Minutes
of
111th PCC Meeting

Date: 28.02.2022
Eastern Regional Power Committee
14, Golf Club Road, Tollygunge
Kolkata: 700 033

EASTERN REGIONAL POWER COMMITTEE

MINUTES OF 111th PROTECTION COORDINATION SUB-COMMITTEE MEETING HELD ON 11.02.2022 AT 10:30 HOURS

Member Secretary, ERPC chaired the meeting. The meeting was convened through Microsoft Teams online platform.

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

PART – A

ITEM NO. A.1: Confirmation of minutes of 110th Protection Coordination sub-Committee Meeting held on 19th January 2022 through MS Teams online platform.

The minutes of 110th Protection Coordination sub-Committee meeting held on 19.01.2022 was circulated vide letter dated 02.02.2022.

Members may confirm.

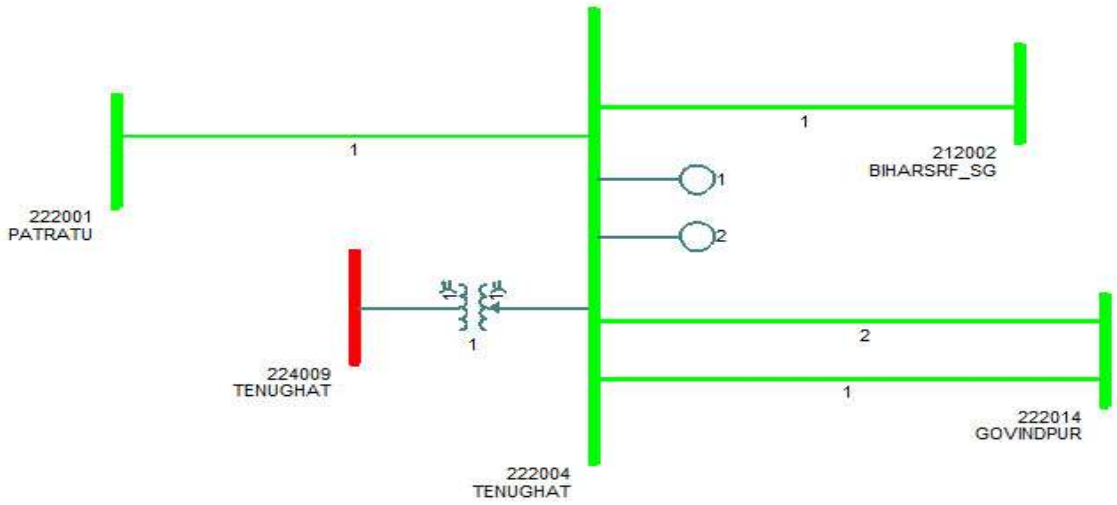
Deliberation in the meeting

Members confirmed the minutes of 110th PCC Meeting.

PART – B

ITEM NO. B.1: Total Power Failure at 220 kV Tenughat (TVNL) S/s on 01.01.2022 at 05:58 Hrs

All 220 kV lines emanating from Tenughat TPS got tripped resulting in tripping of two running units in overspeed protection. This resulted in total power failure at 220 kV Tenughat S/s.



Gen. Loss: 320 MW
Outage Duration: 01:13 Hrs

TVNL, JUSNL & BSPTCL may explain.

Deliberation in the meeting

Based on the DR analysis, the event was explained as follows:

There was a B-phase to ground fault in 220 kV Tenughat Switchyard. The connected 220 kV lines got tripped with the following relay indications:

Name	***End1***	***End2***
220 kV Tenughat-Patratu	*B_N, 2.56 kA, zone-4 picked up*	*Patratu: B_N, 55 km, 2.531 kA, Zone-2*
220 kV Tenughat-Bihar sharif	*B-N, Zone-4 picked up*	*Bihar sharif: B_N, 160 km, 1.4 kA, Zone-2*
220 kV Tenughat-Govindpur	*B-N, Zone-4 picked up*	*Govindpur: B_N, Zone-2, 95 km, 0.8 kA*

TVNL representative informed that the fault was of transient nature as no physical evidence of fault was found in the switchyard. He reported that the units got tripped in overcurrent protection in 60 milliseconds. Regarding operation of busbar protection relay, he informed that though the electromagnetic busbar relay was in service, it did not operate during the incident. The DR was not available due to electromagnetic type of relay hence the analysis could not be done.

Members opined that busbar protection should have operated and cleared the fault in the present incident. They suggested for replacement of electromagnetic relay with numeric busbar relay for added advantages in terms of protection, reliability, trouble shooting and fault information.

PCC advised TVNL following:

- *to implement numerical busbar relay at 220 kV Tenughat S/s.*
- *to configure the DR as per the guidelines finalized in 74th PCC meeting(Annex-B1).*
- *to check and rectify time synchronisation issues in the relays*
- *to submit Generator/GT overcurrent settings for review.*

MS, ERPC suggested to refer the agenda of replacement of electromechanical busbar relay with numerical relays to upcoming TCC Meeting.

Regarding 220 kV Tenughat-Patratu line, it was informed that relay at PTPS send sensed the fault in zone- 2 and operated, however Y-phase circuit breaker did not open at PTPS end. As a result, the faut feeding was continued till the time overcurrent earthfault relay at Tenughat got operated and cleared the fault.

On enquiry from PCC regarding non operation of LBB at PTPS end during this incident, JUSNL representative informed that LBB was not in service at 220 kV Patratu end presently.

He further informed that proposal of shifting old 220 kV PTPS S/s to new 400/220 kV Patratu S/s is underway. After shifting of the feeders and panels to new substation, the LBB would be put into service.

ITEM NO. B.2: Disturbance at 220 kV Tenughat (TVNL) S/s on 25.01.2022 at 10:24 Hrs

At 10:24 hrs, both running units at Tenughat (TVNL) tripped due to loss of auxiliary supply. It is reported that station transformer got tripped due to flash over in 6.6 kV side bus.

Gen. Loss: 320 MW
Outage Duration: 03:24 hrs

TVNL may explain.

Deliberation in the meeting

It was informed that station transformer-1 at Tenughat TPS got tripped due to flash over in 6.6 kV side bus which resulted in tripping of both running units at Tenughat due to loss of auxiliary supply.

TVNL representative informed that during the incident flashover occurred at 6.6 kV side 2 CA Bus (unit 2). The electromechanical relay of station Transformer-1 sensed the fault and got tripped.

As per scheme in Tenughat S/S, auxiliaries of both units are connected to station transformer-1. After tripping of ST-1, both the units got tripped.

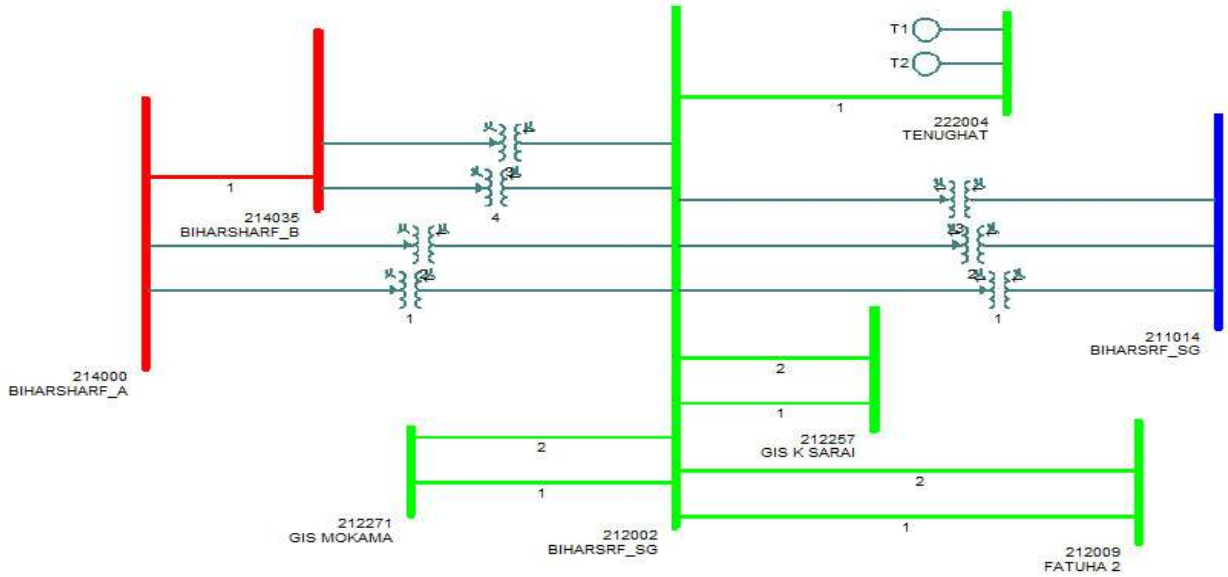
PCC advised TVNL to review the coordination of overcurrent protection settings on lv side of station transformer and to share the overcurrent protection settings of station transformer as well as both units of TTPS to ERPC.

They intimated that they are planning to replace electromechanical relays of station transformer with numerical relay. The relay procurement is in progress and it is expected that numerical relays would be implemented within 2-3 months.

ITEM NO. B.3: Total Power failure at 220/132 kV Biharsharif (BSPTCL) S/s on 17.01.2022 at 13:13 Hrs

At 13:13 hrs, all feeders connected to 220 kV Biharsharif S/s got tripped resulting in total power failure at Biharsharif S/s. Power supply to Ekangarsarai, Rajgir, Baripahari, Hatidah, Harnaut, Barh, Nalanda also got affected.

It was reported that there was a bus fault in 220 kV main bus-2 of Biharshariff and due to non-availability of busbar protection all 220 kV lfeeders got tripped during the event.



Detailed report from ERLDC is attached at **Annexure B.3**.

Load Loss: 147 MW
Outage Duration: 00:19 Hrs

BSPTCL & BGCL may explain.

Deliberation in the meeting

BSPTCL representative explained the event with help of a presentation which is attached at ***Annexure B.3.1.***

220kV Biharsharif- Khizarsarai circuit-1 was already in shutdown for winter maintenance works. After completion of maintenance work, during closing of 220 kV Main bus-2 isolator, a heavy flashing occurred near B phase circuit portion of gantry which resulted a B-phase fault at 220kV Main bus-2 of Biharsharif S/S.

Subsequently all feeders got tripped and total power failure occurred at 220kV Biharsharif S/s.

They added that during physical verification, some burnt armour wires were found near gantry which indicates the possibility of fly bus conductor getting in contact with the gantry through the armour wire.

Relay indications for all connected feeders and ICT at 220kV Biharsharif is as follows:

S.No.	***Name of Element***	***End 1 (Biharsharif)***	***End 2 (Remote)***	***Remarks***
1	*220 kV Biharsharif-TTPS*	*Zone 4 (282 ms)*	*zone 2 picked up*	
2	*220 kV Biharsharif-Mokama circuit-1*	*Zone 4 (250.3 ms)*	*-*	
3	*220 kV Biharsharif-Mokama circuit-2*	*O/V stage 2(settings-150%, time delay- 100ms)*	*-*	
4	*220 kV Biharsharif-Fathua circuit-1*	*Zone 4 (278.7 ms)*	*zone 2 picked up*	
5	*220 kV Biharsharif-Fathua circuit-2*	*Zone 4 (278.7 ms)*	*zone 2 picked up*	
6	*220 kV Biharshariff – khizarsari circuit-2*	*Pick up zone 4 (time settings – 250 ms) but*	*Zone 1(70 ms)*	*Line got tripped from remote end in zone 1 so no tripping observed at Biharsharif end*
7	*400/220 kV ICT-1,2*	*Master trip (Intertrip)*		*LV side directional OC/EF relay available at Biharsharif GSS (BSPTCL) end however it was not tripped. Inter tripping from 86LV to 86HV at Biharsarif PG and from 86HV at PG to 86LV at BSF GSS (BSPTCL) through different core of same cable.*
8	*400/220 kV ICT-3,4*	*Master trip(Intertrip)*		*Only master trip relay available at Biharsharif GSS (BSPTCL) end. Inter tripping from 86 BSPTCL to 86LV at Biharsarif PG and from 86LV at PG to 86 at*

			BSF (BSPTCL) through different core of same cable. *ICT Bay and panel are under PG jurisdiction*

The following discrepancies were deliberated in the meeting:

1. ***Non-availability of Busbar Protection***

PCC expressed serious concern for continuous delay in commissioning of busbar protection at 220 kV Biharsharif S/s and advised BSPTCL to take immediate steps for commissioning of the busbar relay at the earliest.

PCC referred the issue to forthcoming TCC meeting for information and necessary action.

2. ***Initiation of inter-tripping command from LV side of the ICT-1,2 & 4.***

Powergrid representative informed that though HV side backup overcurrent earthfault relays were picked up for ICT 1, 2 and 4, the ICTs got tripped on receiving inter-tripping command from LV side (BSPTCL).

BSPTCL representative submitted that it is difficult to conclude that inter-tripping command initiated from LV side (BSPTCL) in case of ICT-1 & 2, as LV Overcurrent E/F relays are set as directional. They suggested to disable the inter-tripping feature of ICTs for a trial period to find out which relay on either end is triggering first.

After detailed deliberation, it was decided that a committee would visit the Biharsharif substation to look into the inter-tripping issue of ICTs and suggest the remedial measures. PCC advised ERPC Secretariat to coordinate with the concerned utilities for the visit.

3. ***Tripping of 220 kV Biharsharif-Mokama circuit-2 on Overvoltage protection***

PCC advised BSPTCL to investigate the root cause behind operation of overvoltage protection relay for 220 kV Biharsharif-Mokama circuit-2 and share the findings to ERPC/ERLDC. BSPTCL was advised to check the healthiness of overvoltage relay as well as any earthing issue in CVT secondary circuit which might had initiated tripping in the relay.

4. ***Tripping of 220 kV Biharsharif-Khizersarai circuit-2 in zone-1 protection from Khizersarai end.***

The relay at Khizisarai end for 220 kV Bihariff –khizarsari circuit-2 should detect the fault in zone 2 however it was observed that relay sensed fault in zone 1 which resulted in instantaneous tripping from Khizisarai end.

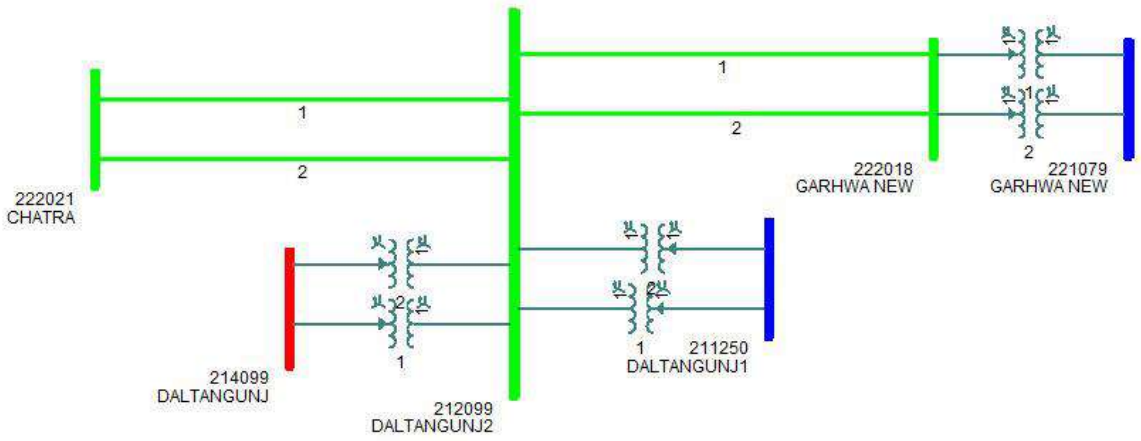
BGCL representative was not available in the meeting.

BSPTCL was advised to communicate the issue to BGCL end for necessary checking and review of zone settings at Khizersarai end. PCC further advised BSPTCL/SLDC Bihar to ensure the representation of BGCL representative in future PCC meetings for fruitful deliberation of the issues.

