

I/4909/2019



भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
विद्युत प्रणाली योजना एवं मूल्यांकन - I प्रभाग
Power System Planning & Appraisal - I Division

To

-As per list enclosed-

विषय: पश्चिमी क्षेत्र की ट्रांसमिशन पर स्थायी समिति की दूसरी बैठक के विषय में


Subject: 2nd meeting of Western Region Standing Committee on Transmission (WRSC) – Additional Agenda Note

Sir/ Madam,

In continuation to our earlier communication dated 02.05.2019 vide which agenda notes were circulated, it is intimated that Additional Agenda Note for 2nd Meeting of Western Region Standing Committee on Transmission is available on CEA website: www.cea.nic.in (path to access – Home Page –Wing- Power System- PSPA-I- Standing Committee on Power System Planning- Western region). The Date, Time and Venue of the meeting: **21-05-2019 at 10:00 hrs at Hotel Radisson Blu, Indore, Madhya Pradesh.**

Kindly make it convenient to attend the meeting.

Yours faithfully,


(Goutam Roy) 12/5/19
Chief Engineer

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1.	Member Secretary, WRPC, F-3, MIDC Area, Andheri (East), Mumbai – 400093 Fax – 022-28370193	2.	Managing Director, CSPTCL, Dangania, Raipur (CG)-492013 Fax - 0771 - 2574246/ 4066566	3.	Executive Engineer, Administration of Daman & Diu (U.T.), Department of Electricity, Moti Daman-396220
4.	Executive Engineer (Projects), UT of Dadra & Nagar Haveli, Department of Electricity Vidyut Bhavan, Amla, Silvassa - 396230	5.	Chief Engineer, Electricity Department, Government of Goa, Vidyut Bhavan, 3rd Floor, Panaji - 403001 Fax – 0832-222354	6.	Managing Director, GETCO, Sardar Patel Vidyut Bhawan, Race Course, Vadodara-390007 Fax - 0265-2338164
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**Additional Agenda note for 2nd Meeting of Western Region Standing Committee on
Transmission**

1. Transmission System for evacuation of Power from potential solar and wind energy zones in Western Region (17.5GW REZs [17GW Solar + 0.5GW Wind])

1.1. As per the agenda item 25 of the 2nd WRSCT, the assumptions and power flow study results along with proposed transmission system alternatives for evacuation of power from the various REZs in WR are given as under:

Study assumptions:

- i) **Time-frame:** Studies were carried out for the 2021-22 time frame
- ii) **Demand:** All India demand is considered as per the 19th EPS of CEA (2021-22). Based on the discussions & past trends, for solar maximized scenario, demand has been considered as about 90% of the peak demand of 19th EPS for various regions except for Northern region where it is considered as about 95% of the peak demand. In view of the above, demand of 61.5 GW has been considered in Western Region.
- iii) **Study considerations:** In the studies, all India transmission network up to 220 kV level has been simulated. This includes, existing and well as under construction transmission network incl. high capacity transmission corridors and Green Energy Corridors. The transmission planning criteria was generally followed for transmission design considerations. Considering envisaged RE (wind & solar) capacity addition and to achieve Load-generation balance, Thermal generation dispatch is reduced upto 55%, wherever required. At some of the locations, thermal generations are even needed to be backed down.
- iv) **Scenarios:** 70% Wind and 80% Solar has been considered on All India basis except in Rajasthan where wind dispatch is considered as 30%. Two scenarios have been studied for WR REZs:

- 80% Solar dispatch (Enclosed as Annexure-1)
- 100% Solar dispatch (Enclosed as Annexure-II)

1.2. Details of the transmission system:

A. Gujarat REZs [8GW Solar + 0.5GW Wind]

- (a) **Kutch (Rapar) SEZ 5000 MW (3000MW near Rapar and 2000MW near Lakadia (S/s augmentation at Lakadia already planned in the 1st WRSCT)) & Banskantha SEZ 2500 MW**

Alternative-1

Estimated cost: ~Rs. 5700Cr.

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- i) Establishment of 400/220 kV, 6x500MVA Kutch (Rapar) SEZ Pooling Point
- ii) Augmentation of Transformation capacity at Lakadia PS by 1x1500MVA, 765/400kV and 4x500MVA, 400/220kV ICTs for interconnection with SEZ
- iii) Establishment of 400/220 kV, 5X500 MVA Banaskantha SEZ Pooling Point
- iv) Establishment of 400 kV switching station at Patan
- v) Establishment of 765/400 kV, 2x1500 MVA at suitable location near Ahmedabad (towards eastern side of Ahmedabad)
- vi) Kutch (Rapar) SEZ PP- Lakadia 400 KV D/c line (Twin HTLS)
- vii) Kutch (Rapar) SEZ PP- Patan 400 kV 2xD/c line (Twin HTLS- multi circuit)
- viii) Banaskantha SEZ PP - Patan 400 kV D/c line (Twin HTLS)
- ix) Banaskantha SEZ PP - Sankhari 400 kV D/c line (Twin HTLS)
- x) Patan - Sami 400 kV D/c line (Twin HTLS)
- xi) Patan - Ahmedabad 400 kV 2xD/c line (Twin HTLS- multi circuit)
- xii) LILO of Pirana(T) – Pirana(PG) 400kV D/c line at Ahmedabad with twin HTLS along with reconductoring of Pirana – Pirana(T) line with twin HTLS conductor
- xiii) Ahmedabad – Indore 765 kV D/c line
- xiv) Ahmedabad – Vadodara 400 kV D/c line (Twin HTLS)
- xv) 220 kV line bays for interconnection of solar projects(25 nos)
- xvi) Associated Reactive Compensation (Line + Bus)
- xvii) Spare reactors and transformers

Alternative-2

Estimated cost: ~Rs. 5250Cr.

- i) Establishment of 765/400 kV, 3x1500 MVA & 400/220kV, 6x500MVA Kutch(Rapar) SEZ Pooling Point
- ii) Augmentation of transformation capacity at Lakadia PS by 1x1500MVA, 765/400kV and 4x500MVA, 400/220kV ICTs for interconnection with SEZ
- iii) Augmentation of transformation capacity at Radhanesda PS by 5X500 MVA, 400/220kV ICTs for interconnection with SEZ
- iv) Establishment of 765/400kV, 2X1500 MVA at suitable location near Ahmedabad (towards eastern side of Ahmedabad)
- v) Radhanesda PS - Sankhari 400 kV D/c line (Twin HTLS)
Or
Radhanesda PS – Banaskantha – Sankhari 400kV D/c corridor (Twin HTLS)
- vi) Kutch (Rapar) SEZ PP - Ahmedabad 765kV D/c line
- vii) LILO of Lakadia – Banaskantha 765kV D/c line at Kutch (Rapar) SEZ PP
- viii) LILO of Pirana(T) – Pirana(PG) 400kV D/c line at Ahmedabad with twin HTLS along with reconductoring of Pirana – Pirana(T) line with twin HTLS conductor
- ix) Ahmedabad – Indore 765 kV D/c line
- x) 220 kV line bays for interconnection of solar projects(25 nos)
- xi) Associated Reactive Compensation (Line + Bus)
- xii) Spare reactors and transformers

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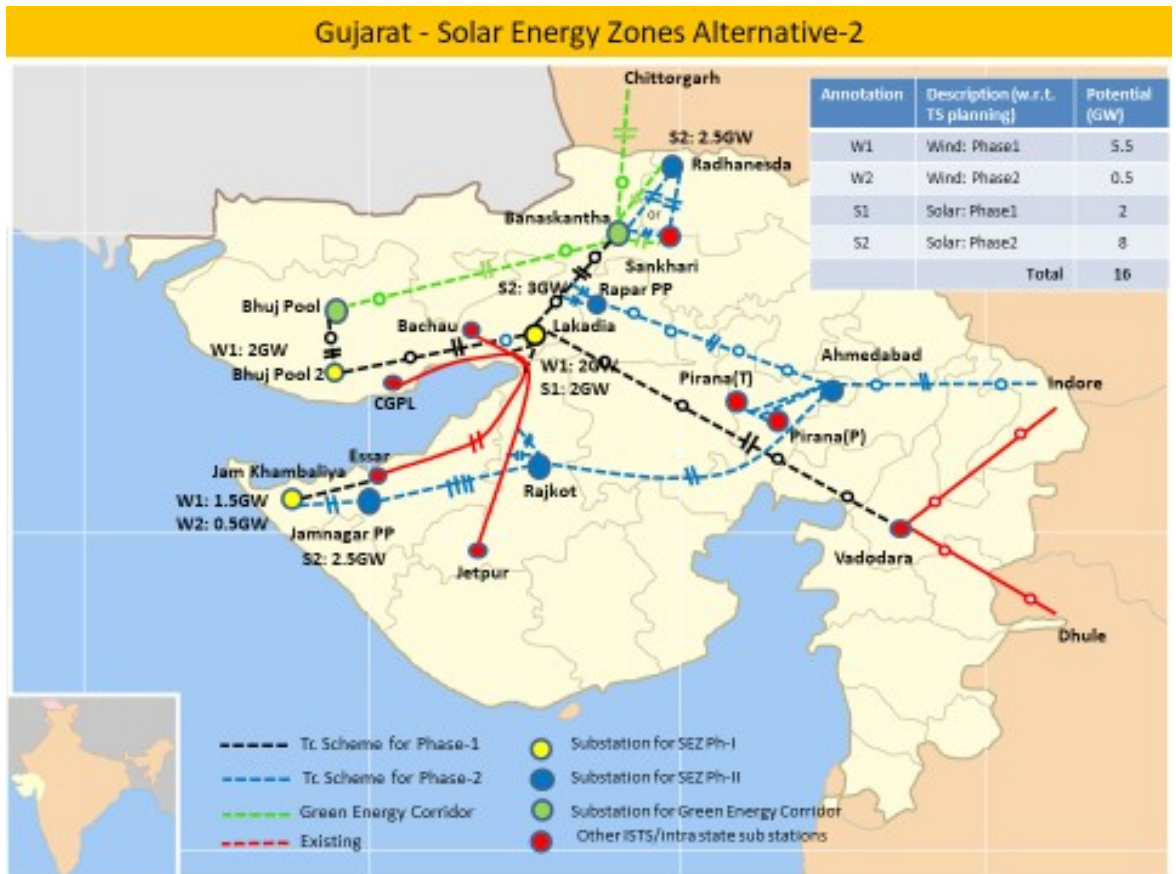
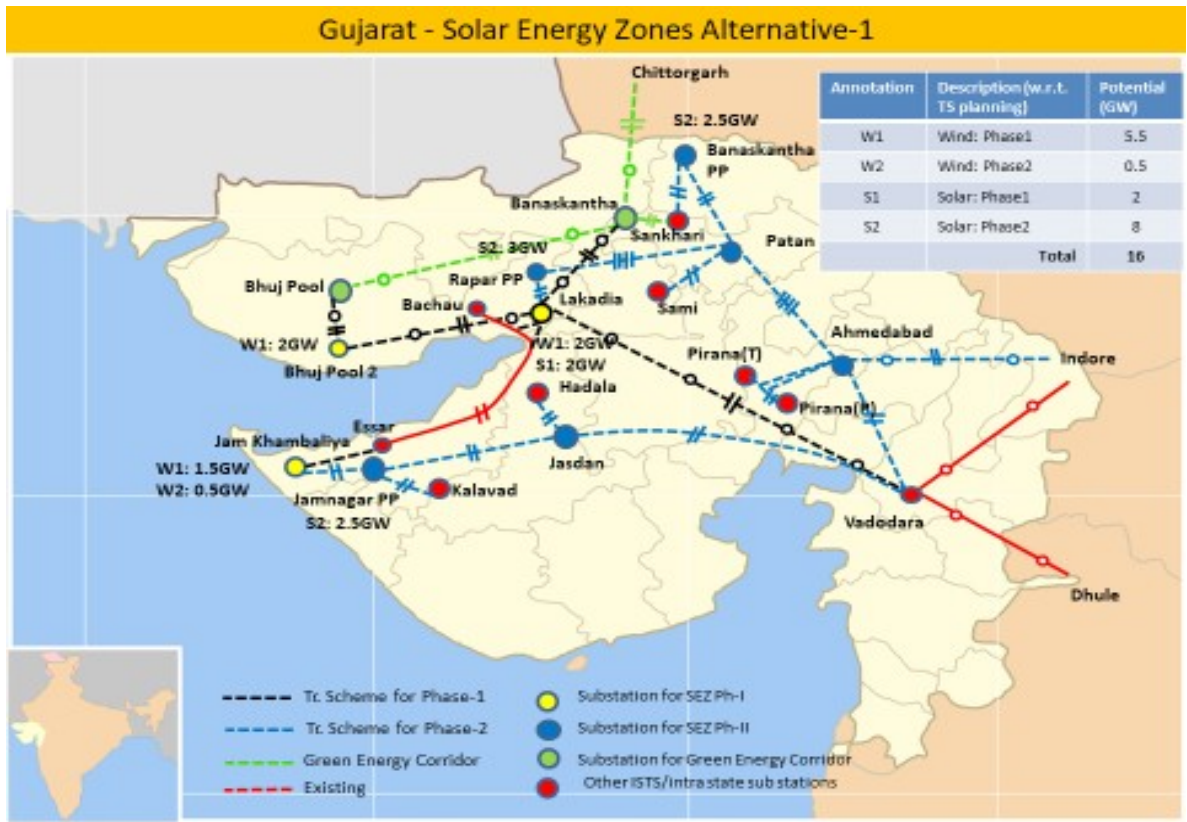
(b) Jamnagar SEZ 2500 MW**Alternative-1****Estimated cost: ~Rs. 1900Cr.**

- i) Establishment of 400/220 kV, 5X500 MVA at Lalpur (Jamnagar) SEZ PP
- ii) Establishment of 400kV switching station at Jasdan
- iii) Lalpur (Jamnagar) SEZ PP - Jasdan 400 kV D/c line (Twin HTLS)
- iv) Lalpur (Jamnagar) SEZ PP – Kalavad (GETCO) 400 kV D/c line (Twin HTLS)
- v) Lalpur (Jamnagar) SEZ PP – Jam Khambhaliya PS 400 kV D/c line (Twin HTLS)
- vi) Jasdan- Hadala (GETCO) 400kV D/c (Twin HTLS)
- vii) Jasdan – Vadodara 400 kV D/c line (Twin HTLS)
- viii) 220 kV line bays for interconnection of solar projects (8 nos)
- ix) Associated Reactive Compensation (Line + Bus)

Alternative-2**Estimated cost: ~Rs. 1300Cr.**

- i) Establishment of 400/220 kV, 5X500 MVA at Lalpur (Jamnagar) SEZ PP
 - ii) Establishment of 400kV switching station at Rajkot
 - iii) Lalpur (Jamnagar) SEZ PP - Rajkot 400 kV 2xD/c line (Twin HTLS)
 - iv) Lalpur (Jamnagar) SEZ PP – Jam Khamabliya PS 400 kV D/c line (Twin HTLS)
- Or
- v) LILO of Jam Khambhaliya – Lakadia 400kV D/c line at Lalpur (Jamnagar) SEZ PP along with Lalpur (Jamnagar) SEZ PP – Jam Khamabliya PS 400 kV 2nd D/c (triple) line
 - vi) LILO of CGPL- Jetpur 400 kV D/C(triple) at Rajkot
 - vii) Rajkot – Ahmedabad 400 kV D/c line (Twin HTLS)
 - viii) 220 kV line bays for interconnection of solar projects (8 nos)
 - viii) Associated Reactive Compensation (Line + Bus)

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B. Maharashtra SEZs [4GW Solar]

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(a) **Solapur SEZ 2500 MW (Phase-I (1000MW) + Phase-II (1500MW) under ISTS)**

Estimated cost: ~Rs. 400Cr.

Phase-I (1000MW)

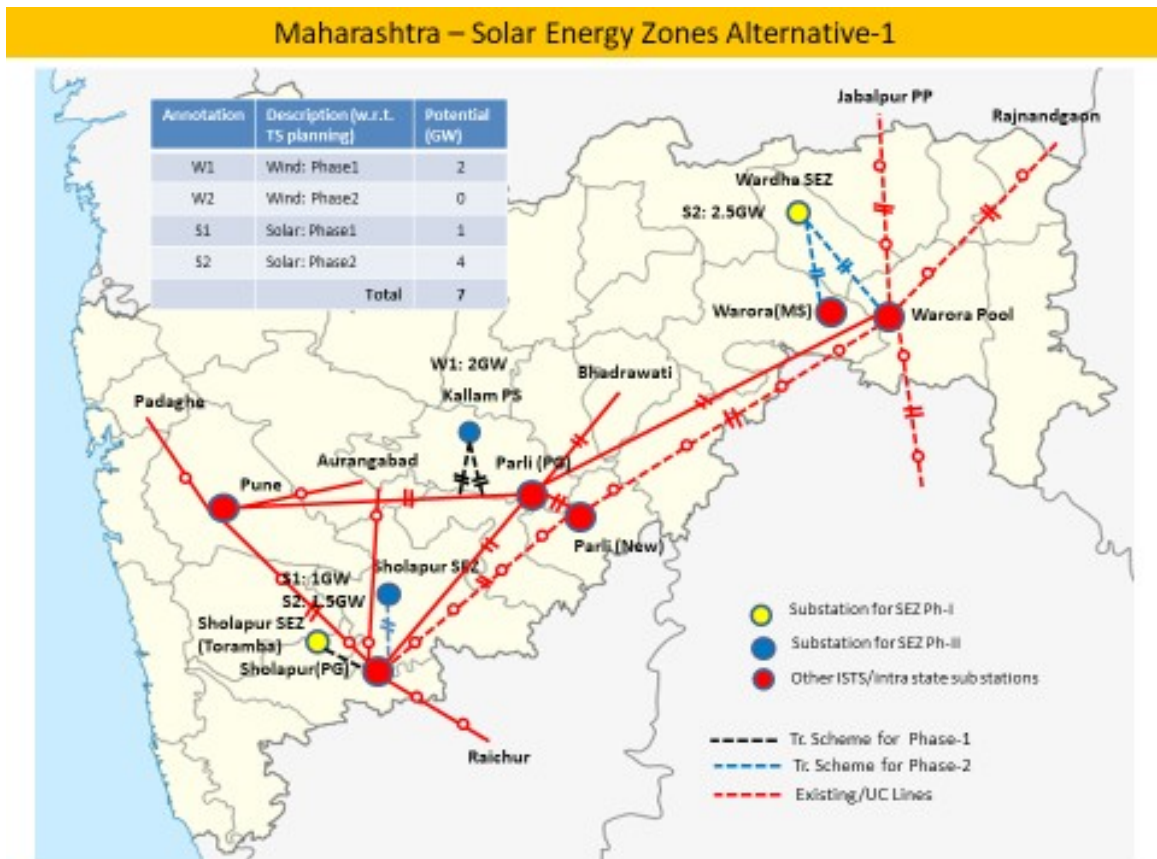
- i) Toramba – Solapur (PG) 400kV S/c line (dedicated line, of M/s TREPL with St-I connectivity of 900MW & St-II connectivity of 300MW)

Phase-II (1500MW) (under ISTS)

- i) Establishment of 400/220 kV, 2X500 MVA at Solapur PP*
 ii) Augmentation of 400/220 kV, Solapur PP with 1x500MVA, 400/220kV transformer
 iii) Solapur PP – Solapur(PG) 400 kV D/c line (Twin HTLS)*
 iv) 220 kV line bays for interconnection of solar projects(8 nos)
 v) 1x125 MVAR, 420 kV Bus Reactor at Solapur PP*

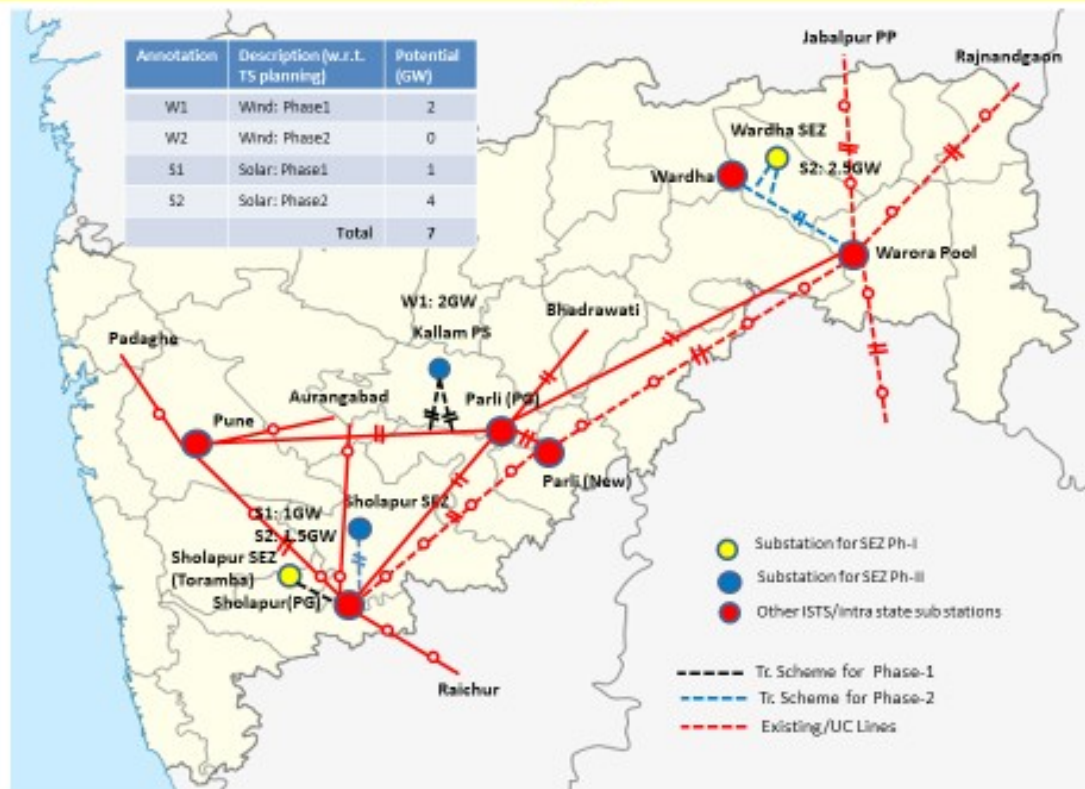
*Already agreed in the 1st WRSCT

Parli(PG) - Parli(MSETCL) 400kV D/c line is observed to be overloaded under N-1 condition. Line reconductoring may be considered.



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Maharashtra – Solar Energy Zones Alternative-2



(b) Wardha SEZ 2500 MW

Alternative-1

Estimated cost: ~Rs. 700Cr.

- Establishment of 400/220 kV, 5X500 MVA at Wardha SEZ PP
- Wardha SEZ PP - Warora Pool 400 kV D/c line (Twin HTLS)
- Wardha SEZ PP - Warora (MSETCL) 400 kV D/c line (Twin HTLS)
- 220 kV line bays for interconnection of Solar projects (8 nos)
- 1x125MVA bus reactor at Wardha SEZ PP

Alternative-2

Estimated cost: ~Rs. 500Cr.

- Establishment of 400/220 kV, 5X500 MVA at Wardha SEZ PP
- LILo of Wardha - Warora Pool 400 kV D/c (Quad) line at Wardha SEZ PP
- 220 kV line bays for interconnection of Solar projects (8 nos)
- 1x125MVA bus reactor at Wardha SEZ PP

C. Madhya Pradesh SEZs [5GW Solar]

(a) Rajgarh 2500 MW

Estimated cost: ~Rs. 800Cr.

- Establishment of 400/220 kV, 5X500 MVA at Rajgarh SEZ PP
- Rajgarh SEZ PP -Bhopal (Sterlite) 400 kV D/c line (HTLS)
- Rajgarh SEZ PP – Shujalpur 400 kV D/c line (HTLS)
- 220 kV line bays for interconnection of solar & wind projects (8 nos)
- 1X125 MVAR, 420 kV Bus Reactor at Rajgarh SEZ PP

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* Shujalpur(PG) - Shujalpur(MPPTCL) 220kV D/c line is observed to be overloaded under N-1 condition. The same may be reviewed.

