that the land shown by THDC is not suitable for establishment of the 400/220kV Pipalkoti (THDC) Substation and PTCUL is in process of finalizing separate land amongst two feasible locations for the substation. THDC and PTCUL may update the status so as the CTU can process the connectivity of the Pipalkoti HEP.

5.4 Further, based on PTCUL presentation, the UITP network re-planned proposal was agreed in 35<sup>th</sup> Standing Committee meeting of Power system Planning of Northern Region as ISTS scheme wherein LILO of one ckt. of 400kV Vishnuprayag-Muzaffarnagar line at Pipalkoti (THDC) S/s is shown. The Single line diagram however did not indicate the approved LILO of one circuit of Vishnuprayag-Muzaffarnagar 400 kV D/c line at Srinagar 4x82.5 MW HEP. It is thus not clear which of two circuits is being LILOed at Pipalkoti (THDC). Correction in SLD alongwith load flow study was also requested by UPPCL in the meeting. It is requested that updated

single line diagram along with Load Flow Studies be provided to committee for consideration.

**Members may please note.**

**6. Additional 1X500 MVA, 400/220kV ICTs at Fatehabad(PG) 400/220kV substation**

6.1 400kV Fatehabad (PG) substation in Haryana has present installed capacity of 2x315 MVA, 400/220kV ICTs. HVPNL has informed that the following 220kV substations are being fed from this substation:

- 220kV substation Fatehabad: 3x100 MVA, 220/132 kV ICTs
- 220kV substation Sirsa: 2x 100 MVA, 220/132 kV ICTs
- 220kV substation Bhuna: 3x 100 MVA, 220/132 kV ICTs

Thus present installed capacity of 2x315MVA 400/220kV at 400kV substation Fatehabad is catering to 800MVA installed at aforesaid 220kV substations

6.2 Further, in order to handle growing load demand, 220kV substation Hukrnawali (460 MVA) which is under construction shall also get feed from 400kV substation Fatehabad. Therefore connected capacity at 220kV level shall increase to 1260 MVA. In order to feed the above mentioned quantum of load, HVPNL has requested to augment the transformation capacity at 400/220kV Fatehabad (PG) substation under Regional system strengthening scheme.

6.3 Accordingly it is proposed to augment the capacity of Fatehbad 400/220 kV substation by 1x500 MVA ICT. HVPNL may inform the Requirement of 220 kV line bays, if any.

**Members may please discuss and concur.**

## **7. Modification in the evacuation System for Lalitpur (3x660 MW) STPS**

7.1 For evacuation of power from Lalitpur TPS, Lalitpur-Agra 765kV 2xS/c lines (about 378km long) had been planned by UPPTCL. Considering the long length of the lines, adequacy of the evacuation system was examined from Dynamic stability considerations. Joint studies were carried out with CEA, CTU, CPRI & UPPTCL and after detailed studies, 50% FSC on both circuits of Lalitpur - Agra 765kV 2\*S/c were agreed in 32<sup>nd</sup> Standing Committee Meeting of Transmission Planning of Northern Region held on 31/08/13. Additionally, LILO of one circuit of Jabalpur-Orai 765 kV D/c at Lalitpur TPS was also proposed for stability purpose at a later date.

7.2 Accordingly, the complete evacuation system agreed is given below:

- 765 kV Lalitpur – Agra (765/400 kV) (UP) 2xS/C lines (380 kms)
- Establishment of 765/400 kV, 2x1500 MVA, Agra (UP) substation
- Establishment of 765/220kV, 2x300 MVA substation at Lalitpur switchyard (under the scope of the generation developer)
- Establishment of a 220/132 kV, 2x100 MVA substation at Lalitpur
- Establishment of 400/132 kV, 2x300 MVA Agra (South) substation
- 220 kV Lalitpur – Jhansi D/C line (90 km) with one circuit to be LILOed at 220/132 kV Lalitpur substation.
- LILO of one circuit of existing 400kV Agra (UP) – Agra (PG) 2xS/C line at 765/400 kV Agra (UP) (10 Km)
- LILO of existing 400 kV Agra (UP) – Muradnagar S/C line at Agra (UP) 765/400 kV substation
- 400 kV Agra (UP) 765/400 kV – Agra (South) D/C line.

### **765kV Line and Bus Reactors:**

- 2x330 MVAr 765kV Line reactors at Lalitpur end of 765 kV Lalitpur –Agra (765kV) UP 2xS/c lines.
- 1x330 MVAr, 765kV Bus reactor at Lalitpur generation switchyard

- 2x240 MVAR 765kV Line reactors at Agra end of 765 kV Lalitpur –Agra (765 kV) UP 2xS/c lines.
- 1x240 MVAR, 765kV Bus reactor at Agra (765 kV) UP S/s
- 50% Fixed Series Compensation (FSC) in 765 kV Lalitpur-Agra (UP) 2xS/C lines along with SSR protection in Lalitpur Generating Plant.
- An additional requirement of 1x330 MVAR 765 kV bus reactor (2nd) at 765kV Lalitpur generation switchyard in addition to the provision of bus and line reactors as proposed by UPPTCL (Item-2x above). For charging of 765kV Lalitpur-Agra lines, it would be preferable to charge it from Agra end.
- LILO of one circuit of 765kV Jabalpur-Orai D/C at Lalitpur to provide stable operation of the Lalitpur generation.

7.3 As implementation of the transmission system of Lalitpur was entrusted to POWERGRID, study for possibility of Sub-Synchronous Resonance with FSC on Lalitpur- Agra 765kV 2\*S/c was undertaken through IIT, Mumbai. It was suggested by IIT Mumbai that a Special Protection Scheme is required, which disallows the series capacitor being bypassed on only one of the line when both lines are in service. The detailed study report was forwarded to UPPTCL for concurrence. UPPTCL expressed apprehension regarding evacuation of full power from Lalitpur.

7.4 Considering the apprehension of UPPTCL, the scheme was revisited and alternatively Thyristor Controlled Series Compensation (TCSC) with 35% fixed & 5-15% variable TCSC on Lalitpur – Agra 765 kV 2\*S/c lines was proposed for reliable evacuation. Dynamic studies were carried out & it was observed that the oscillations are well damped. Further, the possibility of Sub synchronous resonance is also not present. Additionally, the requirement of LILO of one circuit of Jabalpur – Orai 765 kV D/c line at Lalitpur can be dropped as the LILO distance of Jabalpur-Orai at Lalitpur TPS is about 100km and such long distance LILO, would result in unbalanced loadings of such critical inter-regional line and is not desirable.

7.5 Accordingly, POWERGRID vide their letter dated 15-01-2015 suggested following changes on 765kV lines elements.

S.No.	Approved Earlier by SCM	POWERGRID suggested vide letter dt. 15.01.2015
1	50% Fixed Series Compensation (FSC) in 765 kV Lalitpur-Agra (UP) 2xS/C lines (approx. cost 100 cr.)- by year 2016	35%FSC + 15% TCSC
2	LILO of one circuit of 765kV Jabalpur-Orai D/C at Lalitpur to provide stable operation of the Lalitpur generation. (approx. cost 500 cr. for 100km LILO)- by year 2017	Not required
	<b>Total Cost of system approved earlier: 600 cr.</b>	<b>Total cost of suggested system: 150-200 cr.</b>

Looking into the dynamic stability requirements and techno-economic considerations, it was proposed to UPPTCL that TCSC (35% fixed & 5-15% TCSC) may be considered on Lalitpur-Agra 2\*765kV S/c lines for evacuation of power from Lalitpur generation. TCSC can provide reliable evacuation for power from Lalitpur TPS.

UPPTCL vide their letter dated 18-02-2015 intimated that above suggestions made by POWERGRID shall leave Lalitpur TPS generators unanchored from grid and there is no historical experience of installation and functioning of FSC or FSC+TCSC on 765kV lines in India. So UPPTCL has proposed following modification to keep the evacuation system more reliable and flexible network in long run:

- PSS are sufficient to address stability. As such the provision for 50% FSC or 35% FSC+15% TCSC may not be required.
- Lalitpur TPS generators shall be directed to ensure all time proper tuning of PSS in AVR system.
- 765/400kV, 1x630MVA AIS S/S will be developed at near Lalitpur TPS to anchor the generators to Grid. (Approx 350 cr. with land).

- LILO of one circuit of existing Parichha-Orai 400kV D/C UPPTCL line at Lalitpur TPS (120km LILO approx. cost 150 cr.). Orai 400kV UPPTCL is likely to get strongly connected to grid through Orai UP- Orai 765kV(POWERGRID) & Orai-Banda 400kV UPPTCL lines.
- Additional reactor 330MVA at Lalitpur TPS is not required

POWERGRID is of the view that the reliability/ tuning of Power System Stabilizers (PSS) in Indian power sector is not yet proven, PSS installed on the generation machines may not be able to provide the required damping under outage and power evacuation constraints for Lalitpur TPS may occur. Powergrid is of the view that from the dynamic stability consideration the provision of FSC along with TCSC would be more suitable. With the proposal of UPPTCL to LILO of one circuit of existing Paricha-Orai 400kV D/c UPPTCL line at Lalitpur(120km) the Loop in Loop out distance of Paricha-Orai at Lalitpur TPS would be about 120km and such long distance LILO would again result in unbalanced loadings and accordingly is not desirable. **Alternately, Lalitpur- Parichha 400kV D/c line may be considered which would be almost of same length. Further, the proposal of 1\*630MVA 765/400kV ICT at Lalitpur may be considered as 2\*500 MVA 765/400kV ICTs.**

In regard to requirement of the additional 330MVA Bus reactor at Lalitpur TPS, it is submitted that in case only one 330MVA Bus reactor is provided at Lalitpur, there would be MVA absorption by the machines under light load conditions.

