Minutes
of
54th PCC meeting

Date: 26.04.2017
Eastern Regional Power Committee
14, Golf Club Road, Tollygunge
Kolkata: 700 033

EASTERN REGIONAL POWER COMMITTEE

MINUTES OF 54TH PROTECTION SUB-COMMITTEE MEETING HELD AT ERPC, KOLKATA ON 20.04.2017 (THURSDAY) AT 11:00 HOURS

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

PART – A

ITEM NO. A.1: Confirmation of minutes of 53rd Protection sub-Committee Meeting held on 21st March, 2017 at ERPC, Kolkata.

The minutes of 53rd Protection Sub-Committee meeting held on 21.03.17 circulated vide letter dated 04.04.17.

Members may confirm the minutes of 53rd PCC meeting.

Deliberation in the meeting

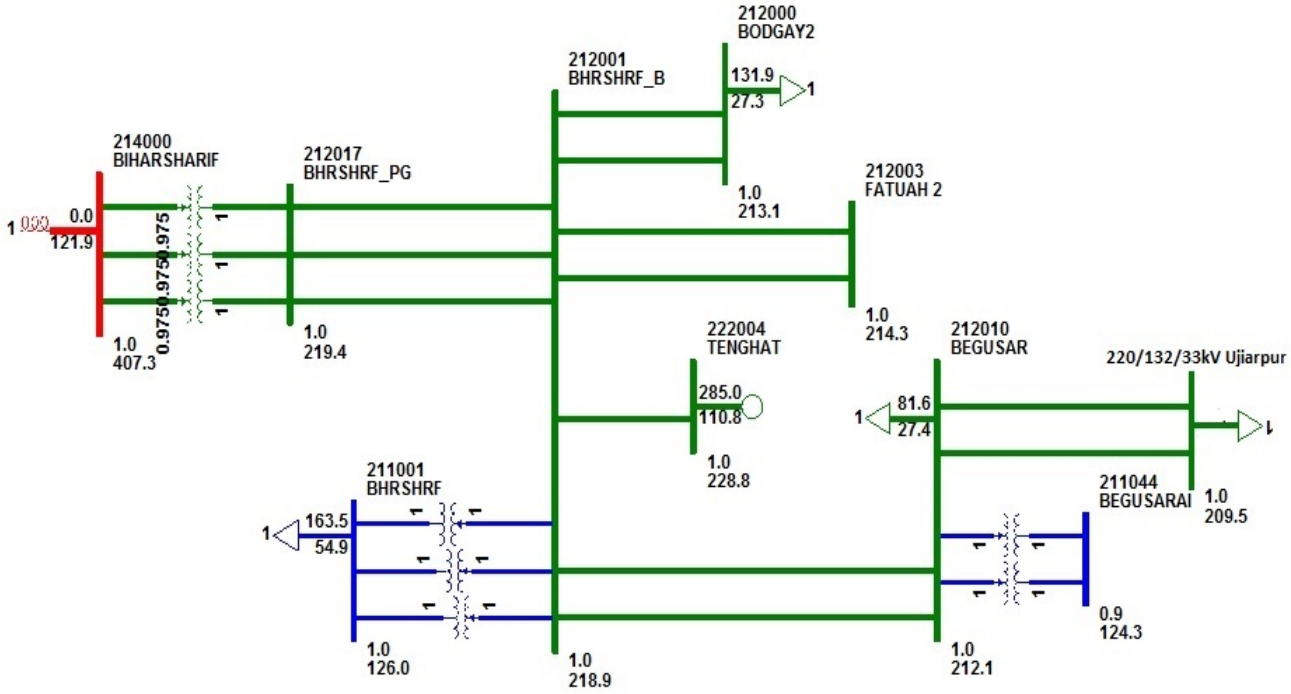
Members confirmed the minutes of 53rd PCC meeting.

PART – B

ANALYSIS & DISCUSSION ON GRID INCIDENCES OCCURRED IN MARCH, 2017

ITEM NO. B.1: Disturbance at 400/220 kV Biharsharff S/s on 03-03-17 at 13:25 hrs.

1. **Single line diagram:** Submitted



2. **Pre fault conditions:** Submitted

Name of feeder	AT 13:00 Hrs.	Name of feeder	AT 13:00 Hrs.
220kv bus voltage	235kv	220 KV BIHARSHARIF-BODHGAYA I-II	0 MW

220kv ICT 1-130mw	130 MW	132 KV SYSTEM VOLTAGE	138 KV
220 KV ICT 2	130 MW	132 KV BIHARSHARIF-BARIPAHARI I-II	20 MW (EACH)
220 KV ICT 3	130 MW	132 KV NALANDA (L-28)	10 MW
220 KV TTPS	70 MW	132 KV RAJGIR (L-29)	10 MW
150 MVA T1-T2-T3	36 MW (EACH)	132 KV BIHARSHARIF- NAWADA	22 MW
220 KV FATUHA I-II	90 MW (EACH)	132 KV BIHARSHARIF-EKANGARSARI	23 MW
220 KV BIHARSHARIF-BEGUSARAI I-II	94 MW	132 BIHARSHARIF-HATHIDAH	OFF DUE TO MAINTENANCE WORK

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

At 13:25 hrs, 400/220 kV 315 MVA ICT-I, II, III at Biharshariff along with 220 kV Biharshariff – Begusarai D/C tripped from Biharshariff end due to fault in 220 kV Begusarai – Ujiarpur – I.

- 220 kV Begusarai – Ujiarpur line – I tripped from Ujiarpur on zone 1 and the fault was not cleared from Begusarai end.
- All the 400/220 kV ICTs tripped on O/C before tripping of 220 kV Biharshariff – Begusarai D/C.
- Relay at Biharshariff end of 220 kV Biharshariff – Begusarai D/C sensed the fault in Z-III. But the fault clearing time was 1863 ms as per BSPTCL data.

Load at Biharshariff, Begusarai, Fatua, Darbhanga was affected due to this disturbance.

The relay Indications are as follows:

Time (Hrs)	**Details of tripping**	**Relay at local end**	**Relay at remote end**
13:25 hrs	220 kV Biharshariff – Begusarai – I	Z-III 113.7 KM from BSF Fault duration 1863 ms, Ia 0.1 kA Ib 0.1 A Ic 0.5kA (As per BSPTCL data)	Did not trip
	220 kV Biharshariff – Begusarai – II	Z-III, Ia 44.2 A, Ib 601 A, Ic 509 A	Did not trip
	220 kV Ujiarpur– Begusarai – I	Z-I, 35 km from Ujiarpur end (total length 60 km)	Did not trip
	400/220 kV ICT – I, II & III	O/C at 400 kV side	

4. **Disturbance record:** Submitted

5. **Remedial action taken :** Submitted

- At Begusarai end, Distance relay ABB REL670 of 220 KV Begusarai-Samastipur CKT I is being replaced by Schneider Micom P442 relay as during testing its tripping function was not Proper.
- In Biharsharif GSS, Main II protection of 220 KV Biharsharif-Begusarai line Distance relay REL 670, Make ABB has been replaced by Schneider's MiCOM P442 relay, as its Tripping was not proper.

Analysis of PMU plots:

- At 13:25 hrs, 10 kV voltage dip has been observed in B-phase at Biharshariff PMU data.
- Fault clearance time was 1400 ms. approx.

Status of Reporting:

- Detail report along with DR & EL was received from BSPTCL on 09-03-17.

BSPTCL may explain the following:

- Reason for not clearing the fault in 220 kV Begusarai – Ujiarpur – I from 220kV Begusarai end
- Reason for not clearing the fault from 220kV Biharshariff end in zone 3
- Fault clearance time of approx. 1400 ms is a gross violation of Clause 3(e) of CEA Grid Standards 2010, which stipulates that any fault at 220 kV level should be cleared within 160 ms.
- Bihar SLDC may furnish amount of energy un-served and duration of disturbance.

Deliberation in the meeting

BSPTCL explained that

- *There was a B-N fault in 220 kV Begusarai – Ujiarpur line – I. The line was tripped from Ujiarpur end on zone 1 but Begusarai end distance protection and backup over current protection failed to identify the fault.*
- *The distance relays of adjacent line, 220 KV Biharsharif-Begusarai D/c line identified the fault in zone III and issued trip command to respective CBs. But the CBs failed to open and clear the fault.*
- *Therefore, the fault was finally cleared from backup directional O/C, E/F protection of 400/220 kV ICT – I, II & III at Biharsharif.*

PCC recommended the following:

- *The relays and CBs of 220 kV Begusarai – Ujiarpur line – I line at Begusarai end should be tested.*
- *The relays and CBs of 220 KV Biharsharif-Begusarai D/c line at Biharsharif end should be tested.*

BSPTCL informed that they have taken the following corrective actions:

- *Relays of 220 kV Begusarai – Ujiarpur line – I line at Begusarai end have been replaced on 9th March 2017.*
- *Main II protection of 220 KV Biharsharif-Begusarai line-II Distance relay REL 670 at Biharshariff has been replaced by Schneider's MiCOM P442 relay, as its Tripping was not proper.*
- *220 KV Biharsharif-Begusarai line-II Circuit Breaker has been tested and found that opening time is 1015 msec. The CB has been replaced with healthy CB.*
- *220 KV Biharsharif-Begusarai line-I relay and CB testing in progress.*

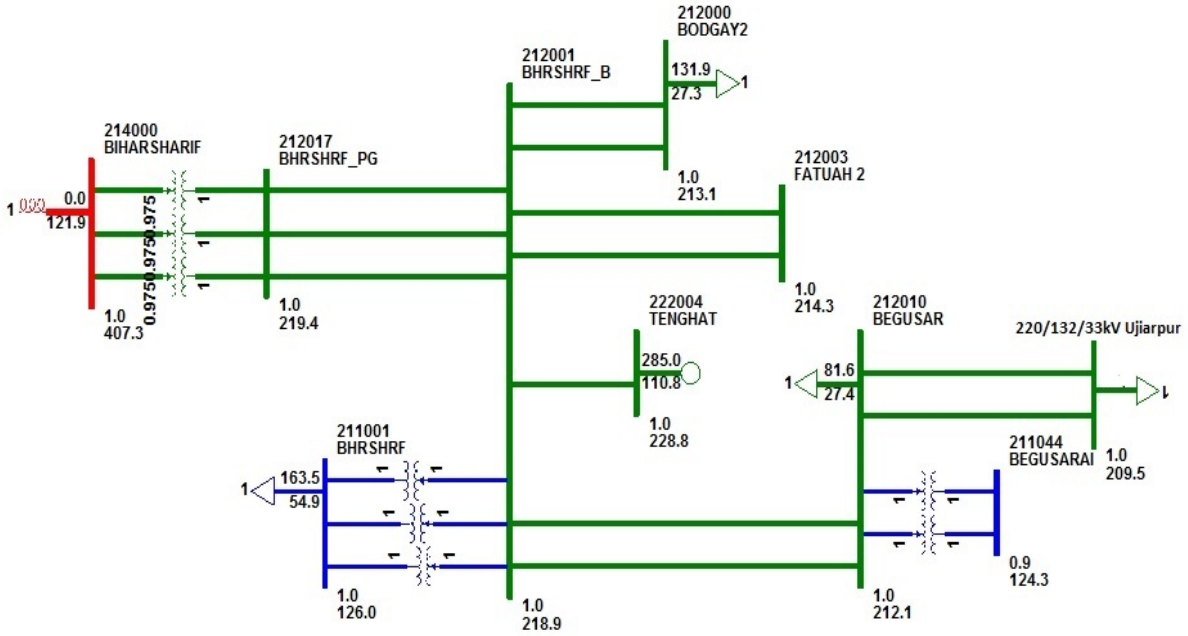
ITEM NO. B.2: Disturbance at 400/220 kV Biharsharff S/s on 04-03-17 at 13:21 hrs.

