EASTERN REGIONAL POWER COMMITTEE
14, GOLF CLUB ROAD, TOLLYGUNGE
KOLKATA-700033

MINUTES OF 17th PROTECTION SUB-COMMITTEE MEETING HELD AT ERPC, KOLKATA ON 21.08.2013 (WEDNESDAY) AT 11:00 HOURS

List of participants is enclosed at **Annexure-A**

Member Secretary I/C welcomed the participants. Thereafter, he requested SE (PS), ERPC to take up the agenda points in seriatim.

PART – A

ITEM NO. A.1: CONFIRMATION OF THE MINUTES OF 16th PROTECTION SUB-COMMITTEE MEETING

The minutes of 16th Protection Sub-Committee meeting held on 24.07.2013 were circulated vide letter no. ERPC/SE (PS)/ PROTECTION/ 2013/635-668 dated 30.07.2013 and also available at ERPC website: www.eastrpc.org.

No comments have been received from any constituent.

The minutes of the above meeting may be confirmed.

ERLDC asked for correction in Item no. B.2, Orissa System as follows,

"ERLDC informed that repeated overvoltage tripping of 400 kV Meramundali – Angul line had occurred in past one month. In Special Protection Committee meeting held on 14th June, 2013, OPTCL informed that, such incident of tripping have been occurring due to problem in B-phase CVT. OPTCL had also informed that they have attended the B-phase CVT of the line at Meramundali end on 1st July, 2013. Further, it was observed that such tripping incidents have not been reduced even after OPTCL attended the B-phase CVT of the line at Meramundali end. However, there is no tripping reported from 20th July, 2013 onwards. ERLDC desired to know the remedial action taken by OPTCL in the intervening time(i.e for the period from 1st July, 2013 to 20th July, 2013). This could not be ascertained as representative from OPTCL was not present in the meeting."

With the above amendments, Members confirmed the minutes of the 16th Protection sub-Committee meeting.

PART- B

FOLLOW-UP OF DECISIONS OF THE PREVIOUS PROTECTION SUB-COMMITTEE MEETING(S)

(The status on the follow up actions is to be furnished by respective constituents)

ITEM NO. B.1: TRIPPING INCIDENCES ON 03.06.2013 AT 21:24HRS, 04.06.2013 AT 02:28 HRS, 05:20 HRS & 06:33 HRS INVOLVING RAMMAM, RANGIT, CHUZACHEN & SIKKIM SYSTEM

In the 16th PCC meeting the status was as given below:

- PSM of Over-Current Relays of all 132kV lines from Rangit HPS, NHPC are now set at 1.5 at Rangit end
- The CT ratio of all 132 kV lines from Rammam HPS is 600/1 and PSM of Over-Current Relays of these lines are set at 1.0
- PSM of Over-Current Relays of CTU control area in Rangit-Chuzachen complex including Gangtok S/s increased to 1.5 as per Special meeting of PCC on 07.06.2013
- M/s. Gati Infrastructure Ltd. appraised that in line with 87th OCC decision, testing of the SPS of Chuzachen was successfully carried out on 23.07.2013 in the presence of representative from POWERGRID, ERTS – II and Rangit, NHPC. Further functioning of the SPS implemented was explained during the meeting with a detail presentation.
- On the request from Chuzachen to maintain higher generation level from the existing level of 50 MW, PCC considered allowing generation at 75MW i.e - an increase of 25MW. PCC desired that performance of the implemented SPS at Chuzachen would be reviewed at 75MW generation level for a week and thereafter if there is no constraint, then the station will be allowed to generate maximum at 99MW.Thereafter, a number of cascade tripping incidences occurred and the performance of implemented SPS may be apprised to the house.

Chuzachen/ ERLDC representative may please elaborate with all the latest developments.

Deliberation in the meeting

In line with decision taken in 16th PCC and no tripping occurred after 24-07-13, Chuzachen was allowed to increase generation by another 10 MW i.e. to 85 MW (interim) from 02-08-13. ERLDC informed that, several trippings have been reported from 3rd to 14th August, 2013 which caused total power failure at Rangit, Rammam, Melli, Gangtok, Lebong (Darjeeling) and Siliguri complex. ERLDC pointed that, even with SPS operation at Chuzachen on 11th August, 2013 island did not survive.

*To review the situation, a separate meeting was held at ERPC, Kolkata on 16-08-2013, wherein it was decided that, Chuzachen HPS generation should be restricted to maximum to the tune of 50 MW. Minutes of the meeting enclosed at **Annexure-B.1**.*

ERLDC informed that, no cascade tripping of the lines have been reported after Chuzachen generation was restricted to 50 MW.

ERLDC informed that, a team of ERLDC and Powergrid inspecting the sub-stations in Rangit, Rammam, Melli, Gangtok, Lebong (Darjeeling) and Siliguri complex to access the protection deficiencies and report will be submitted in next PCC meeting.

ERLDC also informed that, they are working on modification of SPS for survival of the system at all possible conditions.PCC advised ERLDC to place the same in next protection meeting.

Members enquired about LBB operation at 132 kV Siliguri S/s. In reply, Powergrid stated that, trip coil got burnt due to incorrect implementation of the scheme and the same has since been rectified.

ITEM NO. B.2: Tripping of 220 kV Biharsharif-Fatua line from Bihariff S/s on 21.04.13

- Issue was discussed in the Special meeting on14.06.2013.
- It was reported that snapping of the Bottom conductor in between tower location No-103 & 104 of the 220KV Biharsharif – Fatuha Ckt.-II, resulted in total power failure at Biharsharif (BSPHCL) GSS. The line fault of 220KV Biharsharif – Fatuha Ckt.-II, operated the protection relays of all the 220KV incomer breaker of 315 MVA ICT-I, II & III at Biharsharif (BSPHC) end and that of the 220KV Biharsharif –Tenughat line at TenughatTPS end without tripping and isolating the faulty 220KV Biharsharif – Fatuha Ckt.-II itself at Biharsharif (BSPHCL) end.
- It was recommended that relay coordination of Fatuha, Biharsharif (BSPHCL), TenughatTPS and Biharsharif (PG) required to be carried out by BSPHCL in consultation with PGCIL and TenughatTPS and report.

During 16th PCC meeting, representative of BSPHCL was not present in the meeting.

It was reported by BSPHCL that the Protection system at 220 kV Biharsharif substation had been checked and necessary rectification in wiring of relay control circuit has been carried out at Bihariff S/s. The relay setting had also been checked. However, there was no information on compliance of previous recommendations by BSPHCL in respect of Fatuah S/s.

PCC decided that a committee comprising representatives from ERPC and POWERGRID would visit the substations –Fatuah (BSPHCL), Bihariff (BSPHCL), Bihariff (PG) and Tenughat TPS (JSEB) to assess the present status of the protection system and improvements required, if any.

BSPHCL may please give the present status and PCC may decide further course of action.

Deliberation in the meeting

BSPHCL informed that, the zone-II time settings of the lines at Fatuah (BSPHCL), Bihariff (BSPHCL), Bihariff (PG) have been revised from 400 msec to 500 msec. in coordination with Powergrid. This has also been done for 220 kV Bihariff - Tenughat TPS (JSEB) line.
On enquiry, BSPHCL also informed that, PLCC facility is not available at these sub-stations for carrier protection. PCC advised BSPHCL to initiate action for implementation of PLCC based protection of the important substations immediately to which BSPHCL agreed to.

ITEM NO. B.3: SYSTEM DISTURBANCES IN WEST BENGAL

i. BIDHANNAGAR 220 KV SUB-STATION ON 12.05.13 AT 15:55 HRS

In the 16th PCC meeting, WBSETCL informed that it would take some more time to complete necessary rectification work at this sub-station so as to make both the 220 kV buses operational with arrangement for sectionalisation. The work is now expected to be completed by the end of December, 2013.

WBSETCL may please intimate the present status.

Deliberation in the meeting

WBSETCL informed that the target schedule of implementation remains same.

ii. JEERAT 400KV SUB-STATION OF WBSETCL AND SUBSEQUENT POWER FAILURE AT 220 KV

KASBA & OTHER SUBSTATIONS ON 21.05.13 AT 14:28 HRS.

- In order to prevent massive cascading effects of tripping WBSETCL considered to provide implementation of Special Protection Scheme to reduce the overloading of lines from Kasba sub-station. Further, WBSETCL implemented load rejection scheme at Subhasgram & Kasba 220kV sub-station.
- In addition to the above , carrier signal sent with reverse blocking Zone-IV and blocking of Zone-I for 100 msec with carrier receipt from other end have been made through for 220kV Subhasgram – Subhasgram (PGCIL) line I & II.
- In the 16th PCC meeting, it was informed that a separate meeting between WBSETCL and Powergrid, ER-II was held on 06.07.2013 to discuss the blocking scheme for 220 kV Subhasgram (PG) – Subhasgram (WB) D/C line. Outcome of the meeting is as follows:

  i) Only one PLCC link is available for both the circuits;
  ii) In order to prevent overreaching of the Zone – 1 distance protection at POWERGRID end, four (4) nos. of permissive signals are required for blocking the Zone – 1 protection;
  iii) Therefore, for faults in Zone – 2, no direct trip signal would be available to ensure instantaneous tripping from POWERGRID end;
  iv) ERTS – II is already in process of revising the settings of distance protection for this line;
  v) Necessary approval from Corporate Engineering, POWERGRID is expected;
  vi) Implementation of the revised scheme can be taken up by 15.08.2013.

  The line being only 800 Mtr. long, WBSETCL will implement current differential protection at a later date with OPGW as communication media between the ends-WBSETCL informed.

WBSETCL & Powergrid may update the status.

