भारत सरकार
केन्द्रीय विद्युत प्राधिकरण
प्रणाली योजना एवं परियोजना मूल्यांकन प्रभाग
सेवा भवन, रामकृष्णपुरम्, नई दिल्ली 110066

क॰ सं॰ : 26/10/2013–प्र. यो. प. मू./ 455-468 दिनांक: 22.07.2013

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विषय :– पश्चिमी क्षेत्र विद्युत प्रणाली योजना की स्थाई समिति की 36वीं बैठक । – अनुपूरक कार्यसूची

महोदय,

पश्चिमी क्षेत्र विद्युत प्रणाली योजना की स्थाई समिति की 36वीं बैठक की **अनुपूरक** कार्यसूची सूचना केन्द्रीय विद्युत प्राधिकरण की वेबसाइट www.cea.nic.in पर लिंक Home page – Power Systems-Standing Committee on Power System Planning-Western Region) पर उपलब्ध है।

संलग्न – उपरोक्त

के के आर्य

(कृष्ण कुमार आर्य)
मुख्य अभियन्ता (प्रभारी)

भारत सरकार / **Government of India**
विद्युत मंत्रालय / **Ministry of Power**
केन्द्रीय विद्युत प्राधिकरण / **Central Electricity Authority**
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No. 26/10/2013-SP&PA/455-468 **Date: 22nd July 2013**

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Sub: Supplementary Agenda for the 36th meeting of the Standing Committee on Power System Planning in Western Region.

Sir,

The supplementary agenda notes for the 36th meeting of the Standing Committee on Power System Planning in Western Region are available on CEA website (www.cea.nic.in at the following link: Home page-Wing Specific Document-Power Systems-Standing Committee on Power System Planning-Western Region).

The venue and the date of the meeting will be intimated in due course.

Yours faithfully,

(K. K Arya)
Chief Engineer (I/C)

Supplementary Agenda Note for 36th Meeting of Standing Committee on Power System Planning in Western Region

1.0 **Evacuation of Renewable Energy generations located in WR and NR to Northern Region states.**

1.1 POWERGRID, based on the envisaged renewable capacity (42 GW) in the 12th Plan period in the 8 nos. Renewable Energy (RE) rich states, has evolved a comprehensive scheme comprising Intra State as well as Inter-state transmission strengthening(s) and other related infrastructure to address challenges associated with large scale renewable integration as a part of its **"Report on Green Energy Corridors"**.

1.2 Subsequently, CEA convened a meeting in May'13 for assessing RES (Renewable Energy Source) capacity additions in the states of Rajasthan, Himachal Pradesh, J&K, Gujarat, Maharashtra, Tamil Nadu, Karnataka & Andhra Pradesh by the end of 12th Plan period. As per the assessment, the quantum of RES generation expected by the end of 12th Plan period is 32 GW and the same is given as under:

(i)	Rajasthan	-	5694 MW
(ii)	Himachal Pradesh	-	1281 MW
(iii)	J&K	-	476 MW
(iv)	Gujarat	-	4729 MW
(v)	Maharashtra	-	4063 MW
(vi)	Andhra Pradesh	-	4827 MW
(vii)	Karnataka	-	4290 MW
(viii)	Tamil Nadu	-	7353 MW

1.3 With above quantum of envisaged Renewable capacity addition, it is expected that some of the RE rich state including Gujarat, Rajasthan may have more RE capacity than the capacity required for fulfilling their Renewable Purchase Obligations (RPO). Further, such RE rich host state may also not absorb RE energy locally particularly during the other than peak hour condition. Inherent characteristics of renewables necessitates requirement of adequate balancing generation reserves to take care of Intermittency/variability. Further, the IEGC stipulates, renewable energy plants to have "MUST RUN" status and shall not be subjected to "merit order dispatch" principles.

1.4 Kutch in Gujarat is one of the renewable rich pocket in the country endowed with Wind and Solar Generation potential. In 12th Plan period, Gujarat has envisaged about 900 MW Wind and 180 MW Solar generation capacity additions alone in Kutch area. In addition, applications for Connectivity of 600 MW wind generation capacity in Kutch complex has also been received by the CTU. Likewise, Rajasthan has also envisaged 5694 MW Renewable capacity addition during 12th Plan period, increasing total RE capacity to about 8100 MW.

1.5 Considering the above, in order to facilitate transfer of RE power from the RE rich potential States to other States as well as absorption of RE power within the RE rich states (host state), transmission system strengthening both at intra state and inter-state level has been identified. Further, the Renewable generations usually have very short gestation period viz. Wind generation projects (12-16 months) & Solar Generation projects (9-12 months) as compared to development of transmission infrastructure (30-36 months). Therefore, in view of the concentration of renewable potential in some of such locations and short gestation period, RE pooling station in such complexes have been considered which shall encourage development of renewable generation.

1.6 The intra-state transmission system identified for RES generations in **GUJARAT**:

Part A:

Sr.No.	Name of Trasmission Element
(a) 220 kV Transmission lines:	
1	220KV D/C Amreli-Jasdan line
2	220KV D/C Radhanpur-Sankhari line
3	220KV D/C Varsana-Bhachau-Deodar line
4	220KV D/C Shapar-Jasdan line
5	LILO 220KV D/C Jamnvada-Varsana at 220KV Bhachunda line
6	220KV D/C Bhachunda-Nakhatrana line
7	220KV Dhama (New proposed substation) line 220KV D/C Dhrangadhra- Dhama line
	220KV D/C Dhama-Becharaji line
8	220KV D/C Bhatia - Bhogat line
9	220KV D/C Bhogat - Ranavav line
10	220KV D/C Varsana - Charanka line
11	220KV D/C Halvad - Charadva
(b) 220 kV Sub-Stations:	
1	220KV Jasdan Substation, 220/132KV (2X100MVA), 220/66KV (2X100MVA), 4 nos of 220KV & 6 nos of 66KV Feeder bays.
2	220KV Charadva Substation (instead of earlier proposed Tankara substation), 220/66KV(2X100MVA), 2 nos of 220KV bays
3	220KV Bhachunda Substation, 220/66KV (2X100MVA), 6 nos of 220KV & 6 no of 66KV bays.
4	220KV Dhama (New proposed Substation), 220/66KV (3x100MVA), 4 nos of 220KV & 6 no of 66KV bays.
(c) Transmission lines feeder bays	

1	220KV Feeder Bays 2 nos at Amreli, 2 nos at Shapar, 2 nos at Radhanpur, 2 nos at Sankhari, 2 nos at Varsana, 4 nos at Bhachau, 2 nos at Deodar, 2 nos at Nakhatrana, 2 nos at Charanka, 2 nos at Bhatia, 2 nos at Ranava, 4 nos at Bhogat, 2 nos at Dhrangdhara, 2 nos at Bechraji, 2 nos at Halvad.

Additional Proposals:

Part – B:

Sr.No.	Name of Transmission Elements
1	220 KV D/C Vadavi – Chhatral line (Al-59)
2	220 KV D/C Chorania – Salejada line (Al-59)
3	220 KV D/C Botad - Chorania line (Al-59)*
4	220 KV D/C Amreli – Vallabhipur(Al-59)
5	220 KV D/C Dhrangadhra – Chharodi (proposed S/S) line(Al-59)
6	220 KV D/C Vataman (PG) – Jasdan (proposed S/S) line (Al-59)
7	220 KV, 1 x 50 / 1 x 25 MVAR Bus Reactors each at 220 KV Moti Paneli, Bhatia, Nakhatrana, Bhachau, Deodar substations
8	220kV (Line +Reactor + Transformer) Bays

Note(*) – Instead of 220 KV D/C Sarla – Chorania line, it is proposed to have 220 KV D/C Botad - Chorania line, because of 300 MW Wind Farm project is approved to be connected at 220 KV Botad substation. Further, strong 220 KV source is made to be available at 220 KV Sarla substation from 400 KV Halvad & 400 KV Shapar.

Part – C:

400 kV Transmission lines & associated feeder bays:	
Sr. No.	Name of Transmission Element
1	400KV D/C Varsana-Halvad line
2	400KV D/C Hadala - Shapar line
3	400KV D/C Shapar- Pachham (Fedra) line
4	400KV Feeder Bays 2 nos at Varsana, 2 nos at Halvad, 2 nos at Hadala, 4 nos at Shapar, 2 nos at Pachham (Fedra)

Part – D:

Sr. No.	Name of Transmission Element	Quantum
1	400 KV Bhachunda substation (GIS) along with 400/220 KV, 3 x 315 MVA ICTs, 4 Nos. of 400 KV line bays & 125 MVAR Bus reactor (220/66 KV Bhachunda is already considered).	3 x 315 MVA
2	400 KV D/C Bhachunda – Varsana line.	140 RKM
3	400 KV D/C Bhachunda – Bhuj Pool (proposed PG s/s) line.	100 RKM
4	2 Nos. of 400 KV line bays each at Varsana & Bhuj Pool (PG) substations.	4 Nos.

1.7 The intra-state transmission system identified for RES generations in **MAHARASTRA:**

Part – A: Schemes finalized but not yet implemented for ongoing RE generation projects

Sr. No.	Name of line proposed for strengthening	District
1	132 kV Jath (Old) - Jath (New) D/C (2013-14)	Sangli
2	2nd ckt. stringing of 132 kV Satara Road - Satara MIDC SCDC (2013-14)	Satara
3	2nd ckt. stringing of 132 kV Aundh - Dahiwadi SCDC (2016-17)	Satara
4	220 kV Miraj - Ichalkaranji (Tilawani) S/C at 220 kV Sangli S/s. (2016-17)	Sangli
5	110 kV D/C line from 220 kV Miraj - Jaysingpur (2013-14)	Sangli/ Kolhapur
6	132 kV Satara MIDC - Aundh SCDC (2014-15)	Satara
7	132 kV Lonand MIDC - Shirwal SCDC (2014-15)	Satara
8	132 kV Kavthemahankal - Savlaj SCDC (2015-16)	Kolhapur
9	132 kV Kadegaon - Kirloskarwadi SCDC (2013-14)	Sangli
10	132 kV Kavthemahankal - Jath D/C (2015-16)	Sangli
11	LILO on 110 kV Chambukhadi - Kale S/C at 110 kV Bambavde S/s. (2016-17)	Kolhapur
12	220 kV Vita - Kadegaon SCDC (2016-17)	Sangli
13	LILO of 110 kV Oglewadi - Mayni S/C at 220/132-110 kV Kadegaon S/s. (2014-15)	Sangli
14	132 kV SCDC line from Patoda to Manjarsumba S/s. (2015-16)	Beed

15	2nd ckt. stringing of 132 kV Georai - Beed SCDC (2014-15)	Beed
16	2nd ckt. Stringing of 132 kV Babhaleshwar - Sangamner SCDC (2016-17)	Ahmednagar
17	2nd ckt. stringing of 132 kV Ahmednagar - Supa SCDC (2014-15)	Ahmednagar
18	2nd ckt. stringing of 132 kV Shevgaon - Bhenda D/C (2015-16)	Ahmednagar
19	2nd ckt. stringing of 132 kV Shevgaon - Pathardi D/C (2015-16)	Ahmednagar
20	132 kV Ahmednagar - Ahmednagar MIDC SCDC (2015-16)	Ahmednagar
21	2nd ckt. stringing of 132 kV Babhaleshwar - Ahmednagar MIDC SCDC (2016-17)	Ahmednagar
22	2nd ckt. stringing of 220 kV Gangapur - Valve - Jamde D/C (2015-16)	Nandurbar
23	Reconductoring of 100 kV Talegaon - Khopoli S/C (2016-17)	Pune
24	132 kV Sangola - Manegaon SCDC (2014-15)	Solapur
25	132 kV Daund - Shrigonda SCDC (2016-17)	Pune

Part – B: Proposed transmission strengthening within state for conveyance to ISTS for the ongoing RE generation projects.

Sr. No.	Particulars of Strengthening	Remarks
1	220 kV Valve - Dhule D/C line.	At 220 kV Jamde, Valve & Gangapur S/s. total installed capacity of wind generation is around 700 MW. In addition, application for 200 MW is in progress. Also, the work of MSPGCL's 150 MW solar proejct at Sakri (Shivajinagar) is in progress. For evacuation of the same, STU has planned 220 kV Sakri - Dhule D/C lne with high amphacity conductor.
2	220 kV Dondaicha - Dhule D/C line	
3	220 kV Ahmednagar - Bhenda D/C (Instead of M/s. Vish Wind S/s. - Bhenda D/C)	At 220 kV Ahmednagar, grid connectivity for 400 MW projects has been issued out of which the work for 250 MW is in progress. For balance 150 Mw, land acquisition is in progress. At 220 kV Ahmednagar, there is no space. Also, it is not possible to lay 220 kV line near Ahmednagar S/s. However, the work of 200 MW Wind project of M/s. VishWind is in progress. This project is being connected by making LILO on 1 ckt. of 220 kV Ahmednagar - Babhaleshwar D/C line.

		Hence, for this proposed line, Wind Farm S/s. of M/s. Vish Wind can be considered instead of Ahmednagar S/s.
4	220 kV Satara MIDC - Lonand D/C with High Ampacity Conductor	Considering the potential in this area, this line can be considered.
5	LILO of 220 kV Karad-III (Shalgaon) - Karad-II and 220 kV Karad-I - Karad-II at Malharpeth	400/220 kV Karad-III (Shalgaon) has been cancelled. LILO of 220 kV Karad-I - Karad-II at 220 kV Malharpeth S/s. can be considered.
6	132 kV Panchpatta - Nashik D/C	Considering the Wind project developments in Ahmednagar district this line is required.
7	220 kV Sakri - Dhule D/C using High Ampacity Conductor	
8	Additional 1 x 200 MVA, 220/132 kV ICT each at 220 kV Bhenda & 220 kV Peth S/s.	
9	1 x 50 MVAR and 1 x 25 MVAR Bus reactors at 220 kV Dondaicha & 220 kV Dhule S/s. resp.	

Part – C: Schemes finalized but not yet implemented for the proposed RE generation projects:

Sr. No.	Name of line proposed for strengthening	District
1	LILO of 110 kV Vishrambag - Ashta S/C line at 220 kV Sangli S/s. (2015-16)	Sangli
2	132 kV 5 Star MIDC - Shiradwad D/C (2015-16)	Sangli
3	LILO of 132 kV Dahiwadi - Aundh S/C line at 132 kV Mhaswad S/s. (2015-16)	Satara
4	220 kV 5 Star MIDC - Hamidwada D/C (2013-14)	Kolhapur
5	132 kV S/C line from 220 kV Ichalkaranji (Tilawani) - Kurundwad (2015-16)	Kolhapur
6	2nd ckt. stringing of 132 kV Kale (T) - Warna SCDC (2016-17)	Satara
7	132 kV Oglewadi - Kale (T) D/C (2016-17)	Kolhapur
8	132 kV Ichalkaranji (Tilawani) - Jaysingpur SCDC (2016-17)	Kolhapur
9	2nd ckt. stringing of 220 kV Miraj - Ichalkaranji (Tilawani) SCDC (2013-14)	Kolhapur

10	LILO of 132 kV Lonand - Phaltan S/C at Phaltan MIDC (2014-15)	Satara
11	132 kV D/C line from 220 kV Sawantwadi - Kudal (2015-16)	Sindhudurg
12	132 kV Pimpalgaon - Ranwad SCDC (2015-16)	Nashik
13	LILO on 132 kV Ozar - Kalwan S/C at 220/132 kV Pimpalgaon S/s. (2014-15)	Nashik
14	LILO on 132 kV Kalwan - Satana SCDC at 220/132 kV Kalwan-II S/s. (2012-13)	Nashik
15	132 kV SCDC from 220 kV Sinnar-II - Sinnar (Malegaon)MIDC (2014-15)	Nashik
16	2nd ckt. stringing of 132 kV Manmad - Yeola SCDC (2014-15)	Nashik
17	LILO on 132 kV Paithan - Georai S/C at 220 kV Pachod S/s. (2016-17)	Aurangabad
18	132 kV Ahmedpur - Chakur SCDC (2013-14)	Latur
19	LILO of 132 kV Sawangi - Pishor at 220 kV Phulambri S/s. (2016-17)	Aurangabad
20	LILO of 132 kV Padegaon - Sillod S/C at 220 kV Phulambri S/s. (2016-17)	Aurangabad
21	132 kV Kharda - Ashti D/C parly on M/C (2016-17)	Beed
22	132 kV Supa - Wadzire D/C (2013-14)	Ahmednagar
23	2nd ckt. stringing of 132 kV Shevgaon - Ghodegaon SCDC (2015-16)	Ahmednagar
24	2nd ckt. stringing of 132 kV Nandurbar - Visarwadi D/C (2015-16)	Nandurbar
25	132 kV Shirpur - Dondaicha SCDC (2013-14)	Nashik
26	2nd ckt. stringing of 132 kV Nampur - Malegaon SCDC (2015-16)	Nashik
27	2nd ckt. stringing of 132 kV Jeur - Karjat SCDC (2013-14)	Solapur
28	220 kV Phaltan (MIDC) - Walchandnagar D/C (2013-14)	Pune
29	132 kV Phaltan - Walchandnagar SCDC (2014-15)	Pune

Part – D: Transmission system strengthening within state for conveyance to ISTS for the proposed RE generation projects.

Sr. No.	Particulars of Strengthening
1	220 kV Bhalawani - Malinagar D/C. (Line is not possible due to lack of space at 220 kV Malinagar S/s. However, (1) 220 kV Bhalawani - Solapur (PG) D/C, (2) LILO on 220 kV Vita - Pandharpur S/C at Bhalawani and (3) LILO on 220 kV Pandharpur - Malinagar at Bhalawani S/s. needs to be considered instead of 220 kV Bhalawani - Malinagar D/C)

2	220 kV Chinchwad - Chakan D/C
3	220 kV Chinchwad - Urse D/C
4	LILO of 220 kV Chinchwad - Theur at Parvati S/s.
5	LILO of 220 kV Kharepatan - Pawas line Oni S/s.
6	132 kV Nandurbar - Dondaicha line
7	132 kV Dindori - Ozar D/C.
8	LILO of 220 kV Kandalgaon - Lonand S/C at proposed 400/220 kV Kesurdi S/s.(2016-17)
9	LILO of 220 kV Jejuri - Lonand S/C at 220 kV Lonand MIDC S/s. (2016-17)
10	LILO of one ckt. of 220 kV Dhule - Malegaon D/C at 220 kV Sayne S/s. (2012-13)
11	220 kV Malegaon - Kalwan-II D/C (2013-14)
12	220 kV Chakan - Lonikand-II D/C (2015-16)
13	Additional 1 x 200 MVA, 220/132 kV ICT at 220 kV Solapur S/s.
14	1 x 150 MVAR, 420 kV Controlled Bus Reactors (TCR) at 400 kV Alkud S/s.

1.8 In order to identify transmission requirement for transfer of RE power from the RE rich potential States to other States, studies have been carried out for the 2016-17 time frame considering 18th EPS demand for Seasonal Light Load condition (Monsoon off peak) in which renewable is maximized. In such scenario, maximized renewable dispatch scenarios (Wind-70%, Solar-80%) have been considered in other than the peak demand hours (80% of EPS peak demand for WR/SR/ER) for studies. As per the analysis of historical trends of NR demand during monsoon season, demand of Northern region is considered as 95% of the peak demand as the region has a typical flat load profile over the day during the monsoon periods when renewable is maximized. In this scenario, special area despatch i.e. full despatch from Kutch complex generations viz. Mundra UMPP (4150 MW) as well as Adani Mundra (4620 MW) is considered.

1.9 In view of the envisaged RE capacity addition in Kutch complex in Gujarat and existing/planned capacities of conventional generation, it is proposed that a 765/400kV pooling station near Bhuj may be established. Bhuj pool substation may be interconnected to a pooling station in northern part of Gujarat viz. Banaskantha/Sankhari at 765kV level an upcoming Solar generation hub. This substation is also proposed to be anchored with existing 400kV Sankhari (GETCO) substation, a major Solar Pooling hub. Considering the requirement of onward dispersal of power outside Gujarat to other states, a High capacity transmission corridor is being proposed right from the Gujarat (WR) to Punjab in NR via Rajasthan. Between Bhuj pool and Ajmer the following system has been considered :

Rajasthan (Northern Region)

(i) Chittorgarh – Ajmer(New) 765kV D/c
(ii) Ajmer (New)- Ajmer (RVPN) 400kV D/c (Quad)
(iii) Chittorgarh (New)- Chittorgarh (RVPN) 400kV D/c (Quad)
(iv) Establishment of 2x1500 MVA, 765/400kV S/s at Chittorgarh
(v) Establishment of 2x1500 MVA, 765/400kV S/s at Ajmer (New)
(vi) Associated reactive compensation (Bus reactors & Line reactors) at Ajmer and Chittorgarh.

Gujarat (Western Region)

(i) Bhuj Pool – Banaskanta/Sankhari 765kV D/c
(ii) Banaskanta/Sankhari – Chittorgarh 765kV D/c
(iii) Banaskanta – Sankhari 400kV D/c
(iv) Establishment of 2x1500 MVA, 765/400kV S/s at Bhuj Pool
(v) Establishment of 2x1500 MVA, 765/400kV S/s at Banaskanta.
(vi) Associated reactive compensation (Bus reactors & Line reactors)

1.10 Result of simulation studies as (enclosed as **Annexure-I**) are as follows :

- Base Case: From the studies in base case scenario, it is observed that loading on the proposed system is as follows. Result of simulation is plotted in **Exhibit-Base** :

765 kV Banaskanta – Chittorgarh line	: 711 MW/Ckt
765 kV Chittorgarh-Ajmer line	: 566 MW/Ckt
Transformer drop at Ajmer	: 1129 MW

- Under outage of one circuit of Bhadla-Bikaner 400kV the other circuit gets loaded to 937MW. Simulation result shown in Exhibit**-Base-01**. Load flow studies with n-1-1 criteria outage of Bhadla-Bikaner 400kV D/c has also been considered, **Exhibit-Base-02**. Studies indicate that Jodhpur-Merta gets loaded to 848MW/ckt and Bhadla-Merta gets loaded to 808MW/ckt.