1. **Single line diagram:** Submitted

2. **Pre fault conditions:** Submitted

Name of feeder	AT 13:00 Hrs.	Name of feeder	AT 13:00 Hrs.
220kv bus voltage	235kv	220 KV BIHARSHARIF-BODHGAYA I-II	0 MW
220kv ICT 1-130mw	130 MW	132 KV SYSTEM VOLTAGE	137 KV
220 KV ICT 2	130 MW	132 KV BIHARSHARIF-BARIPAHARI I-II	20 MW (EACH)
220 KV ICT 3	130 MW	132 KV NALANDA (L-28)	15 MW
220 KV TTPS	90 MW	132 KV RAJGIR (L-29)	15 MW
150 MVA T1-T2-T3	32 MW (EACH)	132 KV BIHARSHARIF- NAWADA	19 MW

220 KV FATUHA I-II	100 MW (EACH)	132 KV BIHARSHARIF-EKANGARSARI	22 MW
220 KV BIHARSHARIF-BEGUSARAI I-II	108 MW	132 BIHARSHARIF-HATHIDAH	OFF DUE TO MAINTENANCE WORK



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

At 13:21 hrs, tripping of 400/220 kV 315 MVA ICT-I, II, III at Biharshariff along with 220 kV Biharshariff – Begusarai I and 220 kV Tenughat Biharshariff S/C resulted power loss at Biharshariff, Begusarai, Fatua, Patna, Darbhanga including traction load of 60 MW (approx.) at Khagaria, Samastipur, Barh, Fatua and Mukama.

- 220 kV Biharshariff – Begusarai I tripped in Z-IV from Begusarai end and Z-II from Biharshariff end.
- 220 kV Tenughat – Biharshariff S/C tripped from Tenughat end in Z-III protection.

The relay Indications are as follows:

Time (Hrs)	Details of tripping	Relay at local end	Relay at remote end
13:21 hrs	220 kV Biharshariff – Begusarai – I	Z-II (Distance- 93.14 km) Ia- 336.1A, Ib- 2.235KA, Ic- 1.9KA Fault duration 1.863 s	Z-IV from Biharshariff end
	220 kV Tenughat – Biharshariff S/C	Z-III, 186 km from Tenughat	R-Y-B tripped
	400/220 kV ICT – I, II & III	O/C at 400 kV side	

4. **Disturbance record:** Submitted

5. **Remedial action taken :** Submitted

- At Begusarai end, Distance relay ABB REL670 of 220 KV Begusarai-Samastipur CKT I is being replaced by Schneider Micom P442 relay as during testing its tripping function was not Proper.
- In Biharsharif GSS, Main II protection of 220 KV Biharsharif-Begusarai line Distance relay

REL 670, Make ABB has been replaced by Schneider's MiCOM P442 relay, as its Tripping was not proper.

Analysis of PMU plots:

- At 13:21 hrs, 12 kV voltage dip has been observed in Y & B-phase at Biharshariff PMU data.
- Fault clearance time was 700 ms. approx.

Status of Reporting:

- Detail report along with DR & EL was received from BSPTCL on 09-03-17.
- Detail report along with DR & EL was received from TVNL on 04-03-17.

BSPTCL may explain the following:

- Location of the fault
- Reason for tripping of 220 kV Biharshariff – Begusarai – I, 220 kV Tenughat – Biharshariff S/C, 400/220 kV ICT – I, II & III
- Fault clearance time of approx. 700 ms is a gross violation of Clause 3(e) of CEA Grid Standards 2010, which stipulates that any fault at 220 kV level should be cleared within 160 ms.
- Bihar SLDC may furnish amount of energy un-served and duration of disturbance.

Deliberation in the meeting

BSPTCL explained that

- *There was a Y-B-N fault in 220 kV Begusarai – Ujiarpur line – I and Begusarai end distance protection and backup over current protection failed to identify the fault.*
- *As the 220 kV Begusarai – Ujiarpur line – II was under shutdown hence there is no fault feeding from Ujiarpur.*
- *220 KV Biharsharif-Begusarai line-I distance relay identified the fault in zone II and issued trip command to line CB. The line CB failed to open and clear the fault.*
- *220 KV Biharsharif-Begusarai line-II distance relay at Biharshariff end failed to detect the fault.*
- *Therefore, the fault was finally cleared from backup directional O/C, E/F protection of 400/220 kV ICT – I, II & III at Biharshariff.*
- *220 KV Biharsharif-TVNL line tripped from TVNL end on zone 3.*

PCC recommended the following:

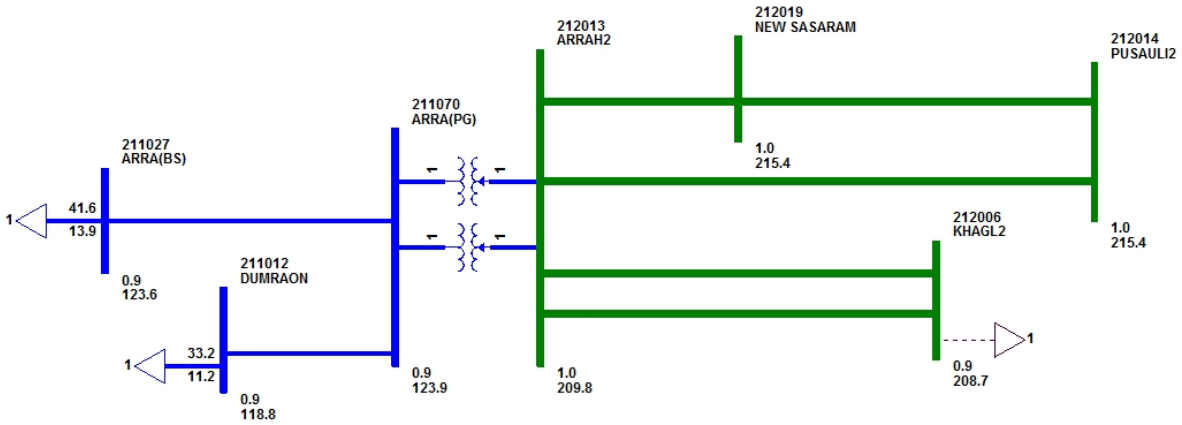
- *220 kV Begusarai – Ujiarpur line – I line relays and CBs at Begusarai end should be tested.*
- *220 KV Biharsharif-Begusarai D/c line relays and CBs should be tested.*
- *220 KV Biharsharif-TVNL line should not trip from TVNL on zone 3 for a fault in 220 kV Begusarai – Ujiarpur line – I, TVNL was advised to check the zone 3 reach setting at TVNL.*

BSPTCL informed that they have taken the following corrective actions:

- *220 kV Begusarai – Ujiarpur line – I line relays at Begusarai end have been replaced on 9th March 2017.*
- *Main II protection of 220 KV Biharsharif-Begusarai line-II Distance relay REL 670 at Biharshariff has been replaced by Schneider's MiCOM P442 relay, as its Tripping was not proper.*
- *220 KV Biharsharif-Begusarai line-II Circuit Breaker has been tested and found that opening time is 1015 msec. The CB has been replaced with healthy CB.*
- *220 KV Biharsharif-Begusarai line-I relay and CB testing in progress.*

ITEM NO. B.3: Disturbance at 220kV Arrah S/s on 30-03-17 at 13:55 Hrs.

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



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

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

At 13:55 hrs, 220 kV Nandokhar – Arrah S/C and 220 kV Nandokhar – Pusauli S/C tripped from Nandokhar end due to high voltage at Nandokhar end.

At same time, both 220/132 kV ICTs at Arrah (PG) were manually tripped resulting power loss at radially connected load at Arrah (BSPTCL), Jagdishpur and Dumraon. As per BSPTCL report phase voltage at Arrah was 148 kV prior to manual tripping of ICTs.

4. **Disturbance record:** Not Submitted

5. **Remedial action taken :** Not submitted

Analysis of PMU plots: At 13:55 hrs, No fault has been observed in PMU data

Status of Reporting: BSPTCL has submitted detail report on 04-04-17

BSPTCL may explain.

Deliberation in the meeting

BSPTCL informed that the 220 kV Nandokhar – Arrah S/C line was in open condition at 220 kV Nandokhar S/s only and 220 kV Nandokhar was getting fed from Pasauli.

Subsequently, severe high voltage(148kV to 154kV phase voltage) was observed at 220 kV Nandokhar S/s after the opening of 220kV Arrah-Pasauli S/c line from Arrah end for voltage controlling. 220 kV Nandokhar – Pusauli S/C tripped on overvoltage.

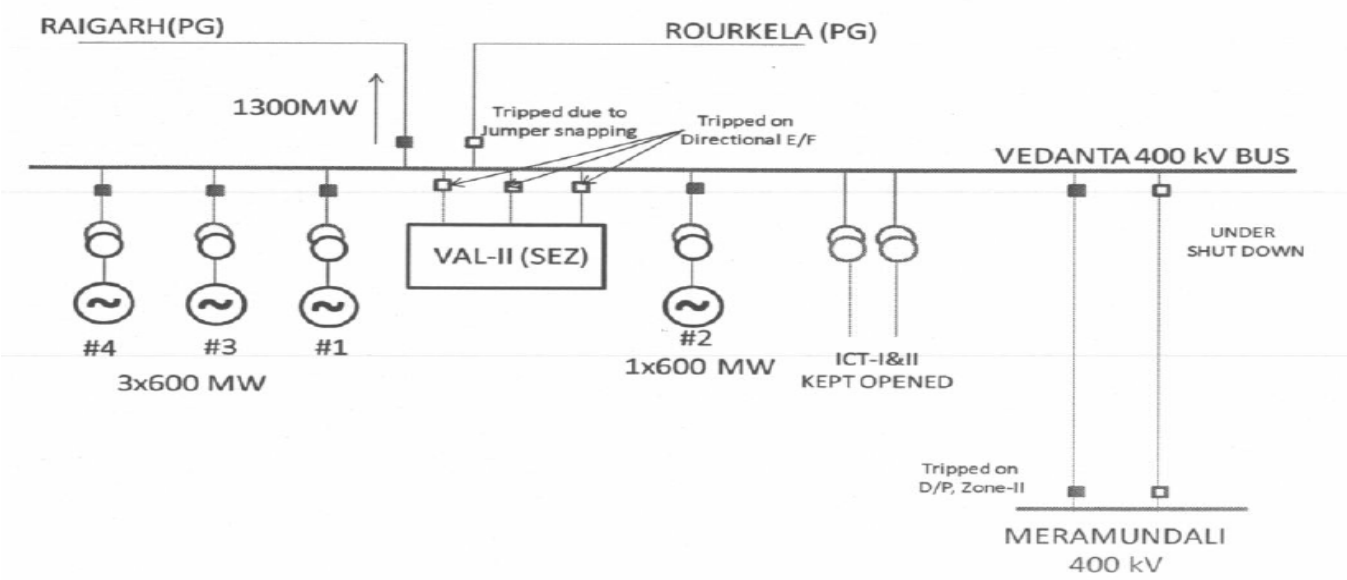
ERLDC informed that Powergrid was directed to change the 400/220kV ICT tap position at 400kV Pusauli from 14 to 12 to control the high voltage.

PCC advised BSPTCL, Powergrid and ERLDC to properly co-ordinate before opening of any line for voltage control.

It was informed the high voltage issue will be discussed in tomorrow's OCC meeting.