Deliberation in the meeting

WBSETCL informed that, they are ready for the implementation of blocking scheme for 220 kV Subhasgram (PG) - Subhasgram (WB) D/C line. However, Powergrid informed that, the scheme is yet to be approved from their corporate office and expected to be approved within a week. Thereafter, the necessary action will be taken up.

ITEM NO. B.4: IMPLEMENTATION OF REVISED UFRs BASED LOAD SHEDDING SCHEME (4 STAGES) IN THE CONSTITUENT SYSTEM

- In the 16th PCC meeting, it was informed that as per decision taken in the 2nd NPC meeting held on 16.07.2013, the total quantum of Under Frequency load shedding to be implemented in all four stages would be 3320 MW for Eastern Region. Accordingly, the total load quantum is divided among the constituents as per present proportionate which is as given below:

Control Area	Stage -I (49.2 Hz) (MW)	Stage -II (49.0 Hz) (MW)	Stage-III (48.8Hz) (MW)	Stage-IV(48.6Hz) (MW)	Total Relief by Control Area
Bihar	98	99	99	101	397
Jharkhand	61	62	61	62	246
DVC	134	135.5	136	137	542.5
Odisha	181.5	183.5	184	186	735

WB & CESC	345.5	350	350	354	1399.5
Total	**820**	**830**	**830**	**840**	**3320**

This was also discussed in the 87th OCC meeting on 23.07.2013 and agreed upon.

- PCC members were requested to implement the revised quantum of Under Frequency load shedding in their respective systems as per the scheme (4 stages) finalised by NPC, within a month timeframe and inform the substation/feeder-wise load relief obtainable through Under Frequency load shedding, for both peak and other than peak conditions.

Members may please intimate the present status.

Deliberation in the meeting

PCC was apprised that Bihar had submitted the feeder wise details in 88th OCC meeting held on 20.8.13 and informed that, the revised scheme has been implemented in their control area with total load relief of 440 MW against 397 MW. CESC also informed that the revised UFR load relief scheme has been implemented and submitted the feeder wise details. DVC, WBSETCL, JSEB also informed that the feeder wise details with quantum of average loads will be submitted soon. PCC requested all other constituents to implement the scheme immediately and give the feeder wise details to ERLDC/ERPC. Members agreed to provide the information within a week.

ITEM NO. B.5: REVIEW OF ZONE-3 PHILOSOPHY

- In the 1st NPC meeting Powergrid informed that they had already reviewed and implemented revised Zone-3 settings for inter-state lines wherever required in the country in coordination with STUs and generators. However, for the intra-state transmission lines, various data including existing Zone-3 settings had not been received by them. All RPCs were requested to advise STUs to furnish all such data to Director (O), Powergrid within three weeks.
- In the 2nd NPC meeting held on 16th July 2013, Powergrid informed that except for a few constituents in ER, the requisite data from most of the ER constituents has been received. The list of the transmission lines of the constituents which require zone-3 settings data is shown at **Annexure-B.5**.
- Powergrid also requested CEA /ERPC to forward the such requisite data to the following address urgently:

AVS Ramesh, (Mob: 9560 890365)
Manager (OS),
Corporate Centre,
POWERGRID,Gurgaon.

Concerned constituents are requested to forward the relevant data to Powergrid.

Deliberation in the meeting

*PCC requested all the constituents to give the relevant data to Powergrid as given in **Annexure-B.5**.*

ITEM NO. B.6: REMEDIAL MEASURES TAKEN BY JSEB FOR TESTING OF EXISTING RELAYS AT HATIA, RAMCHANDRAPUR & CHANDIL SUB-STATIONS AND INSTALLATION OF NEW RELAYS AT CHANDIL 220 KV SUB-STATIONS

JSEB in a communication dated 12.07.2013 intimated that the following remedial actions have been taken recently with the help of PGCIL:

i. On dt. 24.06.2013 and 25.06.2013 each and every relays of both 220/ 132kV and 132/33kV G/S/S of Hatia were checked and reset wherever required with time co-ordination.
ii. On dt. 26.06.2013 and 27.06.2013 each and every relays of 220/132kV Chandil and Ramchandrapur G/S/S were checked and reset wherever required with time co-ordination.
iii. Defective relays of 220kV Ramchandrapur-Chandil T/L at Chandil end were replaced and tested by Micom P430C relays.
iv. On dt. 02.07.13 SEL-311C distance protection relays of 220kV STPS and 220kV PGCIL(Ranchi) bays at Chandil end has been tested and co-ordinated by application engineer of M/s Easun Re-rolley Ltd. Hosur (Bangalore) and found okay.
v. In the first week of July, 2013 Micom P442 distance protection relays has been retrofitted in the 132kV Lalmatia-Dumka-I. Lalmatia-Kahalgon(NTPC) Lalmatia – Sabour (BSEB) line and tested, result found satisfactory.

After carrying out the above work, JSEB informed that the cases of un-coordinated trippings of lines as well as units are not repeating. However, the status is being observed for further course of action.

In the 16th PCC meeting, JSEB representative informed that with the assistance from POWERGRID, the time delay for Zone – 2 distance protection of all 220 KV and 132 KV lines emanating from Chandil, Hatia and Ramchandrapur have been reduced to 150 ms from 400 ms. Since then, indiscriminate tripping of lines on faults has reduced. Further, as single phase auto reclose facility is not present in their 220 kV lines, 3-phase tripping on single phase fault has been ensured with the help of manufacturer.

JSEB also informed that in the first week of July, 2013 Micom P442 distance protection relays has been retrofitted in the 132kV Lalmatia-Dumka-I. Lalmatia-Kahalgon(NTPC), Lalmatia –Sabour (BSEB) lines, which was pending since long. The relays were tested and result found satisfactory. However, there were further uncoordinated trippings occurred during July /August,2013.

JSEB may submit the detail of present relay settings.

Deliberation in the meeting

JSEB informed that, Distance protection relay of 220 kV Chandil-Santaldih at Chandil end is malfunctioning. Rectification of the same is in process.

Members enquired about the status of recommendations given by ERPC inspection team. JSEB informed that, most of the observations were complied and agreed to give the latest status within a week.

ITEM NO. B.7: SPS for Chukha HPS on tripping of 220 kV Birpara –Binaguri & 220 kV Birpara-Salakati lines.

In the 16th PCC meeting, representative from POWERGRID, ERTS – II explained with the help of a presentation the events that had led to tripping of Birpara – Binaguri as well as Birpara – Salakati D/C lines on 9/7/13. From DR output, it could be inferred that after tripping of 220 kV Birpara – Salakati Circuit I, the impedance measured by the Distance Protection of Circuit 2 at Birpara was less than the Zone – 1 value due to which Circuit 2 also tripped.

In this connection, ERLDC proposed that an SPS for reducing Chukha generation may be implemented at Birpara S/s, which would take care of cascaded outage of 220 kV lines connecting Birpara S/s with the rest of the NEW grid in the event of sudden outage of one or two lines on fault. Such SPS would be required only during monsoon when generation of Chukha

would be in full. The proposal was illustrated with the help of a presentation. Powergrid agreed to implement such type of SPS scheme at Birpara S/s once it is approved.

After threadbare deliberation, members decided to re-examine the proposed scheme prepared by ERLDC and revert back with their final views in the next PCC meeting.

ERLDC may present the scheme and members may deliberate.

Deliberation in the meeting

*ERLDC gave a presentation on the proposed SPS scheme of Chuka HPS, Bhutan. Presentation is enclosed at **Annexure-B.7**. PCC agreed for the scheme and decided to send the SPS scheme to Chuka HEP for their study, comments and suggestion. Then the scheme will be placed before all concerned parties in a separate meeting before placing the same in TCC/ERPC meeting for final approval.*

ITEM NO. B.8: Repeated trippings of lines on over voltage from Meramundali 400kV S/S

It was observed that repeated trippings of 400kV Meramundali-Anugul section and other lines from Meramundali have been observed due to over-voltage Stage-I initiation from Meramundali. At Meramundali the Bus voltage generally remains around 420kV to 425kV. Initially problem in B-ph CVT of Meramundali-Anugul line at Meramundali end was reported and the same was reportedly rectified. However, even after rectification of the same, the trippings have not reduced.

In the 16th PCC meeting, ERLDC informed that repeated overvoltage tripping of 400 kV Meramundali – Angul line had occurred in the month of June, 2013. However, such tripping incidents have not been experienced after OPTCL attended the B-phase CVT of the line at Meramundali end. The other details of corrective actions taken by OPTCL could not be ascertained as representative from OPTCL was not present in the meeting.

OTPCL may submit the details of action taken.

Deliberation in the meeting

The remedial action taken by OPTCL at Meramundali S/s in the intervening time (Between 1st July, 2013 and 20th July, 2013) could not be ascertained as representative from OPTCL was not present in the meeting.

ITEM NO. B.9: Tripping of 100MVA ICTs at Purnea & Purnea-Purnea(PG) lines on 06.07.2013 at 20:49 Hrs

At 20:49hrs of 06/07/13, due to fault in downstream system of BSPHCL, 132kV Purnea (PG)-Purnea(BSPHCL)-II & III tripped on earth fault & O/C relay operation at Purnea(PG) end. However no tripping was reported at Purnea (BSPHCL) end. 132kV Purnea(PG)-Purnea(BSPHCL)-I did not trip and it was later detected that Y-Ø CVT fuse of 132kV Purnea (PG)-Purnea (BSPHCL)-I at Purnea (PG) was blown. Due to Y-Ph CVT fuse failure, 132kV Purnea(PG)-Purnea(BSPHCL)-I did not trip and consequently all three 100MVA ICTs at Purnea (PG) end tripped on Directional O/C & E/F operation and cleared the fault. 132kV Purnea (PG) – Kishanganj and 132kV Purnea (PG)-Purnea (BSPHCL)-I were later hand tripped from both the sides as per normal practice. Report from BSEB in this regard is yet to be obtained.