**Members may please discuss and concur.**

## **8. 220kV line bays at 400/220kV ISTS Substation of PGCIL located in U.P.**

8.1 Recently following augmentation for ISTS substations has either been done or approved in SCM of NR.

- (i) Mainpuri 400/220 kV PGCIL S/S - Addition of 500 MVA Transformer approved in the 34<sup>th</sup> Standing Committee Meeting.
- (ii) Allahabad 400/220 kV PGCIL S/S - Additional 500 MVA Transformer has been added in Oct, 2014.



(iii) Meerut 400/220 kV PGCIL S/S - Additional 500 MVA Transformer was added.

220kV interconnection for utilization of additional Transformers Capacity approved at 400/220kV S/s of PGCIL with load center in UP. UPPTCL proposed the following additional 220kV line bays will be required:-

**At Mainpuri**

- (i) Mainpuri(PG) 400 kV S/S - 220 kV bays 2 nos. for Mainpuri-Neebkarori 220 kV D/C line.
- (ii) Neebkarori (Farrukhabad) 220/132 kV 2x100 MVA S/S has been approved by UPPTCL.

UPPTCL has requested for approval and CEA for the above bay provisions at Mainpuri S/S.

**At Allahabad**

- (ii) Allahabad (PG) 400 kV S/S 220 kV 1 no. bay for Allahabad-Jhusi or Allahabad- Phulpur 220 kV SC line.

**At Meerat**

- (iii) Meerut (PG) 400 kV S/S - 220 kV 1 no. bay for Meerut-Charla 220 kV SC line. Presently Charla 220 kV S/S is being radially fed from Muzaffarnagar 400 kV S/S. It may also help in reducing loading on the Meerut-Muzaffarnagar 400 kV SC line.

8.2 In the above proposal UPPTCL has proposed 220kV S/C line from 400kV Allahabad and Meerut S/S of PGCIL, which is technically not correct. UPPTCL may be considered to construct 220kV D/C line from 400kV PGCIL's substations considering the future load growth and for better use of RoW. In addition UP has desired two nos. of 220 kV bays at Mandaula substation of POWERGRID.

**Members may discuss and concur the proposal.**

**9. LILO of one ckt. of NAPP-Khurja 220 kV DC line at UPPTCL Debai 220 kV S/S.**

**9.1** The NAPP (2x220 MWe) is connected with the following UPPTCL 220 kV lines:-

- (i) NAPP-Atrauli 220 kV SC line.
- (ii) NAPP-Khurja 220 kV DC line.
- (iii) NAPP-Sambhal 220 kV SC line.
- (iv) NAPP-Simbhauri 220 kV SC line.

9.2 Now UPPTCL vide letter dated 07-02-2015 intimated that UPPTCL is constructing 220/132 kV substation at Debai which is nearing completion and 220 kV connectivity planned by LILOing one ckt of NAPP-Khurja 220 kV D/C UPPTCL line is also nearing completion. They further mentioned that LILO of NAPP-Khurja one ckt. 220 kV line may not effect evacuation and plant stability. UPPTCL also mentioned that NAPP is well connected by 220 kV UPPTCL lines and outage of any 220 kV with or without LILO line shall not adversely affect evacuation.

9.3 However, NPCIL vide their letter dated 20-02-2015 have made objections on the LILOing proposals of UPPTCL, considering the fact that this LILO will disturb the “operational islanding scheme” of NAPS-1&2, which has been decided based on a good amount of discussion in the NR and its subsequent approval by NRPC. Regulatory stipulations regarding Nuclear plant operation, mandate availability of islanding scheme to ensure that units survive during the grid induced transient(S).

9.4 As per planning criteria of CEA, “the evacuation scheme for sensitive power stations viz., Nuclear power stations shall generally be planned so as to terminate it at large load centers to facilitate islanding of the power station in case of contingency’. So this proposal is not in line with the planning criteria of CEA. However, LILO of NAPP – Khurja at 220/132 kV substation at Debai

requires re-adjustment of the protection/islanding system, which by any means would not be a difficult proposal.

**Constituents may discuss and concur the proposal.**

**10. LILO of Kashipur-Rishikesh 400 kV SC line at Nehtaur 400/132 kV S/S:-**

10.1 The LILO of Kashipur-Rishikesh 400 kV S/C line at Nehtaur 400/132 kV with 2x200 MVA S/S was approved in 26<sup>th</sup> SCM of NR on 13-10-2008 for power supply to Nehtaur area. UPPTCL intimated that construction of Nehtaur 400/132 kV, 2x200 MVA S/S and LILO work is being done by M/S WUPPTCL under PPP mode and is in advanced stage.

10.2 PTCUL has raised objections regarding stability problems due to LILO of this 400kV line jointly owned by UPPTCL and PTCUL.

10.3 It is to be informed that Koteswar Pooling Station- Rishikesh 400kV D/c line with HTLS (High temperature and low Sag) conductor line was approved in the 35<sup>th</sup> meeting of the Standing Committee on Power System Planning in Northern Region held on 3/11/2014. The 400 kV Bareilly – Kashipur 400 kV D/C line has already been charged. This 400kV line and with Rishikesh–Roorkee-Muzaffarnagar-Muradnagar 400 kV S/C line the stability of 400 kV Rishikesh S/s will improve.

Considering the above strengthening being carried out, the LILO at Nehtaur may be agreed.

**Constituents may discuss and concur the proposal.**

**11. Evacuation system for Ghatampur 3x660 MW Thermal Power Station: -**

The Ghatampur Thermal Power Station is an intra-state project being constructed as a Joint Venture of Neyveli Lignite Corporation and Uttar Pradesh Rajya Vidyut Utpadan Nigam Ltd.(UPRUVNL). The 3x660MW Ghatampur TPS is located near Kanpur in

Uttar Pradesh. UPPTCL has proposed following transmission system for its evacuation:

- 21/765KV Generator Transformers, 2x 1500MVA, 765/400kV & 3x200MVA, 400/132kV ICTs at Ghatampur TPS along with 6-8 Nos. of 132 kV outlets
- Ghatampur TPS -Agra(UP) 765kV S/c Line- **320 km** (with Line reactors of 189 MVAR at either end)
- Agra(UP) -Greater Noida(UP) 765kV S/c Line - **200 km** (with Line reactor of 240 MVAR at Agra end)
- Ghatampur TPS -Hapur 765kV S/c Line - **400 km** with line reactors of 330 MVAR at either end.
- Ghatampur TPS- Kanpur(PG) 400kV D/c line-60km

The above evacuation Plan was discussed in the 35<sup>th</sup> SCM of NR. Powergrid was of the view that the NTPC generation at Bilhaur coming in timeframe of Ghatampur has not been considered in the studies. As such, further load flow studies need to be carried out considering the effect of Bilhaur generation on the loading of the line beyond Kanpur with power flow through Ghatampur TPS to Kanpur. Bilhaur which is also close to Kanpur (about 55 km), would likely to be evacuated through Kanpur. So under the above condition with Bilhaur generation, the line beyond Kanpur (PG) would likely to get overloaded with the power flowing from Ghatampur to Kanpur. As such the system proposed from Ghatampur would need to be revisited further considering Bilhaur TPS. In the meeting it was decided that CTU may plan Bilhaur evacuation system separately and put up to the Standing Committee for approval.

UPPCL has stated that they have also carried out studies with the proposed system and there is no overloading problem in the evacuation even under outage Condition. It was informed that at Ghatampur provision has been kept for 400/220/132 ICT through which around 500 MW of the generation could be dropped down at 220 kV or 132 kV level. As such the power flow towards Kanpur from Ghatampur will not that high. UPPCL has indicated that Bilhaur NTPC plant may not fructify in near future and

as such the fresh UPPTCL study considering Bilhaur alongwith Ghatampur may not be required.

The issue was discussed with NTPC and they have informed that process of land acquisition for Bilhaur is under progress and the same is likely to be completed shortly. Once the process of land acquisition is completed the construction activity would start.

Load flow studies were accordingly carried out considering the generation at Ghatampur(1980 MW) as well as Bilhaur(1320 MW). The load flow studies has again been done with the following evacuation system:

**Ghatampur TPS (3x660MW):**

- 21/765KV Generator Transformers, 2x 1500MVA, 765/400kV & 3x200MVA, 400/132kV ICTs at Ghatampur TPS along with 6-8 Nos. of 132 kV outlets
- Ghatampur TPS - Agra(UP) 765kV S/c Line- - 240 km
- Line reactors of 189 MVAR at either end
- Agra(UP) -Greater Noida(UP) 765kV S/c Line - 200 km
- Line reactor of 189 MVAR at Agra end
- Ghatampur TPS - Hapur 765kV S/c Line - 400 km
- line reactors of 330 MVAR at either end
- Ghatampur TPS- Kanpur(PG) (400 or 765kV) 400kV D/C line