ITEM NO. B.4: Disturbance at 400kV Vedanta S/s on 17-03-17 at 10:22 Hrs.

1. **Single line diagram:** Submitted



2. **Pre fault conditions:** Submitted

   400 kV Meramundali – SEL – II and 400/220 kV ICT I & II at SEL were under shut down

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

At 10:22 hrs,

- 400 kV SEL – Rourkela S/C tripped from both ends due to Y phase jumper snapping at Loc. No-88/0 (8.16 km from SEL end).
- A/R operation started at Rourkela after carrier received from remote end.
- After 300 ms, another fault in Y phase has been observed in Z-II and other two breakers tripped after carrier receipt.
- At the same time, 400 kV SEL – Meramundali – I (Ckt – II was under s/d) tripped from Meramundali end but did not trip from SEL end.
- All the three 400 kV SEL internal smelter feeders tripped on E/F resulting increase in 400 kV SEL – Raigarh S/C flow to 1400 MW.
- Though SPS has been implemented to limit the MW flow through 400 kV SEL – Raigarh S/C to 650 MW, more than 800 MW power was flowing through 400 kV SEL – Raigarh S/C for the duration of 17 minutes as per ERLDC SCADA data.
- After restoring 400 kV – Meramundali – SEL – I, power flow in 400 kV SEL – Raigarh S/C decreased to 400 MW.
- No load loss other than smelter load has been reported by GRIDCO. Loss of Smelter load was 800 MW.

Relay indications:

Time (Hrs)	Name of the element	Relay at SEL end	Relay at remote end
10:22 hrs	400 KV SEL – Rourkela S/C	Y-N, Z-I, F/C – 18.67 KA, 8.16 km from SEL	B-N, Z-II, F/C 3.8 kA, A/R started. After 300 ms Y-N, Z-II, F/C 3.1 kA (R & Y breakers tripped)
	220 kV Meramundali – SEL - I	Did not trip	Y-N, 336.5 km
	Three smelter feeders at SEL	E/F	NA

4. **Disturbance record:** Submitted

5. **Remedial action taken :** Not submitted

Analysis of PMU plots:

- In Rourkela PMU data, 40 kV voltage dip in B phase has been observed at 10:22:56.720 hrs. and same voltage dip in Y phase has been observed at 10:22:57.080 hrs.
- Both the faults were cleared within 100 ms.

Status of Reporting:

- Detail tripping report from OPTCL is received on 24-03-17.
- DR & EL were received from POWERGRID on 17-03-17

OPTCL and Powergrid may explain the following:

- Reason for tripping of 400 kV Meramundali – SEL – I and three smelter feeders at SEL may be explained.
- Reason for non-operation of SPS of 400 kV SEL-Raigarh may be reviewed. Power flow of 400 kV SEL-Raigarh was more than 800 MW for almost 17 minutes duration (as per ERLDC SCADA) though SEL injection was being reduced gradually and SEL internal smelter feeders were restored within 5 min of the tripping. After restoring of 400 kV Meramundali – SEL – I, MW flow in 400 kV SEL-Raigarh reduced to 400 MW.

Deliberation in the meeting

OPTCL explained the disturbance with detailed presentation. Presentation is enclosed at **Annexure-B4***. OPTCL explained that*

- *At 10.22Hrs, the 400kV Vedanta-Rourkela ckt. tripped due to B-Y-N fault.*
- *Simultaneously, the smelter feeders at 400kV Vedanta tripped on Non-directional earth fault relay operation.*
- *The 400kV Vedanta-Meramundali Ckt.-I also tripped from Meramundali end on zone 1. 400kV Vedanta-Meramundali Ckt.-II was under shutdown for tree clearance.*
- *OPTCL clarified that in absence of carrier communication and inter tripping scheme, the zone 1 setting for 400kV Vedanta-Meramundali lines was kept at 100%.*

PCC felt that smelter feeders at 400kV Vedanta should not trip for a fault in 400kV Vedanta-Rourkela line and advised OPTCL to use directional over current earth fault relays for better coordination.

OPTCL should implement the inter tripping scheme with zone 1 setting as 80% for 400kV Vedanta-Meramundali D/C line.

PCC felt that SPS scheme should operate as and when power flow in any of the 400 kV SEL-Raigarh or 400 kV SEL-Rourkela line is greater than 650 MW as per the designed SPS scheme and generation backing down of Vedanta units should be initiated in this case.

Vedanta informed that as per the present setting the SPS will be initiated if power flow in 400 kV line exceeds 800 MW. After this disturbance, SPS scheme at Vedanta end has been modified from summation logic to Individual line loading logic.

CE, NPC opined that the SPS settings should not be changed without detail discussion in PCC forum.

PCC took serious note of modifying the SPS settings without intimating ERPC /ERLDC and advised

OPTCL & Vedanta to submit present SPS details immediately for further discussion in OCC/PCC meetings.

OPTCL informed that following corrective measures have already been taken:

- *The OPGW carrier communication for inter tripping scheme between Meramundali & Vedanta has been commissioned.*
- *The zone 1 setting of 400kV Vedanta-Meramundali D/C line has been restored to 80% as per approved Protection Philosophy of Eastern Region.*
- *The Over current Earth fault protection of Smelter feeder has been made directional.*

ITEM NO. B.5: Disturbance at 400kV Bakreswar S/s on 29-03-17 at 09:32 Hrs.

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

2. **Pre fault conditions:** Submitted

   - All 5 units at BkTPP were in running condition.
   - 400 kV Arambag, 400 kV GT #2, 400/220 kV IBT – II were connected to MB #1
   - 400 kV B/R, 400 kV GT#1, 400 kV Jeerat, 400/220 kV IBT – I were connected to MB#2
   - Double Main Bus Transfer bus configuration

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

During diversion of 400 kV GT #2 through bus tie for checking oil pressure of breaker, 400 kV BkTPP – Arambag S/C, 400/220 kV ICT – II, 400 kV bus tie and 400 kV B/C along with GT#2 tripped due to operation of bus bar protection relay (96) of MB#1 at BkTPP.

On investigation it is found that LBB relay of GT#2 operated due to operation of 30/50Z relay & 2/50Z timer due to energization of DC circuit after changeover of NIT (Normal-Inter-Tie) switch from "Inter" to "Tie" position during paralleling of both self & tie breakers of GT#2 for diversion work. Generator #2 remained in house load condition for 22 sec before tripping in reheat protection.

Relay indications:

Time	Name of the element	Relay at BkTPP end	Relay at remote end
09:32 hrs	400 kV Arambag feeder	Line PT U/V relay & B/B tripping relay	Yet to received
	Unit II	Reheat protection	
	400 kV GT#2	LBB Relay, B/B trip relay, Line PT U/V relay at 400 kV side	
	400/220 kV IBT #2	B/B trip relay, Master trip relay at 400 kV side & Master trip relay at 220 kV side	
	400 kV Bus Tie	B/B trip relay	
	400 kV B/C	Line PT U/V relay, B/B trip relay	

4. **Disturbance record:** Not Submitted

5. **Remedial action taken :** Not submitted

Analysis of PMU plots:

- At 09:32 hrs, 0.5 kV dip in all three phases has been observed in Durgapur PMU data for 500 ms.

Status of Reporting: Tripping report received from WBSETCL on 30-03-17

WBPDCL may explain reason for operation of LBB relay.

Deliberation in the meeting

WBPDCL informed that LBB relay of GT#2 operated due to operation of 30/50Z relay & 2/50Z timer on account of energization of DC circuit. Reason for DC energization is yet to be identified.

PCC advised WBPDCL to check the DC circuit.

ITEM NO. B.6: Disturbance at 400 kV RTPS (DVC) S/s on 30-03-17 at 11:54 Hrs.

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

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

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

At 11:54 hrs, main breaker of 400 kV Maithon, Andal #2, idle charged portion of Ranchi #2 and # 3 along with Bus reactor I & II at RTPS tripped due to bus bar protection of main bus #2 at RTPS.

- Two successive faults in R phase have been observed at 11:54:36.640 hrs and 11:54:36.840 hrs in PMU data. Both the faults have been cleared within 100 ms.
- Same has been observed in DR data of 400 kV RTPS – Maithon S/C (Bay 401), 400 kV RTPS – Ranchi #2 & 400 kV B/R I (Bay 407) and 400 kV RTPS – Andal – II (Bay 413) at RTPS end.
- In case of Maithon bay, no D/P relay picked up though F/C was 4.2 kA and voltage was 102 kV in R phase during first voltage dip at 11:54:36.640 hrs.
- In case of Ranchi#2 bay, no tripping occurred though Z-I relay picked up during first voltage dip at 11:54:36.640 hrs (F/C 8.8 kA, voltage was 103 kV).
- All three feeders i.e. Maithon S/C, Ranchi II & III tripped during second voltage dip). In case of Ranchi III bay, Z-I picked up at 11:54:36.890 hrs (during second voltage dip) for R –N fault and R phase breaker opened (Other two phase current was non-zero till the end of the time window captured by DR).

4. **Disturbance record:** Submitted

5. **Remedial action taken :** Not submitted

Analysis of PMU plots:

- Two successive faults in R phase have been observed at 11:54:36.640 hrs and 11:54:36.840 hrs in PMU data.
- Both the faults have been cleared within 100 ms.

Status of Reporting: DR data from DVC has been received on 31-03-17.

DVC may explain the following:

- Reason for non-tripping of 400 kV RTPS – Ranchi #2 even after detecting fault in Z-I may be explained
- D/P relay setting at RTPS end of 400 kV RTPS – Maithon S/C may be checked
- Reason for unbalance in three phase current in 400 kV RTPS – Andal #2 may be checked

Deliberation in the meeting

DVC explained the tripping incidence with detailed presentation. Presentation is enclosed at Annexure-B6. DVC explained that

- *400 kV RTPS – Ranchi ckt #2 & 3 lines were idle charged from RTPS end.*
- *At 11:54 hrs, R-N fault occurred in 400 kV RTPS – Ranchi #2 and the line tripped from RTPS end on zone 1*
- *But the CB at RTPS end was not opened properly and again it got closed after 140 ms.*
- *As the trip L1 signal from Ranchi # 2 distance relay has a pulse width of 150ms, the LBB initiation remained active.*
- *As soon as CB got closed, charging current of more than 100A was flowing through the line and thus LBB operated after sensing the current above its pick up value. (LBB current setting at 100A primary with timer of 200ms.)*
- *After 200 ms, another R-N fault occurred in 400kV RTPS- Ranchi # 2 & 3 and RTPS end relays cleared the fault in zone 1.*
- *As the LBB function was already active, LBB relay tripped all the lines connected to the Bus 2.*

PCC advised DVC to test the CB of 400 kV RTPS – Ranchi #2 at RTPS end. The LBB current setting should be kept slightly greater than the charging current in order to avoid the unwanted operation of LBB protection.

PART- C:: OTHER ITEMS

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. C.1: Disturbance at 220 kV Arrah (BSPTCL) S/s on 02-02-17 at 00:22 hrs.

In 53rd PCC, Powergrid informed that a transient B-N fault occurred in 220 kV Arrah – Sasaram S/C line and Sasaram end relay identified the fault in zone 1. Autoreclose operation was initiated from both the ends but at Arrah end after 1000 ms, poles of other two phases were tripped on pole discrepancy. Autoreclose operation was unsuccessful at Sasaram end also.

PCC advised Powergrid to check the Autoreclose scheme at both Sasaram and Arrah ends and investigate the reason for pole discrepancy at Arrah end.

Powergrid may update.

