Minutes
of
49th PCC meeting

Date: 06.12.2016
Eastern Regional Power Committee
14, Golf Club Road, Tollygunge
Kolkata: 700 033

EASTERN REGIONAL POWER COMMITTEE

MINUTES OF 49TH PROTECTION SUB-COMMITTEE MEETING HELD AT ERPC, KOLKATA ON 29.11.2016 (TUESDAY) AT 11:00 HOURS

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

PART – A

ITEM NO. A.1: Confirmation of minutes of 48th Protection sub-Committee Meeting held on 20th October, 2016 at ERPC, Kolkata.

The minutes of 48th Protection Sub-Committee meeting held on 20.10.16 circulated vide letter dated 31.10.16.

Members may confirm the minutes of 48th PCC meeting.

Deliberation in the meeting

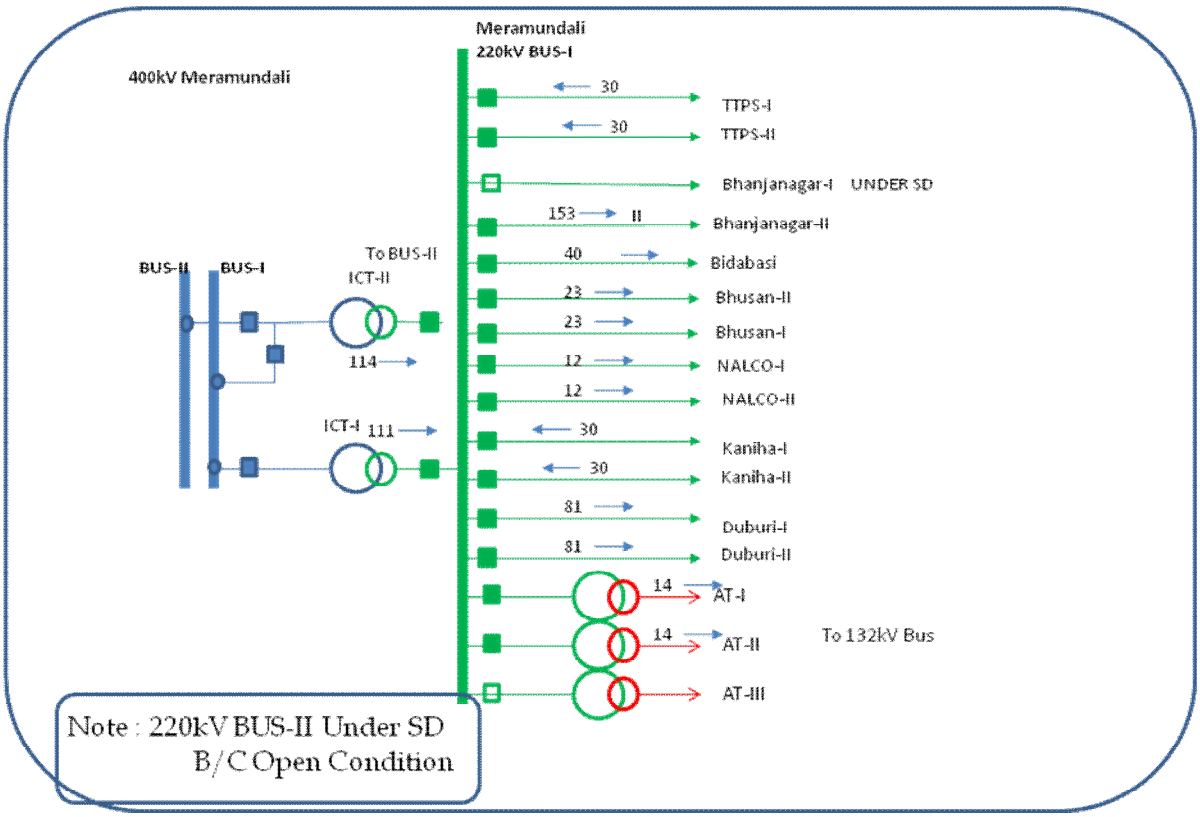
Members confirmed the minutes of 48th PCC meeting.

PART – B

ANALYSIS & DISCUSSION ON GRID INCIDENCES OCCURRED IN OCTOBER 2016

ITEM NO. B.1: Disturbance at 400/220 kV Meramundali (OPTCL) S/s on 05-10-16 at 18:10 hrs.

1. **Single line diagram:** Submitted



2. **Pre fault conditions:** Submitted

- 220 kV Bus – II at Meramundali was under shutdown.
- 220 kV Meramundali – Bhanjanagar – I was under shutdown
- 220 kV B/C was under shutdown

3. **Detailed analysis of tripping incident:** Submitted

While closing Bus – I breaker of 220 kV Meramundali – Bhanjanagar – I after maintenance, the Bus-I PT secondary circuit got connected to idle Bus-II PT and Bus – I PT (R and Y phase) fuse failed. Distance protection relays (MiCom P442) of 220 kV feeders connected to Bus – I operated due to absence of voltage except Bhushan line-I &II which are having SEL relays. The relay indications are as follows:

Feeder	**NALCO1**	**NALCO2**	**TTPS2**	**KANIHA-1**	**KANIHA-1**	**KANIHA-2**	**DUBURI-1**	**DUBURI-2**	**B.NAGAR-2**	**B.NAGAR-1**
Phase	AB	AB	AB	B	AB	AB	ABCN	AB	AB	CN
Zone	Z1	Z1	Z4	Z4	Z4	Z4	Z1	Z1	Z1	
IA	103.8	152.6	107.7	116.5	115.1	112.7	292	287.9	387.3	0
IB	106.4	156.2	110.7	122.1	121.7	120.3	299.4	300.9	416.6	0
IC	109.8	159.3	117.7	121.4	121	120.5	305.1	310	416.3	287.6
VAN KV	1.242	1.351	539.5V	1.333	603.7V	541.6V	2.656KV	1.565	752.9V	1.851
VBN	1.351	1.445	754.5V	1.439	859.8V	794V	887.4V	1.43	1.351KV	1.852
VCN	73.34	73.39	28.4KV	73.54	28.55KV	28.48KV	28.38KV	73.2	70.87KV	2.086
MiCom Relay	444	444	442	444	442	442	442	444	444	444

4. **Remedial action taken :** Submitted

The DR record & settings of MiCom DP relays has been forwarded to OEM to investigate the cause of non operation fuse fail function and blocking of distance protection.

Analysis of PMU plots: No voltage dip has been observed in PMU data

Status of Reporting: Detail report was received from OPTCL on 07-10-16.

OPTCL may explain.

Deliberation in the meeting

OPTCL explained that while closing Bus – I breaker of 220 kV Meramundali – Bhanjanagar – I from Meramundali end after maintenance, the Bus-I PT secondary circuit got connected to idle Bus-II PT and Bus – I PT (R and Y phase) fuse failed at 220 kV Meramundali S/s. Distance relays (MiCom P442) of 220 kV feeders connected to Bus – I operated due to absence of voltage except Bhushan line-I &II which are having SEL relays.

PCC felt that the Bus-I & Bus-II PTs should be selected automatically with the opening/closing of the line-isolator. Moreover the PT fuse supervision in the distance relay should block the relay operation during PT fuse failure.

OPTCL informed that the scheme was not in order and the operator did not check before closing the line breaker.

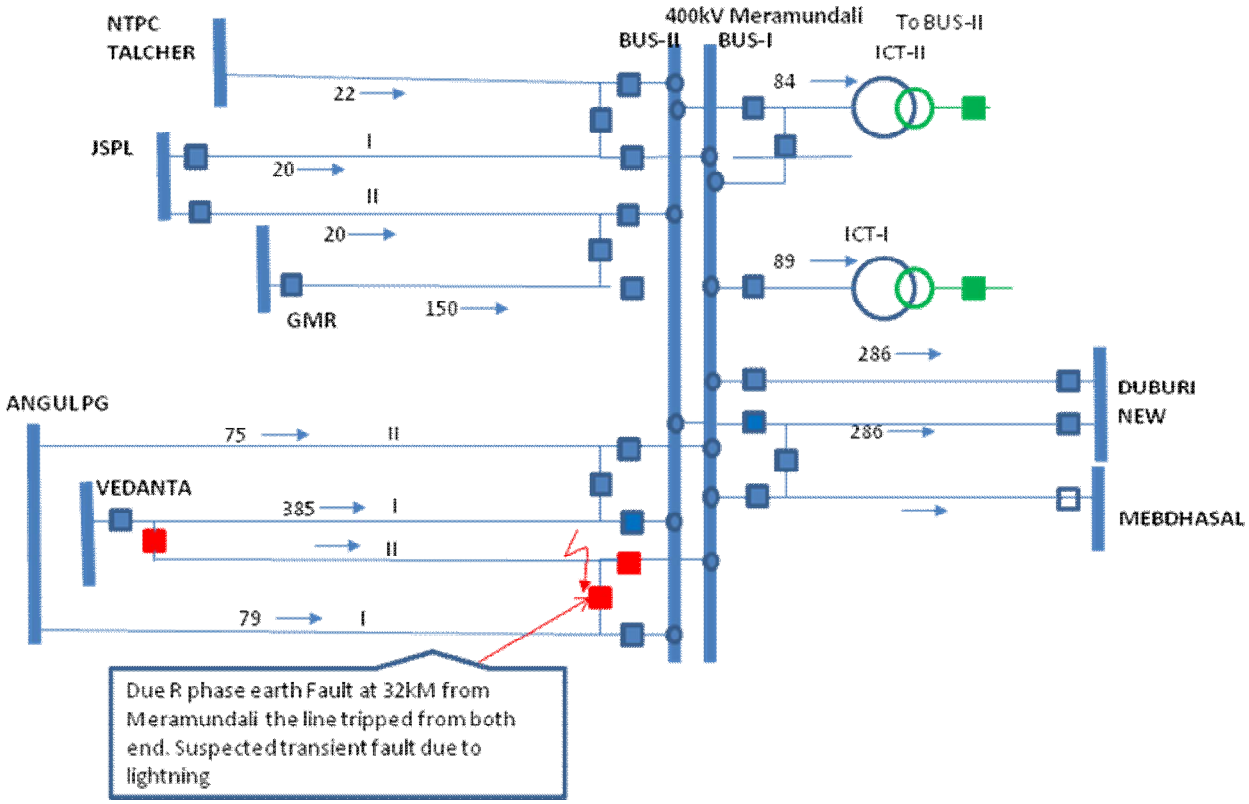
PCC advised OPTCL to carry out the following:

- *PT selection scheme during bus change over should be checked and modified.*
- *Verify the PT fuse supervision settings in Micom relays of 220 kV lines and advised to enable if it was not enabled.*
- *Submit the DR of 220kV Meramundali-Bhanjanagar line-I at Meramundali end.*

OPTCL added that they have already installed the line CVT in 220kV Kaniha line and they are planning to install the line CVTs in all the other 220kV lines.

ITEM NO. B.2: Disturbance at 400 kV Meramundali (OPTCL) S/s on 10-10-16 at 16:35 Hrs.

1. **Single line diagram:** Submitted



2. **Pre fault conditions:** Submitted

Diameter	Bus-I Element	Bus-I I Element	Tie CB Status
401	Vedant IPP-II	Angul-I	ON
402	Mendhasal	Duburi-II	ON

403	Angul-II	Vedant IPP-I	ON
404	Duburi-I	Not Commissioned	Not Commissioned
405	JSPL-I	RSTPS	
406	-	ICT-I	Not Commissioned
407	ICT-II	CB Bypassed	ON
408	GMR	JSPL-II	ON

3. Detailed analysis of tripping incident: Submitted

At 15:28 hrs, 400 kV Meramundali – Vedanta – II tripped from both end on R-N fault. Simultaneously 400 kV Meramundali – Vedanta – I also tripped from Vedanta end only as both line-I & II were charged through same CB.

At 16:35 hrs, R-N fault occurred in 400 kV Meramundali – Vedanta – II due to failure of R phase pad clamp of line Isolator while charging the line from Meramundali end. 400 kV Meramundali – Angul – I and 400/220 kV ICT-I also tripped at Meramundali s/s.

At same time, pole – I of Talcher Kolar HVDC bipolar link blocked due to initiation of DC filter differential protection at Talcher end (As reported) and pole II went to metallic return mode. As antecedent power flow was 990 MW, no reduction in power order took place.

The relay indications are as follows:

Time (Hrs)	Details of tripping	Relay at local end	Relay at remote end
15:28 hrs	400 kV Meramundali-Vedanta-II	D/P, 32.5 km from Meramundali	R-N, Z-I, 203.4 km from Vedanta
	400 kV Meramundali-Vedanta-I	Did not trip at Meramundali	Information yet to be received
16:35 hrs	400 kV Meramundali-Vedanta-II	R-N, 4km from Meramundali (Line was being charged)	--
	400 kV Meramundali – Angul – I	R-N, 1 km from Meramundali	Information yet to be received
	400/220 kV ICT-I at Meramundali	E/F, O/C at both end	

4. Remedial action taken : Submitted

The operation of Main-II distance relay of 400kV Meramundali-Angul line-1 is not justified. The relay testing and on line monitoring of measurement function is under investigation.

5. Disturbance record: Submitted

Analysis of PMU plots: At 15:28 hrs and 16:35 hrs voltage dip observed in PMU data. In both cases, fault was cleared within 100 ms.

Status of Reporting: Detail report was received from OPTCL on 20-10-16.

OPTCL and Vedanta may explain the following:

- Tripping of 400/220 kV ICT-I from both the ends on O/C, E/F.
- Tripping of 400kV Meramundali-Angul line-1 from Meramundali end.

Deliberation in the meeting

OPTCL updated that 400 kV Meramundali-Vedanta-I was not tripped from Vedanta end at 15:28 hrs.

OPTCL explained that at 16:35 hrs, R-N fault occurred in 400 kV Meramundali – Vedanta line – II due to the failure of R phase pad clamp of line Isolator while charging the line from Meramundali end. Since it was a close in fault, huge fault current was observed at 400kV Meramundali S/s and 400 kV Meramundali – Angul line– I tripped from Meramundali on zone 1 distance protection. 400/220 kV ICT-I at Meramundali tripped on high set over current protection.

PCC felt that since it was a close in fault the direction feature of the relay may not function properly as a result 400 kV Meramundali – Angul line– I tripped from Meramundali end on zone 1. However, PCC advised OPTCL to check the relay settings for any further improvement in the directional feature.

PCC felt that permissive trip should be extended from 400kV Meramundali end to 400kV Angul in this case, and advised OPTCL to check.

ITEM NO. B.3: Disturbance at JUSNL system on 09-10-16 at 18:25 Hrs.

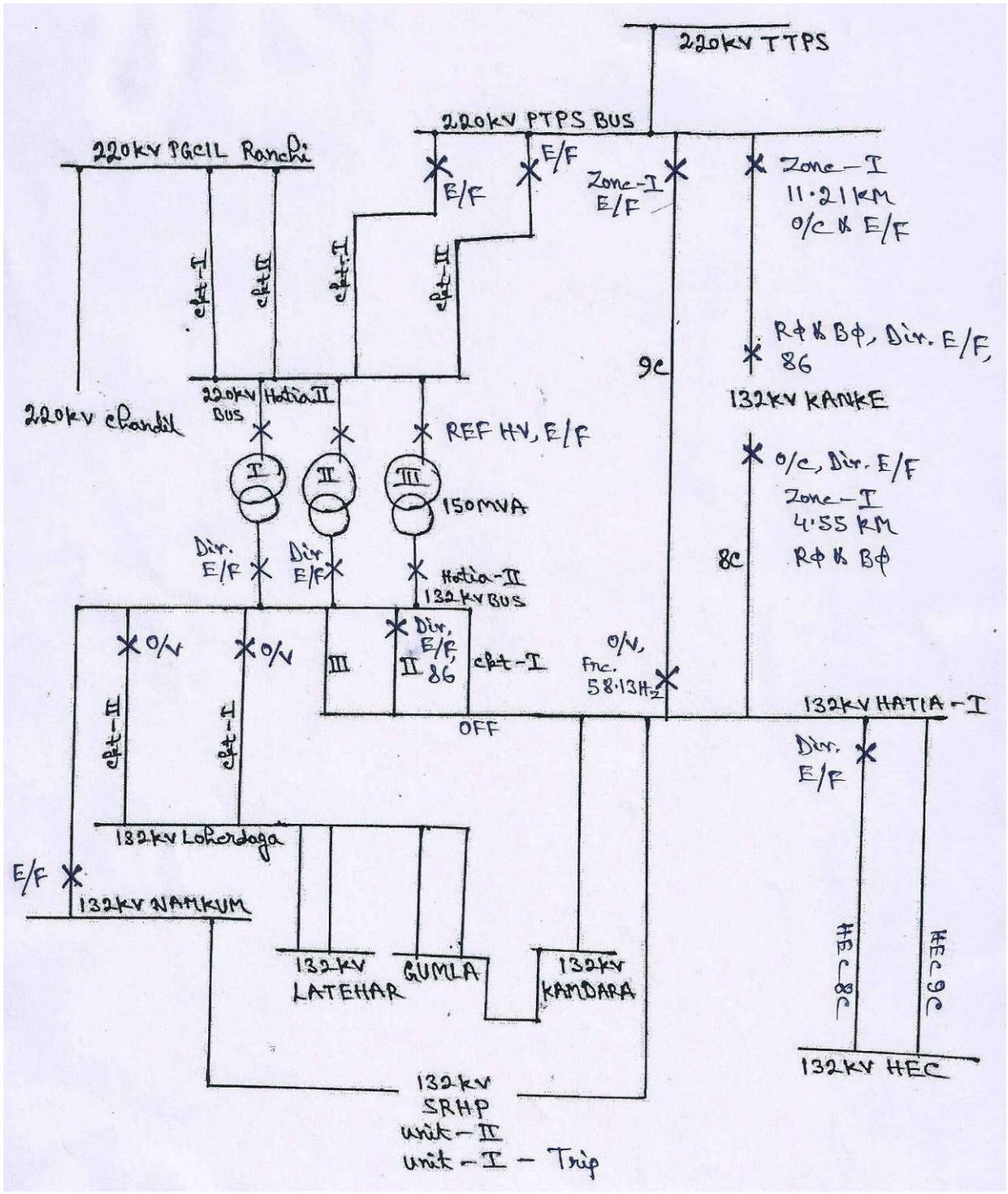
1. **Single line diagram:** Submitted

2. **Pre fault conditions:** Not Submitted

3. **Detailed analysis of tripping incident:** Not Submitted

At 18:25 hrs, 132 kV Hatia I – Kanke line tripped from Kanke end on zone 1 due to R-B –N fault in the line. But Hatia end failed to clear the fault as result the following lines tripped:

- 220 kV PTPS – Hatia – I & II from PTPS end on E/F
- 132 kV Hatia II – Hatia I – II tripped from Hatia II end on E/F
- 132 kV Hatia II – Lohardanga – I & II tripped from Hatia II on E/F
- 132 kV Hatia I – PTPS 9C from both end (at Hatia I O/C and at PTPS end Z-I)
- 132 kV Hatia I – Kanke 8C from Hatia end on R-B-N, Z-I, 45 km
- 132 kV PTPS – Kanke 8C from both end (at PTPS Z-I, 11.21 km, at Kanke R-B fault)
- 132 kV Hatia II – Namkum tripped from Namkum end on E/F
- 150 MVA ATR-I, II & III at Hatia-II
- 50 MVA ATR-I & II at Hatia-I
- 150 MVA ATR-I & II at PTPs
- Inland Power tripped
- SHPS unit#1 tripped



4. **Remedial action taken :** Not Submitted

5. **Disturbance record:** Not Submitted

Analysis of PMU plots: 6-8 kV voltage dip observed in R & B phases. Fault was cleared within 100 ms.

Status of Reporting: Preliminary tripping report from JUSNL received on 09-10-16. Detailed report is not yet received from JUSNL.

The relay indications are as follows:

Tripping Details on Dated 09-10-2016 of Transmission Zone-I, Ranchi

Sl. No	Name of Feeder	Time of Tripping	Time of Closing	Duration	Local End Relay Type and Indications	Remote End Relay Type and Indications
				At 132/33 KV Grid Sub-Station, Hatia-I		
1	132KV PTPS 9C	18:24Hrs	18:46Hrs	00:22HRS	Active Group-1,Started Phase-A B C, O/V>1,Tripped Elements-No,Freq-58.13Hz,Fault Duration-4.997s,Relay Trip Time-80.17ms,Fault in Zone-None	Over Current Relay
2	132KV HEC 8C	18:24Hrs	19:16Hrs	00:52Hrs	Directional Earth Fault	
3	Power Transformer No-1	18:24Hrs	18:47Hrs	00:23Hrs	Trip Relay 86	
4	Power Transformer No-2	18:24Hrs	18:48Hrs	00:24Hrs	Trip Relay 86, Dir. Earth Fault Protn 50/51N	
5	132KV Kamdara	18:38Hrs	18:46Hrs	00:08Hrs	Due to Total Power Failed at GSS Hatia-I at 18:38Hrs	
6	132KV Railway Ckt-2	18:38Hrs	18:46Hrs	00:08Hrs	Due to Total Power Failed at GSS Hatia-I at 18:38Hrs	
7	132KV HEC 9C	18:38Hrs	18:46Hrs	00:08Hrs	Due to Total Power Failed at GSS Hatia-I at 18:38Hrs	
8	132KV Sikidiri 1st Ckt	18:38Hrs	18:46Hrs	00:08Hrs	Due to Total Power Failed at GSS Hatia-I at 18:38Hrs	
9	132KV Kanke(PTPS 8C)	18:38Hrs	18:46Hrs	00:08Hrs	Due to Total Power Failed at GSS Hatia-I at 18:38Hrs	
10	Power Transformer No-3	18:40Hrs	18:49Hrs	00:09Hrs	Made Off	
11	Power Transformer No-4	18:40Hrs	18:50Hrs	00:10Hrs	Made Off	
12	132KV Kanke(PTPS 8C)	19:55Hrs	10:55Hrs on dt 10-10-16	15:00Hrs	Made Off	
				At 220/132 KV Grid Sub-Station, Hatia-II		
1	220 KV PTPS CKT-I	18:24 Hrs.	18:58 Hrs.	00:33 Hrs.	Earth Fault	
2	220 KV PTPS CKT-II	18:24 Hrs.	18:59 Hrs.	00:34 Hrs.	Earth Fault	
3	132 KV Hatia-I CKT-II	18:24 Hrs.	18:46 Hrs.	00:21 Hrs.	Directional Earth Fault, 86	
4	132 KV Lohardaga CKT-I	18:24 Hrs.	18:48 Hrs.	00:23 Hrs.	Over Voltage	
4	132 KV Lohardaga CKT-II	18:24 Hrs.	18:49 Hrs.	00:24 Hrs.	Over Voltage	
5	150 MVA ICT-I	18:24 Hrs.	18:43 Hrs.	00:18 Hrs.	Directional Earth Fault, 67N	
6	150 MVA ICT-II	18:24 Hrs.	18:48 Hrs.	00:23 Hrs.	Directional Earth Fault	
7	150 MVA ICT-III	18:24 Hrs.	18:59 Hrs.	00:34 Hrs.	Earth Fault, REF HV	
				At 132/33 KV Grid Sub-Station, Kanke		
1	132 KV PTPS 8C	18:24 Hrs.	18:45 Hrs.	00:21 Hrs.	R & B Phase Fault, Directional Earth Fault,86	Zone-I O/C, E/F 11.21 Km
2	132 KV Hatia-I (8C)	18:24 Hrs.	10:30 Hrs. (10-10-2016)	16:05 Hrs.	R & B Phase Fault, O/C, Directional Earth Fault, 86 Zone-I 4.55 KM, Ia-1.373 KA, Ib-351 A, Ic-2.63 KA.	
				Other Tripping Details		
1	SRHP Unit-I	18:24 Hrs.	19:30 Hrs.	00:54 Hrs.		
2	PTPS 150 MVA ATR-I	18:24 Hrs.	18:29 Hrs.	00:05 Hrs.	R, Y & B Phase fault, O/C, E/F, Differential	
3	PTPS 150 MVA ATR-II	18:24 Hrs.	18:29 Hrs.	00:05 Hrs.	R, Y & B Phase fault, O/C, E/F, Differential	

JUSNL explain the disturbance with the following details:

- Pre-fault conditions: bus voltages, active and reactive power flows
- DR files of the disturbance
- Relay settings of the lines tripped during the disturbance
- Reason for not clearing the fault in 132kV Kanke-Hatia-I line from Hatia-I
- How 132kV Kanke-PTPS line can trip from Kanke end on directional earth fault when PTPS already tripped on zone 1 distance protection

Deliberation in the meeting

JUSNL failed to explain the disturbance.

After detailed discussion, PCC analyzed the disturbance with the relay indications and felt that there was a R-B–N fault in 132 kV Hatia I – Kanke line and Kanke end tripped on zone 1. But Hatia-I end failed to clear the fault as a result the fault was extended to 132kV Hatia-II, PTPS and Namkum S/s finally the fault got cleared from 150 MVA ATR-I, II & III at 132kV Hatia-II and 150 MVA ATR-I & II at 132kV PTPs.

Total fault clearing time 2 sec was observed from the Ranchi PMU plot.

PCC took serious note of not collecting the complete details of the disturbance and in-complete explanation from JUSNL.

JUSNL informed that PTPS end is being maintained by joint venture of NTPC and they could not collect the tripping details. JUSNL added that 132kV Hatia-I – Hatia-II line relays are old EM type relays and the relays not functioning properly.

PCC advised JUSNL to carry out the following remedial actions for protection system improvement and submit a report to ERPC and ERLDC:

- *Check Hatia-I end relays of 132 kV Hatia I – Kanke line for not clearing the fault*
- *Proper relay coordination between line protection at 132kV Hatia-I, Hatia-II, Kanke, PTPS and Namkum S/s and 220/132kV ATRs at PTPS and Hatia-II S/s*
- *For protection settings at 220/132kV PTPS S/s, PCC advised JUSNL and NTPC to coordinate.*
- *Disable the over voltage settings in all 132kV lines*
- *All the old electro mechanical relays in 132kV Hatia-I, Hatia-II, Kanke and Namkum S/s including ATR protection relays should be replaced with numeraical relays.*
- *Submit the details of energy unserved during the disturbance.*

ITEM NO. B.4: Disturbance at 220 kV Ramchandrapur (JUSNL) S/s on 22-10-16 at 19:16 hrs.