ITEM NO. B.4: Tripping of 220 kV Daltonganj-Garhwa D/C line on 02.01.2022 at 04:29 Hrs

At 04:29 Hrs, 220 kV Daltonganj-Garhwa(New)-1 tripped on Y-phase to earth fault. At the same time, 220 kV Daltonganj-Garhwa(New)-2 tripped on R-phase to earth fault leading to total power failure at 220/132 kV Garhwa(New) S/s.

Disturbance report from ERLDC is attached at **Annexure B.4**.



Load Loss: 51 MW
Outage Duration: 01:22 Hrs

JUSNL may explain.

Deliberation in the meeting

JUSNL representative stated that the fault occurred as R-phase jumper of 220 kV Daltonganj-Garhwa-1 snapped and touched Y- phase of the line at tower number 240 which is around 70 km from Garhwa end. Both end relay of the line sensed the fault in zone-1 protection and cleared the fault instantaneously.

At the same time, relay at Daltongunj end for 220 kV Daltonganj-Garhwa-2 sensed Y phase fault in zone 1 and got tripped however no tripping was observed for the circuit-2 from Garhwa end.

Members opined that snapped jumper in circuit-1 might had induced simultaneous fault in circuit-2 which was observed in Zone 1 by Daltonganj end relay.

ITEM NO. B.5: Total Power failure at 400 kV Dikchu S/s

A. On 04.01.2022 at 13:14 Hrs

At 13:14 Hrs, 400 kV Teesta 3-Dikchu tripped on Overvoltage protection at Dikchu end and DT was sent to Teesta-3 end. As 400 kV Rangpo-Dikchu was out of service due to shutdown of both 400 kV buses at Rangpo, total power failure occurred at Dikchu S/s.

Relay Indications:

Time	Name	End1	End 2	PMU Observation
13:14	400 kV Teesta 3-Dikchu	Teesta 3: DT received	Dikchu: O/V stage 1	418 kV voltage at Kishanganj.1 kV dip

				in all three phases after tripping

No Load and Gen. Loss
Outage Duration: 02:49 Hrs

B. On 05.01.2022 at 12:58 Hrs

400 kV Teesta III-Dikchu tripped on O/V at Dikchu end and DT was sent to Teesta-III. As 400 kV Rangpo-Dikchu was out of service due to shutdown of both 400 kV buses at Rangpo, total power failure occurred at Dikchu S/s.

Relay Indications:

Time	Name	End1	End 2	PMU Observation
12:58	400 kV Teesta III-Dikchu	Teesta III: DT received	Dikchu: O/V stage 1	418 kV voltage at Kishanganj.0.7 kV dip in all three phases after tripping

No Load and Gen. Loss
Outage Duration: 03:43 Hrs

C. On 14.01.2022 at 13:01 Hrs

At 13:01 Hrs, 400 kV Teesta III-Dikchu tripped on O/V at Dikchu end and DT was sent to Teesta-III. 400 kV Dikchu S/s became dead as 400 kV Rangpo-Dikchu was under planned shutdown.

Relay Indications:

Time	Name	End1	End 2	PMU Observation
13:01	400 kV Teesta III-Dikchu	Teesta III: DT received	Dikchu: O/V stage 1	421 kV voltage at Kishanganj. 0.3 kV dip in all three phases after tripping

No Load and Gen. Loss
Outage Duration: 01:50 Hrs

Dikchu & TUL may explain.

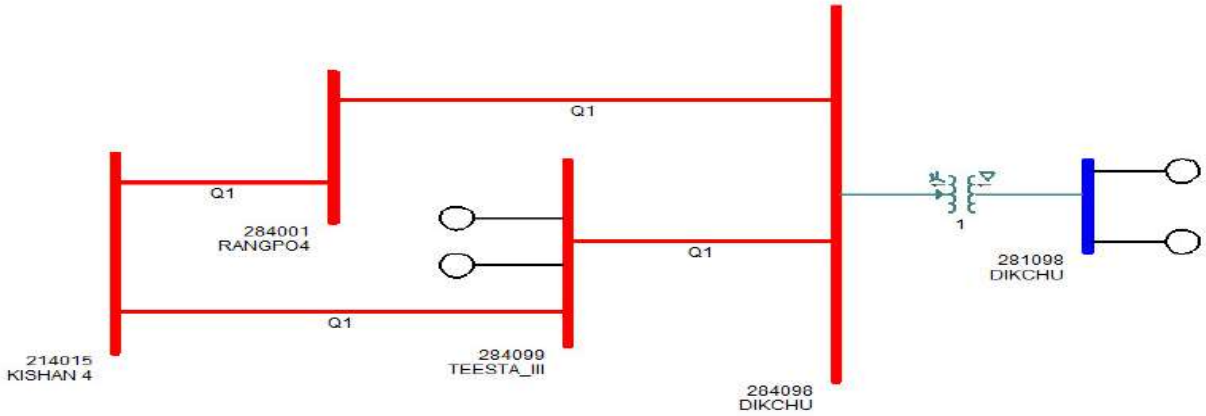
Deliberation in the meeting

ERLDC representative informed that in all of the above three incidents, relay at Dikchu end for 400 kV Teesta III-Dikchu line got tripped on O/V protection and DT was sent to Teesta-III end. Since 400 kV Rangpo-Dikchu was out of service during the above disturbances, total power failure occurred at Dikchu HEP.

It was noted that no protection related issues were observed in the above incidents.

ITEM NO. B.6: Total Power failure at 400 kV Dikchu & 400 kV Teesta III S/s on 16.01.2022 at 14:01 Hrs

400 kV Teesta III-Kishanganj tripped at Teesta 3 end on overvoltage protection and DT was sent to Kishanganj. 400 kV Teesta-III & 400 kV Dikchu S/s became dead as 400 kV Rangpo-Dikchu was under planned shutdown. No generation or load loss occurred.



Relay Indications:

Time	Name	End1	End 2	PMU Observation
14:01	400 kV Teesta 3-Kishanganj	Teesta 3: O/V Stage 1	Kishanganj: DT received	422 kV voltage at Kishanganj. 1 kV dip in all three phase after tripping

No Load and Gen. Loss
Outage Duration: 03:48 Hrs

TUL may explain.

Deliberation in the meeting

TUL representative informed that 400 kV Rangpo-Dikchu was under planned shutdown during the disturbance. At 14:01 Hrs, relay at Teesta 3 end for 400 kV Teesta III-Kishanganj line got tripped on overvoltage protection and DT was sent to Kishanganj end. As a result 400 kV Teesta III-Kishanganj line got tripped resulting in total power failure at 400 kV Teesta-III & 400 kV Dikchu S/s.

ITEM NO. B.7: Major grid events other than GD/GI

B.7.1: Bus tripping occurred in Eastern Region during January-22

During January 2022, following incidents of bus bar tripping have been observed in Eastern Region.

Element Name	Tripping Date	Reason	Utility
220 kV Main Bus-2 at Subhashgram (WB)	10-01-2022 at 02:55 Hrs	Y_ph CT of 220 kV Subhashgram-Kasba-2 burst	WBSETCL
400 kV Main Bus-2 at Subhashgram (PGCIL)	20-01-2022 at 05:41 Hrs	Busbar protection operated due to earth wire snapping from	PG ER-2

		Gantry between Main and Tie bay of ICT-2	

Concerned utilities may explain.

Deliberation in the meeting

- ***Tripping of 220 kV Main Bus-2 at Subhashgram (WB) on 10-01-2022 at 02:55 Hrs***

WBSETCL representative informed that Y phase CT of 220 kV Subhashgram-Kasba-2 got burst which resulted in bus fault in 220 kV Bus 2 at Subhasgram S/s. Subsequently bus bar protection operated and tripped all feeders connected to 220 kV Bus 2 at Subhasgram S/S.

- ***Tripping of 400 kV Main Bus-2 at Subhashgram (PGCIL) on 20-01-2022 at 05:41 Hrs***

Powergrid representative informed that due to snapping of earth wire from gantry between Main and Tie bay of ICT-2, bus fault occurred at 400 kV Bus 2 of Subhasgram S/s as ICT 2 was connected to Bus-2. Subsequently bus bar protection operated and tripped all feeders connected to 400 kV Bus-2 at Subhasgram S/S.

B.7.2: Repeated tripping of 220 kV Chaibasa-Chiabsa (JUSNL)-1

220 kV Chaibasa-Chiabsa (JUSNL)-1 had tripped six times since 13.01.2022. As per available report, it had tripped only from JUSNL end most of time. No fault was observed in PMU

Details of tripping is as follows :

	Element Name	Tripping Date	Tripping Time	Reason	Remarks	Revival Date	Revival Time
>	220KV-CHAIBASA(PG)-CHAIBASA(JUSNL)-1	30/01/2022	06:10	Chaibasa(PG):Not Tripped, Chaibasa(Jh): Details Awaited	Line is taken uder breakdown	30/01/2022	10:44
>	220KV-CHAIBASA(PG)-CHAIBASA(JUSNL)-1	29/01/2022	07:55	Details awaited		29/01/2022	09:35
>	220KV-CHAIBASA(PG)-CHAIBASA(JUSNL)-1	19/01/2022	05:30	Jharkhand end: B ph, 2.03 KA , 39.18 KM		19/01/2022	07:34
>	220KV-CHAIBASA(PG)-CHAIBASA(JUSNL)-1	13/01/2022	22:50	Chaibasa(PG)=Did not trip.Chaibasa(JUSNL)=Earth Fault, Z-1, 39.18Km, IR=155.0A, IY=157.0A, IB=151.5A		14/01/2022	23:59
>	220KV-CHAIBASA(PG)-CHAIBASA(JUSNL)-1	01/02/2022	15:31	DIRECT TRIP OPERATED.		01/02/2022	15:57
>	220KV-CHAIBASA(PG)-CHAIBASA(JUSNL)-1	01/02/2022	12:24	Chaibasa PG=didnot trip.Chaibasa JUSNL=CT SF6 relay operated		01/02/2022	13:56

JUSNL and Powergrid may explain.

Deliberation in the meeting

JUSNL representative informed that the tripping of the line on 13/01/2022, 19/01/2022 and 30/01/2022 was due to SF6 gas leakage in the CT at their end.

He added that the leakage point was later identified and appropriate measures were taken to stop the gas leakage.

Regarding tripping on 01.02.2022, he informed that loose contact was observed and dust was found inside C&R panel & JB of CT after which contact was tightened and cleaned. He stated that no further tripping was observed after 01.02.2022.

ITEM NO.B.7.3: Islanding Event of CESC system

CESC system got islanded twice in the month of January'22.

i. **At 13:25 Hrs on 14.01.2022**
ii. **At 17:05 Hrs on 31.01.2022**

Detail report on analysis of the events is attached at **Annexure B.7.3**.

CESC may update.

Deliberation in the meeting

i. At 13:25 Hrs on 14.01.2022

The event was analyzed by ERLDC representative as follows:

- *On 14.01.2022 at 13:25 Hrs, R-Y fault occurred in 132 kV Liluah -Rishra -2 line. The line got tripped in zone 2 from Liluah end but prior to that SPS logic-1 for CESC islanding got operated and CESC system got islanded.*

- *From SCADA plot, continuous slow variation in frequency(0.5-0.6 Hz) was observed with periodicity of one minute similar to previous cases. However, the frequency got stabilized once synchronization of CESC system with Howrah point was completed.*

- *Similarly cyclic variation of 25 MW in generation was also observed at BBGS.*

They informed that on analysis the following points were noticed:

- *Unit-3 of BBGS was in RGMO mode and frequency was higher than 50.05 Hz hence much variation was not observed in generation data. However, unit 1 & 2 were in FGMO mode hence variations were observed in these cases.*
- *Sluggish governor response was observed during the incident.*
- *It is observed that after 3-4 minutes of island formation, manual intervention was done subsequently variation in generation got minimized however frequency variation was existing.*

On the issue of cyclic variation of frequency in islanded system, CESC representative informed that they have approached Prof Kulkarni of IIT Bombay for analysis of the events and his suggestions in this regard.

ERLDC representative suggested for extending island signal to generating units so that the units may shift to isochronous mode for better performance during islanding. They also advised to check the governor response issue during PFR testing of the units.

PCC advised CESC to share the findings of the analysis and suggested measures for the aforesaid issue of frequency variation in islanded system in the PCC forum.

On enquiry from PCC regarding carrier aided protection scheme in 132 kV Liluah -Rishra lline, WBSETCL representative informed that carrier aided tripping scheme is not implemented for the line.

PCC advised WBSETCL to explore implementing carrier aided protection scheme in 132 kV Liluah -Rishra line so that the fault in the line can be cleared within 100 msec and the islanding of CESC system for a remote fault can be prevented.

iii. At 17:05 hrs on 31.01.2022

The CESC system was islanded from Howrah point at 17:05 hrs on 31.01.2021 on actuation of SPS Logic-3.

CESC representative informed that this spurious islanding event was caused due to malfunctioning of sensors which triggered SPS logic.
CESC
The issue was investigated and followings were observed:

- *The scheme implemented at Synchronization point does not have any line PT. In the PT scheme it was connected with Bus PT and the Bus PT selection was done through contactor switch.*
- *Before some time from the event, the DC charger got failed which resulted in gradual reduction of DC voltage. Subsequently the voltage selection and contactor for U/V relay got dropped and detected the situation as under voltage.*
- *For operation of the SPS, there was a PT fuse logic as well. However, as all three phases got dropped, it could not sense this as PT fuse failure. They added that there is a current supervision relay also (I>100 A), which basically ensures that the CB are connected. During evening as current crossed 100A, SPS logic-3 got activated and all three lines tripped subsequently CESC system got islanded.*

Regarding remedial measure, they informed that the faulty charger had been rectified and further they are planning to replace the contactor switch with a relay.

They also plan to implement a logic to block the SPS logic-3 in case of DC failure so that such spurious islanding can be avoided.

ITEM NO. B.8: Tripping Incidence in month of January-2022

Tripping incidents in the month of January 2022 which needs explanation from constituents of either of the end is attached.

Concerned utilities may explain.

Deliberation in the meeting

Members explained the tripping incidences. The updated status is enclosed at ***Annexure B.8.***

PART-C::OTHER ITEMS

ITEM NO. C.1: Status of Bus Bar protection at various 220 kV substation of BSPTCL

- Based on collected details during operational planning committee meeting, it is observed that many of 220 kV BSPTCL substations (12 out of 19) either do not have bus bar protection or it's not functional/ non-working. The list is provided below. The non-availability of bus bar protection puts the system at threat in case of bus fault or LBB operation. These results in complete substation outage and impact connected 400/220 kV ICTs, if any.
- Recently bus fault and substation outage causing loss of all four 400/220 kV ICTs at Bihar sharif has been experienced by the ER grid on 17 Jan 2021.

	220 kV BUS BAR PROTECTION STATUS at BSPTCL		
Sl.No	Name of the GSS	Status	Action plan and implementation status
1	FATUHA	NOT AVAILABLE	Procurement status and Implementation planto be shared
2	KHAGAUL	NOT AVAILABLE	Procurement status and Implementation planto be shared
3	BIHARSHARIFF	NOT AVAILABLE	Procurement status and Implementation planto be shared
4	DEHRI	NOT AVAILABLE	Procurement status and Implementation planto be shared
5	BODHGAYA	NOT AVAILABLE	Procurement status and Implementation planto be shared
6	SAMPATCHAK (SIPARA)	NOT FUNCTIONAL	Rectification plan to be shared and Timeline for taking the same in service
7	BEGUSARAI	NOT FUNCTIONAL	Rectification plan to be shared and Timeline for taking the same in service
8	BIHTA NEW	NOT IN SERVICE	Reason for not in service. Rectification plan to be shared and Timeline for taking the same in service
9	PUSAULI	NOT IN SERVICE	Reason for not in service. Rectification plan to be shared and Timeline for taking the same in service
10	GOPALGANJ	NOT WORKING	Reason for non-operation. Rectification or Replacement plan to be shared and Timeline for taking the same in service
11	HAJIPUR	NOT WORKING	Reason for non-operation. Rectification or Replacement plan to be shared and Timeline for taking the same in service
12	DARBHANGA	NOT WORKING	Reason for non-operation. Rectification or Replacement plan to be shared and Timeline for taking the same in service
13	SONENAGAR NEW	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)
14	MOTIPUR	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)
15	MUSAHARI	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)
16	KHAGARIA NEW	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)
17	KISHANGANJ NEW	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)
18	MADHEPURA	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)
19	LAUKAHI	WORKING	To be checked for healthiness (Testing done for healthiness check if any and date of testing or any successful operation date)

BSPTCL may update.