1.11 Out the capacity addition of 5694 MW in Rajasthan, about 2000 MW is envisaged near Bhadla (distt. Jodhpur), Jaisalmer belt etc in 12th plan period. With already existing generation and low power demand in the area there is a need for strengthening to transfer power out of the area. RRECL has also informed about development of a solar park near Bhadla of about 2000 MW additional capacity in future. Therefore, establishment of **765/400kV substation at Bhadla with Bhadla-Ajmer 765kV D/c and 400kV interconnection to Bhadla and Pokhran(new-RVPN)** has been considered.

- Simulation results with proposed system are enclosed .In **Exhibit-Case1,** it is seen that with this, total injection at Ajmer is about 1615MW.

- To study the effect of contingency, outage of Ajmer-Jaipur 400kV D/c has been considered, **Exhibit-Case1-01**. It is seen that with reduced outlet the injection as Ajmer reduces to about 1280MW. With the outage of Ajmer-

Jaipur 400kV D/c the line, about 500MW of power from Ajmer is found to be wheeling all the way to Deedwana from where it flows toward Jaipur.

1.12 With above proposed interconnections, 765kV Ajmer, a major power pooling point, shall aggregate power from WR/Gujarat through Banaskantha / Chittorgarh as well as Bhadla(Jodhpur) in Rajasthan. The power injected at Ajmer is getting stepped down to 400kV and are evacuated to Jaipur over 400kV lines. At Jaipur, the power is stepped up at 765kV for evacuation out of Rajasthan. Considering this, there is a need for providing a low impedance corridor for evacuation of power beyond Ajmer, for onward dispersal of above power outside Rajasthan. In view of the above, for onward dispersal of power outside Rajasthan, a 765kV High capacity transmission corridor is proposed towards Moga in Punjab, a major load centre in NR, via Suratgarh pooling station in Rajasthan over 765kV network. Moga is also connected to Kishenpur in J&K, which is large hydro pocket in Jammu & Kashmir. In this manner, this shall facilitate integration of Renewable with hydro complex, enabling supply side balancing through Hydro resources.

- Accordingly load flow studies with proposed **Ajmer-Suratgarh-Moga 765kV transmission corridor** have been considered. The result of simulation studies with this corridor is plotted in **Exhibit-Case2.** It is seen that with the provision of the corridor power available at Ajmer is about 2400MW.
- To study the effect of contingency outage of Bhadla-Bikaner 400kV D/c and Ajmer-Jaipur 400kV D/c has been considered. Result of simulation study is plotted in **Exhibit-Case-2-01 & Case-2-02** respectively. It is seen that with the proposed strengthening, all line loadings are within limits.

1.13 The inter-state transmission system in NR and WR identified with Renewable energy is as given under:

Gujarat (Western Region)

(i) Bhuj Pool – Banaskanta 765kV D/c
(ii) Banaskanta – Chittorgarh 765kV D/c
(iii) Banaskanta – Sankhari 400kV D/c
(iv) Establishment of 2x1500 MVA, 765/400kV S/s at Bhuj Pool
(v) Establishment of 2x1500 MVA, 765/400kV S/s at Banaskanta
(vi) Associated reactive compensation (Bus reactors & Line reactors)

Rajasthan (Northern region)

(i) Chittorgarh – Ajmer(New) 765kV D/c
(ii) Ajmer(New) - Suratgarh(New) 765kV D/c
(iii) Suratgarh(New)-Moga(PG) 765kV D/c
(iv) Bhadla(New)- Ajmer(New) 765kV D/c
(v) Chittorgarh (New)- Chittorgarh (RVPN) 400kV D/c (Quad)
(vi) Ajmer (New)- Ajmer (RVPN) 400kV D/c (Quad)
(vii) Suratgarh (New)- Suratgarh (existing) 400kV D/c (Quad)
(viii) Bhadla (New)- Bhadla (RVPN) 400kV D/c (Quad)
(ix) Bhadla (New)- Pokaran (new-RVPN) 400kV D/c (Quad)
(x) Establishment of 2x1500 MVA, 765/400kV S/s at Chittorgarh
(xi) Establishment of 2x1500 MVA, 765/400kV S/s at Ajmer (New)

(xii) Establishment of 2x1500 MVA, 765/400kV S/s at Bhadla (new)
(xiii) Establishment of 2x1500 MVA, 765/400kV S/s at Suratgarh (New)
(xiv) Associated reactive compensation (Bus reactors & Line reactors).

1.14 In case of delay in implementation of ISTS system as RE corridor, the following elements of ISTS Strengthening scheme identified above are proposed to be implemented with connectivity applications in Bhuj area and strengthening of evacuation system from conventional generation projects Mundra UMPP and Adani Mundra):

(i) Bhuj Pool – Banaskanta 765kV D/c
(ii) Banaskanta – Chittorgarh 765kV D/c
(iii) Chittorgarh – Ajmer(New) 765kV D/c
(iv) Banaskanta – Sankhari 400kV D/c
(v) Ajmer (New)- Ajmer (RVPN) 400kV D/c (Quad)
(vi) Chittorgarh (New)- Chittorgarh (RVPN) 400kV D/c (Quad)
(vii) Establishment of 2x1500 MVA, 765/400kV S/s at Bhuj Pool
(viii) Establishment of 2x1500 MVA, 765/400kV S/s at Banaskanta
(ix) Establishment of 2x1500 MVA, 765/400kV S/s at Chittorgarh
(x) Establishment of 2x1500 MVA, 765/400kV S/s at Ajmer (New)
(xi) Associated reactive compensation (Bus reactors & Line reactors)

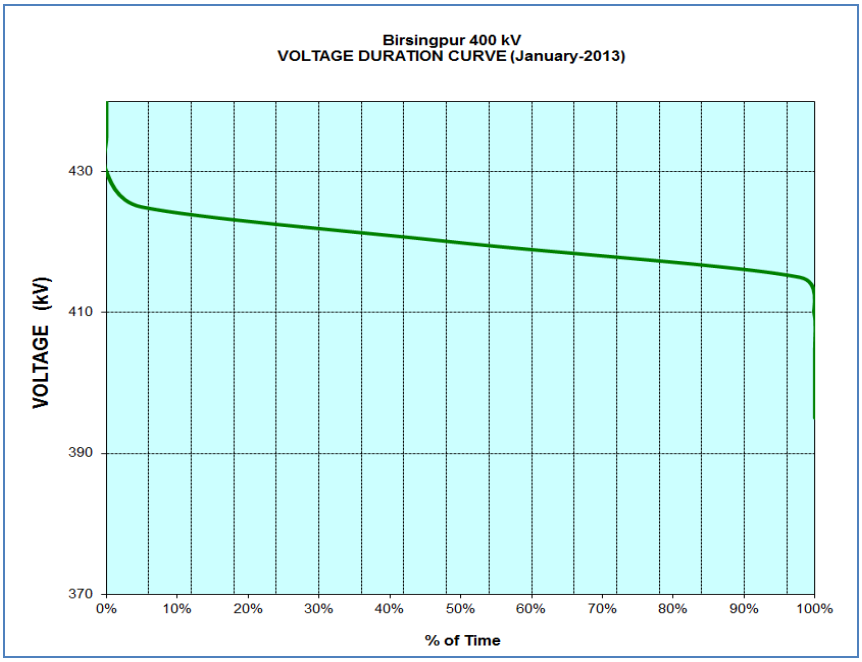
1.15 Members may deliberate.

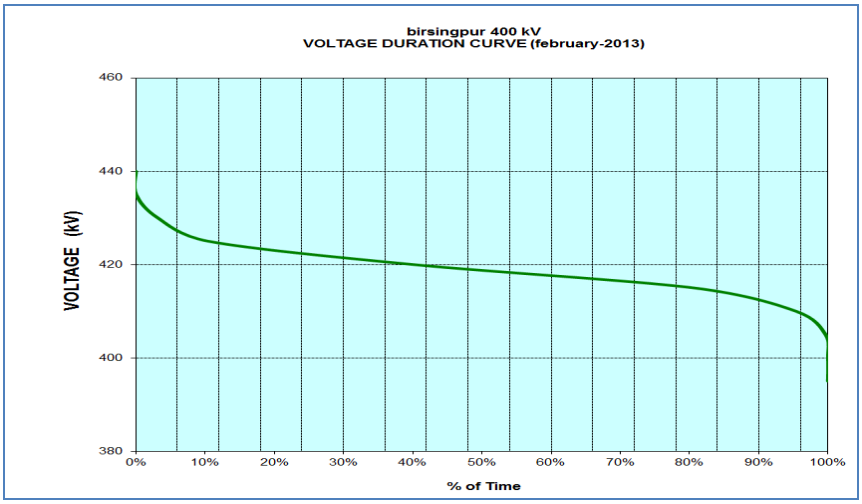
2.0 Installation of 125 MVAR Bus reactor at Birsinghpur TPS switchyard by MPPGCL- Agenda proposed by MPPTCL

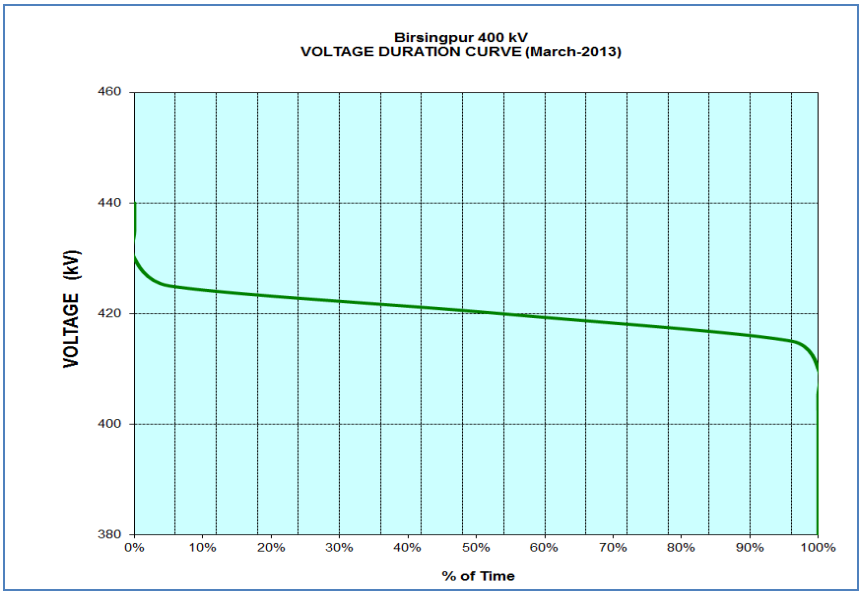
2.1 MPPTCL vide their letter dated 18.06.2013 has intimated that voltage at 400 kV substation of Birsinghpur TPS remains high above 425 kV most of the time. The outage of 500 MW unit at Birsinghpur TPS results in voltage above 430 kV. To control the voltage at Birsinghppur 400 kV substation the Birsinghpur – Katni 400 kV D/C line and Birsinghpur – Damoh 400 kV S/C line is required to be kept out of service. Even one circuit of Birsinghpur – Damoh 400 kV D/C line also has to be kept out of service on various occasions to control overvoltage, consequently endangering grid security.

2.2 To control overvoltage at Birsinghpur, MPPTCL has proposed installation of one 125 MVAR bus reactor at Birsinghpur TPS switchyard by MPPGCL.

2.3 The overvoltage issue at Birsinghpur has also been reported by NLDC in their operational feedback. The voltage duration curve for January 2013 to March 2013 taken from NLDC report is shown below:


Birsingpur 400 kV
VOLTAGE DURATION CURVE (January-2013)
VOLTAGE (kV)
430
410
390
370
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Time


birsingpur 400 kV
VOLTAGE DURATION CURVE (february-2013)
VOLTAGE (kV)
460
440
420
400
380
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Time


Birsingpur 400 kV
VOLTAGE DURATION CURVE (March-2013)
VOLTAGE (kV)
460
440
420
400
380
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Time

2.4 The results of the study furnished by MPPTCL is given below:

Study '13/ Bus Rector Provision at Birsinghpur									
				Case 1 :Bisringhpur 500 MW Unit out of service		Case 2 : Birsinghpur 500 MW Unit in service		Case 3: Case 2 + Bus Reactor of 125 MVAr At Birsinghpur	
Voltage level	From	To	Circuit ID	MW	MVAr	MW	MVAr	MW	MVAr
399	Birsinghpur	Vandana	1	-352	156	-260	108	-255	73
400	Birsinghpur	Balco	1	-336	138	-253	94	-249	63
400	Birsinghpur	Damoh	1	241	-103	294	-98	292	-106
400	Birsinghpur	Damoh	2	241	-103	294	-98	292	-106
400	Birsinghpur (LR)	Katni	1	226	-108	279	-104	276	-113
400	Birsinghpur	Katni	2	226	-108	279	-104	276	-113
Generation									
Balco Generation				324	-102	324	-102	324	-102
Birsinghpur Generation				720	-208	1180	-308	1180	-308
Vandana Generation				135	-67	135	-67	135	-67
Korba Generation				2407	-490	2407	-490	2407	-490
Voltage (kV)									
Birsinghpur				426		422		416	
Damoh				430		425		421	
Balco				407		407		407	
Vandana				407		407		407	
Katni				431		425		420	
MP Demand	5060								

2.5 Members may concur the proposal of MPPTCL.

3.0 **Evacuation of Power from Adani Mundra Generation Project**

3.1 M/s Adani Power Limited (APL) has established a 4620MW generation project at Mundra in Kutch dist. Gujarat. From their generation project, M/s Adani Power has tied up 3966 MW of power under long term, the details of which are as given below:

- Gujarat : 2000MW
- Maharashtra : 200 MW
- Haryana : 1424 MW
- LTOA : 342 MW (With Punjab and Rajasthan (NR) as target beneficiaries without Long Term PPA)

3.2 For transfer of power to Haryana, M/s Adani Power Limited has set up Mundra – Mohindergarh ± 500kV HVDC 2500MW Bi-pole, Mohindergarh - Dhanonda 400kV (Quad) D/c and Mohindergarh – Bhiwani (PG) – 400kV D/c line as dedicated transmission system. Further M/s Adani Power Ltd applied for LTOA for 342 MW beyond Mohindergarh considering that 342 MW power is available at Mohindergarh HVDC terminal. LTOA for 342 MW was given beyond Bhiwani for which Mohindergarh – Bhiwani 400 kV D/c line was implemented by M/s Adani Power as dedicated line. Accordingly LTOA of 342 MW is still operational beyond Bhiwani.

3.3 After the commissioning of HVDC bipole, the issue of transfer of power through HVDC bipole was discussed at length among CEA, CTU and POSOCO. Keeping in view that Adani Mundra generation bus is connected to the HVDC terminal as well as to AC system and outage of a pole/bipole has impact on the power flow on AC

system as well as on inter-regional system, it was decided that power flow on Adani Mundra – Mohindergarh HVDC bipole line shall be maintained at 1500 MW considering the grid security in view.

3.4 While granting the Long Term Open Access for 342 MW to M/s Adani Power Limited for Northern Region, it was indicated by M/s Adani Power that power would be available at Mohindergarh and accordingly system strengthening was finalized beyond Mohindergarh.

3.5 For transfer of power to Haryana, M/s Adani Power implemented 2500 MW HVDC bipole line as dedicated line. Since CEA's Planning Criteria envisaged N-1 criteria, the transmission scheme developed by Adani Power need to take into account one pole outage. Accordingly with this criterion only 1250 MW power can flow under N-1 condition. Keeping this aspect in view it was stated during the 10th TCC & 11th NRPC meetings held on 05/01/2009 & 06/01/2009 that in the event of outage of HVDC pole M/s Adani Power would require to have run back system from their project to maintain loading on other lines within safe limit. In addition DISCOMs of Haryana would need to plan and implement load shedding scheme in the event of outage of pole/bipole.

3.6 The 342 MW, Long Term Access is in operation beyond Bhiwani according to the LTOA intimation and application. But for bringing power to Mohindergarh, security criteria (CEA's Planning Criteria) need to be considered. This means that under one pole outage / under normal conditions for power transfer upto Mohindergarh, parallel AC system in WR, NR and inter-regional system between NR & WR shall be utilized for transfer of power. Now, M/s Adani Power has applied for Long Term Access at their generation switchyard, so that the adequacy of parallel AC system is ascertained and suitable strengthening is planned for transferring power to NR. As per the LTA application, point for LTA is Adani Generation bus. At present Adani generation bus is not an ISTS bus, accordingly LTA is being processed considering usage of ISTS system beyond dedicated system of Adani / STU system and LTA is proposed to be granted for usage of ISTS system of Western Region, Northern Region and Inter-regional system. While processing the LTA application system adequacy of dedicated system as well of STU system in the vicinity has been analysed.

3.7 The system studies have been carried out considering two different scenarios (enclosed as **Annexure-II**)

- **Scenario 1** : Present Scenario
- **Scenario 2** : Scenario after commissioning of Adani Mundra – Zerda 400 kV D/c line.

In all the above studies full dispatch has been considered from Adani generation including 342 MW dispatch to Northern Region. The details of the studies are discussed below:

Scenario 1

This study is for present scenario. The base case load flow study results are enclosed at **Exhibit-VII.** From the base case it may be observed that the loading on Mundra – Sami is 595 MW per ckt, Gwalior – Agra is 981 per ckt etc. In general loading is within limits in base case.

Thereafter different contingencies have been studied:

a) Contingency of outage of one ckt of Gwalior – Agra 765 kV S/c line **(Enclosed at Exhibit-VII-01)**
b) Contingency of outage of one ckt of Mundra – Sami 400 kV S/c line **(Enclosed at Exhibit-VII-02)**

From the above study results it may be seen that under the outage of one ckt of Mundra – Sami 400 kV S/c line, the remaining line gets loaded to 919 MW, which is critical.

From the above it may be seen that full power from Adani Mundra generation including 342 MW of LTA to NR cannot be evacuated.

Scenario 2:

This study has been carried out with 1500 MW power transfer through HVDC bipole and full generation. In this case additional 400 kV D/c line from Adani Mundra generation bus to Zerda has been considered. As per the preliminary information gathered from GETCO (same to be confirmed from GETCO), Adani Mundra generation bus to Zerda 400 kV D/c line would be commissioned during last quarter of 2013-14.

The base case load flow study results are enclosed at **Exhibit-VIII.** From the base case it may be observed that the loading on Mundra – Sami is 400 MW per ckt and Gwalior – Agra is 965 per ckt. In general loading is within limits in base case. Subsequently following contingencies have been studied:

a) Contingency of outage of one ckt of Gwalior – Agra 765 kV S/c line **(Enclosed at Exhibit-VIII-01)**
b) Contingency of outage of one ckt of Mundra – Sami 400 kV S/c line **(Enclosed at Exhibit-VIII-02)**
c) Contingency of outage of one pole and outage of one ckt of Mundra – Sami 400 kV S/c line **(Enclosed at Exhibit-VIII-03)**

From the above study results, no problem is envisaged in transfer of 342 MW to Northern region and the system can meet the security criteria as prescribed in Manual on Transmission Planning Criteria of January 2013. As per the studies carried out, no problem is envisaged in meeting the N-1-1 criteria as detailed in Planning Criteria.

Keeping above in view it is proposed that LTA of 342 MW to Northern region from Adani Mundra generation can become effective after the completion of Mundra – Zerda 400 kV D/c line. This LTA request may be treated as change in LTA from Bhiwani to Adani Mundra generation bus of already granted LTA of 342 MW subject

to that all other terms and conditions remaining the same. Till that time the LTOA for 342 MW shall remain applicable beyond Mohindergarh / Bhiwani.

3.8 In long term perspective, an additional line from Adani Mundra generation bus to Banaskanta / Bhuj pooling station needs to be considered and integrated with the high capacity corridor being planned with RE generation projects in Rajasthan and Gujarat.

3.9 Members may deliberate.

4.0 Response to POSOCO report on Operational Feedback on Transmission Constraints

4.1 POSOCO in its report on 'Operational Feedback on Transmission Constraints - April 2013' has listed transmission lines and ICTs which are experiencing constraints due to overloading and also the nodes experiencing high voltage. The report is available on POSOCO website (posoco.in >document>operational-feedback).

4.2 The constraints mentioned in the report are:

Transmission lines constraints on Kawas-Ichapore 220 kV line, Sugen – Vapi 400 kV S/C line, Parli – Lonikhand 400 kV D/C line and the 400 kV D/C lines emanating from Mundra UMPP.

ICT constraint on 3X315, 400/220 kV ICT at Vapi.

Nodes experiencing high voltages Raipur, Raigarh, Birsinghpur, Khandwa, Damoh, Bhopal, Nagda, Rajgarh, Bhadrawati, Wardha, Dhule, Kolhapur, Bhusawal, Akola, Solapur, Mapusa, Bhilai, Lonikhand, Parli.

Installation of 27 nos. of bus reactors at various locations in WR has been agreed in the 33rd and 34th SCM of WR and are under various stages of implementation. In DNH, Kala 400/220 kV substation has already been planned which would relieve the loading of Vapi ICTs. For Kawas- Ichapore overloading, the LILO of one circuit of Kawas- Vav at Ichapore may be implemented as decided in the 34th SCM of WR. To avoid overloading of Sugen-Vapi 400 kV S/C line, addition interconnection with Vapi has already been planned. Regarding Mundra UMPP, additional strengthening has been proposed in the agenda.

4.3 POSOCO may present the critical lines /corridors which require:

(i) the planned system to be implemented on priority

(ii) additional system to be planned.

4.4 Members may discuss.

5.0 Additional evacuation line from Vindhyachal-IV & V STPP (3x500 MW)

5.1 The immediate evacuation of Vindhyachal-IV & V STPP (VSTPP) consists of Vindhyachal-IV generation switchyard-Vindhyachal Pool 400 kV D/c (quad) line. NTPC vide their letter no. CC:PEE:2260:270/2 dated 10.07.2013 have requested to provide additional outlet from Vindhyachal-IV generation switchyard in order to increase the reliability of the power evacuation system for VSTPP-IV & V project

5.2 In view of the above and to meet the "n-1-1" contingency, following additional transmission system for Vindhyachal-IV & V is proposed:

(i) Vindhyachal-IV & V STPP – Vindhyachal Pool 400 kV D/c (quad) line.