(b) Khandwa SEZ: 2500 MW

Alternative-1

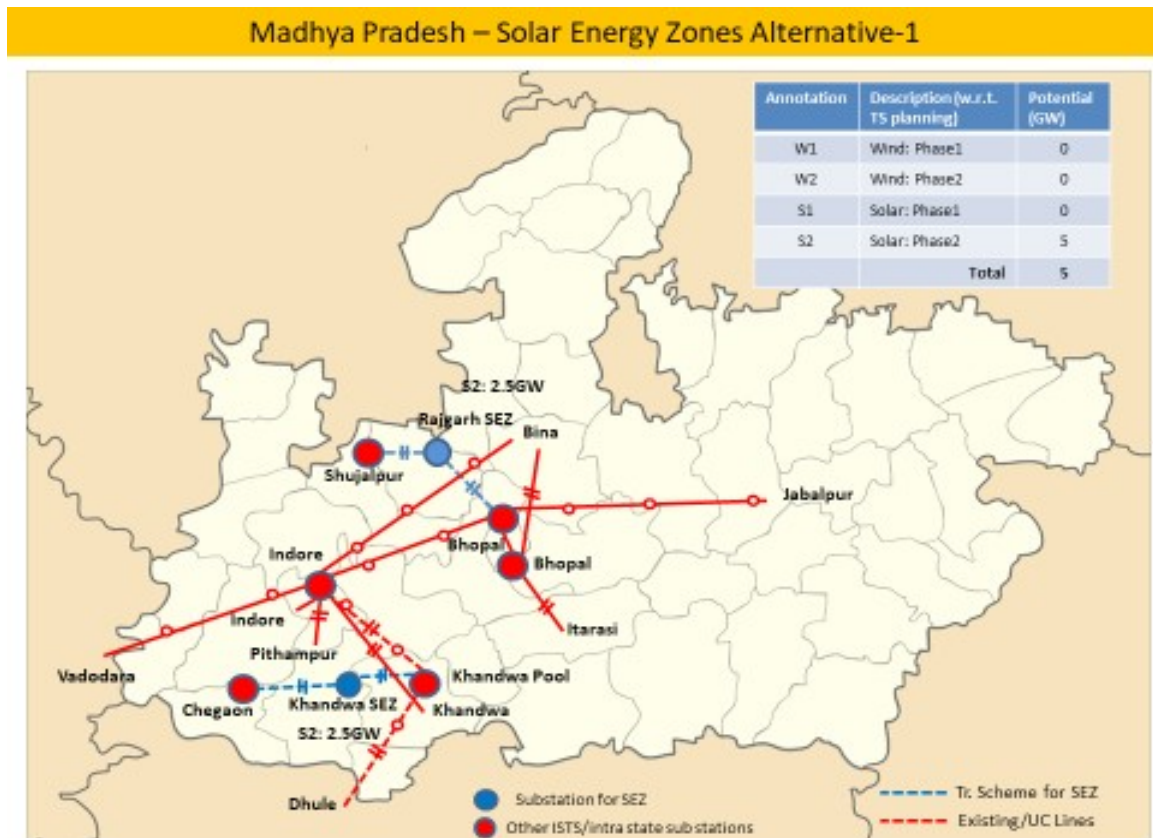
Estimated cost: ~Rs. 700Cr.

- i) Establishment of 400/220 kV, 5X500 MVA at Khandwa SEZ PP
- ii) Khandwa SEZ PP - Khandwa Pool D/c line (Twin HTLS)
- iii) Khandwa SEZ PP - Chegaon (MPPTCL) D/c line (Twin HTLS)
- iv) 220 kV line bays for interconnection of solar projects (8 nos)
- v) Associated Reactive Compensation

Alternative-2

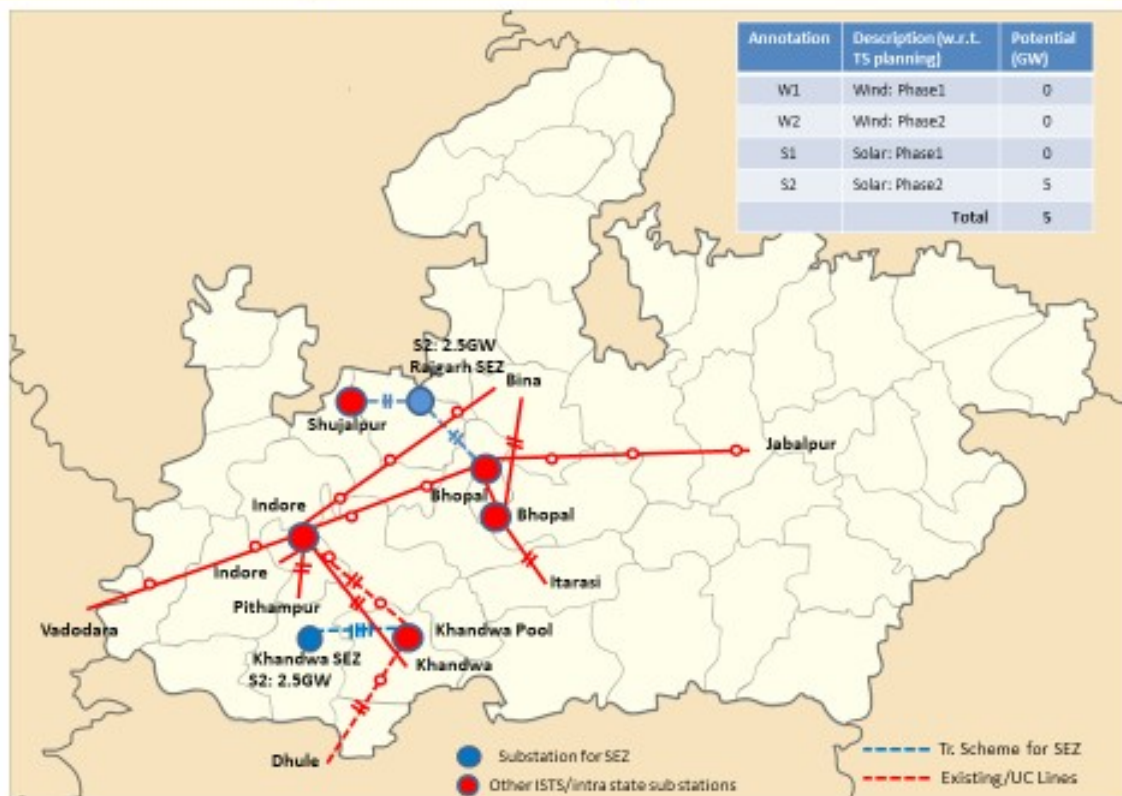
Estimated cost: ~Rs. 700Cr.

- i) Establishment of 400/220 kV, 5X500 MVA at Khandwa SEZ PP
- ii) Khandwa SEZ PP - Khandwa Pool 2XD/c line (Twin HTLS)
- iii) Augmentation of 1X1500 MVA, 765/400kV ICT at Khandwa Pool (Sterlite)
- iv) 220 kV line bays for interconnection of solar projects (8 nos)
- v) Associated Reactive Compensation



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Madhya Pradesh – Solar Energy Zones Alternative-2



Members may deliberate

2. **763MW LTOA granted to Karnataka Power Corporation Limited (2x800 MW) – agenda by CTU**
 - 2.1. KPCL, against their LTOA application of Dec, 2008 under the CERC Regulation 2004, was earlier granted LTOA vide intimation (revised) dated Aug, 2011 for 763 MW transfer of power from its 2x800 MW generation project in Janjgir-Champa, Chhattisgarh to Southern Region. Further, the BPTA was signed on 05.01.2011. As per the grant of LTOA, (i) target beneficiaries were Southern Region for entire 763 MW (ii) the commissioning schedule for generation project was Sept, 15 and March, 2016. In the time frame of the grant of above LTOA, Southern region was projected to be in huge surplus on account of large number of proposed generation projects in SR having target beneficiaries in WR & NR. Therefore, the power transfer to SR from the project was planned through displacement. Accordingly, the transmission system associated with the grant of above LTOA included upgradation of ± 800 kV 3000 MW HVDC bipole link to 6000MW along with downstream network in NR.
 - 2.2. During the 20th SR Conn/LTA meeting held on 13.07.2016, it was observed that the generation project is yet to receive environmental clearance and its time-frame in uncertain. Accordingly, considering the present load generation scenario and the progress of the generation project, it was decided to delink the project from Champa-Kurukshetra HVDC link and modify the LTA intimation with under construction transmission lines between NEW-SR Grid after the commissioning schedule of the generation project attains certainty.

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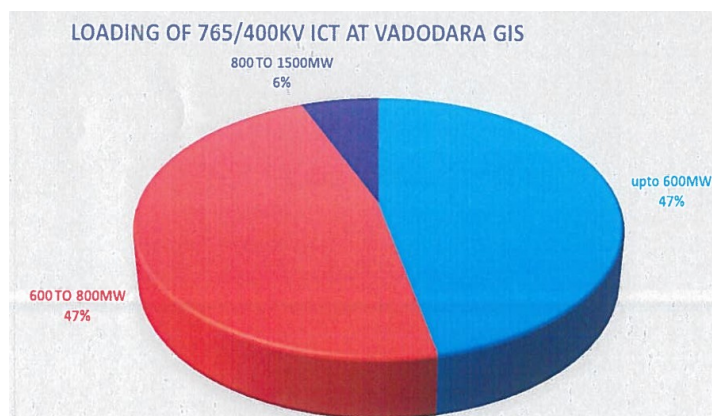
- 2.3. The progress of the generating station is being reviewed continuously in the various JCC meetings of WR and the status of the project remains uncertain with MoEF clearance still awaited for want of coal linkage (as per the status reported by KPCL vide letter dated 15.03.2019).
- 2.4. In view of the adverse progress of the generating station, it is proposed to cancel the grant of 763MW LTOA to M/s KPCL and encash the bank guarantee. M/s KPCL may apply afresh for LTA as and when it gains clarity on the progress of its generating station.
- 2.5. Members may deliberate
- 3. Requirement of Transformer Augmentation in Western Region – agenda by CTU**
- 3.1. As per the operational feedback report of NLDC (January, 2019), several 400/220kV ICTs in WR are getting critically loaded in current time frame. In case of tripping of one ICT in that S/s, the situation becomes critical as the parallel ICT gets overloaded as per the details given below:
- i) **2x315MVA, 400/220kV ICTs at Bhatapara:** ICTs becomes N-1 non compliant when total loading goes above 430MW. Matter was taken up in the 37th WRPC meeting and it was decided to take it up in the next WRSCT
 - ii) **2x315MVA, 400/220kV ICTs at Raigarh:** ICTs becomes N-1 non compliant when total loading is above 400MW.
 - iii) **2x315MVA, 400/220kV ICTs at Morena:** ICTs becomes N-1 non compliant when total loading is above 440MW.
 - iv) **2x315 +1x500 MVA ICTs at Satna:** ICTs becomes N-1 non compliant when total loading is above 730MW
 - v) **2x315MVA, 400/220kV ICTs at Seoni:** ICTs becomes N-1 non compliant when total loading is above 380MW.
- 3.2. In addition to the above, ICTs at Itarsi, Kala and Wardha were also reported to be critically loaded. However, additional transformer at Kala has already been charged in Nov' 18 and that at Itarsi has been planned in the 1st WRSCT meeting. Further, with the implementation of the scheme to control fault level at Wardha S/s, the ICT loading is observed to significantly reduce.
- 3.3. Studies have been carried out in 2022-23 time frame considering all existing and planned systems and the list of transformers with high anticipated loadings and which violate n-1 criteria is given below:

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Sl. / TRANSFORMER			EXISTING /PLANNED TRANSFORMERS (MVA)	CURRENT TIME FRAME	2022-23 TIME FRAME	
				PEAK LOADING (MW)	PEAK LOADING (MW)	N-1 Outage loading (MW)
1	Bhatapara	400/220kV	2x315	2x215	2x200	1x290
2	Raigarh*	400/220kV	2x315	2x200	2x208	1x322
3	Morena	400/220kV	2x315	2x220	2x240	1x346
4	Seoni	400/220kV	2x315	2x190	2x220	1x345
5	Satna	765/400/220kV	2x315+1x500	2x200+1x320	2x203+1x322#	2x315 (500MVA ICT out)#
6	Padghe(GIS)	765/400kV	2x1500	2x550	2x1050	1565

*Additional outlets from Raigarh (PG) substation need to be planned by CSPTCL in addition to Raigarh(PG) – Raigarh(CSPTCL) 220kV D/c line in order to avoid overloading on this line in future

- 3.4. The above loading on Satna is observed without considering the Chhatarpur 400/220kV substation which was planned in the 40th WR SCM and subsequently put on hold in the 42nd WR SCM held on 17.11.2017 till there is clarity on time-frame of requirement of Bijawar S/s from MPPTCL.
- 3.5. In addition to the above ICTs, it has been observed that the loading on the 2x1500MVA 765/400kV ICTs at Vadodara is steadily increasing. Further, during the recent outage of one of the ICTs on 28.06.2018, WRLDC had taken measures towards load curtailment / reduction in TTC. Loading of the ICTs was analyzed from Jan'18 to Aug'18 and following loading pattern was observed:



- 3.6. Studies were carried out in 2022-23 time frame peak load file and the loading on the ICTs was observed to be 2x700MW (N-1: 1147MW). Further, under low generation in Western Part of Gujarat (APL(Mundra) / CGPL etc), the loading further aggravates to 2x920MW (N-1: 1510MW). Hence, it is observed that the ICTs become N-1 insecure under low Mundra generation scenario.

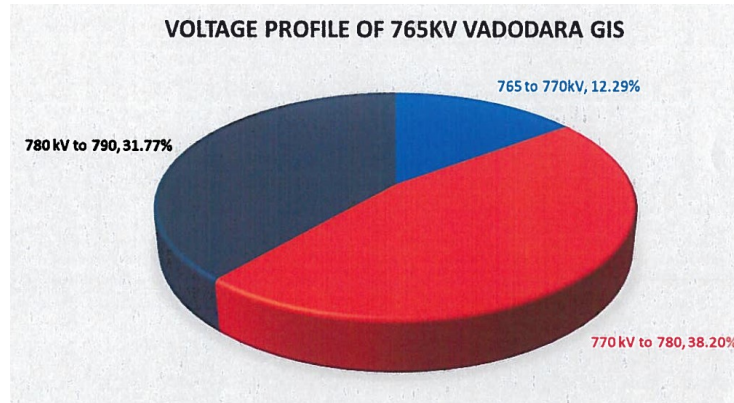
Members may deliberate regarding requirement of additional ICTs at above substations.

4. Requirement of additional 765kV Bus Reactors at Vadodara GIS & Raipur Pool Substations – agenda by CTU

- 4.1. The 765kV bus voltage at Vadodara GIS S/s generally remains high and the Vadodara – Dhule 765kV S/c line is often taken out of service by WRLDC for voltage control

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during night hours. As per the operational feedback report of Jan'19, the line was opened 36 times during the Q3 of 2018-19. The voltage profile was analyzed from Jan'18 to Aug'18 and following voltage pattern was observed:



Further, the issue of high voltage at Raipur Pool (Durg) 765kV S/S was deliberated in the 498th OCC meeting of WRPC held on 22.08.2017, wherein, it was decided that the issue be referred to the standing committee on Power System Planning. As per the operational feedback report of Jan'19, the Raipur Pool – Wardha 765kV D/c line (ckt. 2) was opened 8 times during the Q3 of 2018-19 to control the overvoltages. The matter was deliberated in the 42nd WR SCM held on 17.11.2017 wherein it was observed that the requirement of bus reactor at Raipur PS shall be further reviewed.

- 4.2. The voltages observed at Vadodara and Raipur PS 765kV buses in 2022-23 off-peak time-frame with and without 240MVar bus reactor is as given below:

Sl.	Substation	Existing BR (MVar)	Voltage level (kV)	Voltage without addl 240MVar Bus reactor (kV)	Voltage with addl 240MVar Bus reactor (kV)	Sensitivity (kV)
1	Vadodara	1x240	765	795	786	9
2	Raipur PS	1x240	765	788	785	3

Members may deliberate

5. Commissioning of Solar Farms without Power Plant Controllers (PPC)- agenda by POSOCO

- 5.1. In Western Region, Solar Park of 750MW by RUMSL (Rewa Ultra Mega Solar Limited) at Rewa, Madhya Pradesh is under commissioning phase and part capacity has been commissioned. This Solar park is having three SPDs (Solar park developers) namely ACME, Arinsun & Mahendra with capacity of 250MW each.

As per CEA standard (2013)

“B2. For generating station getting connected on or after completion of 6 months from date of publication of these Regulations in the Official Gazette.

(1) The generating station shall be capable of supplying dynamically varying reactive power support so as to maintain power factor within the limits of 0.95 lagging to 0.95 leading.”

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- 5.2. Recently as per discussion with Mahindra (the SPD) regarding the dynamic VAR compensation by solar park, it was understood that the plant cannot provide the dynamic VAR compensation as PPC (Power Plant Controller) is not available and was not envisaged during the planning phase. However solar park can provide the reactive power support as per system requirement whenever required, but it would be manual. *It is felt that these provisions have to be taken care during the phase of giving connectivity to solar parks.*

Committee may discuss

6. Very High Voltages in the System- agenda by POSOCO

- 6.1. In Western region grid, the peak to off-peak demand variation is around 10000MW to 15000MW. During the off peak hours, very high voltages are observed in the grid resulting into opening of many EHV lines (400kV & 765kV) to control high voltage in the Grid. To arrest the voltage rise in the system, various actions are being taken by system operator on a daily basis vis-a vis:

- Taking all Bus Reactors into service,
- Instruction to SLDCs for Switching off capacitor banks at lower voltage level,
- Instructing generating stations to absorb VAR as per their capability curve.

If high voltages still prevails after the above actions, as a last resort lightly loaded/less important EHV lines are being opened. Number of transmission lines opened on High voltage on daily basis during the fourth quarter of 2018-19 is given in figure-1. Further wherever possible the switchable line reactors are utilized as Bus reactor after opening these lines.

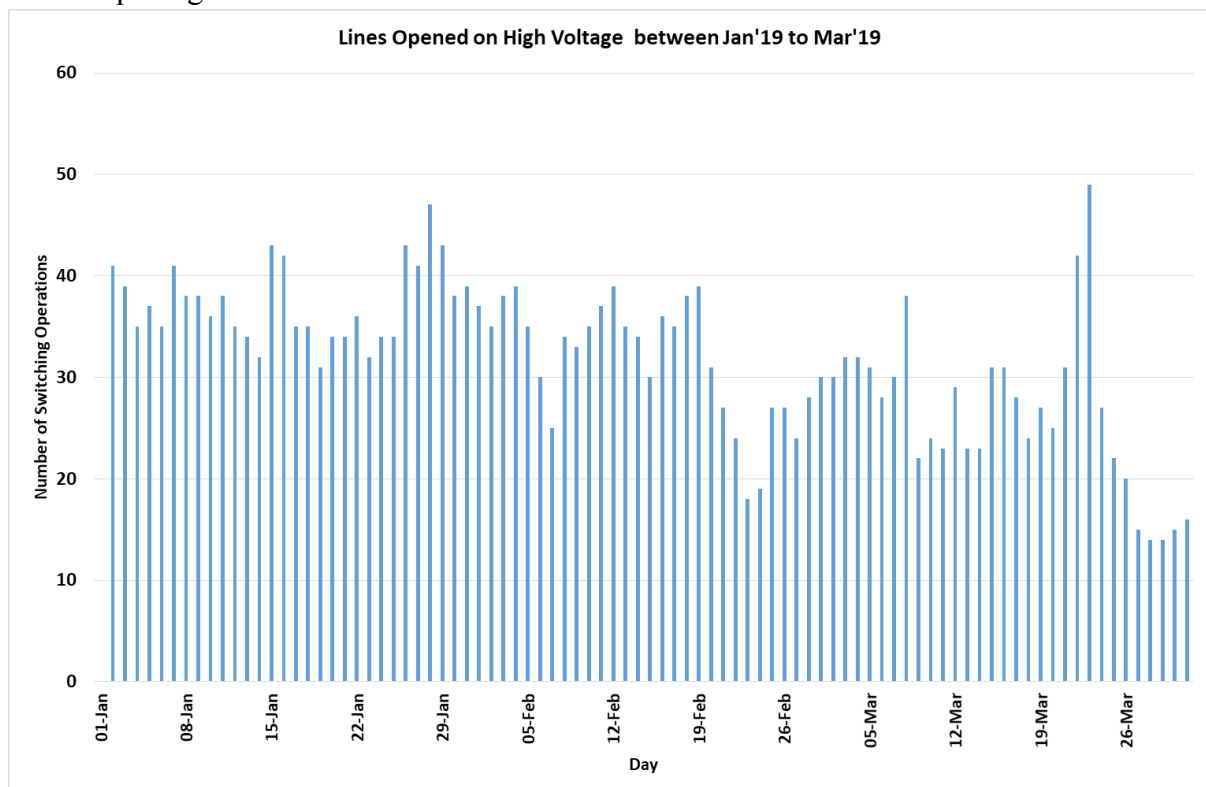


Figure 1 Lines kept opened on high voltage on Daily Basis in Western Region

- 6.2. Some of the lines having line reactors which are being opened regularly to control the high voltages in the system are given below:-

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Sr. No	Voltage (kV)	Transmission Line Name	No of Ckts Kept out to control HV	LR as BR provision not available as intimated by utility	Un-utilized MVAR Capacity as per system requirement
1	765	Aurangabad-Wardha Ckt-1,2,3,4	one, sometimes two	Aurangabad PG end	240
2	765	Warora PS-New Parli Ckt-1,2	one	New Parli end	330
3	765	Raipur PS(Durg)-Wardha Ckt-1,2,3,4	two	Wardha PG end	660
4	765	Raigarh PS(Kotra)-Raipur PS(Durg) Ckt-1,2	one	Raipur PS(Durg) end	240
5	765	Vadodara(PG)-Dhule(BDTCL)-S/C	-	Vadodara PS end	240
6	765	Aurangabad (PG) - Padghe (PG) Ckt-1,2	one	Padghe GIS end	240
7	400	Kosamaba-Chorania	one	Both ends	113
8	400	Aurangabad PG-Boisar Ckt-1,2	one	Boisar PG end	80
9	400	Chandrapur(II)-Nanded Ckt-1,2	one	Chandrapur(II) end	50
10	400	Chandrapur-Parli Ckt-3	-	Both ends	100
11	400	Sugen-Pirana	-	Pirana end	50
Sub Total (MVAR un utilized)					2343

6.3. Provision for taking these line reactors as bus reactors would further help the system operator to control the high voltages in the grid.

Members may deliberate.

7. Commissioning of Switchable Line reactors with NGR Bypass & CSD- agenda by POSOCO

7.1. Recently in the Western Region the TBCB project 765kV Rajnandgaon-Warora PS D/c line (Hexa Zebra) has been commissioned with Switchable Line reactors (SLR) at both ends. Rajnandgaon- 2x330MVAR SLR is owned by RRWTL (a subsidiary of Adani), Warora PS 2x240MVAR SLR is owned by WKTL (a subsidiary of Essel).

7.2. During real time grid operation when the 765kV Rajnandgaon-Warora one circuit was opened to control the voltage profile of the system and when transmission licensee (RRWTL/WKTL) was instructed to convert the line reactor as Bus reactor, it was informed by them that these reactors cannot be taken as Bus reactor as NGR bypass and CSD (control switching device) are not available/commissioned for these switchable line reactors.

7.3. It is suggested that wherever switchable line reactors are being planned with EHV lines, there shall be provision of NGR bypassing along with CSD, so that these

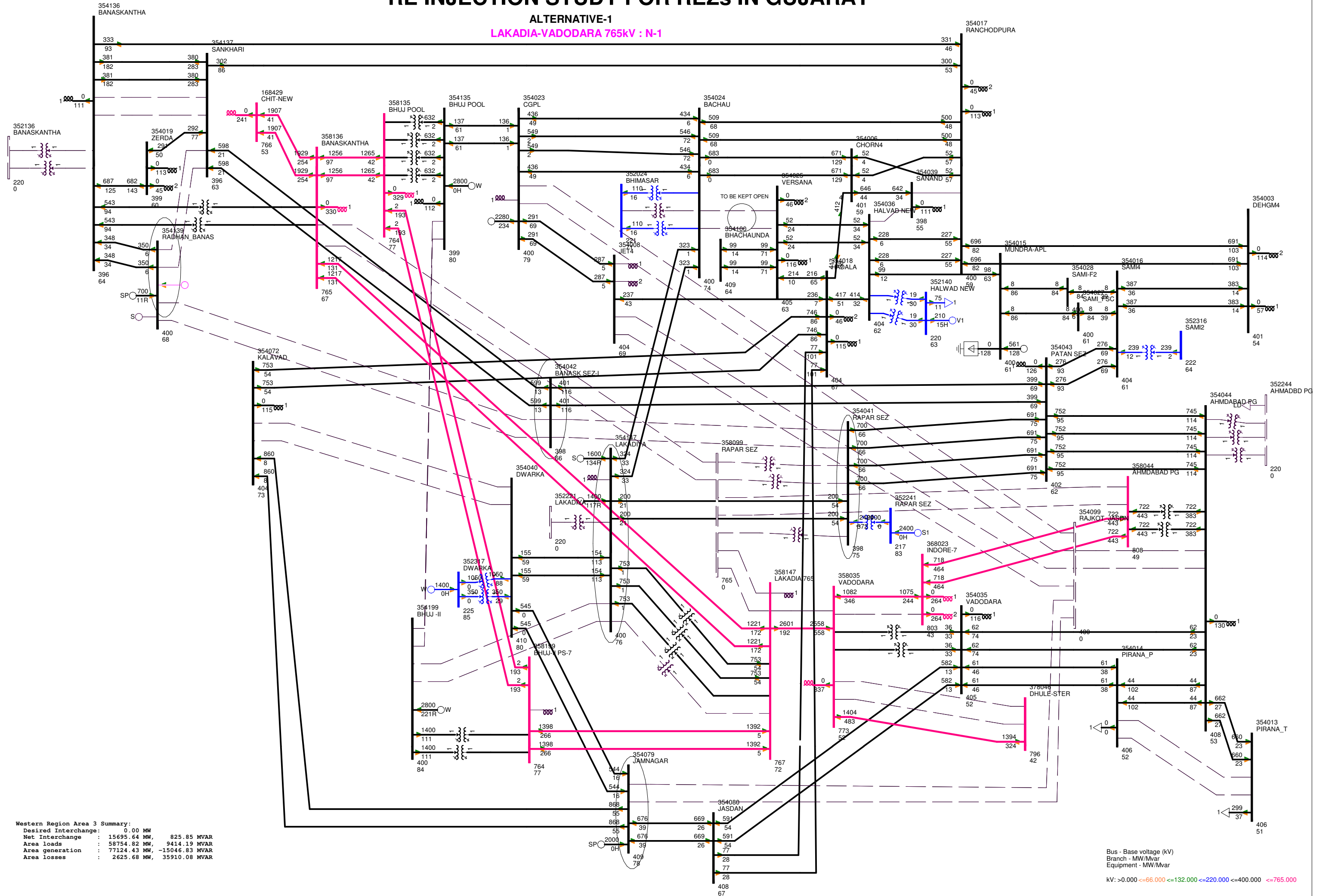
I/4909/2019

switchable line reactors can be utilized as Bus reactors as and when required in the system.