In the 16th PCC meeting, POWERGRID ERTS – I representative, informed that Purnea(PG) – Purnea(BSPTCL) 132 kV D/C line is protected only by directional Over-Current Relay from POWERGRID end. On 06.07.2013, there was a fault in 132 kV Purnea – Khagaria line which could not be cleared from BSPTCL end as MICOM relay installed at BSPTCL

sub-station did not operate. Further, due to failure of PT fuse at POWERGRID end of 132 kV Purnea(PG) – Purnea(BSPTCL) ckt-1, the Directional Over-Current relay at POWERGRID end also failed to pick up. As a result the fault was cleared by operation of back up Over-Current and Earth Fault relay of the 220 / 132 kV ATRs at Purnea (PG) end. Members felt that since static Directional Over-Current Relay is the primary protection available at POWERGRID end, provision should be made for PT fuse supervision immediately.

Members further suggested that Purnea(PG) – Purnea(BSPTCL) line being a short line (around 1 Km.), the line should be protected using numerical relay with differential protection as the main and distance protection as back up protection.

PCC recommended immediate interaction between BSPTCL & Powergrid for relay coordination at the site.

BSPTCL & Powergrid may give the present status.

Deliberation in the meeting

BSPTCL & Powergrid informed that the zone-II time settings of Distance relays have been revised to 500 msec to have proper time coordination with adjacent transmission lines. BSPTCL also informed that, protection relays of 132 kV lines emanating from Purnea (BSPTCL) have been replaced with numerical relays Micom P442.

PCC advised BSPHCL and Powergrid to implement differential protection also and report the status before PCC.

ITEM NO. B.10: Tripping of 220kV Fatuha-Patna(PG) ckt at 12:13hrs on 25.06.13 followed by tripping of ICTs at Biharshariff S/S.

The detailed report from Bihar is awaited.

In the 16th PCC meeting, the incident could not be deliberated in the absence of representative from BSPTCL / BSPHCL

BSPTCL may submit the detail report.

Deliberation in the meeting

BSPTCL informed that, protection relay of 220kV Fatua-Patna(PG) at Fatua end was found mal-operation. The relay has been replaced with numerical relay Micom-127.

ITEM NO. B.11: Oscillation triggered at Jamshedpur by APNRL unit

In the 16th PCC meeting, ERLDC informed that severe power oscillation had been recorded by the PMU at Jamshedpur 400 kV sub-station on 07.07.2013, when Turbine Control valve of APNRL Unit 1 reportedly started hunting due to mal-functioning of the Unit Output Transducers. APNRL subsequently assured that the problem has been rectified by them, but similar incident again occurred on 23.07.2013. Members unanimously agreed that Oscillation in 400 kV power system networks is detrimental to the security of the grid as a whole and requested APNRL to take immediate steps for preventing its recurrence.

APRNL may give the remedial measures taken.

Deliberation in the meeting

APRNL representative was not present in the meeting. PCC advised to send one more reminder to APRNL regarding remedial action taken.

PART - C

ITEM NO. C.1: ANALYSIS & DISCUSSION ON GRID INCIDENCES WHICH OCCURRED IN CTU / STU SYSTEMS DURING JULY & AUGUST, 2013

C.1.1 Jharkhand System

A. REPEATED TRIPPING OF 220KV STPS-CHANDIL AT CHANDIL END ONLY –ERLDC POINTS

It has been observed that 220kV STPS-Chandil line is tripping repeatedly from Chandil end only with no tripping from STPS end. The indication at Chandil end is not being furnished properly. As the above line is an important evacuation path for STPS, it is necessary that operation of relays be checked and if detected to be mal-tripping, the problems needs to be rectified. Patrolling of the line has been carried out in the past but no faults have been detected.

The following points are hence to be clarified/action to be taken w.r.t incident:

a) In case of trippings of the line, the relay indications clearly indicating the type of fault, zone, fault current may be indicated to enable taking a safe charging attempt.
b) A thorough audit and testing of relays at Chandil end for 220kV STPS-Chandil need to be carried out.
c) JSEB may explain regarding the difficulties faced in synchronizing the line at Chandil end(if any) i.r.o non-availability of synchroscope, etc for safe synchronization of the line.
d) In past incidents of disturbances it has been observed that due to fault in reverse zone of Chandil for 220kv Chandil-STPS line(viz. 132kv side or 220kv Ranchi-Chandil), the Chandil end breaker of 220kV STPS-Chandil is tripping. The D.P. settings of the line hence needs to be checked w.r.t to reverse zone settings and corrected.

JSEB may please respond.

Deliberation in the meeting

JSEB informed that, Distance relay of 220 kV Chandil-Santaldih at Chandil end was found malfunctioning. Rectification of the same is in process.

PCC advised JSEB to examine the directional Over Current relay and earth fault relay settings to compare with direction of the current during tripping incidences for identification of relay mal-operation.

On query JSEB informed that, Synchroscope is not available at Chandil S/s. PCC advised JSEB to install Synchroscope immediately. JSEB agreed.

B. LOSS OF GENERATION AT PATRATU AND TENUGHAT TPS ON 04.08.2013

At 14:05, on 04.08.2013 a reoccurrence of tripping was reported in 220/132kV JSEB system (refer **Exhibit –I**) and loss of generation at Patratu and Tenughat. ERPC vide letter dated 06.08.13 has requested JSEB to take immediate measures on the following recommendations as placed by the ERPC protection teams while carrying out visits of Chandil GSS & Hatia GSS.

a) For Chandil GSS:

Name of line	Protection available	Measures required Immediately
3X100 MVA, 220/132 kV Transformer	RYDSB, R1D1: status- not healthy as no test reports & no records of trippings found in the past	The differential relay to be tested & the report to be given to ERPC. ABB to be contacted for any assistance.
Single Main with Transfer Bus	LBB relay available	The bus to be sectionalized and LBB relay to be made operational (Earlier recommendation of ERPC)

b) For Hatia GSS system:

1. The mandatory /routine tests on CTs and PTs should also be carried out and the reports should be submitted to ERPC.
2. The PLCC link on 220 kV Tenughat-Patratu S/C, 220 kV Patratu-Hatia D/C and 220 kV Tenughat-Biharshariff S/C should be established immediately.
3. PGCIL Ranchi S/S is to submit the details of distance relays on their outgoing 220 kV lines to ERPC Secretariat. The protections available on the 400/220 kV ICTs may also be given. The copy of the test reports of the 220 kV side relays may also be made available to ERPC Secretariat. All these details may be given at the earliest.

JSEB may please elaborate and submit the detailed tripping report.

Deliberation in the meeting

Members enquired about the status of recommendations given by ERPC inspection team. JSEB informed that, most of the observations were complied and agreed to give the latest status within a week.

C.1.2 Sikkim, WBSETCL (Kurseong), Rangit and Chuzachen System

A) Trippings of 132kV Siliguri-Kurseong (on ph-ph fault[Y-B-N]) & 132kV Siliguri-Melli (on 3-ph fault[R-Y-B]) at 05.26 Hrs on 03.08.2013.

Reports of ERLDC (refer Exhibit-II)

At 05:26hrs, on 03.08.2013 total power failure occurred in Sikkim system due to tripping of 132kV Siliguri-Kurseong (on ph-ph fault[Y-B-N]) & 132kV Siliguri-Melli(on 3-ph fault[R-Y-B]) due to inclement weather conditions. 132kV Rammam-NBU / 132kVRammam-Lebong (WBSEB) & 132kV Rangit-Rammam lines were manually opened prior to the above incident due to public agitation for Gorkhaland (as reported by WBSETCL). Hence, with the tripping of both the above ckts, an island got formed with Gangtok/Melli/Kurseong loads alongwith Rangit/Chuzachen generation, and the island collapsed on load generation imbalance. All the lines emanating from Rangit were subsequently hand tripped as per normal practice.

The following points are required for deliberation and analysis:

a. Powergrid may explain and confirm the possible reasons for simultaneous fault at same location from Siliguri end.
b. Tripping of Chuzachen units on low frequency need to be explained.

Deliberation in the meeting

The issue was discussed in Item-B.1.

B) Trippings of 132kV lines at Siliguri, Rangit and Chuzachen sub-stations due to fault in 132kV Siliguri-NJP-NBU line at 12.52 Hrs on 11.08.2013.

Reports of ERLDC (refer Exhibit-II).

Details of tripping: Due to suspected fault in 132 kV Siliguri-NJP-NBU line following tripping occurred.

1x160 MVA ICT and 1x100 MVA ICT at Siliguri	132 KV Rangit-Ramam
132 kV Siliguri-NBU	132kV Siliguri- Melli
132 kV Siliguri-NJP-NBU	132kV Chuzachen-Gangtok
132kV Siliguri- Kurseong -Rangit	(Chuzachen SPS operated as reported)
132kV Rangit- Gangtok	132kV Chuzachen-Melli
132kV Rangit- Melli	Chuzachen unit#2 & 1 , Rangit unit#1,2,3

Detailed report awaited from Rangit, Sikkim & Chuzachen.
Concerned constituents may submit the detailed report and explain.

Deliberation in the meeting

The issue was discussed in Item-B.1.

C.1.3 Orissa System

A. Multiple trippings of lines at 220 kV Theruvali S/S in OPTCL system on 30.07.2013

Reports of ERLDC (refer Exhibit-III)

At 23:59hrs on 30.07.2013, transient earth fault occurred in 220kV Theruvali-U.Kolab Ckt (low ground clearance due to growth of bamboo trees) due to which various 220kV feeders & Auto transformers tripped at Theruvali & at Remote s/s also. Around 80MW load loss occurred at Theruvali area due to tripping of both 100MVA ICTs. No generation loss was reported by OPTCL. Following elements tripped as per report submitted by OPTCL.