5.3 Members may deliberate and approve.

6.0 **Termination of Vapi – Navi Mumbai 400kV D/c line at upcoming Kudus substation of MSETCL.**

6.1 In the meeting of 35th Standing Committee meeting on Power System Planning for Western Region held on 3rd January, 2013 at Gurgaon, it was agreed to terminate Vapi – Navi Mumbai 400 kV D/c line at upcoming Kudus substation of MSETCL in view of severe RoW problem. It was desired that POWERGRID will continue their effort for completing the balance portion of Vapi-Navi Mumbai 400 kV D/c line.

6.2 MSETCL have informed POWERGRID in May, 2013 that all bays available at Kudus are earmarked for the lines already sanctioned. Therefore to provide bays for termination, MSETCL has proposed that LILO of only one circuit of Tarapur – Padghe 400 kV D/c may be done at Kudus thereby releasing two nos. of 400 kV bays at Kudus and utilizing these bays for terminating Vapi –Navi Mumbai 400 kV D/c line at Kudus. LILO of Tarapur – Phadge 400 kV D/C line at Kudus (MSETCL) 400 kV substation was proposed by MSETCL in the 32nd SCM and the same was agreed by the members with a request to MSETCL to plan outlets beyond kudus towards load centres.

6.3 POWERGRID has informed due to severe Right-of-Way constraint in the portion between Kudus & Navi Mumbai, the line portion between Kudus and Navi Mumbai cannot be constructed. Hence, it is proposed to modify Vapi-Navi Mumbai 400kV D/c line under WRSS-V as Vapi-Kudus 400kV D/c line.

6.4 Members may deliberate.

7.0 **Commissioning of 2x25% FSC of Rajgarh – Karamsad (Kasor) 400 kV D/c line.**

7.1 Western Region Transmission Gujarat Private Limited (WRTGPL), a subsidiary of Reliance Power Transmission Limited is implementing Rajgarh – Kasor 400 kV D/c line which is held up due to forest clearances. POWERGRID was to implement the bay extensions and 2x25% FSC for above line. POWERGRID has already implemented both the bays as well as FSC. FSC is available since September, 2011 but could not be commissioned due to non-availability of Rajgarh – Kasor 400 kV D/c line.

7.2 Rajgarh – Kasor 400 kV D/c line is not likely to be commissioned in near future and since the commissioning of 2x25% FSC is pending since September, 2011 and involves contractual issues, it has been proposed by POWERGRID that the FSC may be tested and commissioned by connecting to some other 400 kV line emanating from Rajgarh 400 kV substation as an interim arrangement. The modalities of the interim arrangement would be presented by POWERGRID in the meeting.

7.3 Members may deliberate.

8.0 **Additional evacuation line from Sasan UMPP (6x660 MW)**

8.1 POSOCO has recently reported multiple outages in the system and suggested reliable evacuation system in planning horizon from major generation complexes. The evacuation of major generation complex Sasan (6x660 MW) has been reviewed in this regard. The immediate evacuation of Sasan UMPP consists of following elements:

(i) Sasan UMPP – Satna 765 kV 2xS/c line
(ii) Sasan UMPP – Vindhyachal Pool 765 kV S/c line
(iii) 2x1000 MVA, 765/400 kV at Sasan UMPP

Looking at the multiple contingency from Sasan complex, constraints shall be faced with outage of Sasan – Satna 765 kV 2xS/c lines and accordingly it is proposed to provide one more outlet from Sasan as Sasan – Vindhyachal Pool 765 kV S/c line.

Load Flow studies in this regard are enclosed **(Annexure-III)**.

Exhibit-III : Base Case with existing system
Exhibit-IIIA : Base case with Sasan – Satna 765 kV 2XS/c line outage

Exhibit-IV : Base Case with system strengthening
Exhibit-IVA : Base case with Sasan – Satna 765 kV 2XS/c line outage

8.2 Members may deliberate.

9.0 **Augmentation of Transformation capacity at Damoh Station.**

9.1 POWERGRID has intimated that loading pattern of 400/220 kV ICTs at Damoh sub-station of POWERGRID during last one year has revealed that loading on all the ICTs operating at this Substation had exceeded 250 MW on several occasions and maximum loading on each ICT at the sub-station had gone up to 282 MW during April, 2013. The ICTs loadings for different months are enclosed at **Annexure-IV**.

9.2 In view of above such increased loading pattern and to meet any eventuality due to failure of anyone of the ICTs at the above sub-station, it is proposed for augmentation of transformation capacity by installing additional 1x500 MVA ICT as tripping of any one of the ICTs may lead to overloading of other ICT and might cause cascaded tripping of remaining ICT in service leading to complete outage.

10.0 Members may deliberate.

11.0 **Reactive Power Management in Western Regional grid**

11.1 During the light load conditions in Western Region, it has been observed that voltages are in the range of 430-435 kV which is at critical limits. POSOCO as operational feedback is also regularly reporting high voltages at many locations in WR. In the recent report of POSOCO Operational Feedback on Transmission Constraints (April, 2013) POSOCO have reported the following nodes experiencing high voltages.

"Raipur, Raigarh, Birsinghpur, Khandwa, Damoh, Bhopal, Nagda, Rajgarh, Bhadrawati, Wardha, Dhule, Kolhapur, Bhusawal, Akola, Solapur, Mapusa, Bhilai, Lonikhand & Parli."

11.2 During the meeting of 33rd & 34th Standing Committee meeting on Power System Planning for Western Region, the issue of overvoltage and requirement of reactive compensation in the grid was deliberated. With the market development, the variation of power flow on transmission corridor is increasing. Thus, for reactive power management in the grid under such unpredictable scenario, it is necessary to provide adequate reactive compensation all over the grid.

Keeping above in view, the following POWERGRID has proposed:

a) 1x125 MVAR, 420 kV Bus Reactor at all the 400 kV substations of WR wherein presently no bus reactors are existing/planned by respective utility

b) 1x330MVAR, 765 kV at all the 765 kV substations of WR wherein presently no bus reactors are existing/planned by respective utility

c) 1x125 MVAR, 420 Bus Reactor in the generation switchyard of all generators by respective utility wherever no bus reactor exists to control the over-voltages in the system.

d) Converting all line reactors at sending end into switchable line reactors (depending on space available)

11.3 Members may deliberate.

12.0 **Additional System Strengthening Scheme for Chhattisgarh IPPs**

12.1 POWERGRID is implementing a composite high capacity corridor planned for Chattisgarh IPPs having 18,000 MW installed capacity. Considering the uncertainty of materialization of these IPPs at the time of planning, the high capacity corridor was planned with minimum redundancy. The immediate evacuation lines form Chattisgarh complex inter-alia consists of following lines:

(i) Champa (Pool) – Kurukshetra $\pm$ 800 kV, 6000 MW HVDC bi-pole
(ii) Raigarh (Kotra) – Pugalur $\pm$ 600 kV, 4000 MW HVDC bi-pole
(iii) Raipur (Pool) – Wardha Pool 765 kV 2xD/c line
(iv) Champa (Pool) – Dharamjaigarh 765 kV S/c line

12.2 POWERGRID has informed that in the Chattisgarh complex progress of about 21,000 MW generation (List enclosed at **Annexure-V**) is encouraging and many of these are already commissioned. Further, few projects have also taken connectivity over this corridor. To provide reliable evacuation of power from this complex, the following transmission system strengthening for Chhattisgarh IPPs is proposed:

(i) Raipur (Pool) – Rajnandgaon 765 kV D/c line
(ii) Rajnandgaon – Warora (Pool) 765 kV D/c line
(iii) LILO of one circuit of Aurangabad – Padghe 765 kV D/c line at Pune *(*in lieu of LILO of one circuit of Kolhapur – Padghe at Pune)

(iv) Establishment of new substation near Rajnandgaon 765/400 kV, 2x1500 MVA substation
(v) LILO of all circuits of Raipur/Bhilai – Bhadrawati 400 kV lines at Rajnandgaon
(vi) Raigarh (Kotra) - Champa (Pool) – Dharamjaigarh 765 kV 2nd S/c line.

Load Flow Studies are enclosed **(Annexure – V)**

Exhibit-I : Base Case without system strengthening
Exhibit-IA : Base Case without system strengthening and with outage Raipur – Wardha 765 kV D/c line
Exhibit-IB : Base Case without system strengthening and Raigarh – Pugalur HVDC bipole outage

Exhibit-II : Base Case with system strengthening
Exhibit-IIA : Base Case with system strengthening and with outage Raipur – Wardha 765 kV D/c line
Exhibit-IIB : Base Case with system strengthening and Raigarh – Pugalur HVDC bipole outage

From the results, it may be observed that the loadings of all 400/765 kV lines are within their limits with system strengthening.

12.3 Members may deliberate and approve.

13.0 **Transmission system for increasing import of power into Southern Region**

13.1 In the meeting of 31st Standing Committee meeting on Power System Planning for Western Region held on 27th December 2010 at Gurgaon, it was agreed to implement Wardha – Hyderabad 765 D/c line (inter-regional line between WR & SR).

13.2 Subsequently in the meeting of 35th Standing Committee meeting on Power System Planning for Southern Region held on 4th January 2013 at Gurgaon, it was decided by SR constituents to anchor planned Hyderabad –Wardha 765kV D/C line at some intermediate station as the length of this line was becoming more than 500 km as per the preliminary survey. The increase in line length is due to line routing, to avoid Hyderabad City limits and Forest stretches. After discussions, it was decided in above meeting of SR that the location and connectivity at 400kV level of the intermediate station would be decided on the basis of joint studies/visit by CTU, APTRANSCO and CEA. During the joint studies of a team comprising of officers

from CTU, CEA and APTRANSCO it was found that Nizamabad could be the perspective location for the intermediate station. POWERGRID and APTRANSCO has identified 3-4 locations around Nizamabad area, and the proposed line lengths of the Wardha – Nizamabad and the Nizamabad - Hyderabad would be approximately 250km.

13.3 Following connectivity for Nizamabad was studied and finalized in joint studies with PGCIL, APTRANSCO, TNEB and KPTCL held in Hyderabad on 28-30 June 2013:

i. Establishment of Nizamabad 765/400kV substation with 2x1500 MVA transformers
ii. Nizamabad – Dichpalli 400kV D/c line
iii. Nizamabad – Yeddumailaram (Shankarapalli) 400kV D/c line
iv. LILO of Nizamabad – Yeddumailaram (Shankarpalli) 400kV D/c line at Narsapur – by APTRANSCO

13.4 In view of the above, Wardha – Hyderabad 765 kV D/c line agreed earlier shall now be Wardha – Nizamabad – Hyderabad 765 kV D/c.

13.5 Members may note.

14.0 **Transmission system associated with New IPP projects in Chattishgarh-Shifting of converter terminal associated with ± 600 kV 4000 MW, Raigarh (Kotra) – Dhule HVDC line from Dhule in Western Region to a suitable location in Southern Region.**

14.1 In the meeting of 35th Standing Committee meeting on Power System Planning for Western Region held on 3rd January 2013 at Gurgaon, it was agreed to terminate the HVDC terminal of Raigarh (Kotra) – Dhule HVDC bi-pole in Southern Region (near Chennai) instead of Dhule.

14.2 Accordingly, CEA, SR constituents & POWERGRID have carried out the joint studies and proposed the following transmission scheme:

(i) Raigarh (Kotra) – Pugalur ± 600 kV, 4000 MW HVDC bipole
(ii) Pugalur HVDC Station – Pugalur Existing 400kV (quad) D/c line
(iii) Pugalur HVDC Station – Arasur 400kV (quad) D/c line
(iv) Pugalur HVDC Station – Thiruvalam 400kV (quad) D/c line
(v) Pugalur HVDC Station – Edayarpalayam – Udumalpet 400kV (quad) D/c line
(vi) Establishment of 400/220kV substation with 2x500 MVA transformers at Edayarpalayam

14.3 Members may kindly note.

15.0 Development of Analytics as part of Unified Real Time Dynamic State Measurement (URTDSM) scheme

15.1 Implementation of Unified Real Time Dynamic State Measurement (URTDSM) scheme as system strengthening was agreed in the Joint meeting of all the five (5) Regional Standing committees on Power System Planning held on 05.03.2012. It consists of installation of Phasor Measurement Unit(PMU) at existing State, ISTS and IPP stations and lines at 400kV and above including that coming up by 2014-15, generation switchyard at 220kV and above, Phasor Data Concentrator(PDC) at all SLDC, RLDC & NLDC along with OPGW communication links.

15.2 In URTDSM, the user interface application software is proposed to visualize and analyze the real time phasor data. It was also decided that following analytics are to be developed in parallel with implementation of the URTDSM scheme in association with premier academic institutions like IIT using PMU based measurement.

- Vulnerability analysis of distance relays
- Linear state estimator
- Supervised Zone-3 distance protection scheme to prevent unwanted tripping of backup distance relays
- CT/CVT calibration
- Line Parameter Estimation
- Control Schemes for improving system security (based on angular, voltage and frequency instability)

Based on the discussion, development of above analytics in association with IIT Bombay progressively in three(3) years has been undertaken which will be installed at all SLDC, RLDC, NLDC, RPC, CEA and CTU.

15.3 Purpose and deliverables for above analytics is given below.

DEVELOPMENT OF ANALYTICAL TOOLS USING PMU BASED PHASOR MEASUREMENTS

S No.	Task	Aim	Deliverables
1.	Line Parameter Estimation	Estimate & Validate transmission line parameter. Inputs required: a) PMU based phasor measurement at both ends of line, bus voltage phasor	• Positive and Zero sequence Line parameter estimation (R,X,B) • Errors in line parameters will be logged for information to operator & correction in linear state estimator parameter.
2.	On line vulnerability analysis of distance	Development of software for validating distance relay characteristic (Zone-1, Zone-2, Zone-3) in real time basis by	• Visualization of relay characteristic and apparent impedance trajectory in the R-X plane. • Alarm / messages when thresholds

S No.	Task	Aim	Deliverables
	relays.	superimposing on field setting of distance relays. Inputs required: b) PMU based phasor measurement at both ends of line, bus voltage phasor c) Distances relay characteristic and settings.	are violated or apparent impedance is some margin (say 20%) from Zone 1, 2 or Zone 3 characteristics of the relay. • Identification of power swing beyond a configurable threshold due to any disturbance in the system • Identification of load encroachment condition in the system • Creation & storage of distance relay characteristics of different lines using templates & available settings • Data available in standard format(CSV, excel, comtrade) • Trigger input for DSA

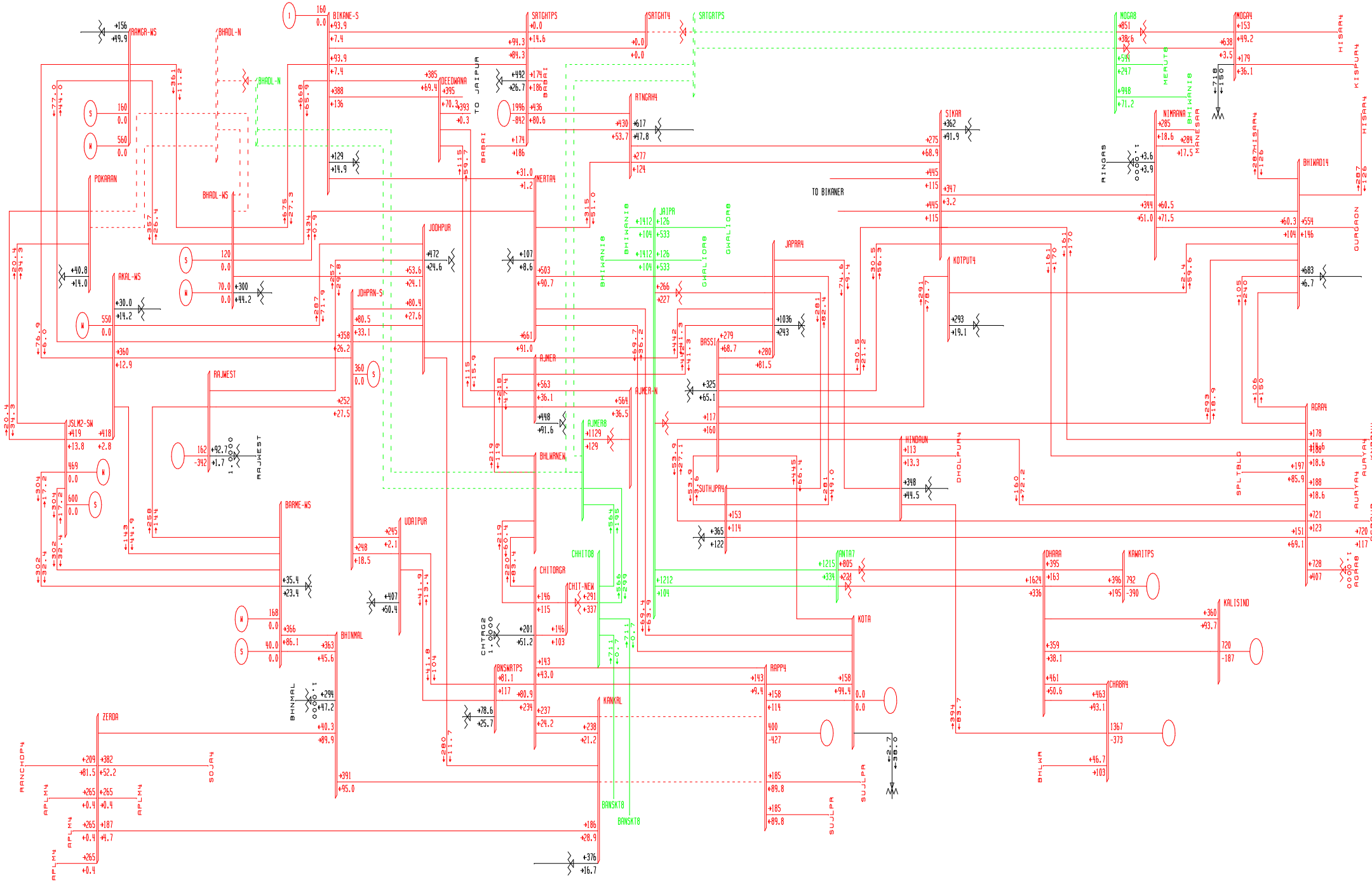
3.	Linear State Estimator	Development of 3-phase linear state estimator, software based on weighted least square technique.
		
		Inputs required:
		a) PMU based phasor measurement at both ends of line and bus voltage phasor,
		
		b) Substation bus switching scheme/topology
			• Network topology processor to update the bus model
			• Bad data detection
			• Topology error detection to identify the switch device errors
			• Observability analysis to identify maximum observable network with available measurement.
			• Pseudo & historical measurement generation in case of lack of observability.
			• Alarms & warnings for model inconsistencies & limit violation.
			• Network connectivity/graph to provide:
			  • Island details
			  • Issue alarm for loss of connectivity
			  • visualisation by making line dotted/different colour
			  • Component outage
			• Visualization of state estimator output in tabular & graphical form.
			• Power system condition can be played-back along with topology connectivity and flow measurement
			• Three phase State Estimator

4.	Supervised Zone-3 distance protection scheme to prevent unwanted tripping	The analytics will provide adaptive Zone-3 backup protection to avoid unwanted Zone-3 tripping. Inputs required: a) PMU based phasor measurement at both ends of line and bus voltage b) Distance relay characteristics and settings of candidate line	• Identification of presence of persistent fault in the observable system. • Identification of presence of power swing & load encroachment in the observable system. • The software will generate control signal for disabling of Zone -3 protection based on system condition and adopted protection philosophy

S No.	Task	Aim	Deliverables
5.	CT/CVT Calibration.	This module will evaluate the accuracy of these instruments. Inputs required: a) PMU based phasor measurement at both ends of line, bus voltage phasor b) Benchmarked PT to act as reference c) Linear State Estimator	• Evaluation of CT/CVT errors in magnitude • Evaluation of CT/CVT errors in phase • Identification of faulty CT/CVT from steady state and transient response • Computation of compensation factors for correcting the steady state response of CT/CVT for state estimation • Verification of measurements against benchmark-CT/CVT • Highlighting the variation using graphs
6	Emergency control for improving system security(Based on angular, voltage & frequency stability)	The module will continuously monitor and analyse the stability (like voltage & angular) based on the trajectories of various parameters like voltage, current phasors, breaker status etc Inputs required: d) PMU based phasor measurement at both ends of line, bus voltage phasor	• Based on the analysis of the evolving trajectories a decision on whether to take an automatic control action and its quantum & location shall be taken by such a scheme. Five such Wide-Area Emergency Control Schemes shall be developed, which will involve appropriate action in any or all regions, adaptively, depending on the event, such as Controlled system separation (adaptive islanding), Adaptation of relays and control systems using wide area Information etc.