Members may deliberate.

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-1
LAKADIA-VADODARA 765KV : N-1



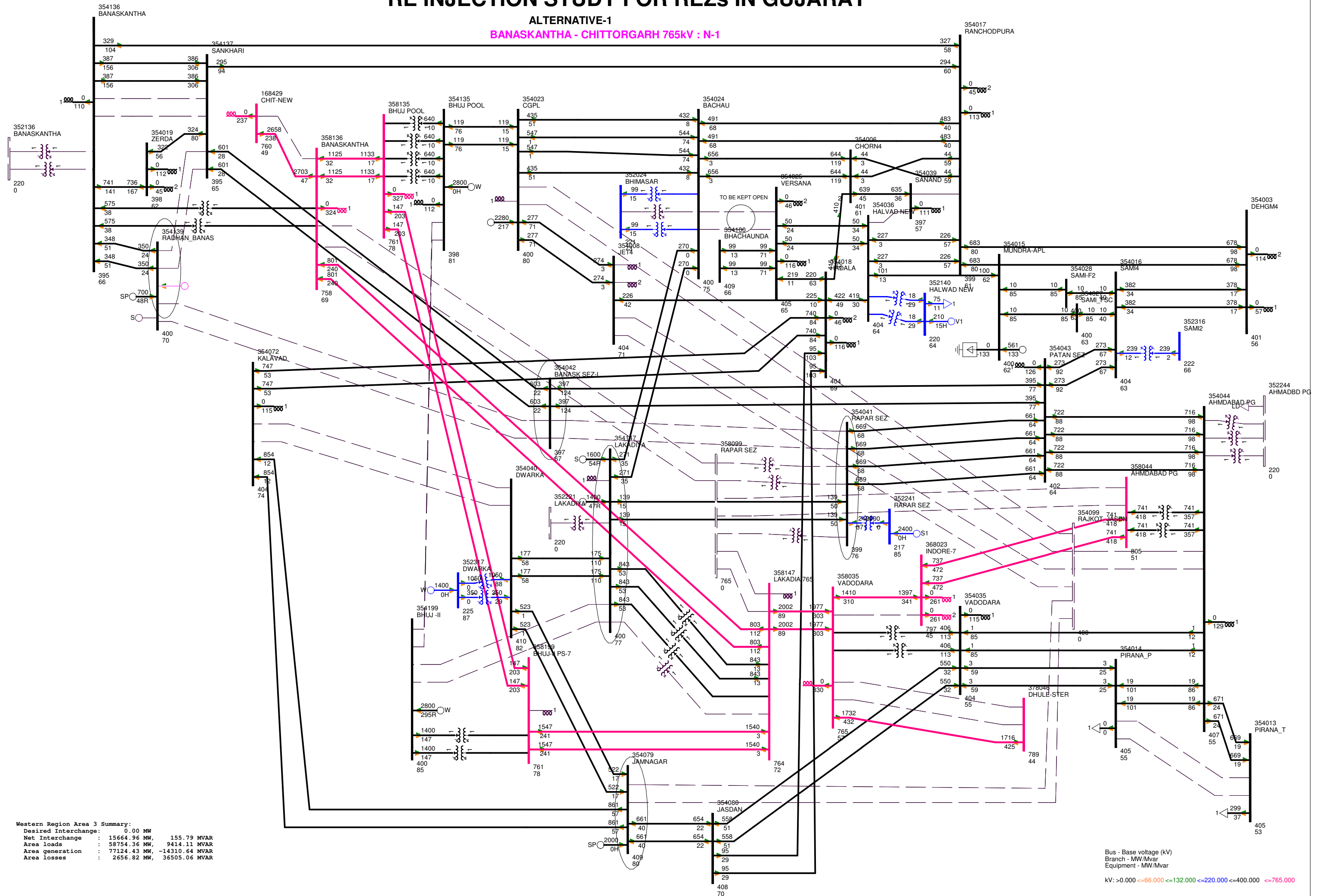
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 15695.64 MW, 825.85 MVAR
 Area loads : 58754.82 MW, 9414.19 MVAR
 Area generation : 77124.43 MW, -15046.83 MVAR
 Area losses : 2625.68 MW, 35910.08 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-1

BANASKANTHA - CHITTORGARH 765KV : N-1



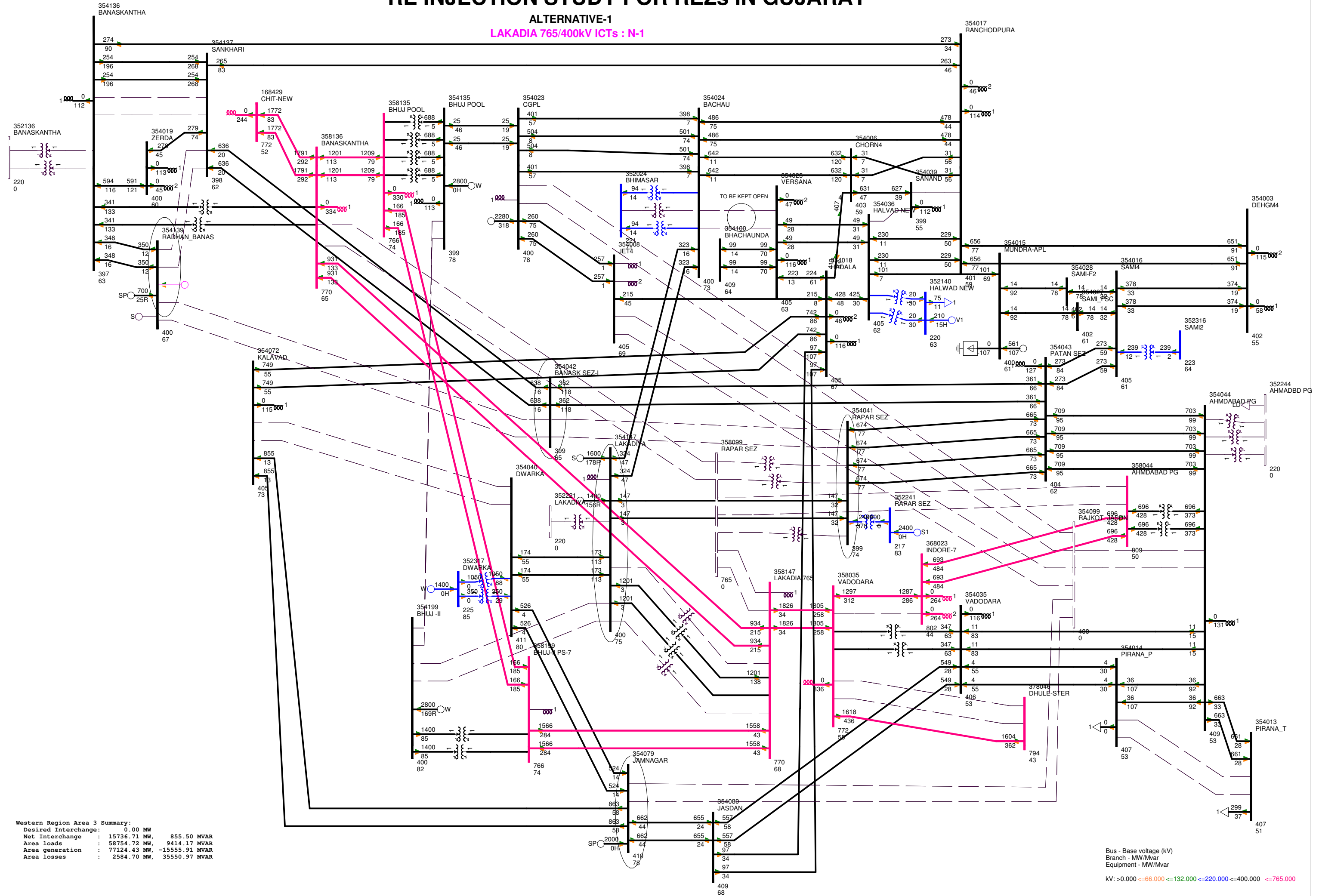
Western Region Area 3 Summary:

Desired Interchange:	0.00 MW
Net Interchange:	15664.96 MW, 155.79 MVAR
Area loads:	58754.36 MW, 9414.11 MVAR
Area generation:	77124.43 MW, -14310.64 MVAR
Area losses:	2656.82 MW, 36505.06 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-1
LAKADIA 765/400KV ICTs : N-1

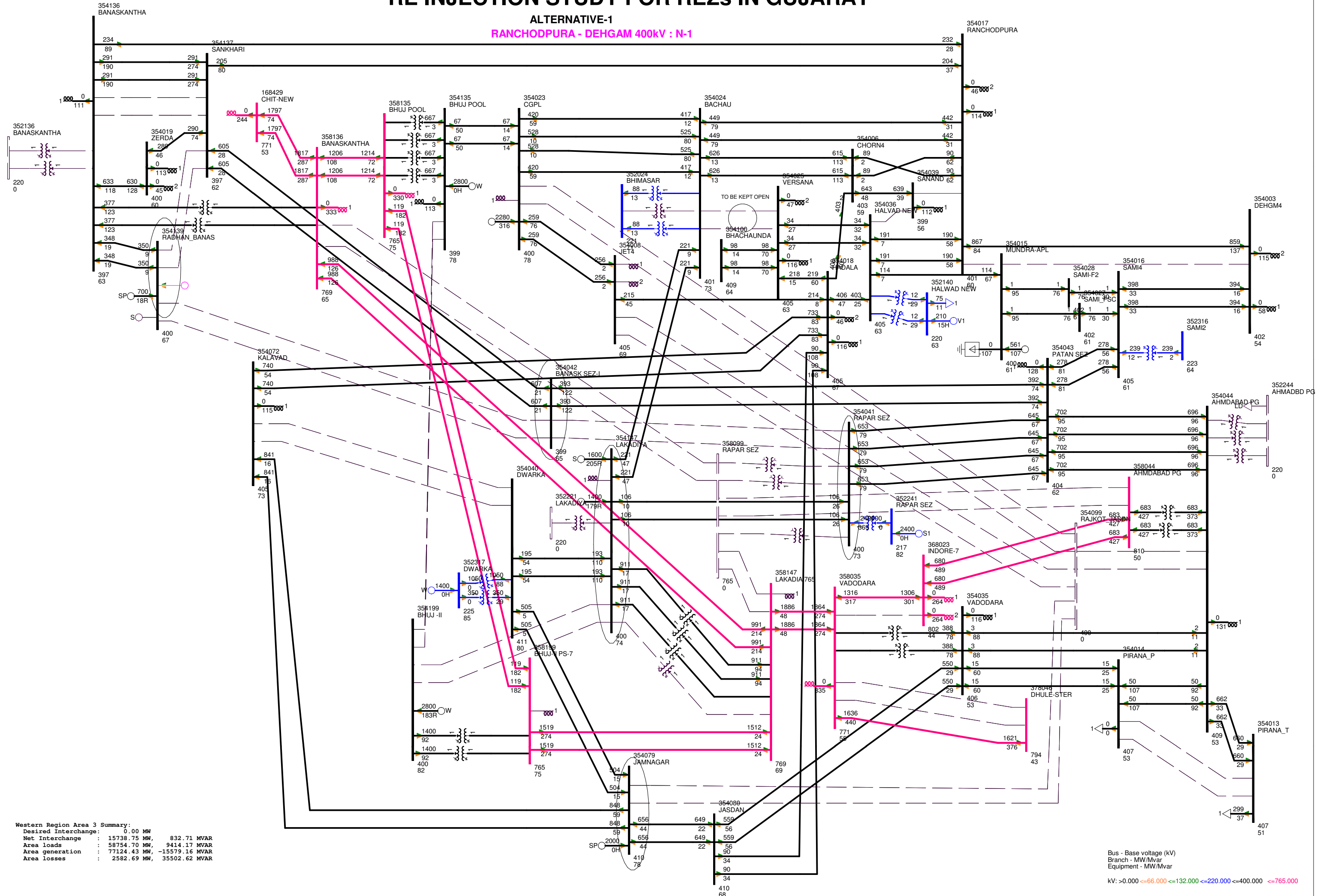


Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 15736.71 MW, 855.50 MVAR
 Area loads : 58754.72 MW, 9414.17 MVAR
 Area generation : 77124.43 MW, -15555.91 MVAR
 Area losses : 2584.70 MW, 35550.97 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-1 RANCHODPURA - DEHGAM 400KV : N-1

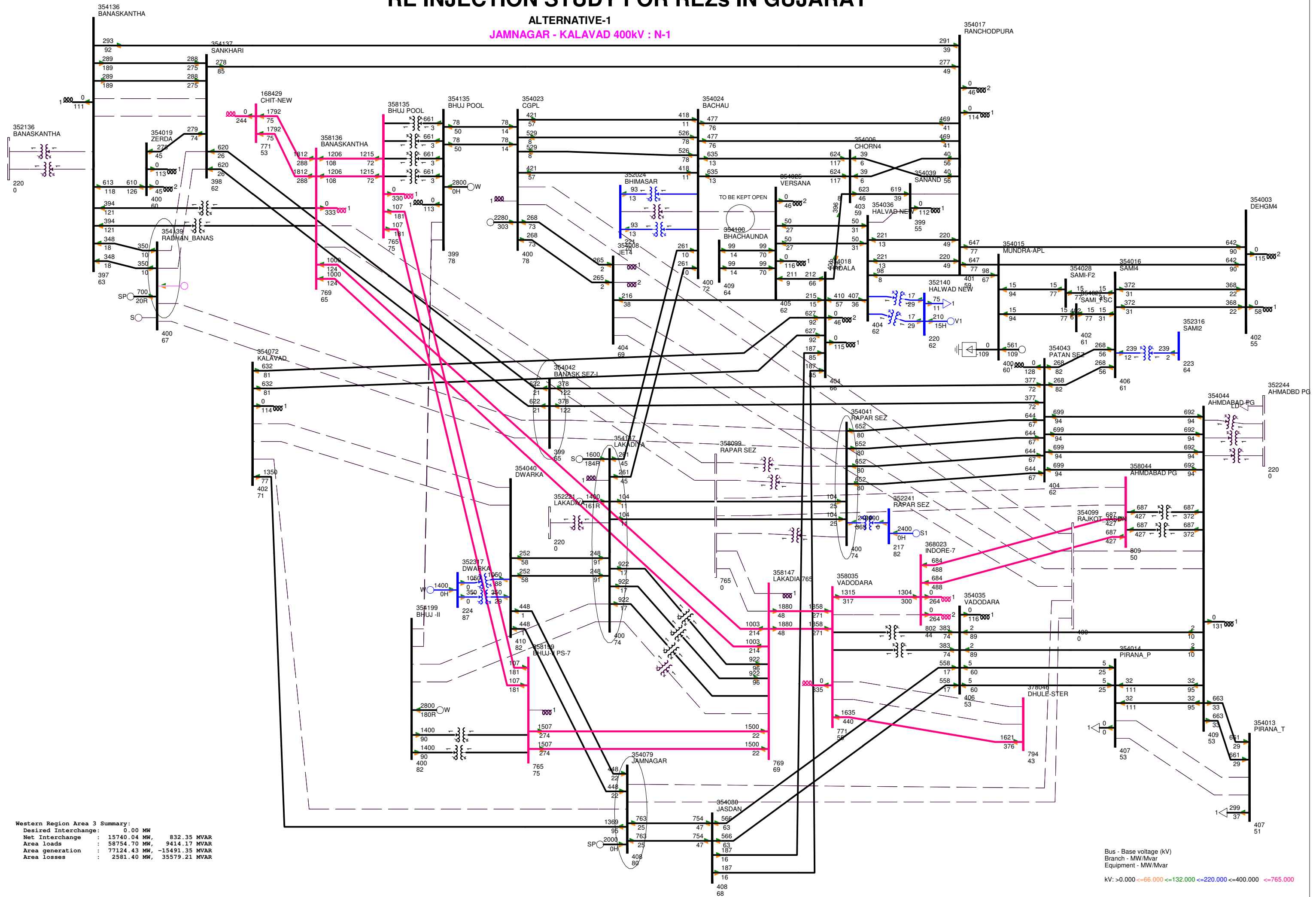


Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 15738.75 MW, 832.71 MVAR
 Area loads : 58754.70 MW, 9414.17 MVAR
 Area generation : 77124.43 MW, -15579.16 MVAR
 Area losses : 2582.69 MW, 35502.62 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-1 JAMNAGAR - KALAVAD 400kV : N-1



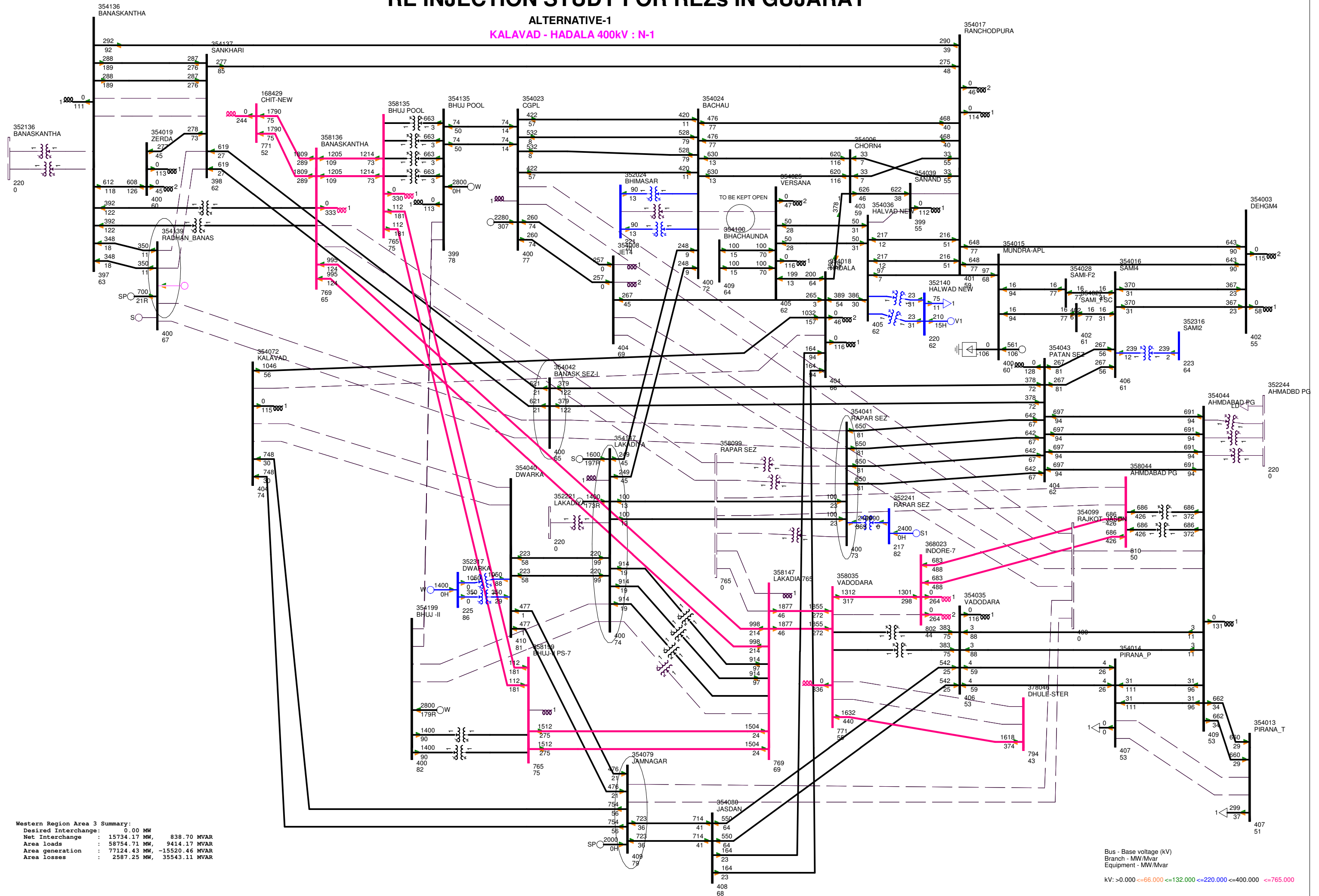
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 15740.04 MW, 832.35 MVAR
 Area loads : 58754.70 MW, 9414.17 MVAR
 Area generation : 77124.43 MW, -15491.35 MVAR
 Area losses : 2581.40 MW, 35579.21 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-1

KALAVAD - HADALA 400KV : N-1

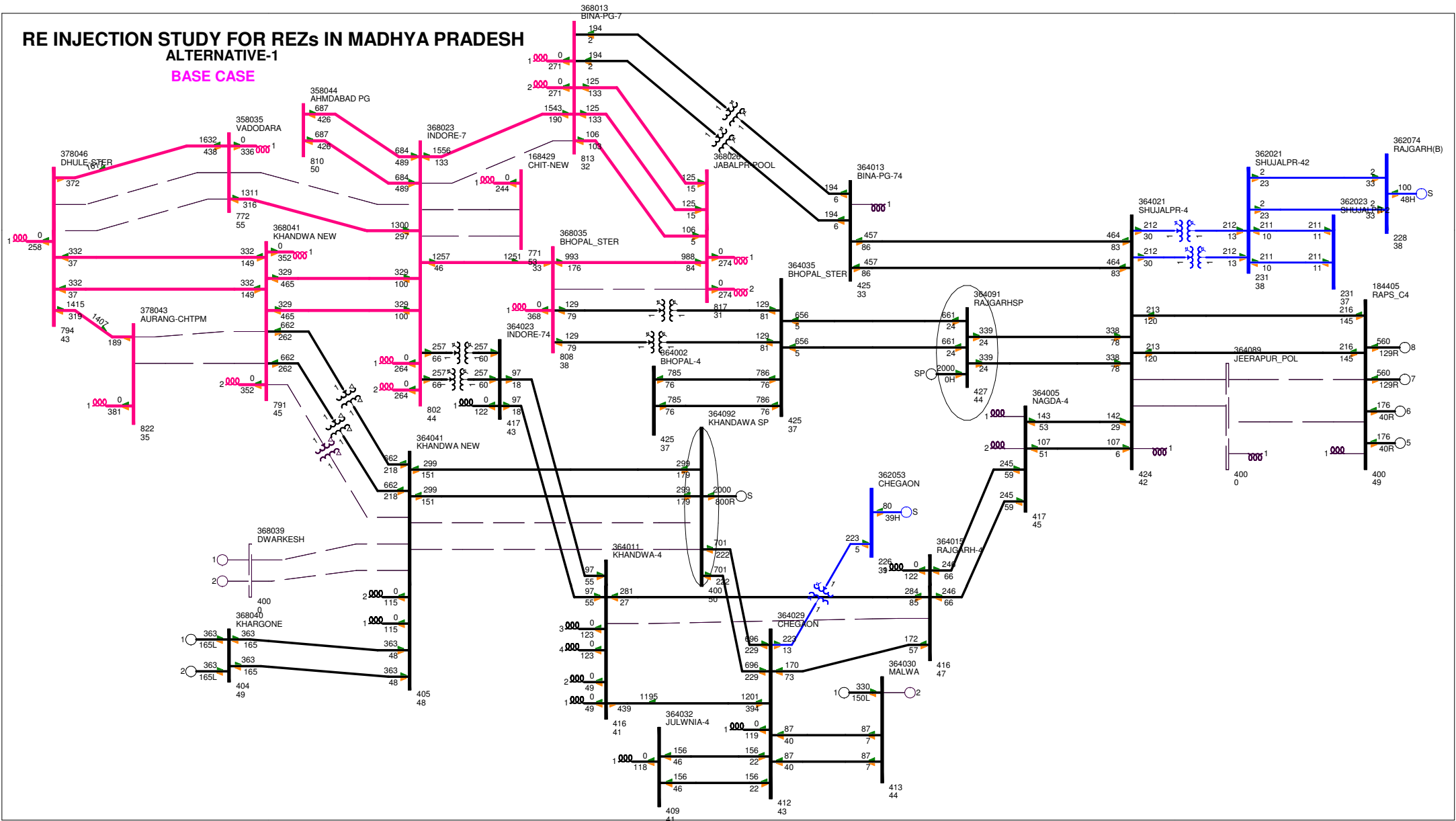


Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 15734.17 MW, 838.70 MVAR
 Area loads : 58754.71 MW, 9414.17 MVAR
 Area generation : 77124.43 MW, -15520.46 MVAR
 Area losses : 2587.25 MW, 35543.11 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