Details:-
It appears that the sequence of events was initiated due to fault in 220kV Theruvali-U.Kolab Ckt (low ground clearance on growth of bamboo trees) on transient earth fault. However, there appears to a delayed opening of CB of the said ckt at Theruvali end (as reported by OPTCL). OPTCL also reported that the LBB scheme at Theruvali end is not functional and as a result tripping of feeders on LBB did not occur. Some of the outgoing lines tripped from Theruvali end possibly on reverse zone protection, while the remaining feeders tripped from remote ends. Thus Theruvali-Indravati-II and Theruvali-Narendrapur-I & II tripped from remote ends (Indravati/Narendrapur) on Zone-III. Also, OPTCL has reported that DP relay in Indravati-Theruvali-IV is not available but only backup O/C E/F relay is available and considering directional element the same did not trip at Theruvali end. Hence the said ckt tripped from Indrāvati end only.

The detailed report from OPTCL is awaited.

The following points are required for deliberation and analysis:
OPTCL has not yet sent a confirmed report and the preliminary report sent by OPTCL has been mentioned to have discrepancies needing further correction. It was verbally

intimated that on observations of the discrepancies(as pointed out by ERLDC)in the preliminary report, OPTCL was in process of further collecting a detailed report. Relay indications have not furnished properly indicating clearly the phase and zone of operation. The details of backup relay operated have not been mentioned. The following are necessary to analyze the disturbance properly:

a) Complete relay indications with DR/EL printouts wherever available
b) Details of Main-I & II relays and backup relays and their settings
c) Non-operation of LBB at Theruvali end needs to be explained by OPTCL.
d) Reverse zone settings for the outgoing lines from Theruvali end needs to be furnished to check whether the trippings from Theruvali have occurred properly.
e) Tripping of ICTs due to fault in 220kv outgoing lines needs to be explained by OPTCL.

Deliberation in the meeting

The issue could not be discussed as OPTCL representative was not present.

B. Tripping at OPTCL (Meeramundali, Duburi, Dhenkanal, Chainpal, Bhanjanagar, Kendrapara) on 02/08/13 at 18:25hrs

Reports of ERLDC (refer Exhibit-IV)

At 18:25hrs, bus fault occurred at 220kV side of Meeramundali s/s when discharge attempt was taken at 'B'-Ø breaker bus side pad clamp of 220kV Meeramundali-Kaniha Ckt-I, when bus isolator was in closed condition. All 220kV lines & some 400kV ckt including 400/220kV & 220/132kV ICTs at Meeramundali tripped. The lists of tripped element are as follows.

220kV Meeramundali-TTPS Ckt-I & II	400kV Meeramundali- GMR
220 kV Meeramundali-NALCO Ckt-I & II	220kV Meeramundali-Bhanjanagar Ckt-II
315MVA ICT-I & II at Meeramundali	220kV bus coupler
100MVA Auto-I & II at Meeramundali	220kV Meeramundali-Duburi-I & II
400kV Meeramundali- Angul	220kV Meeramundali-BSSL Ckt-I & II

At 18:35hrs, all 132kV Ckt hand tripped as per normal practice.

Detail:-
It appears that an inadvertent attempt was taken by a workman to discharge a live section ('B'-Ø breaker bus side pad clamp of 220kV Meeramundali-Kaniha Ckt-I [connected to Bus-II]) and consequent bus fault occurred at Meeramundali as reported by OPTCL. Most of the 220kV Ckts tripped on B-Ø, O/C & E/F except 220kV Meeramundali-Bhanjanagar Ckt-II possibly due to delayed opening of bus coupler CB. O/V relay triggered in 400kV Meeramundali- Angul line may be due to loss load.

OPTCL may please explain the remedial measures taken.

Deliberation in the meeting

The issue could not be discussed as OPTCL representative was not present.

C.1.4 Bihar System

A) Tripping at BSPHCL (Purnea, Kisanganj, part of Nepal) on 02/08/13 at 04:20hrs

Reports of ERLDC (refer Exhibit-V)

At around 04:20hrs, R-Ø drop jumper of 132kV Naugachia bay snapped at Purnea (BSPHCL) due to which following ckts & ICTs tripped.

132kV Purnea (PG)-Purnea (BSPHCL)-T/C
132kV Purnea (PG)-Kishanganj
132kV Purnea (BSPHCL)-Naugachhia (132/33kV, 20MVA Transformer at Purnea (BSPHCL)

Details:-
It appears that the sequence of events was initiated due to R-Ø drop jumper snapping of 132kV Naugachia bay in Purnea (BSPHCL) system. However, due to delayed clearance from Purnea(BSPHCL) side, the Purnea(PG)-Purnea(BSPHCL) T/C from Purnea(PG) tripped on actuation of back up E/F relay. 132kV Purnea (PG)-Kishanganj line also tripped on back up E/F protection.

BSPHCL may please elaborate.

Deliberation in the meeting

BSPTCL & Powergrid informed that the zone-II time settings of Distance relays have been revised to 500 msec. to have proper time coordination with adjacent transmission lines. BSPTCL also informed that, protection relays of 132 kV lines emanating from Purnea (BSPTCL) have been replaced with numerical relays Micom P442.

B) Tripping at 132kV MTPS-Motihari line at 11:58 on 04-08-2013.

Reports of ERLDC (refer Exhibit-VI)

On 04/08/13 at 11:58 hrs, jumper snapping occurred in 132kV MTPS-Motihari ckt at MTPS in BSPTCL system (as reported by BSPTCL) due to which 400/220kV, 315MVA ICT-I at Muzaffarpur (PG) tripped on actuation of Dir. O/C & E/F protection. 220kV Muzaffarpur (PG)-Hajipur-I also tripped at the same time. Since 315MVA ICT-II at Muzaffarpur (PG) was already under shutdown, tripping of ICT-I led to 235MW load loss in north Bihar area (including 25 MW export to Nepal). The detail report from BSTCL is awaited.

The detailed report may please be highlighted (ERLDC may please present the report).

The following points are required for deliberation and analysis:

a. The reasons for non-clearance of fault downstream in 132kV BSPHCL side need to be explained.
b. Powergrid needs to explain the tripping of 315MVA ICT at Muzzaffarpur before operation of 220kV side distance protection at Muzzaffarpur. The B/U O/C operation time of 3.512 secs as mentioned by Powergrid needs to be verified w.r.t the relay characteristics.
c. Proper coordination of 220kV side DP relays with 315MVA ICT backup O/C settings need to audited to ensure no mal operation.

BSPHCL may please elaborate.

Deliberation in the meeting

Powergrid informed that, backup O/C relay operated correctly. However, BSPHCL was suspecting problem in PLCC and rectification of the same is in progress.

C) Tripping at 132kV Purnea(PG)-Purnea(BSEB) T/C line and 132 kV Purnea-Kishanganj S/C at 21:16 on 10-08-2013 & on 13.08.2013 at 11:35 Hrs.

At 21:16 on 10-08-2013, 132kV Purnea(PG)-Purnea(BSEB) T/C line and 132 kV Purnea-Kishanganj S/C tripped reportedly due to jumper snapping in 132 kV Purnea(BSEB)-Naugachia(BSEB).

Deliberation in the meeting

The issue was discussed in Item C.1.4.A

ITEM NO. C.2: Any other points

PCC advised all members to implement the decisions of PCC and report before the committee in a time bound manner for a safe, secure operation of the grid.

The Meeting ended with vote of thanks to the chair.

****

Annexure-A

ERPC::KOLKATA

ATTENDANCE SHEET

17TH Protection Sub-Committee Meeting

DATE: 21.08.2013 (WEDNESDAY)

TIME: 11:00 HRS

VENUE: ERPC CONFERENCE HALL

Sl. No.	Organisation	Name & Designation	Contact Number/ E-mail Id	Signature
1	ERPC	A.K. Bandyopadhyaya, MS I/c	mserpc-power@nic.in	
2	ERLDC	U.K. Verma, GM	ujjwalkumar.verma@gmail.com	
3	ERLDC	डी.के. श्रीवास्तव 35.5.4.	dkshrivastava	
4	~~ERLDC~~	~~PS Das~~	55@yahoo.co.in	
5	ERLDC	P.S Das	psdas_pcd@yahoo.com	
6	ERLDC	S. Banerjee, CM	sarajitb@gmail.com	
7	POWERGRID, ER-2	JITEN DAS/ CHIEF MGR	er-os1@yahoo.com	
8	DVC	P. K Dutta, CE, CTC	pankaj.dutta@dvc.gov.in	
9	NTPC, ER-2	S NAYAK AGM	snayak@ntpc.co.in 9437041581	
10	NTPC, ER-1.	A. K. TIWARY. GM(OS)	aktiwary@ntpc.co.in 9431600703	
11	NTPC. ER-I	RAKESH KUMAR	rakesh kumar12@ntpc.co.in 9431011344	
12	NHPC, TEESTA-V PS	MANISH RAJ, DM.CE)	manisraj@gmail.com 9800003548	
13	EEPD, SIKKIM	NAMGYAL TASHI, A.E	namgyaltashi26@gmail.com	
14	Chuzachen HEP (Gati)	W. Mandal	niladri.mandal@gatiinfra.com	
15	BGL, JSG	SUDIPTA CHOWDHURY	sudipta.chowdhury@vedanta.co.in	
16	MPL	Akash Bajpai	akash.bajpai@tatapower.com	
17	ERLDC	M.K. Thakur		
18	ERLDC	Saurav Kr Sahay	Sahay.Saurav@gmail.com	
19	CESC Ltd.	SANTANU SEN, MANAGER (TR)	santanu.sen@rp-sg.in	
20	CESC Ltd	Ashish Ghoshal, Dy. Chief Engr (Testing)	ashish.ghoshal@rp-sg.in.	
21	GMRSEPCL/SLDC	Y. Raichaudhuri ACE/SLDC	raichaudhuri2811@gmail.com	
22	NBVEYCL	S. Roy	mbya_60@yahoo.co.in	
23	WBSEDCL	T. K. DE A.C.E/ALDC	kumartapan.de@gmail.com 9433870748	