Deliberation in the meeting

PCC advised BSPTCL to submit the present status of work progress as well as timeline for implementation of bus bar protection at various substations of Bihar to ERPC.

Member Secretary ERPC suggested to take up the issue in the forthcoming TCC meeting.

ITEM NO. C.2: DEF protection setting review in Sikkim complex in view of LILO of 400 kV Teesta 3-Kishanganj at Rangpo

After LILO of 400 kV Teesta 3-Kishanganj at Rangpo, DEF settings for all lines at Teesta-3, Dikchu, Rangpo, Kishanganj may be reviewed.

Members may discuss.

Deliberation in the meeting

PCC decided that M/s PRDC would carry out the study for DEF relay setting coordination for Sikkim Complex with revised configuration of transmission network. PRDC was advised to coordinate with ERLDC for necessary information related to the study.

ITEM NO. C.3: Review of Line Reactor Tripping scheme in case of Single-Phase A/R in 400 kV Ranchi-MPL D/C

Line reactor tripping logic was implemented in 400 kV Ranchi-MPL D/C for single phase A/R to avoid any secondary arcing/LC resonance during autorecloser in case of single-phase fault.

Now, 400 kV Ranchi-MPL D/c has been LILOed at 400/220 kV Dhanbad (NKTL) in the month of July'21. Line reactor tripping scheme maybe reviewed as line length and compensation has changed.

Members may discuss.

Deliberation in the meeting

PCC advised Powergrid to furnish their views on line reactor tripping scheme(during single phase autoreclosing in the line) for the revised configuration of 400 kV Ranchi-MPL D/C line.

ITEM NO. C.4: Follow-up of Decisions of the Previous Protection Sub-Committee Meeting(s)

The decisions of previous PCC meetings are attached.

Members may update the latest status.

Deliberation in the meeting

Updated status for decisions of previous PCC meetings is given at ***Annexure C.4****.*

ITEM NO. C.5: Bheramara SPS

In Bheramara SPS, the ramp down has been changed to 700 MW from 750 MW and at present, SPS logic has been implemented with all four circuits of 400 kV Behrampur-Bherama.

<table>
<tr><th>Item</th><th>Information</th></tr>
<tr><td>Reporting Party</td><td>ERLDC, NLDC, POSOCO and NLDC Bangladesh</td></tr>
<tr><td>Scheme's Name</td><td>SPS for power transfer to Bangladesh (HVDC Bheramara SPS)</td></tr>
<tr><td>Classification</td><td>SPS Related ramping down in Power order in case of contingency in the Indian side</td></tr>
<tr><td>Reference No.</td><td>SPS-2</td></tr>
<tr><td>Operating Procedure</td><td>Bheramara is connected to Behrampur in West Bengal, India through 2 X 400 kV Behrampur-Bherama D/C line. 400 kV Farakka-Behrampur D/C and 400 kV Sagardighi-Behrampur D/C circuits are there to facilitate power transfer to Bangladesh from Indian Power System. Keeping in mind low voltage problems at Behrampur and system security, the SPS was devised which takes voltage and frequency as input.</td></tr>
<tr><td>Design Objectives</td><td>To limit low voltage and low frequency on Indian side.</td></tr>
<tr><td>Operation</td><td>Ramping down of HVDC</td></tr>
<tr><td>Modelling</td><td>
<table>
<tr><th>Sl No</th><th>Triggering Criteria for SPS</th><th>SPS actions (signal shall be generated to do the following)</th><th>Signal to be sent Bheramara (Yes/No)</th></tr>
<tr><td>1</td><td>Voltage at 400 kV Behrampur falls below 390 kV</td><td>The SPS shall generate a signal to trip the 125 MVAR bus reactor</td><td>No</td></tr>
<tr><td>2</td><td>Voltage at 400 kV Behrampur going below 380 kV, the SPS shall generate a signal.</td><td>The SPS shall generate a signal to ramp down total HVDC power to 700 MW (with Appropriate Filter switching to maintain Bheramara 400kV Voltage within limits)</td><td>Yes</td></tr>
<tr><td>3</td><td>If the frequency (locally measured at Behrampur) goes below 49.5 Hz.</td><td>To ramp down total HVDC power to 700 MW (with Appropriate Filter switching to maintain Bheramara 400 kV Voltage within limits)</td><td>Yes</td></tr>
<tr><td>4</td><td>If number of 400 kV Behrampur-Bheramra 2 X D/C is less than 2 (Only one circuit is there)</td><td>Total HVDC power to be ramped down to 700 MW with Appropriate Filter switching to maintain Bheramara 400 kV Voltage within IEGC limits) (Implementation confirmed in 8th OCC meeting with Bangladesh)</td><td>No (But for more reliable operation breaker status of Behrampur may also be taken)</td></tr>
</table>
</td></tr>
<tr><td>Original In-Service Year</td><td>October 2013</td></tr>
</table>

Item	Information
Recent Assessment Group	NLDC, POSOCO
Recent Assessment Date	Nov/2019 (After the Addition of other pole, In 8th OCC meeting of India-Bangladesh, NLDC India has asked Bangladesh to update on the implementation of the scheme considering both poles instead of monopolar operation existing earlier) **Nov 2021 : The SPS 4 setting was changed to 700 MW from 750 (confirmed by PGCB through email on 14 Nov 2021-Discussed in 9th OCC meeting of India-Bangladesh)** **Jan 2022: The SPS 2 and 3 setting was changed to 700 MW from 750 (confirmed by PGCB through email on 30 Jan 2022-Discussed in 9th OCC meeting of India-Bangladesh)**

Members may note.

Deliberation in the meeting

Members noted.

ITEM NO. C.6: Protection Audit in Eastern Region

Protection audit is a primary activity to ensure power system protection implemented at substations and power plants are well coordinated and is as per CEA standards. Due to COVID-19, the activity could not be started since March 2020. Since then, various events have occurred where issues of protection coordination have been observed and several new substation and grid element has been connected with the grid. Therefore,it is now prime requirement to re-commence protection audit of substations and power plants in the Eastern Region. In view of this, following activities have been decided to streamline the audit process:

PCC activities

- Formation of Three-Four core audit teams-All utilities to nominate their members
- Nodal officer from all utilities to co-ordinate with audit activities
- Identification of S/s to be audited
- Finalization of audit format

Pre-audit activities

- Utilities of S/s thus identified to check and update latest protection settings in PDMS database within next 7 days
- S/s to fill up pre-requisite data as per format attached before visit of audit team

Input to be obtained from protection database

- SLD of the S/s
- List of elements
- Updated settings from PDMS database (PDF/excel)
- Model setting for the elements of substation being audited

On the day of Audit at Substation/Plants

- Verification of protection setting as per details provided.
- All testing reports
- Equipment's healthiness status, DC healthiness, Aux system healthiness etc.

Audit team observation will be shared with utilities and in PCC for action plans and compliance monitoring.

Format for protection audit checklist is attached at **Annexure C.6.**

Nomination for audit team was received from WBSETCL.

In 110th PCC Meeting, ERPC Secretariat informed that third party protection audit for the year 2022 would be commenced as soon as the current covid situation gets improved.

It was further informed that protection audit of following substations in Odisha would be carried out at first.

- 765/400 kV Jharsuguda(Powergrid) S/s
- 765 kV NTPC Darlipalli S/s
- 400/220kV Lapanga(OPTCL) S/s
- 220 kV Budhipadar(OPTCL) S/s
- 220 kV IB TPS(OPGC) S/s

PCC advised the concerned utilities to verify and update existing relay data and protection settings available in PDMS for the above mentioned substations before the field visit by audit team.

PCC further advised utilities to submit their comments, if any, regarding the protection audit procedure and format for finalization of the document.

Members may update.

Deliberation in the meeting

PCC advised concerned utilities of Odisha to verify and update existing relay data and protection settings available in PDMS before the field visit by audit team.

ITEM NO. C.7: Implementation of Differential protection for short lines

As per the CEA standard, transmission line protection can have either have distance or differential protection scheme as main protection scheme. It has been observed that for short lines distance protection scheme tends to over reach and pose protection coordination issues with other elements from the substation. Further many a times due to this short line distance protection the longer lines from remote ends have to increase their zone-2-time delays to higher values (500-600 ms).

In view of this inherent issue the REPORT OF THE TASK FORCE ON POWER SYSTEM ANALYSIS UNDER CONTINGENCIES recommends the following:

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

Based on the above in the 68th PCC ER forum members agreed on:

PCC opined that differential protection should be implemented for all short lines (<20 kM) to overcome relay coordination issues with respect to distance and over current protection.

In view of the above, the status of implementation differential protection for shorter lines in the eastern region may be followed up at ER PCC forum level.

In 109th PCC Meeting,

PCC enquired about the criteria adopted by utilities for implementing line differential protection in the lines at 220 kV and above level.

The views of utilities are given below:

- WBSETCL representative informed that as per their adopted practice criteria of line length < 10 km is considered for implementing line differential protection. For line length > 10 km, distance protection scheme gives satisfactory results as such they do not require implementing line differential protection for line length of 10-20 km.
- DVC representative informed that they had considered the criteria of line length < 10 km for implementing line differential protection scheme in their system.
- ERPC secretariat opined that in general for very short lines having line length less than 10 km, limitations are imposed by R/X of the relay in accurate setting of zone-1 of distance protection so the criteria of implementing line differential protection for line length of less than 10 km may be adopted by the utilities for lines at 220 kV & above voltage level. However, in critical and important lines as recommended by PCC forum, utility shall provide line differential protection irrespective of length of line. Members agreed to the above proposal.

List comprising of short lines vis-à-vis availability of line differential protection for each utility is attached at Annexure**.**

In 110th PCC, OPTCL, BSPTCL & JUSNL were advised to update the status of implementation of line differential protection for short transmission lines in their system.

Members may update.

Deliberation in the meeting

OPTCL, JUSNL & BSPTCL updated the present status w.r.t implementation of line differential protection in their system. The list is enclosed at ***Annexure-C7.***

PCC decided to place the list of the lines where line differential has been suggested, in the forthcoming TCC meeting.

ITEM NO. C.8: New Element Integration

LILO of 400 kV Teesta 3-Kishanganj S/c at Rangpo is to be first time charged. Line parameters are as below:

Name	Conductor Type	Length
400 kV Teesta 3-Rangpo	Quad Moose (45.34 km), Twin HTLS (10.80 km)	56.14 km
400 kV Rangpo-Kishanganj	Quad Moose (175.556 km), Twin HTLS (11.80 km)	187.356 km

Protection Co-ordination maybe reviewed as per following table :

Reason	Settings to be reviewed	Sub-station	Utility	Remarks
LILO of 400 kV Teesta 3-Kishanganj at Rangpo	400 kV Teesta 3-Rangpo	Teesta 3, Rangpo	PG ER-2, TPTL	Protection coordination to be done for newly connected element as per ERPC guidelines.
	400 kV Rangpo-Kishanganj	Rangpo, Kishanganj	PG ER-2, PG ER-1	Protection coordination to be done for newly connected element as per ERPC guidelines.
	400 kV Teesta 3-Dikchu	Dikchu	Dikchu	Zone-2 and Zone-3 setting of the line may be reviewed as adjacent line will be 400 kV Teesta 3-Rangpo (56.14 km)
	400 kV Rangpo-Kishanganj (Existing)	Rangpo	PG ER-2	Adjacent longest line for these lines will now be 400 kV Darbhanga-Kishanganj D/c (209 km-QM). Hence Zone-3 settings at respective S/s may be reviewed keeping in view it should not encroach next voltage level
	400 kV Binaguri-Kishanganj D/c	Binaguri	PG ER-2	
	400 kV New Purnea-Kishanganj D/c	New Purnea	PG ER-1	
	400 kV Saharsa (PMTL)-Kishanganj D/c	Saharsa	PMTL	
	400 kV Darbhanga-Kishanganj D/c	Darbhanga	ATL	Adjacent longest line will now be 400 kV Rangpo-Kishanganj (Existing) (189 km). Hence Zone-3 settings at respective S/s may be reviewed keeping in view it should not encroach next voltage level.

All utilities are requested to review Protection settings as outlined above and confirm the same at the earliest.

- Respective utilities may share whether revision of any existing protection setting at above mentioned S/S is required or not. In case of any revision, the revised setting may be shared with ERPC and ERLDC. All revisions may be carried out as per ERPC protection philosophy.
- Utilities should ensure that proper protection coordination are in place after charging of these lines/elements.

Concerned utilities may update.

Deliberation in the meeting

Concerned utilities were advised to share revised protection settings for their respective ends to ERPC/ ERLDC.