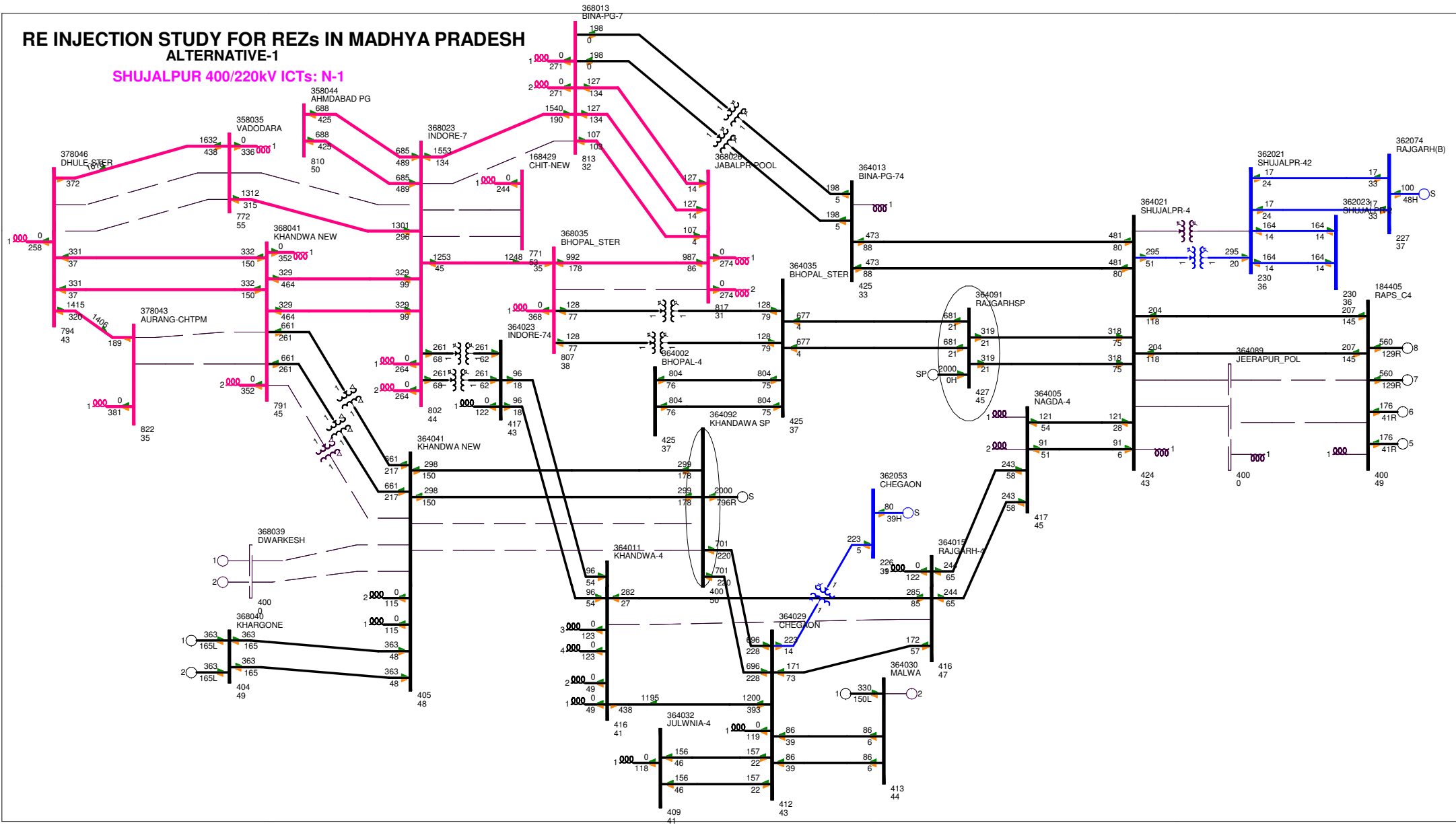
RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-1

BASE CASE



RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-1

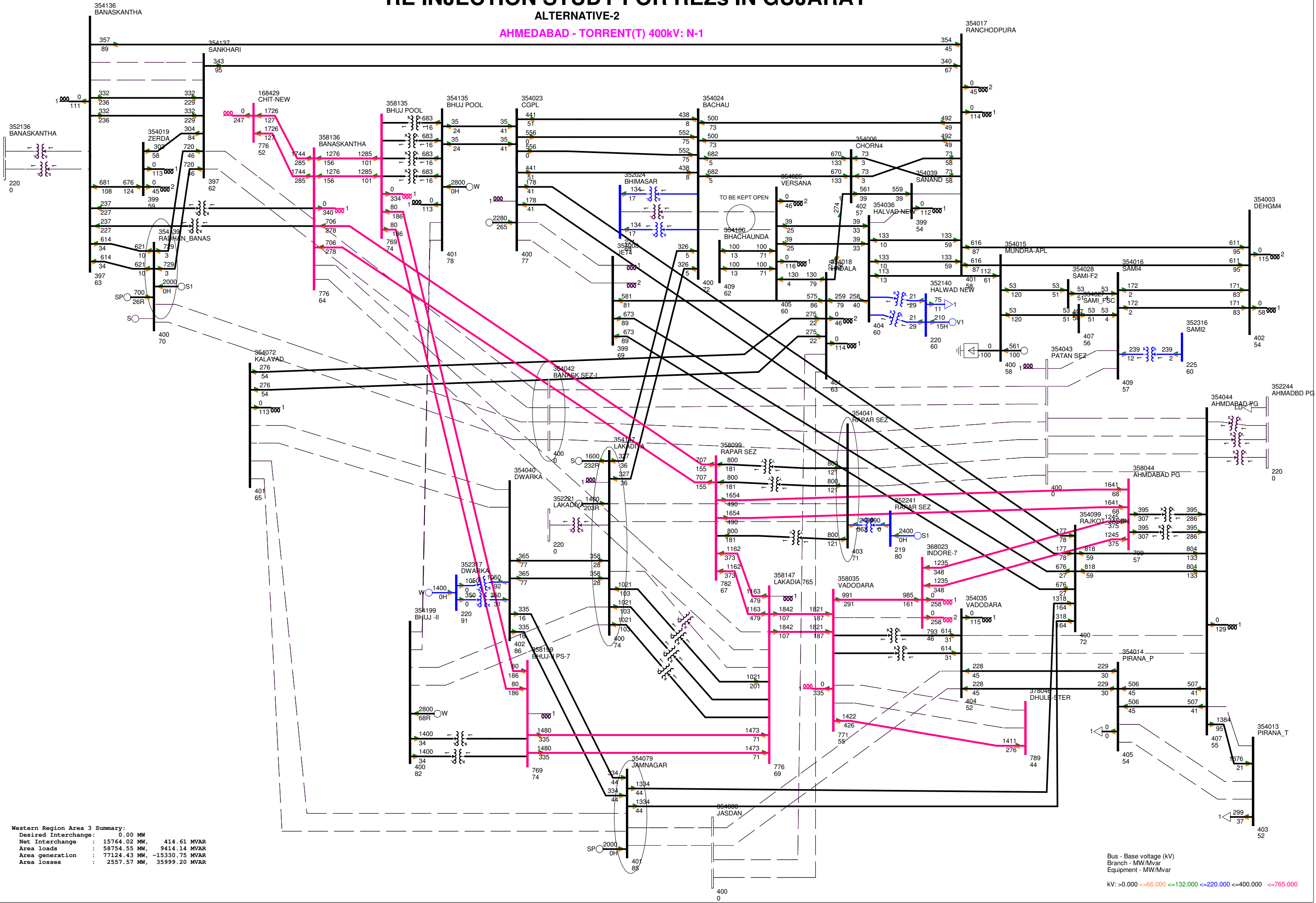
SHUJALPUR 400/220kV ICTs: N-1



RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

AHMEDABAD - TORRENT(T) 400kV: N-1



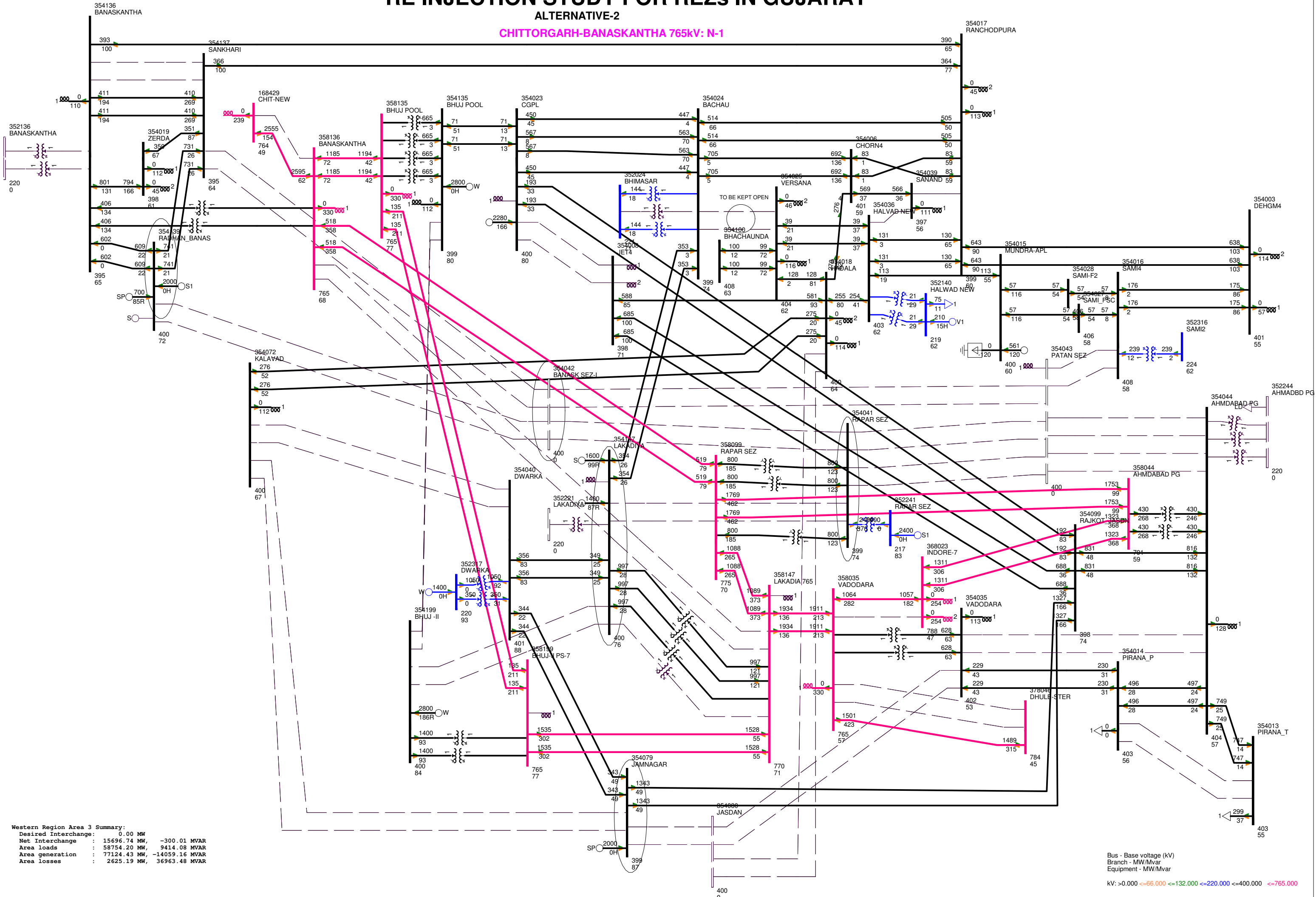
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 15764.02 MW, 414.61 MVAR
 Area loads : 58754.55 MW, 9414.14 MVAR
 Area generation : 77124.43 MW, -15330.75 MVAR
 Area losses : 2557.57 MW, 35999.20 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

CHITTORGARH-BANASKANTHA 765KV: N-1



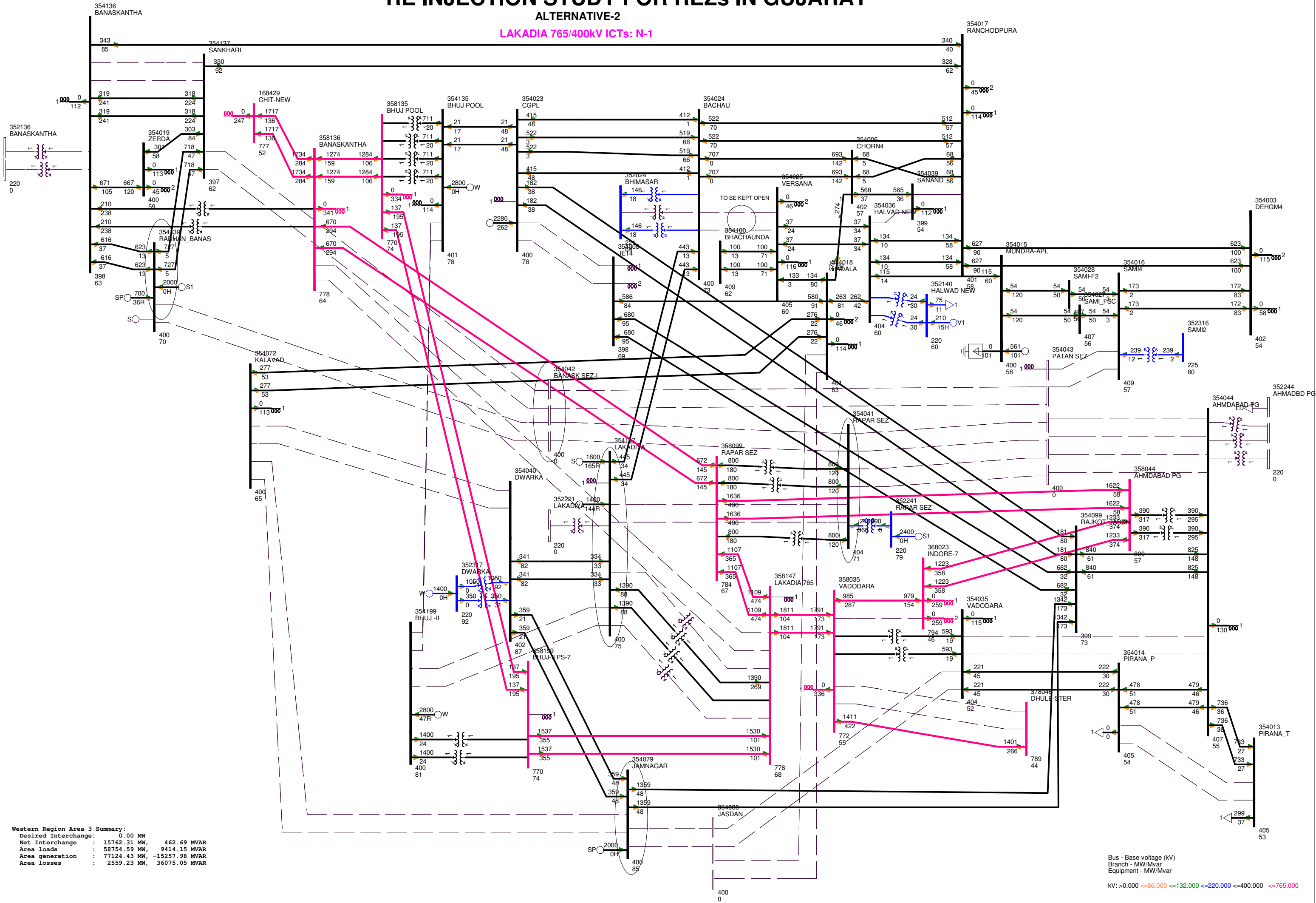
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 15696.74 MW, -300.01 MVAR
 Area loads : 58754.20 MW, 9414.08 MVAR
 Area generation : 77124.43 MW, -14059.16 MVAR
 Area losses : 2625.19 MW, 36963.48 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

LAKADIA 765/400kV ICTs: N-1



Western Region Area 3 Summary:

Desired Interchange :	0.00 MW	
Net Interchange :	15762.31 MW,	462.69 MVAR
Area loads :	58754.59 MW,	9414.15 MVAR
Area generation :	77124.43 MW,	-15257.98 MVAR
Area losses :	2559.23 MW,	36075.05 MVAR

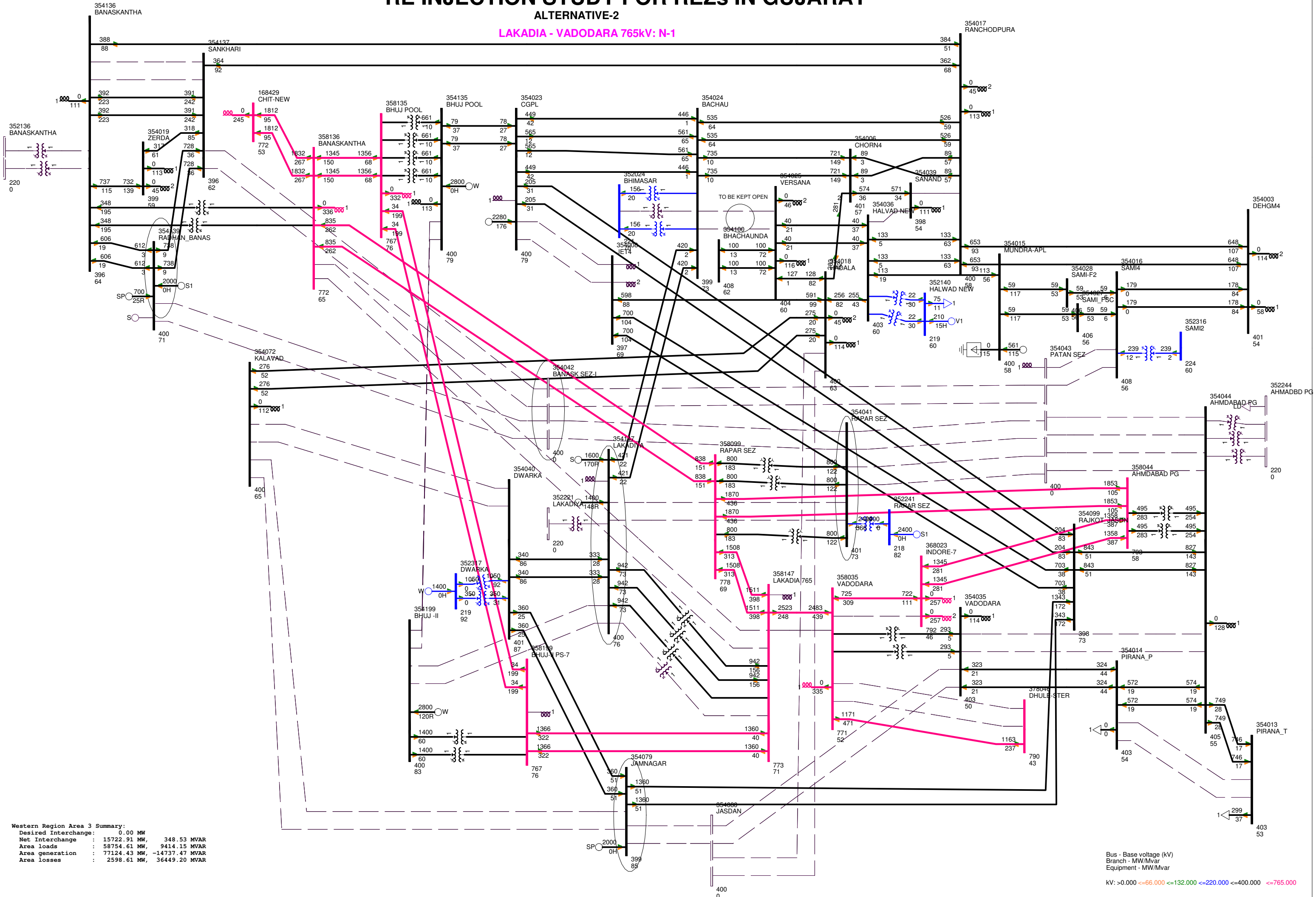
Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar

kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

LAKADIA - VADODARA 765kV: N-1



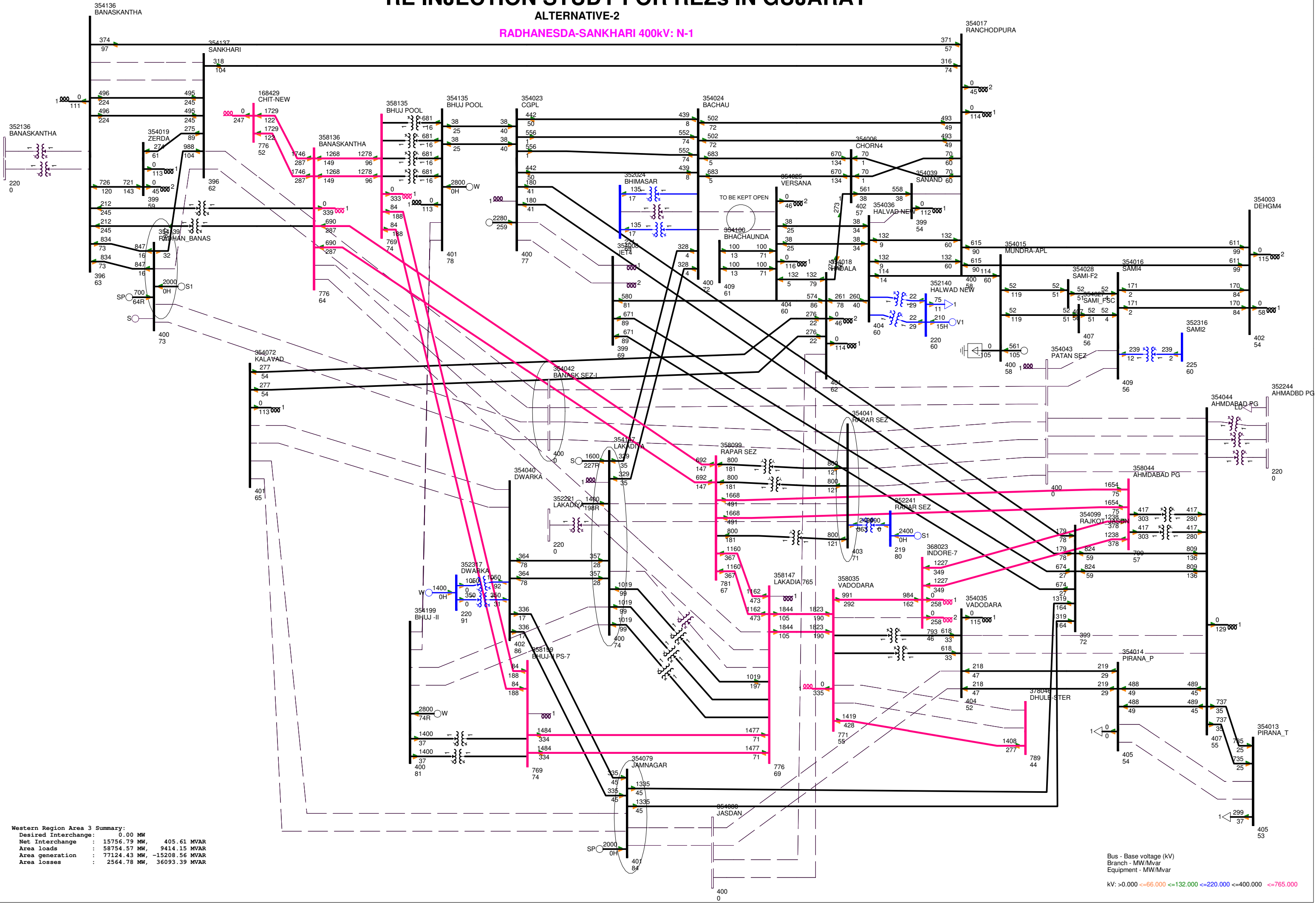
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 15722.91 MW, 348.53 MVAR
 Area loads : 58754.61 MW, 9414.15 MVAR
 Area generation : 77124.43 MW, -14737.47 MVAR
 Area losses : 2598.61 MW, 36449.20 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