Deliberation in the meeting

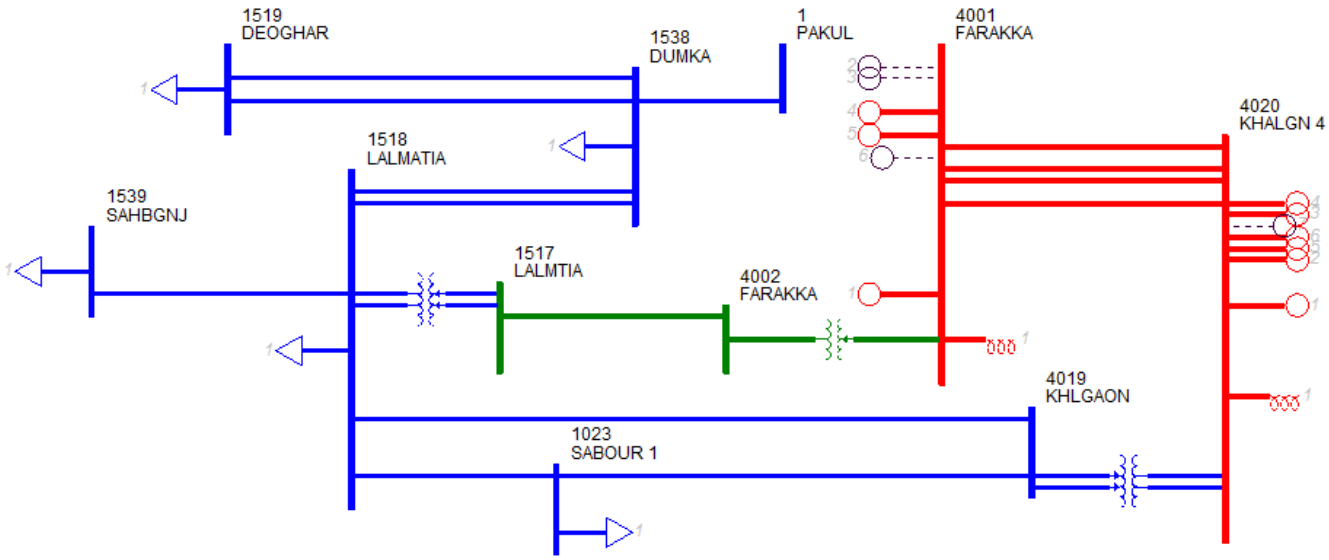
Powergrid informed that there was a problem in autoreclose circuit at 220kV Arrah end and the same has been rectified. There is no problem at 220kV Sasaram end and the auroreclose feature is in service.

ITEM NO. C.2: Multiple elements tripping at 220/132 kV Lalmatia (JUSNL) S/s on 06-02-17 at 16:40 Hrs.

At 16:40hrs, blasting of 132 kV Y & B phase CTs of 132 kV bus sectionalizer at 220/132kV Lalmatia S/s resulted in following events:

- 132 kV Lalmatia - Kahalgaon and 132 kV Lalmatia - Dumka – II tripped from Lalmatia end on zone IV protection.

- 132 kV Lalmatia -Dumka – I feeder tripped from both end.
- Farakka end of 220 kV Farakka Lalmatia line, remain picked up the fault in zone 1 for 880 ms but no line breaker was tripped.



The relay Indications are as follows:

Time	Name of the element	Relay at Lalmatia	Relay at remote end
16:40 hrs	220 kV Lalmatia - Farakka feeder	Did not trip	R-Y-B phase Z-I started, B phase relay picked at 16:40:28.504 hrs, Y phase relay picked at 16:40:28.664 hrs, R phase relay picked at 16:40:28.905 hrs, F/C 1.5 kA in all three phases. All the relay were in picked condition till the end of time frame captured by NTPC end DR (DR is attached)
	132 kV Lalmatia - KhSTPP feeder	B-N, Z-IV, O/C, IA 0.7kA, IB – 0.9 kA, IC – 3kA, Fault duration 183.8 ms.	Did not trip
	132 kV Lalmatia Dumka – I	E/F	D/P
	132 kV Lalmatia Dumka – II	E/F, Z-IV	Did not trip
	220/132 KV ATR, 132/33 KV ATR – I & II at Lalmatia	E/F protection at Lalmatia	

Analysis of PMU plots:

- At 16:40 hrs, 4 kV voltage dip observed in all three phases.
- Fault clearance time is 700 ms. Though the voltage fully recovered to pre-fault value after 600 ms of the fault.

Status of Reporting:

- Preliminary report was received from JUSNL on 06-02-17.
- NTPC has sent DR on 09-02-17

In 53rd PCC, NTPC informed that 132 kV Y & B phase CTs of 132 kV bus sectionalizer were busted at 220/132kV Lalmatia S/s and Bus bar protection was failed to operate. One 220/132kV ATR at Lalmatia (under NTPC control area) tripped on backup E/F protection other ATR which is under JUSNL control area was failed to clear the fault. As a result, 220kV Lalmatia-Farakka line tripped

from Farakka end on directional E/F protection.

JUSNL informed that 132kV Lalmatia-Dumka D/C line and 132kV Lalmatia-Khahalgaon S/C line tripped from Lalmatia end on non directional over current protection. The 220/132kV ATR at Lalmatia under their control area also tripped on over current E/F protection.

PCC observed that 220kV Lalmatia-Farakka line tripped from Farakka end after 6 sec which is not acceptable and tripping of 220/132kV ATRs is not clear.

PCC advised the following:

- NTPC should check the reason for non-operation of busbar protection at 132kV Lalmatia S/s.
- NTPC and JUSNL should jointly test the healthiness of the busbar protection at 132kV Lalmatia S/s
- NTPC and JUSNL should place the details of ATR tripping along the relevant DR.
- JUSNL should disable the non-directional over current protection feature in all 132kV lines and enable directional over current protection with proper relay coordination.

PCC advised JUSNL and NTPC to submit the action taken report to ERPC and ERLDC within a week.

NTPC and JUSNL may update.

Deliberation in the meeting

NTPC and JUSNL informed that they will test the healthiness of the busbar protection at 132kV Lalmatia S/s in May 2017.

JUSNL informed they have not yet disabled the non-directional over current protection feature in all 132kV lines.

PCC advised JUSNL and NTPC to comply the observations at the earliest.

ITEM NO. C.3: Disturbance at 220 kV Chandil (JUSNL) S/s on 24-02-17 at 09:05 Hrs.

At 09:05hrs, 220 kV Ranchi – Chandil S/C tripped due to Y phase CT burst at Chandil end. At the same time, 220 kV STPS – Chandil S/C tripped from Chandil end & 220 kV Ramchandrapur – Chandil S/C and 220 kV Ramchandrapur – Joda S/C tripped from Ramchandrapur end.

Analysis of tripping of 220 kV Ranchi – Chandil:

- As per DR, it is observed that Chandil end identified the fault in 220 kV Ranchi – Chandil S/C on zone 1 protection and issued trip command to CBs
- R & B phase breakers at Chandil end tripped within 80 ms but Y phase breaker did not open properly at Chandil end as Y phase current was not zero for 800 ms approx.

Analysis of tripping of 220 kV Ramchandrapur – Chandil:

- Chandil end tripped on zone IV and Ramchandrapur end tripped on zone –II.
- Though Y & B phase current became zero, R phase current remained more than 520 A at both end for 400 ms and then it increased to 2.9 kA.

Analysis of tripping of 220 kV STPS – Chandil:

- Chandil end tripped on zone IV and all the breakers tripped within 60 ms. F/C I_R = 698 A, I_B = 1.8 kA

Analysis of tripping of 220 kV Ramchandrapur – Joda:

- Ramchandrapur end picked up zone 1 and R&B phase current was more than 200 A while

phase voltage <5kV.

The relay indications are as follows:

Time	Name of the element	Relay at local end	Relay at remote end
09:05 hrs	220 kV Chandil Ranchi S/C	Y-N, Z-I, O/C, E/F	Yet to be received
	220 kV Chandil STPS S/C	Y-N, Z-IV	Did not trip
	220 kV Chandil Ramchandrapur S/C	Y-N, Z-IV	Y-N, Z-II
	220 kV Ramchandrapur Joda S/C	Z-I at Ramchandrapur	Yet to be received

Analysis of PMU plots:

- At 09:05 hrs, 12 kV voltage dip observed in Y phases. Fault clearance time is 800 ms.

Status of Reporting: Preliminary report along with DR was received from JUSNL on 24-02-17.

In 53rd PCC, JUSNL explained that at 09:05hrs,

- 220 kV Ranchi – Chandil S/C line tripped due to Y phase CT burst at Chandil end. Ranchi end tripped and cleared the fault on zone 2 protection.
- Chandil end relay identified the fault in zone 1 and issued trip command to CB but Y-phase pole of breaker did not open from Chandil end.
- As a result, 220 kV STPS – Chandil S/C line tripped from Chandil end on zone –IV protection within 60 ms.
- 220 kV Ramchandrapur – Chandil S/C line tripped from Chandil end on zone-IV protection within 500 ms.

JUSNL failed to explain the tripping of 220 kV Ramchandrapur – Chandil S/C line from Ramchandrapur end on zone 2 protection and tripping of 220 kV Ramchandrapur – Joda S/C line from Ramchandrapur on zone 1 protection.

JUSNL added that 315 MVA, 400/220kV ICT also tripped during this disturbance.

PCC advised the following:

- JUSNL should check the zone IV time setting of 220 kV STPS – Chandil S/C line at Chandil end.
- JUSNL should check & rectify the Y-ph pole of CB of 220 kV Ranchi – Chandil S/C at Chandil end
- Regarding tripping of 220 kV Ramchandrapur – Chandil S/C, 220 kV Ramchandrapur – Joda S/C and 315 MVA, 400/220kV ICT, JUSNL and Powergrid were advised to collect the details and submit the explanation to ERPC and ERLDC within 2 days.

JUSNL and Powergrid may update.

Deliberation in the meeting

Powergrid submitted the event logger data of ICT tripping.

JUSNL informed that 220 kV Ramchandrapur – Chandil S/C line not tripped from Chandil end and zone-IV pickup observed at Chandil end.

JUSNL added that CB of 220 kV Ramchandrapur – Chandil S/C at Ramchandrapur end has been replaced. The testing of CB of 220 kV Ranchi – Chandil S/C at Chandil end will be done in 3rd week of April 2017.

ITEM NO. C.4: Disturbance at 220kV NJP (WBSETCL) S/s on 19-01-17 at 00:12 Hrs.

In 52nd PCC, it was felt that 220kV bus section should not trip for a fault in 132kV system.

PCC advised WBSETCL and Powergrid to place the action plan in next PCC meeting to avoid such unwanted tripping of 220kV bus section.

Powergrid and WBSETCL may update.

Deliberation in the meeting

Powergrid and WBSETCL informed that the scheme has been modified on 27th January 2017 and the scheme is operating correctly.

ITEM NO. C.5: Total power failure at Hatia-Ranchi-Namkom-PTPS complex of JUSNL system on 25-01-17 at 08:45hrs

In 52nd PCC, JUSNL was advised to do proper relay coordination in 132kV lines at Hatia-I, Hatia old, Kanke and PTPS.

JUSNL informed that they are replacing the old EM relays with numerical relays.

PCC advised JUSNL to update the status in next PCC meeting.

In 53rd PCC, JUSNL informed that replacement of old EM relays with numerical relays has been completed. The settings are yet to be incorporated.

JUSNL may update.

Deliberation in the meeting

JUSNL informed that replacement of old EM relays with numerical relays has been completed.

ITEM NO. C.6: Disturbance at 220 kV Gaya (PG) S/s on 13-01-17 at 12:49 Hrs.