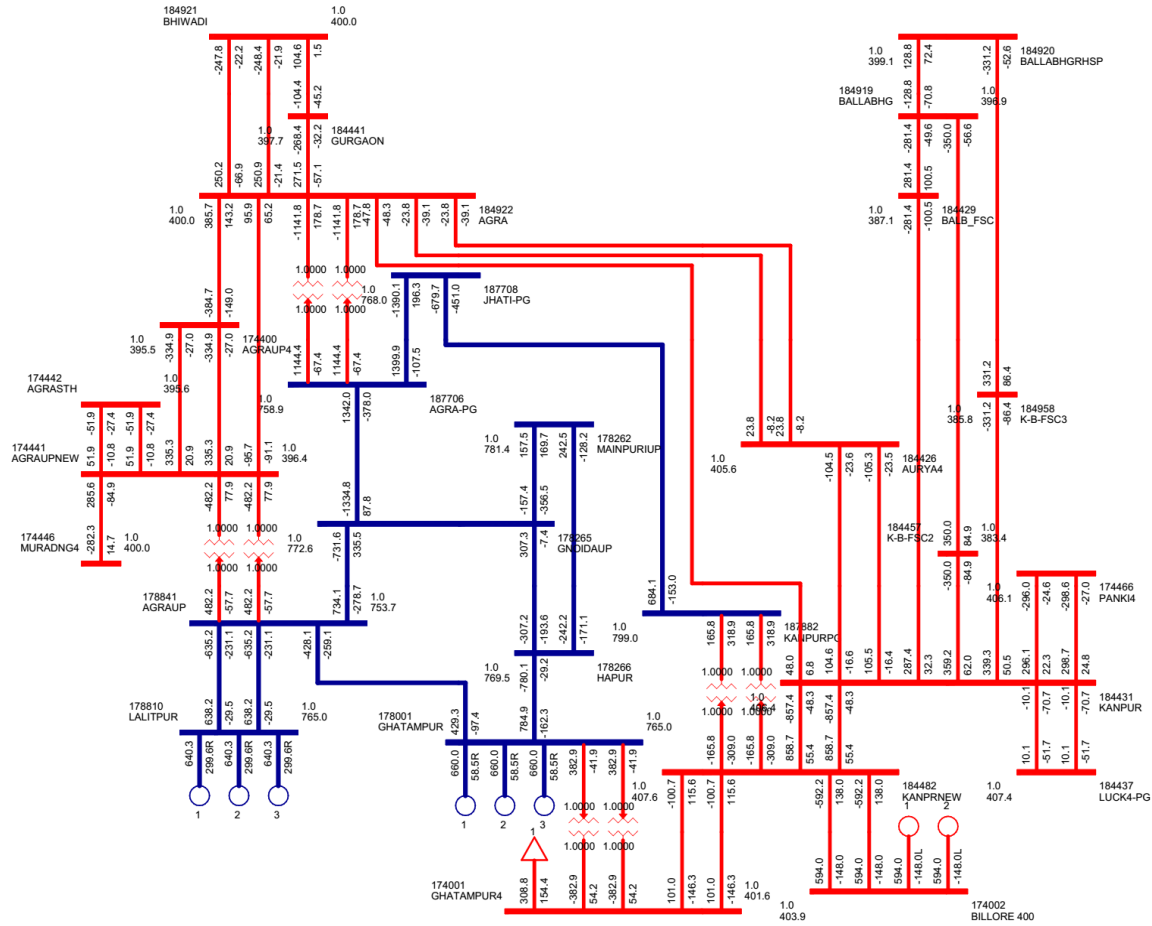
**Billore TPS (2x660MW):**

- Billore TPS – Kanpur(PG) 400kV Quad D/c Line

With the above system in place, following cases were carried out:

- i) base case
- ii) Outage of 765 kV Ghatampur – Hapur S/C line
- iii) Outage of 765 kV Agra– Greater Noida S/C line
- iv) Outage of 765 kV Ghatampur – Agra S/C line.

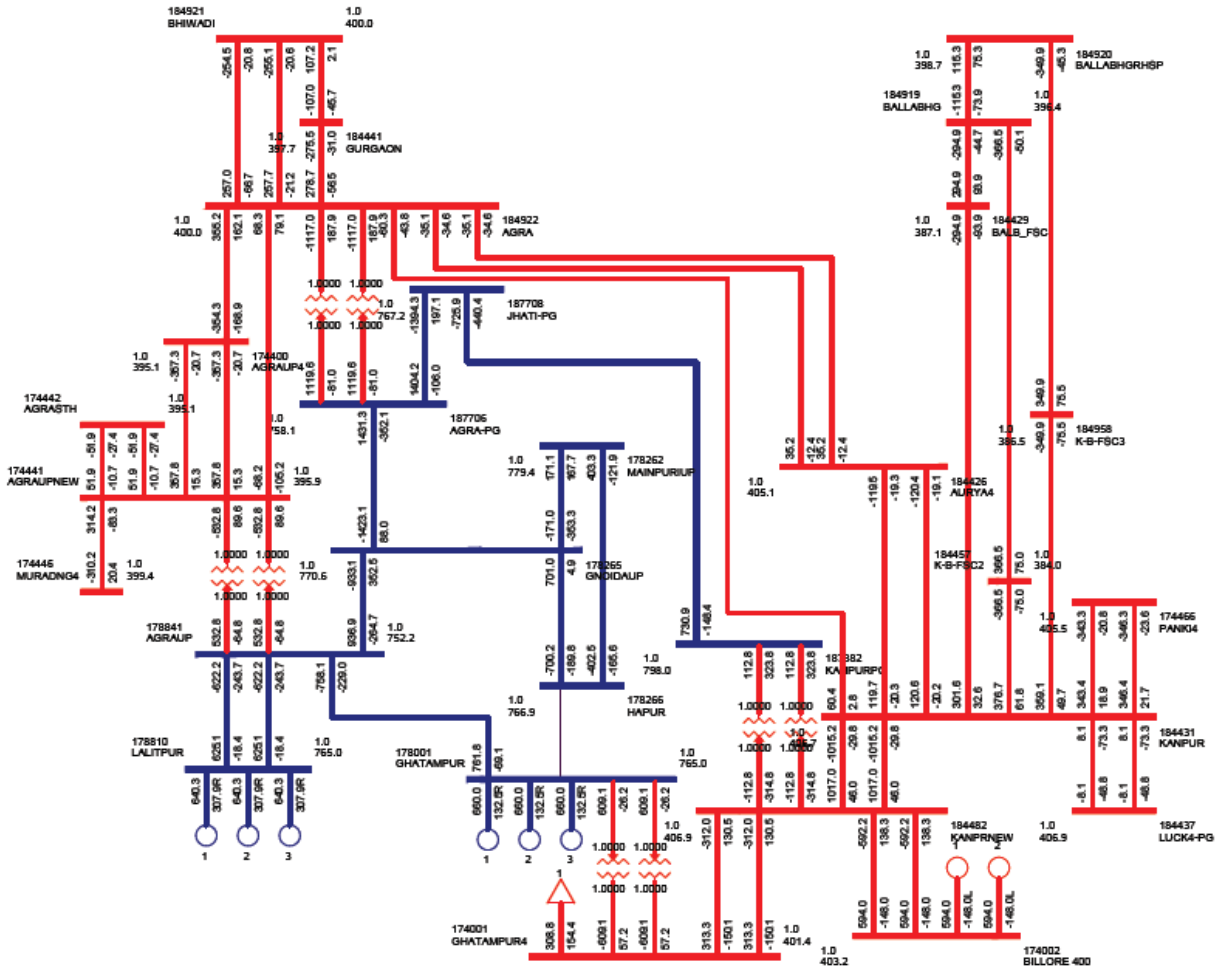
## Base Case



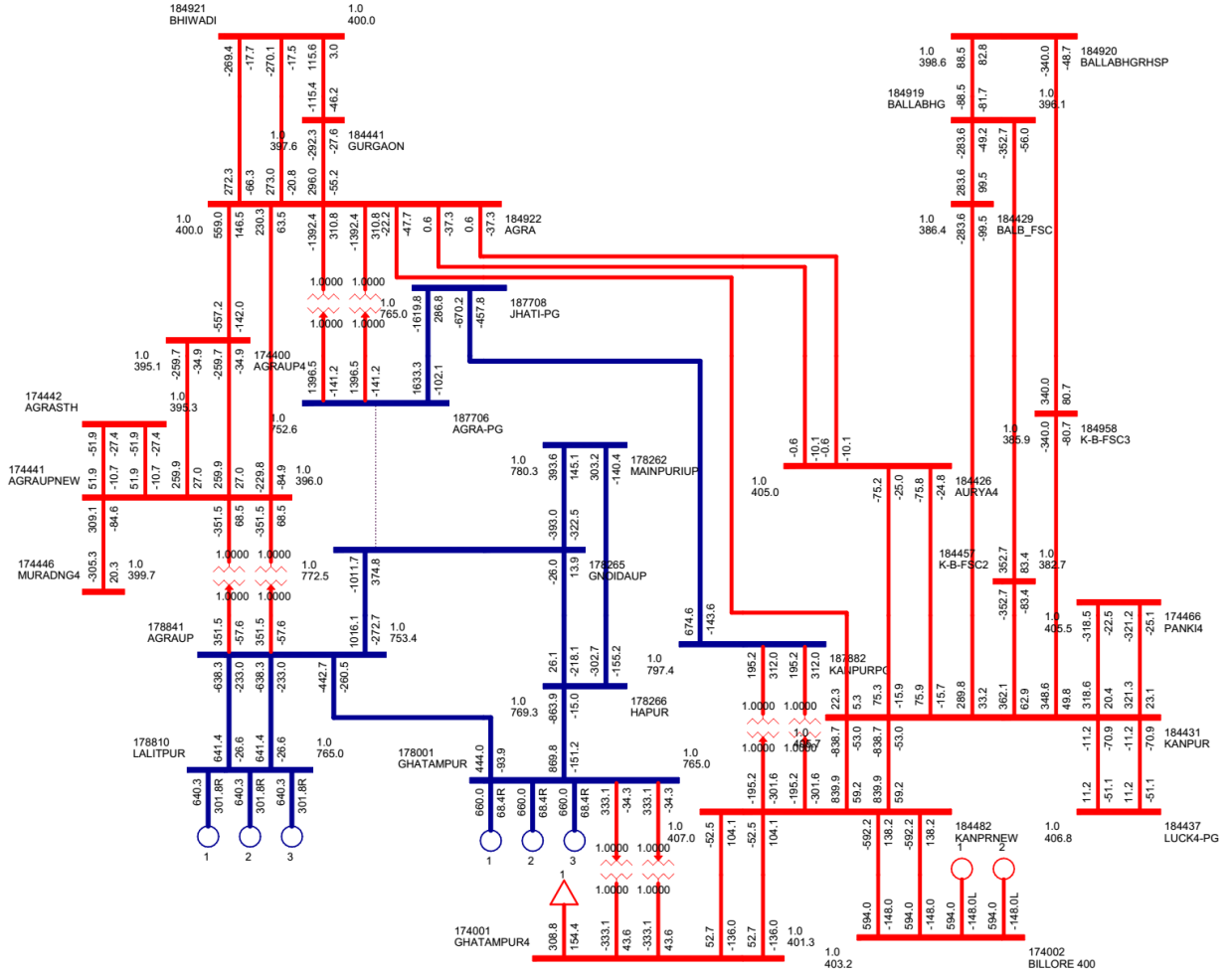
The load flow result indicated no overloading in any of the line beyond Kanpur is within limit.