****

Annexure-A

Full Name	User Action	Timestamp
ERPC Kolkata	Joined	2/11/2022, 10:12:48 AM
BD Kumar	Joined	2/11/2022, 10:12:48 AM
Kumar Satyam, AE, ERPC (Guest)	Joined	2/11/2022, 10:12:48 AM
PG-ER1	Joined	2/11/2022, 10:12:48 AM
MD, OHPC (Guest)	Joined	2/11/2022, 10:12:52 AM
TVNL (Ashish Kr Sharma) (Guest)	Joined	2/11/2022, 10:13:46 AM
JAGANATH PANI NHPC (Guest)	Joined	2/11/2022, 10:13:57 AM
SANJEEV KUMAR (Guest)	Joined	2/11/2022, 10:22:48 AM
NIRMAL MONDAL (WBSETCL) (Guest)	Joined	2/11/2022, 10:24:17 AM
Ch Mohan Rao, Powergrid, Odisha (Guest)	Joined	2/11/2022, 10:25:42 AM
SMS SAHOO, DGM(ELECT), OPTCL (Guest)	Joined	2/11/2022, 10:27:04 AM
Sakti Narayan Dey, DGM (E), Teesta V PS	Joined	2/11/2022, 10:27:37 AM
Amresh Mallick	Joined	2/11/2022, 10:27:56 AM
KUMAR AMRENDRA MADANPURI (Guest)	Joined	2/11/2022, 10:29:57 AM
Pritam Mukherjee	Joined	2/11/2022, 10:30:47 AM
Akash Kumar Modi	Joined	2/11/2022, 10:31:31 AM
DILSHAD ALAM (Guest)	Joined	2/11/2022, 10:31:45 AM
Sougato Mondal	Joined	2/11/2022, 10:32:19 AM
DEBDAS MUKHERJEE WBPDCL (Guest)	Joined	2/11/2022, 10:33:00 AM
DEEPAK THAKUR, CRITL, BSPTCL (Guest)	Joined	2/11/2022, 10:33:07 AM
Gagan Kumar EEE (Guest)	Joined	2/11/2022, 10:33:14 AM
electrical orissa	Joined	2/11/2022, 10:33:21 AM
Sanjay Sharma, Teesta V PS (Guest)	Joined	2/11/2022, 10:33:34 AM
Arindam Bsptcl (Guest)	Joined	2/11/2022, 10:34:05 AM
Satyapriya Behera	Joined	2/11/2022, 10:34:39 AM
Alok Pratap Singh ,ERLDC (Guest)	Joined	2/11/2022, 10:34:45 AM
SLDC ODISHA (Guest)	Joined	2/11/2022, 10:36:17 AM
Prabhat Kumar	Joined	2/11/2022, 10:36:22 AM
Teesta V PS (Guest)	Joined	2/11/2022, 10:36:42 AM
Dharm Das murmu (Guest)	Joined	2/11/2022, 10:37:52 AM
Prachi Gupta (Guest)	Joined	2/11/2022, 10:38:19 AM
U.K.Mishra, DGM,EMR Divn, Burla (Guest)	Joined	2/11/2022, 10:40:45 AM
Dharmbeer Singh	Joined	2/11/2022, 10:41:25 AM
Chandan Kumar	Joined	2/11/2022, 10:42:06 AM
shadab (Guest)	Joined	2/11/2022, 10:42:55 AM
AP (Guest)	Joined	2/11/2022, 10:44:43 AM
Nishant Kumar Shankwar	Joined	2/11/2022, 10:45:30 AM
Deepak Kr. EEE, BSPTCL (Guest)	Joined	2/11/2022, 10:46:09 AM
RAMBABOO SINGH (Guest)	Joined	2/11/2022, 10:46:24 AM
Rajiv Ranjan (Guest)	Joined	2/11/2022, 10:47:09 AM
kranthikumar (Guest)	Joined	2/11/2022, 10:48:33 AM
aditya jha	Joined	2/11/2022, 10:49:15 AM
p chatterjee (Guest)	Joined	2/11/2022, 10:51:24 AM
saibal erldc (Guest)	Joined	2/11/2022, 10:52:38 AM
Sucharit Mondal (Guest)	Joined	2/11/2022, 10:53:15 AM
Dharm Das Murmu, CRITL (Guest)	Joined	2/11/2022, 10:53:57 AM
"prabhat k (TPTL) (Guest)	Joined	2/11/2022, 10:54:29 AM
Shabari Pramanick (Guest)	Joined	2/11/2022, 10:57:00 AM
Ajay Majhi	Joined	2/11/2022, 10:58:05 AM
eeetdhzb@gmail.com (Guest)	Joined	2/11/2022, 10:59:17 AM
Manjesh Kumar	Joined	2/11/2022, 11:00:02 AM
Amresh Prusti	Joined	2/11/2022, 11:03:58 AM
Ashish kumar (Guest)	Joined	2/11/2022, 11:06:29 AM
Barun Vinit (Guest)	Joined	2/11/2022, 11:09:50 AM
eetdhzb (Guest)	Joined	2/11/2022, 11:17:23 AM
shadab EEE CRITL (Guest)	Joined	2/11/2022, 11:23:01 AM
DOLAGOBINDA PATEL OPTCL MERAMUNDALI	Joined	2/11/2022, 11:36:37 AM
CRITL (Guest)	Joined	2/11/2022, 11:37:01 AM
manoj cbsa (Guest)	Joined	2/11/2022, 11:40:36 AM
Santosh Ghodekar, DANS Energy Jorethang	Joined	2/11/2022, 11:42:46 AM
RAHUL RAJ (Guest)	Joined	2/11/2022, 12:03:13 PM
BIHAR GRID COMPANY	Joined	2/11/2022, 12:19:57 PM

Transmission Line

			Guide Lines
			Internal protection trip signals, external trigger input, analog triggering (any phase current exceeding 1.5 pu of CT secondary current or any phase voltage below 0.8pu, neutral/residual overcurrent greater than 0.25pu of CT secondary current).
Triggering criteria for DR :	Any Start		
DR time window :	minimum 3 seconds.		minimum 2 seconds.
Pre-fault time window (S):		0.5	-
Post fault time window (S):		2.5	0.3
Minimum sampling frequency:	1000 Hz		64 Samples Per Cycle
Analog signals as per priority			
A. Mandatory signals:			
	1. Three phase voltage		1. Three phase-to-neutral voltages
	2. Neutral voltage		2. Three phase currents and neutral currents.
	3. Three phase current		3. Neutral Currents
	4. Neutral current		4. Frequency
B. Optional signals:			
	1. Mutual current		1. Polarizing currents and voltages, if used.
	2. Check Sync		2. Real and reactive power
	3. Open Delta		The Minimum parameters to be monitored in the Fault record shall be specified by the respective RPC.
Digital signals as per priority			
A. Mandatory signals:			
	1. Any Start		
	2. Any trip		
	3. Z1, Z2, Z3, Z4 pick up		
	4. Over current and Earth fault pick up		
	5. Over voltage stage I & II pick up		
	6. DT send & reverse		
	7. Carrier send & Receive		
	8. Main three phase CB open signal		
	9. Tie three phase CB open signal (where applicable)		
	10. Power Swing		
	11. SOTF/TOR		
	12. LBB		
	13. A/R L/O		
	14. Main-1/2 operated		
	15. Bus Bar trip		
	16. VT failure		
	17. Distance Forward & Reverse		
	18. T1, T2, T3, T4		
	19. Broken conductor		
	20. 86A & 86B		
	21. A/R 1P In Prog		
	22. A/R Fail		
	23. STUB/TEED (where applicable)		
B. Optional signals:			
	1. Any External input		
	2. Any Binary Input		

TRANSFORMER

			Guide Lines
Triggering criteria for DR :	Any Start		Internal protection trip signals, external trigger input, analog triggering (any phase current exceeding 1.5 pu of CT secondary current or any phase voltage below 0.8pu, neutral/residual overcurrent greater than 0.25pu of CT secondary current).
DR time window :	minimum 3 seconds.		minimum 2 seconds.
Pre-fault time window (S):		0.5 -	
Post fault time window (S):		2.5	0.3
Minimum sampling frequency:	3200Hz		64 Samples Per Cycle

Analog signals as per priority

A. Mandatory signals:

1. Three Phase Currents & Neutral Currents of HV
2. Three Phase Currents & Neutral Currents of LV
3. Three Phase Currents & Neutral Currents of MV
4. I_REF HV
5. I_REF LV
6. I_REF MV
7. Voltages
8. Frequency
9. Differential Currents
10. Restraining Currents
11. Low Impedence REF-DIFF - of all windings
12. Low Impedence REF-Restraining - of all windings

Digital signals as per priority

1. Any Start
2. Any trip
3. Differential Trip
3. REF Trip HV, MV & LV
4. Over-current Trip
5. Earth Fault Trip
6. Over Flux
7. Over Voltage
8. Under Voltage
9. 2nd Harmonic
10. 5th Harmonic
11. Frequency Protection
12. External Trip Signals

BUSBAR

		Guide Lines
Triggering criteria for DR :	Any Start	Internal protection trip signals, external trigger input, analog triggering (any phase current exceeding 1.5 pu of CT secondary current or any phase voltage below 0.8pu, neutral/residual overcurrent greater than 0.25pu of CT secondary current).
DR time window :	minimum 3 seconds.	minimum 2 seconds.
Pre-fault time window (S):		0.5 - 2.5
Post fault time window (S):		0.3
Minimum sampling frequency:	3200Hz	64 Samples Per Cycle
Analog signals as per priority		
A. Mandatory signals:	1. 3Phase Diff Current 2. 3Phase Bias Current 3. Neutral Differential Current 4. Neutral Bias Current	
B. Optional Signals:	1. Individual Feeder Currenrts if available 2. Zone wise Differential and Bias Currents	
Digital signals as per priority		
	1. Any Start 2. Any trip 3. R-Phase Fault 4. Y-Phase Fault 5. B-Phase Fault 6. Earth Fault 7. Check Zone Operated 8. Zone 1 BB Fault 9. Zone 2 BB Fault 10. Trip Bus bar Zone 1 11. Trip Bus bar Zone 2 12. Trip Breaker Failure Zone 1 13. Trip Breaker Failure Zone 2 14. Bus bar Differential Blocked	

पावर सिस्टम ऑपरेशन करपोरेशन लिमिटेड
(भारत सरकार का उद्यम)
POWER SYSTEM OPERATION CORPORATION LIMITED
(A Government of India Enterprise)
Eastern Regional Load Despatch Centre: 14, Golf Club Road, Tollygunge, Kolkata-700 033.
CIN: U40105DL2009GOI188682
फ़ोन: 033- 24235755, 24174049 फैक्स : 033-24235809/5029 Website:www.erldc.org, Email ID- erldc@posoco.in

घटना संख्या: **17-01-2022/1** दिनांक: **07-02-2022**

Report on the grid event in Eastern Region (पूर्वी क्षेत्र में ग्रिड घटना पर रिपोर्ट)

Summary of the event (घटना का सारांश):

At 13:13 hrs on 17-01-2022, all lines emanating from Biharsharif tripped. Total power failure occurred at Biharsharif and supply to Ekangarsarai, Rajgir, Baripahari, Hatidah, Harnaut, Barh, Nalanda interrupted. Total 147 MW load loss occurred.

- **Date / Time of disturbance:** 17-01-2022 at 13:13 hrs.
- **Event type:** GD - 1
- **Systems/ Subsystems affected:** 220/132 KV Biharsharif S/s
- **Load and Generation loss**.
    - No generation loss was reported during the event.
    - 147 MW load loss reported during the event at Ekangarsarai, Rajgir, Baripahari, Hatidah, Harnaut, Barh, Nalanda.

Important Transmission Line/element if out (महत्वपूर्ण संचरण लाइने जो बंद है):

- 220 kV Biharsharif-Khizersarai-1

Major elements tripped (प्रमुख ट्रिपिंग):

- 220 kV Biharsharif-Tenughat
- 220 kV Biharsharif-Mokama D/c
- 220 kV Biharsharif-Fatuah D/c
- 220 kV Biharsharif-Khizarsarai-2
- 4*315 MVA 400/220 kV ICT at Biharsharif

Network across the affected area (प्रभावित क्षेत्र का नक्शा)

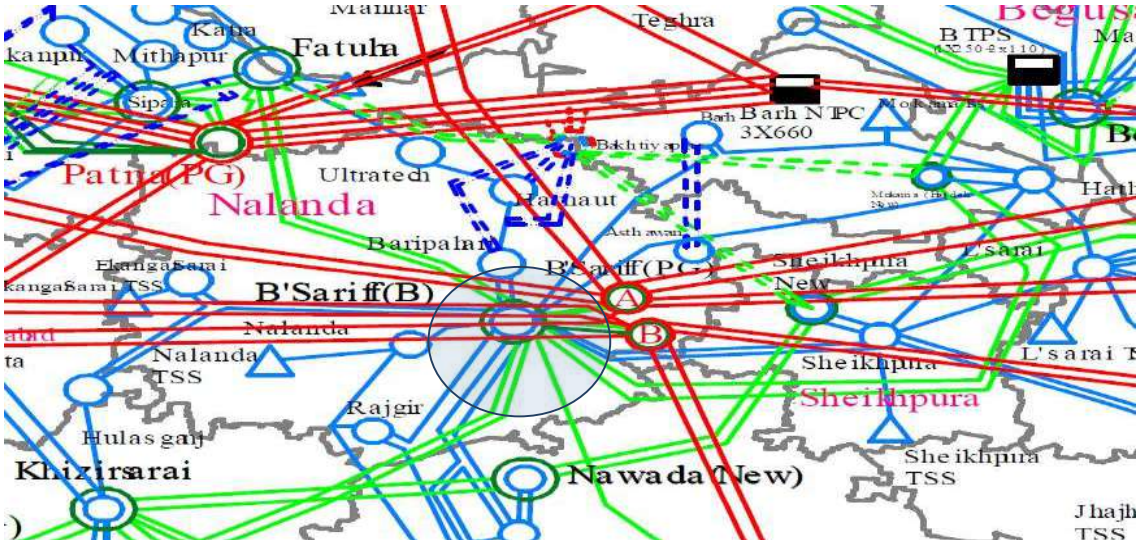


Figure 1: Network across the affected area

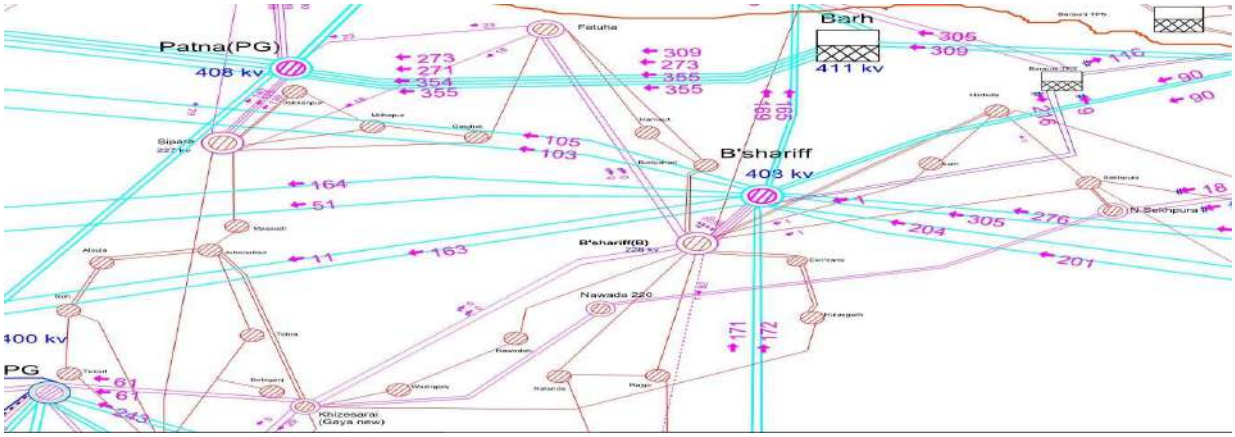


Figure 2: SCADA snapshot for of the system

Relay indication and PMU observation (रिले संकेत और पीएमयू पर्यवेक्षण):

समय	नाम	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	पीएमयू पर्यवेक्षण
13:13	220 kV Biharsharif-Tenughat-1	Biharsharif: B_N, Z-4, -2.609 km, 1.387 kA	Tenughat: Didn't trip	90 kV dip in B_ph at 400 kV Biharsharif. Fault clearance time: 300 msec
	220 kV Biharsharif-Mokama-1	Biharsharif: B_N, 1.88 kA, Z-4	-	
	220 kV Biharsharif-Mokama-2	Biharsharif: O/V St.-2	Didn't trip	
	220 kV Biharsharif-Fatuah-1	Biharsharif: B_N, Z-4, 2.239 kA	Didn't trip	
	220 kV Biharsharif-Fatuah-2	Biharsharif: B_N, Z-4, 2.315 kA	Didn't trip	
	220 kV Biharsharif-Khizarsarai-2	Biharsharif: B_N, Z-4	Khizersarai: B_N, Zone-1, 34.34 km, 3.36 kA	
	400/220 kV ICT-1 at Biharsharif	Intertrip	-	
	400/220 kV ICT-2 at Biharsharif	Intertrip	-	
	400/220 kV ICT-3 at Biharsharif	Didn't trip at PG end	-	
	400/220 kV ICT-4 at Biharsharif	Intertrip	-	