1. **Single line diagram:** Submitted

2. **Pre fault conditions:** Submitted

   - 220 KV Chandil-Ranchi S/C was under shutdown
   - At 19:00 hrs, Chandil Load= 170 MW

   Bus segregation at 220kV Ramchandrapur:

   Bus I: 400/220 kV ICT I, 220 kV Ramchandrapur – Chandil S/C, 220/132 kV ATR I & III
   Bus II: 400/220 kV ICT II, 220 kV Ramchandrapur – Joda S/C, 220/132 kV ATR II
   B/C was closed condition

   ICT- 1(source of Main Bus- 1) and ICT- 2(source of Main Bus-2) serves as the source for the 220kV RCP GSS and BAR COUPLER remains always in closed condition for the sharing of loads between both the buses. ICT- 1 & 2 are parallel which connects directly to 400kV PGCIL Ramchandrapur.

   Powergrid informed the power loading of 315 MVA, 400/220 kV ICTs before the disturbance.

   315 MVA, 400/220 kV ICTs Load(MW) : (At 19:00 Hrs 22.10.2016)
   i) 315 MVA ICT-1 : (-) 190 MW
   ii) 315 MVA ICT-2 : (-) 190 MW

3. **Detailed analysis of tripping incident:** Submitted

At 19:16 hrs,

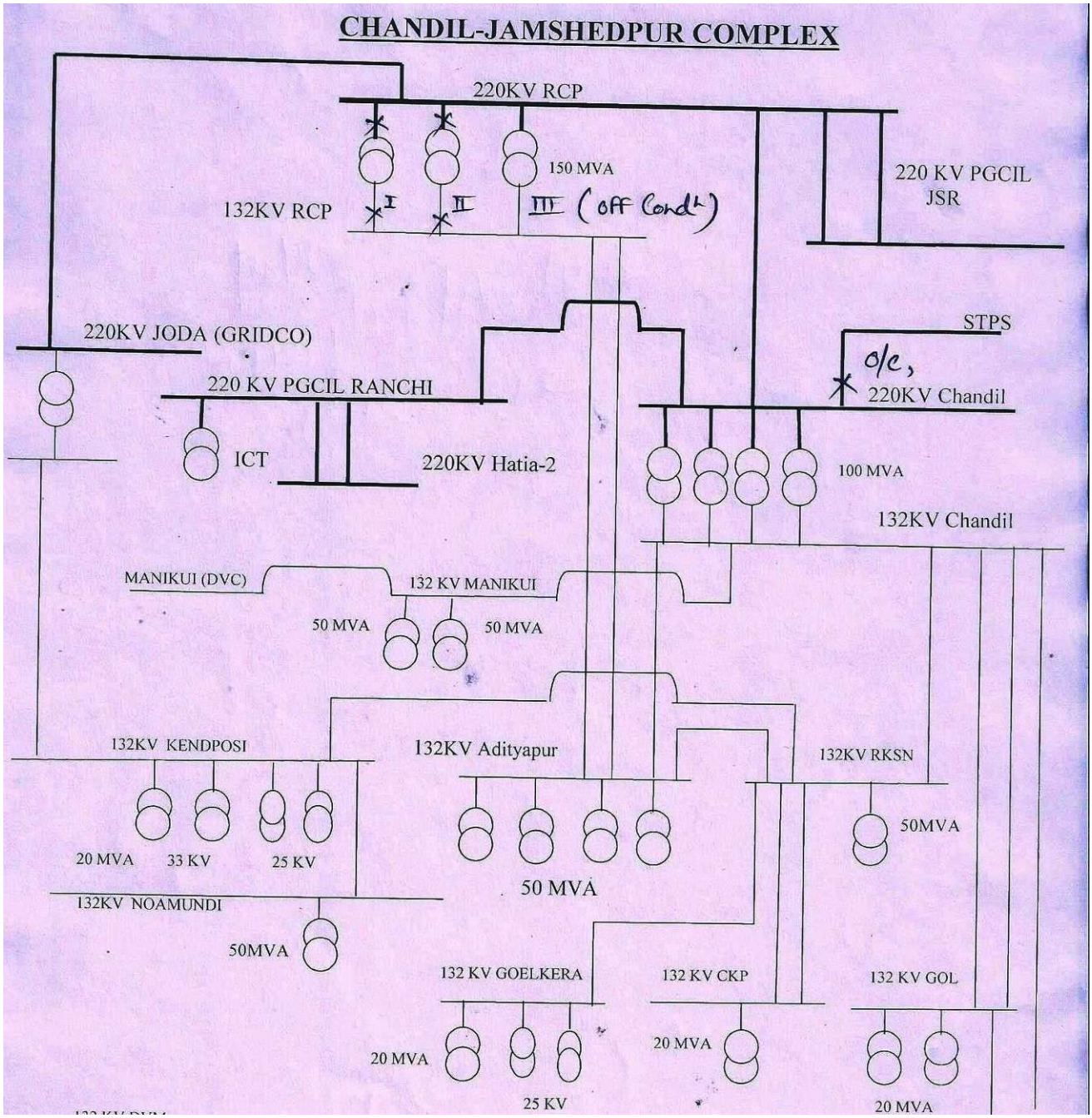
- Bursting of 220 kV side R phase CT of 400/220 KV, 315 MVA ICT-II at Ramchandrapur resulted in tripping of 400/220 KV ICT-II at Ramchandrapur from the both ends on differential protection.
- 400/220 KV ICT-I tripped from LV end and HV end tripped on receipt of inter trip.
- This resulted in back feeding from 220kV Chandil – STPS line to all of the loads (mainly of 132kV Adityapur-1 & 2) of 220kV GSS RCP through 220kV RCP- Chandil Line.
- 220kV Chnadil- STPS Line tripped on Overloading at 220kV GSS Chandil. No Relay operated at STPS end, since 220 Chandil- STPS Line was importing at that time and

because of back feeding to 220kV RCP at the time of tripping.

- Busbar differential protection at 220kV RCP operated for 220 kV bus – II and tripped the following elements:

    - 220 kV Ramchandrapur – Joda S/C
    - 220/132 kV ATR II tripped along with B/C.

- But feeders connected on Main Bus- 1 i.e. 220kV Chandil Line, Tr-1 and Tr-3 did not trip. These lines and transformers of Main Bus- 1 switched off manually for normalising the system.
- This caused total power failure to 220kV RCP GSS. 220kV RCP- Chnadil line manually switched off at RCP end, because of unavailability of power at GSS RCP and for normalisation of the system.
- 220kV Chandil- PGCIL Line was under shut down for its maintenance work, which caused the total power failure of 220kV GSS Chandil also.



The relay indications are as follows:

Time	Details of tripping	Relay at local end	Relay at remote end
19:16 hrs	220 kV STPS – Chandil S/C	Yet to be received	Over Current start i>2,E/F start IN1,2, Ia=630.2A, Ib=636.1 A, Ic= 611.04 A, Van= 113.5 KV, Vbn= 109.4KV, Vcn= 117.2KV
	220 kV Chandil – Ramchandrapur S/C	Hand tripped	
	220kV Bus coupler	NON DIRECTIONAL E/F & OVERCURRENT RELAY & MASTER TRIP RELAY 86	
	400/220 KV ICT-II	Differential protection (Duobias) operated	
	400/220 KV ICT-I	VAJ trip relay at LV end. HV end tripped on receipt of inter-trip from LV end.	

Powergrid informed that DR not triggered during the event. The Relay has been tested and during testing DR is triggering but during actual fault condition DR is not triggering. Matter has been taken up with manufacturer on the issue however they are planning to replace the Duobias relays with another numerical relays.

4. **Remedial action taken :** Not Submitted

5. **Disturbance record:** Submitted

Analysis of PMU plots: At 19:15:45 hrs, 45 kV voltage dip was observed in Jamshedpur PMU data. Fault clearing time is <100 ms.

Status of Reporting: Detail report along with DR/EL was received from JUSNL on 24-10-16.

JUSNL and Powergrid may explain the following:

- Tripping of 220 kV STPS – Chandil from Chandil end.
- Reason for tripping of 400/220 kV ICT – I from both the ends
- Tripping of bus coupler and bus bar protection operation at 220kV RCP S/s

Deliberation in the meeting

*JUSNL explained the disturbance with a detailed presentation. Presentation is enclosed at **Annexure-B4**.*

JUSNL explained that

- *At 19:16 hrs, R-N fault was initiated at 220kV Ramchandrapur S/s due to bursting of 220 kV side R phase CT of 400/220 KV, 315 MVA ICT-II.*
- *Busbar differential protection at 220kV Ramchandrapur operated for 220 kV bus – II and tripped the following elements:*
  - *220 kV Ramchandrapur – Joda S/C*
  - *220/132 kV ATR II tripped along with 220kV Bus Coupler.*
- *220KV bus coupler at Ramchandrapur also tripped on non-directional O/C, E/F protection*
- *400/220 KV ICT-I tripped from LV end with indication of Master trip relay and HV end tripped on receipt of inter trip.*
- *This resulted in back feeding from 220kV Chandil – STPS line to all of the loads (mainly of 132kV Adityapur-1 & 2) of 220kV GSS RCP through 220kV RCP- Chandil Line.*

- *220kV Chnadil- STPS Line tripped on Overloading at 220kV GSS Chandil. No Relay operated at STPS end.*

JUSNL informed that 400/220 KV ICT-I tripped from LV end with the indication of Master trip relay on several incidences for any fault in around the 220kV Ramchandrapur S/s.

PCC felt that 400/220 KV ICT-I at Ramchandrapur should not trip from LV side and advised Powergrid and JUSNL to check the relay settings at LV side.

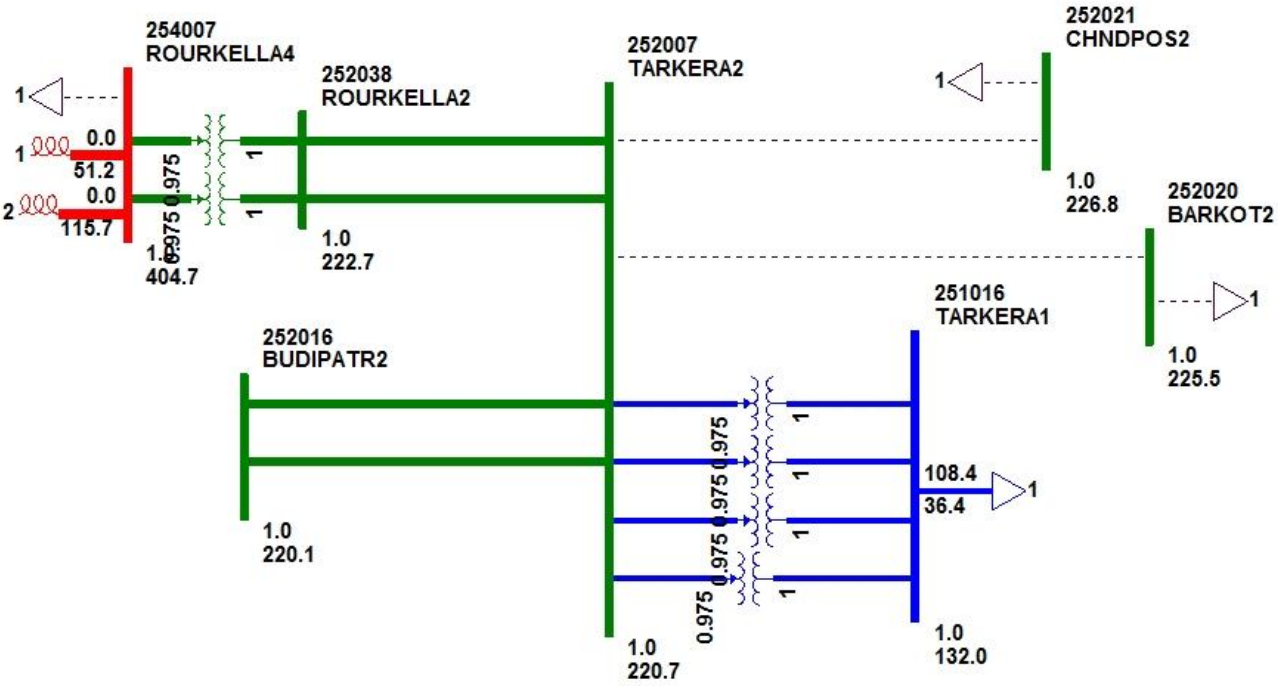
JUSNL was advised to check the reason for tripping of 220kV Bus coupler on non-directional O/C, E/F protection and advised to submit the DR to ERPC and ERLDC for further analysis.

ITEM NO. B.5: Disturbance at 400kV Rourkela(PG) S/s on 28-10-16 at 16:39 hrs..

1. **Single line diagram:** Submitted

2. **Pre fault conditions:** Submitted

    - 400/220 kV ICT – I at Rourkela was under s/d since 09:23 hrs on 20-10-16



3. **Detailed analysis of tripping incident:** Submitted

At 16:39 hrs, 400/220 kV ICT – II at Rourkela & 220 kV Rourkela – Tarkera – I tripped due to breakdown of B phase line isolator of 220 kV Rourkela – Tarkera – I at Rourkela end. At same time, 220/132 kV ATR at Tarkera tripped from both side along with B/C.

220 kV Rourkela – Tarkera – II did not trip during the disturbance.

The relay indications are as follows:

Time	Details of tripping	Relay at local end	Relay at remote end
16:39 hrs	220 kV Rourkela – Tarkera – I	B phase Line isolator breakdown at Rourkela	B-N, Z-I, 12.2 km from Rourkela
	400/220 kV ICT – II at Rourkela	At 220 kV side Back up B-phase, E/F	
	220/132 kV ATR – I at Tarkera	Tripped from both side, At 220 kV side Back up B-phase, E/F	

4. **Remedial action taken :** Not Submitted

5. **Disturbance record:** Submitted

Analysis of PMU plots: At 16:39 hrs, 10 kV voltage dip is observed in B phase at Rengali PMU. Fault clearing time is 400 ms approximately

Status of Reporting: OPTCL & POWERGRID had submitted the tripping report along with DR on 04-11-16.

Powergrid and OPTCL may explain the following:

- Tripping of 400/220 kV ICT – II from 220kV side backup O/C, E/F.
- Tripping of 220/132 kV ATR – I at Tarkera on Back up E/F

Deliberation in the meeting

Powergrid explained the disturbance with a detailed presentation. The presentation is enclosed at ***Annexure-B.5.***

Powergrid placed the details of 220kV bus segregation at Rourkela S/s as follows:

- ***220 KV BUS-1 :*** *315 MVA ICT-1, 220KV Tarkera Line-1.*

Note: 315MVA ICT-1 under shutdown for O/H works & 220KV Tarkera line-1 connected to Bus-1 Through Transfer Bus CB due to mechanism Over hauling of Tarkera-1 CB .

- ***220 KV BUS-1:*** *315 MVA ICT-2, 220KV Tarkera Line-2.*

Powergrid explained that at 16:39 hrs

- *B-N fault occurred in 220kV Rourkela Switchyard due to the breakdown of B-phase line isolator of 220 kV Rourkela – Tarkera line – I.*
- *220kV Busbar protection operated at 220 kV Rourkela S/s and tripped the elements connected to Bus-I (220KV Rourkela-Tarkera Line-1) along with the 220kV bus coupler. 220KV Rourkela-Tarkera Line-1 distance protection sensed the fault in reverse zone.*
- *However, 315 MVAICT-2 also tripped on the operation of 220kV Backup O/C & E/F protection.*

OPTCL submitted the Tarkera end DR of 220KV Rourkela-Tarkera Line-1 tripping.

From Tarkera end DR of 220KV Rourkela-Tarkera Line-1, PCC concluded that the line was tripped from Tarkera end on zone-2 distance protection, which was in order.

Powergrid informed that tripping of 315 MVA ICT-2 at 220kV Rourkela S/s on the operation of 220KV Backup O/C & E/F protection was not in order. The relay is old static type relay. The relay was tested and it was found that the directional element of the relay is defective and the timing of

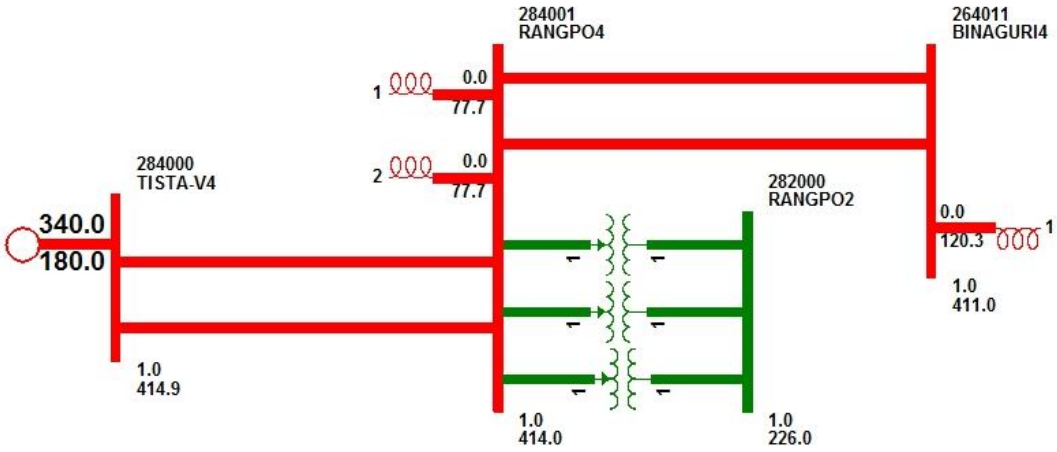
the relay as per settings is also not correct. They are planning to replace the relay with a numerical relay during last week of November'16.

PCC advised the following:

- *Powergrid to update the status of 220KV Backup O/C & E/F protection replacement of 315 MVA ICT-2 at Rourkela S/s in next PCC meeting.*

ITEM NO. B.6: Disturbance at 400 kV Rangpo(PG) S/s on 05-10-16 at 14:25hrs.

1. **Single line diagram:** Not Submitted



2. **Pre fault conditions:** Submitted

In 400kV Rangpo S/S double main bus scheme is implemented. Following feeders were connected to Bus-II prior to the incident:

1. 400 KV Rangpo-Teesta-I
2. 400 KV Rangpo-Binaguri-II
3. 315 MVA ICT-II
4. 315 MVA ICT-IV
5. 80 MVAR Bus Reactor-II

3. **Detailed analysis of tripping incident:** Submitted

At 14:25 hrs, all the elements connected to 400 kV bus II at Rangpo tripped due to mal-operation of Bus Z-II protection initiated from GD-1/414 Bay (Gas pressure detector). On further inspection, it was found that gas pressure was normal. It is suspected that mechanical vibration or problem in electric circuit (contact of GD, connecting cable or contactor/multiplying relay used in zone trip logic) was the reason for mal-operation of Bus Z-II relay.

4. **Remedial action taken :** Not Submitted

5. **Disturbance record:** Submitted

Analysis of PMU plots: At 14:25 hrs, no fault is observed in PMU data as there was no S/C fault in the network.

Status of Reporting: Tripping report along with DR & EL received from POWERGRID on 05-10-16

Powergrid may explain the following:

- Powergrid may place the details and reason for maloperation of Bus Z-II relay.

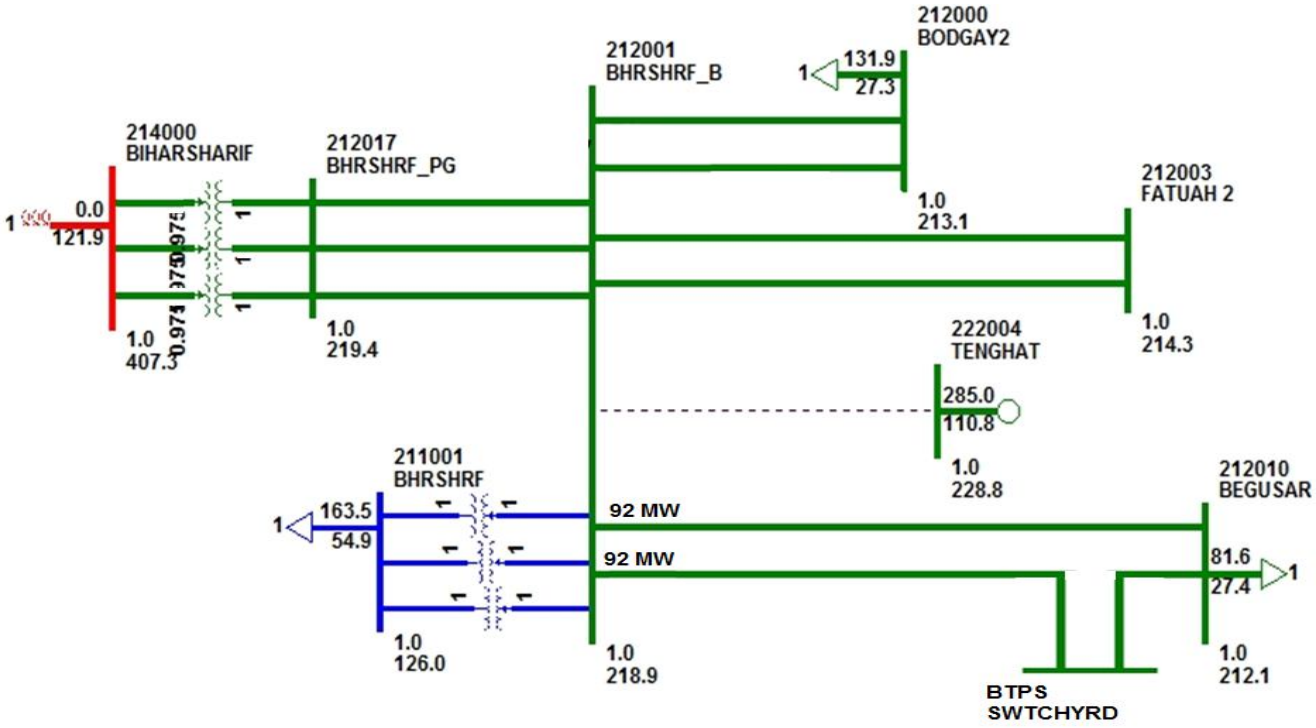
Deliberation in the meeting

Powergrid informed that bus bar protection was activated and tripped all the elements connected to 400 kV bus II at Rangpo due to operation of breaker chamber low Gas Pressure Detection logic.

Powergrid informed that the scheme is being modified to initiate alarm during low gas pressure before going for tripping.

ITEM NO. B.7: Disturbance at 220 kV Begusarai (BSPTCL) S/s on 21-10-16 at 12:12hrs.

1. **Single line diagram:** Submitted



2. **Pre fault conditions:** Submitted

   - Darbhanga was radially supplied from Begusarai with the help of transfer bus of Muzaffarpur (BSPTCL).

3. **Detailed analysis of tripping incident:** Submitted

At 12:12 hrs, 220 KV Biharshariff - Begusarai D/C tripped on B-N fault causing power failure at Begusarai and Darbhanga.

Time (Hrs)	Details of tripping	Relay at local end	Relay at remote end
12:12 hrs	220 kV Biharshariff-Begusarai -I	Did not trip	B-N, E/F, Only B phase breaker opened at Begusarai (As per DR at Begusarai). But all three phase current became zero.
	220 kV Biharshariff-Begusarai -II	B-N, E/F, D/P, 67.8 km from Biharshariff	Did not trip

4. **Disturbance record:** Submitted

5. **Remedial action taken :** Submitted

- After resetting of relay 220 KV Biharsharif-Begusarai ckt-I charged at 09:40 hrs & ckt –II charged at 10:10 hrs from Begusarai end and 10:05 hrs from Biharsharif end stood ok.
- The Distance protection of the 220 KV ckt l &2 checked at GSS Biharsharif on dt 14/10/16 and found ok.

Analysis of PMU plots:

- At Biharshariff PMU data, 12 kV voltage dip has been observed in B phase.
- Fault Clearance time was less than 100 ms.

Status of Reporting: BSPTCL has submitted the tripping report along with DR on 28-10-16

.

BSPTCL may explain the following:

- Reason for tripping of both 220 KV Biharshariff - Begusarai D/C may be explained by BSPTCL.
- As per DR provided by BSPTCL, only B phase was open at Begusarai end for 220 kV Biharshariff – Begusarai – I though all three phases current became zero after the incident.
- Bihar SLDC may furnish amount of energy un-served and duration of disturbance.

Deliberation in the meeting

BSPTCL informed that B-N fault was initiated in 220 KV Biharshariff – Begusarai-II and the fault was cleared from both the ends on zone 1 distance protection.

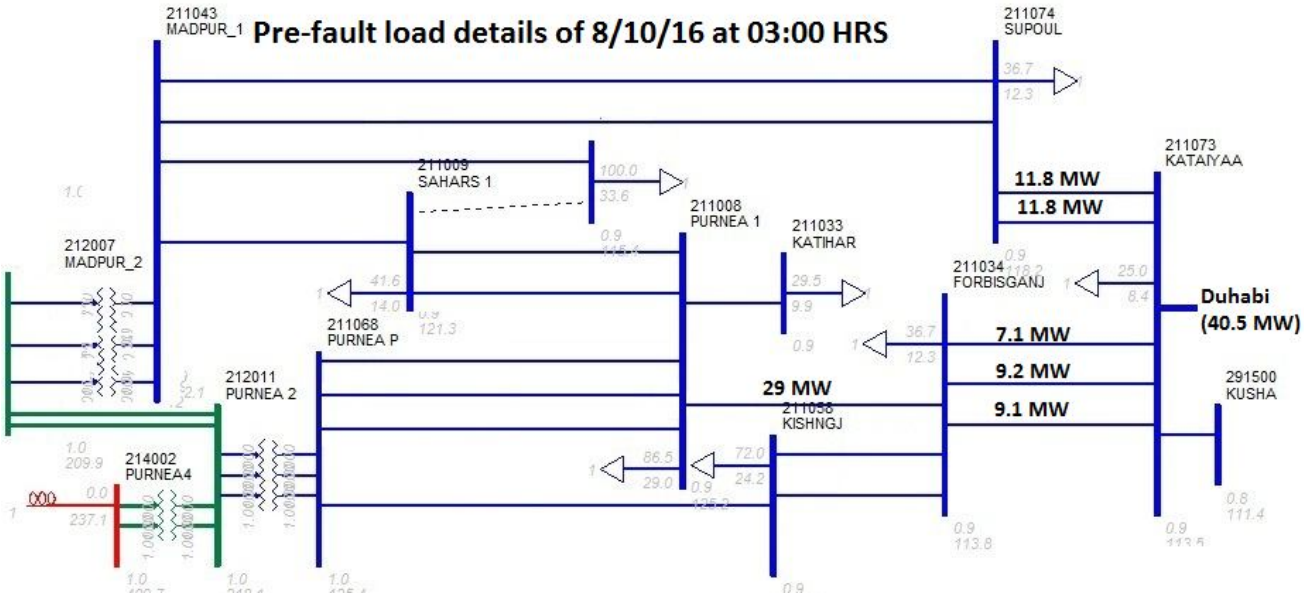
220 KV Biharshariff – Begusarai-I also tripped from Begusarai end on zone 1 distance protection with fault distance of 85 km.