The loading between Ghatampur to Kanpur is around 101 MW/ckt.

## Outage of 765 kV Ghatampur – Hapur S/C line

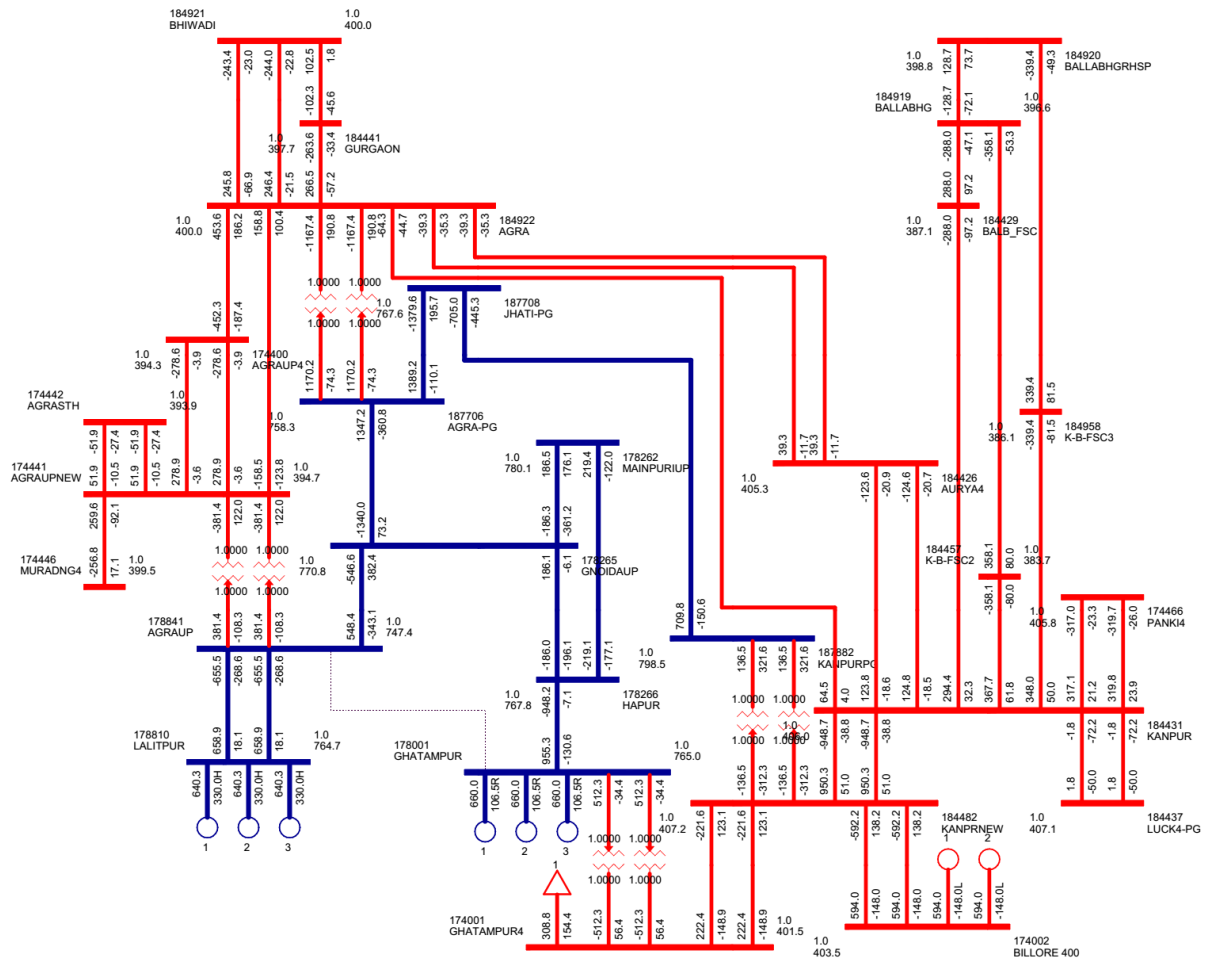


# Outage of 765 kV Agra (PG)– Greater Noida S/C line





## Outage of 765 kV Ghatampur – Agra(UP) S/C line



From the above single line diagram, it is found that even in case of above three outages, power flow in other circuits are within its permissible limit. Accordingly the evacuation system from Ghatampur as under may please be considered.

### Ghatampur TPS (3x660MW):

- 21/765KV Generator Transformers, 2x 1500MVA, 765/400kV & 3x200MVA, 400/132kV ICTs at Ghatampur TPS along with 6-8 Nos. of 132 kV outlets
- Ghatampur TPS - Agra(UP) 765kV S/c Line- - 240 km
- Line reactors of 189 MVAR at either end
- Agra(UP) -Greater Noida(UP) 765kV S/c Line - 200 km
- Line reactor of 189 MVAR at Agra end
- Ghatampur TPS - Hapur 765kV S/c Line - 400 km

- line reactors of 330 MVAR at either end
- Ghatampur TPS- Kanpur(PG) (400 or 765kV) 400kV D/C line

**Members may discuss and concur the proposal.**

## **12. Power evacuation from 2x50 MW Sainj HEP**

12.1 The power evacuation system from Sainj was discussed in the 31st, 32nd and 35th meeting of the Standing Committee of Northern Region. In pursuance of decision taken in 32nd meeting of Standing committee on Power System Planning-NR held on 31.8.2013. Evacuation arrangement for Sainj HEP (100 MW) was finalized as LILO of 400 kV Parvati-II- Banala direct circuit at Sainj HEP with provision of SPS and Bye pass arrangement at Sainj HEP. The work of LILO of 400 kV circuit has now been taken in hand and in this context, following situation has emerged:

- Sainj HEP is located upstream of Parvati-II HEP (barely 350 meters away) and 400 kV circuit from Parvati-II HEP to Parvati-III HEP faces the Sainj HEP pot head yard. Though the Parvati Stage-II Banala Lines are alternately routed on single circuit or double circuit towers depending on the site conditions these circuits are on the same tower at the location proposed for LILO of 400 kV Parvati-II- to Banala direct circuit
- For LILO on direct circuit, the circuits from Sainj HEP shall have to be routed below the Parvati-II –Parvati III 400 kV D/C line and then strung back to the Parvati-II-Banala direct circuit using four gantry towers. Based on site conditions, these gantry towers are falling on steep hilly terrain which is leading to additional complexity. These gantry towers are also straddling a community road and taking the line from below the Parvati-II –Parvati-III circuit for LILOing into the Parvati-II –Banala circuit will reduce the electrical clearance for which the villager's local community located upstream to LILO

point are showing resentment and as such it will be impossible situation to acquire the land and make the LILO arrangement in the present form.

12.2 In view of above constrains CEA/PGCIL were requested to revisit the approved arrangement and revisit the site. In this context a team comprising of officers from CEA, PGCIL, HPPTCL, HPPCL & PKTCL visited the site. It was observed that taking the line from below the Parvati-II- Parvati-III for LILOfing the Sainj Evacuation System into Parvati-II – Banala Circuit would be a difficult proposition as it would lead to less ground clearance from the village road. Since the structures are on the steep gradient so creating the LILO with the already approved arrangement would be difficult considering the resentment from the village people and acquisition of required land in the village.

12.3 From the technical consideration also LILOfing the line from Sainj HEP directly into the Parvati-II to Parvati-III Circuit, which is facing Sainj HEP would be easier and would also require lesser land acquisition and also would not create electrical clearance problem.

11.4 The Team was of the view that it would be technically feasible and electrically suitable solution to LILO the Line from Sainj HEP directly into Parvati-II to Parvati-III circuit. Accordingly, the line from Sainj HEP may be LILOfed at Circuit No. -1, which is Parvati-II to Parvati-III-Banala, instead of the direct circuit between Parvati-II to Banala. The proposal was in principally agreed by CEA as well as CTU.

**Constituents may concur the proposal.**

### **13. Conversion of line reactors to Bus reactors at Karcham Wangtoo end of Karcham Wangtoo Abdullapur line-33SCM Karcham Wangtoo Reactors**

13.1 For evacuation of power from Karcham Wangtoo HEP, Karcham Wangtoo – Abdullapur 400kV D/c quad line with 80MVAR line reactors at Karcham-Wangtoo was established. In the 31<sup>st</sup> Standing committee meeting of NR it was agreed to

Loop-in Loop out of both circuits of Karcham Wangtoo – Abdullapur 400 kV D/c line at Kala Amb located in HP and provide 40% Series Compensation on 400 kV Karcham Wangtoo – Kala Amb D/c line under NRSS-XXXI. The scheme is being implemented under Tariff Based Competitive Bidding. The expected length of Karcham Wangtoo-Kala Amb line after Loop-in Loop out is about 120km. Considering the reduction in length of the line and proposed series compensation on this line, it was proposed that the 80 MVAR line reactors at Karcham Wangtoo end may be converted into bus reactor and both the line reactors may be connected to one 400 kV bay.