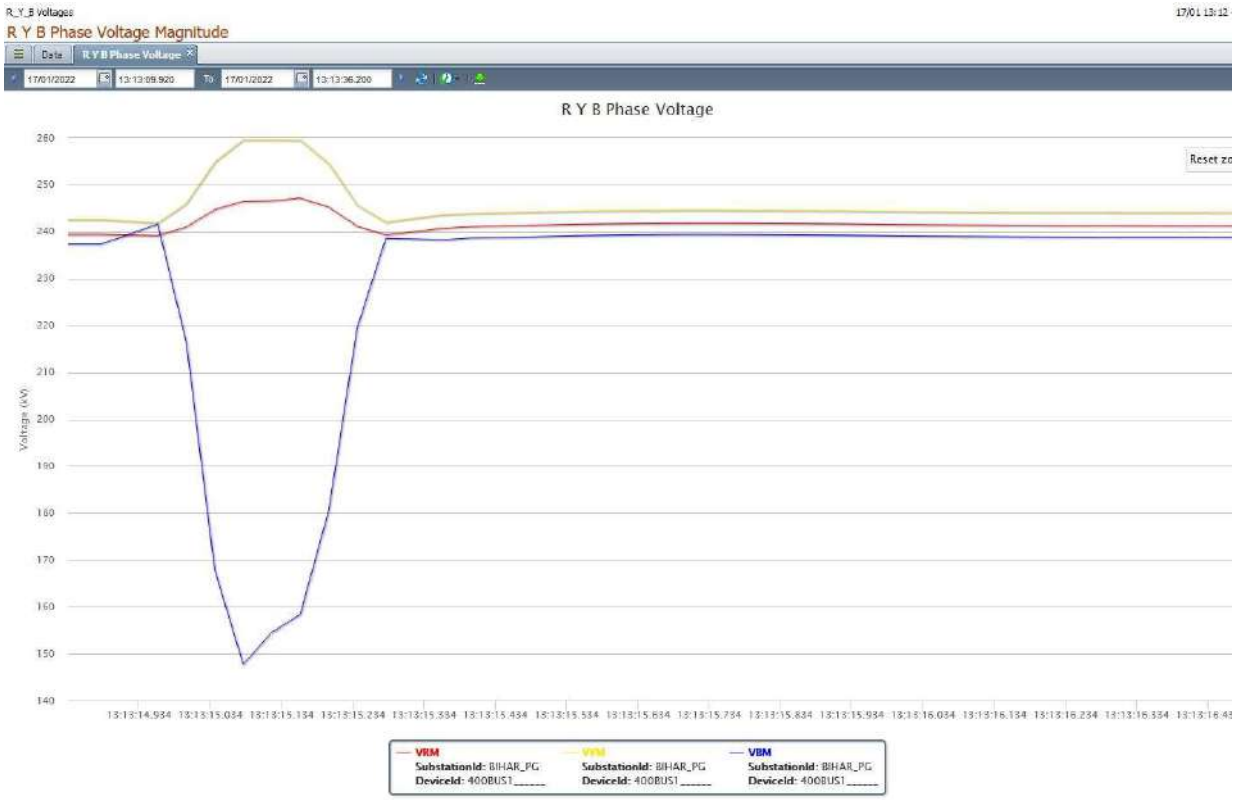


Figure 3: PMU snapshot of 400/220 kV Biharsharif S/s

Restoration (पूर्वावस्था की प्रप्ति)

Transmission/Generation element name	Restoration time
220 kV Biharsharif-Tenughat-1	14:31
220 kV Biharsharif-Mokama-1	13:33
220 kV Biharsharif-Mokama-2	13:32
220 kV Biharshairf-Fatuah-1	14:28
220 kV Biharsharif-Fatuah-2	14:29
220 kV Biharsharif-Khizarsarai-2	14:15
400/220 kV ICT-1 at Biharsharif	16:45
400/220 kV ICT-2 at Biharsharif	14:10
400/220 kV ICT-3 at Biharsharif	13:56
400/220 kV ICT-4 at Biharsharif	14:31

Analysis of the event & Protection Issue (घटना का विश्लेषण):

- While restoration of 220 kV Biharsharif-Khizersarai-1 (Under s/d for maintenance work), flashover occurred near gantry in B_ph. This created bus fault in 220 kV Bus-2, which led to tripping of all lines as bus bar protection is not available at Biharsharif.

- 220 kV Biharsharif-Mokama-2 tripped on O/V Stage-2 within 150 msec. Phase voltage in R_ph shot beyond 310 kV. **BSPTCL to explain.**
- 220 kV Biharsharif-Mokama-1 tripped from Biharsharif in Zone-4 after 250 msec and in Zone-2 from Mokama after 300 msec.
- 220 kV Biharsharif-Tenughat and 220 kV Biharsharif-Fatuah D/c tripped from Biharsharif end after 250 msec in Zone-4. Zone-2 started at remote ends, however, line tripped before that from Biharsharif.
- As per DR, 220 kV Biharsharif-Khizersarai-2 tripped immediately from Khizersarai, while breaker at Biharsharif didn't trip. Zone-4 picked up at Biharsharif but line opened from remote end. How bus fault at Biharsharif was seen in Zone-1 at Khizersarai? **BGCL to explain.**
- 400/220 kV ICT-1,2,4 tripped immediately from both ends (Intertrip signal sent to HV side). ICT-3 tripped from 220 kV side only. It seems, all ICTs have non-directional O/c relay at 220 kV side with Hi-set functionality. Why intertrip signal was not sent for ICT-3. Why O/c relay doesn't have directional feature? **BSPTCL to explain**.
- Bus bar protection at such important node is of utmost importance. It maybe installed at the earliest for reliability of supply at Biharsharif. **BSPTCL to update.**

Non-compliance observed (विनियमन का गैर-अनुपालन):

Issues	Regulation Non-Compliance	Utility
DR/EL not provided within 24 Hours	1. IEGC 5.2 (r) 2. CEA grid Standard 15.3	**BSPTCL, PG-ER1**

Status of Reporting (रिपोर्टिंग की स्थिति):

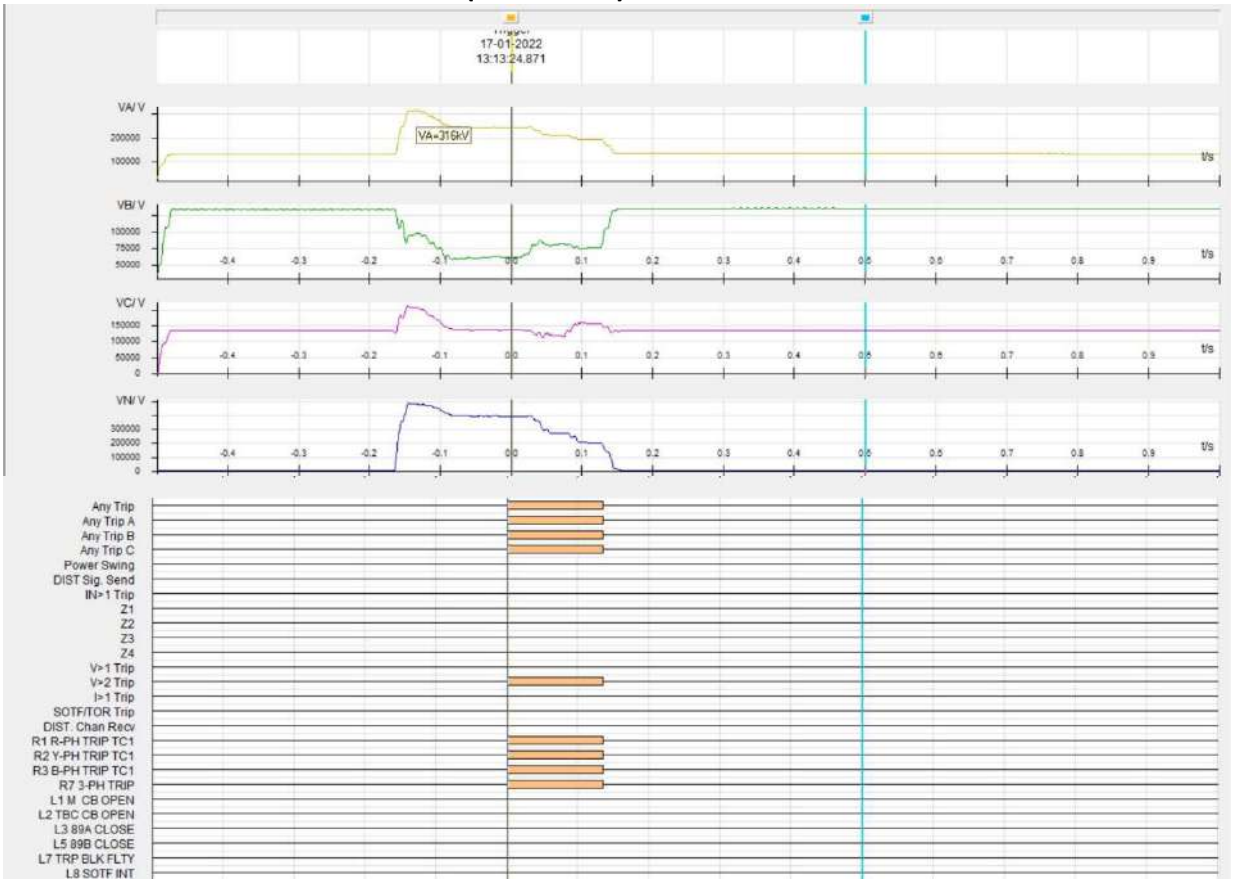
- DR/EL received from BSPTCL
- DR/EL received from PG ER-1

Annexure 1: Sequence of events recorded at ERLDC SCADA data at the time of the event.

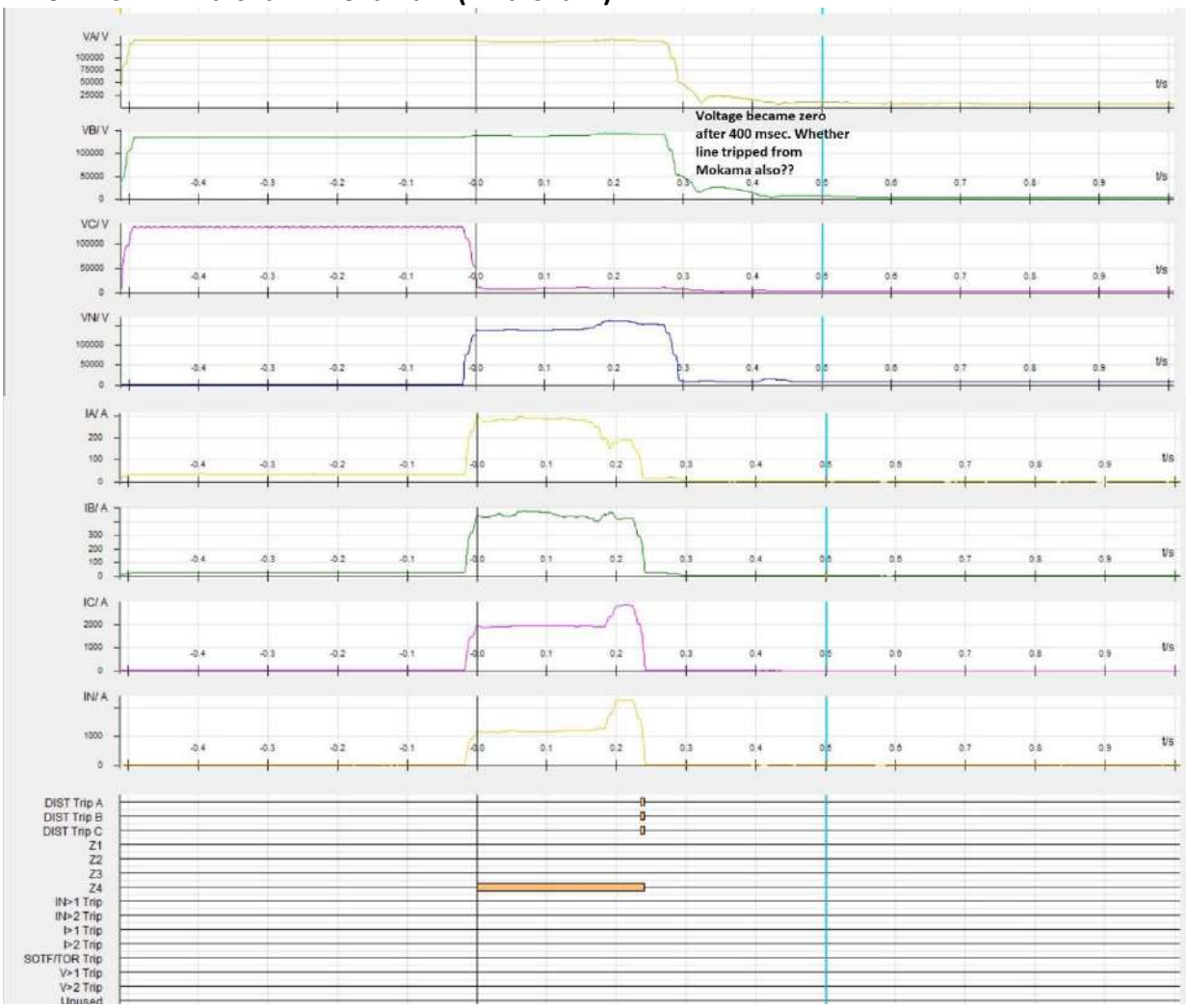
Sequence of event not recorded at time of event.

Annexure 2: DR recorded

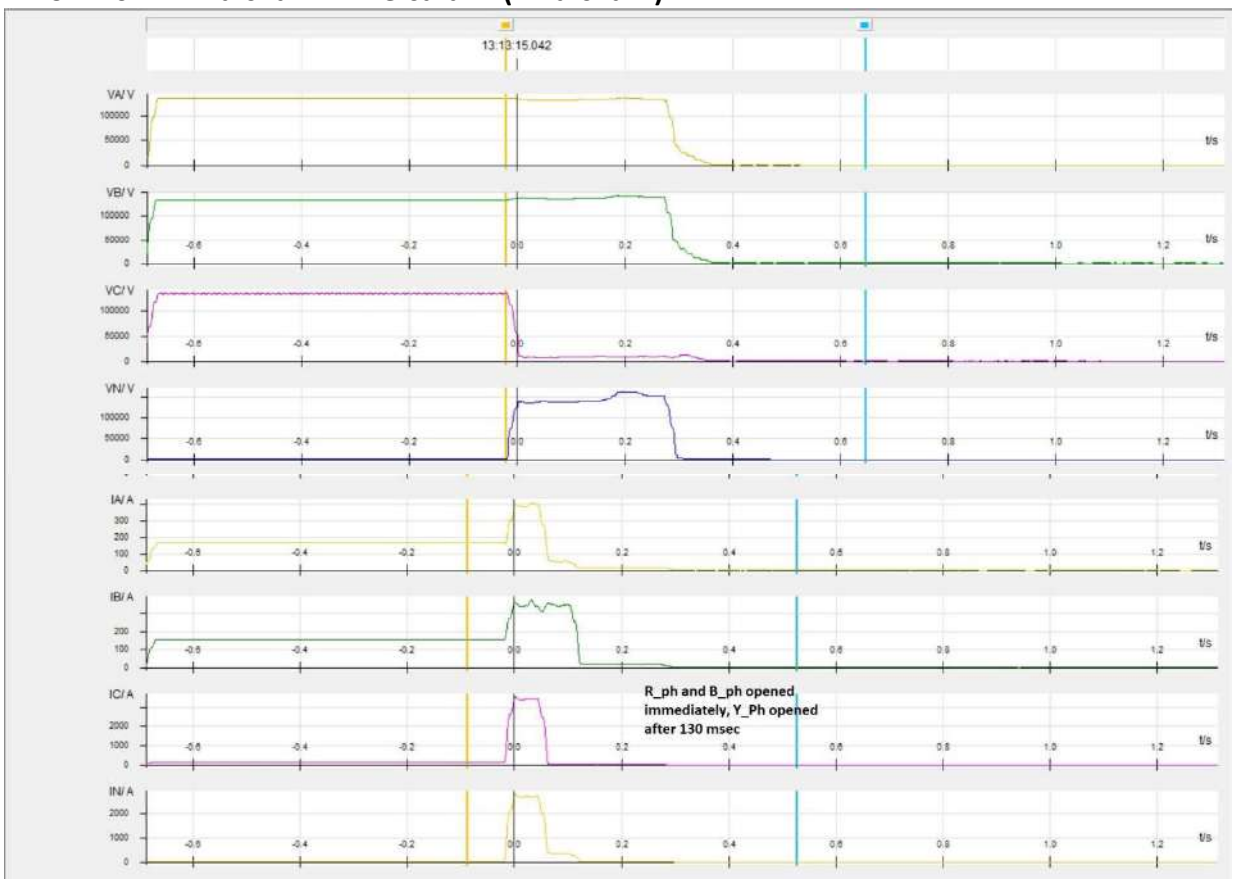
DR of 220 kV Biharsharif-Mokama 2(Biharsharif)