PCC advised BSPTCL to check the distance relay settings at Begusarai end of 220 KV Biharshariff – Begusarai-I as the relay should not trip on zone 1.

In Begusarai end DR of 220 KV Biharshariff – Begusarai-I only B-ph breaker was shown opened but the current is showing zero in all phases and advised to BSPTCL to configure the DR properly.

ITEM NO. B.8: Multiple tripping at 132kV Purnea (PG) and 132kV Forbisgunj (BSPTCL) system on 08-10-16 at 03:33hrs

1. **Single line diagram:** Submitted



2. **Pre fault conditions:** Submitted

3. **Detailed analysis of tripping incident:** Not Submitted

At 03:33 Hrs,

- 132 KV Purnea-Forbesganj Line tripped from Purnea(B) end on zone 2 distance protection due to transient fault near Forbesganj end. Forbesganj end relay failed to clear the fault.
- 132 KV Purnea(PG)-Kishanganj-Forbesganj T/L tripped from Purnea(PG) end.
- Due to tripping of 132 KV Purnea-Forbesganj Line & 132 KV Purnea(PG)-Kishanganj-Forbesganj T/L ,there was total power failure at GSS Forbesganj.
- At the same time 132 KV Supaul-Kataiya D/C tripped from GSS Supaul end on zone 2 distance protection.
- Due to total power failure at GSS Forbesganj and tripping of 132 KV Supaul-Kataiya D/C, there was total power failure at GSS Kataiya.

The relay indications are as follows:

Sl.No	Name of Bay / Line	Local End Relay Indications	Remote End Relay Indications
1.	132 KV Purnea(B)-Fobesganj T/L	Zone-2, 96.72 KM	No tripping
2.	132 KV Purnea(PG)-Kishanganj-Forbisgank Ckt T/Ls	Tripping, No info of relay from Purnea(PG)	No tripping
3.	132 KV Forbesganj-Kataiya T/Ls	No Tripping	No Tripping
4.	132 KV Supaul-Kataiya Ckt-1	R,Y phase Zone-2, 59.50 KM	No Tripping
5.	132 KV Supaul-Kataiya Ckt-2	R,Y phase Zone-2, 59.50 KM	No Tripping

4. **Disturbance record:** Submitted

5. **Remedial action taken :** Submitted

It seems that transient fault was near Forbesganj end of 132 KV Purnea(B)-Fobesganj T/L. But 132 KV Purnea(B)-Fobesganj T/L did not trip from GSS Forbesganj end. So the distance protection relay of 132 KV Purnea(B)-Fobesganj T/L at GSS Forbesganj end is scheduled to be checked and tested on dt-22/11/16.

Analysis of PMU plots:

At 03:33 hrs, 10 kV voltage dip observed in R & Y phases at Binaguri PMU. Fault clearing time is 560 ms approximately.

Status of Reporting:

- Tripping report from BSPTCL & POWERGRID is yet to be received

BSPTCL may explain the following:

- Reason for not clearing the fault from 132kV Forbesganj and Kataiya end.

Deliberation in the meeting

BSPTCL explained that there was a R-Y-N fault in 132 KV Purnea(B)-Fobesganj line close to Forbesganj end. The fault was cleared from Purnea(B) end on zone -2 but forbesganj end relay failed to identify the fault. As a result 132 KV Purnea(PG)-Kishanganj-Forbisganj line tripped from Purnea(PG) end on zone 3. 123kV Kataiya-Supoul D/c lines tripped from Supoul end on zone 2.

BSPTCL informed that 132 KV Purnea(B)-Fobesganj line relay at 132kV Forbesganj end was replaced with new numerical relay on 22nd November, 2016. The distance protection at 132 KV Fobesganj- Kataiya line-I at Kataiya end is also replaced.

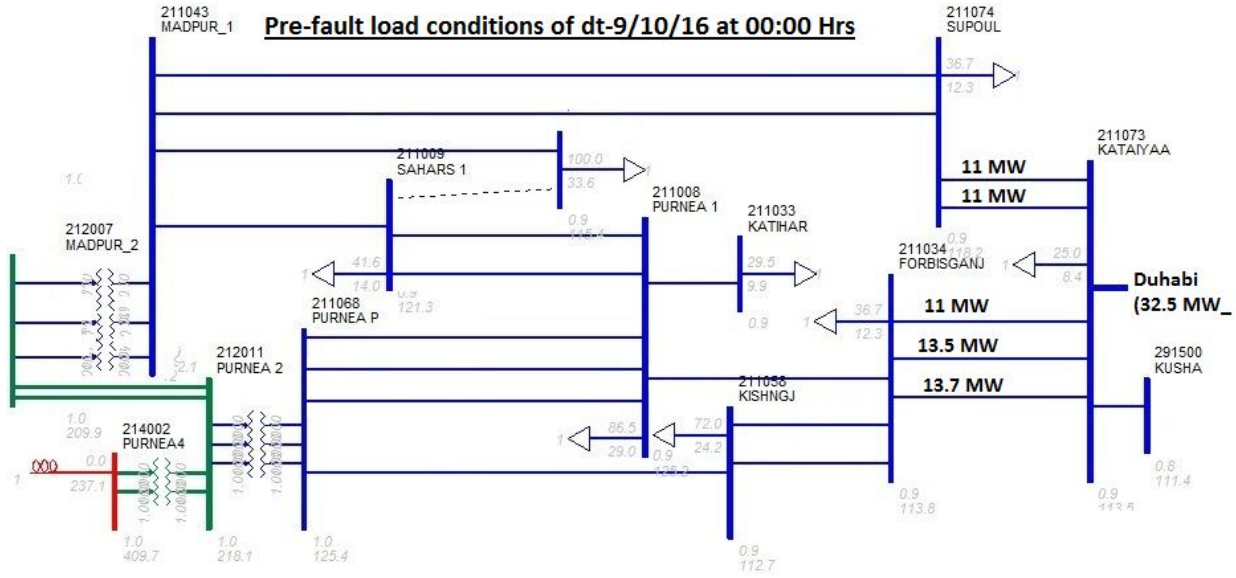
PCC felt that in this case 132kV Kataiya end relays should trip before 132kV Supoul end relays and advised BSPTCL to coordinate the relays at 132kV Forbesganj, Kataiya and Supoul.

ITEM NO. B.9: Multiple tripping at 132kV Purnea (PG) and 132kV Forbisgunj (BSPTCL) system on 09-10-16 at 00:05 hrs.

1. **Single line diagram:** Submitted
2. **Pre fault conditions:** Submitted
3. **Detailed analysis of tripping incident:** Not Submitted

At 00:05 Hrs, 132 kV Purnea (B) – Forbisgunj line tripped from Purnea(B) end on zone 1 distance protection relay due to snapping of jumper in the line. At the same time 132 KV Purnea(PG)-Kishanganj-Forbesganj T/L tripped from Purnea(PG) end .Due to tripping of 132 KV Purnea-Forbesganj Line & 132 KV Purnea(PG)-Kishanganj-Forbesganj T/L ,there was total power failure at GSS Forbesganj.
The relay indications are as follows:

Sl.No.	Name of Bay / Line	Local End Relay Indications	Remote End Relay Indications
1.	132 KV Purnea(B)-Fobesganj T/L	Zone-1, 26.42 KM	No tripping
2.	132 KV Purnea(PG)-Kishanganj-Forbisgank Ckt T/Ls	Tripping, No info of relay from Purnea(PG)	No tripping



4. **Disturbance record:** Not Submitted

5. **Remedial action taken :** Submitted

   Tripping was due to the snapping of Y- Phase jumper at LOC- 94. of 132 KV Purnea(B)-Fobesganj T/L. After replacement of jumper, line was restored at 9:42 on date-9/10/16.

Analysis of PMU plots:

- No voltage dip has been observed in Binaguri PMU data as there was no fault in the network.

Status of Reporting:

- Tripping report from BSPTCL & POWERGRID is yet to be received

BSPTCL and Powergrid may explain the following:

- Tripping of 132 KV Purnea (PG) – Kishangunj and 132 kV Purnea (PG) – Forbisgunj
- Bihar SLDC may submit the amount of energy un-served due to this incident.

Deliberation in the meeting

BSPTCL explained that there was a Y-N fault in 132 KV Purnea(B)-Fobesganj line due to the snapping of Y- Phase jumper at LOC- 94. The fault was cleared from Purnea(B) end on zone -1 but forbesganj end relay failed to identify the fault. As a result 132 KV Purnea(PG)-Kishanganj-Forbisganj line tripped from Purnea(PG) end on zone 3.

BSPTCL failed to explain how the fault was cleared from 132kV Kataiya-Supoul-Madhepura sections.

PCC advised BSPTCL to collect complete details of the tripping and submit a report to ERPC and ERLDC.

ITEM NO. B.10: Spurious tripping of 400 kV Ranchi Sipat – II on 3rd & 7th October 2016

On 3rd October 2016 at 13:04:19 hrs, 400 kV Ranchi – Sipat – II tripped from Ranchi end due to DT receipt. At 13:04:24 hrs, O/V stage II operated Sipat end which send DT signal to Ranchi end and line tripped from Ranchi end. Same incident is repeated at 13:00 hrs on 07th October.

Ranchi end DR is yet to be received.

Powergrid may explain the reason for sending DT signal from Ranchi end.

Deliberation in the meeting

Powergrid informed that there is a problem in frequency allotment of the PLCC system at Ranchi. They have taken up the issue with their corporate office and soon the problem will be rectified.

ITEM NO. B.11: Differential protection for transmission lines - NPC

CEA vide letter no. 4/MTGS/NPC/CEA2016 dated 27th October, 2016 informed that, sub-committee on protection under task force for power system analysis under contingencies(Para 14 in Section-6 of the report under relay setting guide lines for transmission lines recommended the following:

Quote

14. Line differential protection

Many transmission lines are now having OPGW or separate optic fibre laid for the communication. Wherever such facilities are available, it is recommended to have the line differential protection as Main-I protection with distance protection as backup (built-in Main relay or standalone). Main-II protection shall continue to be distance protection. For cables and composite lines, line differential protection with built in distance backup shall be applied as Main-I protection and distance relay as Main-II protection. Auto-recloser shall be blocked for faults in the cables.

Unquote

Members may deliberate.

Deliberation in the meeting

PCC in principle agreed.

Constituents informed that differential protection is already implemented in short lines.

Constituents felt that implementation of differential protection involves huge cost.

CEA informed that constituents may send DPR to PSDF fund for funding and the issue will be further discussed in next NPC meeting.

PART- C:: OTHER ITEMS

ITEM NO. C.1: Tripping incidences in the month of October, 2016

Other tripping incidences occurred in the month of October 2016 which needs explanation from constituents of either of the end is given at **Annexure- C1.**

Members may discuss.

Deliberation in the meeting

Members explained the tripping incidences. Updated status is enclosed at **Annexure- C1.**

ITEM NO. C.2: Protection Committee visit to BSPTCL and JUSNL Sub-stations

In view of repeated uncoordinated trippings in BSPTCL and JUSNL systems, 31st TCC/ERPC formed a committee of following protection engineers to review the situation:

- Shri Sabyasachi Roy, ACE, WBSETCL,
- Shri L Nayak, GM, OPTCL
- Shri Jayanta Datta, SE, DVC
- Shri Surajit Bannerjee Asst GM, ERLDC,
- Shri Jiten Das, Asst GM, PGCIL
- Shri S. B. Prasad, ESE, BSPTCL
- Shri Vidyasagar Singh, ESE, JUSNL

PCC decided that the protection committee members will carry out the site visit of JUSNL substations during 11th to 14th May, 2016 to review the protection system in respect of Chandil, Ramchandrapur, Adityapur and adjoining substations.

In 43rd PCC, it was informed that the Protection team has visited 132/33 kV Ramchandrapur, Adityapur & 220/132 kV Chandil S/s of JUSNL from 11th to 12th May, 2016.

A special meeting was held on 08.06.16 to discuss the observations of the site visit of Chandil, Ramchandrapur, Adityapur & adjoining substations by ERPC team. In the meeting it was emphasized that the distance protection along with the back-up protection of JUSNL system (comprising of 220kV Ramchandrapur, Chandil & Hatia-II and 132 kV Adityapur & Hatia-I) needs to be reviewed for proper protection co-ordination. It was decided that the Protection team will carry out the setting calculations for all the 220 kV & 132 kV lines along with the 220/132 kV ICTs based on the data provided by JUSNL which shall be implemented by JUSNL.

In 33rd TCC, it was advised JUSNL to comply the recommendations given by the ERPC protection team.

Thereafter, a special meeting was held in ERPC on 08.07.16 to review the protection settings of all the 220 kV & 132 kV lines along with the 220/132 kV ICTs of 220/132kV Ramchandrapur, Chandil & Hatia-II and 132 kV Adityapur & Hatia-I substations of JUSNL. Representatives of DVC, WBSETCL and ERLDC as members of ERPC Protection team attended the meeting.

After detail study of the data as submitted by JUSNL, it was observed that there was some missing data/mismatch in the information. Therefore, it was felt that the complete details of all Lines (i.e. Line length, Single or double circuit) originating from the following Sub-stations Bus along with Transformer data (MVA, % Z, Voltage Ratio) are required for finalizing the protection settings for all the 220 kV & 132 kV lines:

1. 220KV Ramchandrapur
2. 132KV Ramchandrapur
3. 132KV Tamar
4. 132KV Golmuri
5. 132KV Rajkharswan
6. 220KV Chandil
7. 132KV Chandil
8. 132KV Adityapur
9. 220KV PTPS
10. 132KV PTPS
11. 132KV Lohardaga
12. 132KV Namkum
13. 132KV HEC
14. 132KV Kanke
15. 132KV Kamdara
16. 132KV Hatia I
17. 132KV Hatia 2
18. 220KV Hatia 2
19. 132KV Sikidri

JUSNL has submitted the desired information and the same has been circulated to protection team.

Protection settings of all the 220 kV & 132 kV lines along with the 220/132 kV ICTs of 220/132kV Ramchandrapur, Chandil & Hatia-II and 132 kV Adityapur & Hatia-I substations of JUSNL were finalized in a special meeting on 28.07.2016. JUSNL was advised to implement the settings.

In 46th PCC, JUSNL informed that they have incorporated the recommended settings at 220 kV Chandil, Hatia-I and 132 kV Hatia-II sub-stations. 220 kV Ramchandrapur & 132 kV Adityapur Sub-stations will be implemented by 1st week of September, 2016.

PCC advised JUSNL to submit a report on improvements observed in protection system performance after implementation of the recommended settings.

JUSNL agreed.

JUSNL vide mail dated 5th October 2016 informed that the relay settings have been changed for all the lines of 220kV Chandil, Ramchndrapur and 132kV Adityapur as per the ERPC committee recommendations. Latest status of implementation is enclosed at ***Annexure-C2***

JUSNL may update.

Deliberation in the meeting

Members noted.

ITEM NO. C.3: PROTECTION PHILOSOPHY OF EASTERN REGION

The Protection Philosophy finalized in special PCC meeting held on 20th July, 2015 is as given below:

Sl. No.	Zone	Direction	Protected Line Reach Settings	Time Settings (in Seconds)	Remarks
1	Zone-1	Forward	80%	Instantaneous (0)	As per CEA
2a	Zone-2	Forward	For single ckt- 120 % of the protected line	0.5 to 0.6 - if Z2 reach overreaches the 50% of the shortest line ; 0.35- otherwise	As per CEA
			For double ckt- 150 % of the protected line		As per CEA
2b	Zone-2 (for 220 kV and below voltage Transmission lines of utilities)	Forward	120 % of the protected line, or 100% of the protected line + 50% of the adjacent shortest line	0.35	As per CEA with minor changes
3	Zone-3	Forward	120 % of the (Protected line + Next longest line)	0.8 - 1.0	As per CEA
4	Zone-4	Reverse	10%- for long lines (for line length of 100 km and above) 20%- for shot lines (for line length of less than 100 km)	0.5	As per CEA

Note:

1) **Zone-2:- Z2 Reach should not encroach the next lower voltage level.**
2) **Zone-3:- If Z3 reach encroaches in next voltage level (after considering "in-feed"), then Z3 time must be coordinated with the fault clearing time of remote end transformer.**
3) **Zone-4:- If utility uses carrier blocking scheme, then the Z4 reach may be increased as per the requirement. It should cover the LBB of local bus bar and should be coordinated with Z2 time of the all other lines.**
4) **The above settings are recommended primarily (exclusively) for uncompensated lines.**

All the constituents agreed on the principles read with notes as above.

Till date DVC, WBSETCL, JUSNL, OPTCL, Powergrid (ER-I, ER-II & Odisha-Projects), NTPC, BSPTCL, NHPC, Vedanta and GMR had submitted the zone settings.

PCC advised all the other constituents to implement the revised zone philosophy and submit the settings to ERPC at the earliest.

JITPL, MPL and Adhunik may submit the revised zone settings data at the earliest.

Deliberation in the meeting

PCC advised JITPL, MPL and Adhunik to submit the revised zone settings data at the earliest.

ITEM NO. C.4: Third Party Protection Audit

1. Status of 1st Third Party Protection Audit:

The compliance status of 1st Third Party Protection Audit observations is as follows:

Name of Constituents	Total Observations	Complied	% of Compliance
Powergrid	54	37	68.52
NTPC	16	14	87.50
NHPC	1	1	100.00
DVC	40	26	65.00
WB	68	27	39.71
Odisha	59	38	64.41
JUSNL	34	16	47.06
BSPTCL	16	5	31.25
IPP (GMR, Sterlite and MPL)	5	5	100.00

The substation wise status of compliance are available at ERPC website (Observations include PLCC rectification/activation which needs a comprehensive plan).

Members may update.

Deliberation in the meeting

PCC advised all the constituents to comply the pending observations at the earliest.

2. Schedule for 2nd Third Party Protection Audit:

The latest status of 2nd Third Party Protection audit is as follows:

1) Jeerat (PG) Completed on 15th July 2015
2) Subashgram (PG) Completed on 16th July 2015
3) Kolaghat TPS (WBPDCL)- Completed on 7th August 2015
4) Kharagpur (WBSETCL) 400/220kV - Completed on 7th August 2015
5) Bidhannagar (WBSETCL) 400 &220kV Completed on 8th September, 2015
6) Durgapur (PG) 400kV S/s Completed on 10th September, 2015
7) DSTPS(DVC) 400/220kV Completed on 9th September, 2015
8) Mejia (DVC) TPS 400/220kV Completed on 11th September, 2015
9) 400/220/132kV Mendhasal (OPTCL) Completed on 2nd November, 2015
10) 400/220kV Talcher STPS (NTPC) Completed on 3rd November, 2015
11) 765/400kV Angul (PG) Completed on 4th November, 2015
12) 400kV JITPL Completed on 5th November, 2015
13) 400kV GMR Completed on 5th November, 2015
14) 400kV Malda (PG) Completed on 23rd February, 2016
15) 400kV Farakka (NTPC) Completed on 24th February, 2016
16) 400kV Behrampur(PG) Completed on 25th February, 2016
17) 400kV Sagardighi (WBPDCL) Completed on 25th February, 2016
18) 400kV Bakreswar (WBPDCL) Completed on 26th February, 2016
19) 765kV Gaya(PG) Completed on 1st November, 2016
20) 400kV Biharshariff(PG) Completed on 3rd November, 2016
21) 220kV Biharshariff(BSPTCL) Completed on 3rd November, 2016

Third party protection audit observations of 220kV Biharshariff (BSPTCL) S/s:

- Event logger (EL) is not in service
- Local breaker backup protection(LBB) is not available

- Bus bar protection is not installed
- Synchronizing facility is not available
- Two sets of 220 V DC sources are available but relays are not electrically and physically segregated into two groups
- Time Synchronizing Equipment is not available
- Both Main-I & II distance relays of 220kV Fatua-I & II, Bodhgaya-I & II, and Tenughat lines are same make (Micom P442)
- Main-II distance protection is not available for 220kV Begusarai line-I.
- Backup directional overcurrent earth fault protection in Micom P442 of 220kV Fatua-I & II is enabled with definite time instead of IDMT characteristics
- Backup directional overcurrent E/F protection relays (Micom P127) of all the lines are being operated as non-directional instantaneous overcurrent E/F protection. BSPTCL should enable the directional feature and coordinate the relay settings with distance protection.
- Static relay of 132kV Baripahari line-I & II (Quadra Mho -21) should be replaced with a numerical relay. Quadra Mho -21 may be kept as Main-II.
- PLCC is not available for all the lines
- Auto reclosing feature is not available.
- Disturbance Recorder in numerical relays is not properly configured. All analog and digital channels are to be properly configured.
- Overload alarm for 150MVA, 220/132/33kV ATRs is not available

BSPTCL may update.

Deliberation in the meeting

It was informed that the third party protection audit observations are available in the ERPC website in important documents.

PCC advised all the constituents to comply the observations at the earliest.

ITEM NO. C.5: Implementation of Protection Database Management System Project.

ERPC proposal for "Creation & Maintenance of web based protection database management system and desktop based protection calculation tool for Eastern Regional Grid" has been approved by the Ministry of Power for funding from Power System Development Fund (PSDF) vide No-10/1/2014-OM dated 07.03.2016. Subsequently, the LOA was given to PRDC and the first implementation meeting was held on 12.04.2016.

Operational load flow requisite data format is available in ERPC website. All the constituents are requested to submit the filled formats at the earliest and co-operate for smooth implementation of the project in time bound manner.

In last PCC, all the constituents were advised to submit the filled formats at the earliest.

A hands on training program was held from 05/09/2016 to 09/09/2016 at ERPC Kolkata.

PRDC updated the latest status of the implementation of the project and informed the following:

- Data collection for Odisha including IPPs has been completed.
- Data collection for JUSNL and DVC (located at Jharkhand) is going on and around 40 sub-stations have been completed.
- Data collection for DVC (located in West Bengal) has also been started.
- Data collection for West Bengal, WBPDCL, DPL and CESC will be started after Puja.

PCC requested all the respective members to extend their supports for data collection of their sub-stations.

Members may note.

Deliberation in the meeting

PRDC informed that data collection for West Bengal is in progress and it will be completed by December, 2016.

ITEM NO. C.6: Zone-2 setting of long line followed by short line

As per ERPC/CEA protection guidelines Zone-2 time setting of two adjacent lines needs to be properly co-ordinated to avoid undesirable trippings on account of racing between relays. In the past major disturbances occurred due to lack of proper coordination in Zone-2 time setting.

For proper coordination of operation of Zone-2 Distance Protection, an effort has been made to list out the adjacent shortest line for 400 kV transmission lines, and all the lines whose Zone-2 reach is overlapping with that of adjacent lines have been highlighted. The details are given in **Annexure-C6**.

Concerned transmission utilities are requested to review the same and share the present Zone-2 time setting and update in case of mismatch.

In 48th PCC, all the constituents were advised to go through the Annexure and review the settings with intimation to ERPC and ERLDC.

Deliberation in the meeting

PCC advised all the constituents to review the settings with intimation to ERPC and ERLDC.

ITEM NO. C.7: Line over voltage protection settings for 400 kV and 765 kV Lines in Eastern Region

Last year over voltage protection setting for all 400 kV and above lines was collected from the constituents. However, in the meantime many changes took place in the system, which includes commissioning of new lines as well as LILO of existing line.

Further CEA guidelines suggest that the following should be considered while setting over voltage protection in transmission line.

FOR 400kV LINES: *Low set stage (Stage-I) may be set in the range of 110% - 112% (typically 110%) with a time delay of 5 seconds. High set stage (Stage-II) may be set in the range 140% - 150% with a time delay of 100milliseconds.*

FOR 765kV LINES*: Low set stage (Stage-I) may be set in the range of 106% - 109% (typically 108%) with a time delay of 5 seconds. High set stage (Stage-II) may be set in the range 140% - 150% with a time delay of 100milliseconds.*

However, for over voltage Stage-I protection, a time grading of 1 to 3 seconds may be provided between overvoltage relays of double circuit lines. Grading on overvoltage tripping for various lines emanating from a station may be considered and same can be achieved using voltage as well as time grading. Longest timed delay should be checked with expected operating time of Over-fluxing relay of the transformer to ensure disconnection of line before tripping of transformer.

It is desirable to have Drop-off to pick-up ratio of overvoltage relay better than 97% (Considering limitation of various manufacturers relay on this aspect).

Present overvoltage setting record available at ERLDC is given in **Annexure-C7**. Concerned transmission utilities are requested to provide the missing information and updated the exiting one (if any).

In 48th PCC, all the constituents were advised to go through the Annexure and update the settings, if any.

Deliberation in the meeting

PCC advised all the constituents to update the settings.

ITEM NO. C.8: Non-commissioning of PLCC / OPGW and non-implementation of carrier aided tripping in 220kV and above lines.