No.	Organisation	Name & Designation	Contact Number	Signature
24	WBPDCL	Gopinath Maji, SM(PS)	9432021137	
25	WBPDCL	PRABIR HALDER, DGM(Engg)	9432014803 bhaldarp@wbpdcl.co.in	P.Halder
26	TVNL	SANATAN SINGH, E.S.E	9431510020 Sanatantvnl@gmail.com	
27	JSEB	VIDYA SAGAR SINGH EEE	9934169984 sagarjseb@gmail.com	
28	BSPHCL	G.K. Choubey; ESE	7763177705 gkc-1959@rediffmail.com	
29	ERPC	Ganeswara Rao, AEE		
30	ERPC	D. K. Bauri, EE	9883617236	
31	ERPC	B. SARKHEL, SE(PS)	9433065724	
32	"	JOYDEB BANDYOPADHYAY SE(C)		
33	POWERGRID	P. HARSHA VARDHANA	9434049232	P. Harsha
34	GATI Infra	RAJESH SHARMA, SM(C)	8800792546	
35	NERPC	SHRIMOHAN JHA		
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Annexure-B.1

Minutes of Special Meeting on "Frequent Tripping around Rangit, Chuzachen and Rammam" held on 16.08.2013 at ERPC, Kolkata

1. Sh. Ankan Bandyopadhaya, Member Secretary I/c, ERPC welcomed the participants to this meeting.

2. Representatives from Sikkim & Chuzachen were not present in the meeting.

3. ERLDC pointed that, Chuzachen generation was restricted to 50 MW from 14-06-13 till 24-07-13. No tripping incidence had occurred during this period. Meanwhile, SPS was implemented after discussion in OCC and PCC. In 16th PCC meeting held on 24-07-13, PCC considered enhancing Chuzachen generation at 75MW i.e. - an increase of 25MW. PCC desired that performance of the implemented SPS at Chuzachen would be reviewed at 75 MW generation level for a week and thereafter if it found to be satisfactory, then the station generation will be further enhanced.

4. Since no tripping occurred after 24-07-13, Chuzachen was allowed to increase generation by another 10 MW i.e. to 85 MW (interim) from 02-08-13. However, from 03-08-13 onwards, several tripping incidences occurred which caused total power failure at Rangit, Rammam, Melli, Gangtok, Lebong (Darjeeling) and Siliguri complex.

5. Members enquired about dedicated transmission for evacuation of Chuzachen generation. In reply Powergrid informed that, 400/132 kV Rangpo S/s is expected to be ready by March, 2014.

6. ERLDC proposed SPS for backing down generation at Rammam HEP and Rangit HEP in case of tripping of any downstream lines from 132 kV Rammam HPS (i.e. 132 kV Rammam-NBU & Rammam-Lebong-NBU) till new sub-station is ready.

7. WBSETCL and NHPC did not agree for backing down generation at Rammam and Rangit. It was opined that Rammam & Rangit HPS have LTOA & any reduction of generation there need consent from ER beneficiaries as well as Bhutan. It was further reiterated that problems of overloading downside network are arising mainly because of additional generation of Chuzachen even without proper ATS.

8. Threadbare deliberations were held and it was decided,

i. Rangit & Rammam HPS will be allowed full generation first. After that Chuzachen will be allowed to generate to the maximum of 50 MW.

ii. In view of frequent tripping & non operation of SPS implemented for all the possible contingencies it was also decided that, the SPS would be further reviewed to take care of the additional contingencies not covered under present SPS. Any increase in generation at Chuzachen would be reviewed only after argumentation of the present SPS and its successful testing/implementation.

iii. Augmentation/revision of the SPS will be done by Gati Infrastructure. For this purpose, ERTS-II, NHPC, WBSETCL and Sikkim shall extend all necessary cooperation.

iv. Powergrid/CTU was requested to bring the ATS of Chuzachen as early as possible so that evacuation problem of Chuzachen could be resolved.

v. The matter will be referred to next TCC/ERPC and till date Chuzachen generation will be maintained to the maximum of 50 MW.

Meeting ended with vote of thanks to the chair

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ANNEXURE-B.5

LIST OF THE LINES WHICH REQUIRE ZONE -3 SETTINGS DATA BY POWERGRID

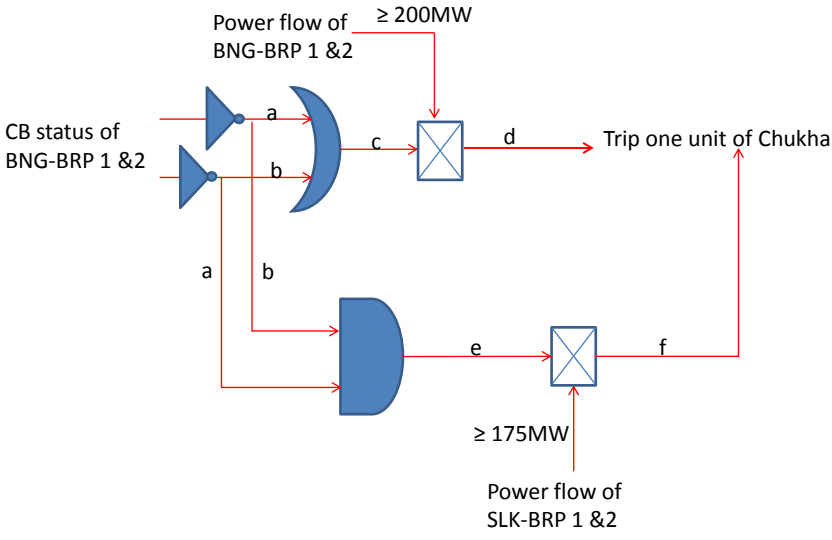
Sl. No.	Region	Name of the Line	Concerned Constituents	kV	Zone-3 settings (End-1)	Zone-3 settings (End-2)
1	ER	Arambagh-Bidhan Nagar-I	WBSETCL	400	Not available	
2	ER	Arambagh-Purulia Pps-I	WBSETCL/WBSEDCL	400	Not available	Not available
3	ER	Arambagh-Purulia Pps-II	WBSETCL/WBSEDCL	400	Not available	Not available
4	ER	Bakreshwar-Arambagh-I	WBPDCL/ WBSETCL	400	Not available	Not available
5	ER	Barh - Patna-I	NTPC / POWERGRID	400	Not available	
6	ER	Barh - Patna-II	NTPC / POWERGRID	400	Not available	
7	ER	Baripada - Kolaghat (Kharagpur)	POWERGRID / WBPDCL	400		Not available
8	ER	Bidhan Nagar-Parulia -I	WBSETCL / POWERGRID	400		Not available
9	ER	Bidhan Nagar-Purulia Pps-I	WBSETCL/WBSEDCL	400		Not available
10	ER	Bidhan Nagar-Purulia Pps-II	WBSETCL/WBSEDCL	400		Not available
11	ER	Bolangir - Meramundali	POWERGRID / OPTCL	400		Not available
12	ER	Farakka - Durgapur-I	NTPC/ POWERGRID	400	Not available	
13	ER	Farakka - Durgapur-II	NTPC/ POWERGRID	400	Not available	
14	ER	Farakka - Jeerut-I	NTPC / WBSETCL	400	Not available	
15	ER	Farakka - Kahalgaon-I	NTPC	400	Not available	
16	ER	Farakka - Kahalgaon-II	NTPC	400	Not available	
17	ER	Farakka - Malda-II	NTPC/ POWERGRID	400	Not available	
18	ER	Jamshedpur (DVC) - Baripada I	POWERGRID	400	Not available	
19	ER	Jamshedpur (DVC) - Baripada II	POWERGRID	400	Not available	
20	ER	Jeerat-Bakreshwar-I	WBSETCL / WBPDCL	400	Not available	Not available
21	ER	Kahalgaon - Barh-I	NTPC	400		Not available
22	ER	Kahalgaon - Barh-II	NTPC	400		Not available
23	ER	Koderma - Biharshariff I	DVC / POWERGRID	400	Not available	
24	ER	Koderma - Biharshariff II	DVC / POWERGRID	400	Not available	
25	ER	Kolaghat Tps-Arambagh-I	WBPDCL /WBSETCL	400		Not available
26	ER	Kolaghat Tps-Jeerat-I	WBPDCL /WBSETCL	400		Not available
27	ER	Maithon - Maithon RB I	POWERGRID / MPL	400		Not available
28	ER	Maithon - Maithon RB II	POWERGRID / MPL	400		Not available
29	ER	Maithon RB - Ranchi I	MPL /POWERGRID	400	Not available	
30	ER	Maithon RB - Ranchi II	MPL /POWERGRID	400	Not available	
31	ER	Meramundali-Jindal -I		400		Not available
32	ER	Meramundali-Jindal -II		400		Not available
33	ER	Meramundali-Mendhasal-I	OPTCL	400		Not available
34	ER	Meramundali-Mendhasal-II	OPTCL	400		Not available
35	ER	New Siliguri - TALA-I	POWERGRID / Bhutan	400		Not available
36	ER	New Siliguri - TALA-II	POWERGRID / Bhutan	400		Not available
37	ER	New Siliguri - TALA-IV	POWERGRID / Bhutan	400		Not available
38	ER	Tala - Malbase	BHUTAN	400	Not available	Not available
39	ER	Malbase - New Siliguri	BHUTAN /POWERGRID	400	Not available	
40	ER	Sagardighi-Parulia -I	WBPDCL / POWERGRID	400		Not available
41	ER	Sagardighi-Parulia -II	WBPDCL / POWERGRID	400		Not available
42	ER	Talcher - Meramundali-II	NTPC / OPTCL	400		Not available
43	ER	Maithon-Andal	POWERGRID /DVC	400		Not available
44	ER	Baripada-Kharagpur	POWERGRID /WBSETCL	400		Not available
45	ER	Talcher-GMR Power	NTPC/GMR	400		Not available
46	ER	GMR Power-Meramundali	GMR/OPTCL	400	Not available	Not available
		Ends with yellow background indicate other utilities' ends				