13.2 However in the meeting M/s Jaypee representative agreed to examine the feasibility of bus extension and provision of additional GIS bay equipment and would inform CTU/CEA in 2 months. Jaiprakash Power Ventures Limited vide their letter dated 20/05/2015 informed that the above proposal is feasible and this can be implemented by extending 400 kV GIS Bus Duct and adding one additional GIS bay. To achieve the same, about 2 days shut down of the Karcham Wangtoo Power House would be involved and this could be planned during low water availability period so that generation loss is minimum.

13.3 Keeping above in view it is proposed that the 2x80 MVAR line reactors may be converted into the bus reactor.

**Constituents may discuss and concur the proposal.**

**14. VSC from Jhatikara to Karampura in place of establishment of 400/220kV GIS substation at Karampura alongwith two associated 400kV D/c lines**

14.1 Under ISTS, a 4x500MVA, 400/220kV GIS substation was planned to be constructed at Karampura area of Delhi alongwith following 400kV lines:

1. 400kV D/c line from 765kV Jhatikra substation on M/c towers &
2. 400kV D/c line from 400kV Bawana substation on M/c towers.

14.2 During survey of both the line routes, it was observed that the construction of transmission lines, both from Jhatikra and Bawana substations were not feasible as

the line routes were passing through dense inhabitable areas with the issues of RoW. Accordingly, option of locating the Karampura 400/220kV substation in the outskirts of Delhi was explored from where construction of Multicircuit (M/c) lines would not be difficult. In this regard, POWERGRID identified an alternate site at Rithala (Sec 25, Rohini).

14.3 For finalization of location of Karampura substation, a meeting was held in CEA on 16/04/15 where the proposal of locating the substation at Rithala (Sec 25, Rohini) was not agreed as the load demand is in Karampura / Karol Bagh area and by locating it at Rithala, it would not be able to meet the load demand of Karampura and adjoining area. Accordingly, as an alternate measure, power supply to Karampura by VSC was also discussed.

14.4 Considering that Karampura substation is very important for providing Grid connectivity to Central Delhi, the general opinion was that instead of planning through HVAC it may be possible to provide Grid connectivity to Karampura area through DC and the proposal of VSC (voltage source converter) was identified and it was desired that a proposal in this regard may be put up in the SCM of NR.

14.5 VSC HVDC technology is for the meshed network as we have today. It permits continuous and independent control of real and reactive power. Reactive power, controlled independently at each terminal, can be used for dynamic voltage regulation to support the interconnecting AC system following contingencies and, thus, increasing system stability. A VSC HVDC system has a low contribution to the short circuit (current) level and can be connected to a weak AC network, or to a network where no generation is available. The forced commutation with VSC technology even permits black start; the converter can be used to create a balanced three phase AC system similar as a synchronous machine.

14.6 Accordingly, it is proposed that grid connectivity to Karampura area may be through a 2000 MVA (1000 MVA+1000 MVA) VSC link from Jhatikara 765/400kV S/s

with underground cables keeping in view RoW problem. The inverter terminal could be somewhere near the present proposed location at Karampura. The rest provision beyond Karampra S/S would remain same as proposed earlier. As such, the earlier proposal for the 400kV D/c line from 765kV Jhatikra substation & 400kV D/c line from 400kV Bawana substation to Karanpura may be dropped.

14.7 Accordingly, following is proposed for Karampura substation:

- i) A 2000 MW VSC based HVDC link from Jhatikara to Karampura through underground cable
- ii) Earlier approved Jhatikara – Karampura 400 kV D/c and Bawana – Karampura 400kV D/c lines may be dropped.

The consolidated revised scheme is enclosed at Annexure-I

**Members of the Committee may deliberate and decide.**

#### **15. Maharaniabagh–Rajghat 400kV D/c additional line**

15.1 400kV Maharaniabagh(PG) substation is the main ISTS link for supplying power to Central and South Delhi areas. The substation presently has a provision for 12 nos. of 220 line bays out of which 10 nos. are in operation.( 2 Okla, 2 Masjid Moth, 2 Trauma Center, 2 Electric Lane, 2 Gazipur and two nos of bays are kept for LILO of one circuit of IP – Sarita Vihar line). On 400kV side the Maharaniabagh substation is presently linked with the ISTS system through LILO of Dadri - Samaypur 400kV line at Maharaniabagh. Some portion of the line towards Maharaniabagh is on D/C tower. Since the S/s has become a life line for supply of power to Delhi, any 400kV tower outage would cause blackout in half of Delhi area. Considering this, it is proposed to strengthen the Maharaniabagh S/s by linking it with the 400kV ISTS Rajghat (PG) S/s through 400 kV D/c line with HTLS conductor(about 5 kms.). This would give adequate redundancy for uninterrupted power supply to this S/s even under tower outage condition.

15.2 As such following works is being proposed as a part of system strengthening scheme **NRSS XXXIX**

- i. 400 kV Rajghat – Maharaniabagh D/c line with HTLS conductor
- ii. Two nos. of 400kV GIS bays each at Rajghat and Maharaniabagh

**Members of the Committee may deliberate and decide.**

## **16. Modification of Suratgarh Substation Location in Green Energy Corridor**

16.1 In view of the requirement of transmission strengthening beyond Bhuj Pooling station, due to integration of Generation from Mundra UMPP and Adani Mundra in Kutch (Gujarat) complex as well envisaged renewable capacity in Gujarat and Rajasthan, a comprehensive ISTS strengthening in Northern region was agreed to be implemented in compressed time schedule in 32nd meeting of Standing Committee of Northern Region held on 31.08.13:

### **Northern region**

- i) Chittorgarh-Ajmer (New) 765 kV D/c
- ii) Ajmer (New)-Suratgarh (New) 765 kV D/c
- iii) Suratgarh (New)-Moga (PG) 765 kV D/c
- iv) Chittorgarh-Chittorgarh (RVPN) 400 kV D/c (Quad)
- v) Ajmer (New)- Ajmer (RVPN) 400 kV D/c (Quad)
- vi) Suratgarh (New)- Suratgarh 400 kV D/c (Quad)
- vii) vii.2x1500 MVA, 765/400 kV sub-station each at Chittorgarh, Ajmer (New) and Suratgarh (New)
- viii) viii. Associated reactive compensation (Bus reactors & line reactors)

16.2 However from funding point of view, scheme was divided in various parts. Ministry of Power, vide letter dated March 3, 21015, has also approved the following scheme (element ii, iii, vi, part vii above) for implementation by POWERGRID under compressed time schedule through regulated tariff mechanism.

- i) Establishment of 2x1500 MVA, 765/400 kV substation at Suratgarh (New)
- ii) Ajmer (New) – Suratgarh (New) 765kV D/c

- iii) Suratgarh (New) – Moga 765kV D/c
- iv) Suratgarh (New) – Suratgarh (RVPN) 400kV D/C (Quad)

16.3 Reactive compensation for above scheme was also discussed and agreed in 34<sup>th</sup> NR Standing Committee meeting held on 08.08.14.

16.4 Subsequently, Rajasthan Rajya Vidyut Prasaran Nigam Ltd (RRVPN) through its letter dated March 24, 2015 requested that substation may be established near Bikaner in place of Suratgarh due to Solar generation potential near Bikaner. Accordingly, revised scope of works proposed under the scheme is as under:

- i) Establishment of 2x1500 MVA, 765/400 kV substation at Bikaner (New)
- ii) Ajmer (New) – Bikaner (New) 765kV D/c
- iii) Bikaner (New) – Moga 765kV D/c
- iv) Bikaner (New) – Bikaner (RVPN) 400kV D/c (Quad)

16.5 Further, due to change of s/s location, line lengths of various sections have changed. Therefore, revised reactive compensation is proposed as under:

▪ **Line Reactors**

S. No.	Transmission Line	From end (each ckt.) MVAR	to end (each ckt.) MVAR
(i)	Ajmer (New) – Bikaner (New) 765kV D/C line-272 km	1x240 (switchable) (each ckt.)	1x330 (switchable) (each ckt.)
(ii)	Bikaner (New) – Moga 765kV D/C line-350 km	1x330 (switchable) (each ckt.)	1x330 (switchable) (each ckt.)



▪ **Bus Reactors**

S. No.	Bus	Reactor (MVAR)
(i)	Bikaner (New)	1x330 (765kV Bus) 1x125 (400kV Bus)

**Members may concur the proposal.**

## Annexure-I

The scheme "Creation of 400/220kV substations in NCT of Delhi during 12<sup>th</sup> Plan period" had been discussed and agreed in the 34<sup>th</sup> SCM of NR held on 8/8/2014. There were some minor modifications in the scheme originally agreed in the 34<sup>th</sup> SCM.

- e) The establishment of Papankalan substation was earlier envisaged at Papankalan-I existing substation by replacing existing 220/66 kV substation of DTL. While working out the details it was observed that accommodating 400/220 kV S/s in existing Papankalan-I substation will be difficult without disturbing the present set up in the compressed time schedule. Accordingly, after considering other constraints, an alternate site in Sector-5, Dwarka, close to Papankalan-I was identified which would be named as Dwarka-I 400/220kV ISTS substation. Further, sufficient line corridor for LILO of one circuit of Bamnauli – Jhatikara D/c line at Dwarka-I is available and dismantling of existing 220kV D/c line would not be required. Accordingly, for LILO of one ckt. of Bamnauli – Jhatikara 400 kV D/c line, a new corridor with 400 kV D/c (Quad/HTLS) shall be constructed.
- f) Provision of 1\*125MVAR Bus Reactor at each of the Rajghat, Tughlakabad, Karampura & Dwarka-I (earlier Papankalan-I) Substations,
- g) Deletion of Dwarka-I (earlier Papankalan-I) to Jhatikalan D/c line,
- h) LILO of both circuits of Bawana -Mandola at Rajghat & construction of complete LILO as M/c line had been agreed in the 34<sup>th</sup> Standing Committee meeting.