RADHANESDA-SANKHARI 400KV: N-1



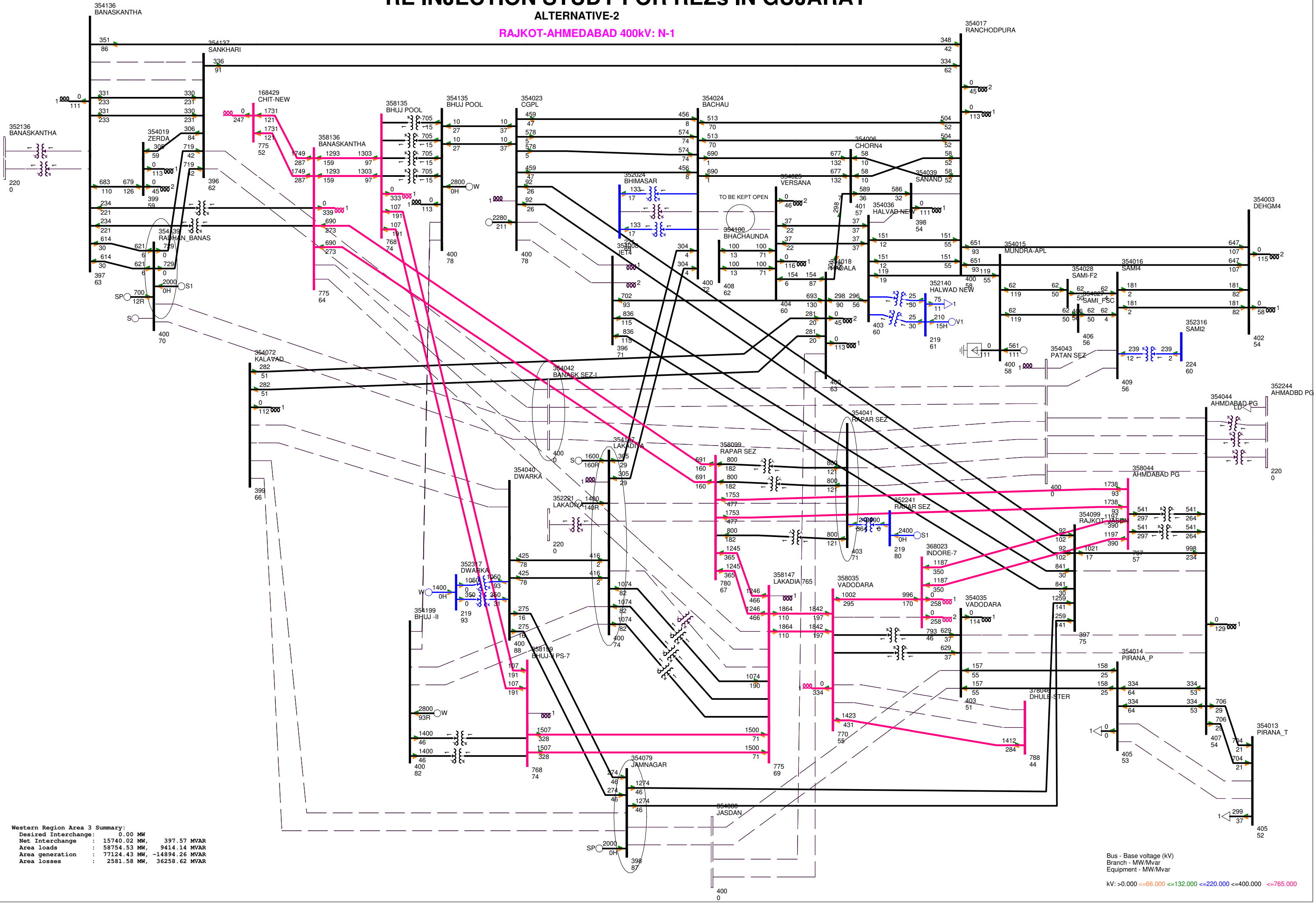
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 15756.79 MW, 405.61 MVAR
 Area loads : 58754.57 MW, 9414.15 MVAR
 Area generation : 77124.43 MW, -15208.56 MVAR
 Area losses : 2564.78 MW, 36093.39 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

RAJKOT-AHMEDABAD 400kV: N-1



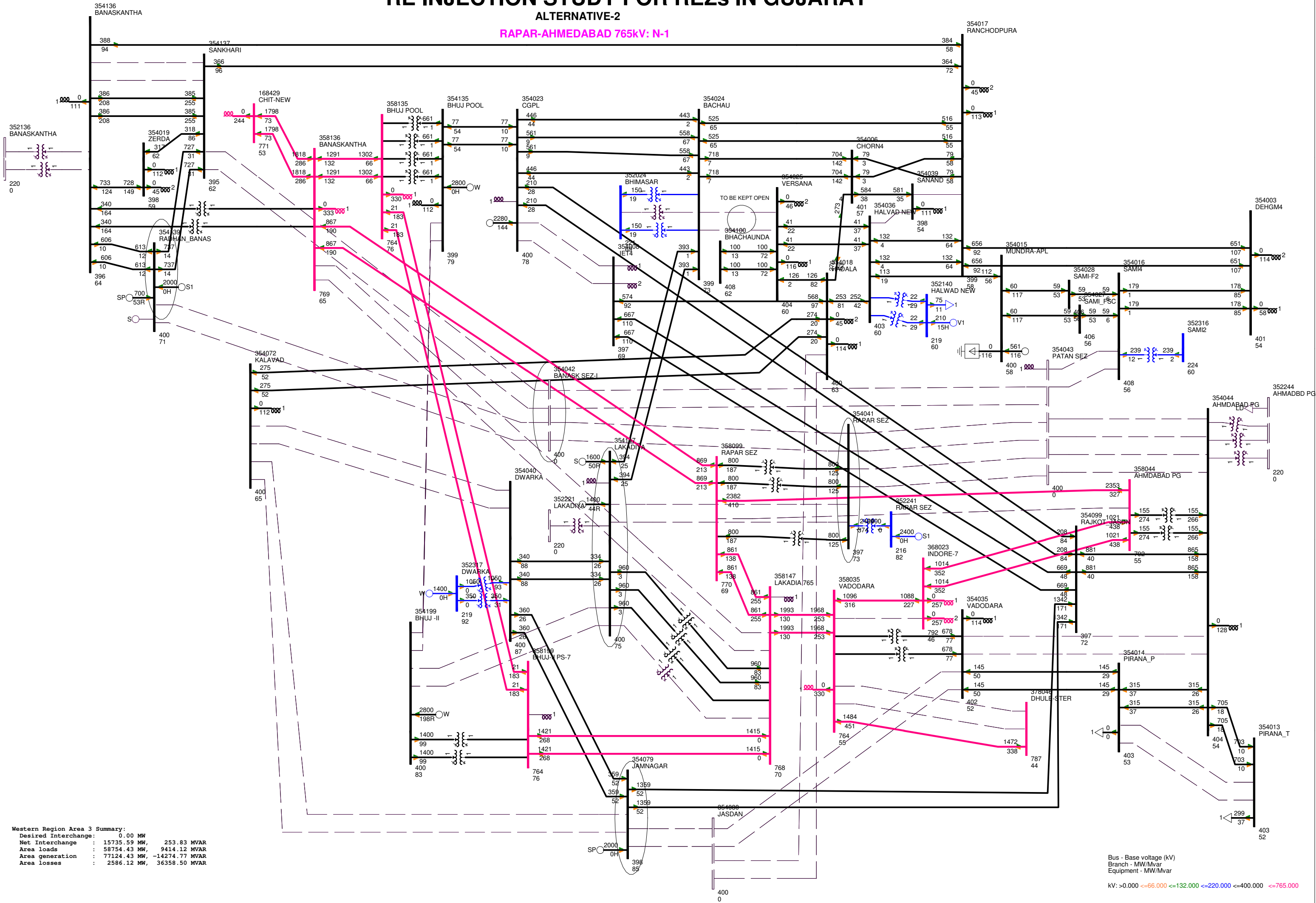
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 15740.02 MW, 397.57 MVAR
 Area loads : 58754.53 MW, 9414.14 MVAR
 Area generation : 77124.43 MW, -14894.26 MVAR
 Area losses : 2581.58 MW, 36258.62 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

RAPAR-AHMEDABAD 765kV: N-1



Western Region Area 3 Summary:

Desired Interchange :	0.00 MW	
Net Interchange :	15735.59 MW,	253.83 MVAR
Area loads :	58754.43 MW,	9414.12 MVAR
Area generation :	77124.43 MW,	-14274.77 MVAR
Area losses :	2586.12 MW,	36358.50 MVAR

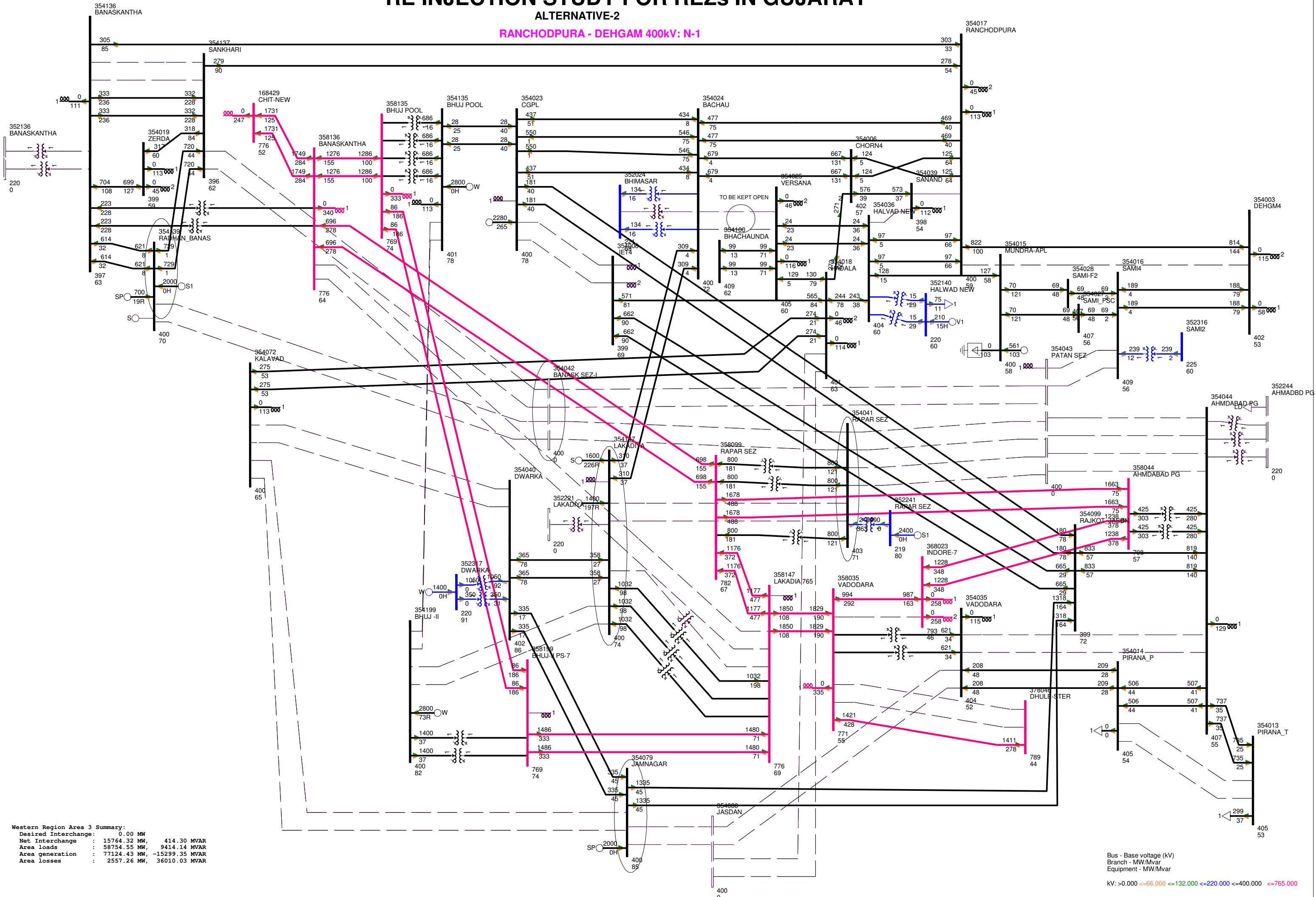
Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar

kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

ALTERNATIVE-2

RANCHODPURA - DEHGAM 400KV: N-1

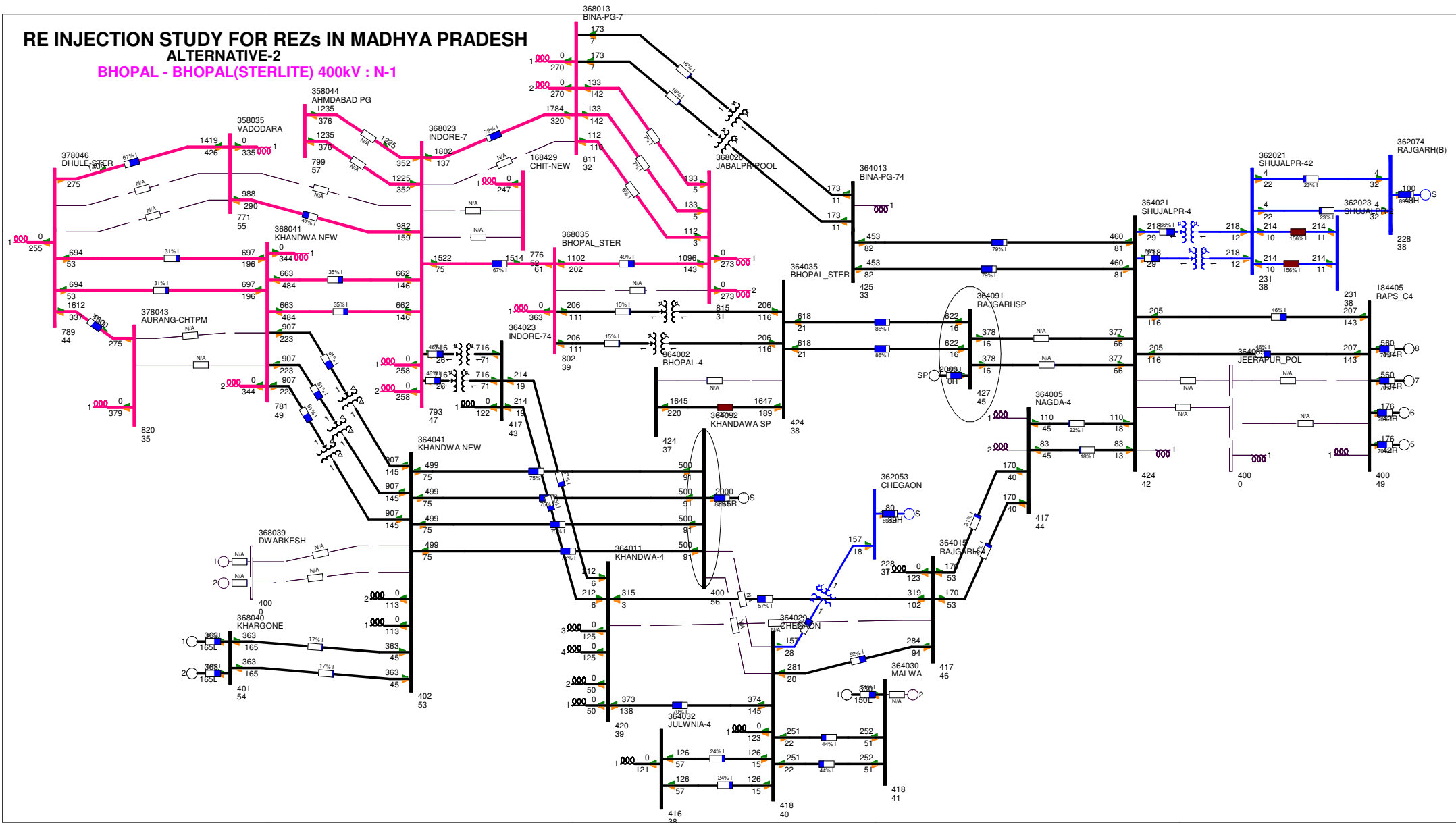


Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 15764.32 MW, 414.30 MVAR
 Area loads : 58754.55 MW, 9414.14 MVAR
 Area generation : 77124.43 MW, -15299.35 MVAR
 Area losses : 2557.26 MW, 36010.03 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

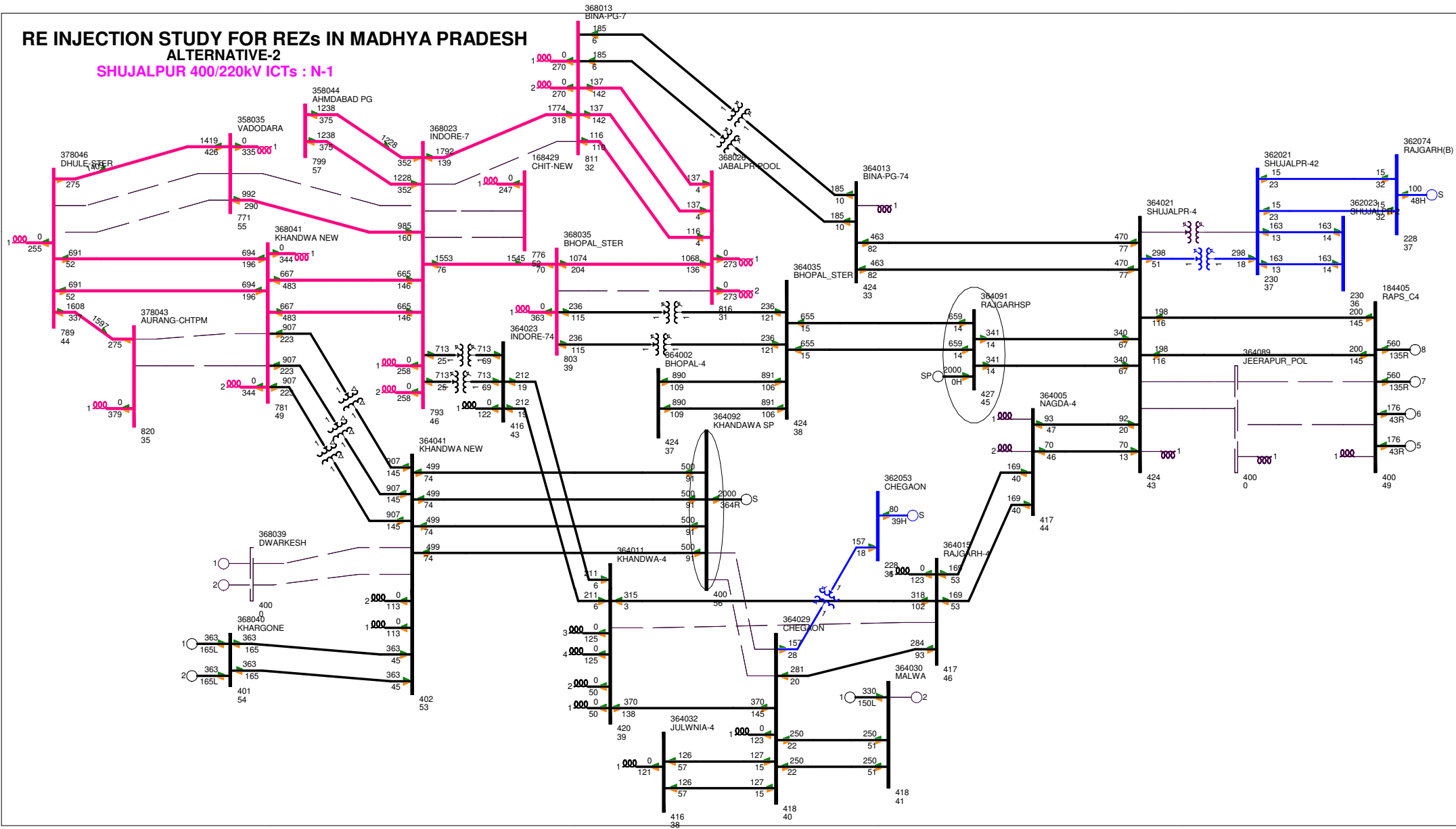
RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-2

BHOPAL - BHOPAL(STERLITE) 400kV : N-1



RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-2

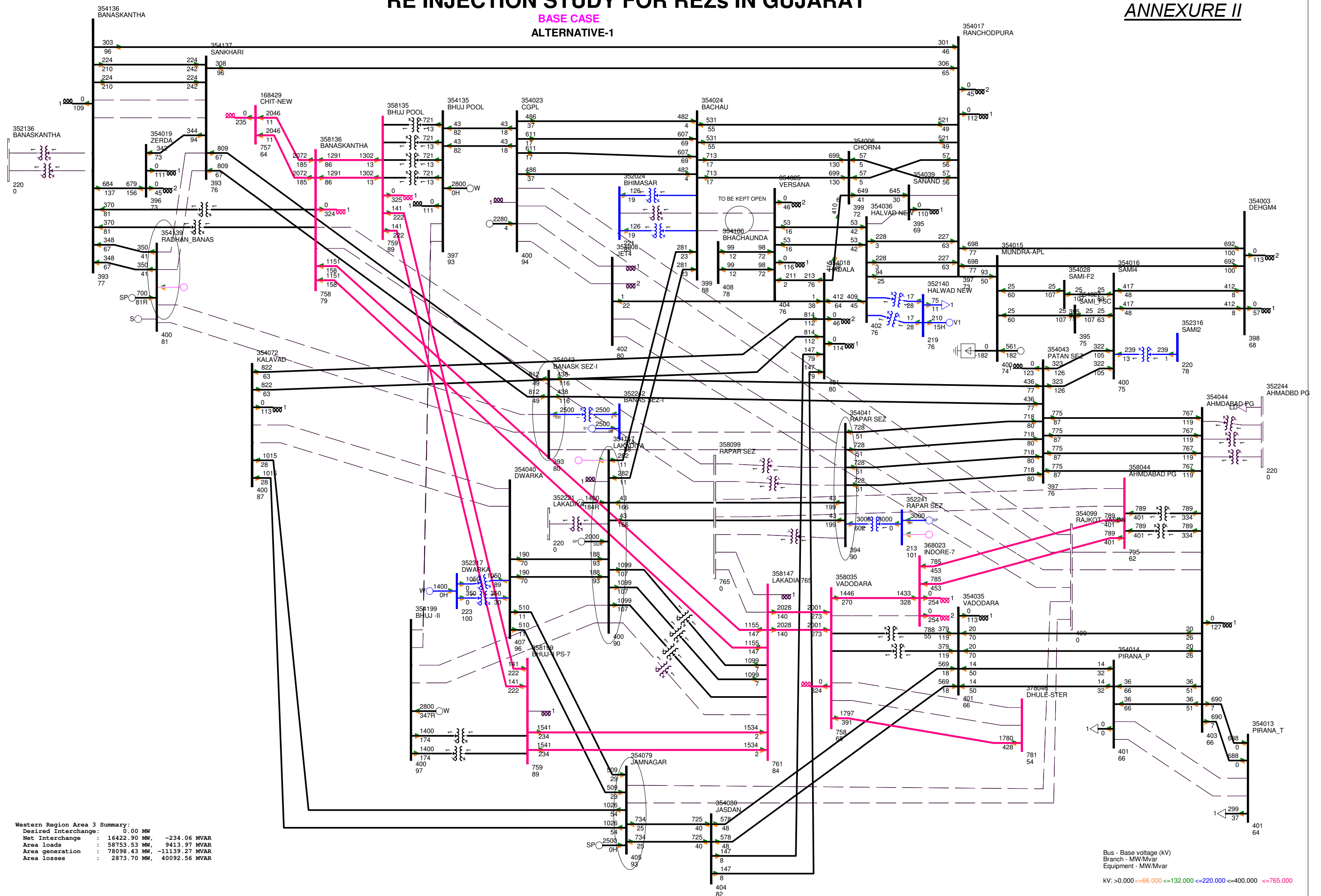
SHUJALPUR 400/220KV ICTS : N-1



RE INJECTION STUDY FOR REZs IN GUJARAT

ANNEXURE II

BASE CASE
ALTERNATIVE-1



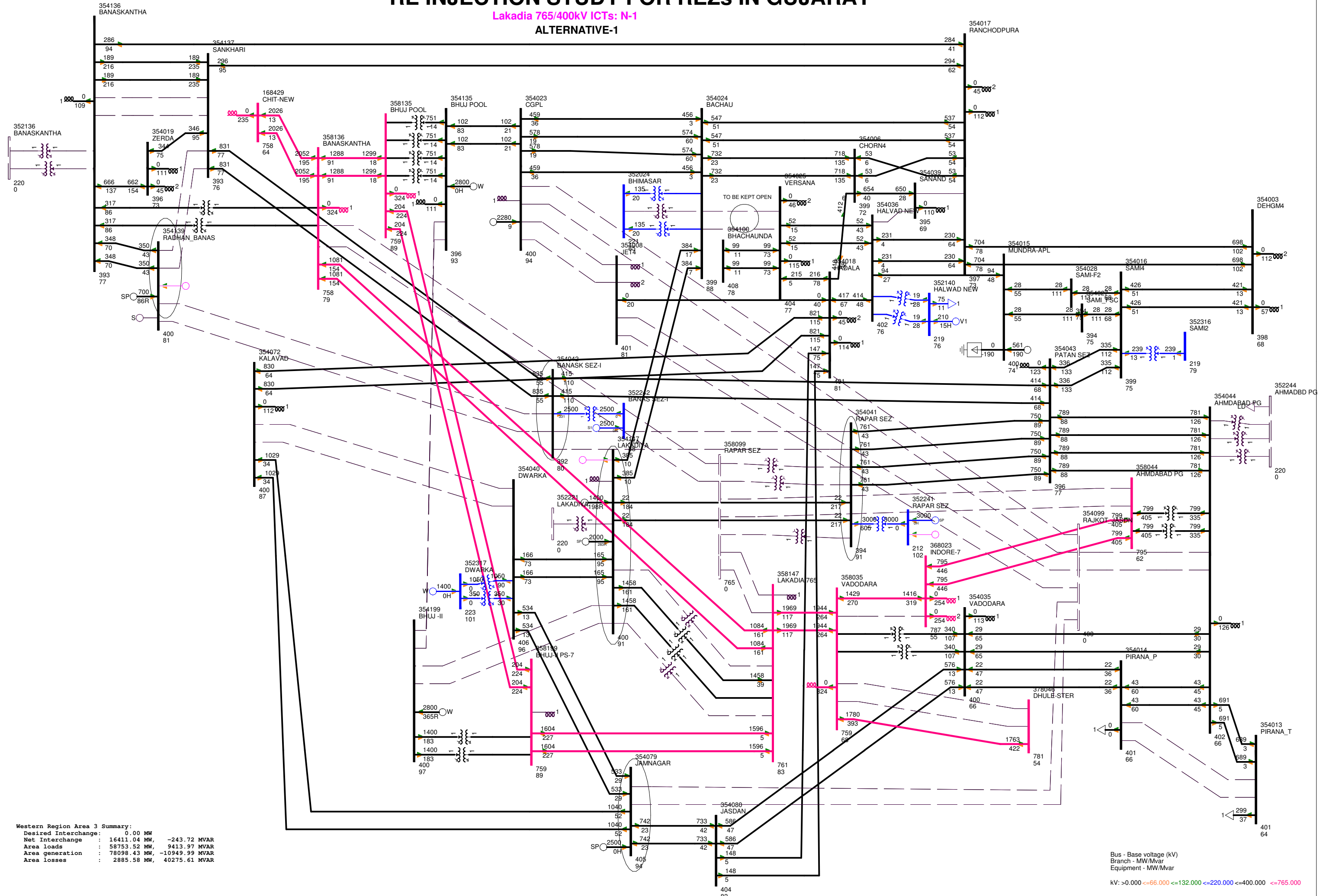
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 16422.90 MW, -234.06 MVAR
 Area loads : 58753.53 MW, 9413.97 MVAR
 Area generation : 78098.43 MW, -11139.27 MVAR
 Area losses : 2873.70 MW, 40092.56 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