Annexure-B.7

SPS for Chukha - modified

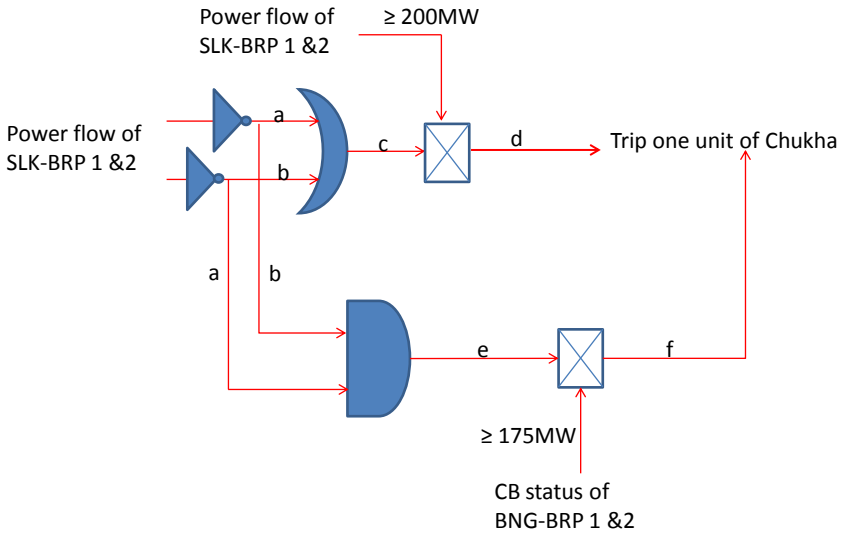
Functioning

- Summated flow of Birpara-Salakati and Birpara-Binaguri is taken as input. After occurrence of (n-1) contingency, flow in the remaining parallel ckt may be allowed upto 175 MW (keeping a safety margin of around 20MW w.r.t the thermal limit of 192 MW)
- Load shedding done only if power flow continues to violate the allowable limit even after tripping first unit at CHPS



Operation of SPS

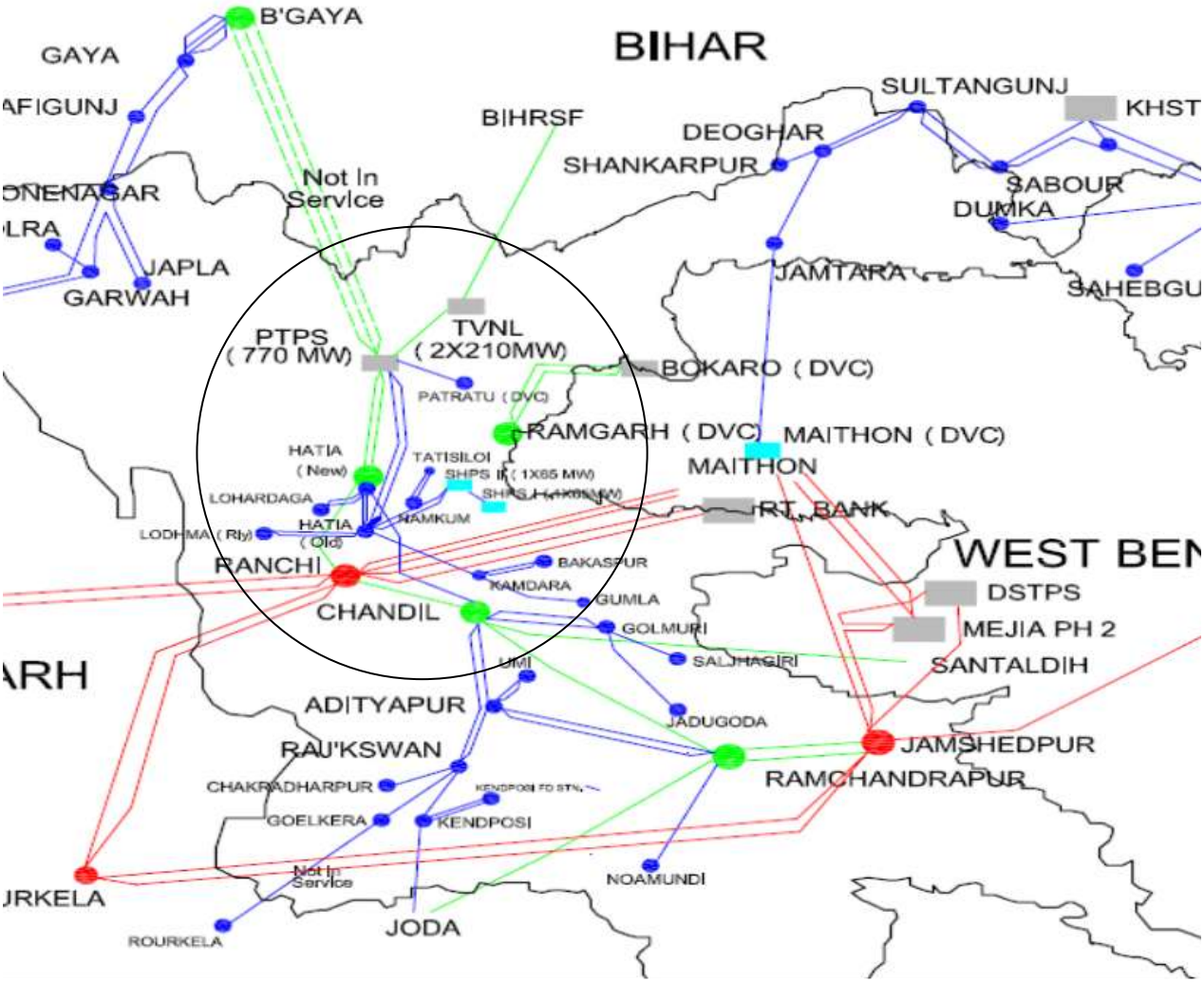
- Tripping of Binaguri-Birpara D/C
  - signal a=1, b=1
  - a AND b = 1 that is = e
  - e X 175 = f (tripping of on unit of chukha)
- Tripping of Binaguri-Birpara ckt-1 or ckt-2
  - signal a=0, b=1
  - a OR b = 1 that is = c
  - c X 200 = d (tripping of on unit of chukha)



Operation of SPS

- Tripping of Binaguri-Salakati D/C
  - signal a=1, b=1
  - a AND b = 1 that is = e
  - e X 175 = f (tripping of on unit of chukha)
- Tripping of Binaguri-Salakati ckt-1 or ckt-2
  - signal a=0, b=1
  - a OR b = 1 that is = c
  - c X 200 = d (tripping of on unit of chukha)

EXIHIBIT-I


B'GAYA
GAYA
BIHAR
SULTANGUNJ
KHST
B|HRSF
DEOGHAR
SHANKARPUR
Not In
Service
SABOUR
DUMKA
JAMTARA
JAPLA
GARWAH
PTPS
(770 MW)
TVNL
(2X210MW)
BOKARO (DVC)
PATRATU (DVC)
RAMGARH (DVC)
MAITHON (DVC)
MAITHON
HATIA
(New)
TATISILOI
LOHARDAGA
HATIA
(Old)
NAMKUM
LODHMA (Rly)
RANCHI
BAKASPUR
KAMDARA
GUMLA
CHANDIL
GOLMURI
SALJHAGIRI
DSTPS
MEJIA PH 2
SANTALDIH
ADITYAPUR
JADUGODA
JAMSHEDPUR
RAU'KSWAN
RAMCHANDRAPUR
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KENDPOSI
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Service
NOAMUNDI
ROURKELA
JODA