The complete scheme after incorporating above modifications is:

### **"Creation of 400/220kV Substations in NCT of Delhi during 12<sup>th</sup> Plan Period (Part-A)"**

#### Transmission Lines

- (i) LILO of both circuits of Bawana –Mandola 400kV D/C line at Rajghat on M/c tower with Twin/HTLS conductor;
- (ii) LILO of one circuit of Bamnauli - Jattikalan 400kV D/C line at Dwarka-I with Twin/HTLS conductor

Substations:

(i) Establishment of 4x500MVA, 400/220 kV GIS Substation at Rajghat

400 kV

- a. Line bays : 4 nos. (with provision for future expansion)
- b. 500 MVA, 400/220 kV ICTs : 4 nos.
- c. 125 MVAR Bus Reactor : 1 no.
- d. Transformer bay : 4 nos.
- e. Reactor Bay : 1 no.

220 kV

- a. Line bays : 12 Nos.
- b. Transformer bay : 8 Nos. (4 nos. for 400/220kV ICTs &  
4 nos. for 220/33kV ICTs)
- c. Bus coupler bays : 2 Nos.
- d. Bus Sectionalizer bays : 2 Nos.

(ii) Establishment of 4x500MVA, 400/220 kV GIS Substation at Dwarka-I

400 kV

- a. Line bays : 2 Nos. (with provision for future expansion)
- b. 500 MVA, 400/220 kV ICTs : 4 Nos.
- c. 125 MVAR Bus Reactor : 1 No.
- d. Transformer bay : 4 No.
- e. Reactor Bay : 1 No.

220 kV

- a. Line bays : 12 Nos.
- b. Transformer bay : 4 Nos.
- c. Bus coupler bays : 2 Nos.
- d. Bus Sectionalizer bay : 2 Nos.

**“Creation of 400/220kV Substations in NCT of Delhi during 12<sup>th</sup> Plan Period (Part-B1)”**

Transmission Lines

- (i) LILO of both circuits of Bamnauli – Samaypur 400kV D/c line at Tughlakabad with Twin HTLS conductor - 35 km

Substations:

- (i) Establishment of 4x500MVA, 400/220 kV GIS Substation at Tughlakabad  
400 kV

- a. Line bays : 4 nos. (with provision for future expansion)
- b. 500 MVA, 400/220 kV ICTs : 4 nos.
- c. 125 MVAR Bus Reactor : 1 no.
- d. Transformer bay : 4 nos.
- e. Reactor Bay : 1 no.

220 kV

- e. Line bays : 12 Nos.
- f. Transformer bay : 8 Nos. (4 nos. for 400/220kV ICTs & 4 nos. for 220/33kV ICTs)
- g. Bus coupler bays : 2 Nos.
- h. Bus Sectionalizer bays : 2 Nos.

**“Creation of 400/220kV Substations in NCT of Delhi during 12<sup>th</sup> Plan Period (Part-B2)”**

**Earlier scope**

Transmission Lines

- i. 400kV Jattikalan-Karampura D/c line on M/c tower with Quad/HTLS conductor
- ii. 400kV Bawana – Karampura D/c line on M/c tower with Quad/HTLS conductor

### Substation

#### **i. 4x500MVA, 400/220 kV GIS at Karampura 400/220kV Substation**

##### 400 kV

- a. Line bays: 4 nos. (with provision for future expansion)
- b. 500 MVA, 400/220 kV ICTs: 4 Nos.
- c. 125MVAr Bus Reactor: 1 Nos.
- d. Transformer bay: 4 Nos.
- e. Reactor Bay: 1 Nos.

##### 220 kV

- f. Line bays : 12 Nos.
- g. Transformer bay : 8 Nos. (4 nos. for 400/220kV ICTs &  
4 nos. for 220/33kV ICTs)
- h. Bus coupler bays : 2 Nos.
- i. Bus Sectionalizer bays : 2 Nos.

### **Revised scope**

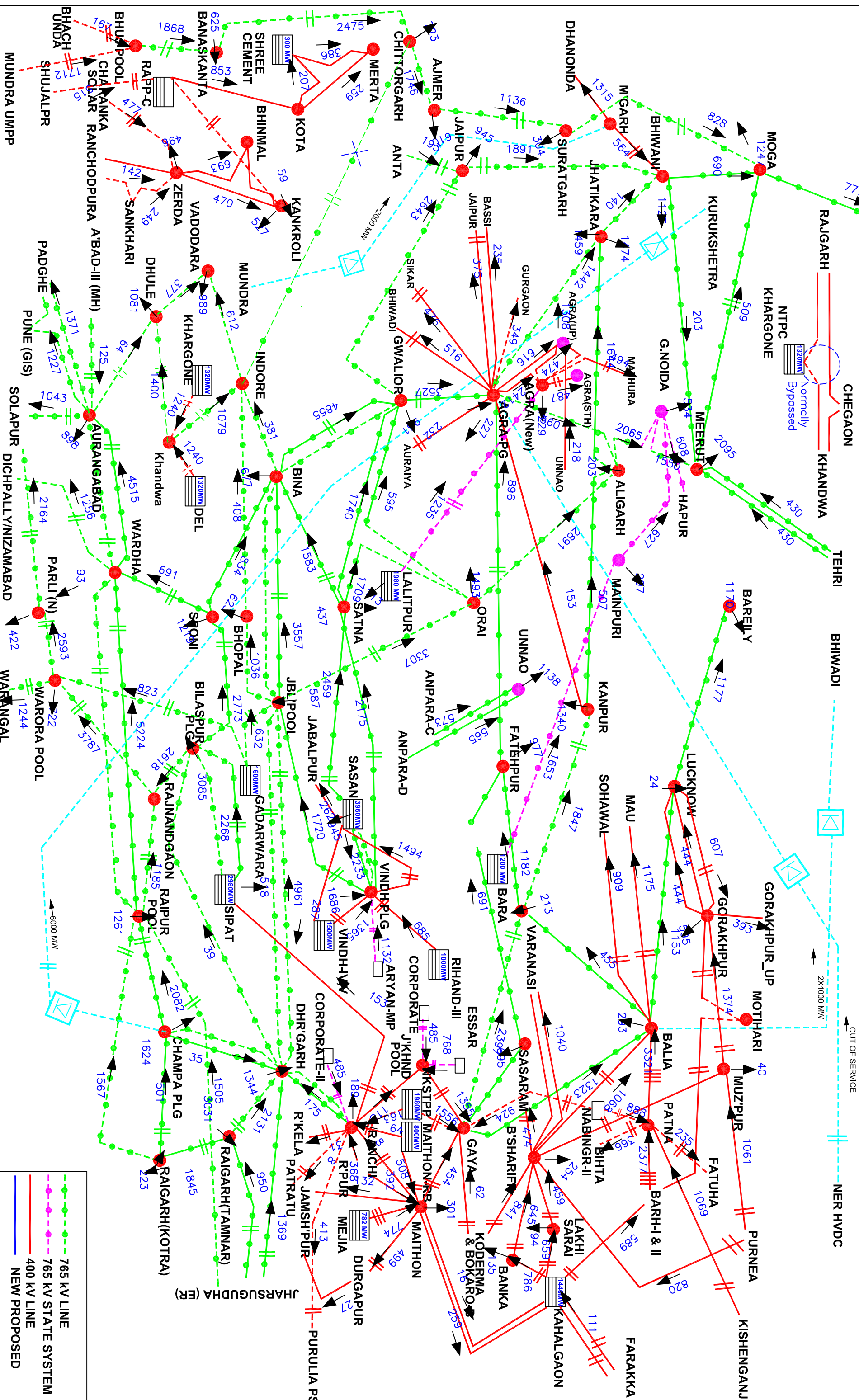
#### Transmission Lines

- i. A 2000 MW VSC based HVDC link from Jhatikara to Karampura through underground cable
- ii. Earlier approved Jhatikara – Karampura 400 kV D/c and Bawana – Karampura 400kV D/c lines may be dropped.