Lakadia 765/400kV ICTs: N-1

ALTERNATIVE-1



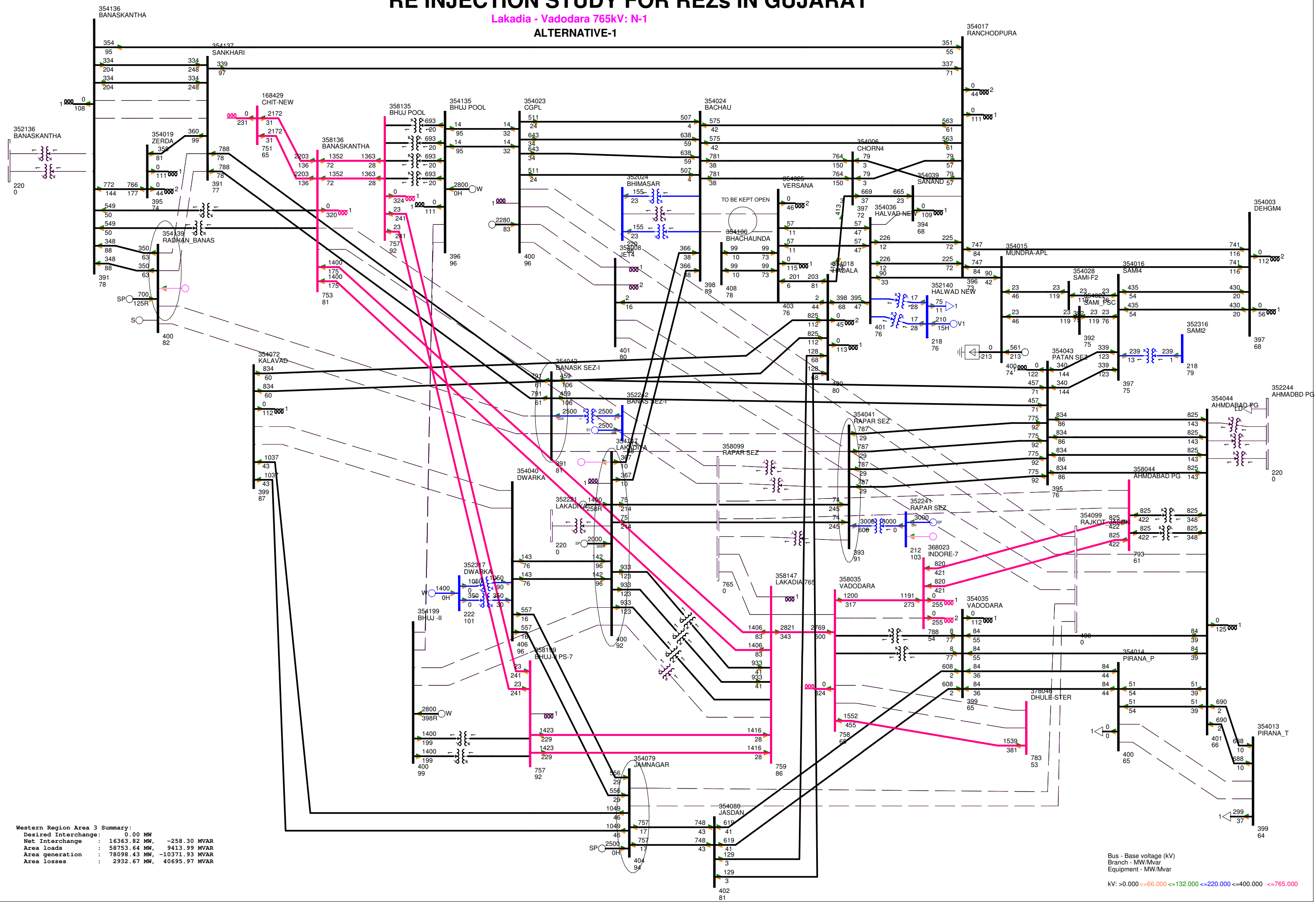
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 16411.04 MW, -243.72 MVAR
 Area loads : 58753.52 MW, 9413.97 MVAR
 Area generation : 78098.43 MW, -10949.99 MVAR
 Area losses : 2885.58 MW, 40275.61 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

Lakadia - Vadodara 765kV: N-1

ALTERNATIVE-1



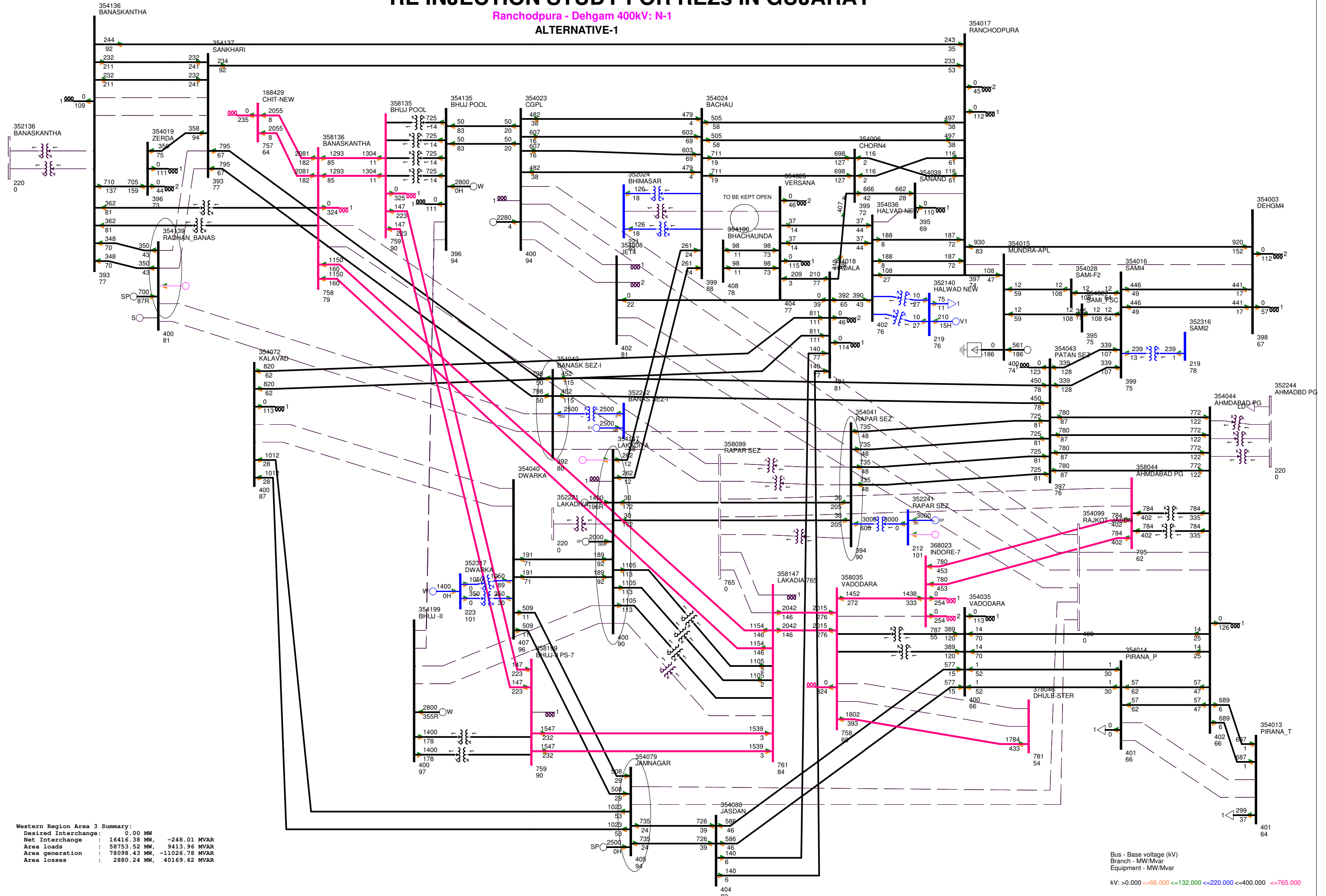
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 16363.82 MW, -258.30 MVAR
 Area loads : 58753.64 MW, 9413.99 MVAR
 Area generation : 78098.43 MW, -10371.93 MVAR
 Area losses : 2932.67 MW, 40695.97 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

Ranchodpura - Dehgam 400kV: N-1

ALTERNATIVE-1



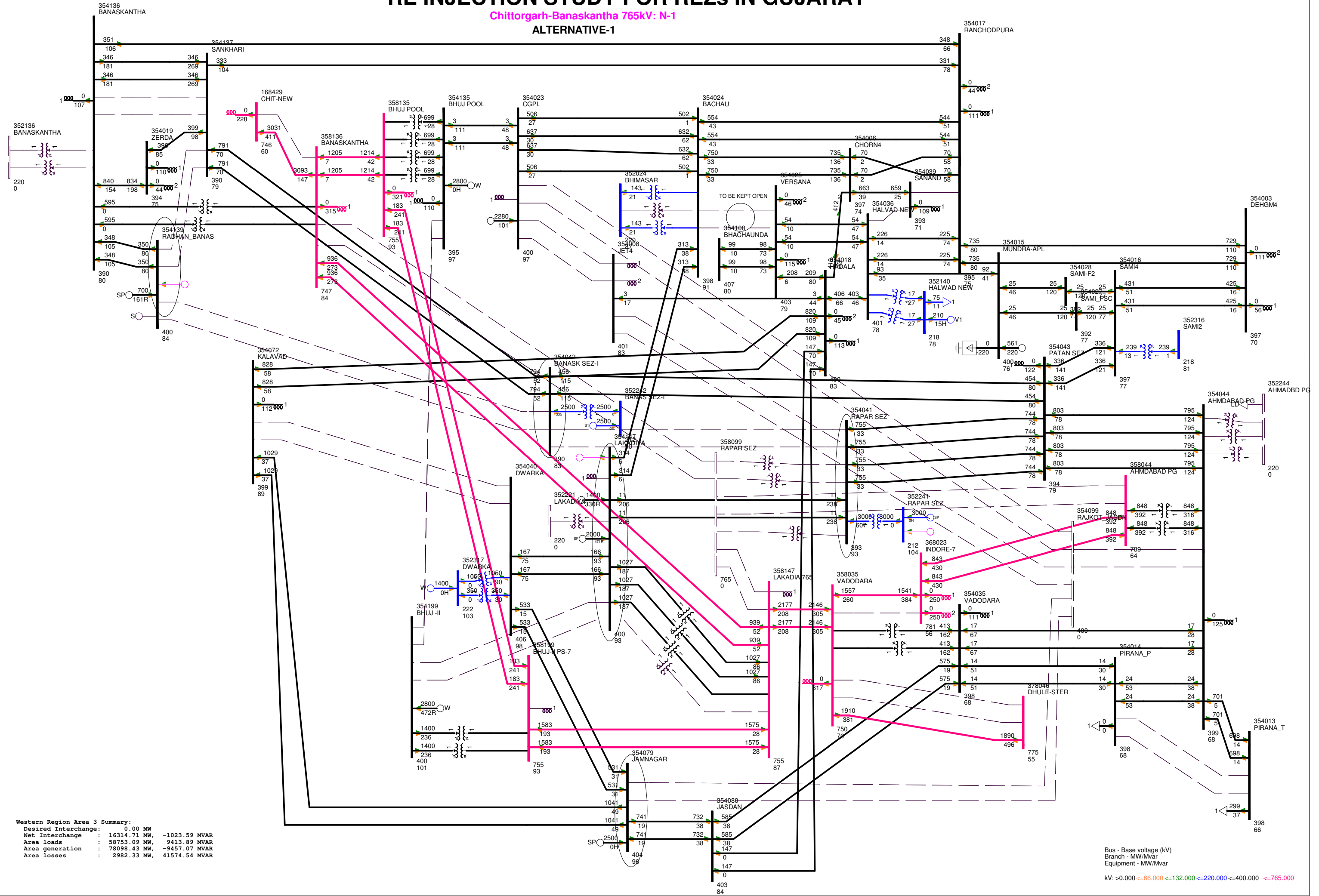
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 16416.38 MW, -248.01 MVAR
 Area loads : 58753.52 MW, 9413.96 MVAR
 Area generation : 78098.43 MW, -11026.78 MVAR
 Area losses : 2880.24 MW, 40169.62 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

Chittorgarh-Banaskantha 765kV: N-1

ALTERNATIVE-1



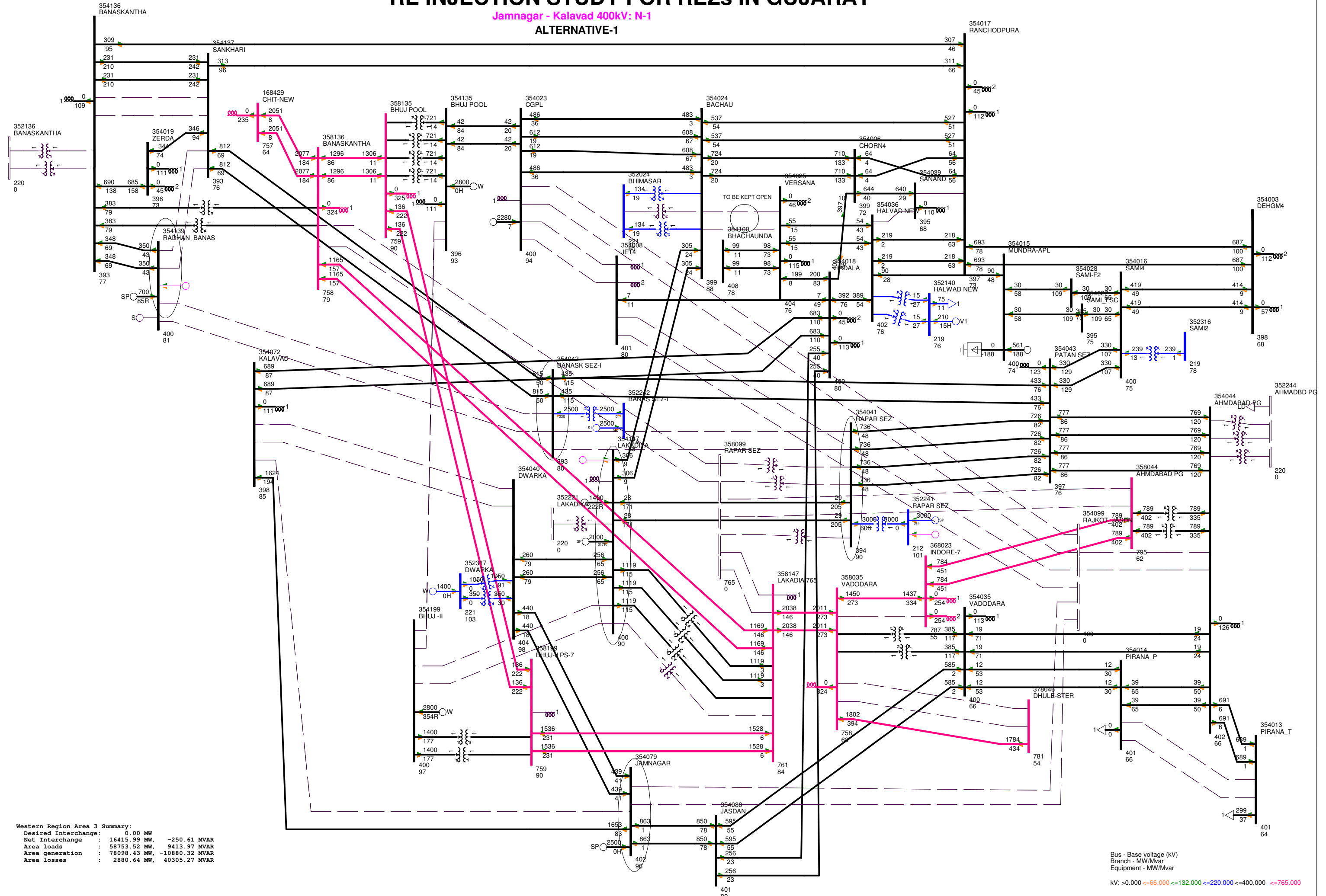
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange: 16314.71 MW, -1023.59 MVAR
 Area loads: 58753.09 MW, 9413.89 MVAR
 Area generation: 78098.43 MW, -9457.07 MVAR
 Area losses: 2982.33 MW, 41574.54 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

Jamnagar - Kalavad 400kV: N-1

ALTERNATIVE-1



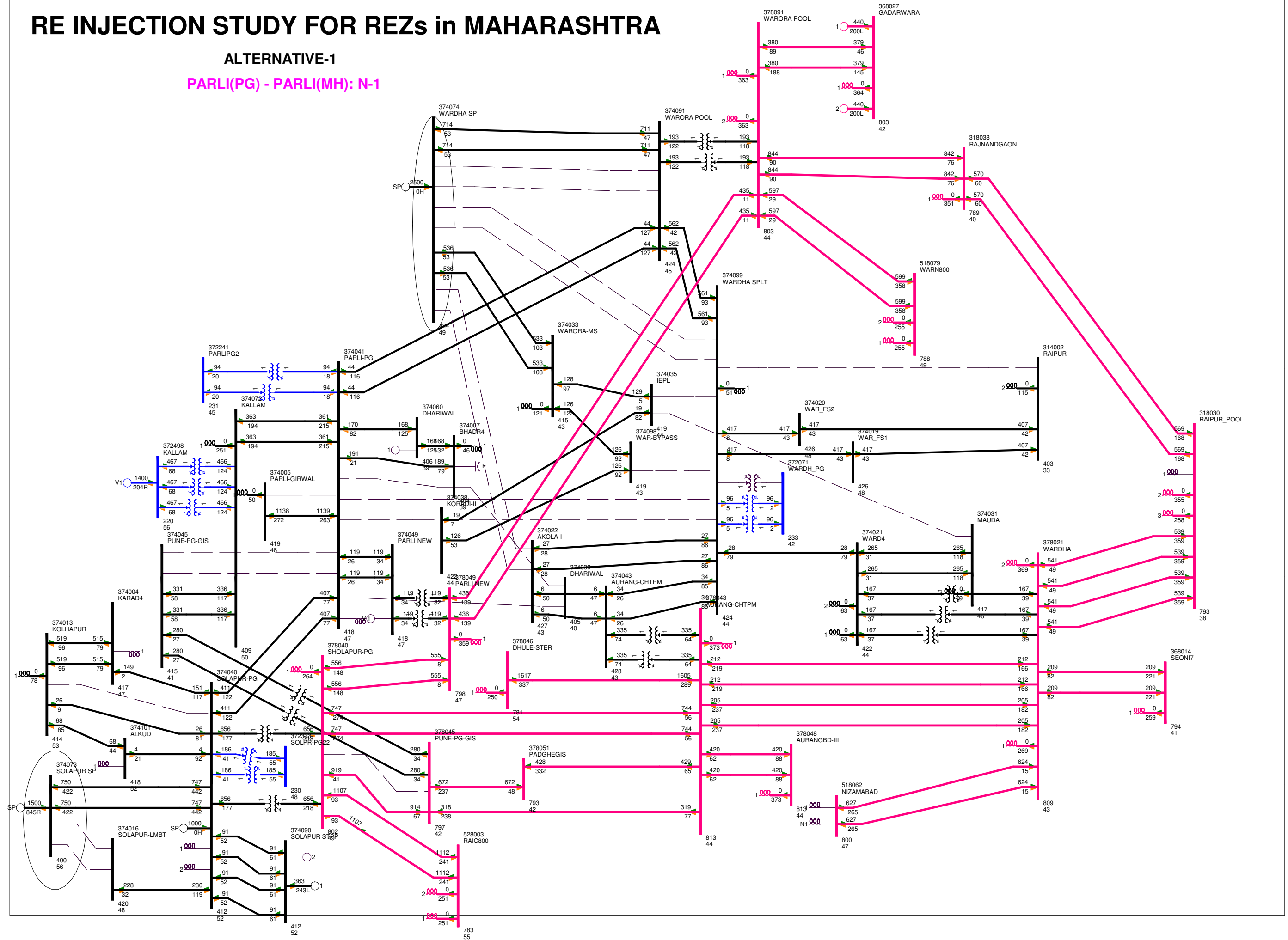
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange : 16415.99 MW, -250.61 MVAR
 Area loads : 58753.52 MW, 9413.97 MVAR
 Area generation : 78098.43 MW, -10880.32 MVAR
 Area losses : 2880.64 MW, 40305.27 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs in MAHARASHTRA