15.4 POWERGRID may present this for kind information of the members.

ANNEXURE – I



POWER TECHNOLOGIES, INC.®	WITH STRENGTHENING		EXHIBIT-BASE
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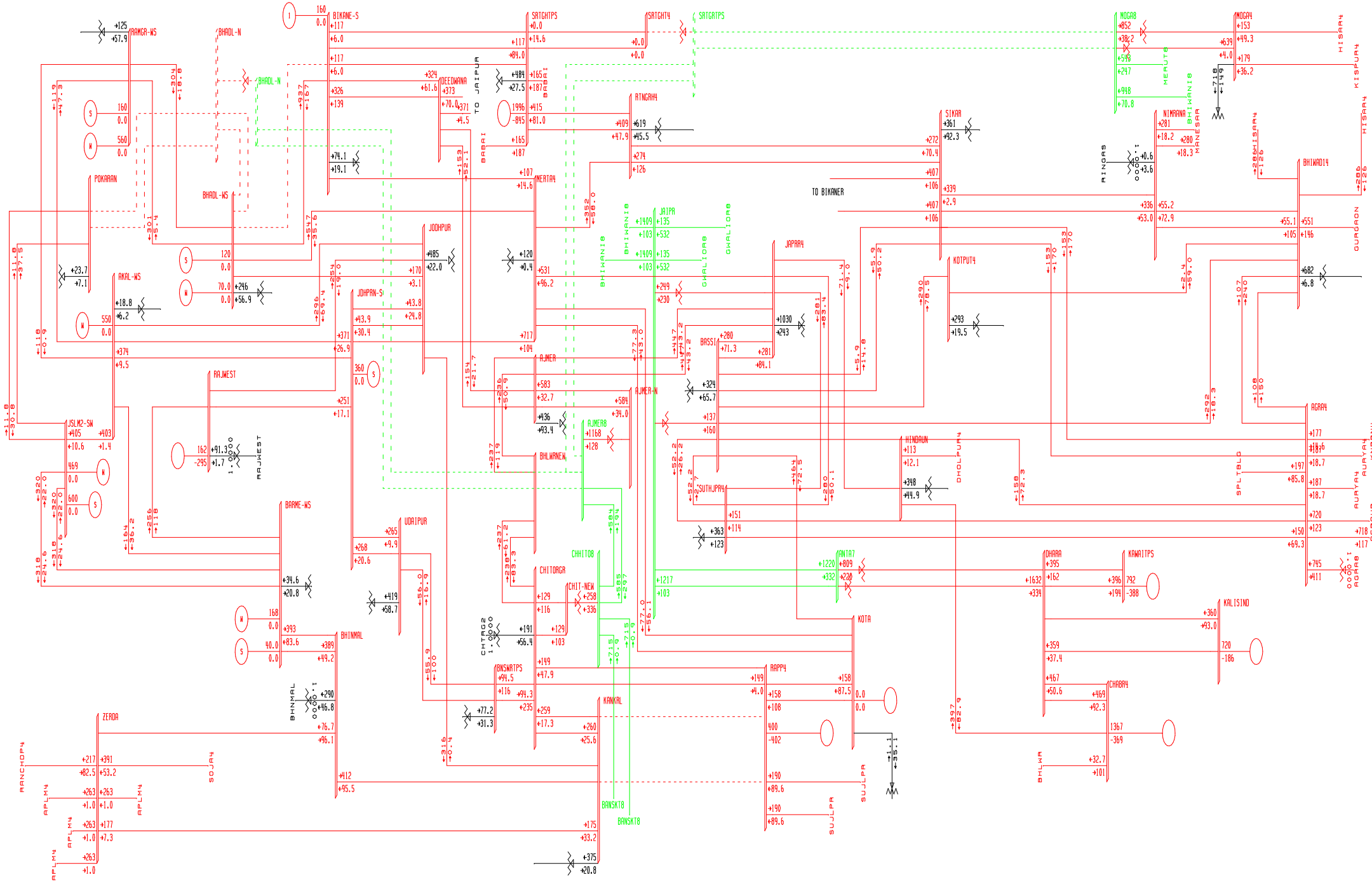


WITH STRENGTHENING

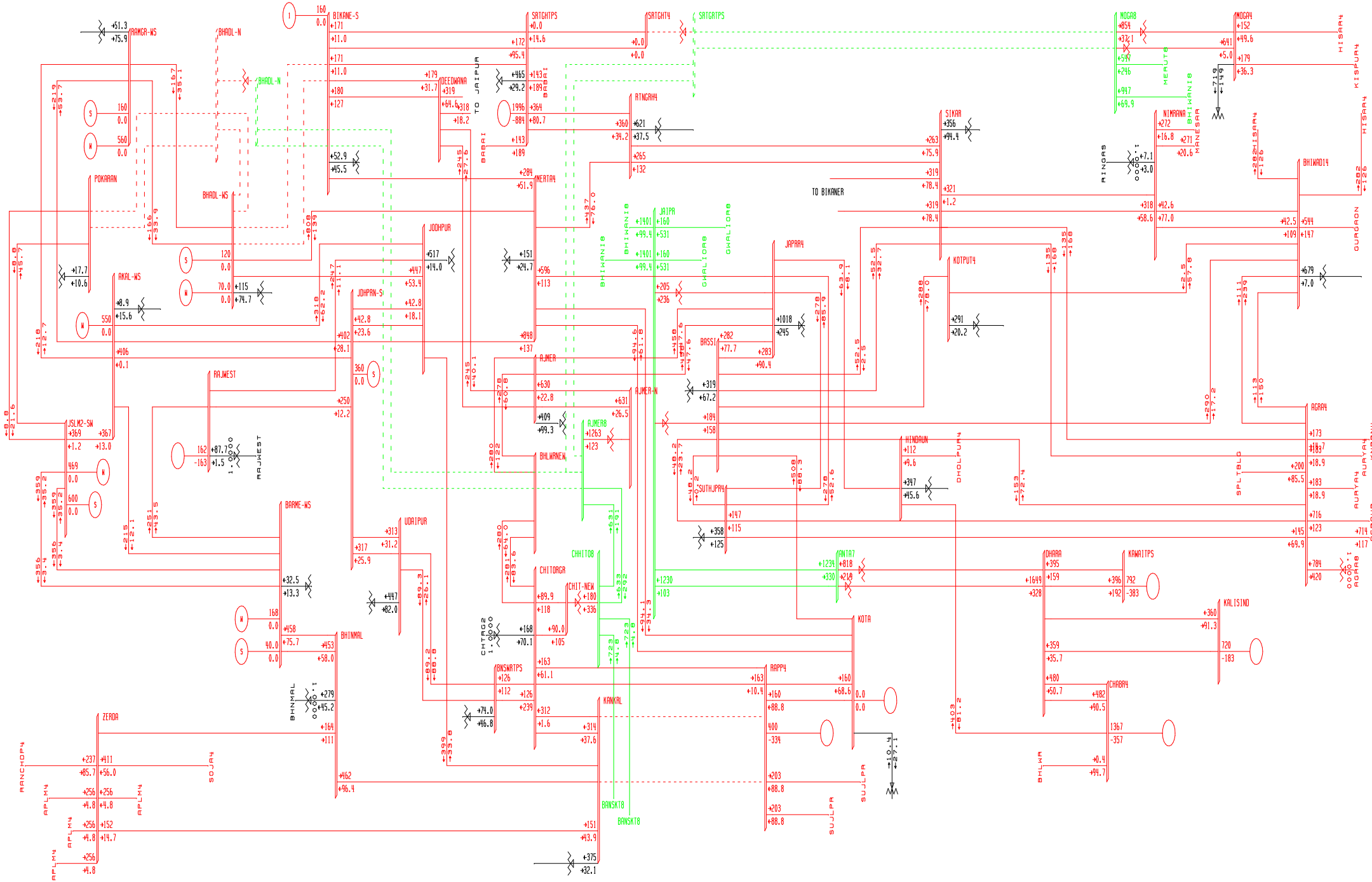
POWER TECHNOLOGIES, INC.®

FRI, JUL 12 2013 15:55

KV: ≤220 , ≤400 , ≤765

BUS - NONE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

EXHIBIT-BASE-01



WITH STRENGTHENING		BUS - NONE	EXHIBIT-BASE-02
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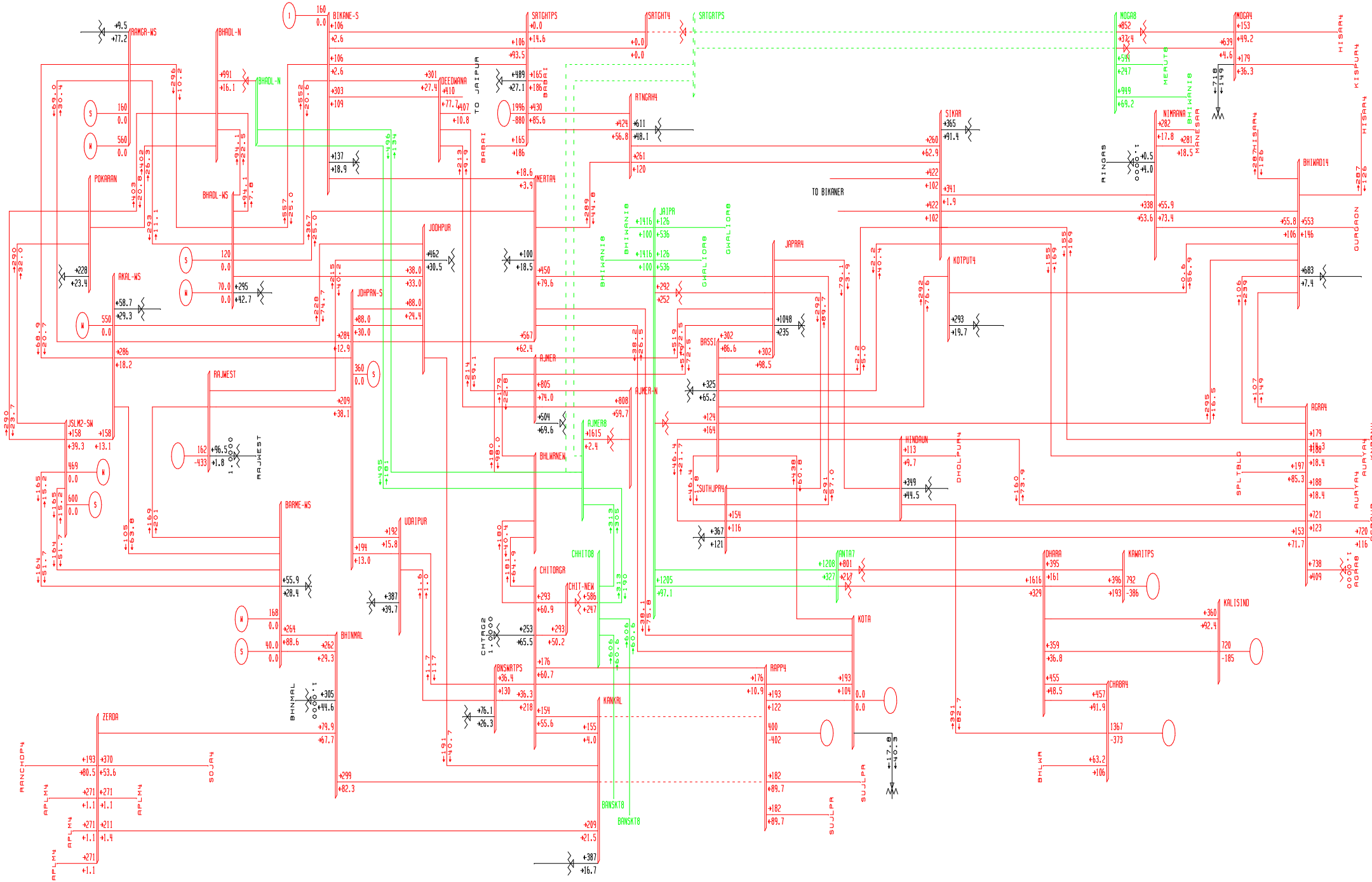


WITH STRENGTHENING

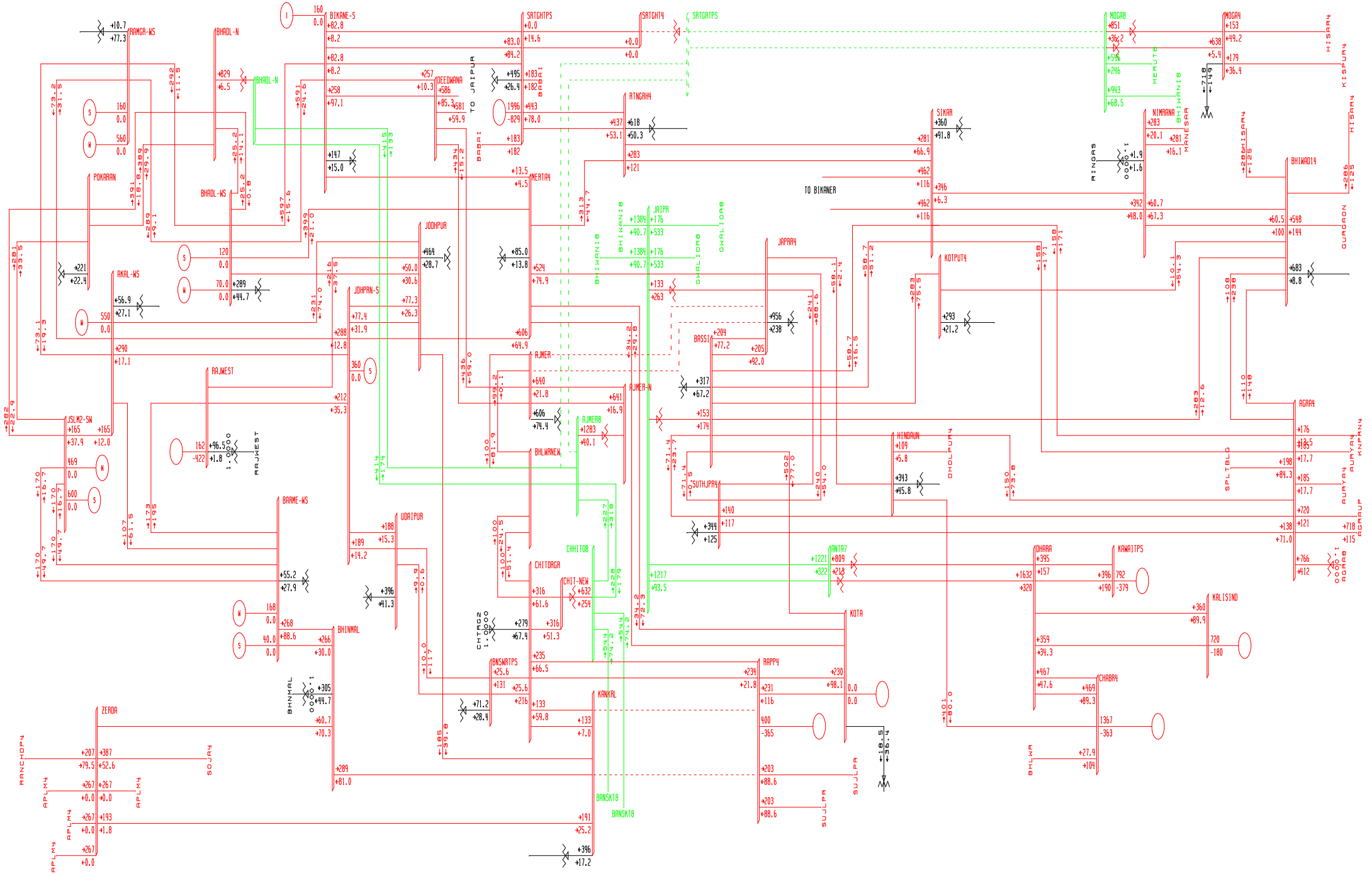
POWER TECHNOLOGIES, INC.®

FRI, JUL 12 2013 16:05

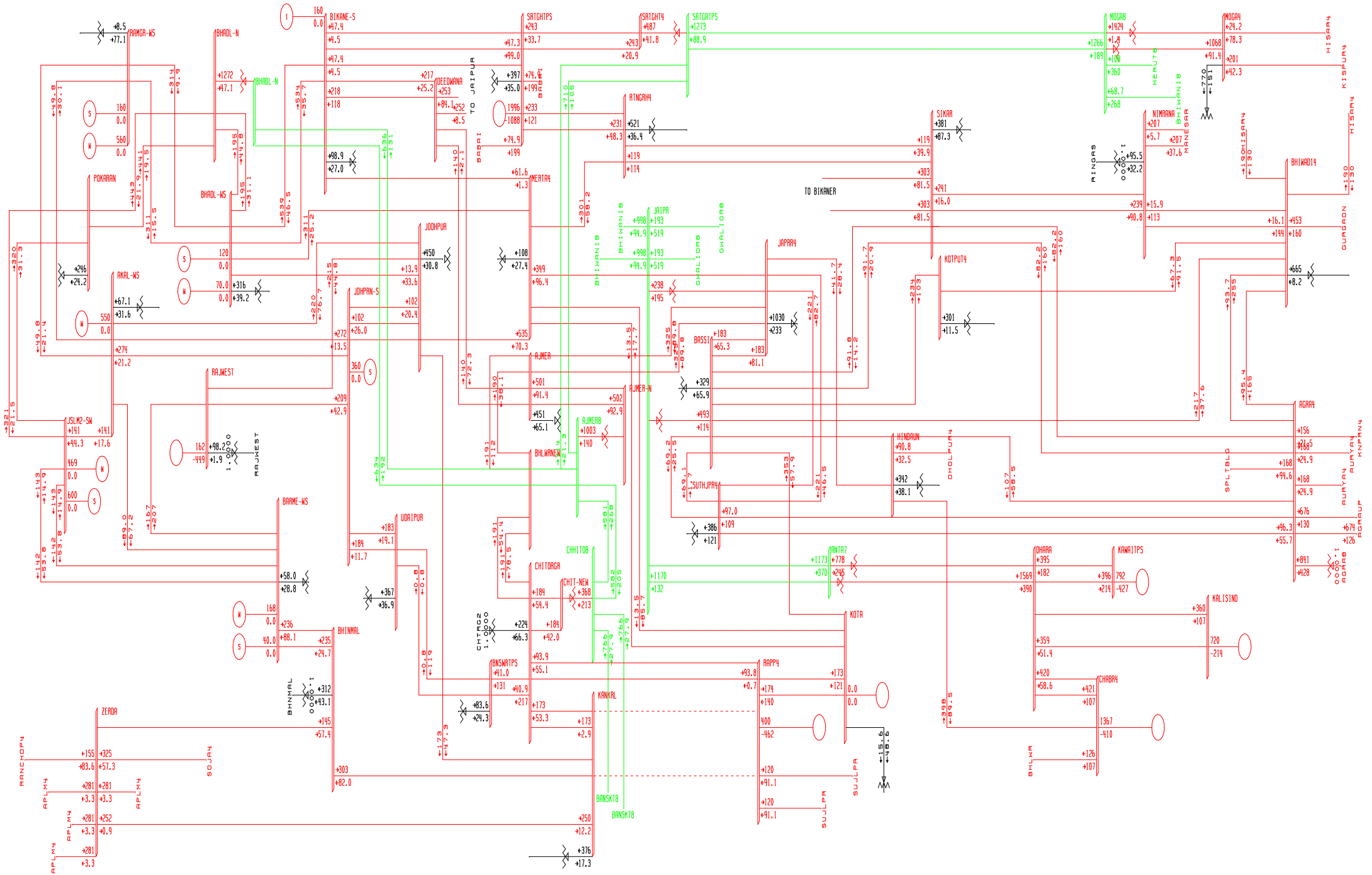
KV: ≤220 , ≤400 , ≤765

BUS - NONE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

EXHIBIT-CASE 1



WITH STRENGTHENING		BUS - NONE	EXHIBIT-CASE 1-01
POWER TECHNOLOGIES, INC.® FRI, JUL 12 2013 16:10	KV: ≤220 , ≤400 , ≤765	BRANCH - MW/MVAR EQUIPMENT - MW/MVAR	