According to CEA technical standard for construction of electric plants and electric lines -Clause 43(4) (c), transmission line of 220 KV and above should have single-phase auto-reclosing facility for improving the availability of the lines. However, from the tripping details attached June-August, 2016 it is evident that the some of 220kV above Inter & Intra-Regional lines do not having auto-reclose facility either at one end or at both ends. Out of these for some of the lines even PLCC/OPGW is not yet installed and carrier aided protection including Autorecloser facility is not yet implemented. Based on the trippings of June- August, 2016 and PMU analysis a list of such lines has been prepared and as given below:

List of line where auto reclose facility is not available(Information based on PMU data analysis)							
S. No	**Transmission Lines name**	**Date of Tripping**	**Reason of Tripping**	**Owner Detail**		**Present Status**	
				End-1	**End-2**	**OPGW/PLCC Link available**	**AR facility functional**
1	400 KV ANGUL - TALCHER	02.06.16	B-N FAULT	PGCIL	NTPC		
2	400 KV BIHARSARIFF-VARNASI-I	07.06.16	B-N FAULT	PGCIL	PGCIL		
3	400KV BIHARSARIFF - BANKA-II	12.06.16	Y - N FAULT	PGCIL	PGCIL		
4	220KV SASARAM-SAHUPURI	12.06.16	B - N FAULT	PGCIL	UPTCL		
5	400 KV TALA -BINAGURI -IV	13.06.16	B - N FAULT	Durk Green	PGCIL		
6	400 KV KODERMA-BOKARO-I	14.06.16	B-N FAULT	DVC	DVC		
7	400 KV FARAKKA-KAHALGAON-IV	15.06.16	R-N FAULT	NTPC	NTPC		
8	400 KV MUZAFFARPUR-BIHARSARIFF-II	17.06.16	Y-N FAULT	PGCIL	PGCIL		
9	400 KV MERAMUNDALI-NEWDUBRI - I	20.06.16	B-N FAULT	OPTCL	OPTCL		
10	400KV PATNA-BALIA-II	21.06.16	B-N FAULT	PGCIL	PGCIL		
11	400KV PATNA-KISHANGANJ-II	21.06.16	Y-N FAULT	PGCIL	PGCIL		
12	400KV PATNA-BALIA-I	21.06.16	R-N FAULT	PGCIL	PGCIL		
13	220KV BUDIPADAR-KORBA-II	23.06.16	Y-N FAULT	OPTCL	CSEB		
14	400 KV ARAMBAGH - BIDHANNAGAR	02.07.16	Y-N FAULT	WBSETCL	WBSETCL		
15	400 KV FARAKKA-DURGAPUR-I	06.07.16	Y-N FAULT	NTPC	PGCIL		

16	400 KV NEW RANCHI - CHANDWA - I	13.07.16	B-N FAULT	PGCIL	PGCIL		
17	220 KV TSTPP-RENGALI	17.07.16	EARTH FAULT	NTPC	OPTCL		
18	220KV BUDIPADAR-RAIGARH	21.07.16	EARTH FAULT	OPTCL	PGCIL		
19	400 KV KOLAGHAT-KHARAGPUR	03.08.16	Y-N FAULT	WBPDCL	WBSETCL		
20	220 KV FARAKKA-LALMATIA	03.08.16	B-N FAULT .	NTPC	JUNSL		
21	400 KV PURNEA-MUZAFARPUR-I	03.08.16	R-N FAULT	PGCIL	PGCIL		
22	400 KV GAYA - CHANDWA -II	04.08.16	B-N FAULT .	PGCIL	PGCIL		
23	220 KV MUZAFFARPUR - HAZIPUR - II	10.08.16	B-N FAULT	PGCIL	BSPTCL		
24	220 KV ROURKELA - TARKERA-II	11.08.16	B-N FAULT	PGCIL	OPTCL		
25	220 KV CHANDIL-SANTALDIH	25.08.16	R-N FAULT	JUSNL	WBPDCL		
26	400 KV MPL-RANCHI-II	02.09.16	R-N FAULT	MPL	PGCIL		
27	220 KV BIHARSARIF-TENUGHAT	07.09.16	B-N FAULT	BSPTCL	TVNL		
28	400KV MERAMANDALI-STERLITE-II	10.09.16	Y-N FAULT	OPTCL	SEL		
29	220 KV RAMCHANDRAPUR - CHANDIL	22.09.16	B-N FAULT	JUSNL	JUNSL		
30	400KV SEL - MERAMUNDALI-I	22.09.16	B-N FAULT	SEL	OPTCL		
31	400 KV KOLAGHAT - CHAIBASA	28.09.16	B-N FAULT	WBPDCL	PGCIL		

34th TCC advised all the respective members to update the above list along with the last tripping status in next PCC meeting.

TCC further advised all the constituents to give the latest status of PLCC of other 220kV and above lines under respective control area.

TCC advised to review the status of above in lower forums report back in next TCC.

Members may update the status.

Deliberation in the meeting

NTPC vide mail dated 2nd December, 2016 informed the status as follows:

List of line where auto reclose facility is not available(Information based on PMU data analysis)							
S. No	**Transmission Lines name**	**Date of Tripping**	**Reason of Tripping**	**Owner Detail**		**Present Status**	
				End-1	**End-2**	**OPGW/PLCC Link available**	**AR facility functional**
7	400 KV FARAKKA KAHALGAON-	15.06.16	R-N FAULT	NTPC	NTPC	Yes	Yes and operated last on dated

	IV						28.09.2016.
15	400 KV FARAKKA DURGAPUR-I	06.07.16	Y-N FAULT	NTPC	PGCIL	Yes	Yes and operated last on 19.07.2016 & 06.11.2016
20	220 KV FARAKKA-LALMATIA	03.08.16	B-N FAULT	NTPC	JUNSL	Yes	Old Relay and not functional. 7-8 months required for auto re-close relay procurement.

PCC advised all the other constituents to communicate the latest status along with the last tripping status to ERPC and ERLDC.

ITEM NO. C.9: Non-commissioning / non-functional status of bus-bar protection at important 220 kV Sub-stations.

It has been observed that at many 220 kV substations particularly that of STU, bus-bar protection is either not commissioned or non-functional. The non-availability / non-functionality of bus bar protection, results in delayed, multiple and uncoordinated tripping, in the event of a bus fault.This in turn not only results in partial local black out but also jeopardises the security of interconnected national grid as a whole. The matter was also pointed out during the third party protection audit which is being carried out regularly. Constituents are required to meet the audit compliance and commission or made bus –bar protection functional where ever it is not available. A list of such important 220 kV sub-stations as per the first third party audit is placed in the meeting.

In 34th TCC, members updated the status as follows:

Bus Bar Protection not availble (reccord as per third party protection audit)

Bihar				
Sl No	**Name of Substation**	**Bus Bar protection status**	**Date of audit**	**Present Status**
1	220 kV Bodhgaya	Not available	28-Dec-12	*Single bus and there is no space available for busbar protection*
Jharkhand				
1	220 kV Chandil	Not available	29-Jan-13	*LBB available*
2	220 kV Ramchandrapur	Not available	29-Jan-13	*Functional from October 2013*
3	220 kV Tenughat	Not available	12-Apr-13	
DVC				
1	220 kV Jamsedpur	Not available	10-Apr-13	*Single bus. Bus bar will be commissioned under PSDF.*
Odisha				
1	220 kV Mermandali	Not functional	30-Dec-12	*Commissioned in Mar 2015*

West Bengal				
1	220 kV Arambah	Not available	24-Jan-13	
2	220 kV Jeerat	Not available	20-Dec-12	
3	220 kV Kolaghat	Not available	19-Dec-12	*Commissioned in May 2014*
4	220 kV Howrah	Not available	26-Mar-13	
Powergrid				
1	220 kV Silliguri	Not available	30-Mar-13	*Commissioned in Mar 2016*
2	220 kV Bolangir	Not available	31-Mar-13	*Commissioned in April 2013*

TCC further advised all the constituents to give the latest status of Bus Bar protection of other 220KV S/S under respective control area.

TCC advised to review the status of above in lower forums report back in next TCC.

Members may update.

Deliberation in the meeting

PCC advised all the constituents to submit the latest status to ERPC and ERLDC.

PART- D

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 D.1 Disturbance at 220 kV Sasaram S/s on 28-08-16 at 10:38 hrs & 11:10 hrs.

1. **Single line diagram:** Submitted.

2. **Pre fault conditions:** Submitted

Pre Fault data on 28.8.16 at 10:00 hrs in Pusauli GSS:

Voltage of 132 KV Kudra –Pusauli (PG)	134.4 KV
Load on 220 Pusauli (PG)- Pusauli	125.2 MW
Load on 132 KV Kudra –Pusauli (PG)	55.1 MW

Pre Fault data on 28.8.16 at 11:00 hrs in Pusauli GSS:

Load on 220 KV ARA (PG)-pusauli	9.7 MW
Load on 132 KV Kudra –Pusauli (PG)	6.1 MW

3. **Detailed analysis of tripping incident:** Submitted

At 10:38 hrs, 220 kV Sasaram- Nandokhar S/C along with 220/132 kV ATRs at Nandokhar tripped due to Y-N fault in 132 kV Kudra – Nadokhar S/C.

In order to restore supply to Khurda, 132 kV Kudra – Nadokhar S/C was charged at 11:10 hrs. At the

same time, 220 kV Arrah –Nadokhar tripped from Arrah end with relay indication Y-N fault with distance of 113 km from Arrah(PG) end and fault current of 0.9 kA. On investigation, it was found there was a clearance problem between 132 kV Kudra – Nadokhar S/C and 33 kV feeders of 132/33 kV Khurda S/S.

4. **Relay indications:** Submitted

Time (Hrs)	Details of tripping	Relay at local end	Relay at remote end
10:38 hrs	132 kV Nandokhar - Kudra S/C	Y-N, F/C 2.76 KA	Yet to be received
	220 kV Sasaram- Nandokhar S/C	Y-N, Z-III, 92.76 km from Sasram, F/C 1.76 kA	Did not trip
	150 MVA, 220/132 kV ATR-II at Nadokhar	HV- Over-current , Earth fault LV- Over-current earth fault	
11:10 hrs	220 kV Arrah- Nandokhar S/C	Tripped	Earth Fault

5. **Disturbance record:** Sequence of events submitted

6. **Remedial action taken:** Submitted

During patrolling it was found that clearance between Y phase conductor of 132 Kv Nadokhar - Kudra Transmission line and 33 KV Kudra –Chenari line was not sufficient.

Clearance between Y phase conductor of 132 Kv Nadokhar -Kudra Transmission line and 33 KV Kudra –Chenari line was increased. After rectification, the line was Charged.

Analysis of PMU plots:

At 10:38 hrs

- 30 kV voltage dip in Y phase is observed at 10:38:16.700 hrs. 7 kV voltage dip in R phase is observed at 10:38:18.700 hrs.
- Fault clearing time is 1500 ms.

At 11:10 hrs

- 25 kV voltage dip in Y phase is observed at 11:10:33.700 hrs. 25 kV voltage dip in R phase is observed at 11:10:34.400 hrs.
- Fault clearing time is 900 ms.

Status of Reporting: BSPTCL has submitted the tripping report on 30-08-16.

In 47th PCC, BSPTCL informed that –

- The 132 kV Sasaram- Nadokhar was made T-connection at Kudra Substation.
- There was a clearance problem between 132 kV Kudra – Nadokhar S/C and 33 kV Kudra – Chenari line of 132/33 kV Khurda S/S..
- The distance protection at Nadokhar end did not pick up the fault.
- Finally the 132 kV Kudra-Nadokhar line tripped in E/F at Nadokhar end as the earth fault setting is non-directional with definite time of 500 ms.
- 150 MVA, 220/132 kV ATR-II at Nadokhar also tripped on E/F.

After detailed discussion, PCC advised the following—

- Any transmission line of 132 kV and above voltage level should not be made T-connection without any prior intimation to ERLDC/ERPC. BSPTCL should remove the T-connection of 132 kV Sasaram- Nadokhar at Kudra Substation at the earliest.

- The distance protection settings of 132 kV Sasaram- Nadokhar line need to be reviewed at both the end for the T-Connection of the line at Kudra S/s.
- BSPTCL was advised to review the E/F settings of lines and recommended to adopt directional feature with IDMT characteristics.
- BSPTCL was also advised to check the CB opening timings at Nadokhar end.

BSPTCL may update.

Deliberation in the meeting

BSPTCL updated the status as follows:

- *Distance protection settings of 132kV Sasaram-Nadokhar line has been reviewed and relay settings have been corrected.*
- *The CT polarity of 132kV Sasaram-Nadokhar line was corrected from bus side to line side.*
- *CB operating time has been checked and found satisfactory.*

Item No D.2 Disturbance at 220 kV Khagul (BSPTCL) S/s on 30-08-16 at 19:18 hrs

In 47th PCC, BSPTCL was advised the following—

- The reverse zone protection may be implemented for all the 220 kV and 132 kV lines as per the Protection Philosophy of ER (In SEL311 the Z3 (reverse) may be used for Z4-Reverse zone protection & Z4 (forward) may be used for Z3 zone protection).
- To review the E/F settings of all 220 kV and 132 kV lines with recommendations to adopt directional feature with IDMT characteristics.

BSPTCL may update.

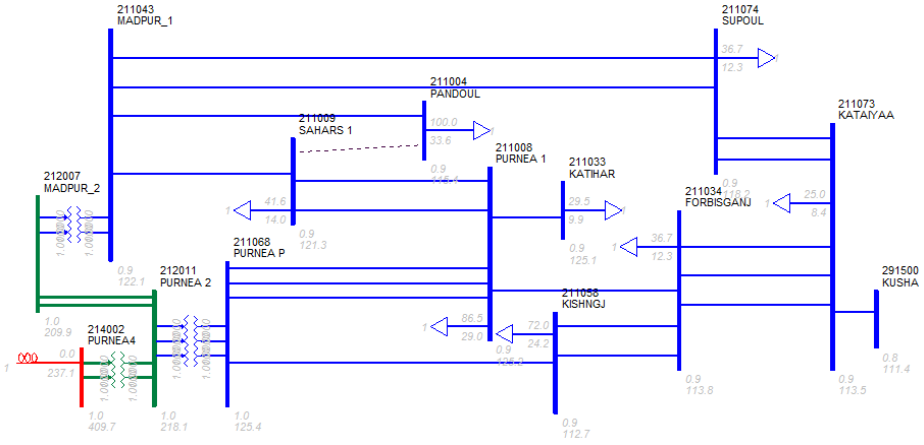
Deliberation in the meeting

BSPTCL updated the status as follows:

- *Overcurrent E/F protection settings of all 220kV and 132kV lines have been revised and made directional with IDMT characteristics.*

Item No D.3 Multiple elements tripping at 132kV Purnea (PG) and 132kV Purnea (BSPTCL) system on 14-08-16 at 12:32 hrs.

At 12:32 hrs, 132 kV Purnea (PG) - Kishangunj – Forbisgunj line tripped from Purnea end on zone 2 and 132 kV Purnea (BSPTCL) - Forbisgunj line tripped from Purnea(B) end on zone 2. Both lines did not trip from remote end.



Relay indications:

Time (Hrs)	Details of tripping	Relay at local end	Relay at remote end
12:32	132 kV Purnea (PG) - Kishangunj - Forbisgunj	Z-II, 146.8 km, IA=1.045KA, IB=779.5A, IC=270.7A	Did not trip from Forbisgunj
	132 kV Purnea (BSPTCL) - Forbisgunj	Z-II, 88.49 KM, IA-339.7A, IB-601.7A, IC-279. 6A, O/C - B phase , E/F	Did not trip from Forbisgunj

Status of Reporting:

- BSPTCL has submitted the tripping report on 30-08-16.

Analysis of PMU plots:

- 4 kV voltage dip observed in R & Y phase at Binaguri PMU. Fault clearing time 2000 ms.

BSPTCL and Powergrid may explain the following:

- The reason for tripping of 132 kV Purnea (PG) - Kishangunj – Forbisgunj & 132 kV Purnea (BSPTCL) – Forbisgunj
- The reason for not-tripping of both the circuits from Forbisgunj end.
- The reason for delayed fault clearing, as per Binaguri PMU data, fault clearance time was approx. 2000 ms.

In 47th PCC, BSPTCL informed that 132 kV Purnea (PG) - Kishangunj – Forbisgunj & 132 kV Purnea (BSPTCL) – Forbisgunj lines were tripped on transient fault.

BSPTCL failed to explain the exact cause of disturbance in the meeting.

The following points are still not cleared from the report and needs explanation from BSPTCL:

- The reason for non-tripping of both the circuits from Forbisgunj end.
- The reason for delayed fault clearing, as per Binaguri PMU data, fault clearance time was approx. 2000 ms.

BSPTCL may update.

Deliberation in the meeting

PCC advised BSPTCL to submit the report to ERPC and ERLDC within a week.

Item No D.4 Tripping of 132kV BTPS-Bighati line-1 and subsequent tripping of BTPS Unit #1, 2, 4 & 5 at 11:05 hrs on 01.09.2016

WBPDCL vide letter dated 02.09.2016 informed that at 11:05 hrs on 01.09.2016, 132kV BTPS-Bighati line-1 tripped due to snapping of B-ph conductor at 5.04 km (tower location 73 & 74) from Bighati end.

Bighati end tripped on zone 1 protection but BTPS end tripped on zone 5 after 1005 ms.

Due to delayed fault clearance from BTPS end, all the running units (Unit #1, 2, 4 & 5) of BTPS tripped.

WBPDCL requested for reviewing of the protection setting for proper relay coordination.

In 47th PCC, PCC advised WBSETCL and WBPDCL to review the relay settings bilaterally with intimation to ERPC/ERLDC.

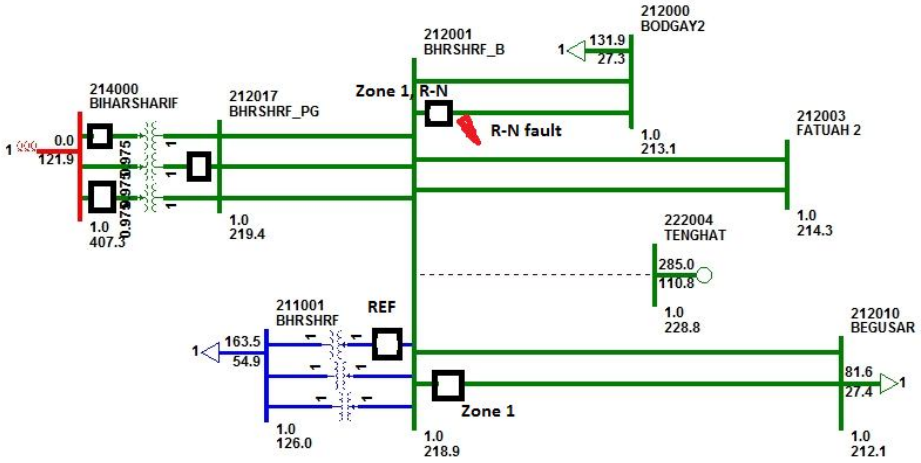
WBSETCL and WBPDCL may update.

Deliberation in the meeting

PCC advised WBSETCL and WBPDCL to review the relay settings bilaterally with intimation to ERPC/ERLDC.

Item No D.5 Total Power failure at 220/132kV Biharsharif S/s of BSPTCL system on 26-06-16 at 07:28 hrs.

1. **Single line diagram:**



2. **Pre fault conditions:** Submitted

Name of feeder	Power flow in MW	Name of feeder	Power flow in MW
220KV ICT1	170	132KV Baripahari ckt 1	30
220KV ICT2	170	132KV Baripahari ckt 2	30
220KV ICT3	170	132KV Hathidah ckt 1	00
220KV FATHUA CKT 1	110	132KV Hathidah ckt 2	00
220KV FATHUA CKT 2	110	132KV L28(Nalanda)	20
220KV Begusarai ckt 1	70	132KV L29(Rajgir)	20
220KV Begusarai ckt 2	70	132KV Nawada	35
220KV Bodhgaya ckt 1	00	132KV Ekangarsarai	20
220KV Bodhgaya ckt 2	00	132KV Sheikhpura	00
150MVA Tr no 1	48		
150MVA Tr no 2	48		
150MVA Tr no 3	48		

3. **Tripping incident details:**

At 07:28 hrs, R phase jumper of wave trap of 220 kV Biharshariff- Bodhgaya-II snapped at Biharshariff end and 220 kV Biharshariff- Bodhgaya-II tripped on zone 1 from Biharshariff end. Simultaneously the following elements tripped:

- 400/220 kV 315 MVA ICT - II at Biharshariff (PG) on back up O/C, R-N from 400 kV side.
- 400/220 kV 315 MVA ICT – III tripped from 220 kV side
- After tripping of ICT II & III, 400/220 kV ICT I at Biharshariff tripped on overload from 400 kV side.
- 220kV Biharsharif-Begusarai ckt-ll tripped from Biharshariff end on zone 1
- 150 MVA, 220/132kV ATR-I at 220 kV Biharshariff (Bihar) S/s on REF protection

At the time of incident, 220 kV Tenughat Biharshariff was not in service due to tower collapse. So, 220/132 kV Biharshariff (BSPTCL) S/S became after tripping of ICTs and power failure occurred at Biharshariff, Begusarai and Fatua.

4. Relay indications:

Time (Hrs)	Details of tripping	Relay at local end	Relay at remote end
07:28 hrs	220 kV Biharshariff- Bodhgaya-II	Micom P442/(R-N fault) Distance relay, Zone 01	NA
	220 kV Biharshariff- Begusarai-II	Siemens 7SA52,Zone-1	NA
	315 MVA 400/220 kV ICT II	Back up O/C protection in R-Phase from 400 kV side	
	315 MVA 400/220 kV ICT III	Tripped from 220 kV side	
	315 MVA 400/220 kV ICT I	Tripped on Overload at 400 kV side	

Analysis of PMU plots:

- From the Biharshariff PMU plot 80 kV voltage dip has been observed in R-Ph at 07:28 hrs
- Fault Clearance time was less than 100 ms.

Powergrid and BSPTCL may explain the following:

- BSPTCL may furnish the tripping details of 220 kV Biharshariff- Bodhgaya-II at Bodhgaya end.
- BSPTCL may explain the tripping of 220 kV Biharshariff- Begusarai-II
- BSPTCL explain the tripping of 150 MVA, 220/132kV ATR at 220 kV Biharshariff (Bihar) S/s.
- Powergrid may explain the tripping of 400/220 kV ICT I & II on backup O/C protection as the fault was cleared within 100 msec, (as per PMU data).
- Bihar SLDC may furnish amount of energy un-served and duration of disturbance.

In 45th PCC, BSPTCL explained the disturbance as follows:

- *There was a fault in 220 kV Biharshariff- Bodhgaya-II near to 220kV Biharshariff S/s and the line tripped from Biharshariff end on Zone 1 but did not trip from Bodhgaya end.*
- *220 kV Biharshariff- Bodhgaya line-I tripped from Bodhgaya end on high set O/C protection.*

BSPTCL failed to explain the following:

- *Tripping of 315 MVA ICT-II from 220kV side*
- *Tripping of 150 MVA, 220/132kV ATR-I from 220kV side*
- *Tripping of 220 kV Biharshariff- Begusarai-II from Biharshariff end on zone 1.*

PCC could not able to conclude the tripping incidence and advised BSPTCL to submit a detailed report within a week.

Thereafter BSPTCL submitted a presentation and DR of Begusarai end.

In 46th PCC, BSPTCL failed to explain the cause of unwanted tripping of 150 MVA, 220/132kV ATR-I from 220kV side on REF protection and 220 kV Biharshariff- Begusarai-II from Biharshariff end on zone 1.

PCC advised BSPTCL to submit the schematic diagram and other connectivity details of REF protection of 150 MVA, 220/132kV ATR-I.

PCC also advised to submit the softcopy of DR files of 220 kV Biharshariff- Begusarai line tripping.

BSPTCL may explain.

Deliberation in the meeting

PCC advised BSPTCL to submit the details at the earliest.

Item No D.6 Frequent Blackouts at Kanti TPS

On 7th April, 2016, total station power failure (Blackout) incident has occurred at Kanti TPS. There was some fault at 220KV Gopalganj side from Kanti TPS Switchyard and 220kV Muzaffarpur-Kanti D/C line tripped on Zone 3 before fault was cleared from Kanti TPS end. This had resulted in total power failure at Kanti TPS leading to Emergency situation with hot turbine coasting down without normal lub oil supply.

A special meeting was convened at ERPC, Kolkata on 18-04-2016 and the following decisions were taken:

a) As a temporary measure, zone 1 and zone 2 time setting of all 220kV and 132kV lines at Kanti TPS end should be changed to instantaneous and zone 3 time setting as 200ms in order to clear the downstream faults from Kanti TPS end.
b) Powergrid was advised to change the zone 3 time settings at Muzaffarpur (PG) end as per protection philosophy of ERPC.
c) NTPC and Powergrid were advised to activate the PLCC scheme for 220kV Muzaffarpur-Kanti D/C by 26th April, 2016 and give feedback in 42nd PCC Meeting.
d) On activation of PLCC system, Powergrid is to change the zone 2 time setting at Muzaffarpur (PG) end as per protection philosophy of ERPC.
e) BSPTCL was advised to check the clearance between cross arm and jumper and rectify if required.
f) BSPTCL was advised to review the protection system and relay coordination of 220kV Gopalgunj, Darbhanga and Begusarai and all 132kV feeders in around Kanti. Therefore, BSPTCL was advised to submit their relay details to Powergrid by 22nd April, 2016 for review. Powergrid was requested to study the details and give feedback in 42nd PCC Meeting scheduled to be held on 27th April, 2016.
g) It was decided that the above temporary measure will be followed, till BSPTCL protection system is full proof.
h) Further course of action will be decided in PCC Meeting for relay coordination in BSPTCL system in and around Kanti TPS.

In 42nd PCC, Kanti TPS, NTPC informed that zone settings at their end have been revised as per the recommendation. Regarding activation of PLCC scheme for 220kV Muzaffarpur-Kanti D/C line NTPC informed that cabling has been done but some parts in PLCC panels were defective and needs to be replaced.

Powergrid informed that they have not yet revised the zone 3 time setting at Muzaffarpur (PG) end.

PCC advised Powergrid to revise the zone 3 time setting at Muzaffarpur (PG) end as per protection

philosophy of ERPC at the earliest. PCC also advised Powergrid to implement the PLCC scheme for 220kV Muzaffarpur-Kanti D/C line at the earliest.

Members may update.

Deliberation in the meeting

PCC advised Powergrid and NTPC to comply and update the status.

Item No D.7 Multiple tripping of 400kV lines from Jamshedpur(PG) on 26-08-16 and 29-08-16

On 26.08.2016, 400KV Mejia Substation had taken shutdown of 400kV Jamshedpur-Mejia Line. At 9:27 Hrs, the line was switched off from Mejia end. DT was received at Jamshedpur after opening Mejia circuit from remote end. R phase tie breaker at Jamshedpur failed to open due to problem in trip coil. Flashover occurred when R phase isolator was tried to open (R Phase was idle charged from Jamshedpur end.