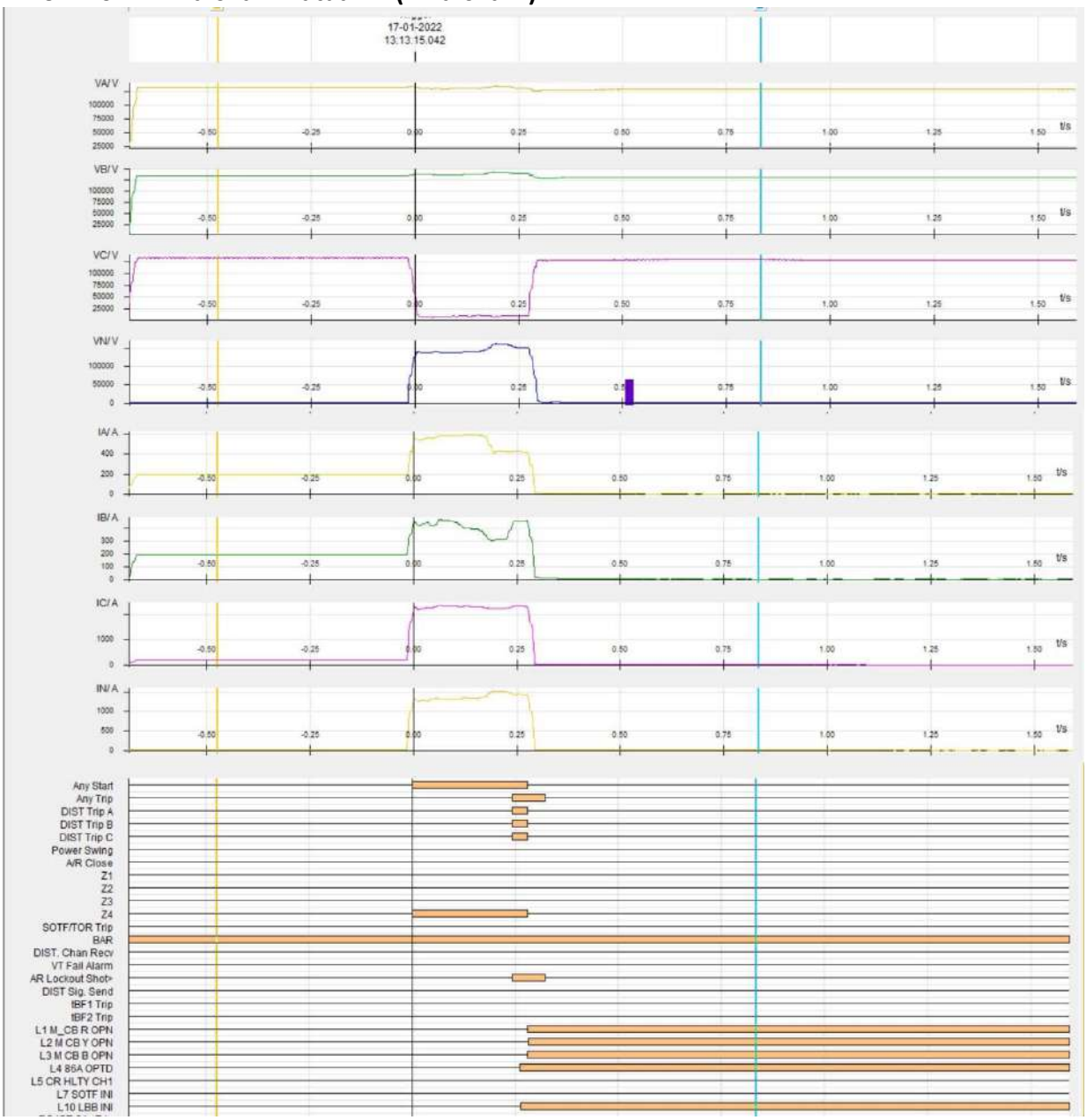
DR of 220 kV Biharsharif-Mokama-1 (Biharsharif)



DR of 220 kV Biharsharif-Khizersarai-2 (Biharsharif)



DR of 220 kV Biharsharif-Fatuah-1 (Biharsharif)



Annexure B.3.1

DISTURBANCE REPORT

- 220/132/33kV Biharsharif GSS (BSPTCL)
  on 17.01.22 at13:13

ROOT CAUSE

- As reported 220KV Biharsharif- Khizarsarai ckt-1 was already in shutdown for winter maintenance works. After completion of work, during closing of 220 kV Main bus-2 isolator, a heavy flashing occurred near B phase circuit portion of gantry which further resulted in total power fail at GSS Biharsharif. During physical verification, some burnt armour wires were found near gantry which indicates the possibility of sky bus conductor getting in contact through the armour wire with the gantry(Bird fault) . This further resulted into 220 kV Main bus-2 earth fault during closing of main bus 2 isolator of 220 kV Biharsharif-Khizarsarai ckt-1 causing tripping of all 220 kV Incoming sources.

Sl. no.	Name of element	Type/location on Main bus	Relay	Remarks
01	220KV Biharsharif-TTPS	Incoming Source(Main bus2)	Start phase CN,TripABC,Start element distance trip z4,fault duration-282msec,relay trip time-80.10msec,fault loc- negative2.609km,Ia-212.9A,Ib-568A,Ic-1.387KA,Van-131.8KV,Vbn-138KV,Vcn-6.76KV,Fault resistance-negative 3.897ohm	Tripped in zone 4 with fault duration 282ms.(Setting o Z4 changed to 250ms as per recommendation of ERPC)
			Start phase AC,Trip ABC,O/C start I>2, E/F start IN>2 overvoltage start over	Tripped in zone 4 with fault duration 250.3ms.(Setting

Sl. no.	Name of element	Type/location on Main bus	Relay	Remarks
03	220KV Biharsharif-Mokama ckt-2	Incoming Source(Main bus 2)	Start phase AC,Trip ABC,O/C start I>2, E/F start IN>2,overvoltage start,over voltage trip,fault duration-313.7msec,relay trip time-135.2msec,Ia-265.2A,Ib-423.5A,Ic-1.910KA,Van-315.4KV,Vbn-96.32KV,Vcn-208KV,Fault in zone none	Since the 2 stage overvoltage setting is 150% and time day 100ms , so the overvoltage hiset triggered. Might have mal-operated. Relay Under observation
			Start phase CN,TripABC,distancetrip z4,fault duration-	Tripped in zone 4 with fault duration

Sl. no.	Name of element	Type/location on Main bus	Relay	Remarks
05	220KV Biharsharif-Fathua ckt-2	Outgoing(Main bus 2)	Start phase CN,TripABC,distancetrip z4,fault duration-278.7msec,relay trip time-80.10msec,fault loc- negative 1.481km,Ia-540.9A,Ib-412.2A,Ic-2.315KA,Van-131.9KV,Vbn-137.9KV,Vcn-6.886KV,Fault resistance-negative 2.092ohm	Tripped in zone 4 with fault duration 278.7ms.(Setting of Z4 changed to 250ms as per recommendation of ERPC)
			Start phase	Tripped in zone 1 with fault

07	ICT-1,2	Incoming Source(Main bus 1 and 2 resp.)	Master trip3 86	LV side dir OC/EF relay available at Biharsharif GSS (BSPTCL) end. Inter tripping from 86LV to 86HV at Biharsarif PG and from 86HV at PG to 86LV at BSF GSS (BSPCTl) through different core of same cable.
				Only 86 relay available at Biharsharif GSS (BSPTCL) end. Inter tripping from 86 BSPTCL to 86LV at

NOTE

- In 105th PCC meeting it was informed by bSPTCL representative that intertripping for ICT1 & ICT 3 are connected through comman cable .Separate cable laying had to be done by PG .IR test of intertripping cable of ITC 2 has been done on 18 june 2021 and no abnormality was found.
- In 106th PCC meeting ,powergrid informed that intertrip command from LV side to HV side of the ICTs which is through 86 relays will be changed and implemented through numerical relay by oct21.

NOTE

- As per our analysis ,it is difficult to conclude that intertripping command initiated from LV side (BSPTCL) in case of ICT1&3, as LV OC/EF relay are directional.
- HV side OC/EF(PG end) of ICTs relay feeding the fault should have operated.
- It is requested to disable the intertripping from LV side to HV side of ICT for some time to find out which relay is triggering first.
- ERPC may kindly suggest the remedial measures to be taken.

पावर सिस्टम ऑपरेशन करपोरेशन लिमिटेड
(भारत सरकार का उद्यम)
POWER SYSTEM OPERATION CORPORATION LIMITED
(A Government of India Enterprise)
Eastern Regional Load Despatch Centre: 14, Golf Club Road, Tollygunge, Kolkata-700 033.
CIN: U40105DL2009GOI188682
फ़ोन: 033- 24235755, 24174049 फैक्स : 033-24235809/5029 Website:www.erldc.org, Email ID- erldc@posoco.in

घटना संख्या: **02-01-2022/1** दिनांक: **31-01-2022**

Report on the grid event in Eastern Region (पूर्वी क्षेत्र में ग्रिड घटना पर रिपोर्ट)

Summary of the event (घटना का सारांश):

On 2nd Jan 2022 at 04:29 Hrs, 220 kV Daltonganj-Garhwa (New)-1 circuit tripped on Y-phase to earth fault. At the same time, 220 kV Daltonganj-Garhwa (New)-2 circuit also tripped on R-phase to earth fault, leading to total power failure at 220/132 kV Garhwa (New) S/s and below radial interconnections. There was total load loss of 51 MW during the event.

Date / Time of disturbance: 02-01-2022 at 04:29 hrs

- **Event type:** GD-1
- **Systems/ Subsystems affected:** 220/132 kV Garhwa (New)
- **Load and Generation loss**.
  - No generation loss was reported during the event.
  - Around 51 MW load loss reported during the event at Garhwa (New) by Jharkhand SLDC.

Important Transmission Line/element if out (महत्वपूर्ण संचरण लाइने जो बंद है):

- NIL

Major elements tripped (प्रमुख ट्रिपिंग):

- 220 kV Daltonganj-Garhwa (New) D/c

Network across the affected area (प्रभावित क्षेत्र का नक्शा)

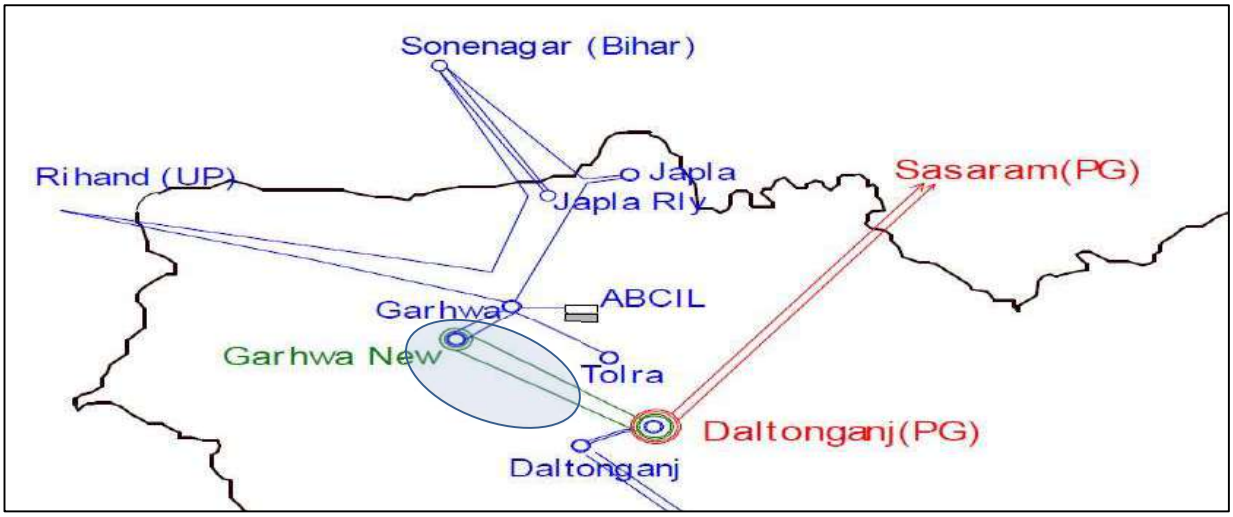


Figure 1: Network across the affected area

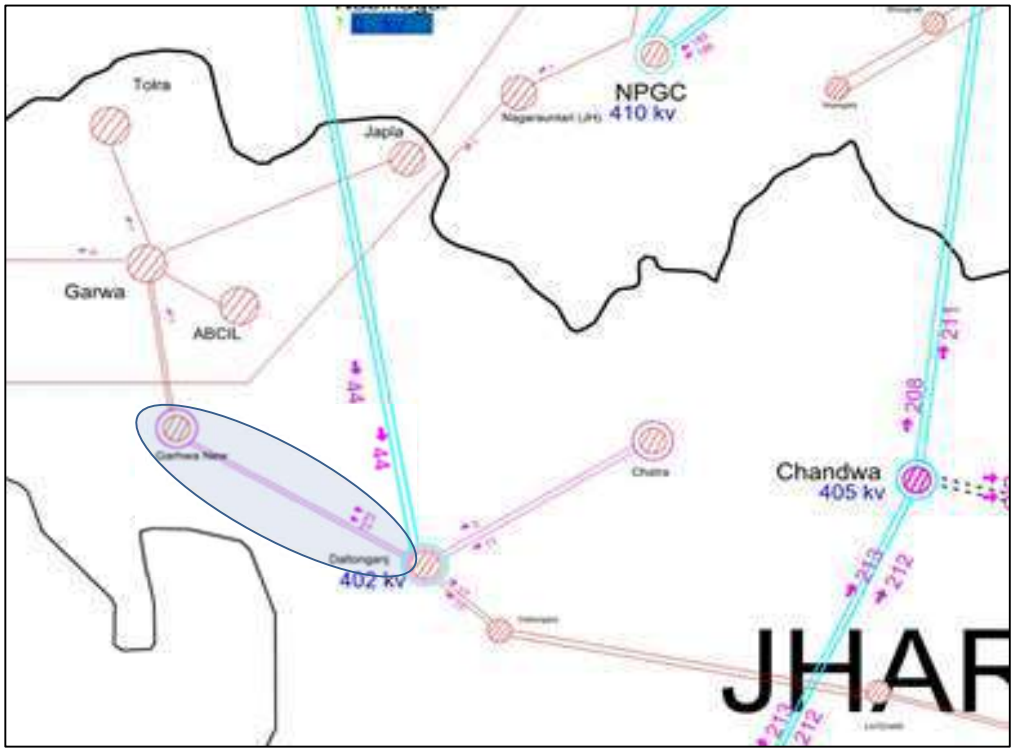


Figure 2: SCADA snapshot of the system prior to event

Relay indication and PMU observation (रिले संकेत और पीएमयू पर्यवेक्षण):

Time समय	Name of elements (एलिमंट का नाम)	Relay indication from substation end 1 उप केंद्र 1 रिले संकेत	Relay indication from substation end 1 उप केंद्र 2 रिले संकेत	PMU observation पीएमयू पर्यवेक्षण
04:29 Hrs	220 kV Daltonagnj-Garhwa(New)-1	Y_N, FC-1.6 kA, 63.9 km	-	R and Y phase fault is observed from the PMU measured bus voltage of 400 kV Daltonganj (PG)and A/R is also observed after 1 seconds
	220 kV Daltonagnj-Garhwa(New)-2	R_N, FC-1.183 kA, 63.9 km	-	