KISHENPUR

# WITHOUT NEW INTER-REGIONAL CORRIDOR : WR - NR

## (2018-19 TIME FRAME) (WITH GUJARAT RENEWABLES: S-80%; W-80%)

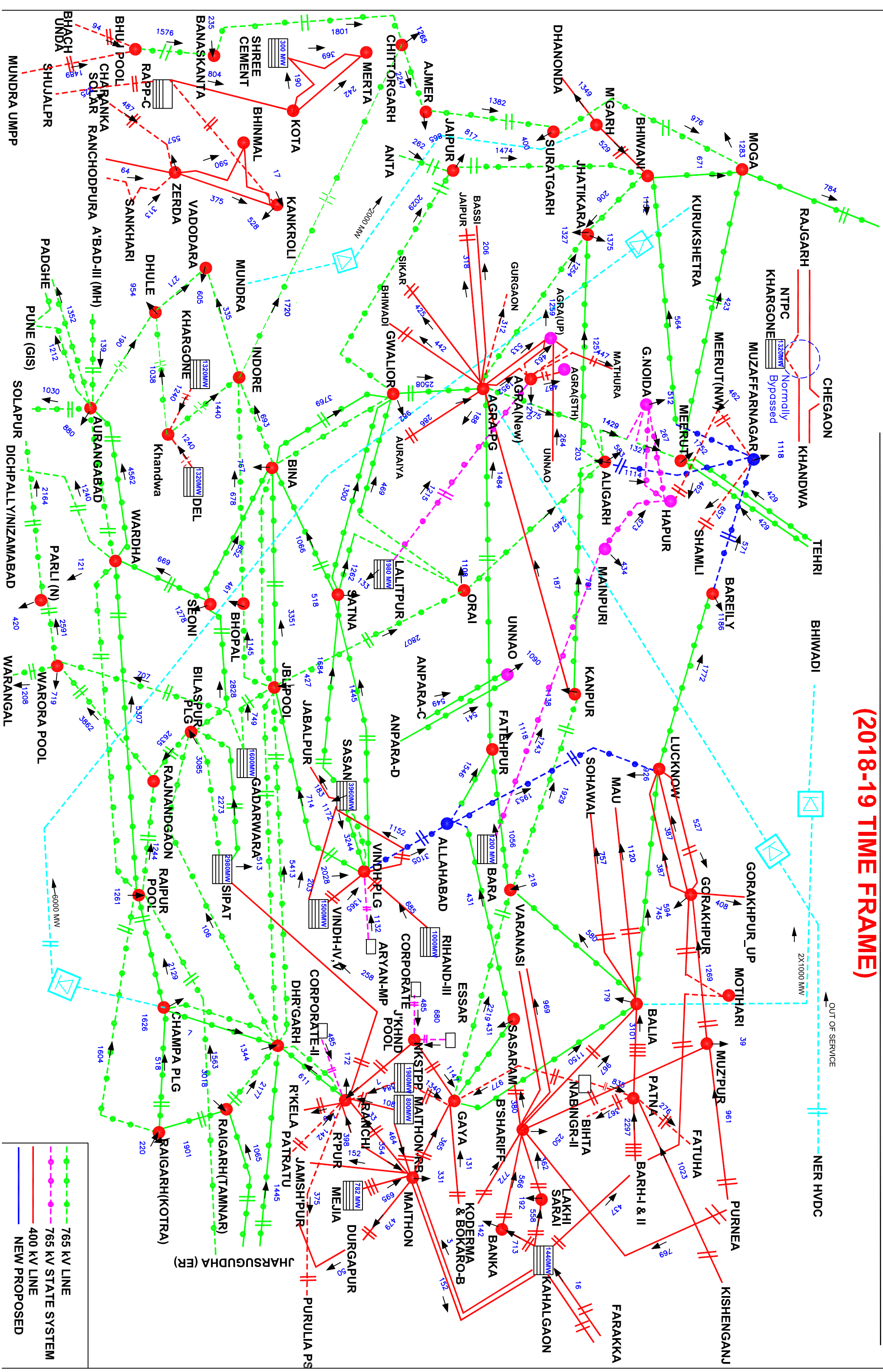


765 kV LINE  
 765 kV STATE SYSTEM  
 400 kV LINE  
 NEW PROPOSED

KISHENPUR

# NEW INTER-REGIONAL CORRIDOR : WR - NR

## (2018-19 TIME FRAME)



CHEGAON  
 NTPC KHARGONE  
 Normally Bypassed  
 MUZAFFARNAGAR  
 MEERUT(NW)  
 MEERUT

TEHRI

BHIWADI

GORAKHPUR\_UP  
 MOTIHARI

MUZPUR  
 PATNA  
 BARH-I & II

PURNEA  
 KISHENGANJ

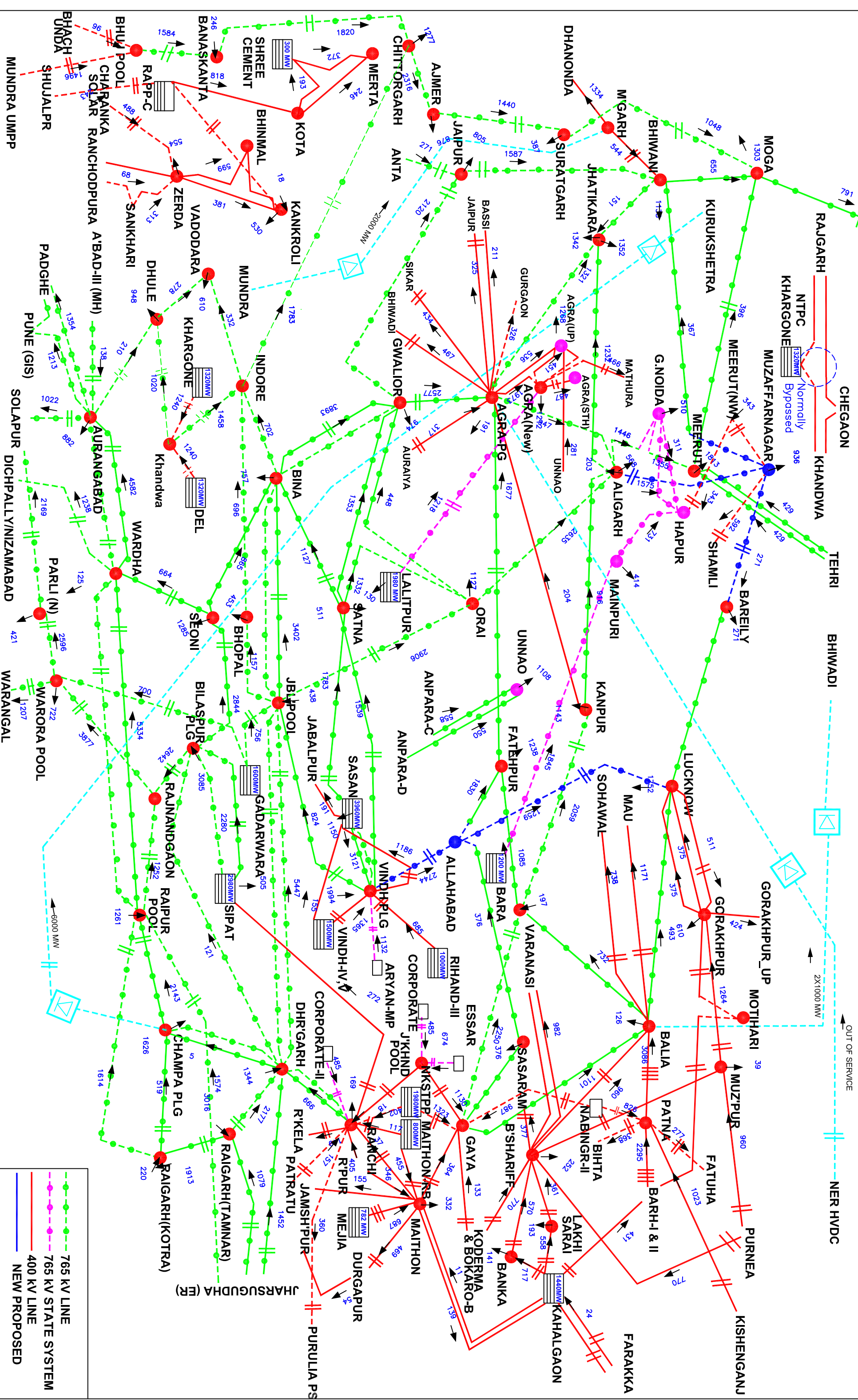
OUT OF SERVICE  
 NER HVDC

- 765 kV LINE
- 765 kV STATE SYSTEM
- 400 kV LINE
- NEW PROPOSED

KISHENPUR

# NEW INTER-REGIONAL CORRIDOR : WR - NR

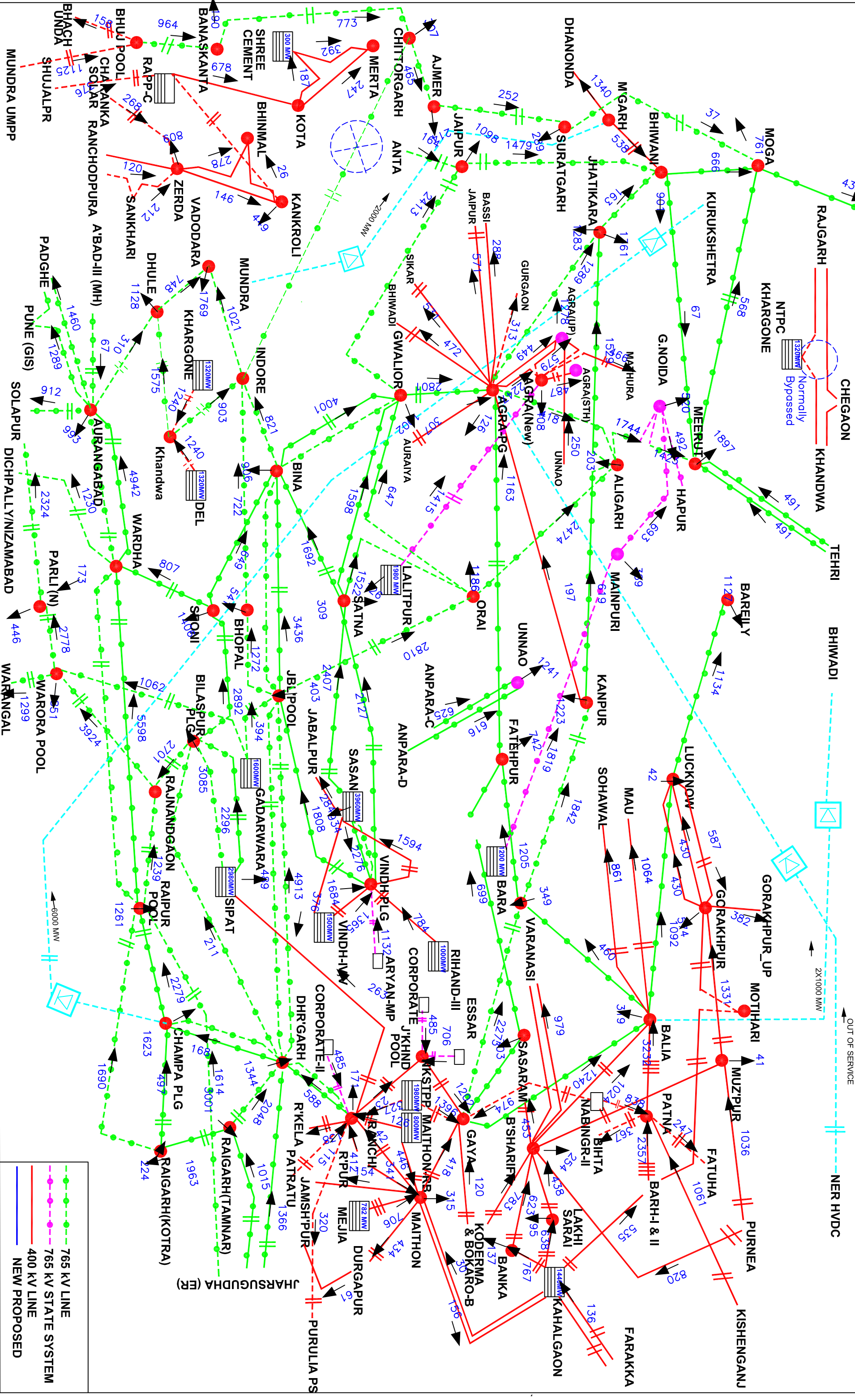
(2018-19 TIME FRAME)