In 52nd PCC, Powergrid informed that it was maloperation of bus bar protection and the details have been forwarded to Siemens. The analysis report is yet to be received from Siemens.

PCC advised Powergrid to place the outcome in next PCC meeting.

Powergrid may update.

Deliberation in the meeting

Powergrid informed that bus bar protection mal-operated due to CT problem in 220kV Sonenagar line. The same has been rectified.

ITEM NO. C.7: Disturbance at 400 kV Kahalgaon (NTPC) S/s on 24-01-17 at 17:12 Hrs

In 52nd PCC, NTPC was advised to check the PLCC scheme of Kahalgaon-Barh line-I.

NTPC may update.

Deliberation in the meeting

NTPC informed that PLCC scheme has been checked and found correct.

ITEM NO. C.8: 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

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

ITEM NO. C.9: 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*	46	85.19
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

** Pending observations of Powergrid are related to PLCC problems at other end.*

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 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

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.

Members may update.

Deliberation in the meeting

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

ITEM NO. C.10: 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-C10**.

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.

Members may update.

Deliberation in the meeting

Powergrid ER-I, ER-II and Powergrid-Odisha have submitted the details.

ITEM NO. C.11: 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-C11**. 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.

In 52nd PCC, Powergrid ER-I has submitted the over voltage settings. PCC advised all other constituents to update the settings.

Members may update.

Deliberation in the meeting

Powergrid ER-I, ER-II and Powergrid-Odisha have submitted the details.

ITEM NO. C.12: 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.

In 49th PCC, PRDC informed that data collection for West Bengal is in progress and it will be completed by December, 2016.

In 50th PCC, It was informed that Software Acceptance Tests are in progress.

In 51st PCC, PRDC informed that data collection of Odisha and Jharkhand has been completed. Data collection in West Bengal and Bihar is in progress. Data collection of Eastern Region will be completed by 15th February 2017.

PRDC added that software acceptance trails of PSCT phase-I have been completed and phase-II will be done from 19th to 21st January 2017. Software acceptance trails of web based PDMS system have been completed and observations will be implemented at the earliest.

It was informed that a format for on-line reporting of tripping incidence has been prepared in PDMS and PRDC will present details in next PCC meeting.

In 52nd PCC, PRDC explained the format for on-line reporting of tripping incidence.

PCC suggested PRDC to include details of the elements under shutdown before the disturbance.

In 53rd PCC, PRDC informed that data survey and modeling has been completed and PDMS will be operational by 31st March 2017. The login id will be provided soon.

PRDC presented the format for on-line reporting of tripping incidence.

PCC in principle agreed with the format and advised PRDC to include a summery sheet for the each tripping incidence.

PRDC may update.

Deliberation in the meeting

PRDC informed that summery sheet for on-line tripping incidence reporting has been prepared. The PDMS is operational and constituents can access the data. Login credentials were given to all the constituents.

It was decided that a separate will be convened in May 2017 to finalize the procedure for on-line reporting and data updation.

ITEM NO. C.13: 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	PLCC available	Functional
2	400 KV BIHARSARIFF-VARNASI-I	07.06.16	B-N FAULT	PGCIL	PGCIL	PLCC available	Functional (10.11.2016)
3	400KV BIHARSARIFF - BANKA-II	12.06.16	Y - N FAULT	PGCIL	PGCIL	PLCC available	Functional (25.09.2016)
4	220KV SASARAM-SAHUPURI	12.06.16	B - N FAULT	PGCIL	UPTCL	PLCC available	Functional at Pusauli
5	400 KV TALA -BINAGURI -IV	13.06.16	B - N FAULT	Durk Green	PGCIL		Tala end AR is disabled.
6	400 KV KODERMA-BOKARO-I	14.06.16	B-N FAULT	DVC	DVC	PLCC available	AR in service
7	400 KV FARAKKA-KAHALGAON-IV	15.06.16	R-N FAULT	NTPC	NTPC	Yes	Yes and operated last on dated 28.09.2016.
8	400 KV MUZAFFARPUR-BIHARSARIFF-II	17.06.16	Y-N FAULT	PGCIL	PGCIL	PLCC available	Functional (08.10.2016)
9	400 KV MERAMUNDALI-NEWDUBRI - I	20.06.16	B-N FAULT	OPTCL	OPTCL	PLCC available	Yes
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	PLCC available	Functional (21.06.2016)
12	400KV PATNA-BALIA-I	21.06.16	R-N FAULT	PGCIL	PGCIL	PLCC available	
13	220KV BUDIPADAR-KORBA-II	23.06.16	Y-N FAULT	OPTCL	CSEB	PLCC available	will be activated in consultation with Korba
14	400 KV ARAMBAGH - BIDHANNAGAR	02.07.16	Y-N FAULT	WBSETCL	WBSETCL	PLCC available	AR in service but some problem in y-ph pole
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
16	400 KV NEW RANCHI - CHANDWA - I	13.07.16	B-N FAULT	PGCIL	PGCIL	PLCC available	
17	220 KV TSTPP-RENGALI	17.07.16	EARTH FAULT	NTPC	OPTCL		
18	220KV BUDIPADAR-RAIGARH	21.07.16	EARTH FAULT	OPTCL	PGCIL	PLCC defective	
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	Yes	Old Relay and not functional. 7-8 months required for auto re-close relay procurement.
21	400 KV PURNEA-MUZAFARPUR-I	03.08.16	R-N FAULT	PGCIL	PGCIL	PLCC available	
22	400 KV GAYA - CHANDWA -II	04.08.16	B-N FAULT .	PGCIL	PGCIL	PLCC available	Functional (01.09.2016)
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	OPGW available	Expected to install protection coupler by Jan 17
25	220 KV CHANDIL-SANTALDIH	25.08.16	R-N FAULT	JUSNL	WBPDCL	not available	
26	400 KV MPL-RANCHI-II	02.09.16	R-N FAULT	MPL	PGCIL	PLCC available	
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	OPGW not commissioned	
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	OPGW not commissioned	
31	400 KV KOLAGHAT - CHAIBASA	28.09.16	B-N FAULT	WBPDCL	PGCIL	PLCC available	

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.

PCC advised Powergrid, DVC, NTPC, WBSETCL, WBPDCL, JUSNL, BSPTCL, MPL and SEL to communicate the latest status along with the last tripping status to ERPC and ERLDC.

Members may update the status.

Deliberation in the meeting

Members updated the status as given above.

ITEM NO. C.14: 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 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.*
West Bengal				
1	220 kV Arambah	Not available	24-Jan-13	*Available in alarm mode. Planning to replace with numerical relay*
2	220 kV Jeerat	Not available	20-Dec-12	*Relays have been received at site. Installation is in progress.*

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

Members noted.

ITEM NO. C.15: Frequent Blackouts at Kanti TPS

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.

51st PCC, NTPC informed that PLCC has been installed in 220kV Kufen line.

PCC advised BSPTCL to install PLCC system for all the transmission lines connected to 220kV Gopalgunj, Darbhanga and Begusarai and enable the carrier tripping for reliable protection.

Members may update.

Deliberation in the meeting

BSPTCL informed that work is in progress.

ITEM NO. C.16: 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
- 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.

In 52nd PCC, OPTCL updated the status as follows:

- *Numerical Distance protection Relays are provided at 220kV Tarkera S/s except 132kV Rourkela-1 feeder. As new relay released is not fitting with the existing panel. REL670 relay of Kaunga feeder in is being interchanged.*
- *Procurement of numerical O/C & E/F are under process. On receipt of the same, EM relays will be replaced.*

OPTCL may update.

Deliberation in the meeting

OPTCL informed that 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

OHPC informed that work is in progress.

3. 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

WBSETCL informed that the scheme has been modified in coordination with Powergrid on 15th February 2017.

PART- D

Item No D.1 Tripping incidences in the month of March, 2017

Other tripping incidences occurred in the month of March 2017 which needs explanation from constituents of either of the end is given at **Annexure- D1**.

Members may discuss.

Deliberation in the meeting

Members explained the tripping incidence. Updated status is enclosed at AnnexureD1.

Item No D.2 Any other issues.

Meeting ended with vote of thanks to the chair.

****

Annexure-A

Participants in 54th PCC Meeting of ERPC

Venue: ERPC Conference Room, Kolkata Time: 11:00 hrs Date: 20.04.2017 (Thursday)

Sl No	Name	Designation/ Organization	Contact Number	Email	Signature
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"Coming together is a beginning, staying together is progress, and working together is success." –Henry Ford

Participants in 54th PCC Meeting of ERPC

Venue: ERPC Conference Room, Kolkata Time: 11:00 hrs Date: 20.04.2017 (Thursday)

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Participants in 54th PCC Meeting of ERPC

Venue: ERPC Conference Room, Kolkata Time: 11:00 hrs Date: 20.04.2017 (Thursday)

Sl No	Name	Designation/ Organization	Contact Number	Email	Signature
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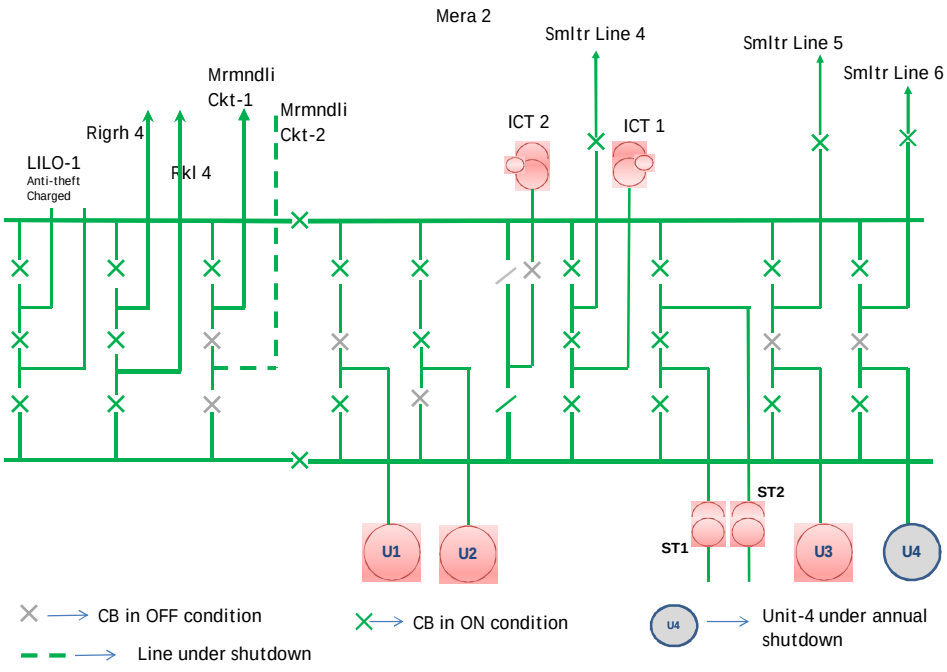
Annexure-B4

INCIDENT ANALYSIS REPORT

Date of Incident: 17.03.2017
Time of Incident: 10.21 hrs

SLD showing CB status of Vedanta 400KV Switchyard before the incident:

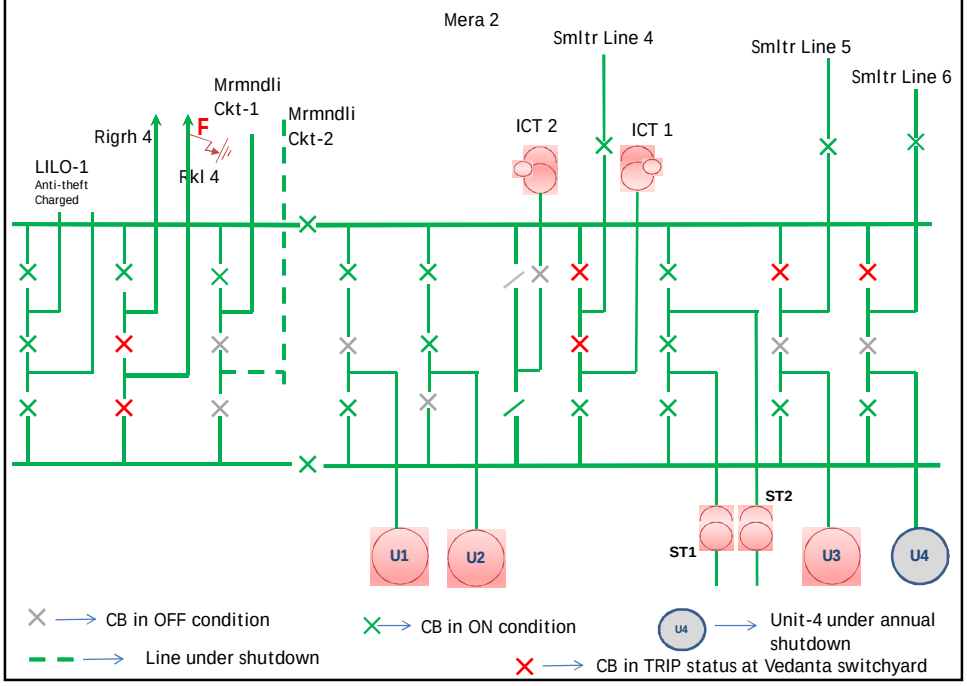


Power Balance just before incident :

Description	Power (MW)
GT1 (Net)	480 MW
GT2 (Net)	450 MW
GT3 (Net)	465 MW
GT4 (Net)	S/D
ST1	10 MW
ST2	IDLE CHARGED
LINE4(SMELTER FEEDER)	250MW
LINE5(SMELTER FEEDER)	285 MW
LINE6(SMELTER FEEDER)	295 MW
LINE7(400 KV VL- Meramndalli-ckt#2)	S/D
LINE8(400 KV VL- Meramndalli-ckt#1)	180 MW
LINE9(400 KV VL- Rourkela-ckt#2)- LILO-2	260 MW
LINE10(400 KV VL- Raigarh-ckt#2) –LILO-2	120 MW
LINE11(400 KV VL Rourkela -ckt#1) –LILO-1	Antitheft Charged
LINE12(400 KV VL Raigarh -ckt#1) –LILO-1	Antitheft Charged

- Unit 1, 2, 3 Combined Generation = 1395 MW, Smelter Load= 825 MW, Station Load= 10 MW, Grid Export= 560 MW
- Unit#4 in S/D and 400KV VL-Meramundali Circuit-II was in S/D condition

SLD showing CB trip status of Vedanta 400KV Switchyard after the incident:



Bay ground of Incident :

400KV VL-Meramundali Circuit-II (Line-7) was under Shutdown Condition from 10.18 hrs for checking of intertripping & carrier protection. Consequently at 10.21 hrs 400 KV Vedanta- Rourkela LILO-2 tripped on Distance protection (Distance= 8.16 kms, Fault Current= 18.86 KA). Because of the heavy fault current, 400 KV Vedanta- Meramndalli Ckt#1 (Line-8) got trippeded from remote end (Meramndalli S/S End) and simultaneously all 400 KV CBs of Smelter Feeders got tripped on Earth Fault (Due to Nondirectional Feature set in relay).

Sequence of Events:

Date	Time (in Hrs)	Sequence of events	Remarks
17.03.2017	10.21.39.200	B phase CB of 400 KV Vedanta –Rourkela (Main Feeder)along with Tie Feeder got opened	Zone1 –B Phase Trip Fault Current= 19 KA Distance=1.8 Kms Setting:-Td=0 secs , Z1=80% of Line Length
17.03.2017	10.21.39.200	Single Phase Autoreclosure Initiation given to Main and Tie of 400 KV Vedanta- Rourkela feeder	Setting:- Single Phase A/R Dead Time=1 sec (Main Breaker) Tie Breaker= 2 secs
17.03.2017	10.21.39.585	Single Phase Autoreclosing Initiation Blocked as Z1 Fault Occurred in Y phase of 400 KV Vedanta –Rourkela within auto reclosing dead time of 1 sec.	Distance protection Zone1 acted – Y phase Trip Fault Current=18.665 KA Distance= 8.16 Kms Setting:-Td=0 secs , Z1=80% of Line Length
17.03.2017	10.21.39.587	R,Y pole of CB got opened for 400 KV Vedanta – Rourkela (Main Feeder)along with Tie Feeder	Three Phase Trip Command Issued to Main and Tie Feeder of 400 KV Vedanta- Rourkela
17.03.2017	10.21.39.587	400 KV Vedanta- Meramandalli Ckt#2 got tripped from Remote End (Meramundali SS).	Y-N Phase Fault Fault Current= 2.2 KA, around 336Km
17.03.2017	10.21.39.590	400 KV Vedanta- Smelter Feeders (Line4,5,6) tripped on TEF (Earth Fault)	Due to Non Directional Features, all Smelter Feeders got tripped as the Earth fault current was 3.15 KA. Setting- 100% of 2500 A, Time Delay= 0 secs

Observations

- Y phase Jumper found snapped at Location no-88/0 at a distance of 8.16 kms from Vedanta End in 400 KV Vedanta- Rourkela Ckt#2. Due to this Heavy Fault Current, Remote End (400 KV Vedanta- Meramndalli Ckt#1) got opened at 10.21.39 hrs.
- simultaneously Smelter Line (Line-4, Line-5, Line-6) Tripped on TEF (Earth Fault Protection acted due to Non-directional Setting 3.15kA in each feeder).
- Meramandali SS end fault recorded as Y-N FAULT, Fault Current-2.2 KA, Fault distance-336.0 km.
- At Rourkela SS end details fault recorded as - 1ST fault :-B-N Fault, Fault current-3.77 KA, Fault distance-126 km, 2nd fault- Y-N fault, Fault current-3.06 KA, Fault distance-126 km.
- Inter-tripping of Meramandali line was in the verge of commissioning,. Zone settings of the line was kept 100% at both the Vedanta Switchyard end & Meramundali SS end as per recommendation of OPTCL.
- Generation of the available Generator reduced to the technical minimum level sensing two line availability (Raigarh & Meramandali circuit-1) at Vedanta switchyard end.

Following Actions executed after the incident

- 400 KV Vedanta – Smelter Feeders Charged at 10.27 hrs
- 400 KV Vedanta- Meramandalli Ckt#1 (Line8) Charged from Meramndalli End at 10.40 hrs.
- Shut-down clearance availed for 400KV Vedanta-Rourkela Ckt at 12:02 Hrs for jumper correction
- 400KV Vedanta-Rourkela Ckt#4 charged at 17:32Hrs

From Disturbance Recorder of Vedanta Rourkela feeder

General data

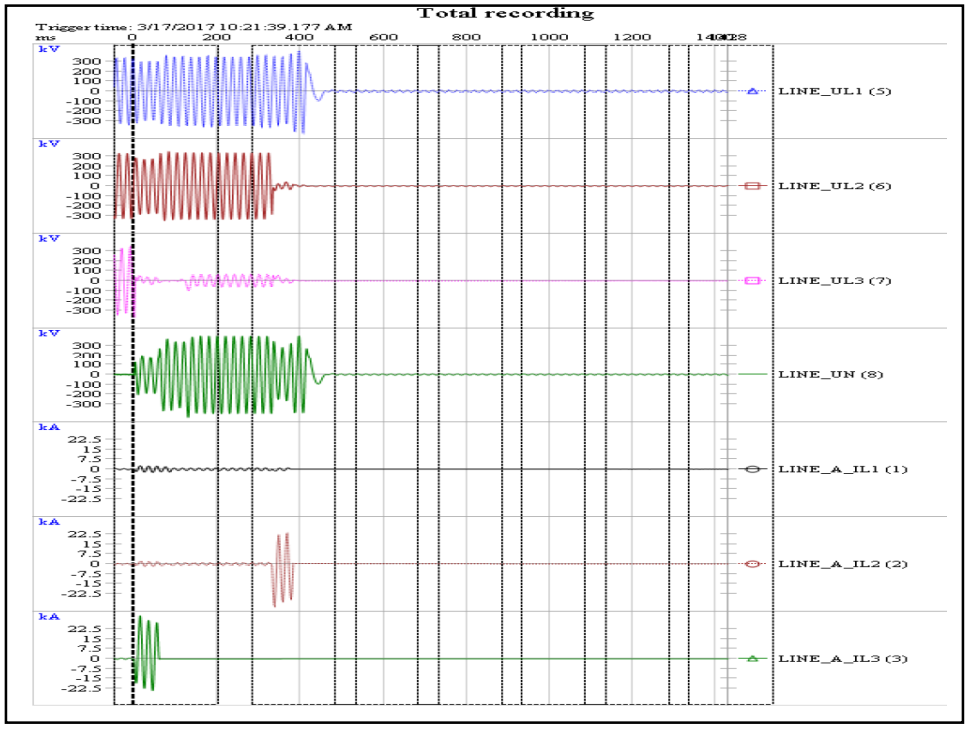
Name	Value
Station name	STERLITE ENERGY
Object name	REL 670_4R06
IED name	ROURKELA_LILO2
Line length	135.0
System Frequency	50.0 Hz
Recording number	170
Trigger signal name	PHS-STPE
Trig date and time	3/17/2017 10:21:39.177 AM
Pre-trig recording time	50 ms
Post trig recording time	999 ms
Total recording time	1479 ms
Max. recording time	2000 ms

Fault location

Name	Value
Fault loop type	L2-L3
Fault location	8.2 (6.0 %)
Status of fault calculation	Ok
Fault Direction	Forward

Analog channels

Number	Channel name	Prefault RMS	Prefault angle	Fault RMS	Fault angle
1	LINE_A_IL1	0.4 kA	22.5°	1.7 kA	39.9°
2	LINE_A_IL2	0.4 kA	-95.0°	1.3 kA	17.2°
3	LINE_A_IL3	0.4 kA	138.7°	18.9 kA	43.3°
5	LINE_UL1	234.2 kV	0.0°	208.1 kV	9.8°
6	LINE_UL2	234.5 kV	-120.0°	206.2 kV	-127.8°
7	LINE_UL3	233.9 kV	119.7°	24.4 kV	79.2°
8	LINE_UN	1.1 kV	4.7°	132.8 kV	-51.2°



Recommendations

- Inter-tripping with carrier protection of Vedanta – Meramundali 400KV Transmission line to be taken in service: Status- put in service on 3rd April'17
- Zone-1 setting of both Vedanta-Meramandali Circuits to be revised from 100% to 80% at Meramundali SS end as per recommended setting of OPTCL: Status- completed on 3rd April'17
- Zone-1 setting of both Vedanta-Meramandali Circuits to be revised from 100% to 80% at Vedanta Switchyard end as per recommended setting of OPTCL: Status- completed on 6th April'17
- Smelter feeder settings need to be revised from non-directional to directional EF: Status- completed on 25th March'17
- To overcome such type of contingency in future, Vedanta requesting for combine operation philosophy by connecting 220KV Budhipadar system with 400KV existing system through existing 400KV/220KV 315MVA ICTs.