On 29.08.2016 at 13:38 Hrs, Direct Trip command was received at Jamshedpur in 400kV Andal Ckt-I & II. Both the lines were in charged condition from remote end. On receipt of the Direct Trip command, the Main & Tie CBs of Andal Ckt-II tripped at Jamshedpur end. For Andal Ckt-I, the tie CB got tripped, however for Main CB only R & Y Phase got tripped. The B pole of the Main CB of Andal Ckt-I at Jamshedpur did not open causing operation of LBB protection. This caused operation of the 400kV Bus Bar-I protection resulting into tripping of Main CBs of the feeders connected with Bus-I. Simultaneously DT was sent for Baripada (Both main & tie breakers got tripped), Adhunik –II (Due to not considering tie breaker status in logic) & TISCO (due to problem in wiring) circuits

In 48th PCC, Powergrid informed that R phase tie breaker at Jamshedpur failed to open due to mechanical problem. The operating mechanism of CB got rusted and jammed. The same has been replaced.

PCC decided to discuss the tripping in next PCC meeting and advised Powergrid and DVC to collect the related information and send to ERPC and ERLDC.

Powergrid and DVC may update.

Deliberation in the meeting

PCC advised Powergrid and DVC to collect the related information and send to ERPC and ERLDC.

Item No D.8 Members may update the following:

1. OPTCL may please update the latest status on following substations:

In last PCC, OPTCL informed that

- OPTCL informed that they will review the logic of all the newly installed LBB protection: Old distance protection relays in 132kV system at 220kV Tarkera S/s will be replaced after replacing old relays at 220kV level*: The replacement work of relays at Tarkera is in progress*
- In 48th PCC, OPTCL was advised to change non directional over current E/F relays in 132 KV lines at 220/132kV Tarkera S/s with directional relays.

OPTCL may update.

Deliberation in the meeting

OPTCL informed that the work is in progress.

2. Disturbance at 400/220kV Indravati (PG) and 400/220kV Indravati (OPTCL) S/s on 11-06-16 at 19:59 hrs.

In 45th PCC, OHPC, was advised the following:

- OHPC should check and restore the bus bar protection at 220 kV Indravati (OHPC) S/s.--- *OHPC informed that they will test the bus bar protection of 220 kV Indravati (OHPC) S/s on 25th Aug, 2016.*
- PCC felt that 400/220kV ICT-I&II should clear the fault on backup overcurrent protection before tripping of 400kV lines from PG end and advised OHPC to install directional O/C relays at both HV & LV side of 400/220kV ICT-I&II. Proper time coordination should be done with the adjacent line relays.

OHPC may update.

Deliberation in the meeting

PCC advised OHPC to comply.

3. Disturbance at 220/132kV Budhipadar S/s of OPTCL System on 14-07-16 at 16:33 hrs

In 46th PCC, OPTCL was advised to collect the tripping details of 132 kV Budhipadar – Lapanga –I , 132 kV Tarkera – Kalunga-Budhipadar and 132 kV Budhipadar – Rajgangpur lines at 16:51 hrs and submit a report to ERPC and ERLDC.

Time	Name	Local end	Remote end
16:51 Hrs.	132 kV Budhipadar – Lapanga - I	Did not trip	O/C, E/F at Lapanga
	132 kV Tarkera – Kalunga _ Budhipadar	Did not trip	E/F, D/P at Tarkera
	132 kV Budhipadar - Rajgangpur	Did not trip	Tripped from Rajgangpur

4. In 42nd PCC, on multiple elements tripping at 400kV Bidhannagar S/s of WBSETCL system on 30-03-16 at 16:25 hrs, PCC felt that since the fault was in common zone of the bus differential protection, the differential protection for both Bus-A & B should have operated to clear the fault immediately.

PCC advised WBSETCL to check the bus differential scheme at 400kV Bidhannagar S/s.

WBSETCL may update.

Deliberation in the meeting

PCC advised WBSETCL to comply.

5. Disturbance at 220 kV Bakreswar (WBPDCL) S/s on 19-08-16 at 13:39 hrs.

In 47th PCC, WBPDCL was advised to check the CB at Bakreswar end of 220 kV Bakreswar – Gokhorno –I line.

WBPDCL may update.

Deliberation in the meeting

WBPDCL informed that B-phase CB has been changed on 27th October, 2016.

6. Disturbance at 220/132 kV NJP System on 01.09.2016 at 09:40 hrs.

In 48th PCC, it was felt that tripping of both the 220kV NJP (POWERGRID) lines for a fault in one bus section is not in order and advised WBSETCL to review the busbar protection scheme.

PCC also advised WBSETCL to submit the enquiry committee report on malfunction of 220 kV Isolator arm driving mechanism of 220/132 kV ATR I.

WBSETCL may update.

Deliberation in the meeting

PCC advised WBSETCL to submit the report.

7. Disturbance at 400kV Khahalgaon S/s on 28-09-16 at 06:50 hrs.

In 48th PCC, NTPC and Powergrid were advised to check the Micom P442 of 400 kV Kahalgaon – Farakka – III & IV and TEED protection of 400 kV Kahalgaon – Barh – I.

Deliberation in the meeting

PCC advised NTPC and Powergrid to comply.

8. PCC recommendations to BSPTCL

In 46th PCC

- PCC advised BSPTCL to check all the distance relays at Forbisganj end and take the appropriate action to restore the protection system.
- PCC felt that BSPTCL is not getting any additional benefit for keeping two circuits connected in the Kishanganj – Forbisganj section as the Purnea-Kishanganj section is single circuit, Therefore, PCC advised BSPTCL to keep only one circuit in service for the Kishanganj – Forbisganj section. This will ease the relay zone setting problem for 132 KV Purnea (PG)-Kishanganj-Forbisganj line.
- Since there is no protection available at 132kV Kishanganj S/s, PCC advised BSPTCL and Powergrid to co-ordinate the zone settings of the line considering 132 KV Purnea (PG)-Kishanganj-Forbisganj line as a single section.

In 48th PCC

- *Take the appropriate action to eliminate short circuit between control cables and DC supply at 220KV Biharshariff S/s*
- *PCC felt that Begusarai end of 220 kV Biharshariff- Begusarai -II should clear the fault and advised BSPTCL to coordinate Begusarai end line relays. PCC felt that 400/220 kV ICTs and 220/132 kV ATR – I should not trip for a line fault and advised BSPTCL to coordinate the relays with line protection relays.*
- *PCC felt that since the distance to the fault for 220 kV Biharshariff- Begusarai line was showing half of the actual fault distance, the CT and PT ratio selected in the numerical relay may not be appropriate. PCC advised BSPTCL to verify the CT and PT ratio in the numerical relay.*
- *PCC advised BSPTCL to coordinate the over current relays of 3X100 MVA, 200/132 KV*

ATRs at GSS Madhepura and 132 KV Madhepura-Supaul D/C line relays so that the line will trip before the ATRs.

BSPTCL may update.

Deliberation in the meeting

BSPTCL informed that the work is in progress.

Item No D.9 Any other issues.

Meeting ended with vote of thanks to the chair.

****

Annexure-A

Participants in 49th PCC Meeting of ERPC

Venue: ERPC Conference Room, Kolkata Time: 11:00 hrs Date: 29.11.2016 (Tuesday)

Sl No	Name	Designation/ Organization	Contact Number	Email	Signature
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20	K. Maiti	Addl. CE, WBSETCL	9434910282	kamales858@yahoo.com	

"Coming together is a beginning, staying together is progress, and working together is success." –Henry Ford

Participants in 49th PCC Meeting of ERPC

Venue: ERPC Conference Room, Kolkata Time: 11:00 hrs Date: 29.11.2016 (Tuesday)

Sl No	Name	Designation/ Organization	Contact Number	Email	Signature
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36	Debasati Basu	PRDC	9903110743	debasati.basu@prdcinfotech.com	
37	S. K. Harichandan	OPTCL	9438907042	sk.harichandan@optcl.co.in	
38	Jitesh Ku	BSPTCL	7763817783	jiteshku1@gmail.com	
39	Devidev Choudhary	BSPTCL	7091077883	Devidev@gmail.com	
40					

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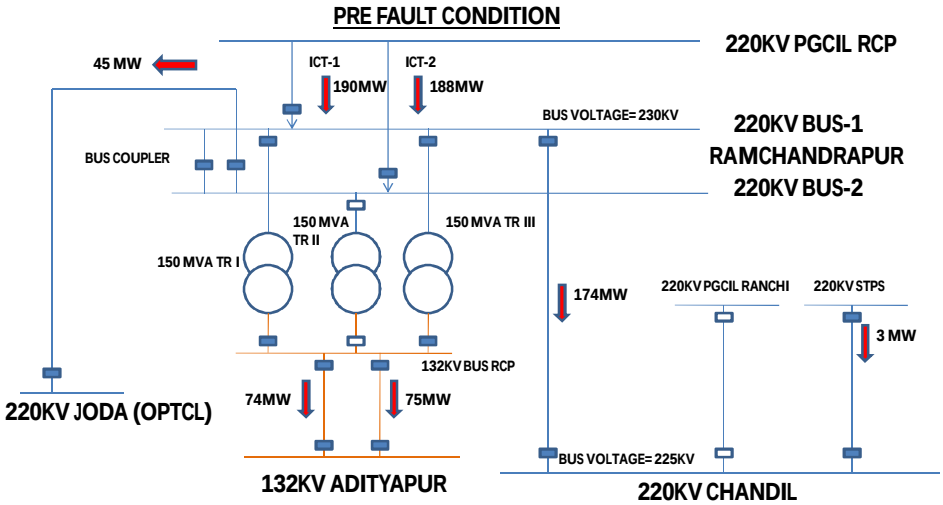
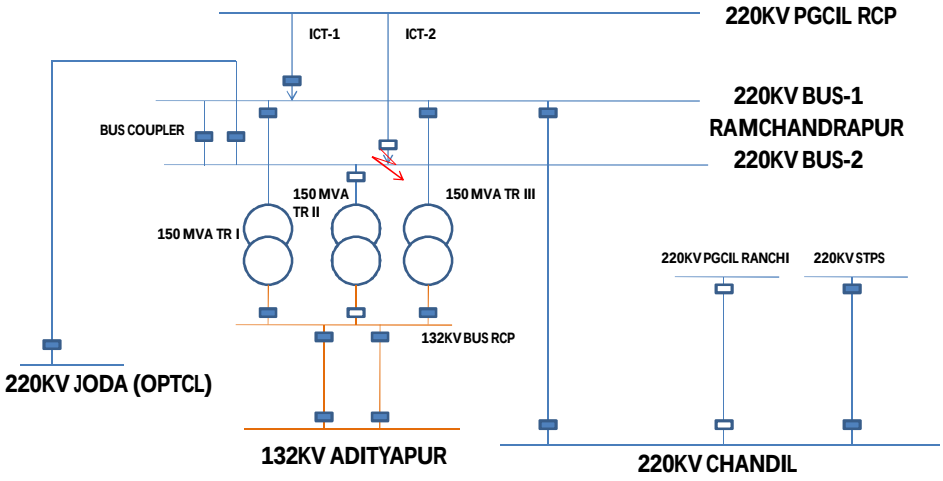
JUSNL

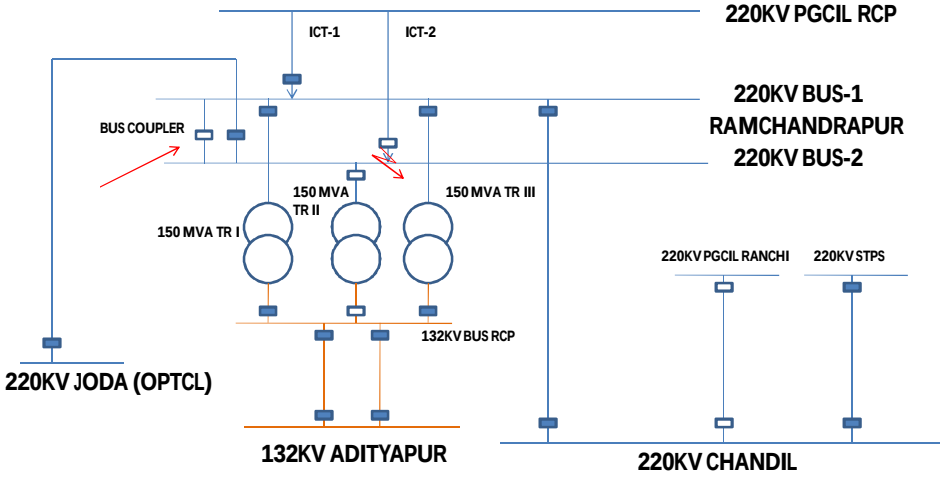
REPORTS ON DISTURBANCE AT 220KV RAMCHANDRAPUR S/S ON 22.10.2016



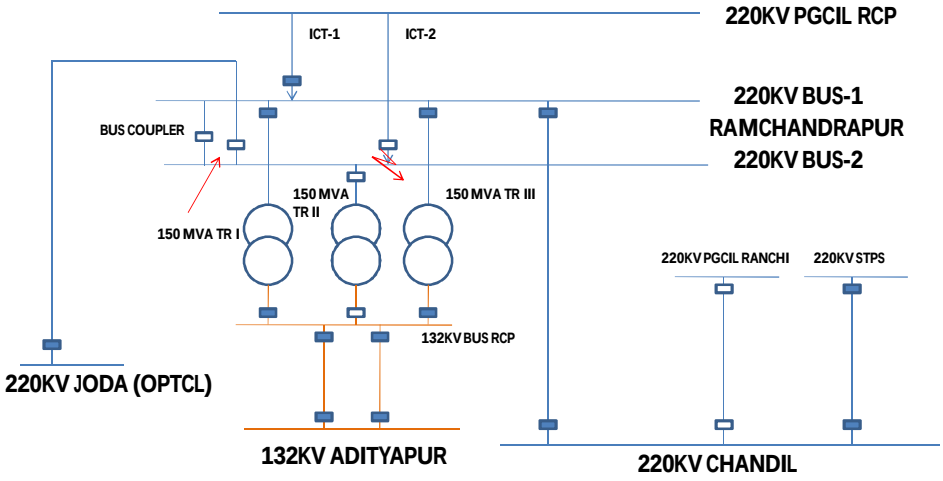
- 220KV CHANDIL- PGCIL RANCHI LINE WAS UNDER SHUTDOWN FOR MAINTENANCE
- 150 MVA TR-II WAS IN OFF CONDITION BACAUSE OF MAINTENANCE WORK



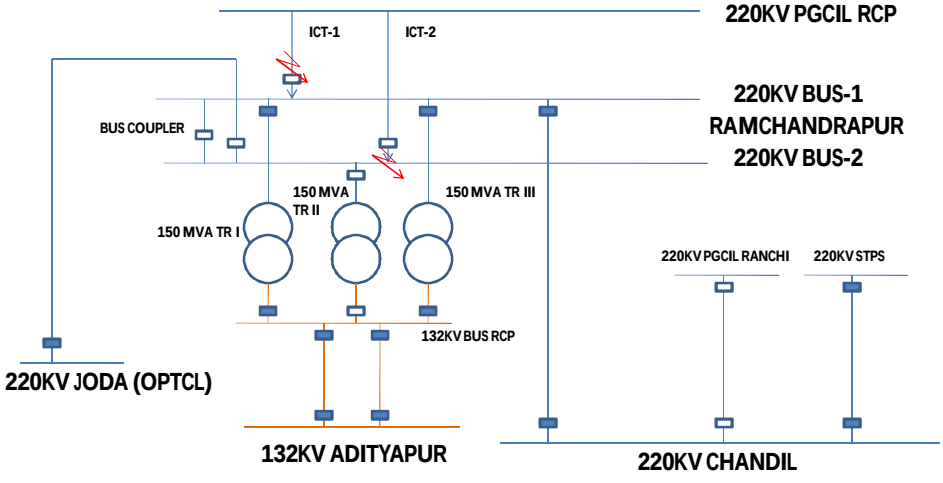
- AT 19:16 HRS ON 22-10-2016 R- PH CT BURSTED OF 400/220 KV, 315MVA ICT-II AT RAMCHANDRAPUR



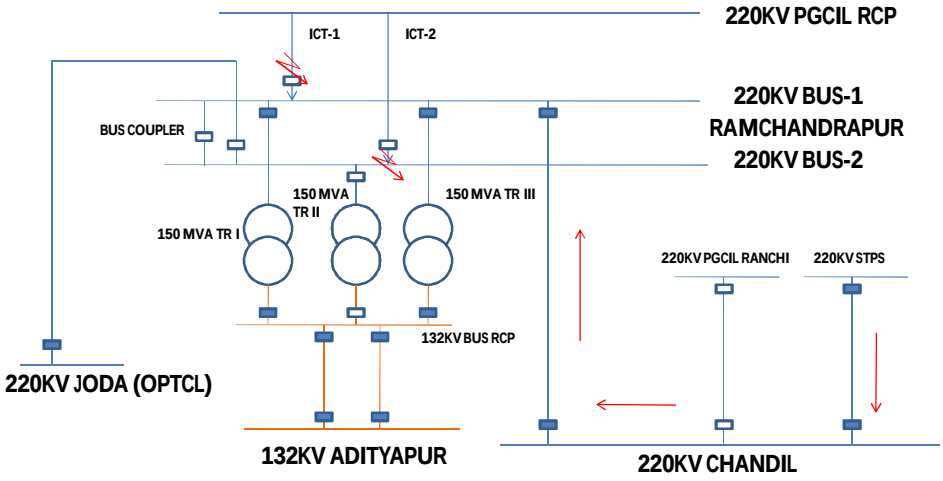
- 220KV BUS COUPLER TRIPPED ON NON DIRECTIONAL E/F & O/C RELAY & BUS DIFFERENTIAL RELAY



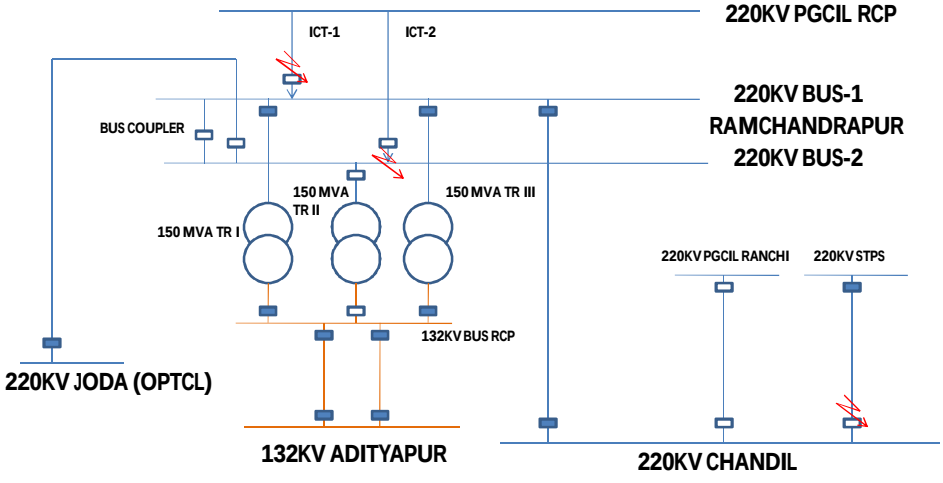
- BUS-2 GOT IMMIDIATELY SEPARATED BECAUSE OF BUS COUPLER TRIPPING & 220KV JODA LINE ALSO TRIPPED BECAUSE OF BUS DIFFERENTIAL PROTECTION



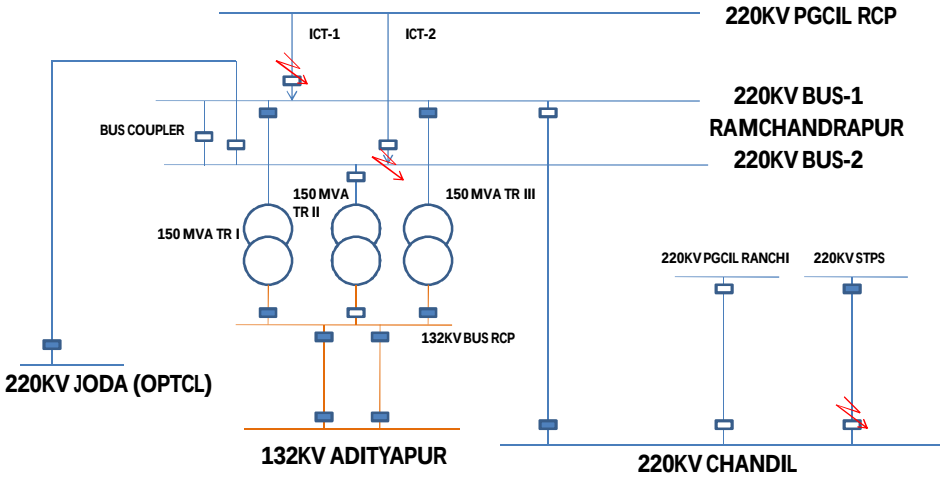
- ICT- 1 TRIPPED ON INTERTRIP WITH INDICATION OF MASTER TRIP RELAY ONLY.



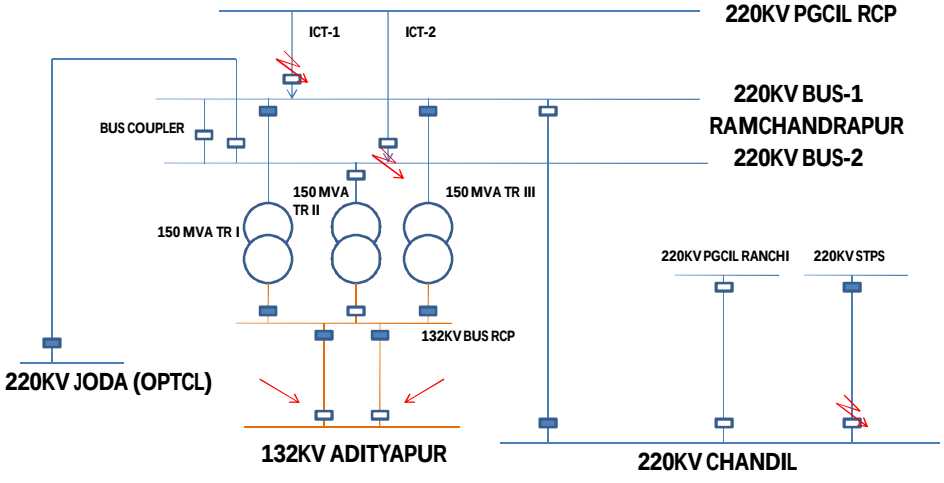
•TRIPPING OF ICT-1 CAUSED BACKFEEDING FROM STPS SIDE TO ALL OF RAMIANING LOADS OF RCP



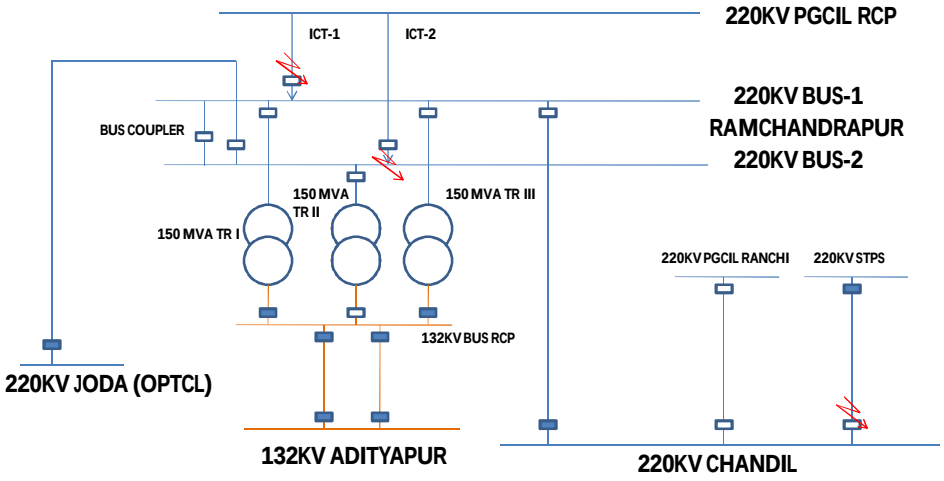
•BACKFEEDING FROM STPS LINE CAUSED THE TRIPPING OF CHANDIL- STPS LINE AT CHANDIL END ON OVERLOAD



• AFTER THE TRIPPING OF CHANDIL- STPS LINE AT CHANDIL END, CHADIL – RCP LINE WAS HANDTRIPPED AT RCP END



• FOR NORMALISING THE SYSTEM, 132KV LOADS OF ADITYAPUR 1&2 WERE HANDTRIPPED FROM ADITYAPUR END.



•THESE INCIDENCES IN TOTALITY CAUSED THE TOTAL POWER FAILURE AT 220KV RCP AND CHANDIL

Report on Disturbance at 400 KV Rourkela S/S at 16:39hrs on 28/10/16

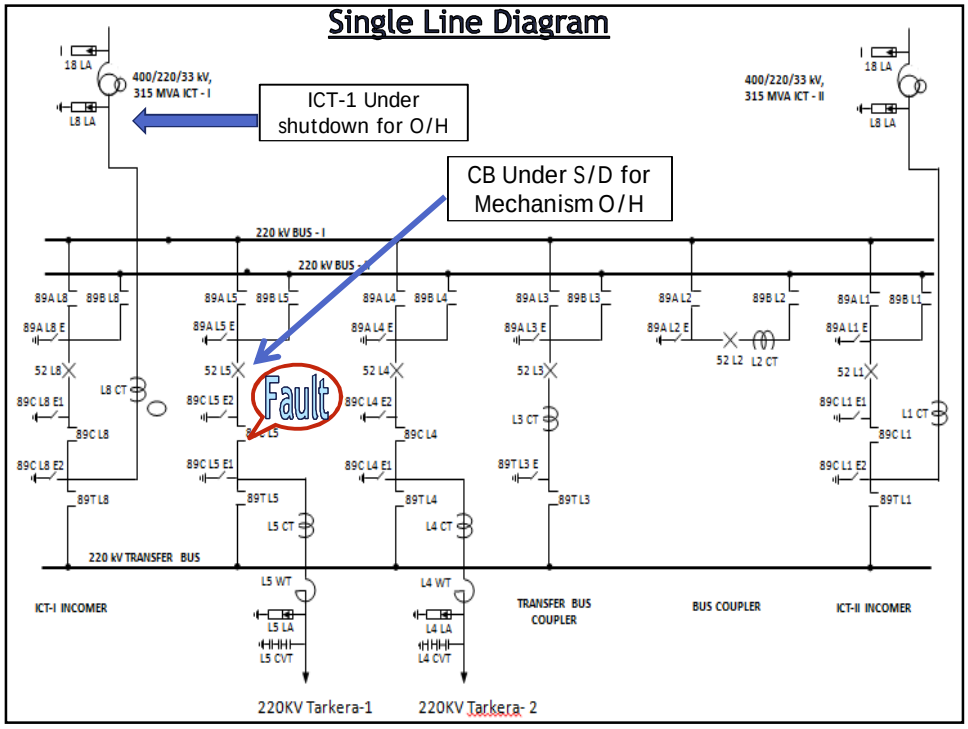
Ch Mohan Rao,
Deputy Manager,
Power Grid - Odisha Projects.