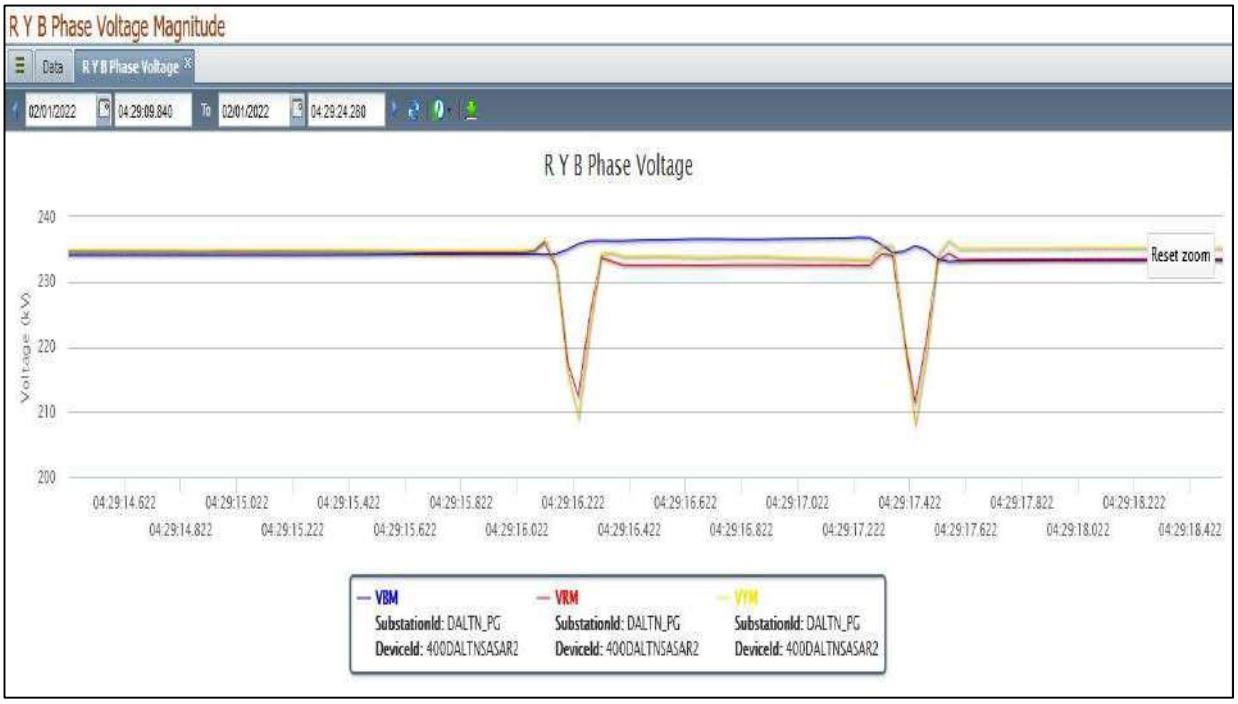


Figure 3: PMU snapshot of 400/220 kV Daltonganj S/s

Restoration (पूर्वावस्था की प्रप्ति)

Transmission/Generation element name	Restoration time
220 kV Daltonganj-Garhwa (New)-1	16:34 (03.01.22)
220 kV Daltonganj-Garhwa (New)-2	06:14

Analysis of the event (घटना का विश्लेषण) & Protection issue (सुरक्षा समस्या):

- As reported, R phase jumper of 220 kV Daltonganj-Garhwa-1 snapped at loc. 240.

Daltonganj end DR analysis

- The snapped jumper induced simultaneous Y phase fault in Ckt-1 and R phase fault in Ckt-2 from Daltonganj end. These fault were observed in Zone 1 by Daltonganj end relay.
- A/R operated successfully in both lines from Daltonganj end. However, line tripped again within reclaim time after 1 second due to permanent nature of fault. This observed in DR as well as PMU data.

Garhwa end DR analysis

- R phase fault in Ckt. 1 was observed by relay at Garwah end. Its A/R operated successfully; and line tripped within reclaim time from Garwa end due to permanent nature of the fault. Single phase tripping occurred during reclaim time. **JUSNL to explain the physical nature of the fault which led to Y phase fault from Daltonganj end and R phase from Garwa end.**
- Ckt-2 saw the fault in R phase in Zone-4 from Garhwa and line didn't trip from Garhwa end.

Non-compliance observed (विनियमन का गैर-अनुपालन):

Issues	Regulation Non-Compliance	Utility
DR/EL not provided within 24 Hours	1. IEGC 5.2 (r) 2. CEA grid Standard 15.3	**JUSNL, PG ER-I**

Status of Reporting (रिपोर्टिंग की स्थिति):

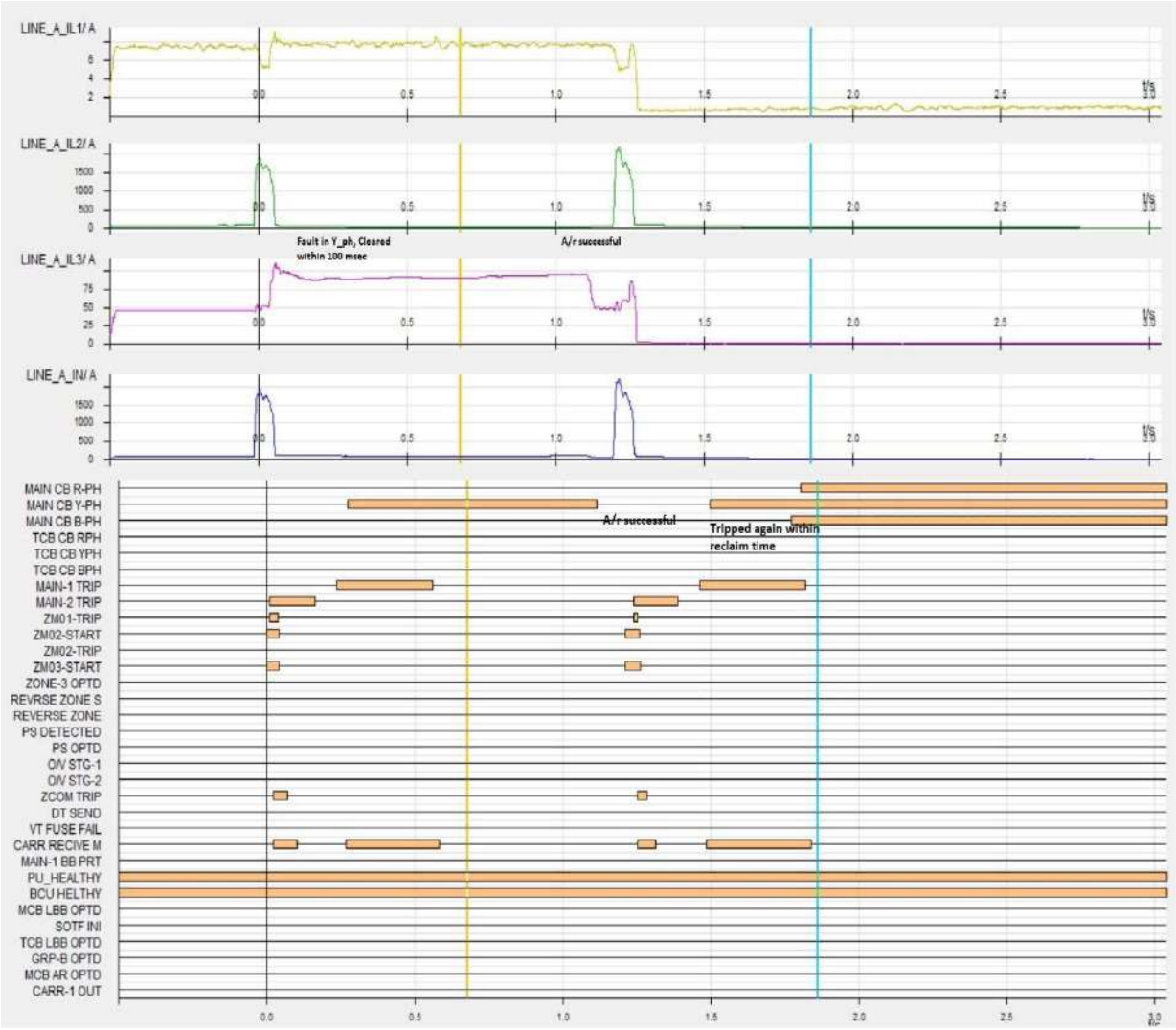
- DR/EL received from JUSNL
- DR/EL received from PG ER-I

Annexure 1: Sequence of events recorded at ERLDC SCADA data at the time of the event.

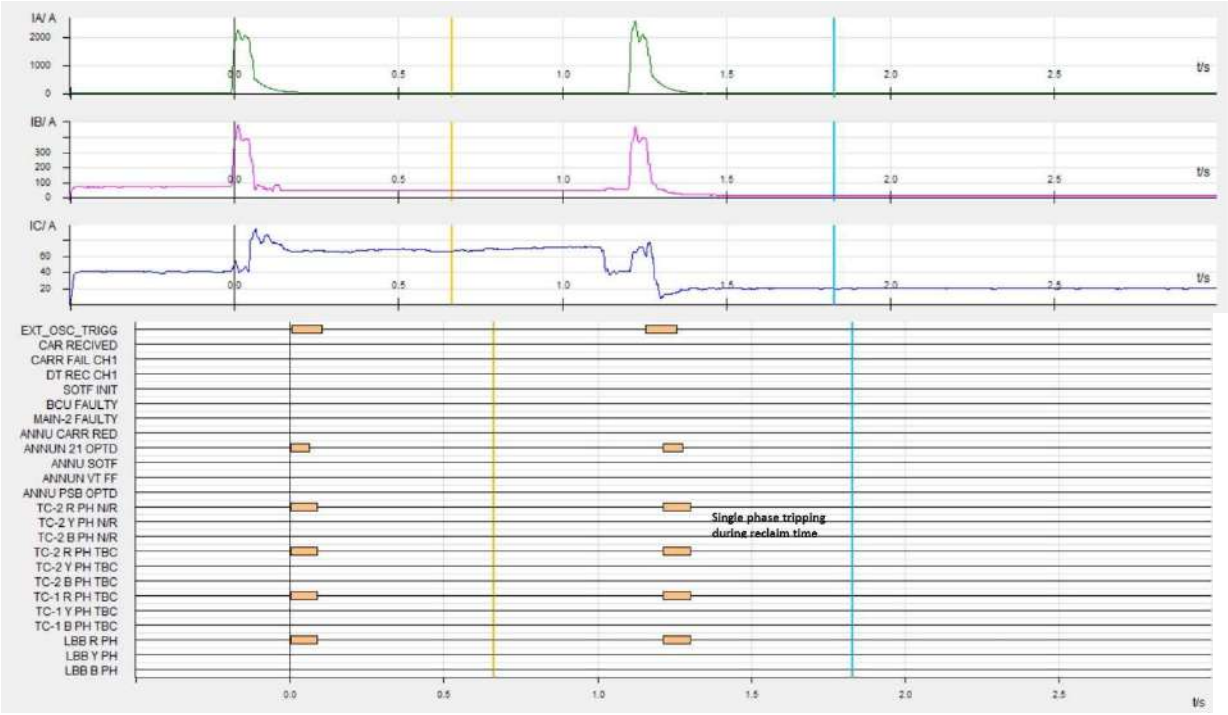
Sequence of event (SOE) not recorded at time of event.

Annexure 2: DR recorded

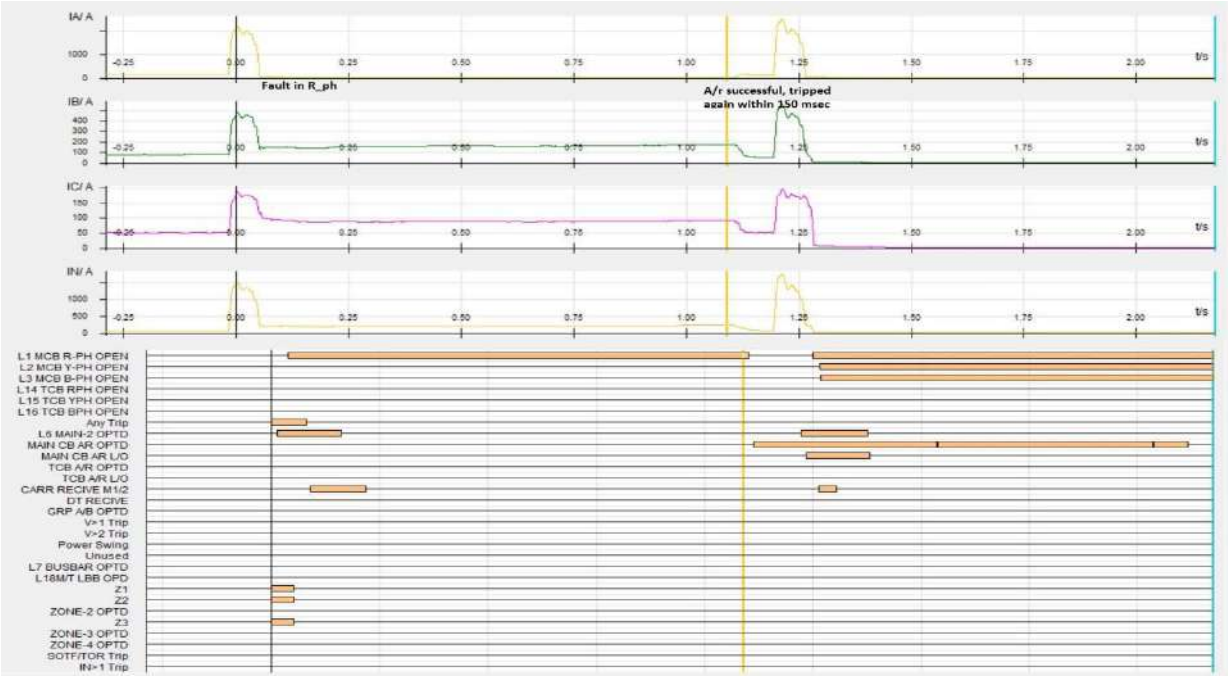
DR of 220 kV Daltonganj-Garhwa 1 (Daltonganj end)



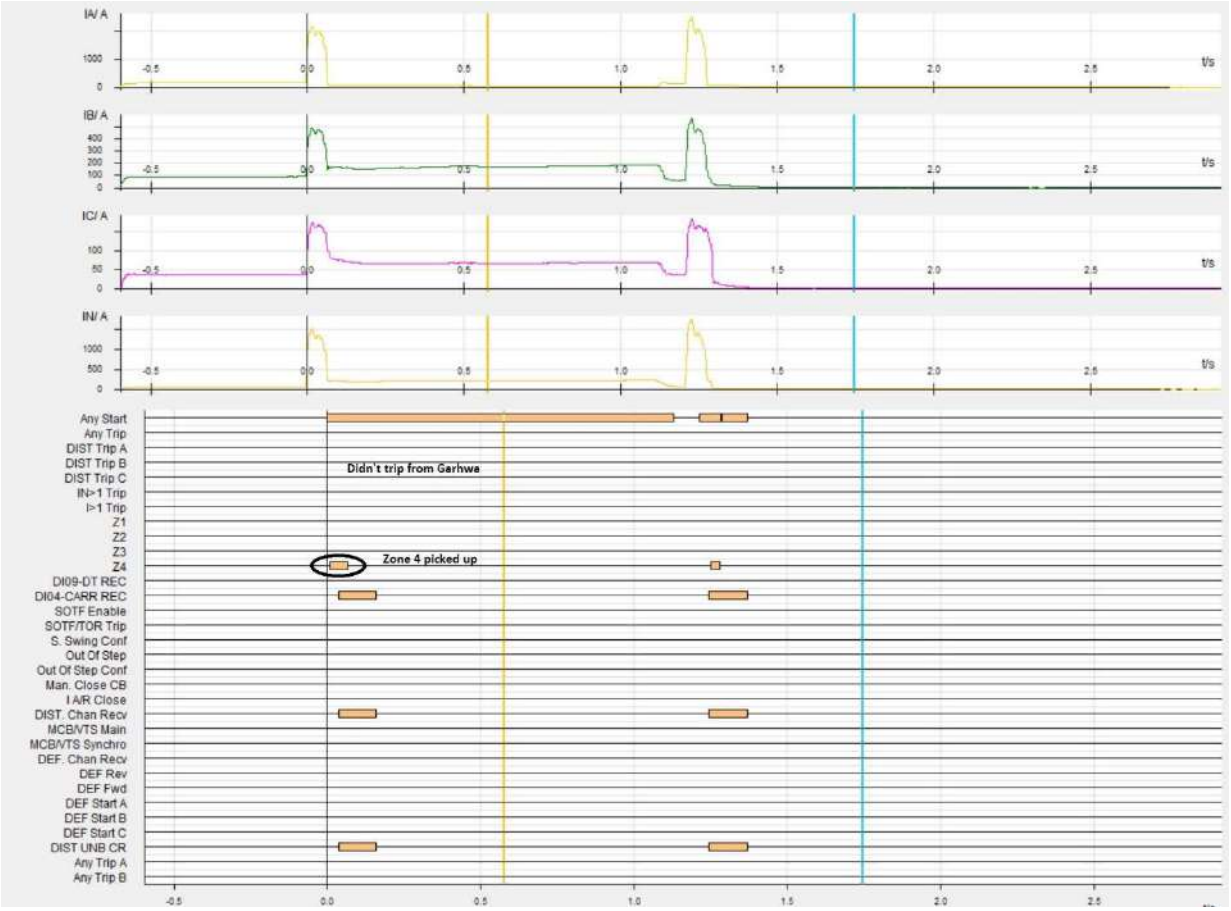
DR of 220 kV Daltonganj-Garhwa 1 (Garhwa end)



DR of 220 kV Daltonganj-Garhwa 2 (Daltonganj end)



DR of 220 kV Daltonganj-Garhwa 2 (Garhwa end)



Islanding Event:

3.1 CESC Islanding Event:

CESC system got islanded twice in the month of January'22.