SPS Power_Export_Logic

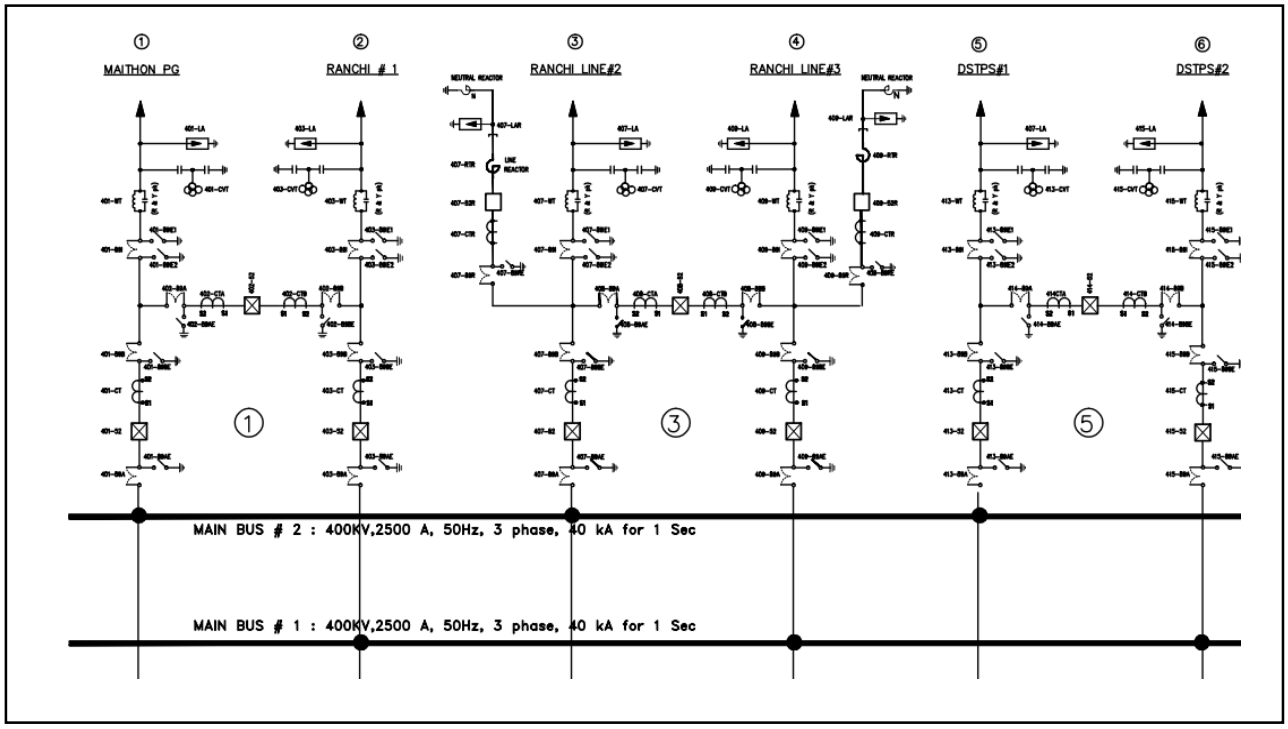
Before 17th March Incident	After 17th March'17 Incident
Grid export set point in CILMS on the basis of SUMMATION of Power Export (MW) in GRID lines from Vedanta power network (Operator Settable)	Modification carried out in CILMS based on the common set point power export through 400KV lines from Vedanta power network (Operator Settable)

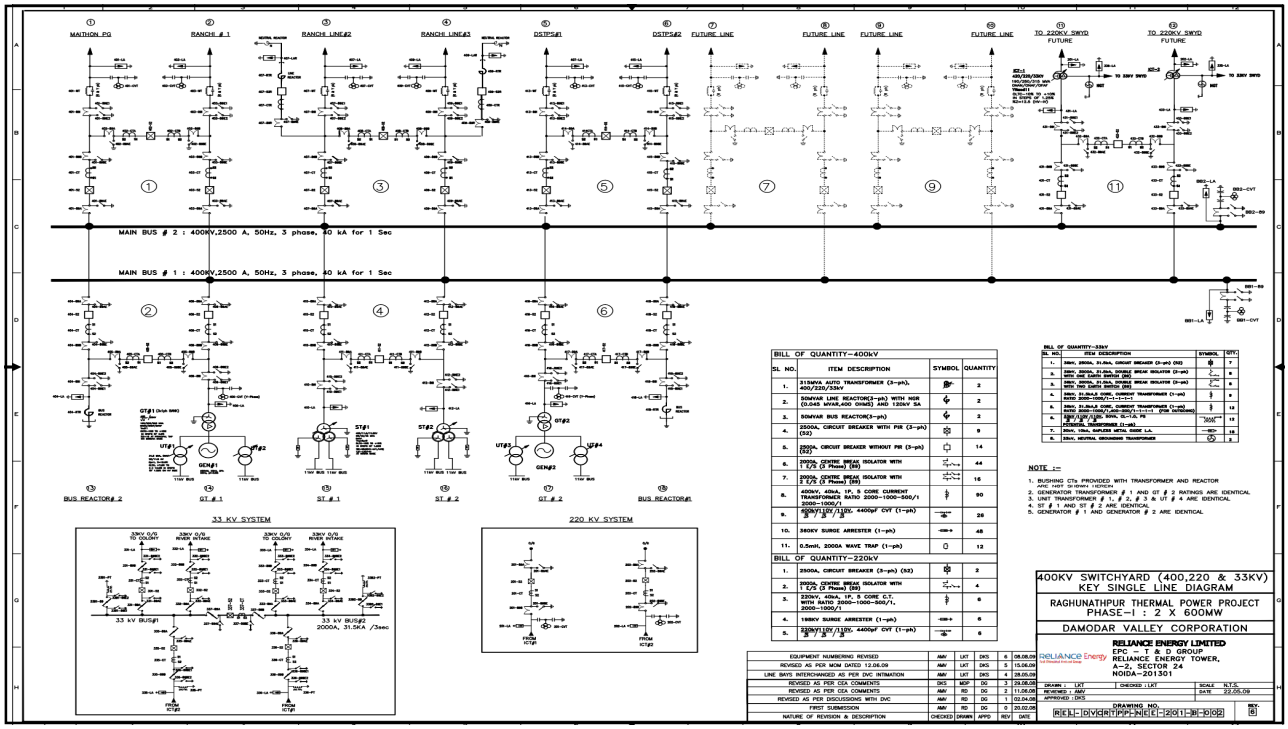
Annexure-B6

DISTURBANCE AT RTPS ON 30.03.17

BRIEF HISTORY AND PRE FAULT CONDITIONS

- At about 11:54 hrs RTPS Ranchi Line # 2 & 3 tripped within 200ms of each other along with tripping of Bus # 2 due to operation of LBB of Ranchi # 2 Line.
- All the lines i.e Line # 401 (RTPS-Maithon), Line # 403 (RTPS-Ranchi-I), Line # 407 (RTPS-Ranchi-II), Line # 409 (RTPS-Ranchi-III), Line # 413 (RTPS-DSTPS-I), Line # 415 (RTPS-DSTPS-II) were in service and main & Tie breaker of GT # 1 & 2 were in open condition.
- Relevant SLD next page. Bus # 2 has Maithan, Ranchi # 2 & DSTPS # 1, ST # 1.


① MAITHON PG
② RANCHI # 1
③ RANCHI LINE#2
④ RANCHI LINE#3
⑤ DSTPS#1
⑥ DSTPS#2
MAIN BUS # 2 : 400KV,2500 A, 50Hz, 3 phase, 40 kA for 1 Sec
MAIN BUS # 1 : 400KV,2500 A, 50Hz, 3 phase, 40 kA for 1 Sec


MAIN BUS # 2 : 400KV,2500 A, 50Hz, 3 phase, 40 kA for 1 Sec
MAIN BUS # 1 : 400KV,2500 A, 50Hz, 3 phase, 40 kA for 1 Sec
33 KV SYSTEM
220 KV SYSTEM
400KV SWITCHYARD (400,220 & 33KV)
KEY SINGLE LINE DIAGRAM
RAGHUNATHPUR THERMAL POWER PROJECT
PHASE-I : 2 X 600MW
DAMODAR VALLEY CORPORATION
RELIANCE ENERGY LIMITED

TIMELINE OF EVENTS

- 11:54:36.676 hrs – -11ms – R-N fault appears in Ranchi # 2 Line. If = 8.69kA and Fd = 25km in M1 & 50km in M2 relay.
- 11:54:36.687 hrs – 0ms – Z1 trip issued.
- 11:54:36.707 hrs – 30ms – CB opens – fault cleared evident from regaining of bus voltages of other connected lines.
- But probably not opened properly as voltage is not completely dying down.
- Trip L1 signal from Ranchi # 2 distance relay has a pulse width of 150ms and till then LBB initiation remains.
- 11:54:36.836 hrs – 140ms – Before LBB initiation drops OFF, Main CB of Ranchi # 2 closes somehow once more.
- LBB current setting at 100A primary with timer of 200ms.

TIMELINE OF EVENTS

- As soon as CB closes more than 100A line charging flows and thus LBB function is always sensing current above its P/U value.
- 11:54:36.882 hrs – 200ms – An E/F in R-phase of Ranchi # 2 & 3 both lines simultaneously in Zone 1 R Phase.
- 11:54:36.909 – 225 ms – Zone # 2 [Bus 2] BFP Trip – LBB trip occurs before 2nd fault is cleared by Ranchi # 2 relay.

EVENT RECORD REC 670 RANCHI # 2 LINE

3/30/2017 11:54:36:706 AM	**START_AR**	**On**
3/30/2017 11:54:36:707 AM	**Q52_RPH_CLOSE**	**Off**
3/30/2017 11:54:36:715 AM	AR_READY	Off
3/30/2017 11:54:36:716 AM	**Q52_RPH_OPEN**	**On**
3/30/2017 11:54:36:814 AM	**Q52_RPH_OPEN**	**Off**
3/30/2017 11:54:36:836 AM	**Q52_RPH_CLOSE**	**On**
3/30/2017 11:54:36:842 AM	CB_SPR_CHG	Off
3/30/2017 11:54:36:845 AM	SPRING_NOT_CH	On
3/30/2017 11:54:36:854 AM	Q52_CLOSE_BLK	On
3/30/2017 11:54:36:854 AM	Q52-CLOSE_BLK	On
3/30/2017 11:54:36:856 AM	**START_AR**	**Off**
3/30/2017 11:54:36:912 AM	**86A_RESET**	**Off**
3/30/2017 11:54:36:912 AM	86B_RESET	Off
3/30/2017 11:54:36:917 AM	86A_OPD	On
3/30/2017 11:54:36:917 AM	86B_OPD	On
3/30/2017 11:54:36:917 AM	START_AR	On
3/30/2017 11:54:36:918 AM	Q52_RPH_CLOSE	Off
3/30/2017 11:54:36:920 AM	BB_TR_RLY_RST	Off
3/30/2017 11:54:36:921 AM	Q52_YPH_CLOSE	Off
3/30/2017 11:54:36:923 AM	**BB_TR_RLY_OPD**	**On**
3/30/2017 11:54:36:923 AM	**Q52_BPH_CLOSE**	**Off**
3/30/2017 11:54:36:928 AM	**Q52_RPH_OPEN**	**On**
3/30/2017 11:54:36:930 AM	**Q52_YPH_OPEN**	**On**
3/30/2017 11:54:36:933 AM	**Q52_BPH_OPEN**	**On**