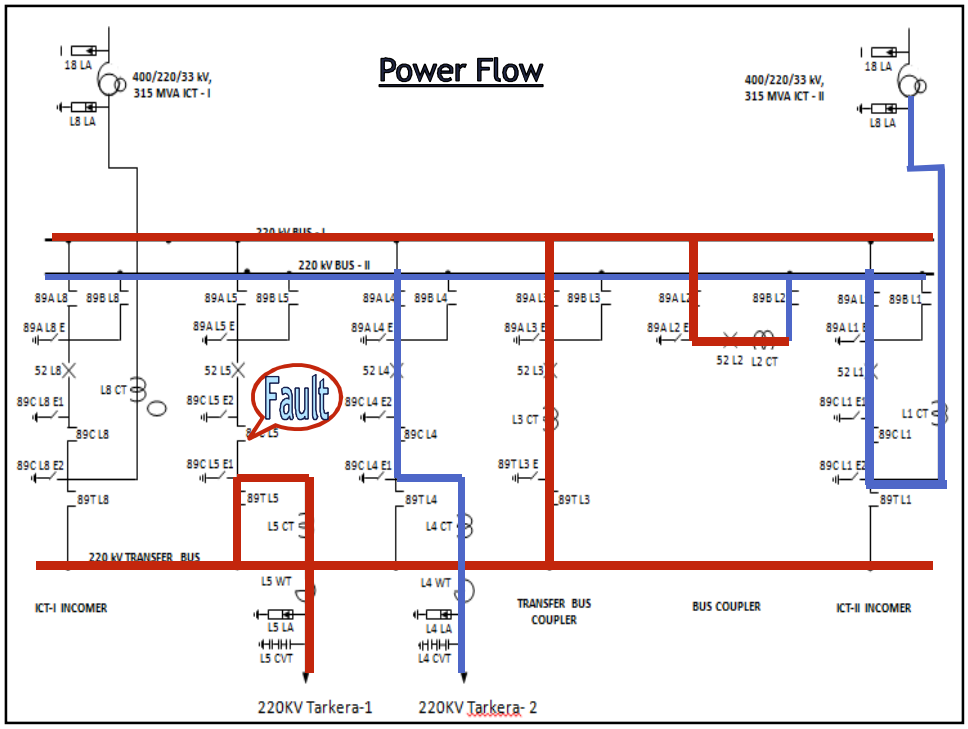
Pre-Fault conditions:

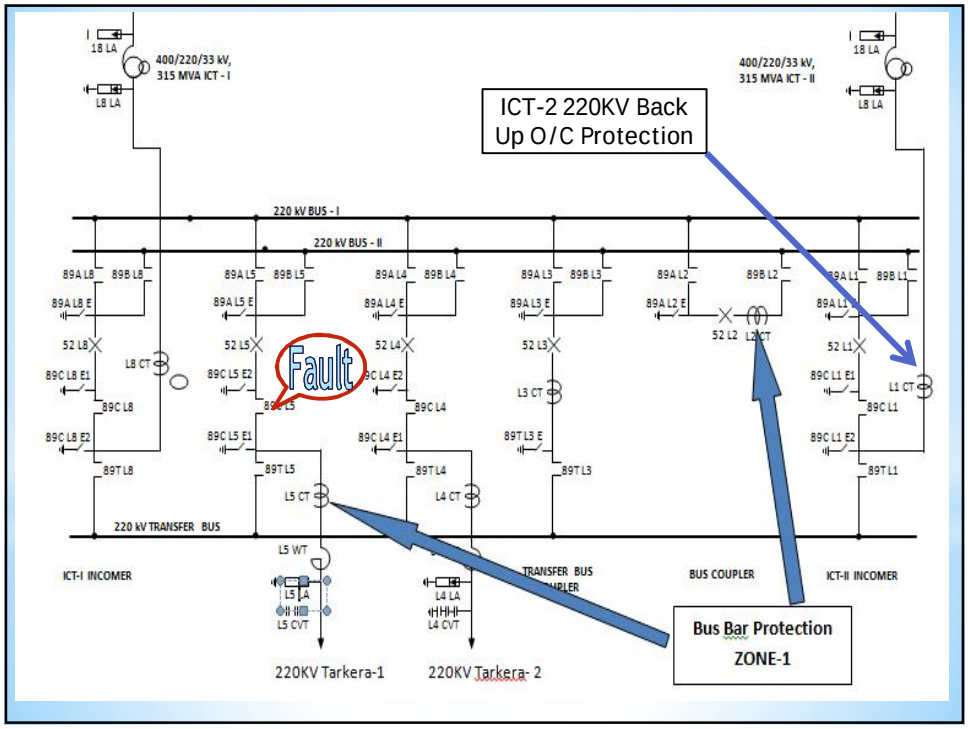
- Connectivity of lines with 220KV Buses.
- **220 KV BUS-1 connection:** 315 MVA ICT-1 , 220KV Tarkera Line-1.

Note: 315MVA ICT-1 under shutdown for O/H works & 220KV Tarkera line-1 connected to Bus-1 Through Transfer Bus CB due to mechanism Over hauling of Tarkera-1 CB .

- **220 KV BUS-1 connection:** 315 MVA ICT-2 , 220KV Tarkera Line-2.


Single Line Diagram
400/220/33 kV, 315 MVA ICT - I
400/220/33 kV, 315 MVA ICT - II
ICT-1 Under shutdown for O/H
CB Under S/D for Mechanism O/H
220 kV BUS - I
220 kV BUS - II
Fault
220 kV TRANSFER BUS
ICT-I INCOMER
TRANSFER BUS COUPLER
BUS COUPLER
ICT-II INCOMER
220KV Tarkera-1
220KV Tarkera- 2


Power Flow
400/220/33 kV, 315 MVA ICT - I
400/220/33 kV, 315 MVA ICT - II
220 kV BUS - II
Fault
220 kV TRANSFER BUS
ICT-I INCOMER
TRANSFER BUS COUPLER
BUS COUPLER
ICT-II INCOMER
220KV Tarkera-1
220KV Tarkera- 2



Sequence of operation:

1. **16:39:47 hrs 315 MVAICT-2 tripped on operation of 220KV Back up O/C & E/F protection.**
2. **At the same time, 220KV Bus-1 B/B protection operated and tripped Bus Coupler & Transfer Bus coupler.**
3. **220KV Tarkera line-1 protection sensed the fault in reverse zone but did not trip the CB due to time delay. Meantime, B/B has cleared the fault feeding by opening the TBC & BC CBs.**

Correct operation:

1. 220KV Bus-1 B/B protection should operate and trip Bus Coupler & Transfer Bus coupler.
2. 220KV Tarkera line-1 protection at Tarkera end should trip the line on Zone-2 protection after Z2 time(350ms).
3. In this case, the tarkera line-2 will be in service and fed from ICT-II.

Remedial Action:

1. Tripping of ICT is unwarranted. Later, The 220KV side Back up O/C & E/F relay was tested which is of old static type relay. It was found that the directional element of the relay found to be defective and the timing of the relay as per settings was also not correct.
2. It was planned to replace the relay with a numerical relay shortly during ICT-2 shutdown in last week of Novemebr'16.

Annexure-C1

List of important transmission lines (220 kV & above) in ER which tripped in October'16

S.NO	LINE NAME	TRIP DATE	TRIP TIME	RESTORATION DATE	RESTORATION TIME	Reason	Fault Clearance time in msec	Relay Indication LOCAL END	Relay Indication REMOTE END	Auto Recloser status	DR/EL RECEIVED FROM LOCAL END	DR/EL RECEIVED FROM REMOTE END	Remarks
Fault clearing time is violating protection standard (As per PMU data)													
1	400KV BINAGURI-BONGAIGON-III	27.10.16	11:55	27.10.16	12:07	R-N FAULT	1100 ms	TEF, IR 1.5 kA	Yet to be received	--	Yes	No	
Multiple tripping at same time													
1	220 KV RAMCHANDRAPUR - CHANDIL	07.10.16	16:20	07.10.16	17:42	B-N FAULT	<100	B-N, Z-I, 4.73 KM from RCP, F/C 13.3 KA	B-N, Z-II, F/C 3.1 kA, 32.1 km from Chandil	No autoreclose operation observed in PMU data	Yes	Yes	315 MVA 400/220 KV ICT I & II at Ramchandrapur tripped at same time due to operation of master trip relay. PCC advised PG to verify.
Fault Not observed in PMU data													
1	220KV DALKHOLA - DALKHOLA-II	01.10.16	15:12	01.10.16	15:27	SPURIOUS TRIPPING	--	SPURIOUS BROKEN CONDUCTOR INDICATION AT PG END	Yet to be received	--	No	No	Pg informed that broken conductor kept in alarm
2	400 KV RANCHI--SIPAT-II	03.10.16	13:03	03.10.16	15:13	DT RECEIVED AT BOTH END	--	DT received	DT received	--	No	Yes	First DT received at Sipat end and three phase breakers opened & then o/v occurred at Sipat end and DT was sent to Ranchi end
3	400KV BARH -GORAKHPUR-I	06.10.16	18:11	06.10.16	20:07	DT RECEIVED AT BARH	--	DT Received	Yet to be received	--	No	No	
4	400KV RANCHI - SIPAT-II	07.10.16	13:09	07.10.16	14:15	DT RECEIVED AT SIPAT END	--	Did not trip	DT received	--	--	Yes	
5	400KV BIHARSHARIFF-VARANASI-I	17.10.16	10:16	17.10.16	10:30	DT RECEIVED AT VARANASI	--	Did not trip	DT received	--	--	Yes	Line tripped from Varanasi end only on DT receipt. PLCC problem.
6	765KV NEW RANCHI - DHARAMJAYGARH-I	26.10.16	20:08	26.10.16	20:54	DT RECEIVED AT N.RACHI	--	DT Received	O/V	--	Yes	No	
No autorecloser operation observed in PMU data													
1	400KV BAKRESWAR-JEERAT	26.10.16	13:04	26.10.16	13:23	B-N FAULT	<100	Y-N, Z-I	Pole discrepency	No autoreclose operation observed in PMU data	No	No	Main-I PXLS will be reconfigured.
2	400KV KOLAGHAT-KHARAGPUR	28.10.16	11:27	28.10.16	11:46	B-N FAULT	<100	B-N, Z-I, IB = 3.722 kA, 73.19 km from KTPP, A/R successful from KTPP end	B-N, Z-I, 5.95 kA, 17.27 km from KGP, A/R not operated	No autoreclose operation observed in PMU data	Yes	Yes	A/R successful from KTPP end. PLCC problem.

REPORT FOR 220 KV Chandil, Ramchandrapur and 132 KV ADITYAPUR GSS

1. **STATUS OF IMPLEMENTATION OF RECOMMENDED SETTINGS FOR LINES AND ICT AT 220 KV CHANDIL, RAMCHANDRAPUR & 132 KV ADITYAPUR SUBSTTATIONS.**

   Recommended settings given by ERPC are already been implemented for all the lines and ICT's 220 KV Chandil, Ramchandrapur and 132 KV Adityapur GSS's. this has been intimated to ERPC by the mail dated 05.10.2016 (mail copy attached), for which we have even received thanking mail back from the ERPC.

2. **BEHAVIOUR OF PROTECTION SYSTEM POST RECOPMMENDATION PERIOD.**
   After the implementation of the recommended settings given by ERPC, we have noticed a genuine improvement in the stability of the system of the system with the decrease in the unwanted tripping also.

3. **STATUS OF OVERALL IMPLEMENTATION OF RECOMMENDTIONS OF THE PROTECTION TEAM.**
   The status of the overall implementation of recommendations of the protection team are as follows.

Point No. 1- The requirement of Control Panels having Main-1 And Main-2 Distance Protection Scheme are already been forwarded to Transmission O & M, JUSNL, Ranchi for its procurement. It will be implemented after the availability of the panels.

Point No.2- For having Distance Protection Relay and Back up OC/EF Protection Relay feature in single panel needs new Panels for which LOI has already has been issued by Transmission O & M JUSNL, Ranchi. It will be commissioned after its availability.

Point No.3- For enabling these features, settings have already been uploaded to the various relay as per ERPC philosophy.

Point No. 4- Single Phase Auto Reclosing features of 220 KV Ramchandrapur-Chandil Line, 220 KV Chandil -PGCIL Line are already in operation, however for 220 KV Chandil-STPS Line and 220 KV Ramchandrapur- Joda Line, arrangements are completed form our side and we are waiting for it completion report form the other side.

Point No.5- Requirement of New Panels are already been sent to Nigam Headquarters, LOI has already been issued by CE, O & M, Transmission, Ranchi. It will be commissioned after its availability.

Point No. 6- GPS System in 220 KV Ramchandrapur and 220 KV Chandil are already been commissioned.

Point No. 7- At 220 KV Ramchandrapur S/S, Bus Bar Protection is already working properly. In 220 KV Chandil S/S, there is no provision for the second Bus, so Bus Bar Protection is not seems to be possible. However LBB are commissioned in all feeder and an order has already been placed to Alstom T&D for the connection and configuration of LBB and it will be complete after their arrival.

Point No. 8- Tender for procurement of DC Earth Fault location for locating DC earth fault has already been floated, it will be procured shortly.

Point No. 9- Panel Indications are working in all feeders.

Point No.10- All the Pre and post Close Circuit supervision for Trip Coil-I and Trip Coil-2 are healthy

Point No. 11- Annunciation Circuitry for all trip and not trip functions are working as per schematic.

Point No. 12- Old CTJB, PTJB are replaced with new JB's and even the terminations of the cables are also completed in both the sub stations.

Point No.13- Most of the Panel diagrams are available at all the sub stations.

Point No.14- Old Panels are soon to be replaced with the new ones, so no need of removal of redundant relay.

Point No.15- Some 220 KV CT's having old and abnormal Tan Delta characteristics along with 220 KV ICT-I at 220 KV RCP Breakers are being replaced and work order are already been issued for the same.

Point No.16- Earth Resistance of Sub Stations are measured at regular intervals and most of them are under the limit.

Point No.17- Two sources of DC are available at 220 KV Ramchandrapur S/s and working properly. At 220 KV Chandil, other set of Battery has already been supplied and will be commissioned very soon after the arrival of its charger.

Point No.18- Earth wire/OPGW is available in all 220 KV and 132 KV Transmission Lines This is for your kind information and needful action.

REPORT OF 132 KV HATIA-1 and 220 KV Hatia-2 Grid Sub Stations

1. Recommended setting for lines and ICTs at 220 KV Hatia-II and 132 KV Hatia-I has been implemented by CRITL, Ranchi.
2. Till date behaviour of protection system has been found satisfactory.
3. Status and roadmap for implementation of recommendation of protection team are as follows:-

Sl. No.	Recommendation	Status
(i)	Take suitable measure for detection and rectification of the DC earth fault.	Complied
(ii)	To carry out relay coordination as per the revised protection philosophy of ERPC.	Complied as per recommendation settings provided by ERPC.
(iii)	To complete the DPR for PSDF funding towards improvement/development of JUSNL protection system at the earliest.	Tender has been floated by HQ. for appointment of consultant.
(iv)	As per PART 3 of CEA (Technical Standards for connectivity of The Grid) Regulation, 2007, wherein it is clearly mentioned that 220 KV Transmission lines have both Main 1 and Main 2 Distance Protection Schemes applicable for New Sub-Stations and for the Old Sub-Stations, it should be implemented in a reasonable time frame. The Same should be implemented.	Complied
(v)	One Number Numerical Distance Protection Relay has been used for 132 KV Feeders. One Numerical Distance Protection Relay and another Back-up O/C and E/F protection relay (Two Separate units) should be used.	Complied at 220/132 KV GSS Hatia-II. For 132/33 KV GSS, procurement is under process at HQ. Level.
(vi)	In order to provide protection in case of high resistive fault, earth fault protection may be used where Main 1 and Main 2 protection is suggested i.e. for 220 KV Transmission lines. The characteristics should be IDMT (Normal Inverse). The ground over current threshold should be set to ensure detection of all ground faults, but above any continuous residual current under normal system operation. The timing should be coordinated with the Zone-3 timing for a remote end bus fault.	Complied
(vii)	Availability of carrier protection ad single phase Auto-reclose for all 220 KV and above transmission lines.	Complied
(viii)	Replacement of Electromechanical Relays with Numerical Relays, wherever applicable for Transmission lines and transformers.	Complied at 220 KV & 132 KV Line. For 33 KV, Procurement of Numerical Relays is under processed.

(ix)	Connectivity of GPS clock in every Sub-Station with Time synchronisation facility to the Numerical Relays.	Implemented at 220/132 KV GSS Hatia-II. Rest are under process. Completed by 31-01-17
(x)	As per PART 3 of CEA (Technical Standards for connectivity of The Grid) Regulation, 2007, wherein it is clearly mentioned that Bus bar protection shall be [provided on all Sub-Stations at and above 220 KV leaves for all new Sub-Stations. For existing Sub-Stations, this shall be implemented in a reasonable time frame. (i) Local Breaker Back-up (LBB) protection shall be provided for all Sub-Stations of 220 KV and above.	Complied
(xi)	All panel indications wherever applicable for Isolators, Breakers, Circuit Breaker Spring Charge, Trip Circuit Healthy or any other indications as per the scheme should be made healthy.	Complied
(xii)	Pre and Post Close Trip circuit supervision for trip coil 1 (TC#1) and trip coil 2 (TC#2) should be made healthy wherever applicable.	Complied
(xiii)	Annunciation circuitry should be made proper for all trip and non-trip functions as per the schematic.	Complied
(xiv)	CTJB, PTJB should be changed wherever applicable and terminations of the cables should be completed with proper specification of Terminal Blocks and LUGS. The CTJB and PTJB should be earthed through earthing strips.	Procurement of JB for Hatia-I & Namkum is under process. Completed by 31-03-17.
(xv)	All relevant drawings required during trouble shooting should be made available in each of the control rooms of every sub-stations. (i) Update Drawings related to protection and Control Panel of individual bays, CT's PT's, Circuit breakers, Isolators, Transformers etc. are to be made available at sub-station level. (ii) LOGICS and configuration of the Numerical Relays should be made proper with the availability of relevant protection as per CEA guidelines and the same should be made available at the sub-Station level.	Available
(xvi)	Redundant relays which are not in use should be removed from the protection panels and the Numerical Relays and Auxiliaries installed should be newly wired as per the approved scheme.	Under Process. Completed by 31-01-2017.
(xvii)	220 KV and 132 KV CT's should be tasted for characteristics and proper core should be used for proper protection purpose, i.e. PS for Differential, 5P for Distance/Backup protection, 0.2/0.5 for metering purpose. Kindly note that for booth 220 KV and 132 KV CT protection schemes, separate cores should be used for separate protection purpose.	Complied
(xviii)	Earth resistance of sub-station should be measures at regular intervals and the value should be less than 1 ohms. The result should be marked in the sub-station earth pit with the date of	Complied

	testing.	
(xix)	Two source of D.C may be provided to control and relay panels for 220 KV and above system for security and redundancy. Accordingly the Bus wire of the panel is to be segregated and scheme developed accordingly.	Complied
(xx)	Meticulous Patrolling of 220 KV and 132 KV Transmission Lines along with availability of earth wires should be ensured to reduce transient faults. (i) Individual Tower Earthing should also be ensured to provide earth paths to lighting strikes through the shortest path. (ii) Regular Conditioning monitoring of sub-station equipment (Transformer, CT, CVT, PT, LA, CB, etc.) may be done as per CEA recommendation and proper record may be maintained (iii) The types of taste on the sub-station equipments along with the technology used with its duration is provided and the same should be meticulously followed for all 220 KV and 132 KV Sub-Station.	Complied

Annexure-C6

SL No	Zone-2 timer setting at	For line	No of circuits	Length (km)	Zone-2 Reach in %	Zone-2 reach of protected line length (km)	Shortest line at remote end	Length (km)	Considering Ideal Zone-1 reach i.e Upto 80%			Considering Zone-1 under reaches by 30% i.e. Zone -1 reach is only upto 50% (as per ERPC/CEA philosophy)		
									Zone-2 reach (Beyound 80% upto 120/150%) of the shortest line Starts at (km)	Zone -2 Overlap ?	Zone-2 Time setting	Zone-2 reach (Beyound 50% upto 120/150%) of the shortest line Starts at (km)	Zone -2 Overlap ?	Zone-2 Time setting
1	Muzaffarpur	Gorakhpur	D/C	261	150%	392	Gorakhpur-Gorakhpur-UP D/C	46	37	Y	0.5 to 0.6	23	Y	0.5 to 0.6
		Biharshariff	D/C	133	150%	200	Biharsariff Lakhisarai D/C	89	71	N	0.35	45	Y	0.5 to 0.6
		Purnea	D/C	242	150%	363	Purnea-Kishanganj D/C	71	57	Y	0.5 to 0.6	36	Y	0.5 to 0.6
2	Purnea	Muzzafarpur	D/C	242	150%	363	Muzzafarpur-Biharsariff D/C	133	107	Y	0.5 to 0.6	67	Y	0.5 to 0.6
		Kishanganj	D/C	71	150%	107	Kishangaj-Purnea other ckt	71	57	N	0.35	36	N	0.35
		Biharsariff	D/C	231	150%	347	Biharsaiff-Lakhisarai D/C	89	71	Y	0.5 to 0.6	45	Y	0.5 to 0.6
		Malda	D/C	167	150%	251	Malda-Farraka D/C	40	32	Y	0.5 to 0.6	20	Y	0.5 to 0.6
		Binaguri	D/C	168	150%	252	Binaguri-Kishanhanj D/C	98	78	Y	0.5 to 0.6	49	Y	0.5 to 0.6
3	Kishanganj	Purnea	D/C	71	150%	107	Purnea Kishangaj other ckt	71	57	N	0.35	36	N	0.35
		Patna	D/C	348	150%	521	Patna-Barh D/C	69	55	Y	0.5 to 0.6	34	Y	0.5 to 0.6
		Binaguri	D/C	98	150%	147	Binaguri-Kishanhanj other ckt	98	78	N	0.35	49	N	0.35
4	Barh	Patna	D/C	93	150%	140	Patna-Barh D/C	69	55	N	0.35	34	Y	0.5 to 0.6
		Patna	D/C	69	150%	103	Patna-Barh other ckt	69	55	N	0.35	34	N	0.35
		Gorakhpur	D/C	349	150%	524	Gorakhpur-Gorakhpur-UP D/C	46	37	Y	0.5 to 0.6	23	Y	0.5 to 0.6
		Kahalgaon	D/C	217	150%	326	Khalgaon-BankaD/C	48	38	Y	0.5 to 0.6	24	Y	0.5 to 0.6
5	Patna	Kishanganj	D/C	348	150%	521	Kishangaj-Purnea D/C	71	57	Y	0.5 to 0.6	36	Y	0.5 to 0.6
		Barh	D/C	93	150%	140	Barh-Patna D/C	69	55	N	0.35	34	Y	0.5 to 0.6
		Barh	D/C	69	150%	103	Barh-Patna other ckt	69	55	N	0.35	34	N	0.35
		Balia	D/C	185	150%	278	Balia-Mau D/C	9	7	Y	0.5 to 0.6	5	Y	0.5 to 0.6
		Balia	D/C	195	150%	293	Balia-Mau D/C	9	7	Y	0.5 to 0.6	5	Y	0.5 to 0.6
6	Sasaram	Biharsariff	D/C	210	150%	315	Biharsaiff-Lakhisarai D/C	89	71	Y	0.5 to 0.6	45	Y	0.5 to 0.6
		Nabinagar	D/C	82	150%	123	Sasaram-Nabinagar D/C	82	66	N	0.35	41	N	0.35
		Varanasi	S/C	143	120%	172	Varansi-Saranathi S/C	70	56	N	0.35	35	N	0.35
		Allahabad	S/C	212	120%	254	Allahabad-Varanasi S/C	98	78	N	0.35	49	N	0.35
7	Gaya	Maithon	D/C	276	150%	414	Maithon-MPL D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
		Chandwa	D/C	117	150%	176	Chandwa-N.Ranchi D/C	68	54	Y	0.5 to 0.6	34	Y	0.5 to 0.6
		Koderma	D/C	125	150%	188	Koderma-Bokaro D/C	100	80	N	0.35	50	Y	0.5 to 0.6
8	Biharsariff	Muzzafarpur	D/C	133	150%	200	Muzzafarpur-Biharsariff D/C	133	107	N	0.35	67	N	0.35
		Purnea	D/C	231	150%	347	Purnea Kishangaj D/C	71	57	Y	0.5 to 0.6	36	Y	0.5 to 0.6
		Sasaram	D/C	210	150%	315	Sasaram-Nabinagar D/C	82	65	Y	0.5 to 0.6	41	Y	0.5 to 0.6
		Lakhisari	D/C	89	150%	134	Lakhisarai-Biharsaiff Other ckt	89	71	N	0.35	45	N	0.35
		Banka	D/C	185	150%	277	Banka-Khalgaon D/C	48	38	Y	0.5 to 0.6	24	Y	0.5 to 0.6
		Koderma	D/C	111	150%	166	Koderma-Bokaro D/C	100	80	N	0.35	50	Y	0.5 to 0.6
		Balia	D/C	241	150%	362	Balia-Mau D/C	9	7	Y	0.5 to 0.6	5	Y	0.5 to 0.6
9	Lakhisari	Biharsariff	D/C	89	150%	134	Biharsaiff-Lakhisarai D/C	89	71	N	0.35	45	N	0.35
		Kahalgaon	D/C	145	150%	218	Khalgaon-BankaD/C	48	38	Y	0.5 to 0.6	24	Y	0.5 to 0.6
10	Banka	Biharsariff	D/C	185	150%	277	Biharsaiff-Lakhisarai D/C	89	71	Y	0.5 to 0.6	45	Y	0.5 to 0.6
		Kahalgaon	D/C	48	150%	72	Khalgaon-BankaD/C	48	38	N	0.35	24	N	0.35
		Lakhisari	D/C	145	150%	218	Lakhisarai-Biharsaiff D/C	89	71	Y	0.5 to 0.6	45	Y	0.5 to 0.6
		Banka	D/C	48	150%	72	Banka-Khalgaon Other ckt	48	38	N	0.35	24	N	0.35