Exhibit-II

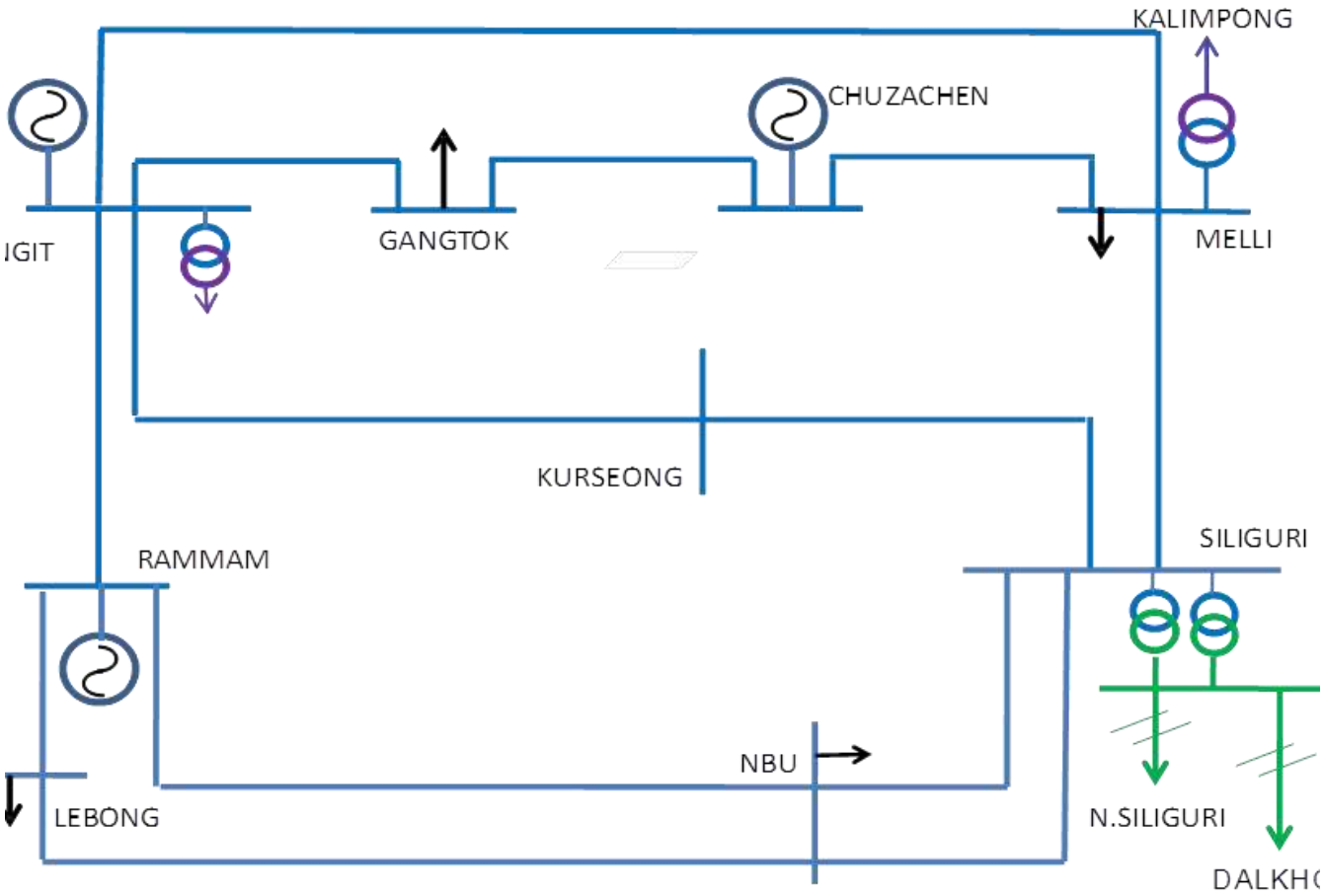

KALIMPONG
CHUZACHEN
IGIT
GANGTOK
MELLI
KURSEONG
SILIGURI
RAMMAM
NBU
LEBONG
N.SILIGURI
DALKH

Exhibit-III

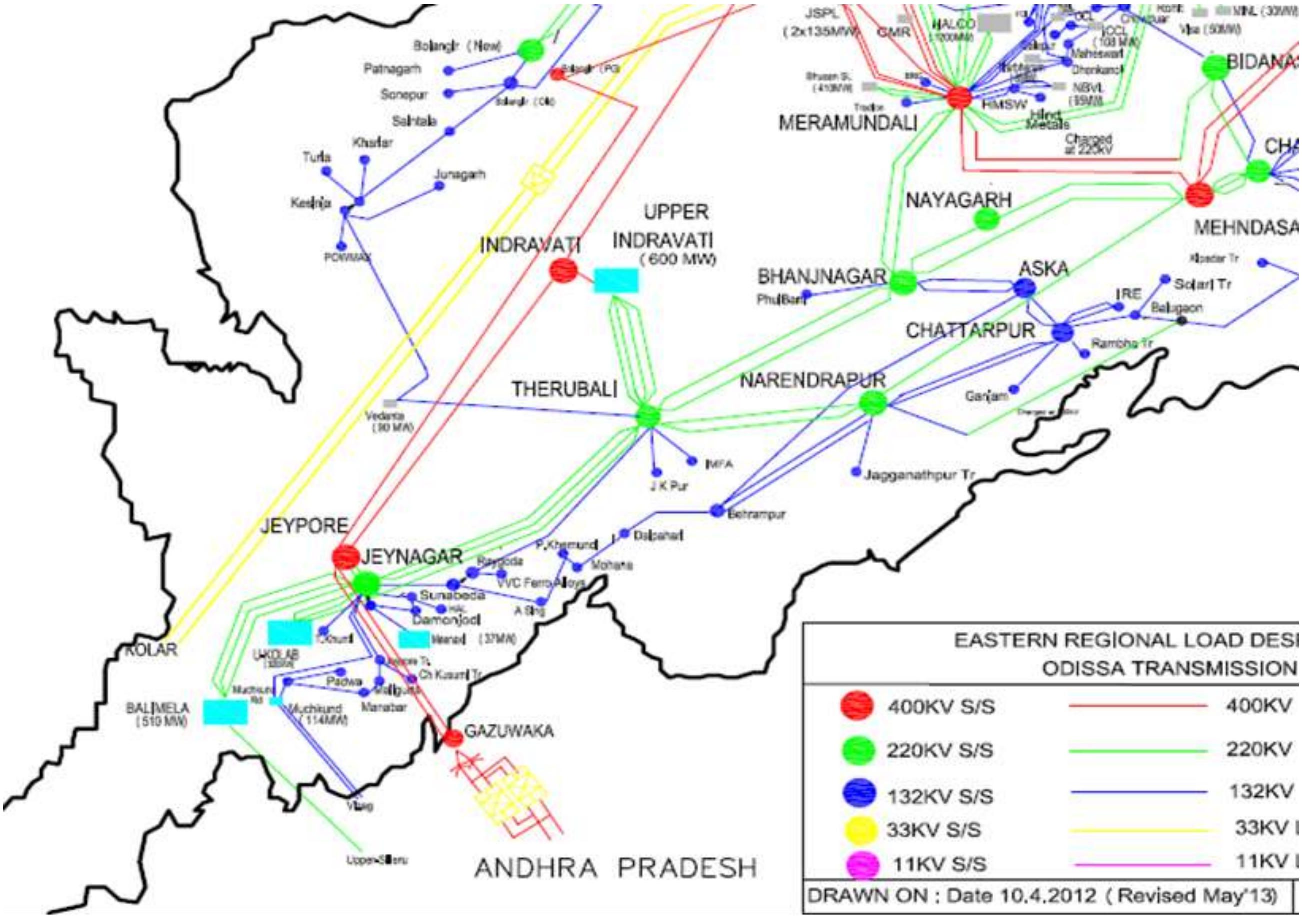
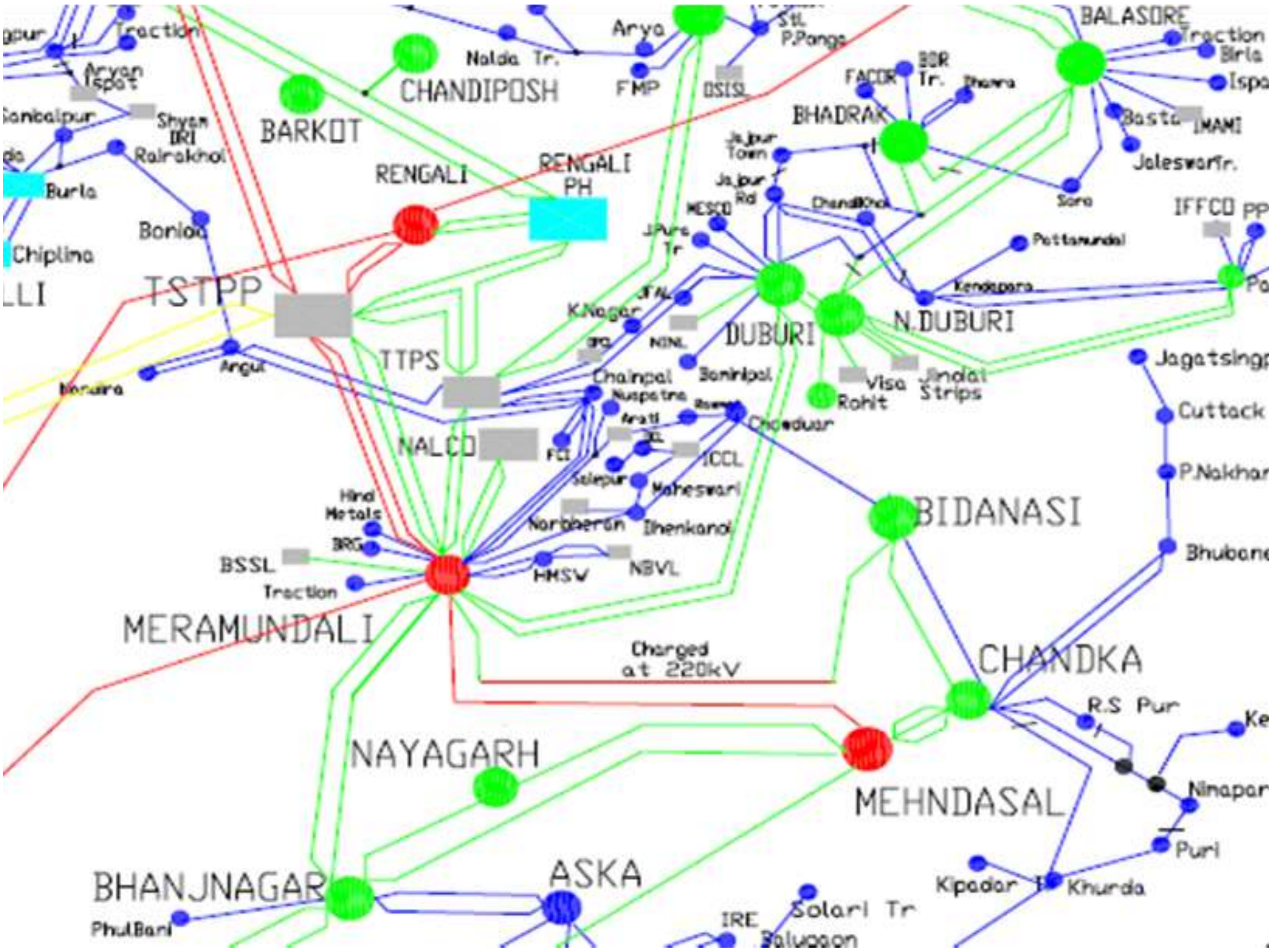