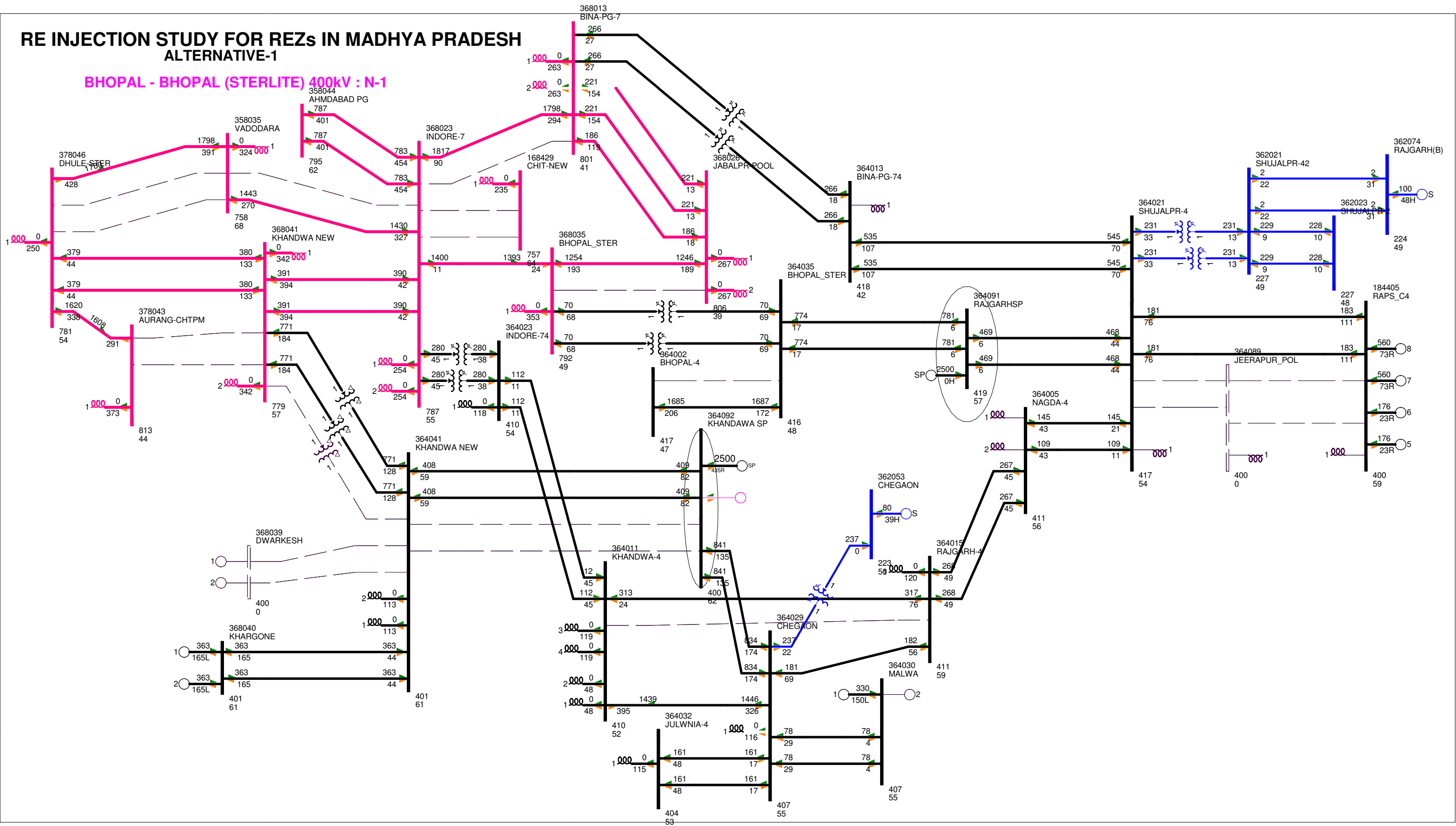
ALTERNATIVE-1

PARLI(PG) - PARLI(MH): N-1



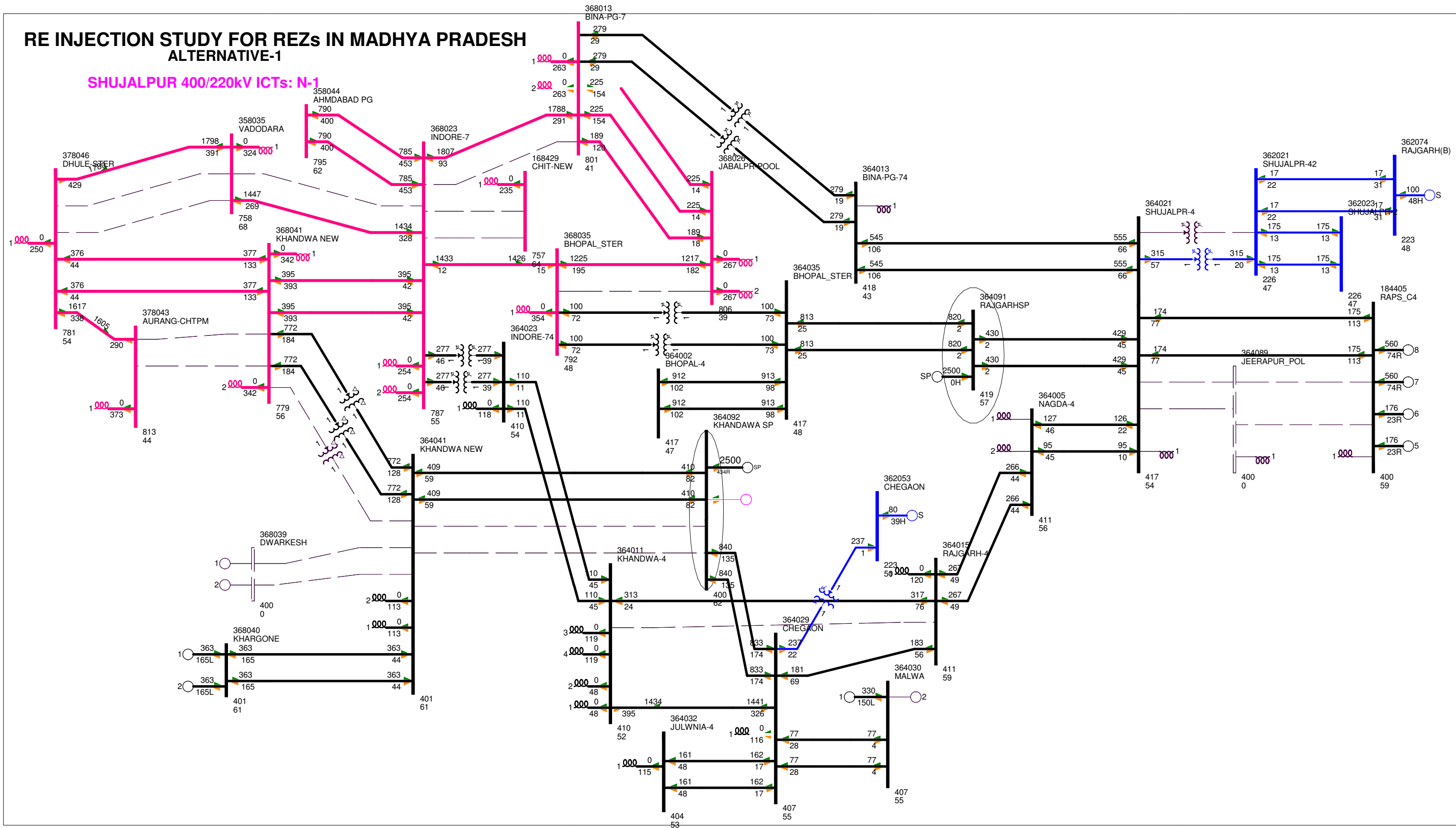
RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-1

BHOPAL - BHOPAL (STERLITE) 400KV : N-1



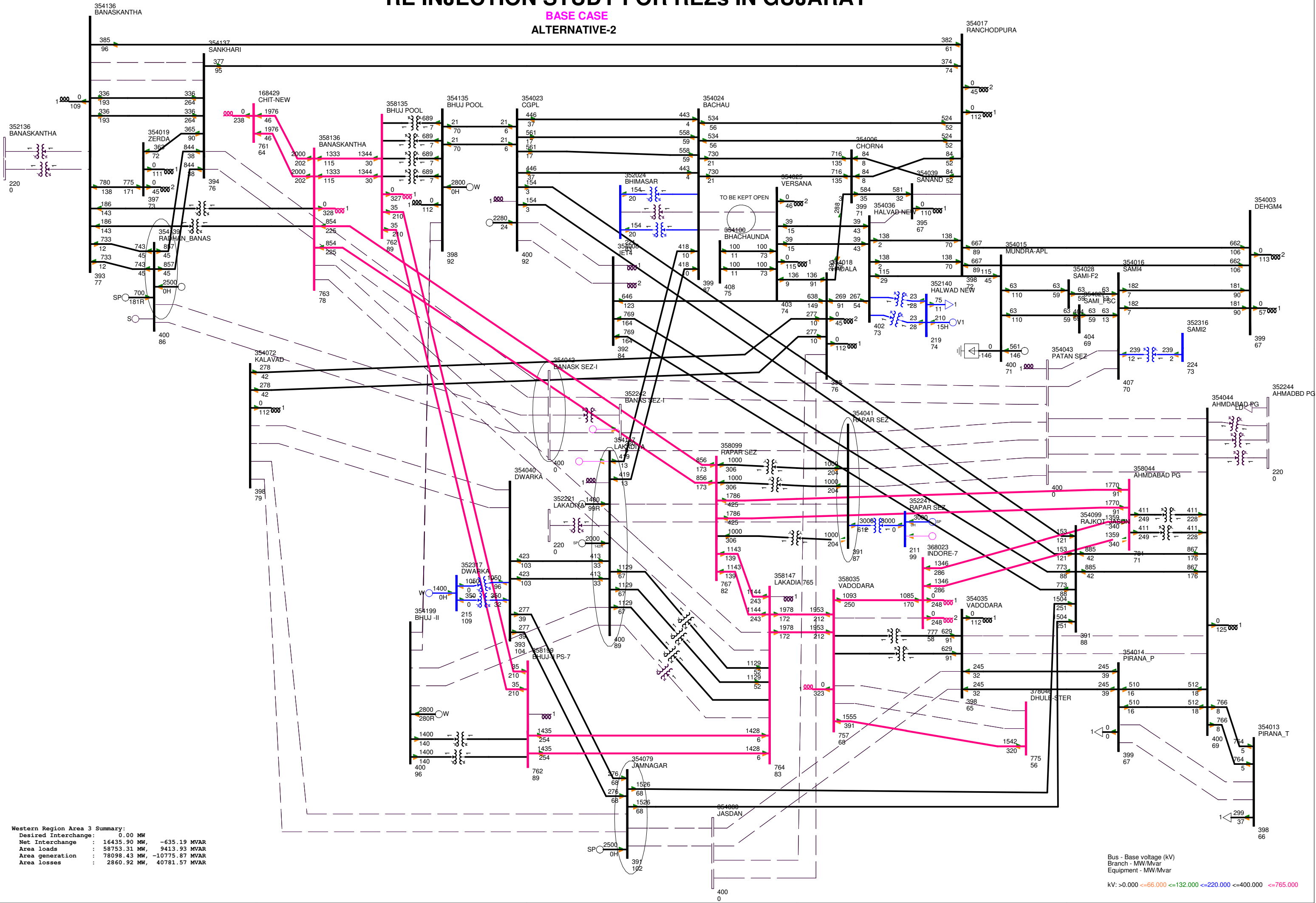
RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-1

SHUJALPUR 400/220kV ICTs: N-1



RE INJECTION STUDY FOR REZs IN GUJARAT

BASE CASE
ALTERNATIVE-2

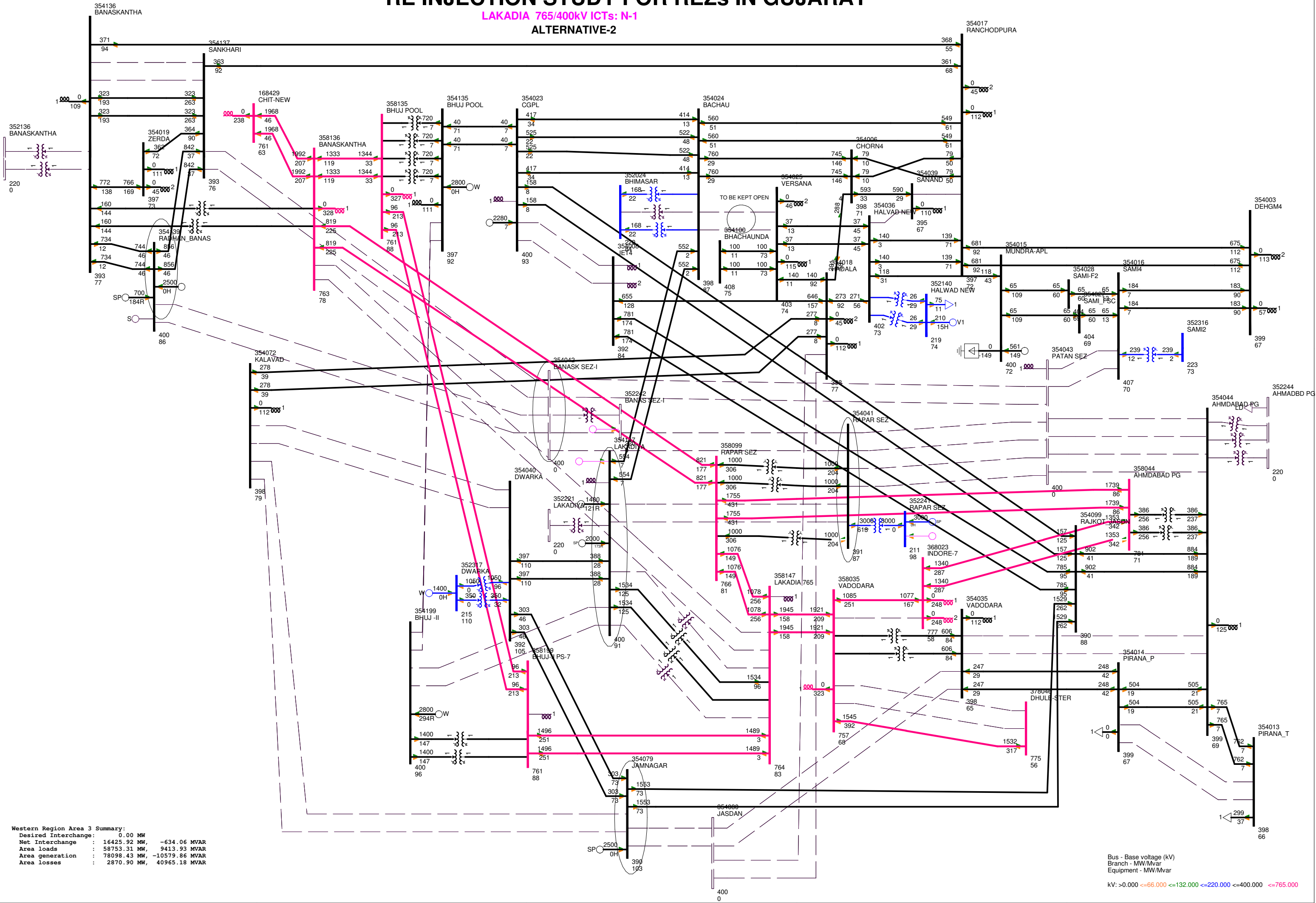


Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16435.90 MW, -635.19 MVAR
 Area loads : 58753.31 MW, 9413.93 MVAR
 Area generation : 78098.43 MW, -10775.87 MVAR
 Area losses : 2860.92 MW, 40781.57 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

LAKADIA 765/400kV ICTs: N-1
ALTERNATIVE-2



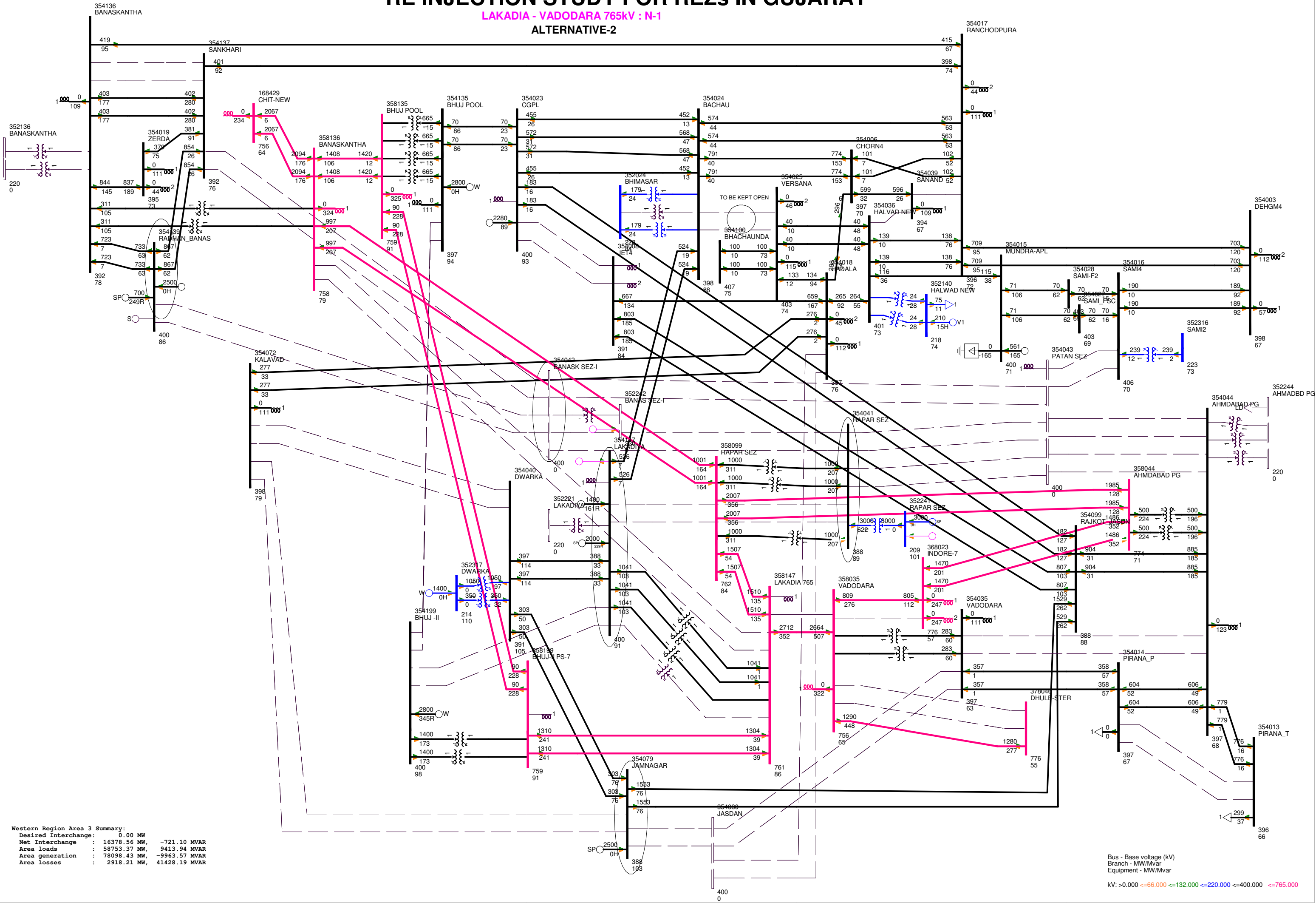
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16425.92 MW, -634.06 MVAR
 Area loads : 58753.31 MW, 9413.93 MVAR
 Area generation : 78098.43 MW, -10579.86 MVAR
 Area losses : 2870.90 MW, 40965.18 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

LAKADIA - VADODARA 765kV : N-1

ALTERNATIVE-2



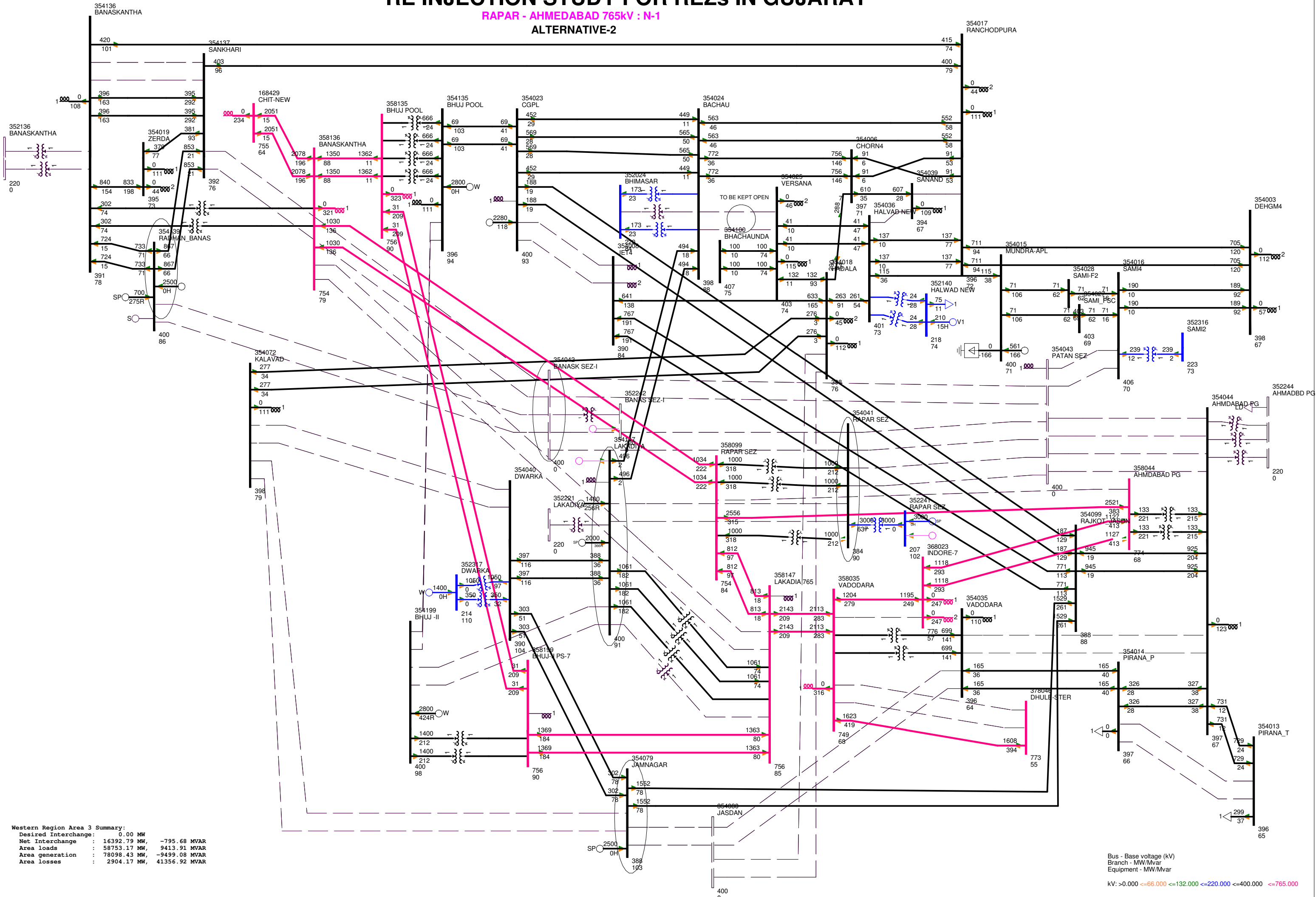
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16378.56 MW, -721.10 MVAR
 Area loads : 58753.37 MW, 9413.94 MVAR
 Area generation : 78098.43 MW, -9963.57 MVAR
 Area losses : 2918.21 MW, 41428.19 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kv: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

RAPAR - AHMEDABAD 765kV : N-1

ALTERNATIVE-2



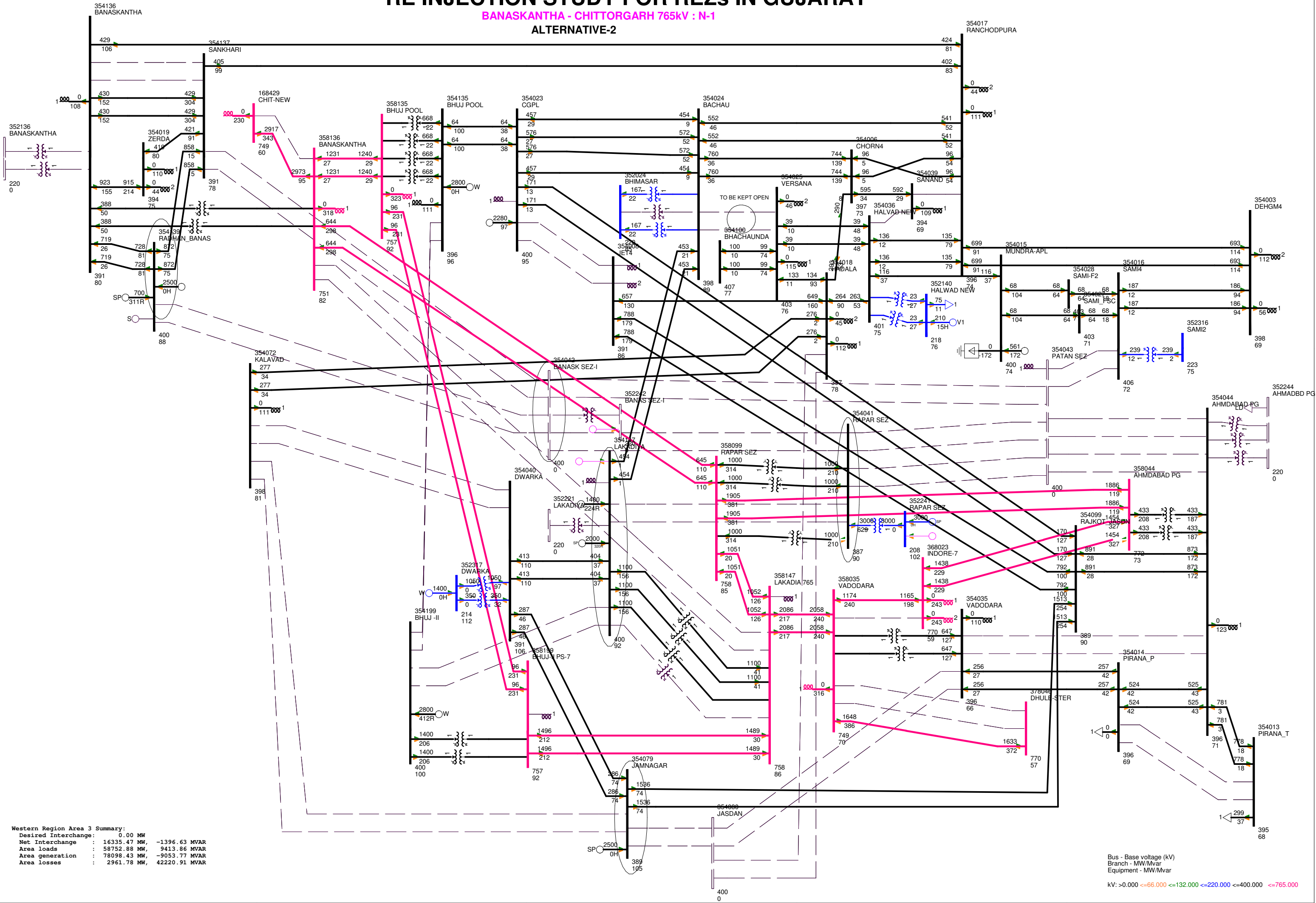
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16392.79 MW, -795.68 MVAR
 Area loads : 58753.17 MW, 9413.91 MVAR
 Area generation : 78098.43 MW, -9499.08 MVAR
 Area losses : 2904.17 MW, 41356.92 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