EVENT RECORD REL 670 RANCHI # 2 LINE

3/30/2017 11:54:36:676 AM	TEF1_START	On
3/30/2017 11:54:36:684 AM	PHS-STFWL1	On
3/30/2017 11:54:36:687 AM	**TRIP L1**	**On**
3/30/2017 11:54:36:687 AM	ZCOM_CS	On
3/30/2017 11:54:36:687 AM	ZM01-TRIP	On
3/30/2017 11:54:36:744 AM	PHS-STFWL1	Off
3/30/2017 11:54:36:840 AM	**TRIP L1**	**Off**
3/30/2017 11:54:36:882 AM	**PHS-STFWL1**	**On**
3/30/2017 11:54:36:888 AM	TRIP L1	On
3/30/2017 11:54:36:888 AM	ZM01-TRIP	On
3/30/2017 11:54:36:906 AM	BCU_PR_3PH_TR	On
3/30/2017 11:54:36:907 AM	TOC1_STL1	On
3/30/2017 11:54:36:912 AM	TIECB_PRE_3PH	On
3/30/2017 11:54:36:924 AM	**BUSBAR_TRIP**	**On**
3/30/2017 11:54:36:954 AM	ZM01-TRIP	Off
3/30/2017 11:54:37:041 AM	TRIP L1	Off
3/30/2017 12:29:27:431 PM	BUSBAR_TRIP	Off

EVENT RECORD REB 670 BUSBAR RELAYS

3/30/2017 11:54:36:681 AM	**ZB Iin ALARM**	**On**
3/30/2017 11:54:36:687 AM	ZA Iin ALARM	On
3/30/2017 11:54:36:729 AM	ZA Iin ALARM	Off
3/30/2017 11:54:36:738 AM	**ZB Iin ALARM**	**Off**
3/30/2017 11:54:36:879 AM	ZB Iin ALARM	On
3/30/2017 11:54:36:888 AM	ZA Iin ALARM	On
3/30/2017 11:54:36:909 AM	**ZB BFP TRIP**	**On**
3/30/2017 11:54:36:909 AM	ZB COMON TRIP	On
3/30/2017 11:54:36:951 AM	ZB Iin ALARM	Off
3/30/2017 11:54:37:008 AM	ZA Iin ALARM	Off
3/30/2017 11:54:37:113 AM	ZB BFP TRIP	Off
3/30/2017 11:54:37:314 AM	ZB COMON TRIP	Off

SIMULTANEOUS TRIPPING OF BOTH LINES

- Relays of both lines had seen fault in forward direction evident from voltage current relationship during fault [-78 degree I lag V].
- As these lines are not terminated at Ranchi, Line # 3 relay could not trip in reverse.
- The fault current in Line # 2 was 7.24 kA and in line # 3 was 4.913 kA.
- Probably some fault involving earth wire and both line top conductor.
- Nothing was found on patrolling and line held in first charging attempt. Normalized at 17:45hrs after getting code from ERLDC.
- Weather condition normal so no chance of lightning.
- Thus no real reason could be ascertained about simultaneous tripping except it being a real power system event.

POINTS IN AGENDA

- Ranchi # 2 CB had actually tripped but has somehow closed again.
- RTPS Maithan saw the fault in reverse [evident from I lead V by about 110°] so no question of operating. DR P/U due to Busbar Trip.
- RTPS Ranchi # 3 had only its R Phase tripped in the second fault [Z1 E/F]. Thus other phases contain charging current of order of 160A [I lead V by 90°].

REMEDIAL MEASURES

- Main 2 SIEMENS relay of Ranchi # 2 bay had a wrong CTR of 1000/1. Now corrected to 2000/1. Thus Main 1 had shown Fd as 25km and Main 2 as about 50km.
- Breaker Time tests to be done. Tripping through 86R1 relay to be checked multiple times for possibility of any accidental closing.
- We are trying to introduce in DR of Busbar relay the LBB initiation signals (at least the single phase initiation signals) so as to study what time the single phase initiation is dropping OFF in the REB relay during single phase fault.
- Opinion about LBB P/U current: Normal 20% P/U used in DVC would translate into 400A primary which is higher than the load current in many cases if RTPS Gen is OFF. Shall we increase to 200A which should be above charging current?

Annexure-C10

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-C11

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		

Annexure-D1

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 within 24 Hrs	DR/EL received after 24 Hrs	Remarks
Fault clearing time is violating protection standard (As per PMU data)													
1	400 KV BINAGURI - MALBASE	17.03.17	19:05	17.03.17	19:30	B-N FAULT	500 ms approx.	B-N, Z-II, F/C 2.73 kA, 97.54 km from Binaguri, A/R un-successful at Binaguri	Yet to be received	No autoreclose operation observed in PMU data	Yes	No	A/R un-successful at Binaguri due to permanent fault
2	400 KV STERLITE-MERAMUNDALI - I	28.03.17	13:08	28.03.17	14:02	B-N FAULT	160 ms approx	B-N, Z-I, 127.5 KM from SEL, f/c: 1.75 kA	B-N, Z-I, 121.2 KM from MMND, F/C 2.6 kA	No autoreclose operation observed in PMU data	No	No	No PLCC
3	400 KV BAKERSWAR -ARAMBAG	29.03.16	09:32	29.03.17	13:20	LBB OPERATED AT BUS - I AT BAKRESWAR DURING EMERGENCY S/D OF 400 KV MAIN BREAKER OF GT - II DUE TO LOW OIL PRESSURE	500 ms approx.	Yet to be received	Yet to be received	--	No	No	400/220 IBT - II at Bakreswar tripped during the incident. On 13-02-17 at 09:55 hrs. LBB operated at Bakreswar Bus - I due to mal-operation. At that time, all elements at 220 kV level tripped as 220 kV bus - II was under s/d.
Multiple tripping at same time													
1	220 kV RAMCHANDRAPUR - CHANDIL S/C	10.03.17	15:01	10.03.17	15:37	B-N FAULT	<100	B-N, Z-I, O/C, 16.5 km from Ramchandrapur, F/C 2.32 kA	B-N, Z-I, 31.79 km from Chandil, F/C 2.825 kA	No autoreclose operation observed in PMU data	Yes	Yes	400/220 kV ICT - I & II at Jamshedpur along with 220 kV Bus coupler (due to Non directional O/C & E/F) tripped from 220 kV side due to VAJ operation. Relay at Chandil oprtaed but CB failed to clear the fault.
2	220KV RANGPO - NEW MELLI - I	27.03.17	17:01	28.03.17	12:47	R-Y FAULT	350 ms approx	R-Y , Z-III Started, Fuse failure, Line current did not become zero as per DR data	Yet to be received	No autoreclose operation observed in PMU data	Yes	No	132 kV Rangpo Gangtok S/C tripped at same time (R-B, Z-I, 0.73 km from Rangpo, F/C 5.3 kA). Charging attempted for 220 kV Rangpo - New Melli S/C at 20:30hrs but line did not hold due to bad weather.
3	400KV BIHARSARIF-SASARAM-II	30.03.17	13:51	30.03.17	16:02	O/V TRIPPED	--	Yet to be received	Yet to be received	--	No	No	PG was advised to send the details.
4	HVDC SASARAM			30.03.17	16:52	CONVERTOR CONTROL PROTECTION OPERATED	--	Yet to be received	Yet to be received	--	No	No	400kV Biharshariff-Sasaram -I contact was not recieved by HVDC and assumed that the line was out.
Fault Not observed in PMU data													
1	400KV ANGUL-JITPL-I	07.03.17	22:55	08.03.17	09:05	SPURIOUS TRIPPING	--	DT received	Did not trip	--	Yes	--	Spurious tripping
2	400KV JEERAT - BAKRESWAR	13.03.17	03:48	13.03.17	04:22	SPURIOUS TRIPPING	--	DT Received	Did not trip	--	No	--	Operational mistake
3	400KV TALA - BINAGURI-II	21.03.17	22:42	21.03.17	23:31	SPURIOUS TRIPPING	--	Did not trip	Yet to be received		--	No	Relay contact burned, the same has been changed.
4	765 KV GAYA-BALIA S/C	24.03.17	13:25	24.03.17	13:50	SPURIOUS TRIPPING	--	DT received	Yet to be received	--	No	No	PLCC problem at Balia, the same has been rectified.
5	400 KV FARAKKA-KAHALGAON-I	25.03.17	09:40	25.03.17	10:30	SPURIOUS TRIPPING	--	Yet to be received	DT received	--	No	No	Spurious tripping
No autorecloser operation observed in PMU data													

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 within 24 Hrs	DR/EL received after 24 Hrs	Remarks
1	400KV BARIPADA-KEONJHOR	05.03.17	16:34	06.03.17	10:27	B-N FAULT	<100	B-N, Z-I, F/C 1.34 KA, 2.104 km from Baripada, A/R unsuccessful due to DT received	B-N, Z-I, DT sent due to O/V in R & Y phases	No autoreclose operation observed in PMU data	No	No	B phase insulator puncher at LOC no. 48 (2.10km from Baripada), A/R started at Baripada end but failed due to DT receipt on permanent fault
2	400KV NEW PURNEA-KISHANGUNJ - I	10.03.17	03:11	10.03.17	03:41	B-N FAULT	<100	Yet to be received	Yet to be received	No autoreclose operation observed in PMU data	No	No	4 times successfull but 5th time failed.
3	400KV NEW PURNEA-MUZZAFFARPUR-I	10.03.17	06:15	10.03.17	06:37	B-N FAULT	<100	Yet to be received	Yet to be received	No autoreclose operation observed in PMU data	No	No	Storm weather, 2 times successfull but 3rd time failed.
4	400KV CHAIBASA-ROURKELA-I	10.03.17	13:24	10.03.17	14:03	Y-N FAULT	<100	Y-N, Z-I, F/C 2.61KA, 99 KM from Chaibasa	Y-N, Z-I, Carrier received, F/C 3.2 kA, O/V start	No autoreclose operation observed in PMU data	No	Yes	Permanent fault due to insulator puncture
5	400KV KOLAGHAT-KHARAGPUR-II	10.03.17	14:27	10.03.17	15:37	B-N FAULT	<100	B-N, Z-I, F/C 5.764 kA, 33.67 km from KTPP, A/R started but after 80 ms it got blocked	B-N, Z-I, Carrier received, DT received, 65.59 km from KGP, F/C 1.776kA	No autoreclose operation observed in PMU data	Yes	No	A/R relay problem at Kharagpur end the same has been rectified.
6	400 KV BARH - KAHALGAON - I	26.03.17	21:06	26.03.17	22:40	Y-N FAULT	<100	Y-N, Z-I, 4.78 km from Barh, F/C - 21 kA	A/R successful	No autoreclose operation observed in PMU data	Yes	No	Successful at KhSTPP end, Barh end was open.
7	400KV ANDAL-JAMSHEDPUR-I	27.03.17	19:35	28.03.17	20:47	R-N FAULT	<100	Yet to be received	Yet to be received	No autoreclose operation observed in PMU data	No	No	Line was under s/d. during charging attempt, line tripped again due to CB problem at Jamshedpur.
8	400KV ANDAL - RTPS-I	28.03.17	13:57	28.03.17	14:43	B-N FAULT	<100	B-N, 78.2 km from Andal, Carrier Received	B-N, Z-I, 13.4km from RTPS	No autoreclose operation observed in PMU data	No	No	Fault appeared within the lockout time.
9	400 KV ALIPURDUAR - BONGAIGAON - I	30.03.17	11:20	30.03.17	12:11	Y-N FAULT	<100	Y-N, F/C 1.75 kA	Y-N, F/C 1.37 kA, 92 km from Bongaigaon, A/R successful	No autoreclose operation observed in PMU data	No	No	Successful at Bongaigaon end, Weak infeed was wrongly enabled. The same has been corrected.