MERAMUNDALI
BIDANASI
NAYAGARH
MEHNDASAL
UPPER INDRAVATI (600 MW)
INDRAVATI
BHANJNAGAR
ASKA
CHATTARPUR
THERUBALI
NARENDRAPUR
Jagganathpur Tr
Behrampur
JEYPORE
JEYNAGAR
KOLAR
BALIMELA (510 MW)
GAZUWAKA
ANDHRA PRADESH
EASTERN REGIONAL LOAD DESI
ODISSA TRANSMISSION
400KV S/S
220KV S/S
132KV S/S
33KV S/S
11KV S/S
400KV
220KV
132KV
33KV
11KV
DRAWN ON : Date 10.4.2012 (Revised May'13)

Exhibit-IV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Traction
Birla
Arya
Nalda Tr.
CHANDIPOSH
FMP
OSISL
BARKOT
BHADRAK
FACOR
RENGALI
RENGALI PH
Burla
Chiplima
Bonlai
Rairakhol
Aryan Ispat
TSTPP
TTPS
NALCO
Angul
DUBURI
N.DUBURI
Jajpur Town
Jajpur Rd
MESCO
Pattamundai
Kendrapara
IFFCO
Soro
Jaleswar Tr.
Basta
Visa
Rohit
Jindal Strips
Chainpal
Choudwar
ICCL
Maheswari
Dhenkanal
NBVL
HMSW
FCI
Hind Metals
BRG
BSSL
Traction
MERAMUNDALI
BIDANASI
Cuttack
Charged at 220kV
CHANDKA
R.S Pur
NAYAGARH
MEHNDASAL
Puri
Kipadar
Khurda
BHANJNAGAR
ASKA
PhulBani
IRE
Solari Tr

Exhibit-V

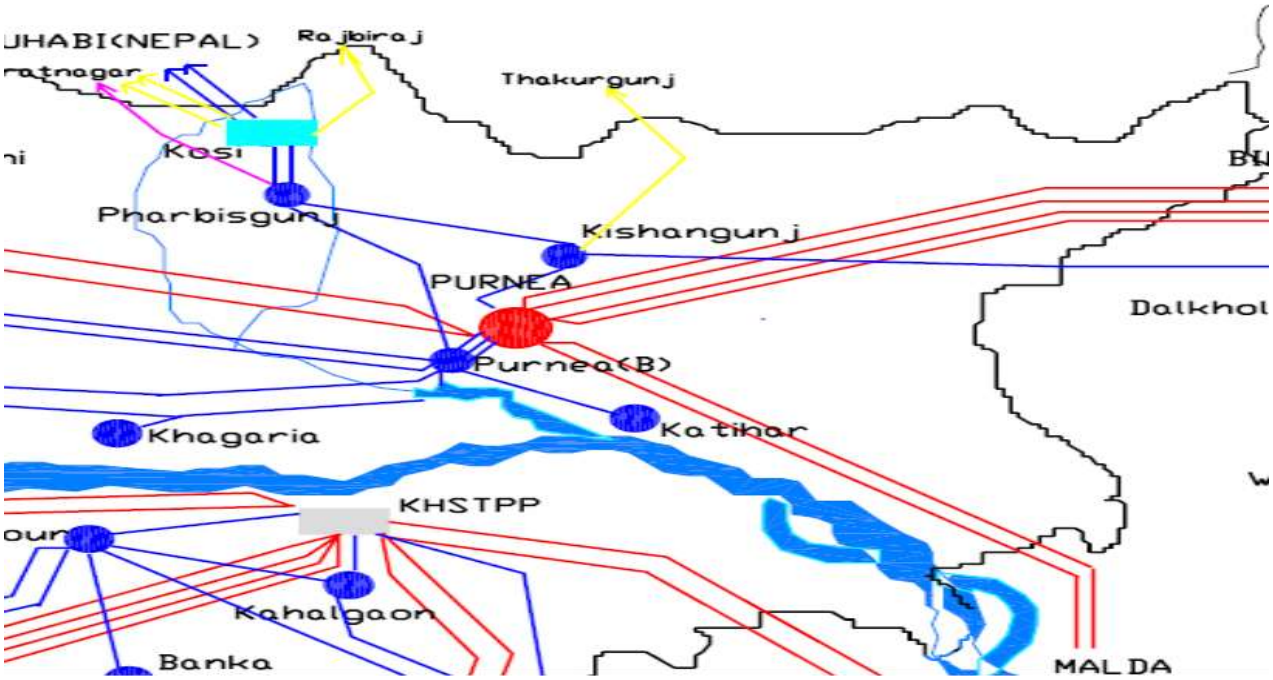
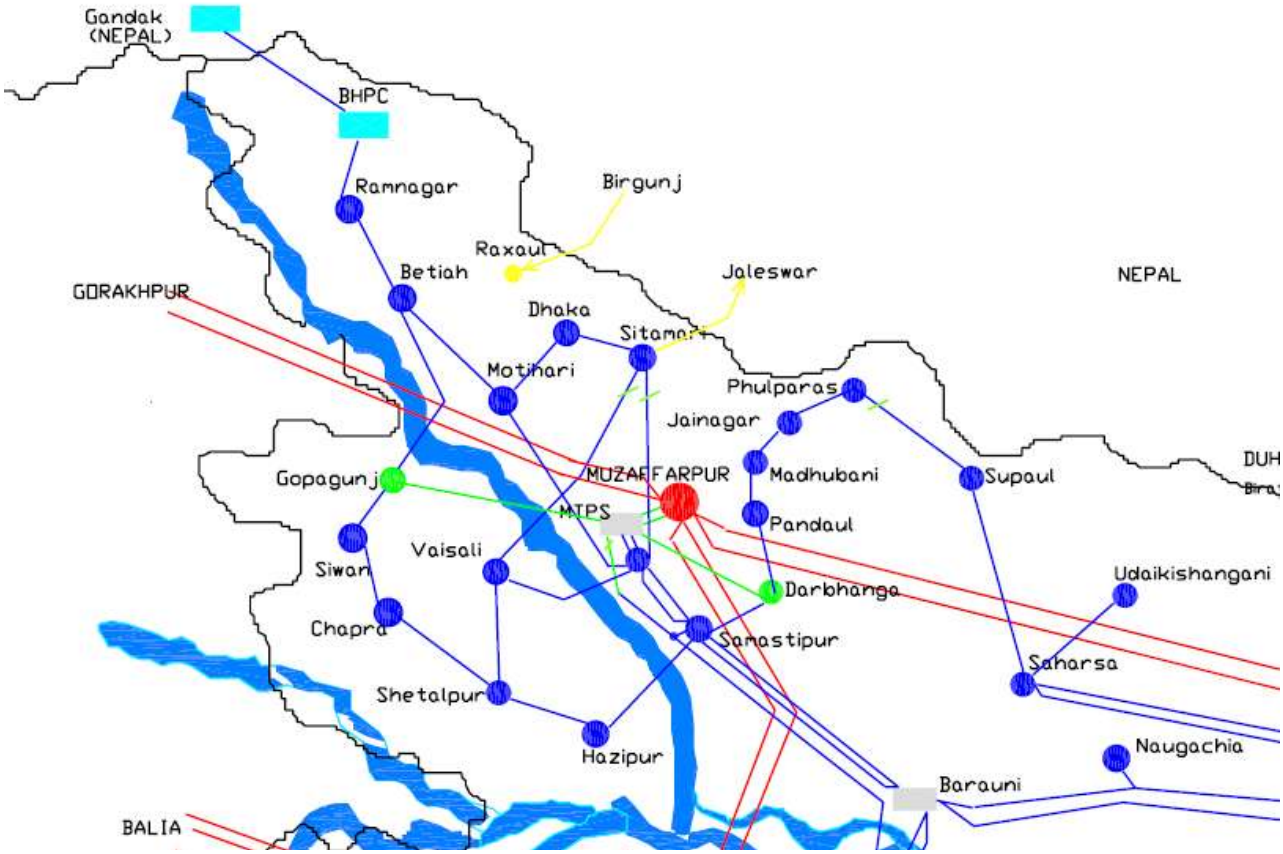

JHABI(NEPAL)
Rajbiraj
Thakurgunj
Kosi
Pharbisgunj
Kishangunj
PURNEA
Purnea(B)
Khagaria
Katihar
KHSTPP
Kahalgaon
Banka
MALDA
Dalkhol

Exhibit-VI


Gandak
(NEPAL)
BHPC
Ramnagar
Birgunj
Raxaul
Betiah
Jaleswar
NEPAL
GORAKHPUR
Dhaka
Sitamarhi
Motihari
Phulparas
Jainagar
Madhubani
Supaul
Gopagunj
MUZAFFARPUR
MTPS
Pandaul
Vaisali
Siwan
Darbhanga
Udaikishangani
Chapra
Samastipur
Saharsa
Shetalpur
Hazipur
Naugachia
Barauni
BALIA