WITH STRENGTHENING

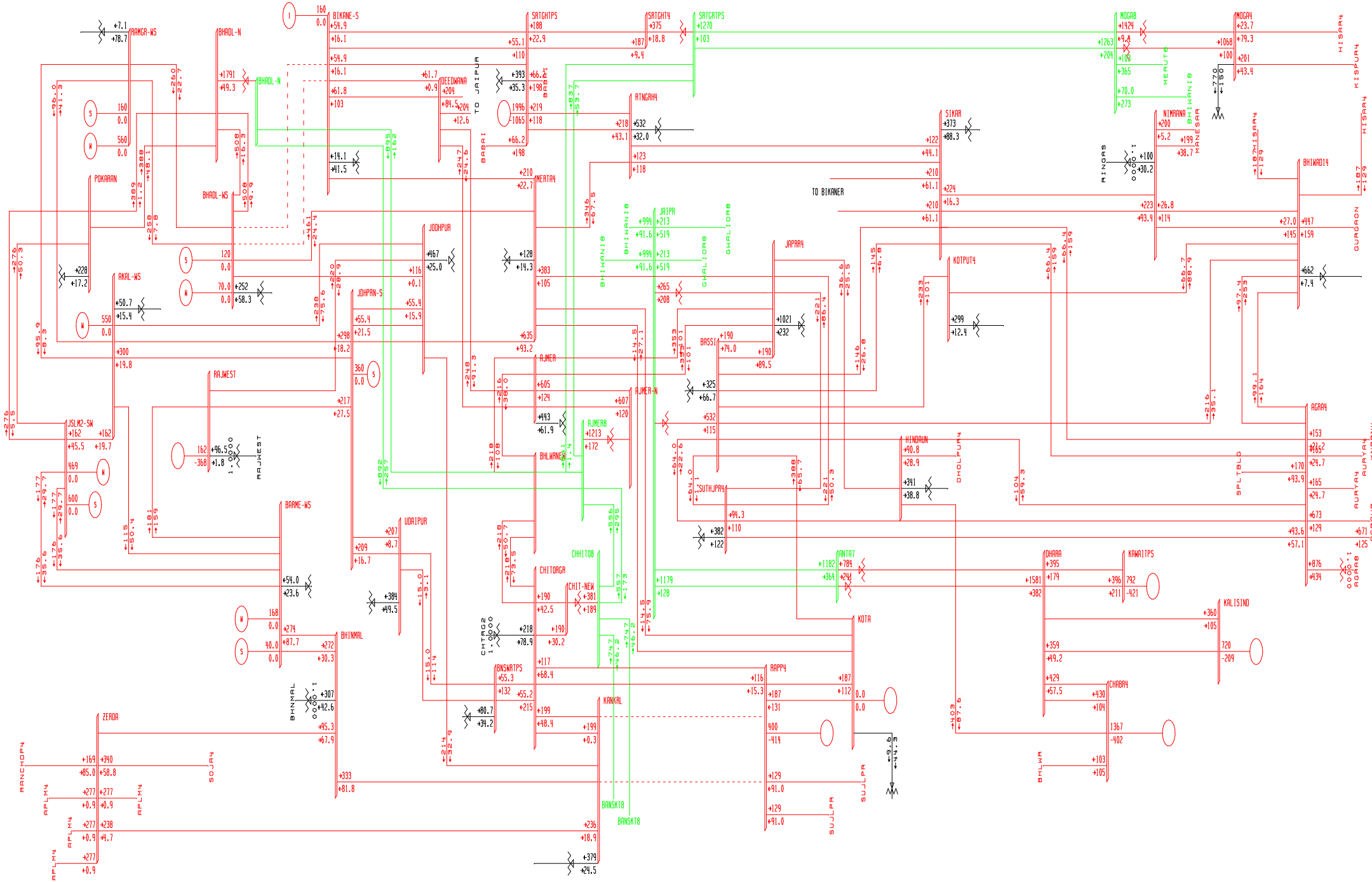
POWER TECHNOLOGIES, INC.®

FRI, JUL 12 2013 16:10

KV: ≤220 , ≤400 , ≤765

BUS - NONE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

EXHIBIT-CASE 2



WITH STRENGTHENING

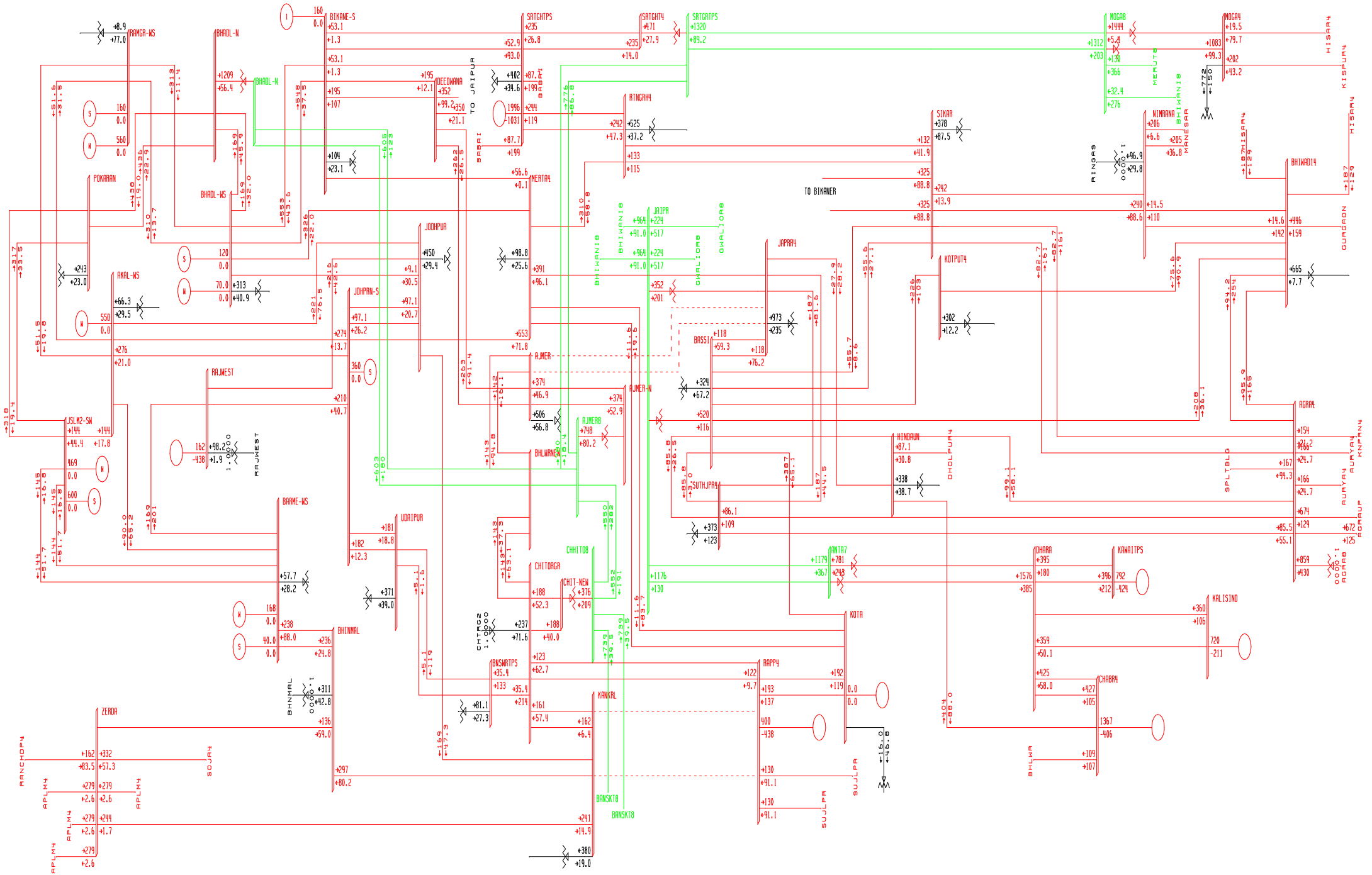
POWER TECHNOLOGIES, INC.®

FRI, JUL 12 2013 16:18

KV: ≤220 , ≤400 , ≤765

BUS - NONE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

EXHIBIT-CASE 2-01



WITH STRENGTHENING

POWER TECHNOLOGIES, INC.®

FRI, JUL 12 2013 16:10

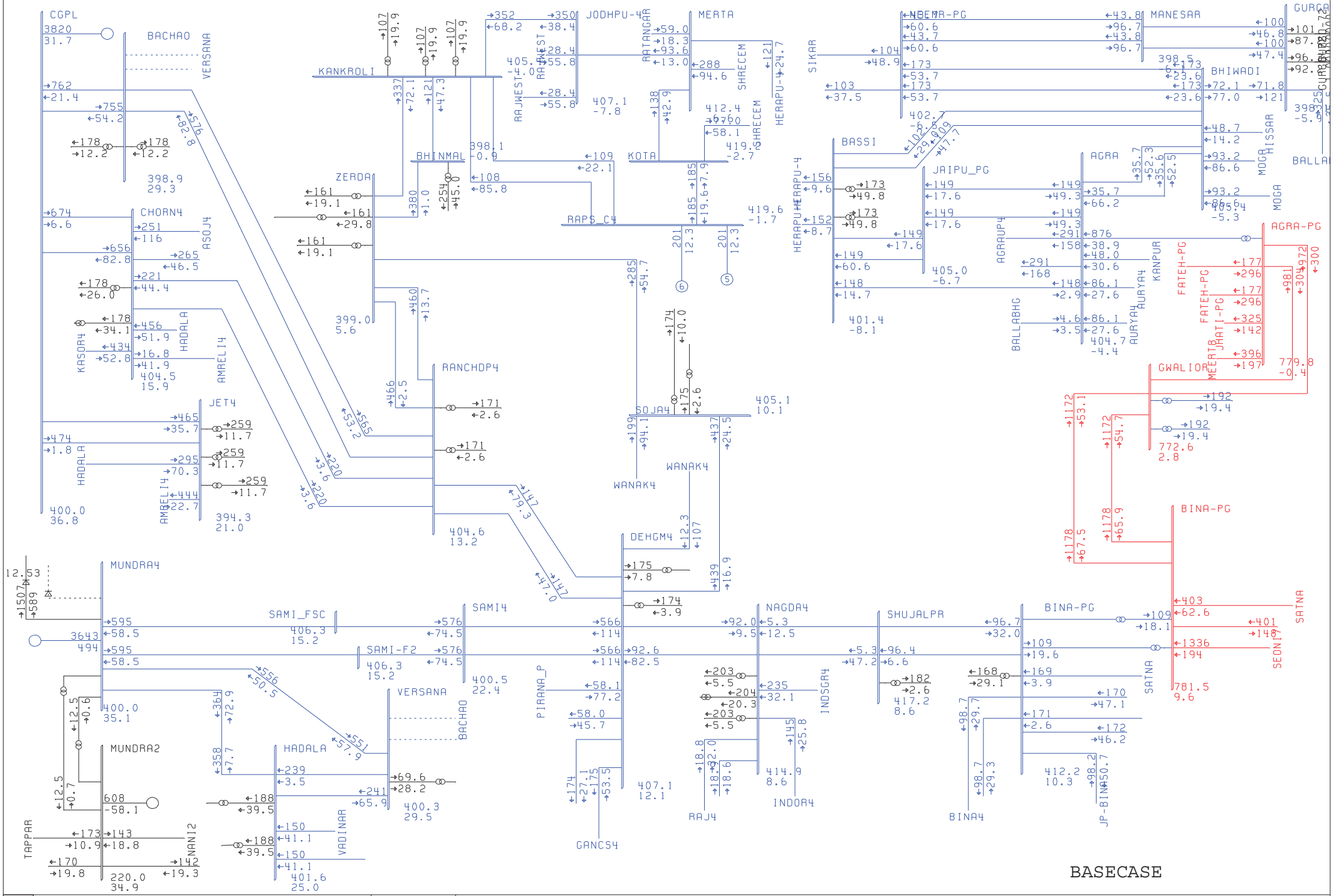
KV: ≤220 , ≤400 , ≤765

BUS - NONE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

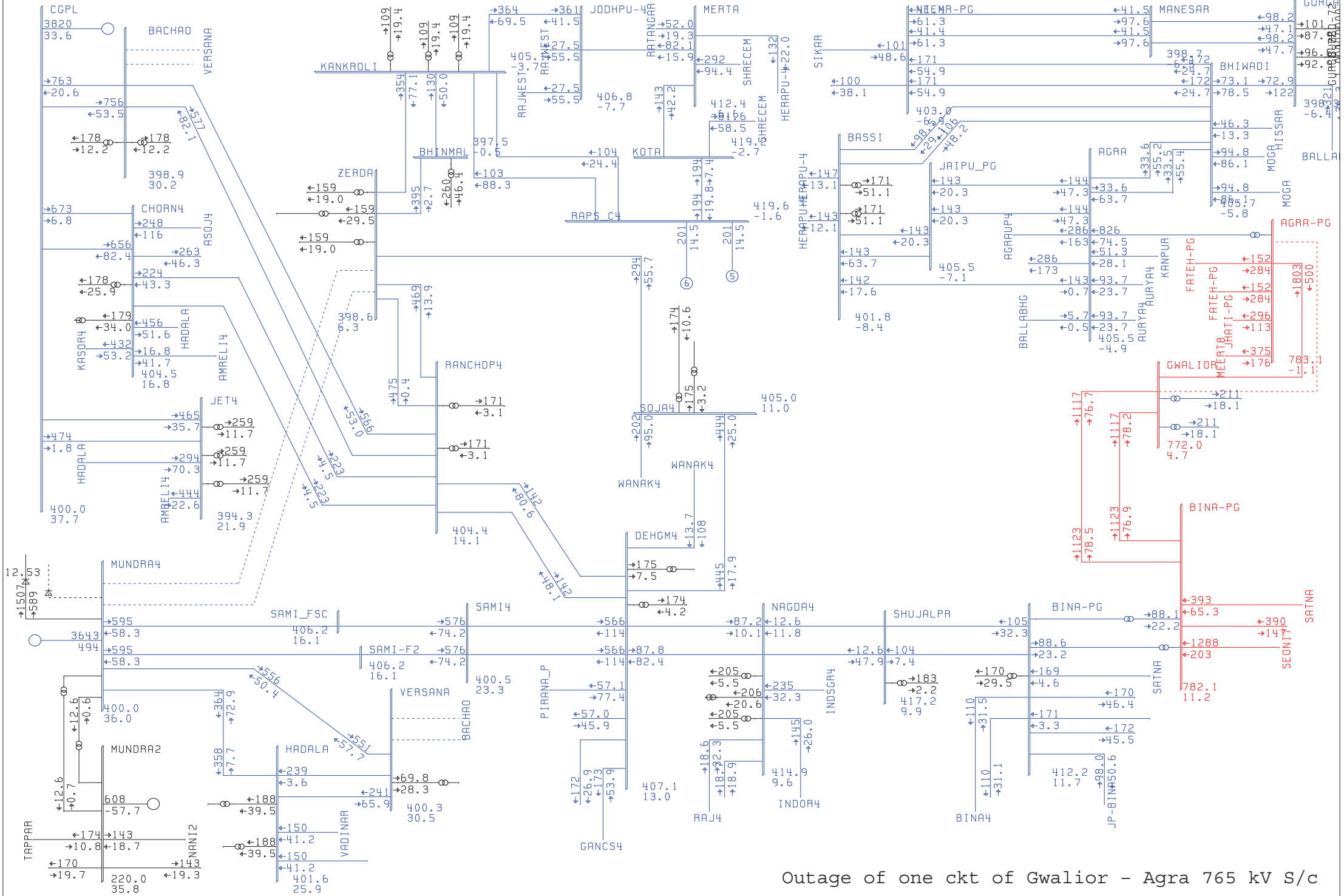
EXHIBIT-CASE 2-02

ANNEXURE - II

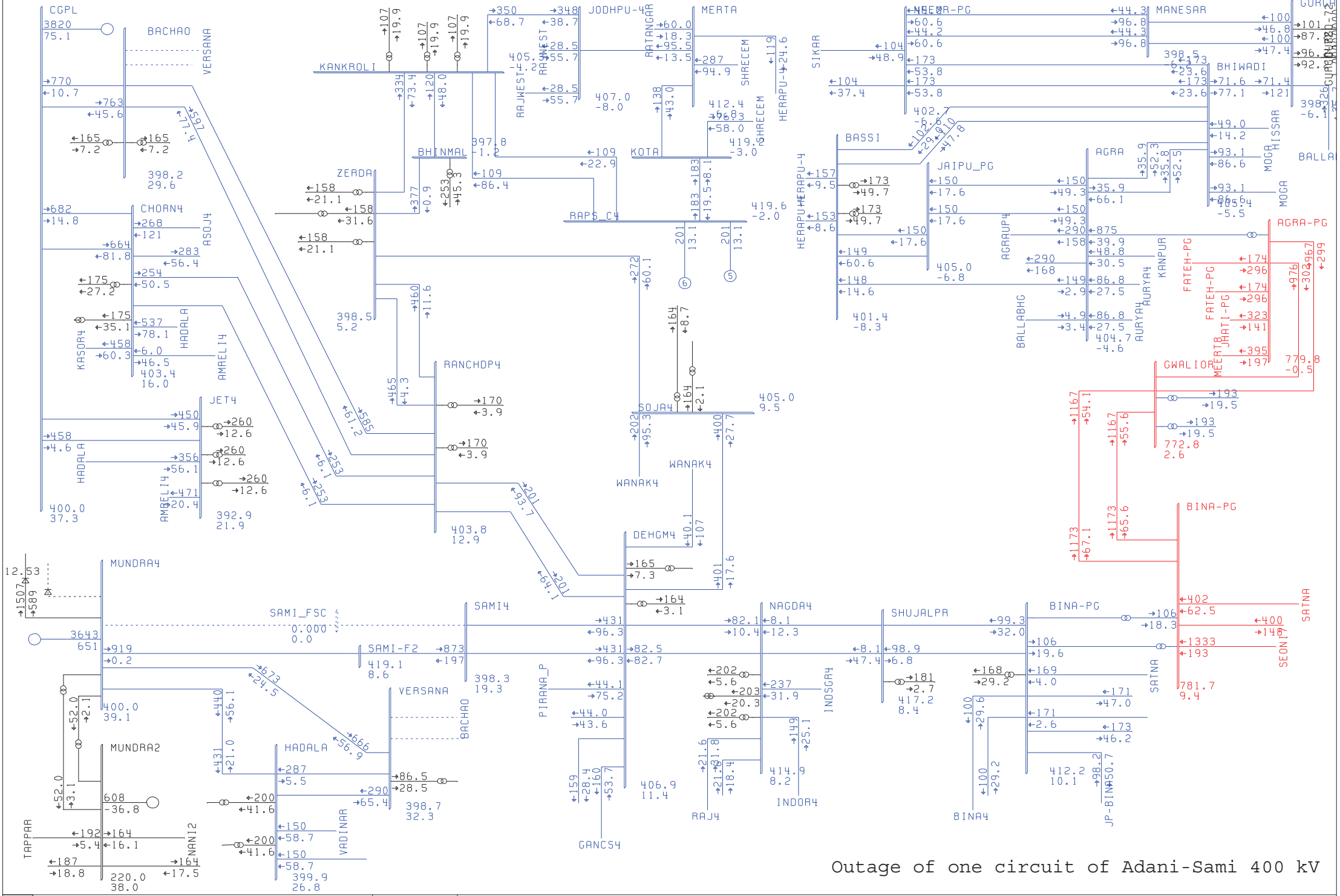
EXHIBIT-VII


CGPL
BACHAO
VERSANA
KANKROLI
JODHPU-4
MERTA
RATANGAR
SHRECEM
HERAPU-4
BHINMAL
ZERDA
KOTA
RAPS_C4
CHORN4
ASOJ4
KASOR4
HADALA
AMARELI4
JET4
RANCHDP4
SOJA4
WANAK4
DEHGM4
MUNDRA4
MUNDRA2
SAMI_FSC
SAMI4
SAMI-F2
VERSANA
HADALA
TAPPAR
NANI2
VADINAR
PIRANA_P
GANCS4
RAJ4
NAGDA4
INDOR4
INDSGR4
SHUJALPR
BINA4
BINA-PG
SATNA
SEONI4
JP-BINA
NEEMR-PG
MANESAR
SIKAR
BHIWADI
HISSAR
MOGA
GURGA
BASSI
HERAPU-4
JAIPU_PG
AGRAUP4
AGRA
BALLABHG
AURYA4
KANPUR
AGRA-PG
FATEH-PG
JHATI-PG
MEERT8
GWALIOR
BASECASE
MON, JUL 08 2013 13:18
BUS - VOLTAGE(KV)/ANGLE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR
KV:≤220 ,≤400 ,≤765

EXHIBIT=VII-01



Outage of one ckt of Gwalior - Agra 765 kV S/c



Outage of one circuit of Adani-Sami 400 kV

EXHIBIT-VIII

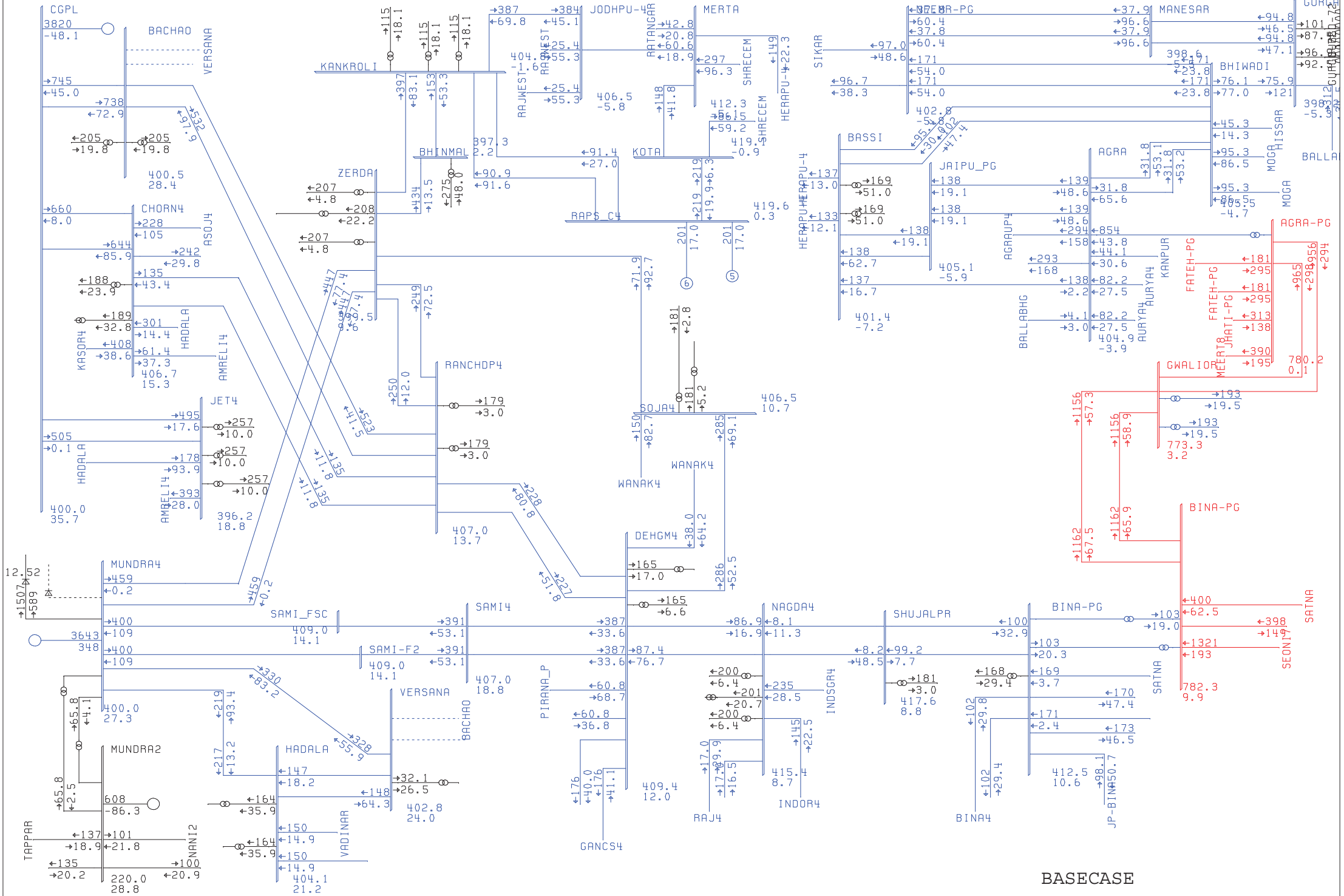
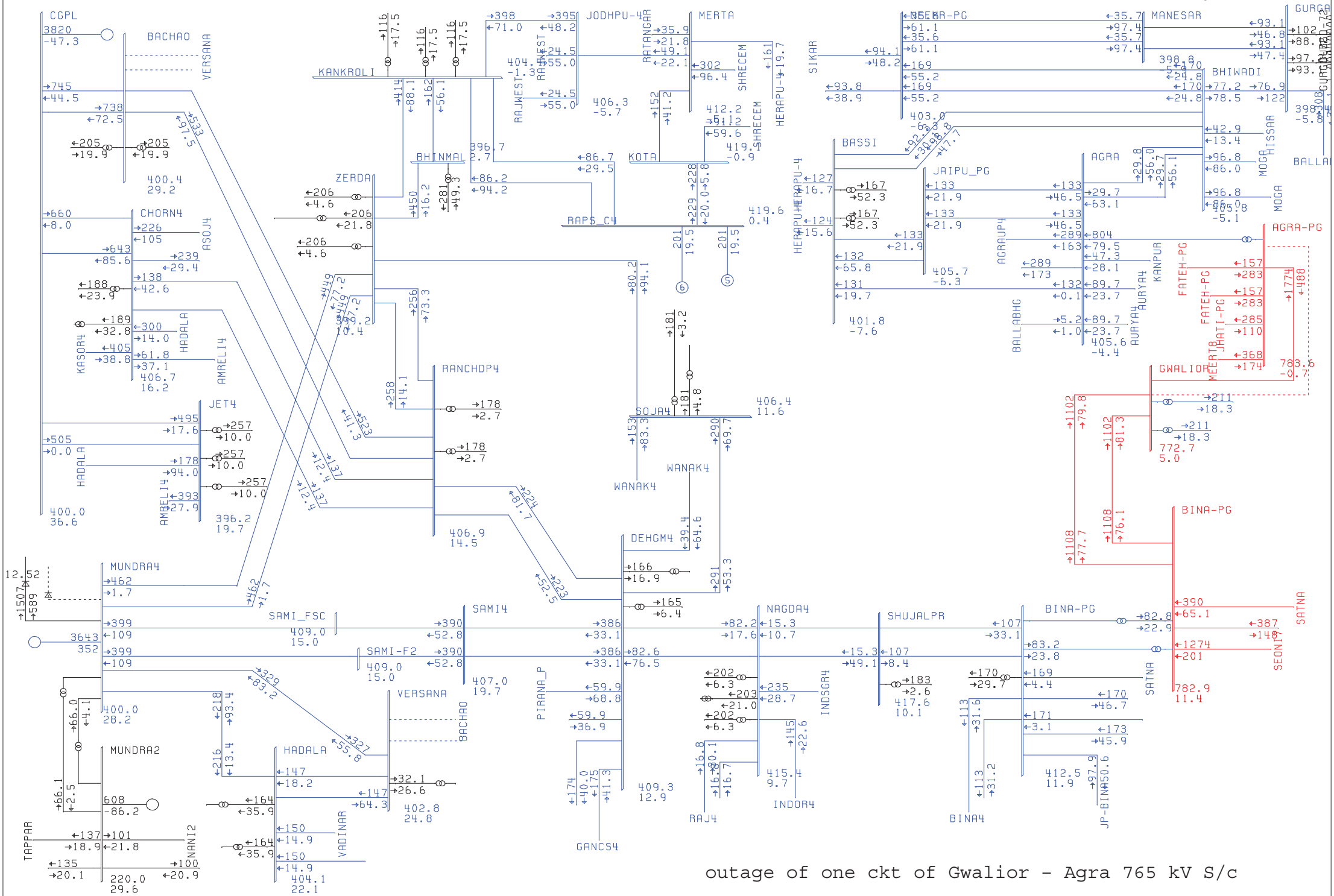