# WITHOUT NEW INTER-REGIONAL CORRIDOR : WR - NR

## (2018-19 TIME FRAME) (WITH GUJARAT RENEWABLES: LOW RENEWABLES)

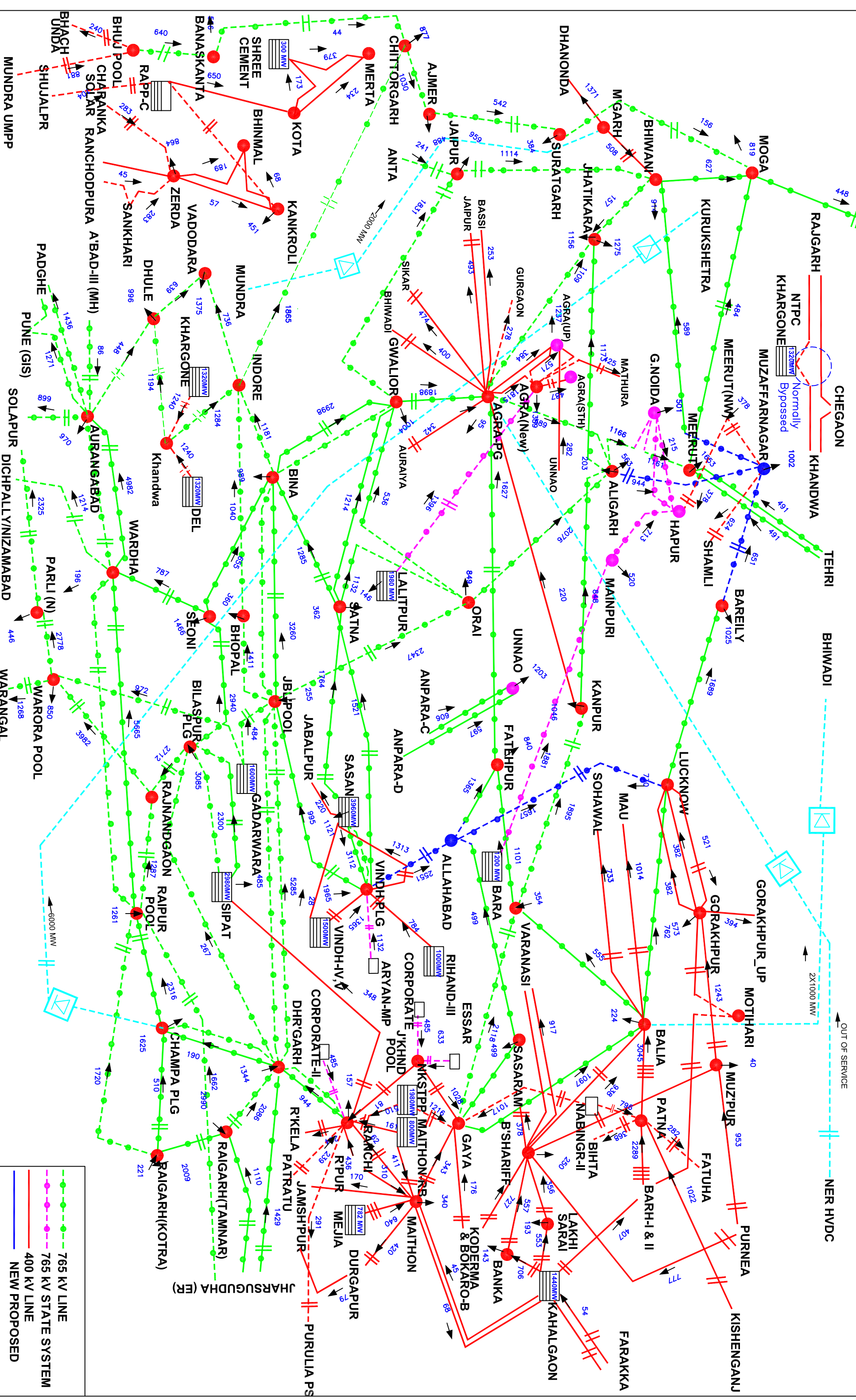


765 kV LINE  
765 KV STATE SYSTEM  
400 kV LINE  
NEW PROPOSED

KISHENPUR

# NEW INTER-REGIONAL CORRIDOR : WR - NR

## (2018-19 TIME FRAME)



CHEGAON  
 KHANDWA  
 NTPC Khargone  
 Normally Bypassed  
 1002

TEHRI  
 BHIWADI

GORAKHPUR\_UP  
 MOTIHARI  
 40

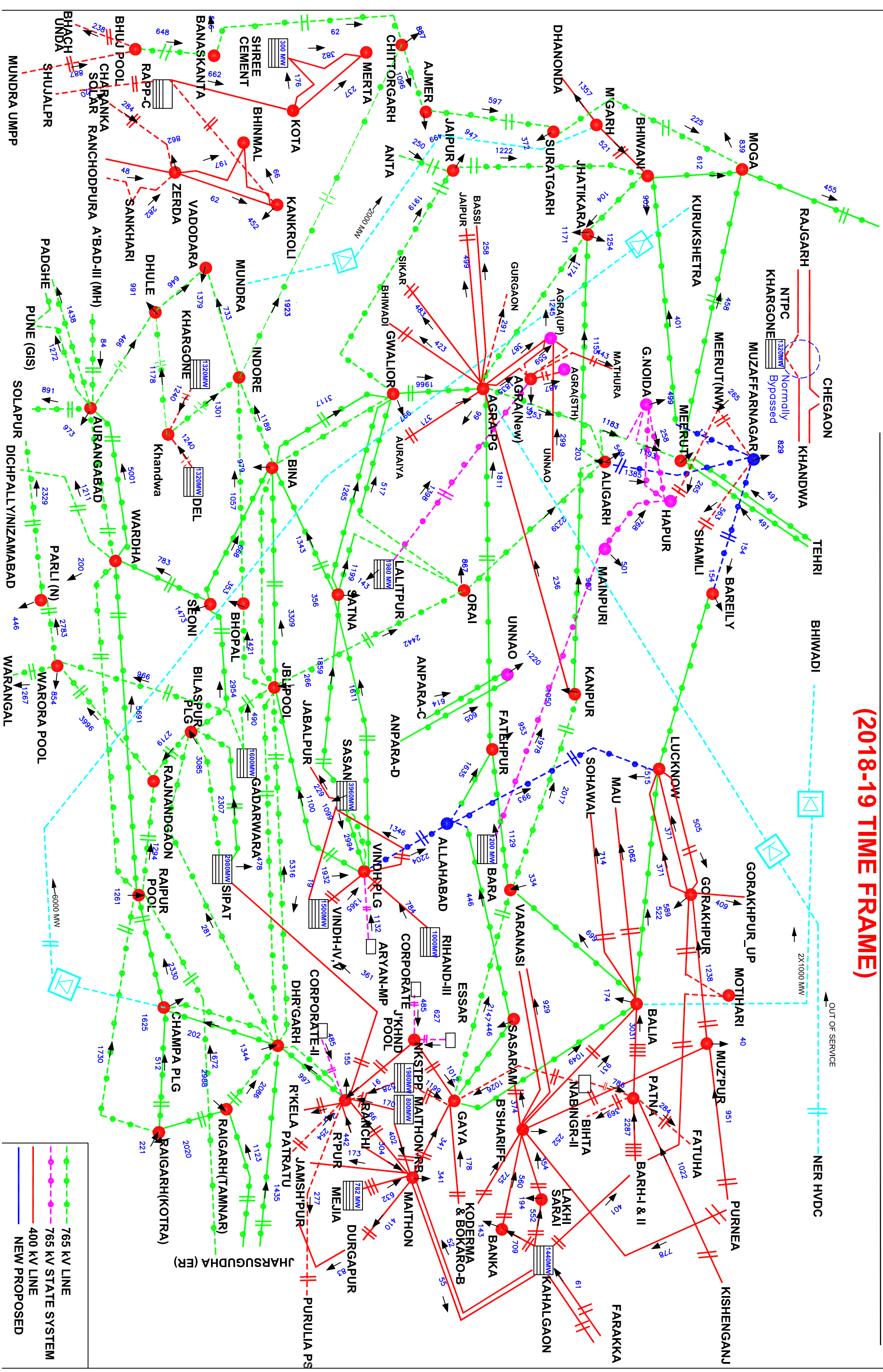
NER HVDC

- 765 kV LINE
- 765 kV STATE SYSTEM
- 400 kV LINE
- NEW PROPOSED

KISHENPUR

# NEW INTER-REGIONAL CORRIDOR : WR - NR

## (2018-19 TIME FRAME)



- 765 kV LINE
- 765 kV STATE SYSTEM
- 400 kV LINE
- NEW PROPOSED