11	Kahalgaon	Farraka	D/C	95	150%	143	Farraka -Malda D/C	40	32	Y	0.5 to 0.6	20	Y	0.5 to 0.6
		Farraka	D/C	95	150%	143	Farraka -Malda D/C	40	32	Y	0.5 to 0.6	20	Y	0.5 to 0.6
		Maithon	D/C	172	150%	258	Maithon-MPL D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
12	Farraka	Kahalgaon	D/C	95	150%	143	Khalgaon-BankaD/C	48	38	Y	0.5 to 0.6	24	Y	0.5 to 0.6
		Kahalgaon	D/C	95	150%	143	Khalgaon-BankaD/C	48	38	Y	0.5 to 0.6	24	Y	0.5 to 0.6
		Malda	D/C	40	150%	60	Malda-Farraka D/C	40	32	N	0.35	20	N	0.35
		Bahrampur	S/C	71	120%	85	Bahrampur-Sagardighi D/C	26	21	N	0.35	13	Y	0.5 to 0.6
		Sagardighi	S/C	72	120%	86	Sagardighi-Bahrampur D/C	26	21	N	0.35	13	Y	0.5 to 0.6
		Durgapur	D/C	146	150%	219	Durgapur-Bidhannagar D/C	11	9	Y	0.5 to 0.6	6	Y	0.5 to 0.6
13	Malda	Purnea	D/C	167	150%	251	Purnea Kishangaj D/C	71	57	Y	0.5 to 0.6	36	Y	0.5 to 0.6
		Farraka	D/C	40	150%	60	Farraka -Malda D/C	40	32	N	0.35	20	N	0.35
14	Binaguri	Purnea	D/C	168	150%	252	Purnea Kishangaj D/C	71	57	Y	0.5 to 0.6	36	Y	0.5 to 0.6
		Kishanganj	D/C	98	150%	147	Kishangaj-Purnea D/C	71	57	N	0.35	36	Y	0.5 to 0.6
		Rangpo	D/C	12	150%	18	Rangpo-Binaguri D/C	12	9	N	0.35	6	N	0.35
		Bongaigaon	D/C	218	150%	327	Bongaigaon-BTPS D/C	3.12	2	Y	0.5 to 0.6	2	Y	0.5 to 0.6
		Bongaigaon	D/C	221	150%	332	Bongaigaon-BTPS D/C	3.12	2	Y	0.5 to 0.6	2	Y	0.5 to 0.6
		Tala	D/C	145	150%	218	Tala -Malbase S/C	24	19	Y	0.5 to 0.6	12	Y	0.5 to 0.6
		Tala	S/C	140	120%	168	Tala -Malbase S/C	24	19	Y	0.5 to 0.6	12	Y	0.5 to 0.6
		Malbase	S/C	125	120%	150	Malbase -Tala S/C	24	19	Y	0.5 to 0.6	12	Y	0.5 to 0.6
15	Bahrampur	Farraka	S/C	71	120%	85	Farraka -Malda D/C	40	32	N	0.35	20	N	0.35
		Sagardighi	D/C	26	150%	39	Sagardighi-Bahrampur D/C	26	21	N	0.35	13	N	0.35
		Jeerat	S/C	165	120%	198	Jeerat-Subhasgram S/C	63	50	N	0.35	32	Y	0.5 to 0.6
		Bheramara	D/C	100	150%	150	Bheremara-Bahrampur other ckt	100	80	N	0.35	50	N	0.35
16	Sagardighi	Farraka	S/C	72	120%	86	Farraka -Malda D/C	40	32	N	0.35	20	N	0.35
		Bahrampur	D/C	26	150%	39	Bahrampur-Sagardighi D/C	26	21	N	0.35	13	N	0.35
		Durgapur	D/C	128	150%	192	Durgapur-Bidhannagar D/C	11	9	Y	0.5 to 0.6	6	Y	0.5 to 0.6
		Subhasgram	S/C	246	120%	295	Subhasgram-Jeerat S/C	63	50	N	0.35	32	Y	0.5 to 0.6
17	Durgapur	Farraka	D/C	146	150%	219	Farraka -Malda D/C	40	32	Y	0.5 to 0.6	20	Y	0.5 to 0.6
		Sagardighi	D/C	128	150%	192	Sagardighi-Bahrampur D/C	26	21	Y	0.5 to 0.6	13	Y	0.5 to 0.6
		Bidhannagar	D/C	11	150%	17	Bidhannagar-Durgapur D/C	11	9	N	0.35	6	N	0.35
		Jamsedpur	S/C	177	120%	212	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
		Maithon	D/C	71	150%	106	Maithon-MPL D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
18	Bidhannagar	Durgapur	D/C	11	150%	17	Durgapur-Bidhannagar D/C	11	9	N	0.35	6	N	0.35
		PPSP	D/C	185	150%	278	PPSP-Bidhannagar D/C	185	148	N	0.35	93	N	0.35
		Arambagh	S/C	114	120%	137	Arambag-Kolaghat S/C	64	51	N	0.35	32	N	0.35
19	PPSP	Bidhannagar	D/C	185	150%	278	Bidhannagar-Durgapur D/C	11	9	Y	0.5 to 0.6	6	Y	0.5 to 0.6
		Arambagh	D/C	210	150%	315	Arambag-Kolaghat S/C	64	51	Y	0.5 to 0.6	32	Y	0.5 to 0.6
20	Arambagh	Bidhannagar	S/C	114	120%	137	Bidhannagar-Durgapur D/C	11	9	Y	0.5 to 0.6	6	Y	0.5 to 0.6
		PPSP	D/C	210	150%	315	PPSP-Bidhannagar D/C	185	148	N	0.35	93	Y	0.5 to 0.6
		Bakreswar TPS	S/C	130	120%	156	Arambag-Bakreswar S/C	130	104	N	0.35	65	N	0.35
		Kolaghat TPS	S/C	64	120%	77	Kolaghat-Arambagh S/C	64	51	N	0.35	32	N	0.35
21	Bakreswar TPS	Arambagh	S/C	130	120%	156	Arambag-Kolaghat S/C	64	51	N	0.35	32	N	0.35
		Jeerat	S/C	162	120%	194	Jeerat-Subhasgram S/C	63	50	N	0.35	32	Y	0.5 to 0.6
22	Jeerat	Bahrampur	S/C	165	120%	198	Bahrampur-Sagardighi D/C	26	21	Y	0.5 to 0.6	13	Y	0.5 to 0.6
		Bakreswar TPS	S/C	162	120%	194	Arambag-Bakreswar S/C	130	104	N	0.35	65	N	0.35
		Subhasgram	S/C	63	120%	76	Subhasgram-Jeerat S/C	63	50	N	0.35	32	N	0.35
		Kolaghat TPS	S/C	134	120%	161	Kolaghat-Arambagh S/C	64	51	N	0.35	32	N	0.35
23	Subhasgram	Sagardighi	S/C	246	120%	295	Sagardighi-Bahrampur D/C	26	21	Y	0.5 to 0.6	13	Y	0.5 to 0.6
		Jeerat	S/C	63	120%	76	Jeerat-Subhasgram S/C	63	50	N	0.35	32	N	0.35
		Haldia TPS	D/C	90	150%	135	Haldia-Subhasrgram other ckt	90	72	N	0.35	45	N	0.35
24	Kolaghat TPS	Arambagh	S/C	64	120%	77	Arambag-Kolaghat S/C	64	51	N	0.35	32	N	0.35
		Jeerat	S/C	134	120%	161	Jeerat-Subhasgram S/C	63	50	N	0.35	32	N	0.35

24	Kolaghat TPS	Kharagpur	S/C	98	120%	118	Kharagpur-Baripada S/C	98	78	N	0.35	49	N	0.35
		Chaibasa	S/C	240	120%	288	Chaibasa-Jamsedpur S/C	46	37	Y	0.5 to 0.6	23	Y	0.5 to 0.6
25	Kharagpur	Kolaghat TPS	S/C	98	120%	118	Kolaghat-Arambagh S/C	64	51	N	0.35	32	N	0.35
		Baripada	S/C	98	120%	118	Baripada-Kharagpur S/C	98	78	N	0.35	49	N	0.35
		Chaibasa	S/C	161	120%	193	Chaibasa-Jamsedpur S/C	46	37	N	0.35	23	Y	0.5 to 0.6
26	Baripada	Kharagpur	S/C	98	120%	118	Kharagpur-Baripada S/C	98	78	N	0.35	49	N	0.35
		N. Duburi	S/C	190	120%	228	N. Duburi-Meeramandali D/C	90	72	N	0.35	45	N	0.35
		Pandiabilli	S/C	302	120%	362	Pandiabilli-Mendasal D/C	28	22	Y	0.5 to 0.6	14	Y	0.5 to 0.6
		Keonjhar	S/C	156	120%	187	Keonjhar-Rengali S/C	100	80	N	0.35	50	N	0.35
		Jamsedpur	S/C	108	120%	130	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
		TISCO	S/C	140	120%	168	TISCO-Baripada S/C	33	26	Y	0.5 to 0.6	16	Y	0.5 to 0.6
27	N. Duburi	Baripada	S/C	190	120%	228	Baripada-Kharagpur S/C	98	78	N	0.35	49	N	0.35
		Pandiabilli	S/C	143	120%	172	Pandiabilli-Mendasal D/C	28	22	Y	0.5 to 0.6	14	Y	0.5 to 0.6
		Meramandali	D/C	90	150%	135	Meramandali-GMR S/C	8	6	Y	0.5 to 0.6	4	Y	0.5 to 0.6
28	Pandiabilli	Baripada	S/C	302	120%	362	Baripada-Kharagpur S/C	98	78	N	0.35	49	Y	0.5 to 0.6
		N. Duburi	S/C	143	120%	172	N. Duburi-Meeramandali D/C	90	72	N	0.35	45	N	0.35
		Mendasal	D/C	28	150%	42	Mendasal Pandiabilli D/C	28	22	N	0.35	14	N	0.35
29	Mendasal	Pandiabilli	D/C	28	150%	42	Pandiabilli-Mendasal D/C	28	22	N	0.35	14	N	0.35
		Meramandali	S/C	98	120%	118	Meramandali-GMR S/C	8	6	Y	0.5 to 0.6	4	Y	0.5 to 0.6
30	Meramandali	Mendasal	S/C	98	120%	118	Mendasal Pandiabilli D/C	28	22	N	0.35	14	Y	0.5 to 0.6
		Angul	S/C	25	120%	30	Angul-Mermandali S/C	19	15	N	0.35	9	N	0.35
		Angul	S/C	19	120%	22	Angul-Mermandali S/C	19	15	N	0.35	9	N	0.35
		TSTPS	S/C	51	120%	61	TSTPS-Rengali D/C	24	19	N	0.35	12	N	0.35
		JSPL	D/C	38	150%	57	JSPL-Meramandali Other ckt	38	30	N	0.35	19	N	0.35
		GMR	S/C	8	120%	10		999	799	N	0.35	500	N	0.35
		SEL	D/C	220	150%	330	SEL-Meramandali Other ckt	220	176	N	0.35	110	N	0.35
31	Angul	Meramandali	S/C	25	120%	30	Meramandali-GMR S/C	8	6	N	0.35	4	Y	0.5 to 0.6
		Meramandali	S/C	19	120%	22	Meramandali-GMR S/C	8	6	N	0.35	4	N	0.35
		Bolangir	S/C	196	120%	235	Bolangir-Angul S/C	196	157	N	0.35	98	N	0.35
		TSTPS	S/C	68	120%	82	TSTPS-Rengali D/C	24	19	N	0.35	12	Y	0.5 to 0.6
		JITPL	D/C	80	150%	120	JITPL-Angul Other Ckt	80	64	N	0.35	40	N	0.35
		GMR	D/C	31	150%	47	GMR-Angul Other Ckt	31	25	N	0.35	16	N	0.35
32	Bolangir	Angul	S/C	196	120%	235	Angul-Mermandali S/C	19	15	Y	0.5 to 0.6	9	Y	0.5 to 0.6
		Jeypore	S/C	287	120%	344	Jeypore-Indravati S/C	71	57	Y	0.5 to 0.6	36	Y	0.5 to 0.6
33	Jeypore	Bolangir	S/C	287	120%	344	Bolangir-Angul S/C	196	157	N	0.35	98	N	0.35
		Indravati	S/C	71	120%	85	Indravati-Indravti (O) S/C	4	3	Y	0.5 to 0.6	2	Y	0.5 to 0.6
		Gazuwaka	D/C	220	150%	330	Gazuwaka-Jeypore other ckt	220	176	N	0.35	110	N	0.35
34	Indravati	Jeypore	S/C	71	120%	85	Jeypore-Indravati S/C	71	57	N	0.35	36	N	0.35
		Rengali	S/C	356	120%	427	Rengali-TSTPS D/C	24	19	Y	0.5 to 0.6	12	Y	0.5 to 0.6
		Indravati (o)	S/C	4	120%	4		999	799	N	0.35	500	N	0.35
35	Indravati (o)	Indravati	S/C	4	120%	4	Jeypore-Indravati S/C	71	57	N	0.35	36	N	0.35
36	Rengali	Indravati	S/C	356	120%	427	Indravati-Indravti (O) S/C	4	3	Y	0.5 to 0.6	2	Y	0.5 to 0.6
		Keonjhar	S/C	100	120%	120	Keonjhar-Rengali S/C	100	80	N	0.35	50	N	0.35
		TSTPS	D/C	24	150%	36	TSTPS-Rengali D/C	24	19	N	0.35	12	N	0.35
37	Keonjhar	Baripada	S/C	156	120%	187	Baripada-Kharagpur S/C	98	78	N	0.35	49	N	0.35
		Rengali	S/C	100	120%	120	Rengali-TSTPS D/C	24	19	Y	0.5 to 0.6	12	Y	0.5 to 0.6
38	TSTPS	Meramandali	S/C	51	120%	61	Meramandali-GMR S/C	8	6	Y	0.5 to 0.6	4	Y	0.5 to 0.6
		Angul	S/C	68	120%	82	Angul-Mermandali S/C	19	15	N	0.35	9	Y	0.5 to 0.6
		Rengali	D/C	24	150%	36	Rengali-TSTPS D/C	24	19	N	0.35	12	N	0.35
		Rourkela	D/C	171	150%	257	Rourkela-Chaibasa D/C	131	105	N	0.35	66	Y	0.5 to 0.6
		TSTPS	D/C	171	150%	257	TSTPS-Rengali D/C	24	19	Y	0.5 to 0.6	12	Y	0.5 to 0.6
		Jharsuguda	D/C	145	150%	218	Jharsuguda-Rourkela S/C	63	50	Y	0.5 to 0.6	31	Y	0.5 to 0.6

39	Rourkela	SEL	S/C	135	120%	162	SEL-Rourkela S/C	135	108	N	0.35	68	N	0.35
		Chaibasa	S/C	131	120%	158	Chaibasa-Jamsedpur S/C	46	37	N	0.35	23	Y	0.5 to 0.6
		Jamsedpur	S/C	182	120%	218	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
		Ranchi	D/C	144	150%	217	Ranchi-N.Ranchi D/C	79	63	Y	0.5 to 0.6	39	Y	0.5 to 0.6
		Raigarh	S/C	139	120%	167	Raigarh-Raigarg Polling D/C	6	5	Y	0.5 to 0.6	3	Y	0.5 to 0.6
40	Jharsuguda	Rourkela	D/C	145	150%	218	Rourkela-Chaibasa D/C	131	105	N	0.35	66	Y	0.5 to 0.6
		Raigarh	S/C	115	120%	137	Raigarh-Raigarh Polling D/C	6	5	Y	0.5 to 0.6	3	Y	0.5 to 0.6
		IBEUL	S/C	63	120%	75	IBEUL-Raigrah S/C	63	50	N	0.35	31	N	0.35
41	IBEUL	Jharsuguda	S/C	63	120%	75	Jharsuguda-Raigarh S/C	115	92	N	0.35	58	N	0.35
		Raigarh	S/C	91	120%	109	Raigarh-Raigarg Polling D/C	6	5	Y	0.5 to 0.6	3	Y	0.5 to 0.6
42	SEL	Raigarh	S/C	147	120%	176	Raigarh-Raigarg Polling D/C	6	5	Y	0.5 to 0.6	3	Y	0.5 to 0.6
		Rourkela	S/C	135	120%	162	Rourkela-Chaibasa S/C	131	105	N	0.35	66	N	0.35
43	Chaibasa	Kolaghat TPS	S/C	240	120%	288	Kolaghat-Arambagh S/C	64	51	N	0.35	32	Y	0.5 to 0.6
		Kharagpur	S/C	161	120%	193	Kharagpur-Baripada S/C	98	78	N	0.35	49	N	0.35
		Rourkela	S/C	131	120%	158	Rourkela-Chaibasa S/C	131	105	N	0.35	66	N	0.35
		Jamsedpur	S/C	46	120%	55	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
44	Jamsedpur	Durgapur	S/C	177	120%	212	Durgapur-Bidhannagar D/C	11	9	Y	0.5 to 0.6	6	Y	0.5 to 0.6
		Baripada	S/C	108	120%	130	Baripada-Kharagpur S/C	98	78	N	0.35	49	N	0.35
		Rourkela	S/C	182	120%	218	Rourkela-Chaibasa D/C	131	105	N	0.35	66	N	0.35
		Chaibasa	S/C	46	120%	55	Chaibasa-Jamsedpur S/C	46	37	N	0.35	23	N	0.35
		Mejia B	S/C	168	120%	201	Mejia B- Maithon D/C	59	47	N	0.35	30	Y	0.5 to 0.6
		Maithon	S/C	153	120%	184	Maithon-MPL D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
		DSTPS	D/C	157	150%	235	DSTPS-Jamsedpur D/C	69	55	Y	0.5 to 0.6	35	Y	0.5 to 0.6
		TISCO	S/C	33	120%	39	TISCO-Baripada S/C	33	26	N	0.35	16	N	0.35
		Adhunik	D/C	1	150%	2	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
45	Mejia B	Jamsedpur	S/C	168	120%	201	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
		Maithon	S/C	84	120%	100	Maithon-MPL D/C	32	25	N	0.35	16	Y	0.5 to 0.6
		Maithon	D/C	59	150%	89	Maithon-MPL D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
46	Maithon	Gaya	D/C	276	150%	414	Gaya-Chandwa D/C	117	94	Y	0.5 to 0.6	59	Y	0.5 to 0.6
		Kahalgaon	D/C	172	150%	258	Khalgaon-BankaD/C	48	38	Y	0.5 to 0.6	24	Y	0.5 to 0.6
		Durgapur	D/C	71	150%	106	Durgapur-Bidhannagar D/C	11	9	Y	0.5 to 0.6	6	Y	0.5 to 0.6
		Jamsedpur	S/C	153	120%	184	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
		Mejia B	S/C	84	120%	100	Mejia B- Maithon D/C	59	47	N	0.35	30	N	0.35
		Mejia B	D/C	59	150%	89	Mejia B- Maithon D/C	59	47	N	0.35	30	N	0.35
		MPL	D/C	32	150%	47	MPL-Maithon D/C	32	25	N	0.35	16	N	0.35
		Raghunatpur	S/C	55	120%	65	Raghunathpur-Maithon S/C	55	44	N	0.35	27	N	0.35
		Ranchi	S/C	200	120%	240	Ranchi-N.Ranchi D/C	79	63	N	0.35	39	Y	0.5 to 0.6
47	MPL	Maithon	D/C	32	150%	47	Maithon-MPL D/C	32	25	N	0.35	16	N	0.35
		Ranchi	D/C	188	150%	281	Ranchi-N.Ranchi D/C	79	63	Y	0.5 to 0.6	39	Y	0.5 to 0.6
48	DSTPS	Jamsedpur	D/C	157	150%	235	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
		Raghunatpur	D/C	69	150%	104	Raghunathpur-Maithon S/C	55	44	N	0.35	27	Y	0.5 to 0.6
49	Raghunathpur	Maithon	S/C	55	120%	65	Maithon-MPL D/C	32	25	N	0.35	16	N	0.35
		DSTPS	D/C	69	150%	104	DSTPS-Jamsedpur D/C	69	55	N	0.35	35	N	0.35
		Ranchi	S/C	166	120%	199	Ranchi-N.Ranchi D/C	79	63	N	0.35	39	N	0.35
50	Ranchi	Rourkela	D/C	144	150%	217	Rourkela-Chaibasa D/C	131	105	N	0.35	66	Y	0.5 to 0.6
		Maithon	S/C	200	120%	240	Maithon-MPL D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
		MPL	D/C	188	150%	281	MPL-Maithon D/C	32	25	Y	0.5 to 0.6	16	Y	0.5 to 0.6
		Raghunatpur	S/C	166	120%	199	Raghunathpur-Maithon S/C	55	44	N	0.35	27	Y	0.5 to 0.6
		N. Ranchi	D/C	79	150%	118	N. Ranchi-Chandwa D/C	68	54	N	0.35	34	Y	0.5 to 0.6
		N. Ranchi	D/C	79	150%	118	N. Ranchi-Chandwa D/C	68	54	N	0.35	34	Y	0.5 to 0.6
		Sipat	D/C	405	150%	608	Sipat-Korba S/C	100	80	Y	0.5 to 0.6	50	Y	0.5 to 0.6
		Ranchi	D/C	79	150%	118	Ranchi-N.Ranchi D/C	79	63	N	0.35	39	Y	0.5 to 0.6

51	N. Ranchi	Ranchi	D/C	79	150%	118	Ranchi-N.Ranchi D/C	79	63	N	0.35	39	N	0.35
		Chandwa	D/C	68	150%	102	Chandwa-N.Ranchi D/C	68	54	N	0.35	34	N	0.35
52	Chandwa	Gaya	D/C	117	150%	176	Gaya-Chandwa D/C	117	94	N	0.35	59	N	0.35
		N. Ranchi	D/C	68	150%	102	N. Ranchi-Chandwa D/C	68	54	N	0.35	34	N	0.35
53	Koderma	Gaya	D/C	125	150%	188	Gaya-Chandwa D/C	117	94	N	0.35	59	Y	0.5 to 0.6
		Biharsariff	D/C	111	150%	166	Biharsaiff-Lakhisarai D/C	89	71	N	0.35	45	Y	0.5 to 0.6
		Bokaro	D/C	100	150%	150	Koderma-Bokaro D/C	100	80	N	0.35	50	N	0.35
54	Bokaro	Koderma	D/C	100	150%	150	Koderma-Bokaro D/C	100	80	N	0.35	50	N	0.35
55	Rangpo	Binaguri	D/C	110	150%	165	Binaguri-Kishanhanj D/C	98	78	N	0.35	49	Y	0.5 to 0.6
		Teesta V	D/C	12	150%	18	Rangpo-Teesta D/C	12	10	N	0.35	6	N	0.35
56	TISCO	Baripada	S/C	140	120%	168	Baripada-Kharagpur S/C	98	78	N	0.35	49	N	0.35
		Jamsedpur	S/C	33	120%	39	Jamsedpur - Adhunilk D/C	1	0	Y	0.5 to 0.6	0	Y	0.5 to 0.6
57	Teesta V	Rangpo	D/C	12	150%	18	Rangpo-Teesta D/C	12	10	N	0.35	6	N	0.35
58	GMR	Angul	D/C	31	150%	47	Angul-Meramandali S/C	19	15	Y	0.5 to 0.6	10	Y	0.5 to 0.6
59	GMR(0)	Meramandali	S/C	8	120%	10	Meramandali-Angul S/C	19	15	N	0.35	10	N	0.35
60	JITPL	Angul	D/C	80	150%	120	Angul-Meramandali S/C	19	15	Y	0.5 to 0.6	10	Y	0.5 to 0.6

Annexure-C7

Name of the substation	NAME OF LINE	OVERVOLTAGE % SETTING						REMARK
		LOCAL END(STAGE-I)			REMOTE END(STAGE-I)			
		VOLTAGE GARDIENT(% setting)	TIME DELAY(sec)	Drop Off to Pickup ratio	VOLTAGE GARDIENT(% setting)	TIME DELAY(sec)	Drop Off to Pickup ratio	
Binaguri	400KV BINAGURI-RANGPO-I	110	5		112	7		
	400KV BINAGURI-RANGPO-II	112	5		112	7		
	400KV BINAGURI-TALA-I	110	5		105	5		
	400KV BINAGURI-TALA-II	112	5		105	5		
	400KV BINAGURI-MALABASE-III	110	5		105	5		
	400KV BINAGURI-TALA-IV	112	5		105	5		
	400 KV BINAGURI-PURNEA- I	110	5		112	5		
	400 KV BINAGURI-PURNEA- II	112	5		110	5		
	400 KV BINAGURI-KISHANGANJ- I	110	5		112	5		Need to be updated after LILO at Kishanganj
	400 KV BINAGURI-KISHANGANJ- II	112	5		110	7		
	400KV BINAGURI-BONGAIGAON-I	110	5		OTHER REGION			May be submitted by ER - II, Powergrid
	400KV BINAGURI-BONGAIGAON-II	110	6					
	400KV BINAGURI-BONGAIGAON-III	110	5					
	400KV BINAGURI-BONGAIGAON-IV	110	6					
Kishanganj	400 KV KISHANGANJ-PURNEA-I							
	400 KV KISHANGANJ-PURNEA-II							
	400 KV KISHANGANJ-BINAGURI-I							
	400 KV KISHANGANJ-BINAGURI-II							
	400 KV KISHANGANJ-PATNA-I							
	400 KV KISHANGANJ-PATNA-II							
Rangpo	400KV RANGPO-TEESTA-I	112	7		110	7		
	400KV RANGPO-TEESTA-II	112	7		112	5		
	400KV RANGPO-BINAGURI-I	112	7		110	5		
	400KV RANGPO-BINAGURI-II	112	7		112	5		
Tala	400KV TALA-BINAGURI-I	105	5		110	5		
	400KV TALA-BINAGURI-II	105	5		112	5		
	400KV TALA-MALABASE-III	105	5		110	5		
	400KV TALA-BINAGURI-IV	105	5		112	5		
Teesta	400KV TEESTA-RANGPO-I	110	7		112	7		
	400KV TEESTA-RANGPO-II	112	5		112	7		
PURNEA	400 KV PURNEA - MALDA - I	110	7		110	5		
	400 KV PURNEA - MALDA - II	112	5		110	6		
	400 KV PURNEA- BINAGURI - I	112	5		110	5		
	400 KV PURNEA- BINAGURI - II	110	5		112	5		
	400 KV PURNEA- KISHANGANJ - I	112	5		110	5		Need to be updated after LILO at Kishanganj
	400 KV PURNEA- KISHANGANJ - II	112	5		112	5		
	400 KV PURNEA-MUZAFFARPUR-I	110	7		110	7		
	400 KV PURNEA-MUZAFFARPUR-II	112	7		112	7		
	400 KV PURNEA-BIHARSHARIFF-I	110	5		110	5		
	400 KV PURNEA-BIHARSHARIFF-II	110	7		110	7		
MALDA	400 KV MALDA - PURNEA - I	110	5		110	7		
	400 KV MALDA - PURNEA - II	110	6		112	5		
	400 KV MALDA - FARAKKA - I	110	5		110	5		
	400 KV MALDA - FARAKKA - II	110	6		110	5		
	400 KV FSTPP-MALDA-I	110	5		110	5		
	400 KV FSTPP-MALDA-II	110	5		110	6		
	400 KV FSTPP-DURGAPUR-I	112	7		110	5		