BANASKANTHA - CHITTORGARH 765kV : N-1

ALTERNATIVE-2



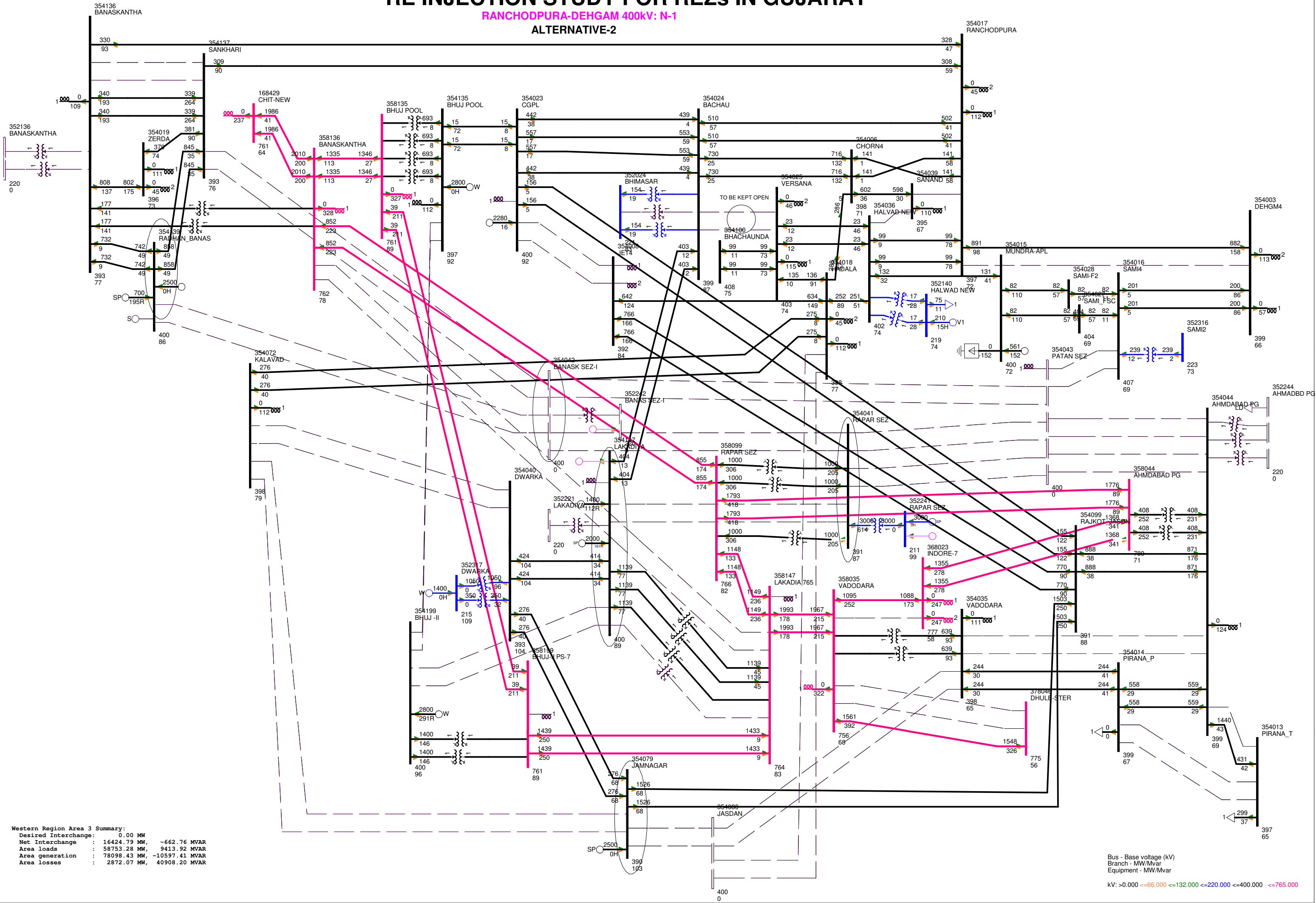
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16335.47 MW, -1396.63 MVAR
 Area loads : 58752.88 MW, 9413.86 MVAR
 Area generation : 78098.43 MW, -9053.77 MVAR
 Area losses : 2961.78 MW, 42220.91 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

RANCHODPURA-DEHGAM 400kV: N-1

ALTERNATIVE-2

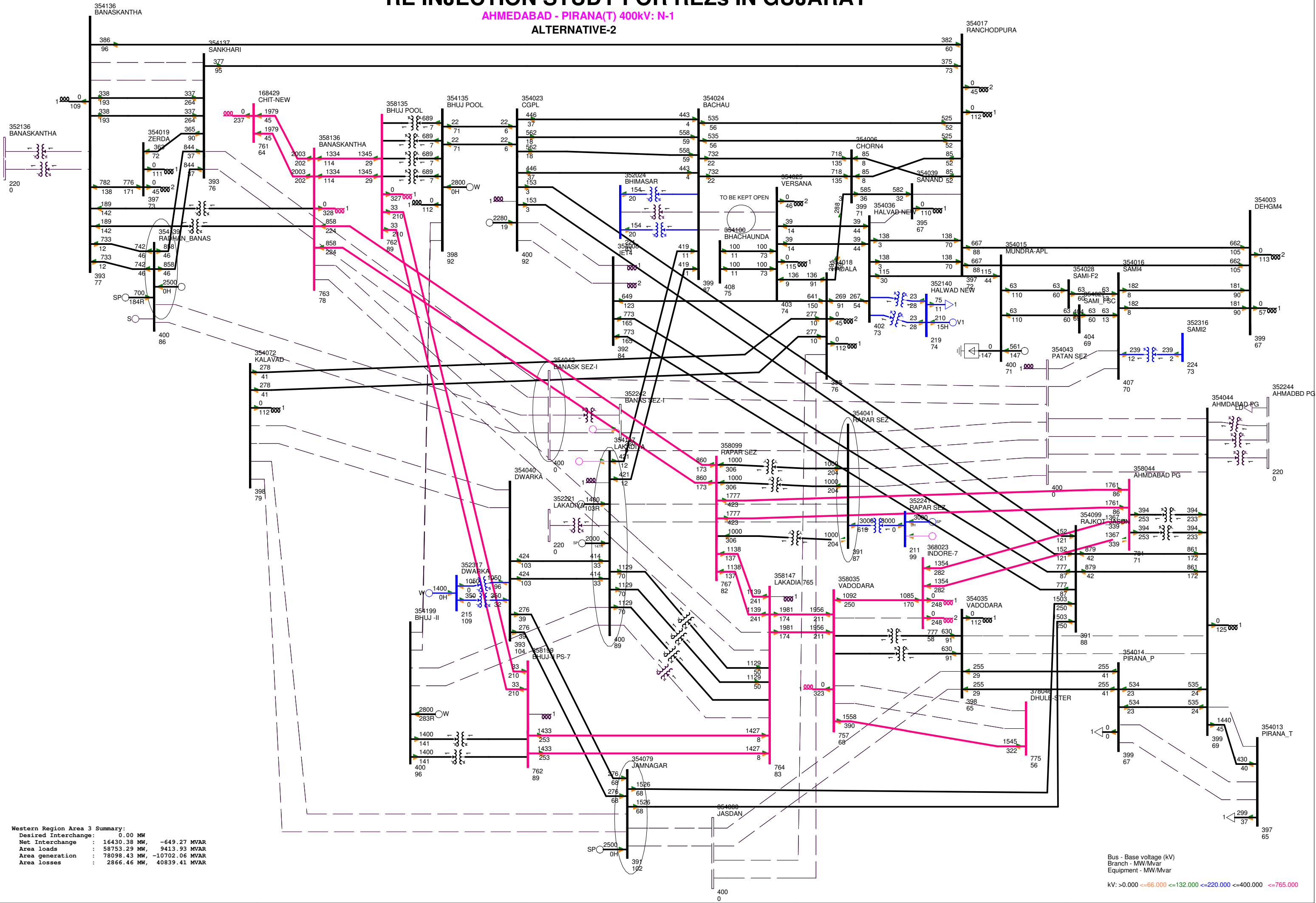


Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16424.79 MW, -662.76 MVAR
 Area loads : 58753.28 MW, 9413.92 MVAR
 Area generation : 78098.43 MW, -10597.41 MVAR
 Area losses : 2872.07 MW, 40908.20 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

AHMEDABAD - PIRANA(T) 400kV: N-1
ALTERNATIVE-2



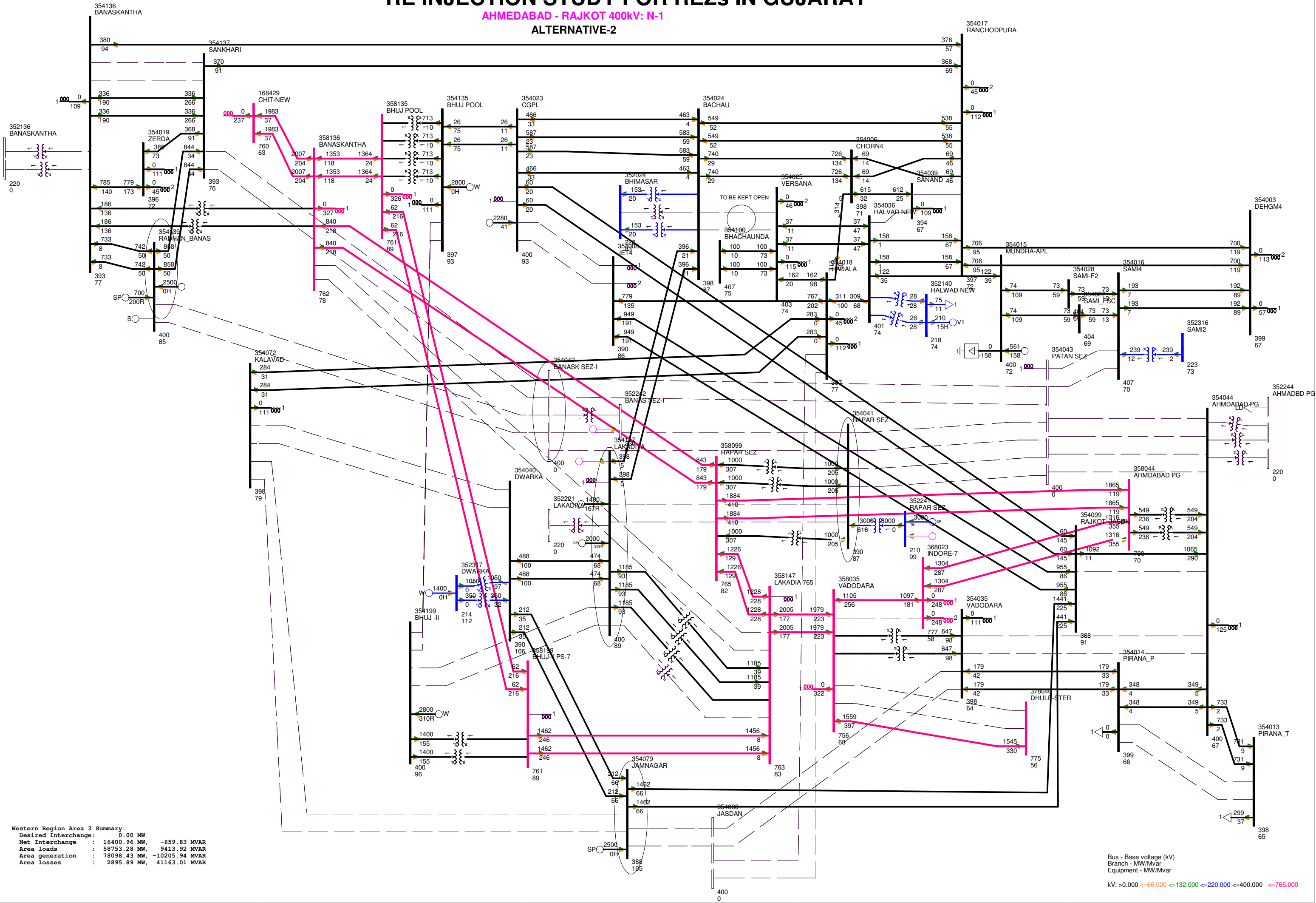
Western Region Area 3 Summary:
 Desired Interchange: 0.00 MW
 Net Interchange: 16430.38 MW, -649.27 MVAR
 Area loads: 58753.29 MW, 9413.93 MVAR
 Area generation: 78098.43 MW, -10702.06 MVAR
 Area losses: 2866.46 MW, 40839.41 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

AHMEDABAD - RAJKOT 400kV: N-1

ALTERNATIVE-2



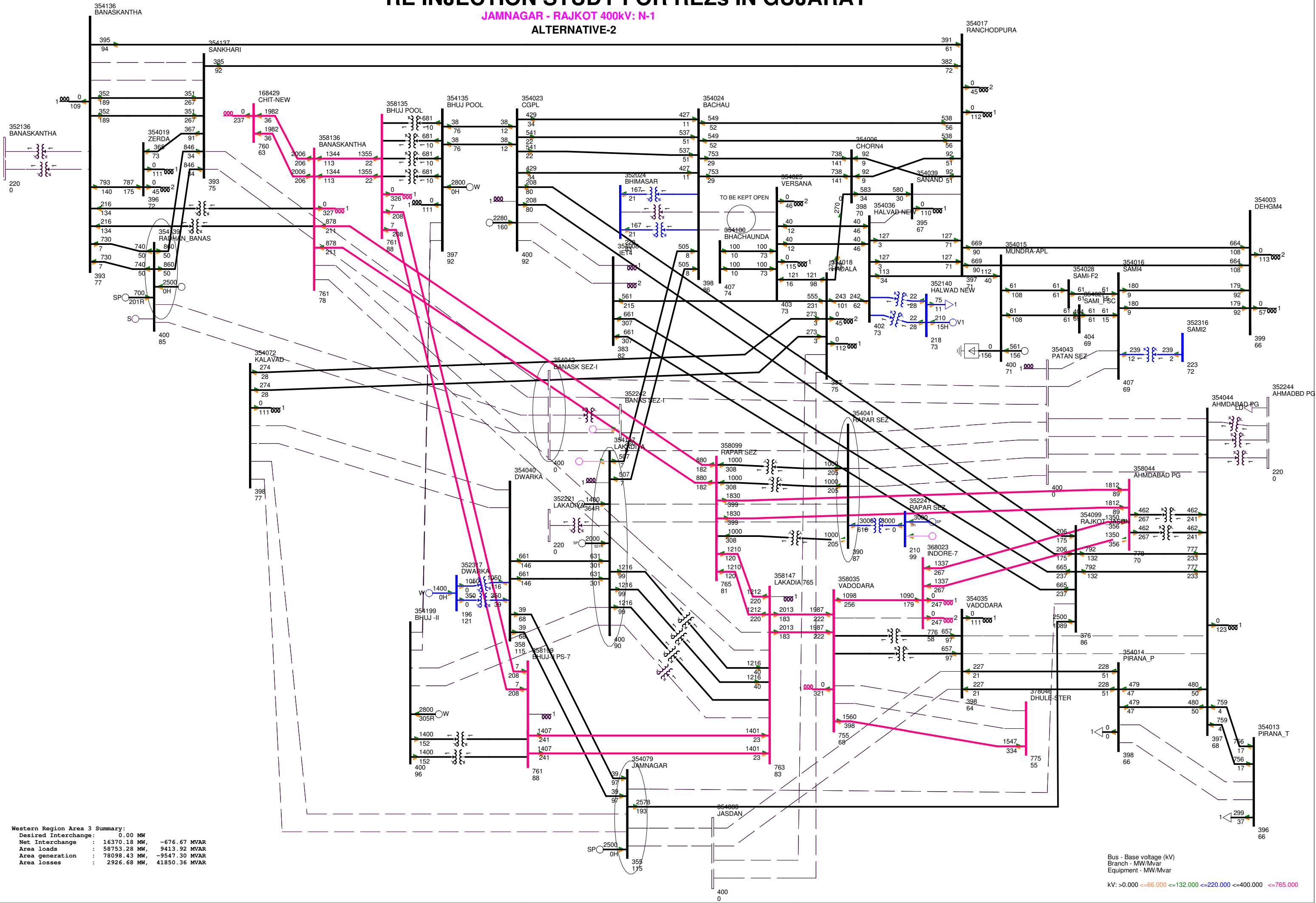
Western Region Area 3 Summary:
 Desired Interchange : 0.00 MW
 Net Interchange : 16400.96 MW, -659.83 MVAR
 Area loads : 58753.28 MW, 9413.92 MVAR
 Area generation : 78098.43 MW, -10205.94 MVAR
 Area losses : 2895.89 MW, 41163.01 MVAR

Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar
 kv: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs IN GUJARAT

JAMNAGAR - RAJKOT 400kV: N-1

ALTERNATIVE-2



Western Region Area 3 Summary:

Desired Interchange:	0.00 MW	
Net Interchange:	16370.18 MW	-676.67 MVAR
Area loads:	58753.28 MW	9413.92 MVAR
Area generation:	78098.43 MW	-9547.30 MVAR
Area losses:	2926.68 MW	41850.36 MVAR

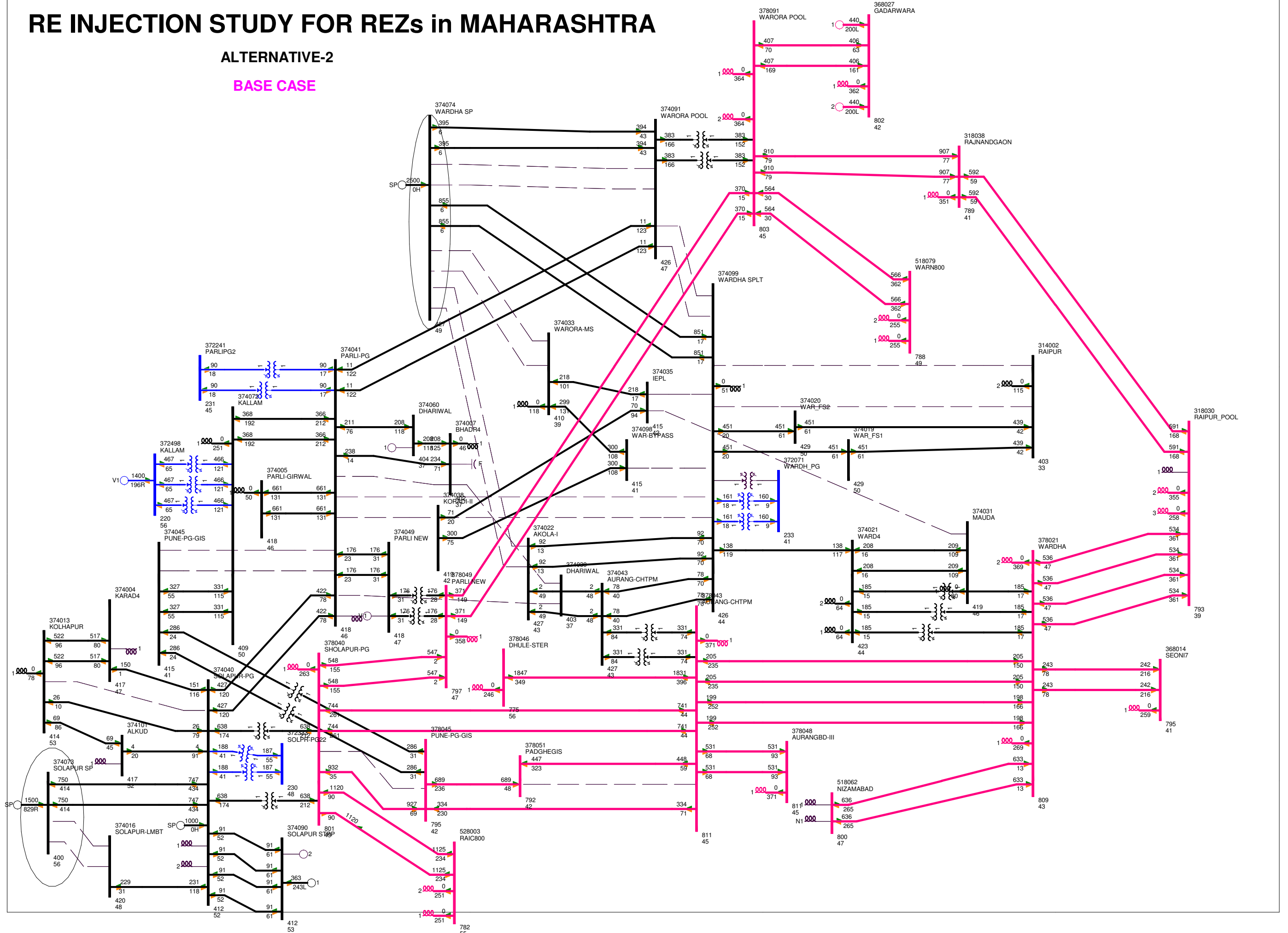
Bus - Base voltage (kV)
 Branch - MW/Mvar
 Equipment - MW/Mvar

kV: >0.000 <=66.000 <=132.000 <=220.000 <=400.000 <=765.000

RE INJECTION STUDY FOR REZs in MAHARASHTRA

ALTERNATIVE-2

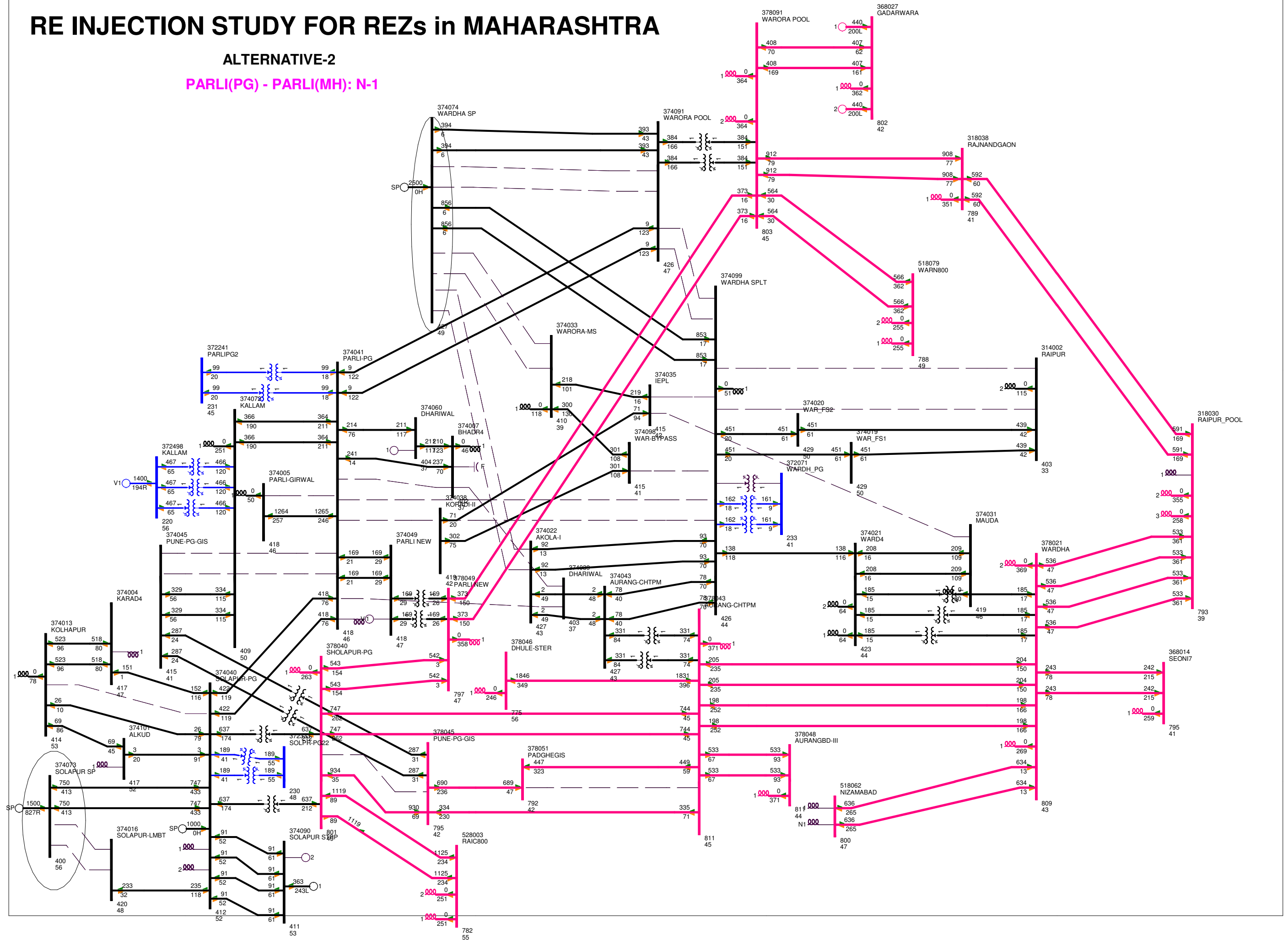
BASE CASE



RE INJECTION STUDY FOR REZs in MAHARASHTRA

ALTERNATIVE-2

PARLI(PG) - PARLI(MH): N-1



RE INJECTION STUDY FOR REZs IN MADHYA PRADESH ALTERNATIVE-1

BASE CASE