EXHIBIT-VIII-01



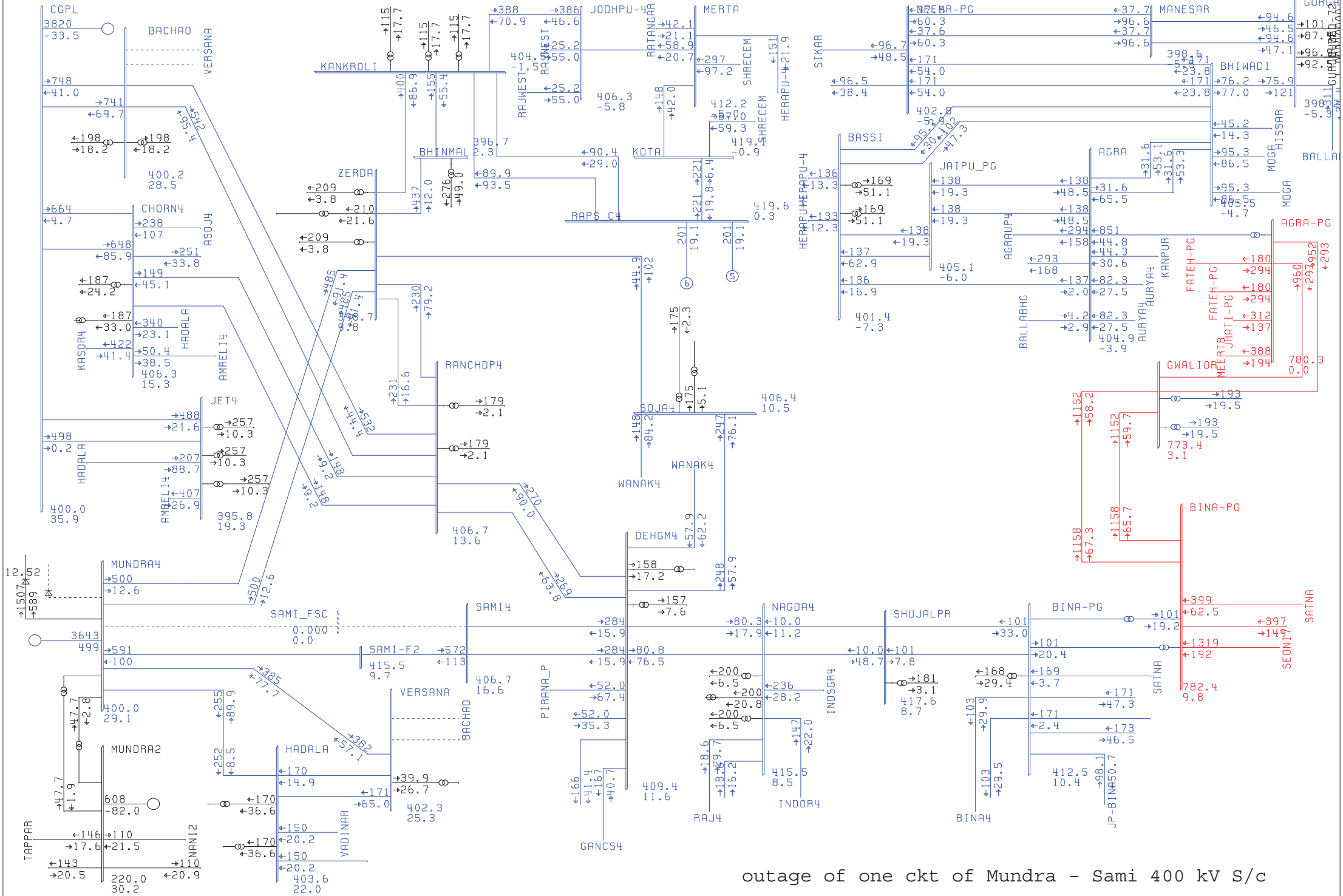
outage of one ckt of Gwalior - Agra 765 kV S/c

TUE, JUL 09 2013 16:54

BUS - VOLTAGE(KV)/ANGLE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

KV: ≤220 , ≤400 , ≤765

EXHIBIT VIII-02



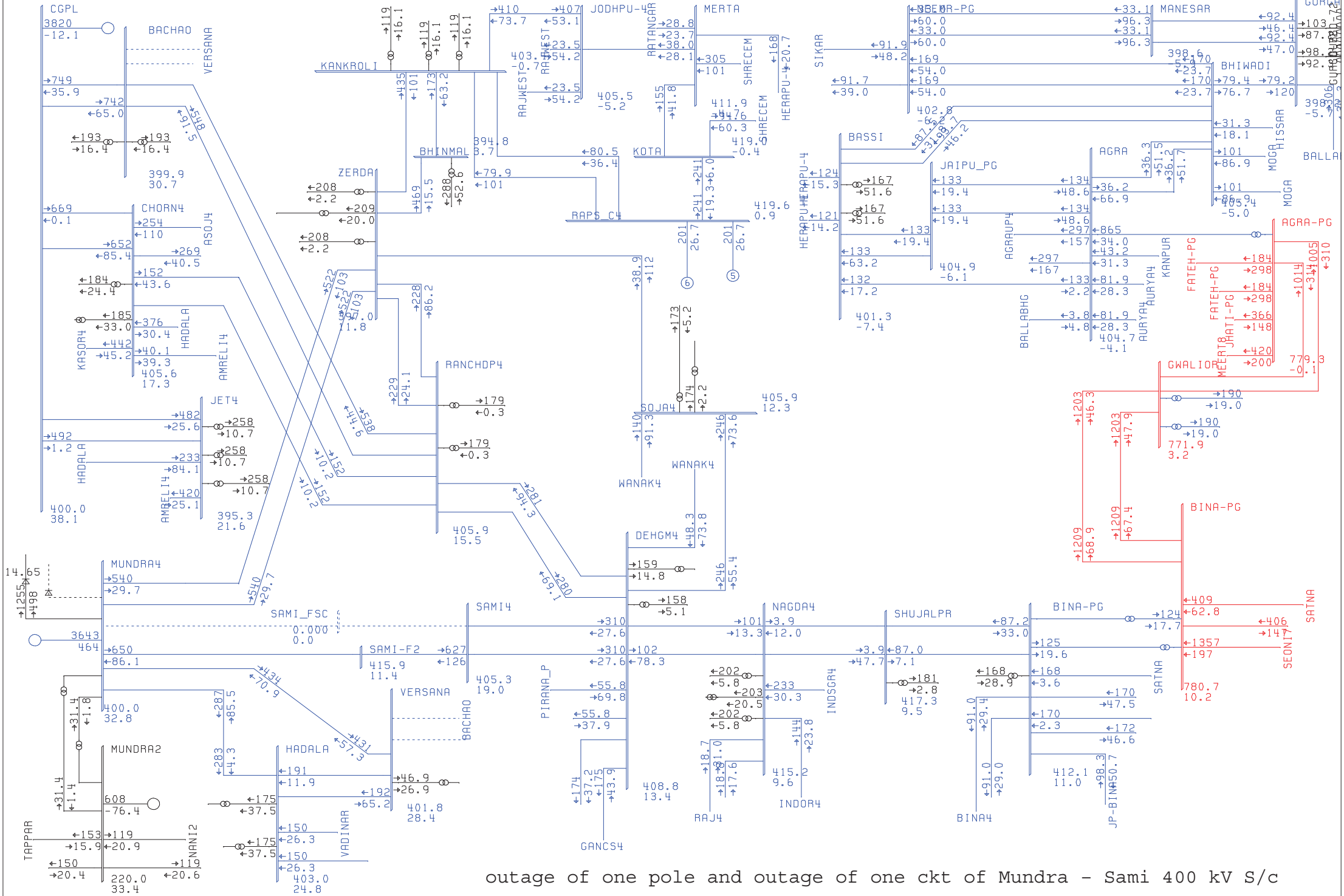
outage of one ckt of Mundra - Sami 400 kV S/c