FARAKKA	400 KV FSTPP-DURGAPUR-II	110	5		112	5		
	400 KV FSTPP-KhSTPP-I	110	5		110	5		
	400 KV FSTPP-KhSTPP-II	112	5		112	5		
	400 KV FSTPP-KhSTPP-III	110	7		110	7		
	400 KV FSTPP-KhSTPP-IV	112	7		112	7		
	400 KV FSTPP-BEHRAMPUR	110	12		110	6		
	400 KV FSTPP-SAGARDIGHI	112	7		140	0.1		
Behrampur	400 KV BEHRAMPUR-BHERAMARA -I	110	5		110	4		
	400 KV BEHRAMPUR-BHERAMARA -II	110	10		110	5		
	400 KV BEHRAMPUR - FARAKKA	110	6		110	12		
	400KV BERHAMPORE-SAGARDIGHI-I	110	5		110	5		
	400KV BERHAMPORE-SAGARDIGHI-II	110	6		110	7		
	400 KV BEHRAMPUR - JEERAT	110	7		110	7		
Jeerat	400KV JEERAT-SUBHASHGRAM	112	5		112	5		
	400 KV JERAT - BERHAMPUR	110	7		110	7		
	400 KV Jeerat-Bakreswar	110	5		110	5		
	400 KV Jeerat-Kolaghat	NOT INSTALLED AT BOTH ENDS						Present status may be updated
Subhashgram	400 KV SUBHASHSHGRAM-SAGARDIGHI	112	5		112	5		
	400KV SUBHASHGRAM-HALDIA-I	110	5		110	3		
	400KV SUBHASHGRAM-HALDIA-II	110	6		110	5		
	400 KV SUBHASHGRAM-JEERAT	112	5		112	5		
HALDIA	400KV HALDIA-SUBHASHGARM-I	110	3		110	5		
	400KV HALDIA-SUBHASHGRAM-II	110	5		110	6		
SAGARDIGHI	400 KV SAGARDIGHI - FARAKKA	140	0.1		112	7		
	400 KV SAGARDIGHI - DURGAPUR-I	110	5		110	5		
	400 KV SAGARDIGHI - DURGAPUR-II	110	6		110	6		
	400KV SAGARDIGHI-BERHAMPORE-I	110	5		110	5		
	400KV SAGARDIGHI-BERHAMPORE-II	110	7		110	6		
	400 KV SAGARDIGHI - SUBHASHGRAM	112	5		112	5		
Durgapur	400 KV DURGAPUR - SAGARDIGHI-I	110	5		110	5		
	400 KV DURGAPUR - SAGARDIGHI-II	110	6		110	6		
	400 KV DURGAPUR-FSTPP-I	110	5		112	7		
	400 KV DURGAPUR-FSTPP-II	112	5		110	5		
	400 KV DURGAPUR-MAITHON-I	110	5		110	5		
	400 KV DURGAPUR-MAITHON-II	110	6		110	6		
	400 KV DURGAPUR-JAMSHEDPUR	110	5		112	5		
	400 KV DURGAPUR - BIDHANNAGAR-I	110	5		110	5		
	400 KV DURGAPUR - BIDHANNAGAR-II	110	5		110	5		
BIDHANNAGAR	400 KV BIDHANNAGAR-PPSP-I	110	5		110	5		
	400 KV BIDHANNAGAR-PPSP-II	110	5		110	5		
	400 KV BIDHANNAGAR - DURGAPUR-I	110	5		110	5		
	400 KV BIDHANNAGAR - DURGAPUR-II	110	5		110	5		
	400 KV BIDHANNAGAR-ARAMBAG	110	5		110	5		
PPSP	400 KV PPSP-BIDHAN NAGAR-I	110	5		110	5		
	400 KV PPSP-BIDHAN NAGAR-II	110	5		110	5		
	400 KV PPSP-ARAMBAG-I	110	5		110	5		
	400 KV PPSP-ARAMBAG-II	110	5		110	5		
Arambag	400 KVARAMBAG-PPSP-I	110	5		110	5		
	400 KV ARAMBAG-PPSP-II	110	5		110	5		
	400 KV ARAMBAG -KOLAGHAT	110	5		NOT INSTALLED AT KOLAGHAT END			Present status may be updated
	400 KV ARAMBAG-BAKRESWAR	110	5		110	5		
	400 KV ARAMBAG-BIDHANNAGAR	110	5		110	5		
BAKRESWAR	400 KV BAKRESWAR-JEERAT	110	5		110	5		
	400 KV BAKRESWAR-ARAMBAG	110	5		110	5		

KOLAGHAT	400 KV KOLAGHAT-JEERAT	NOT INSTALLED AT BOTH ENDS						Present status may be updated
	400 KV KOLAGHAT-ARAMBAG	NOT INSTALLED TA KOLAGHAT END			110	5		Present status may be updated
	400 KV KOLAGHAT-KHARAGPUR-I	110	5		110	5		
	401 KV KOLAGHAT-CHAIBASA-I	110	5		110	5		Need to be updated after Chaibasa connectivity
KHARAGPUR	400 KV KHARAGPUR-KOLAGHAT-I	110	5		110	5		
	400 KV KHARAGPUR-CHAIBASA-I	110	5		110	5		Need to be updated after Chaibasa connectivity
	400KV KHARAGPUR-BARIPADA	110	5		112	7		
BARIPADA	400 KV BARIPADA-KEONJHAR	110	3		110	5		
	400 KV BARIPADA- TISCO(JAMSHEDPUR)	111	5		110	4		
	400 KV BARIPADA-N. DUBURI -I	112	6		110	5		Needs to be upgated after LILO at N. Duburi
	400 KV BARIPADA-PANDAIABILLI-I	112	6		110	5		Needs to be updated after LILO at Pandiabilli
	400 KV BARIPADA-KHARAGPUR	112	7		110	5		
	400 KV BARIPADA-JAMSHEDPUR	111	5		110	4		
Jamshedpur	400 KV JAMSHEDPUR-CHAIBASA - I	112	5		112	5		
	400 KV JAMSHEDPUR-CHAIBASA- II	110	7		110	6		
	400 KV JAMSHEDPUR - MEJIA	112	5		117	2.5		
	400 KV JAMSHEDPUR - DSTPS(ANDAL)-I	110	5		117	2.5		
	400 KV JAMSHEDPUR - DSTPS(ANDAL)-II	112	5		117	2.5		
	400KV JAMSHEDPUR - APNRL-I	110	5		115	5		
	400KV JAMSHEDPUR - APNRL-II	110	5		115	5		
	400 KV JAMSHEDPUR - DURGAPUR	112	5		110	5		
	400 KV JAMSHEDPUR - TISCO	112	7		112	7		
	400 KV JAMSHEDPUR-MAITHON	110	5		110	5		
	400 KV JAMSHEDPUR-BARIPADA	110	4		111	5		
CHAIBASA	400KV CHAIBASA-JAMSHEDPUR-I	112	5		112	5		
	400KV CHAIBASA-JAMSHEDPUR-II	110	6		110	7		
	400KV CHAIBASA-KHARAGPUR-II							Need to be updated after Chaibasa connectivity
	400KV CHAIBASA-KOLAGHAT-II							Need to be updated after Chaibasa connectivity
	400KV CHAIBASA-ROURKELA-I	112	7		110	5		
	400KV CHAIBASA-ROURKELA-II				110	6		
APNRL	400 KV APNRL-JAMSHEDPUR-I	115	5		110	5		
	400 KV APNRL-JAMSHEDPUR -II	115	5		110	5		
TISCO	400 KV TISCO-JAMSHEDPUR	112	7		112	7		
	400 KV TISCO-BIRPADA	110	4		111	5		
Maithon	400 KV MAITHON-RANCHI	112	5		112	5		
	400 KV MAITHON-KAHALGAON-I	110	5		112	5		
	400 KV MAITHON-KAHALGAON-II	110	6		110	5		
	400 KV MAITHON -MAITHON RB-I	110	5		110	7		
	400 KV MAITHON -MAITHON RB-II	112	5		112	7		
	400 KV MAITHON -GAYA - I	110	5		110	5		
	400 KV MAITHON -GAYA-II	110	6		110	5		
	400 KV MAITHON-JAMSHEDPUR	110	5		110	5		
	400 KV MAITHON -MEJIA- I	110	5		117	2.5		
	400 KV MAITHON -MEJIA- II	112	5		117	2.5		
	401 KV MAITHON -MEJIA- III	110	5		117	2.5		
	400 KV MAITHON - DURGAPURR - I	110	5		110	5		
	400 KV MAITHON - DURGAPURR - II	110	6		110	6		
	400 KV MAITHON -RAGHUNATHPUR	112	6		113	5		
Ranchi	400 KV RANCHI-MAITHON	112	5		112	5		
	400 KV RANCHI-NEW RANCHI-I	110	5		110	5		
	400 KV RANCHI-NEW RANCHI-II	110	5		110	5		
	400 KV RANCHI-NEW RANCHI-III	110	5		110	5		
	400 KV RANCHI-NEW RANCHI-IV	110	5		110	5		
	400 KV RANCHI-RAGHUNATHPUR	110	5		113	5		
	400 KV RANCHI-MAITHON RB-I	112	7		112	7		
	400 KV RANCHI-MAITHON RB-II	110	7		110	7		

	400 KV RANCHI - SIPAT - I	110	7		OTHER REGION			May be submitted by ER - I, Powergrid
	400 KV RANCHI - SIPAT - II	112	5					
	400 KV RANCHI-ROURKELA- I	110	5		110	5		
	400 KV RANCHI-ROURKELA - II	112	7		110	6		
765/400 KV NEW RANCHI S/S	400 KV NEW RANCHI- RANCHI-I	110	5		110	5		
	400 KV NEW RANCHI- RANCHI-II	110	5		110	5		
	400 KV NEW RANCHI- RANCHI-III	110	5		110	5		
	400 KV NEW RANCHI- RANCHI-IV	110	5		110	5		
	400 KV NEW RANCHI- CHANDWA-I							
	400 KV NEW RANCHI- CHANDWA-II							
	765 KV KV NEW RANCHI-DHARMJAYGARH-I	107	5		OTHER REGION			May be submitted by ER - I, Powergrid
	765 KV KV NEW RANCHI-DHARMJAYGARH-II							
CHANDWA	400 KV CHANDWA-N.RANCHI-I							
	400 KV CHANDWA-N.RANCHI-II							
	400 KV CHANDWA-GAYA-I							
	400 KV CHANDWA-GAYA-II							
MAITHON RIGHT BANK	400 KV MAITHON RB-RANCHI-I	112	7		112	7		
	400 KV MAITHON RB-RANCHI-II	110	7		110	7		
	400 KV MAITHON RB-MAITHON-I	110	7		110	5		
	400 KV MAITHON RB-MAITHON-II	112	7		112	5		
DSTPS	400 KV DSTPS-JAMSHEDPUR-I	117	2.5		110	5		
	400 KV DSTPS-JAMSHEDPUR-II	117	2.5		112	5		
	400 KV DSTPS-RAGHUNATHPUR-I	117	2.5		113	5		
	400 KV DSTPS-RAGHUNATHPUR-II	117	2.5		113	5		
KODERMA	400 KV KODERMA-GAYA-I	113	5		110	5		
	400 KV KODERMA-GAYA-II	113	5		110	5		
	400 KV KODERMA-BIHARSHARIFF-I	113	5		112	7		
	400 KV KODERMA-BIHARSHARIFF-II	113	5		110	5		
	400KV KODERMA-BOKARO-A-I	113	5		110	6		
	400KV KODERMA-BOKARO-A-II	113	5		110	6		
BOKARO-A	400KV BOKARO-A-KODERMA-I	110	6		113	5		
	400KV BOKARO-A-KODERMA-II	110	6		113	5		
Mejia	400 KV MEJIA-MAITHON -I	117	2.5		110	5		
	400 KV MEJIA-MAITHON -II	117	2.5		112	5		
	400 KV MEJIA-MAITHON -III	117	2.5		110	5		
	400 KV MEJIA-JAMSHEDPUR	117	2.5		112	5		
RAGHUNATHPUR	400 KV RAGHUNATHPUR-MAITHON	113	5		112	6		
	400 KV RAGHUNATHPUR-RANCHI	113	5		110	5		
	400 KV RAGHUNATHPUR-DSTPS-I	113	5		117	2.5		
	400 KV RAGHUNATHPUR-DSTPS-II	113	5		117	2.5		
MENDHASAL	400 KV MENDHASAL-PANDIABILLI-I	110	5		112	6		Needs to be updated after LILO at Pandiabilli
	400 KV MENDHASAL-PANDIABILLI-II	110	5		112	6		Needs to be updated after LILO at Pandiabilli
	400 KV MENDHASAL-MEERAMUNDALI	110	5		110	5		
PANDIABILLI	400 KV PANDIABILLI-MENDASAL-I							
	400 KV PANDIABILLI-MENDASAL-II							
	400 KV PANDIABILLI-N.DUBURI							
	400 KV PANDIABILLI - BARIPADA							
N. DUBURI	400 KV N.DUBURI-PANDIABILLI							
	4OO KV N.DUBURI-BARIPADA							
	400 KV N.DUBURI-MERAMANDALI-I							
	400 KV N.DUBURI-MERAMANDALI-II							
	400 KV MEERAMUNDALI-TALCHER	110	5		110	5		
	400 KV MEERAMUNDALI-ANGUL-II	112	5		110	5		
	400 KV MEERAMUNDALI-JINDAL-I	110	5		110	5		
	400 KV MEERAMUNDALI-JINDAL-II	110	5		110	5		
	400 KV MEERAMUNDALI-ANGUL-I	112	5		110	5		

MEERAMUNDALI	400 KV MEERAMUNDALI-MENDHASAL	110	5		110	5		
	400KV MERAMUNDALI-GMR	110	5		110	5		
	400 KV MERAMUNDALI-STERLITE -I							
	400 KV MERAMUNDALI-STERLITE -II							
	400 KV MERAMUNDALI-N.DUBURI -I							
	400 KV MERAMUNDALI-N.DUBURI -I							
JINDAL	400 KV JINDAL-MEERAMUNDALI-I	110	5		110	5		
	400 KV JINDAL-MEERAMUNDALI-II	110	5		110	5		
GMR	400 KV GMR-ANGUL-I	110	2		110	5		
	400 KV GMR-ANGUL-II	110	2		110	6		
	400KV GMR-MERAMUNDALI	110	5		110	5		
ANGUL	400 KV ANGUL-MEERAMUNDALI-I	110	5		112	5		
	400KV ANGUL-BOLANGIR	110	5		110	5		
	400KV ANGUL-TSTPP	110	5		110	5		
	400 KV ANGUL-MERAMUNDALI-II	110	5		112	5		
	400 KV ANGUL-JITPL-II	110	5		110	5		
	400 KV ANGUL-JITPL-I	110	5		110	5		
	400KV ANGUL-GMR-I	110	5		110	2		
	400KV ANGUL-GMR-II	110	6		110	2		
	765kV Angul-Jharsuguda-I	110	4		110	4		
	765kV Angul-Jharsuguda-II	110	4		110	4		
JITPL	400 KV JITPL-ANGUL-I	110	5		110	5		
	400 KV JITPL-ANGUL-II	110	5		110	5		
BOLANGIR	400 KV BOLANGIR-ANGUL	110	5		110	5		
	400 KV BOLANGIR-JEYPORE	112	5		112	5		
Jeypore	400 KV JEYPORE-BOLANGIR	112	5		112	5		
	400 KV JEYPORE-GAZUWAKA-I	110	5		110	9		
	400 KV JEYPORE-GAZUWAKA-II	110	10		110	10		
	400KV JEYPORE-INDRAVATI	112	5		110	5		
INDRAVATI(PG)	400 KV INDRAVATI-JEYPORE	110	5		112	5		
	400 KV INDRAVATI-INDRAVATI	115	5		115	5		
	400 KV INDRAVATI-RENGALI	113	5		110	5		
INDRAVATI(GR)	400 KV INDRAVTI(GR)-INDRAVATI(PG)	115	5		115	5		
Rengali	400 KV RENGALI-INDRAVATI(PG)	110	5		113	5		
	400 KV RENGALI-KEONJHAR	110	5		110	5		
	400 KV RENGALI-TALCHER-I	110	5		110	5		
	400 KV RENGALI-TALCHER-II	110	6		112	5		
KEONJHOR	400 KV KEONJHAR-RENGALI	110	5		110	5		
	400 KV KEONJHAR-BIRPADA	110	3		110	5		
Talcher	400 KV Talcher-Rourkela-I	110	5		110	5		
	400 KV Talcher-Rourkela-II	112	5		110	6		
	400 KV Talcher-Rengali-I	110	5		110	5		
	400 KV Talcher-Rengali-II	112	5		110	6		
	400 KV Talcher-MERAMUNDALI	110	5		110	5		
	400 KV Talcher-ANGUL	110	5		110	5		
Rourkela	400 KV ROURKELLA-JHARSHUGUDA-I	110	5		110	10		
	400 KV ROURKELLA-JHARSHUGUDA-II	110	6		110	6		
	400 KV ROURKELLA-RAIGARH	112	5		OTHER REGION			May be submitted by Odisha Project, Powergrid
	400 KV ROURKELLA-STERLITE-II	110	6		115	5		
	400 KV ROURKELA-TALCHER-I	110	5		110	5		
	400 KV ROURKELA-TALCHER-II	110	6		112	5		
	400 KV ROURKELA-CHAIBASA-I	110	5		112	7		
	400 KV ROURKELA-CHAIBASA-II	110	6					
	400 KV ROURKELA-RANCHI-I	110	5		110	5		
	400 KV ROURKELA-RANCHI-II	110	6		112	7		
	400 KV STERLITE - ROURKELA - II	115	5		110	6		

STERLITE	400 KV STERLITE - RAIGARH - II	115	5		OTHER REGION			May be submitted by Odisha Project, Powergrid
	400 KV STERLITE-MERAMANDALI-I							
	400 KV STERLITE-MERAMANDALI-II							
Jharshuguda	400KV JHSUGUDA-ROURKELA-I	110	10		110	5		
	400KV JHSUGUDA-ROURKELA-II	110	6		110	6		
	400 KV JHARSHUGUDA-IBEUL	110	10		110	5		
	765kV Jharsuguda-ANGUL-I	110	4		110	4		
	765kV Jharsuguda-ANGUL-II	110	4		110	4		
	400 KV JHARSHUGUDA-RAIGARH -II	110	6		111	7		
Jharsguda 765KV S/s	765kv Jharsuguda-Dharmjaygarh-I	108	5		OTHER REGION			May be submitted by Odisha Project, Powergrid
	765kv Jharsuguda-Dharmjaygarh-II	108	7		OTHER REGION			May be submitted by Odisha Project, Powergrid
	765kV Jharsuguda-Angul-I	110	4		110	4		
	765kV Jharsuguda-Angul-II	110	4		110	4		
IBEUL	400kV IBEUL-Raigarh	110	5		OTHER REGION			May be submitted by Odisha Project, Powergrid
	400kV IBEUL-Jharsuguda	110	5		110	10		
APNRL	400 KV APNRL-JAMSHEDPUR-I	115	5		110	5		
	400 KV APNRL-JAMSHEDPUR -II	115	5		110	5		
BIHARSHARIFF	400 KV BIHARSHARIFF-BANKA-I	112	7		112	7		
	400 KV BIHARSHARIFF-BANKA-II	110	6		110	6		
	400 KV BIHARSHARIFF - PUSAULI - I	110	5		110	5		
	400 KV BIHARSHARIFF - PUSAULI- II	112	5		112	5		
	400 KV BIHARSHARIFF - VARANASI- I	112	7		112	7		
	400 KV BIHARSHARIFF - VARANASI- II	110	7		110	7		
	400 KV BIHARSHARIFF - BALIA - I	110	5		OTHER REGION			May be submitted by ER-I, Powergrid
	400 KV BIHARSHARIFF - BALIA - II	112	5					
	400 KV BIHARSHARIFF-KODERMA-I	112	7		113	5		
	400 KV BIHARSHARIFF-KODERMA-II	110	5		113	5		
	400 KV BIHARSHARIFF-PURNEA-I	110	5		110	5		
	400 KV BIHARSHARIFF-PURNEA-II	110	7		110	7		
	400 KV BIHARSHARIFF-LAKHISARAI-I	110	7		110	5		
	400 KV BIHARSHARIFF-LAKHISARAI-II	112	5		110	5		
	400 KV BIHARSHARIFF-MUZAFFARPUR-I	110	5		110	5		
	400 KV BIHARSHARIFF-MUZAFFARPUR-II	112	5		112	5		
Kahalgaon	400 KV KhSTPP-BANKA -I	110	6		110	6		
	400 KV KhSTPP-BANKA - II	112	7		112	7		
	400 KV KhSTPP - LAKHISARAI- I	110	7		110	7		
	400 KV KhSTPP - LAKHISARAI- II	112	5		112	5		
	400 KV KhSTPP-MAITHON -I	112	5		110	5		
	400 KV KhSTPP-MAITHON -II	110	5		110	6		
	400 KV KhSTPP-BARH - I	112	6		112	6		
	400 KV KhSTPP-BARH- II	112	6		112	6		
	400 KV KHSTPP-FSTPP-I	110	5		110	5		
	400 KV KHSTPP-FSTPP-II	112	5		112	5		
	400 KV KHSTPP-FSTPP-III	110	7		110	7		
	400 KV KHSTPP-FSTPP-IV	112	7		112	7		
Barh	400 KV BARH-KAHALGAON-I	112	6		112	6		
	400 KV BARH-KAHALGAON-II	112	6		112	6		
	400 KV BARH - PATNA-I	112	6		112	6		
	400 KV BARH - PATNA-II	112	7		112	7		
	400 KV BARH - PATNA-IIII	110	4		110	4		
	400 KV BARH - PATNA-IV	110	5		110	5		
	400 KV BARH - GORAKHPUR-I							
	400 KV BARH - GORAKHPUR-II							
	400 KV PATNA-BARH-I	112	6		112	6		
	400 KV PATNA-BARH-II	112	7		112	7		
	400 KV PATNA-BARH-III	110	4		110	4		

PATNA	400 KV PATNA-BARH-IV	110	5		110	5		
	400 KV PATNA-KISHANGANJ-I							
	400 KV PATNA-KISHANGANJ-II							
	400 KV PATNA - BALIA - I	110	4		OTHER REGION			May be submitted by ER-I, Powergrid
	400 KV PATNA - BALIA - II	110	5					
	400 KV PATNA - BALIA - III	112	6					
	400 KV PATNA- BALIA - IV	112	7					
Sasaram	765KV SASARAM-FATEHPUR	108	5		108	5		
	400 KV PUSAULI - VARANASI	112	5		OTHER REGION			May be submitted by ER-I, Powergrid
	400 KV PUSAULI - ALLAHABAD	112	7					
	400 KV PASAULI-BIHARSHARIFF-I	110	5		110	5		
	400 KV PASAULI-BIHARSHARIFF-II	112	5		112	5		
	400KV PUSAULI-NABINAGAR-I	110	5					
	400KV PUSAULI-NABINAGAR-II	110	6					
Gaya	400 KV GAYA-KODERMA-I	110	5		113	5		
	400KV GAYA-KODERMA-II	110	5		113	5		
	400KV GAYA-MAITHON-I	110	5		110	5		
	400KV GAYA-MAITHON-II	110	5		110	6		
	765 KV GAYA-VARANASI-I							
	765 KV GAYA-VARANASI-II							
	765 KV GAYA-BALIA	110	5		OTHER REGION			May be submitted by ER-I, Powergrid
BANKA	400 KV BANKA-BIHARSHARIFF-I	112	7		112	7		
	400 KV BANKA-BIHARSHARIFF-II	110	6		110	6		
	400 KV BANKA-KAHALGAON-I	110	6		110	6		
	400 KV BANKA-KAHALGAON-II	112	7		112	7		
Muzaffarpur	400 KV MUZAFFARPUR - NEW PURNEA - I	110	7		110	7		
	400 KV MUZAFFARPUR - NEW PURNEA - II	112	7		112	7		
	400 KV MUZAFFARPUR - GORAKHPUR - I	110	7		OTHER REGION			May be submitted by ER-I, Powergrid
	400 KV MUZAFFARPUR - GORAKHPUR - II	112	5					
	400 KV MUZAFFARPUR - BIHARSHARIFF - I	110	5		110	5		
	400 KV MUZAFFARPUR - BIHARSHARIFF - II	112	5		112	5		
LAKHISARAI	400 KV LAKHISARI-BIHARSHARIFF-I	110	5		110	7		
	400 KV LAKHISARI-BIHARSHARIFF-II	110	5		112	5		
	400 KV LAKHISARAI-KAHALGAON-I	110	5		110	7		
	400 KV LAKHISARI-KAHALGAON-II	110	5		112	5		