TUE, JUL 09 2013 16:54

BUS - VOLTAGE(KV)/ANGLE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

KV: ≤220 , ≤400 , ≤765

EXHIBIT-VIII-03



outage of one pole and outage of one ckt of Mundra - Sami 400 kV S/c

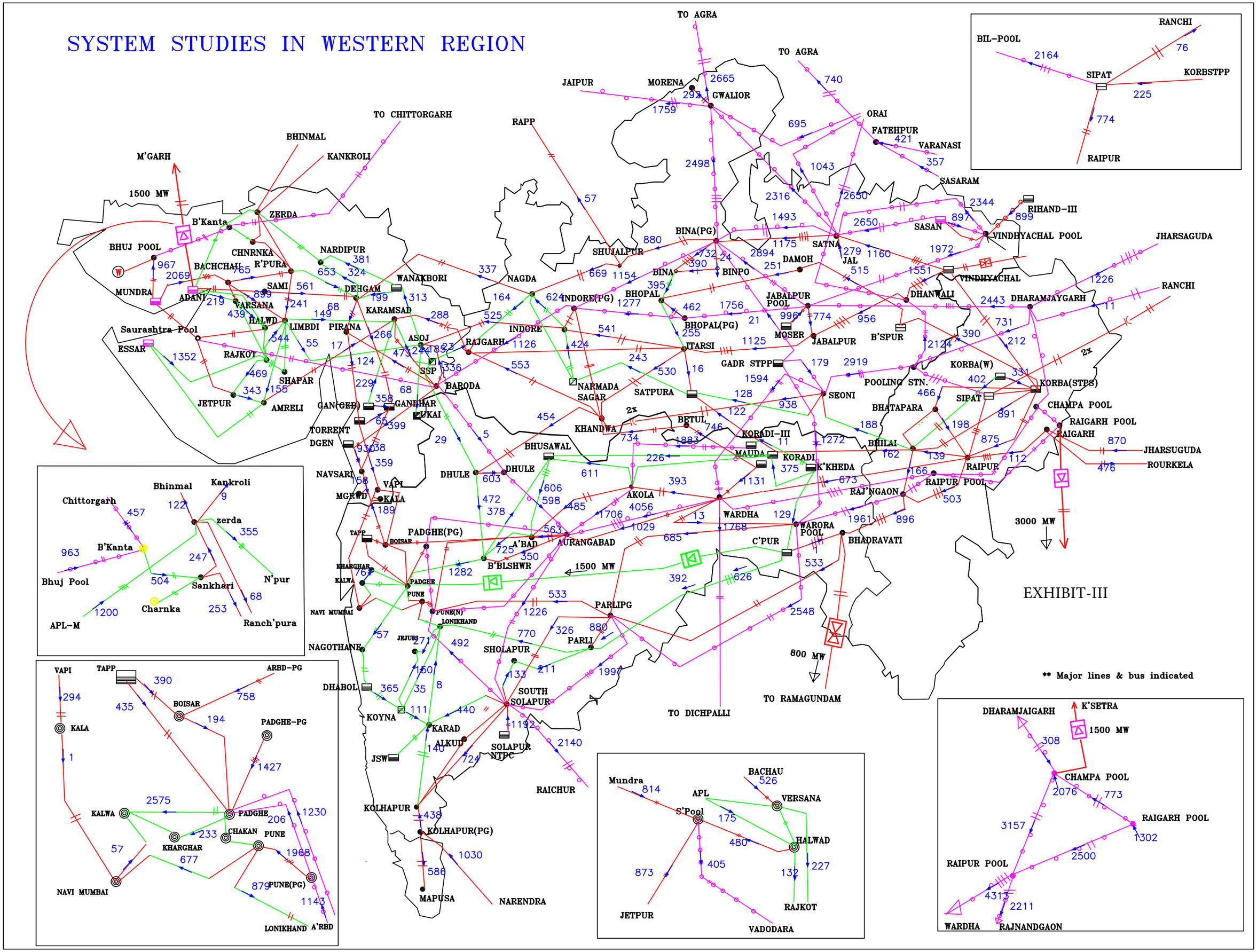
TUE, JUL 09 2013 16:54

KV: ≤220 , ≤400 , ≤765

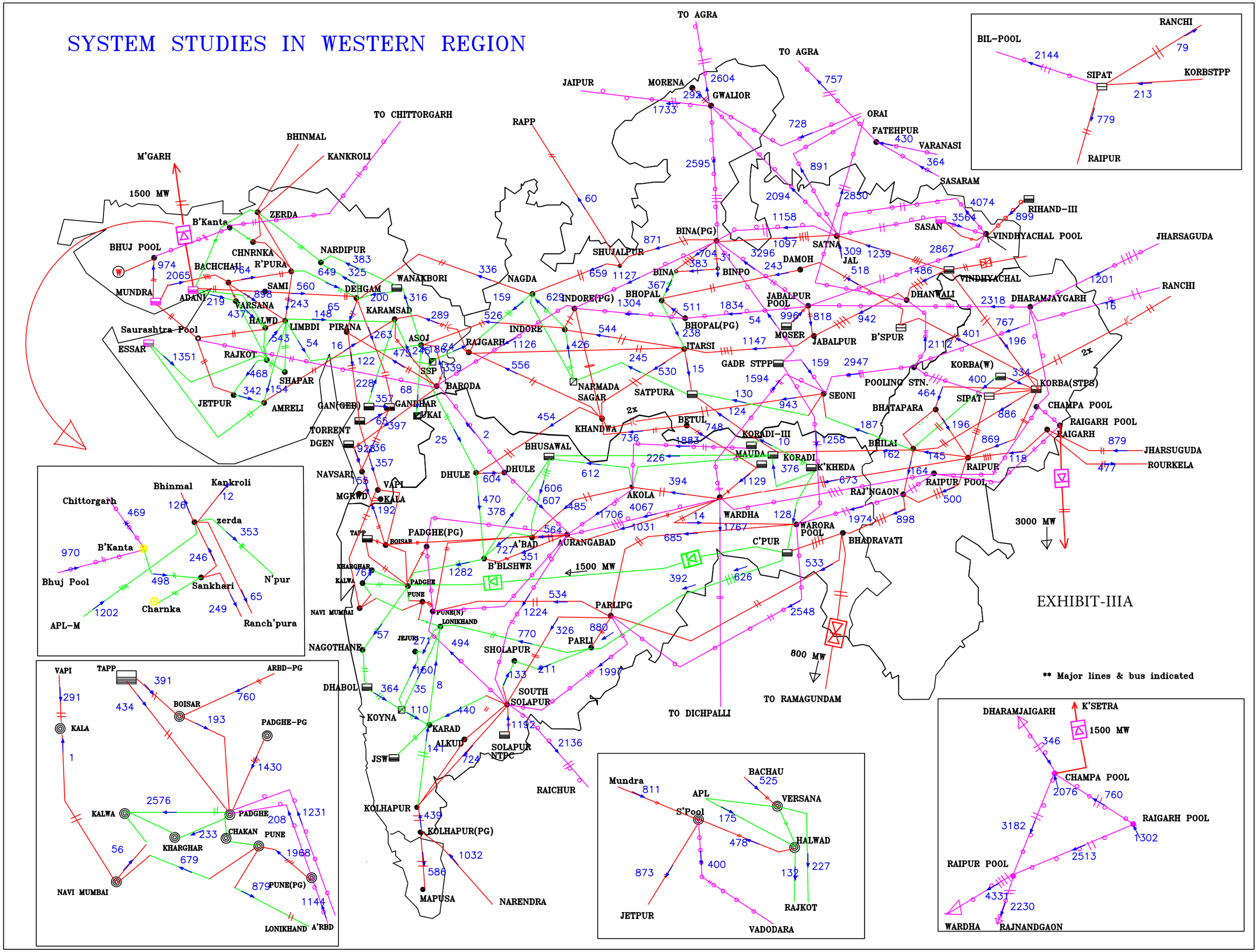
BUS - VOLTAGE(KV)/ANGLE
BRANCH - MW/MVAR
EQUIPMENT - MW/MVAR

ANNEXURE -III

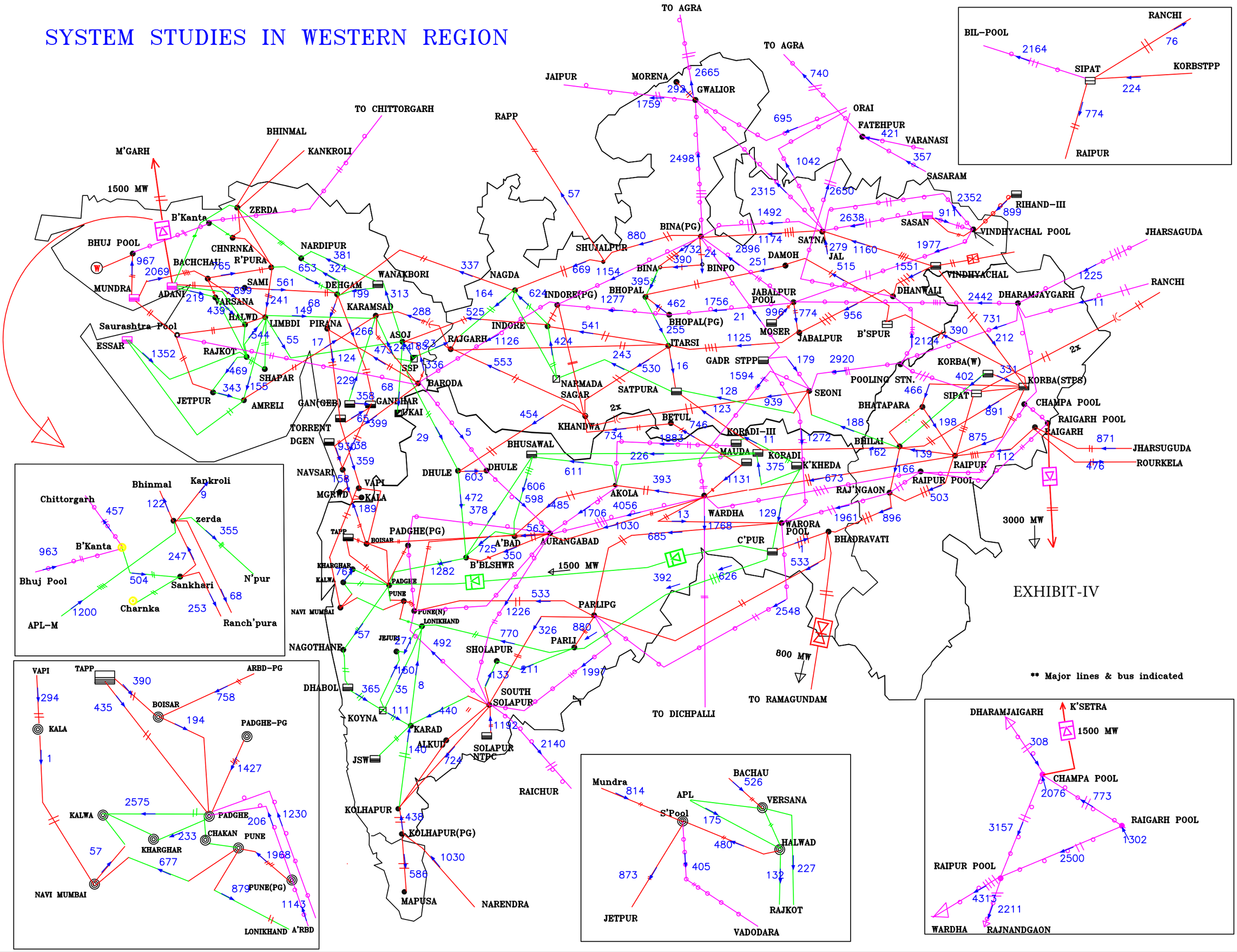
SYSTEM STUDIES IN WESTERN REGION



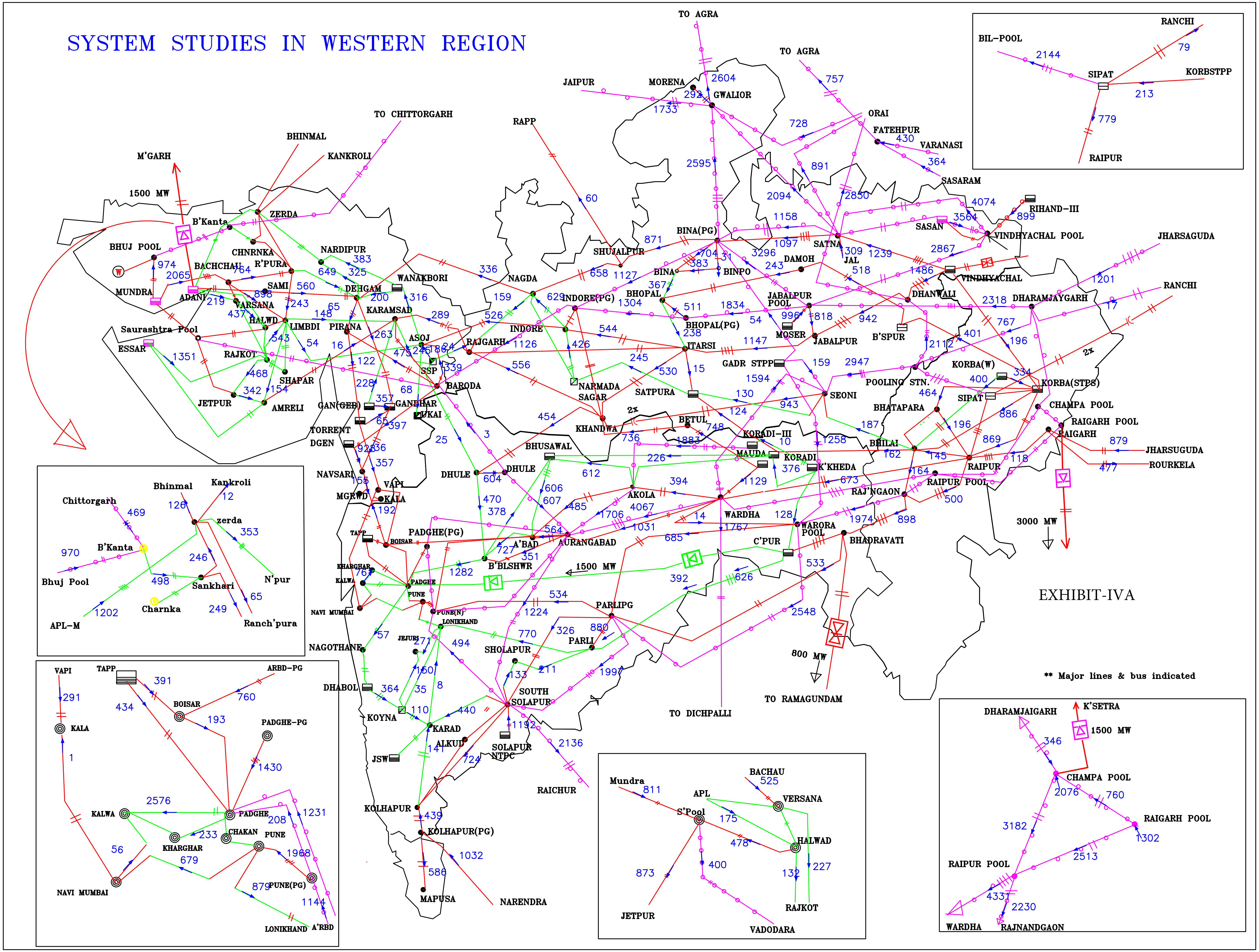
SYSTEM STUDIES IN WESTERN REGION



SYSTEM STUDIES IN WESTERN REGION



SYSTEM STUDIES IN WESTERN REGION



ANNEXURE -IV

Annexure – IV

LOADING PROFILE OF Damoh ICTs					
Month	**Apr-13**	**ICT#1**		**ICT#2**	
DATE	**TIME (HOURS)**	**LOAD**		**LOAD**	
		MW	**MVAR**	**MW**	**MVAR**
01.04.13	400	158	1	158	1
	800	128	4	128	4
	1200	112	9	112	9
	1600	97	7	97	7
	2000	183	22	183	22
	2400	161	11	161	11
06.04.13	400	153	7	153	7
	800	130	4	130	4
	1200	174	7	0	0
	1600	86	-3	86	-3
	2000	197	34	197	34
	2400	172	16	172	16
07.04.13	400	161	4	161	4
	800	135	3	135	3
	1200	89	10	89	10
	1600	93	3	93	3
	2000	193	32	193	32
	2400	162	10	162	10
08.04.13	400	155	4	155	4
	800	136	0	136	0
	1200	114	3	114	3
	1600	104	-2	104	-2
	2000	183	22	183	22
	2400	268	13	268	13
10.04.13	400	169	7	169	7
	800	129	2	129	2
	1200	122	1	122	1
	1600	128	0	128	0
	2000	193	23	193	23
	2400	181	9	181	9
11.04.13	400	176	6	176	6
	800	134	0	134	0
	1200	136	3	136	3
	1600	127	-2	127	-2
	2000	193	20	193	20
	2400	179	8	179	8
20.04.13	400	158	11	158	11

	800	126	-1	126	-1
	1200	99	2	99	2
	1600	95	-1	95	-1
	2000	184	13	184	13
	2400	182	1	182	1
21.04.13	400	189	-2	189	-2
	800	147	0	147	0
	1200	90	0	90	0
	1600	156	17	156	17
	2000	175	11	175	11
	2400	138	14	138	14
22.04.13	400	140	3	140	3
	800	107	-2	107	-2
	1200	184	15	184	15
	1600	80	8	80	8
	2000	282	44	282	44
	2400	197	31	197	31
23.04.13	400	194	20	194	20
	800	125	7	125	7
	1200	149	17	149	17
	1600	124	2	124	2
	2000	219	41	219	41
	2400	209	23	209	23
24.04.13	400	206	15	206	15
	800	131	3	131	3
	1200	142	29	142	29
	1600	101	13	101	13
	2000	229	49	229	49
	2400	220	23	220	23
26.04.13	400	211	23	211	23
	800	140	6	140	6
	1200	139	27	139	27
	1600	131	10	131	10
	2000	232	57	232	57
	2400	229	42	229	42
27.04.13	400	142	21	142	21
	800	139	11	139	11
	1200	118	17	118	17
	1600	110	18	110	18
	2000	241	54	241	54
	2400	235	23	235	23
28.04.13	400	145	11	145	11
	800	145	9	145	9

	1200	146	23	146	23
	1600	156	24	156	24
	2000	211	43	211	43
	2400	216	41	216	41
29.04.13	400	216	41	216	41
	800	148	3	148	3
	1200	145	28	145	28
	1600	139	13	139	13
	2000	239	51	239	51
	2400	231	27	231	27
30.04.13	400	225	31	225	31
	800	148	3	148	3
	1200	109	21	109	21
	1600	141	29	141	29
	2000	199	57	199	57
	2400	195	46	195	46

LOADING PROFILE OF Damoh ICTs					
Month	**May-13**	**ICT#1**		**ICT#2**	
DATE	**TIME (HOURS)**	**LOAD**		**LOAD**	
		MW	**MVAR**	**MW**	**MVAR**
01.05.13	400	222	29	222	29
	800	157	-2	157	-2
	1200	162	24	162	24
	1600	130	5	130	5
	2000	239	38	239	38
	2400	227	24	227	24
02.05.13	400	206	30	206	30
	800	160	-2	160	-2
	1200	146	16	146	16
	1600	151	5	151	5
	2000	243	41	243	41
	2400	222	25	222	25
03.05.13	400	229	30	229	30
	800	152	10	152	10
	1200	75	4	75	4
	1600	112	5	112	5
	2000	164	20	164	20
	2400	170	15	170	15
04.05.13	400	177	7	177	7
	800	149	3	149	3
	1200	176	12	176	12
	1600	174	14	174	14
	2000	195	15	195	15

	2400	179	12	179	12
05.05.13	400	185	15	185	15
	800	144	3	144	3
	1200	144	9	144	9
	1600	135	6	135	6
	2000	189	22	189	22
	2400	180	13	180	13
07.05.13	400	163	15	163	15
	800	136	4	136	4
	1200	143	12	143	12
	1600	136	22	136	22
	2000	181	23	181	23
	2400	182	10	182	10
08.05.13	400	173	6	173	6
	800	149	4	149	4
	1200	150	7	150	7
	1600	130	0	130	0
	2000	190	19	190	19
	2400	177	7	177	7
09.05.13	400	186	2	186	2
	800	149	-2	149	-2
	1200	148	6	148	6
	1600	145	0	145	0
	2000	194	14	194	14
	2400	179	8	179	8
10.05.13	400	171	3	171	3
	800	144	-3	144	-3
	1200	156	0	156	0
	1600	145	-4	145	-4
	2000	188	14	188	14
	2400	180	15	180	15
13.05.13	400	153	5	153	5
	800	129	-1	129	-1
	1200	146	11	146	11
	1600	153	5	153	5
	2000	210	21	210	21
	2400	178	8	178	8
14.05.13	400	182	6	182	6
	800	146	14	146	14
	1200	149	11	149	11
	1600	155	9	155	9
	175	175	11	175	11
	2400	185	10	185	10
15.05.13	400	189	3	189	3
	800	159	-2	159	-2

	1200	148	3	148	3
	1600	161	4	161	4
	2000	180	12	180	12
	2400	183	9	183	9
16.05.13	400	185	3	185	3
	800	153	4	153	4
	1200	149	4	149	4
	1600	169	9	169	9
	2000	176	8	176	8
	2400	186	13	186	13
17.05.13	400	194	7	194	7
	800	160	6	160	6
	1200	150	5	150	5
	1600	125	0	125	0
	2000	187	27	187	27
	2400	183	10	183	10
18.05.13	400	190	0	190	0
	800	185	0	185	0
	1200	145	3	145	3
	1600	151	3	151	3
	2000	251	15	251	15
	2400	211	9	211	9
19.05.13	400	159	7	159	7
	800	186	9	186	9
	1200	188	-5	188	-5
	1600	181	-8	181	-8
	2000	229	11	229	11
	2400	214	2	214	2
20.05.13	400	220	-4	220	-4
	800	176	-13	176	-13
	1200	167	5	167	5
	1600	161	2	161	2
	2000	193	22	193	22
	2400	205	0	205	0
21.05.13	400	185	7	185	7
	800	145	-5	145	-5
	1200	162	5	162	5
	1600	158	-7	158	-7
	2000	170	9	170	9
	2400	165	8	165	8
22.05.13	400	146	-6	146	-6
	800	130	-7	130	-7
	1200	144	2	144	2
	1600	143	5	143	5
	2000	181	21	181	21

	2400	171	15	171	15
23.05.13	400	135	-5	135	-5
	800	128	-10	128	-10
	1200	162	3	162	3
	1600	163	11	163	11
	2000	190	23	190	23
	2400	183	11	183	11
24.05.13	400	171	5	171	5
	800	148	5	148	5
	1200	146	0	146	0
	1600	152	8	152	8
	2000	161	4	161	4
	2400	170	13	170	13
25.05.13	400	175	6	175	6
	800	136	-5	136	-5
	1200	147	7	147	7
	1600	145	16	145	16
	2000	197	27	197	27
	2400	181	8	181	8
26.05.13	400	178	13	178	13
	800	140	-1	140	-1
	1200	150	9	150	9
	1600	149	10	149	10
	2000	189	21	189	21
	2400	179	10	179	10
27.05.13	400	172	5	172	5
	800	134	-8	134	-8
	1200	149	10	149	10
	1600	145	8	145	8
	2000	197	26	197	26
	2400	182	8	182	8
28.05.13	400	171	6	171	6
	800	135	8	135	8
	1200	147	5	147	5
	1600	145	11	145	11
	2000	200	20	200	20
	2400	188	4	188	4
29.05.13	400	173	6	173	6
	800	143	-3	143	-3
	1200	165	8	165	8
	1600	160	2	160	2
	2000	200	17	200	17
	2400	183	9	183	9
30.05.13	400	168	5	168	5
	800	128	-2	128	-2

	1200	147	4	147	4
	1600	154	5	154	5
	2000	197	18	197	18
	2400	183	6	183	6
31.05.13	400	168	0	168	0
	800	131	-5	131	-5
	1200	102	8	102	8
	1600	133	2	133	2
	2000	174	13	174	13
	2400	164	2	164	2

LOADING PROFILE OF Damoh ICTs

Month	Jun-13	ICT#1		ICT#2	
DATE	TIME (HOURS)	LOAD		LOAD	
		MW	MVAR	MW	MVAR
01.06.13	04:00	163	1	163	1
	08:00	131	-5	131	-5
	12:00	152	4	152	4
	16:00	165	5	165	5
	20:00	182	12	182	12
	24:00	182	7	182	7
02.06.13	04:00	173	2	173	2
	08:00	136	-8	136	-8
	12:00	148	2	148	2
	16:00	156	-6	156	-6
	20:00	193	11	193	11
	24:00	185	7	185	7
03.06.13	04:00	171	0	171	0
	08:00	145	-8	145	-8
	12:00	165	2	165	2
	16:00	158	1	158	1
	20:00	189	16	189	16
	24:00	181	11	181	11
04.06.13	04:00	166	2	166	2
	08:00	145	3	145	3
	12:00	174	8	174	8
	16:00	166	-1	166	-1
	20:00	202	15	202	15
	24:00	186	8	186	8
05.06.13	04:00	169	1	169	1
	08:00	146	2	146	2
	12:00	161	6	161	6
	16:00	164	4	164	4

	20:00	205	20	205	20
	24:00	195	8	195	8
18.06.13	04:00	154	-6	154	-6
	08:00	158	-7	158	-7
	12:00	155	-9	155	-9
	16:00	152	-11	152	-11
	20:00	186	7	186	7
	24:00	194	-2	194	-2
19.06.13	04:00	176	-6	176	-6
	08:00	172	-10	172	-10
	12:00	168	-6	168	-6
	16:00	157	-5	157	-5
	20:00	191	6	191	6
	24:00	191	1	191	1
20.06.13	04:00	171	-5	171	-5
	08:00	159	-6	159	-6
	12:00	154	-3	154	-3
	16:00	159	-3	159	-3
	20:00	181	9	181	9
	24:00	189	6	189	6
23.06.13	04:00	167	2	167	2
	08:00	148	-6	148	-6
	12:00	150	-4	150	-4
	16:00	158	3	158	3
	20:00	188	10	188	10
	24:00	183	8	183	8
24.06.13	04:00	167	-3	167	-3
	08:00	171	-1	171	-1
	12:00	163	-3	163	-3
	16:00	147	-2	147	-2
	20:00	186	12	186	12
	24:00	191	6	191	6
25.06.13	04:00	180	1	180	1
	08:00	147	-3	147	-3
	12:00	165	1	165	1
	16:00	146	-5	146	-5
	20:00	183	10	183	10
	24:00	182	1	182	1

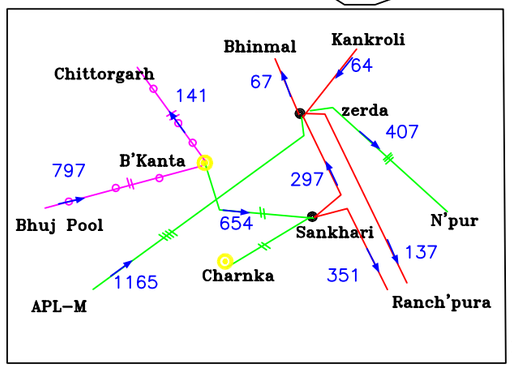
ANNEXURE - V

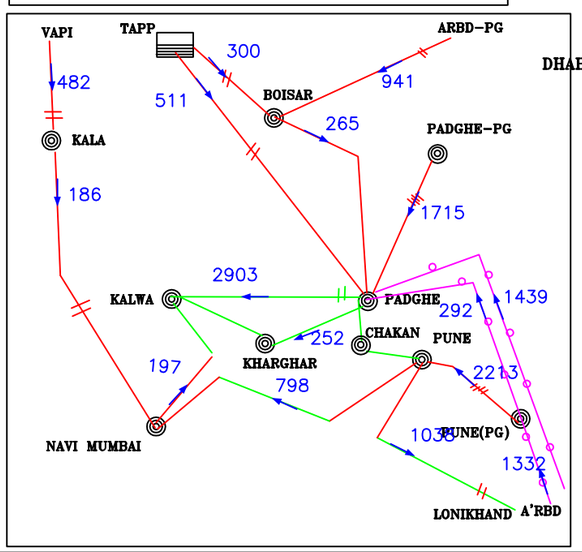
Annexure- V

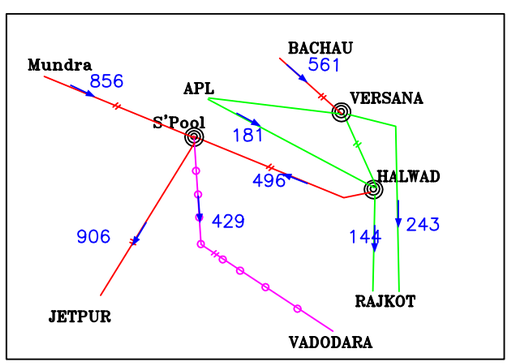
Details of IPP Projects in Chhattisgarh

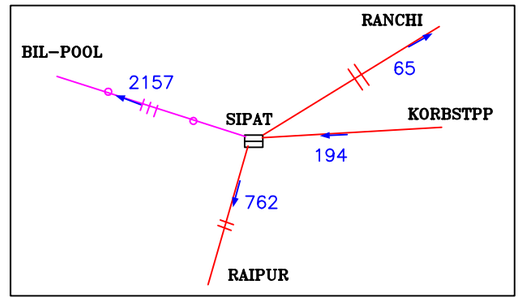
	Applicant	Installed Capacity (MW)
	RAIGARH(KOTRA) COMPLEX	
1	RKM Powergen Ltd.(4x360)	1440
2	Athena Chhattisgarh Power Ltd.(2x600)	1200
3	SKS Power Gen. (Ch) Ltd.(4x300)	1200
4	Korba West Power Co. Ltd.(1x600)	600
5	DB Power Ltd.(2x600)	1200
6	Visa Power Ltd.	1200
	RAIGARH(TAMNAR) COMPLEX	
1	Jindal Power Ltd.(4x600)	2400
2	Jindal Power Ltd. (225 MW from Dongamahua CPP+ 175MW from existing Tamnar TPS	400
3	TRN Energy Pvt. Ltd.(2x300)	600
4.	Jayaswal Neco(600MW)	600
5.	Sarda Energy Minerals(350MW)	350
	JANJGIR-CHAMPA COMPLEX	
1	KSK Mahanadi Power Co. Ltd (6x600)	3600
2	Lanco Amarkantak Power Pvt. Ltd.(2x660)	1320
3	NTPC Lara-I(2x800MW)	1600
	RAIPUR COMPLEX	
1	GMR Chhattisgarh Energy Pvt. Ltd.	1370
	Dharamjaygarh/Kotra Complex	
1	BALCO(4x300)	1200
2	Vandana Vidyut Ltd.(2x135+1x270)	540
	Total	**20,820 MW**

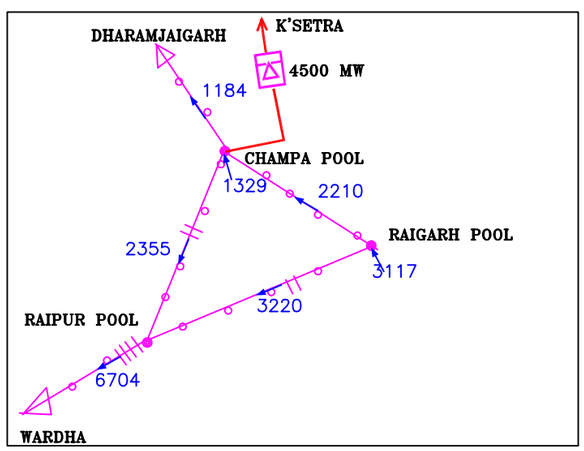
SYSTEM STUDIES IN WESTERN REGION









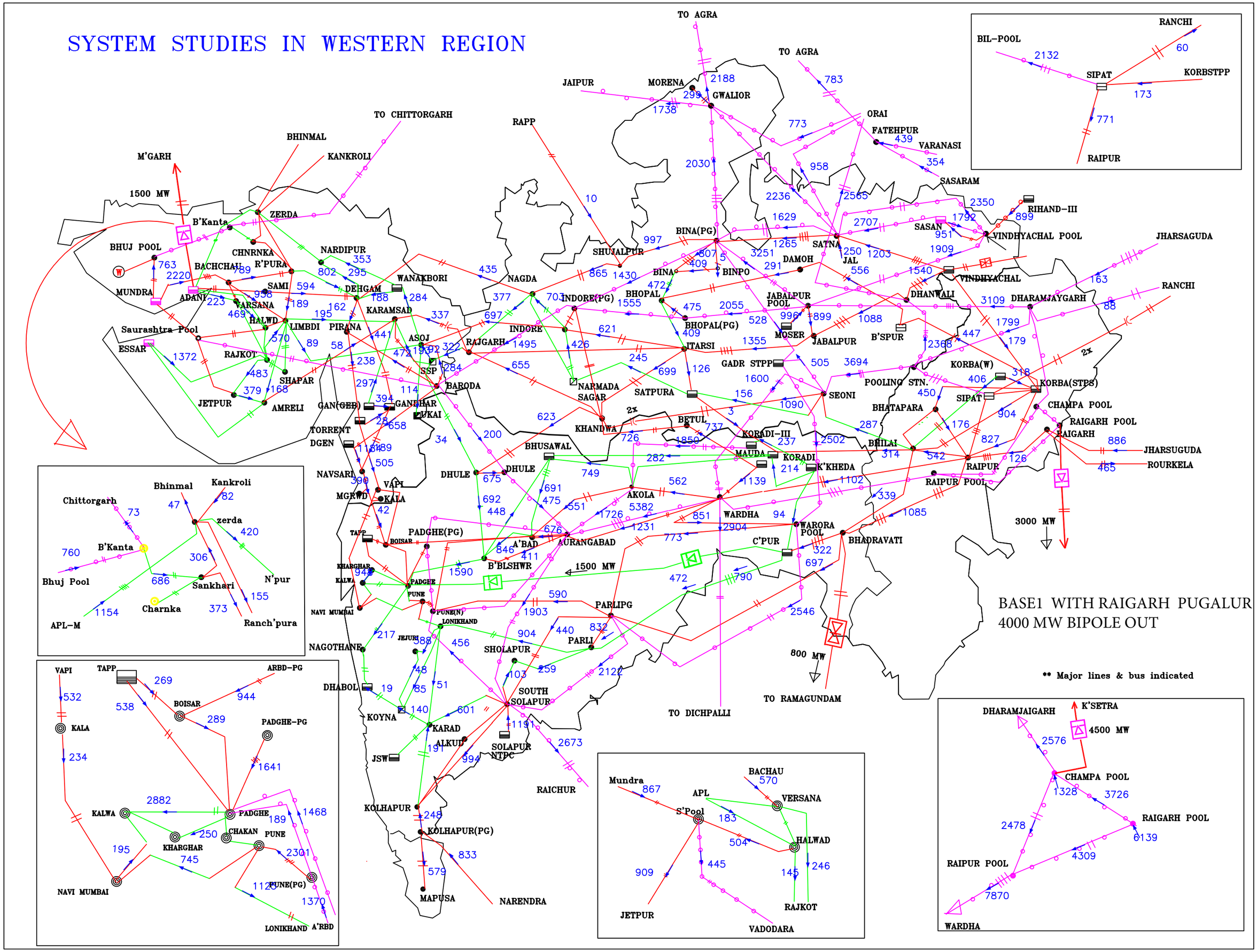


TO AGRA
TO AGRA
JAIPUR
MORENA
2205
298
GWALIOR
1716
764
TO CHITTORGARH
RAPP
ORAI
FATEHPUR
427
VARANASI
747
2057
343
966
SASARAM
BHINMAL
KANKROLI
M'GARH
1500 MW
2227
2512
2331
RIHAND–III
899
ZERDA
1605
2687
SASAN
1811
951
B'Kanta
BINA(PG)
968
VINDHYACHAL POOL
JHARSAGUDA
CHNRNKA
NARDIPUR
SHUJALPUR
1242
SATNA
1948
BHUJ POOL
359
792
3111
259
1184
DAMOH
R'PURA
774
301
405
281
JAL
544
1548
BACHCHAU
800
2194
785
BINA
BINPO
VINDHYACHAL
859
RANCHI
WANAKBORI
413
826
1373
456
MUNDRA
SAMI
588
DEHGAM
NAGDA
340
689
INDORE(PG)
BHOPAL
1488
JABALPUR POOL
DHANWALI
2853
DHARAMJAYGARH
ADANI
222
948
191
291
468
1979
996
868
1058
33
VARSANA
199
142
KARAMSAD
325
BHOPAL(PG)
423
1426
461
189
661
603
373
MOSER
B'SPUR
431
HALWD
LIMBDI
PIRANA
INDORE
1299
2245
191
Saurashtra Pool
567
82
53
408
ASOJ
427
JABALPUR
ESSAR
1368
RAJKOT
280
RAJGARH
1411
ITARSI
246
647
GADR STPP
392
3475
KORBA(W)
2x
480
476
319
SSP
96
661
1501
404
321
SHAPAR
374
166
281
106
BARODA
NARMADA SAGAR
SATPURA
150
POOLING STN.
KORBA(STPS)
JETPUR
AMRELI
GAN(GEB)
384
GANDHAR
UKAI
1065
SEONI
453
SIPAT
CHAMPA POOL
2x
32
BHATAPARA
900
RAIGARH POOL
35
608
579
BETUL
749
263
181
TORRENT
KHANDWA
738
KORADI–III
198
2285
BHILAI
838
RAIGARH
DGEN
115
556
11
1797
MAUDA
275
446
890
JHARSUGUDA
BHUSAWAL
264
KORADI
124
115
477
718
K'KHEDA
245
RAIPUR
NAVSARI
DHULE
DHULE
710
526
988
473
ROURKELA
330
VAPI
658
1127
RAIPUR POOL
MGRWD
KALA
643
596
531
AKOLA
5142
299
17
437
1658
750
WARDHA
98
953
3000 MW
TAPP
BOISAR
PADGHE(PG)
680
1183
WARORA POOL
BHADRAVATI
A'BAD
AURANGABAD
712
C'PUR
KHARGHAR
853
413
226
KALWA
B'BLSHWR
1553
1500 MW
633
PADGHE
440
724
PUNE
599
PARLIPG
NAVI MUMBAI
PUNE(N)
1487
2296
LONIKHAND
894
354
868
JEJURI
562
588
PARLI
NAGOTHANE
164
SHOLAPUR
800 MW
83
131
224
1796
DHABOL
73
50
9
SOUTH SOLAPUR
TO RAMAGUNDAM
TO DICHPALLI
252
571
KOYNA
KARAD
1192
1850
ALKUD
SOLAPUR NTPC
381
849
JSW
RAICHUR
KOLHAPUR
628
KOLHAPUR(PG)
1238
602
MAPUSA
NARENDRA

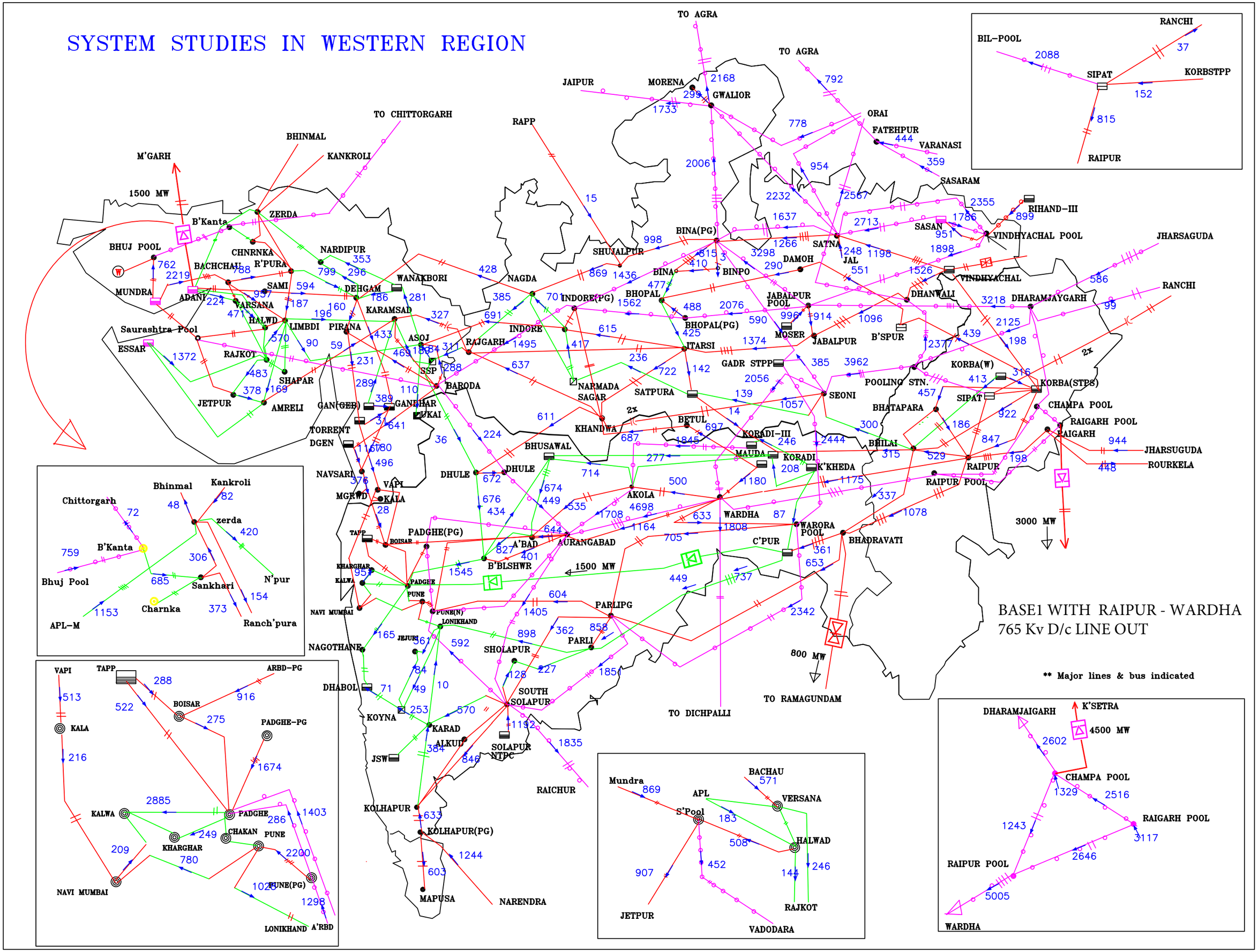
** Major lines & bus indicated

BASE CASE W/O SYSTEM STRENGTHENING : BASE1

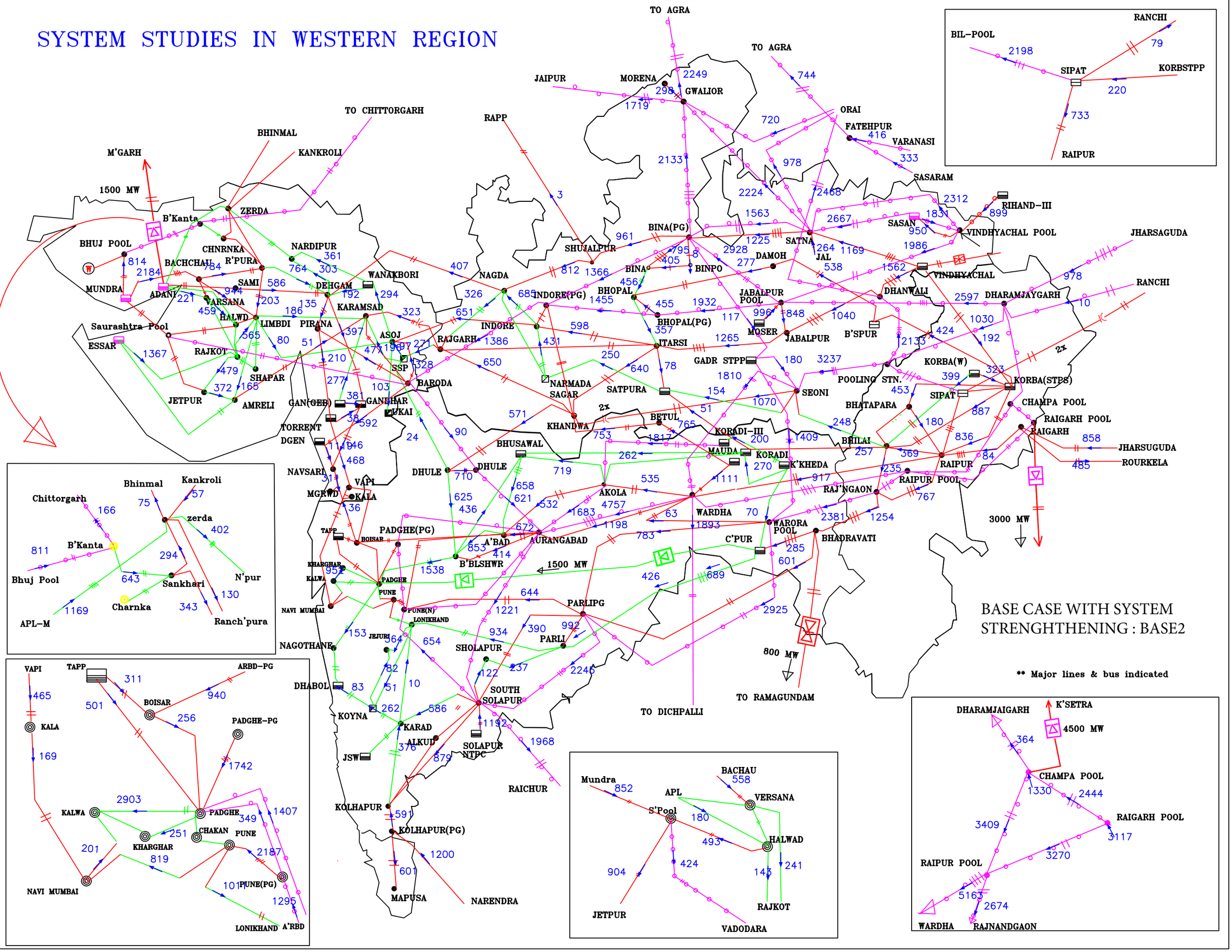
SYSTEM STUDIES IN WESTERN REGION



SYSTEM STUDIES IN WESTERN REGION



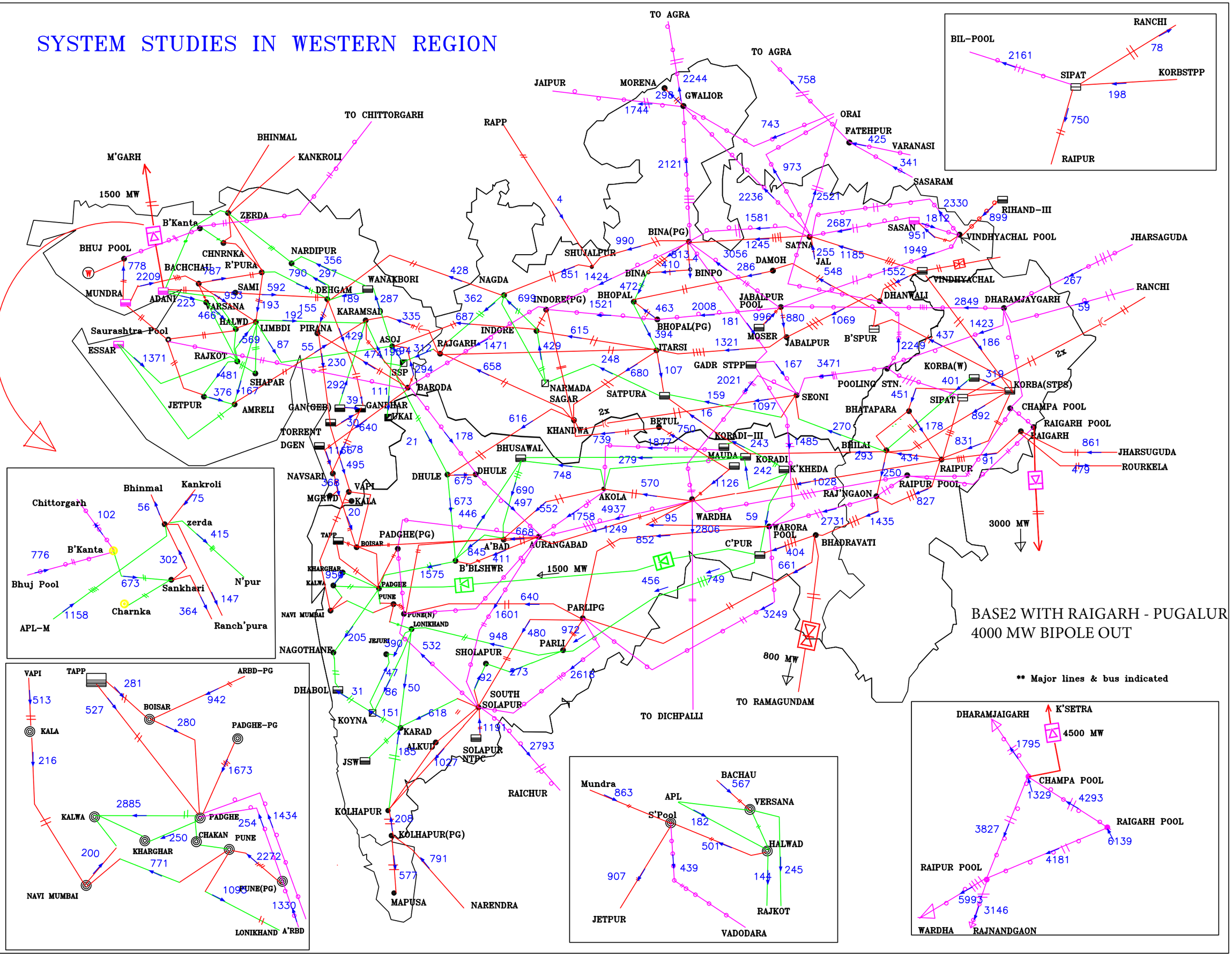
SYSTEM STUDIES IN WESTERN REGION



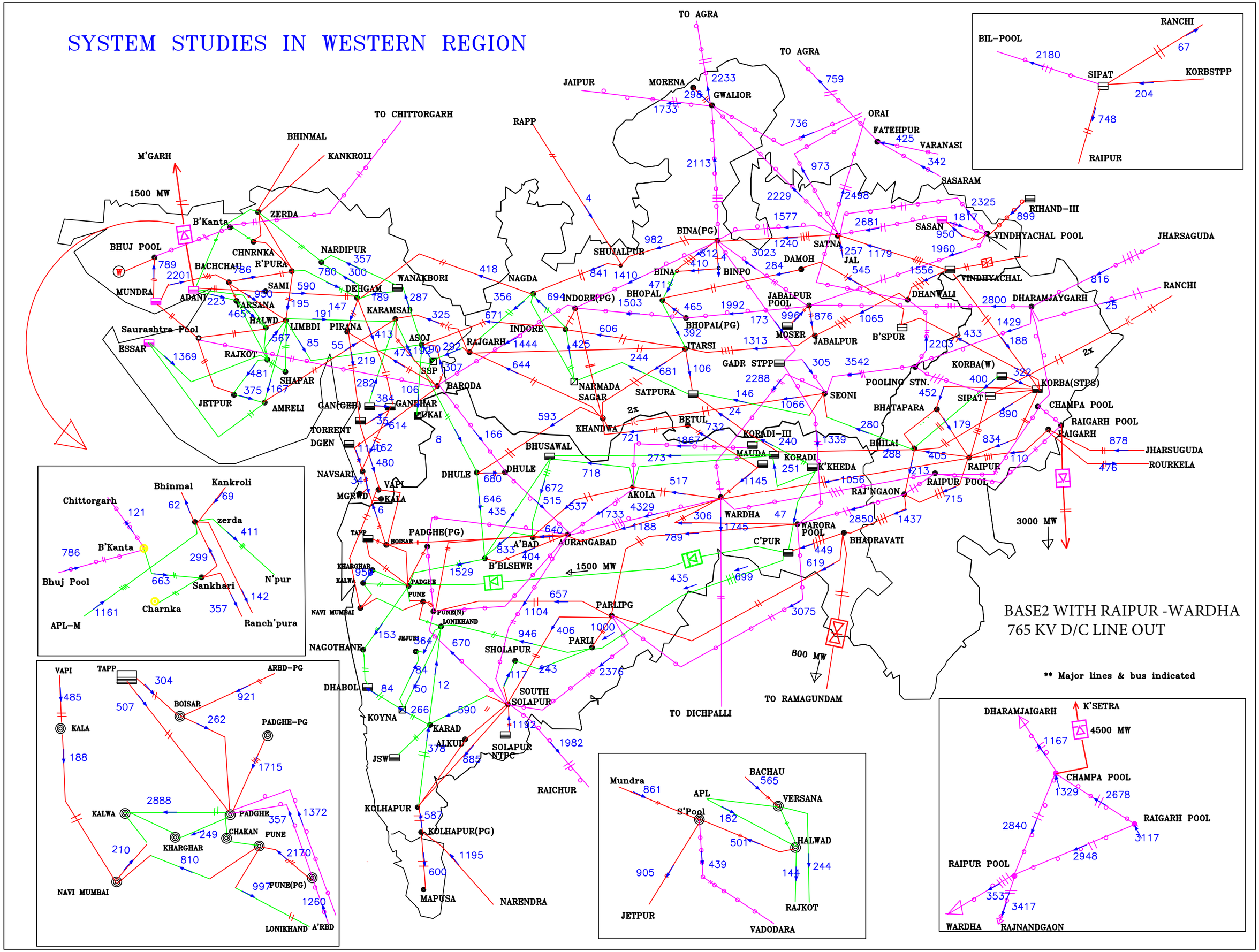
BASE CASE WITH SYSTEM STRENGHTHENING : BASE2

** Major lines & bus indicated

SYSTEM STUDIES IN WESTERN REGION



SYSTEM STUDIES IN WESTERN REGION



BASE2 WITH RAIPUR -WARDHA
765 KV D/C LINE OUT

** Major lines & bus indicated