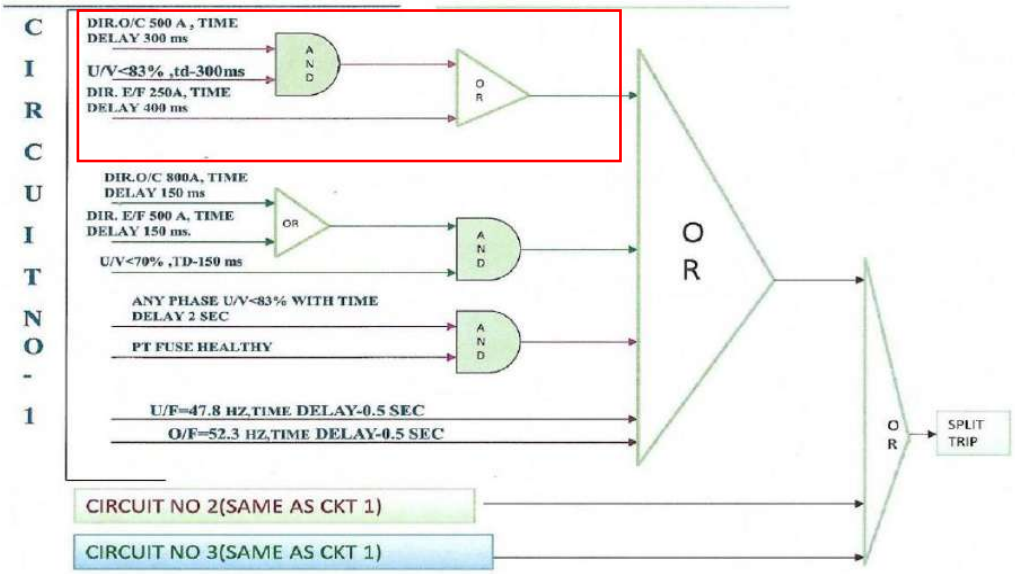
Islanding Event 1: 13:25 Hrs on 14.01.2022

Sequence of event

- At about 13:25:18 Hrs, CESC system got islanded from Grid with tripping of WBSEB 1, BOT 2// 2A and BOT 3 circuits at SRS.
- Load connected at Botanical Garden SS continued to be fed radially from WBSETCL Howrah SS.

Analysis

- Splitting occurred via SPLIT logic -1 as encircled in islanding logic diagram provided below.
- At that time at WBSETCL end fault was in 132 kV Liluah -Rishra -2 and fault was in zone-2 from Liluah end. This circuit tripped in Zone -2 (350 msec) time from Liluah and prior to that SPS logic for islanding got satisfied as for that time delay is only 150 msec.



- Total Fault current fed from CESC circuits was around 2.9 kA in R & Y ph for 70 ms and then around 1.8 kA for next 350 ms (shared as W1- 400A, BOT2/2A -700A, BOT3-700A)
- Phase Voltage dip occurred in R & Y ph and it was to the tune of 55 kV for 70 ms and then 63 kV for the next 350ms.

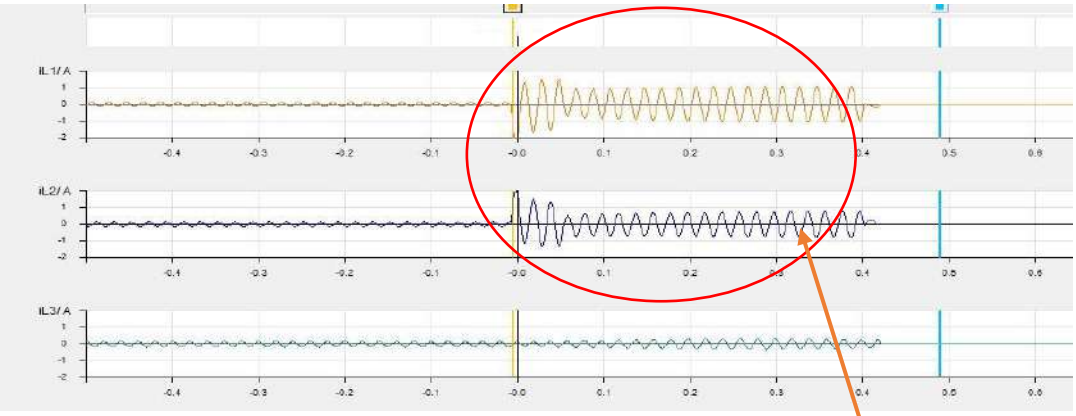


FIG: BOT3 CURRENT WAVEFORM

R-Y phase to phase fault occurred in WBSETCL Rishra– Liluah circuit for more than 300ms.

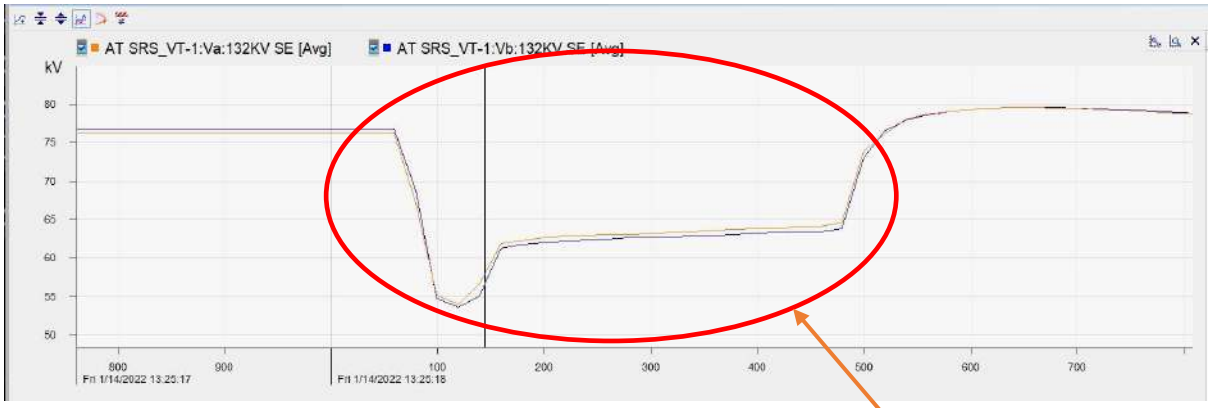
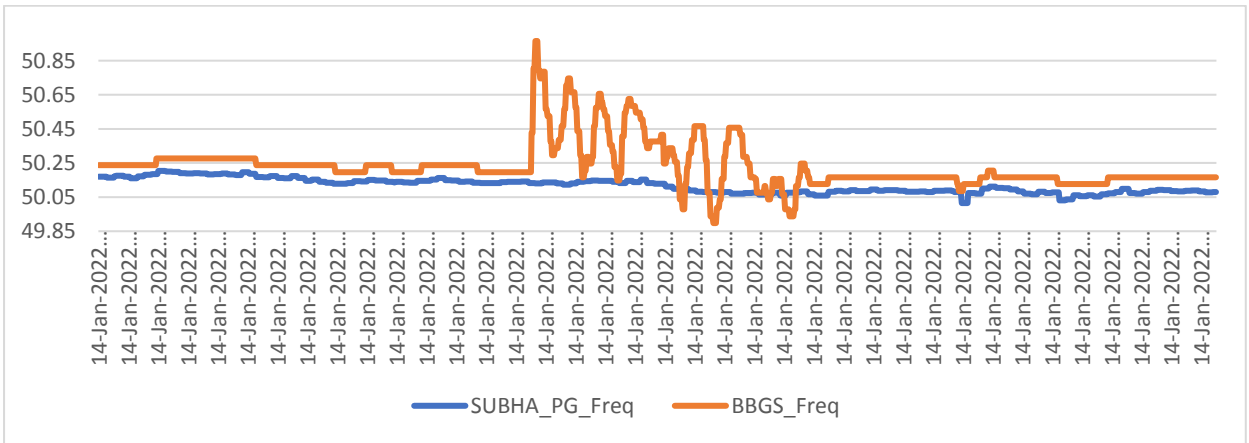


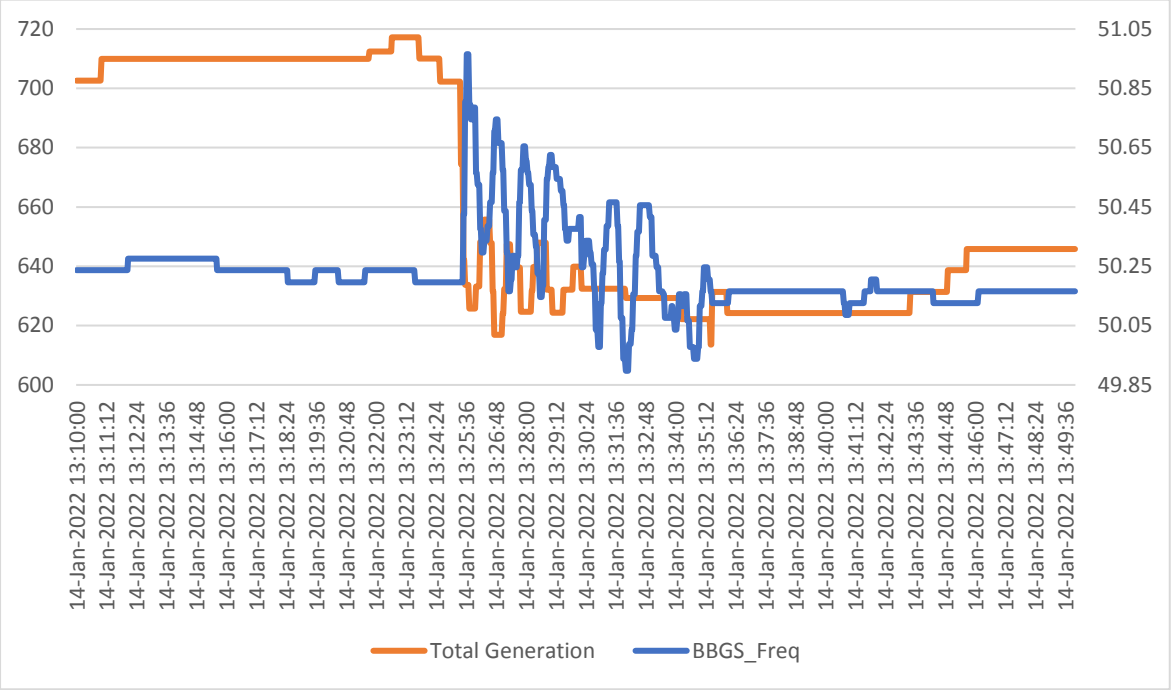
FIG: 132 kV VOLTAGE WAVEFORM

Voltage Dip observed in R & Y phases for 420ms

Frequency Comparison: From Scada plot 0.5-0.6 Hz continuous slow variation as observed in previous cases ,with periodicity of 1 Minute and 0.014 Hz mode. From PMU variation will be slightly more. After Synchronization at 13:35 it stabilized.



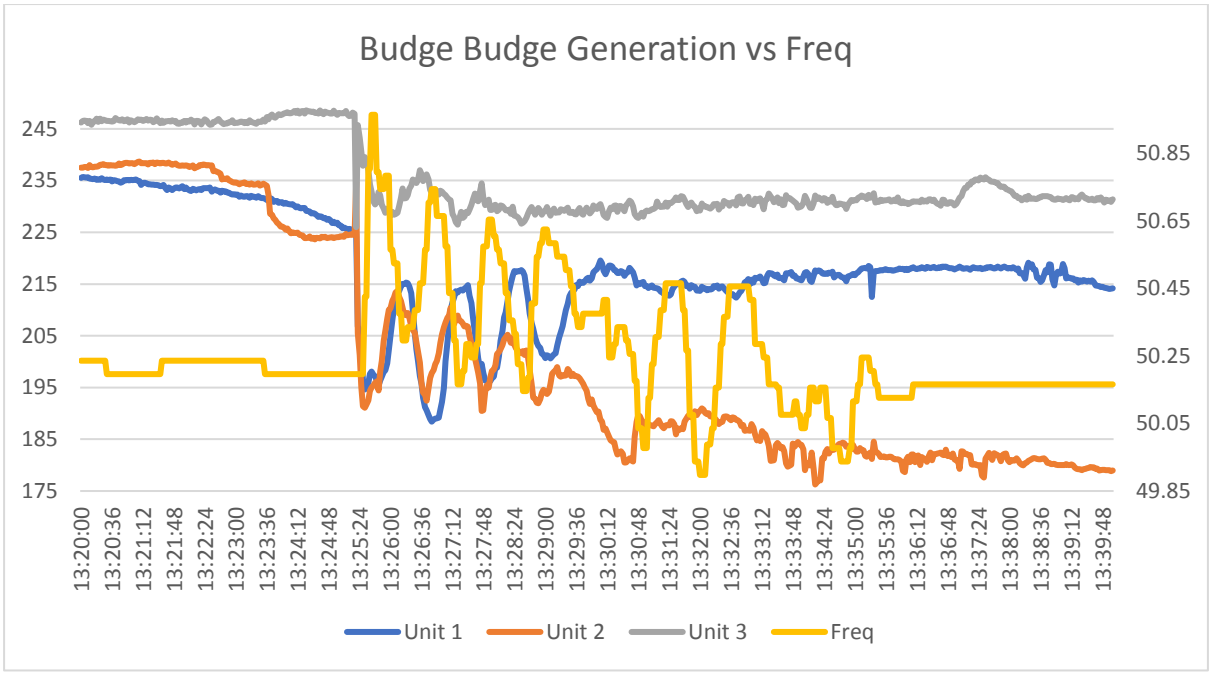
Generation Variations: Frequency variation appears to be due to variation in generation as seen from below plot.25 Mw variation observed in total generation of budge-budge periodically.



Root cause analysis for frequency variation:

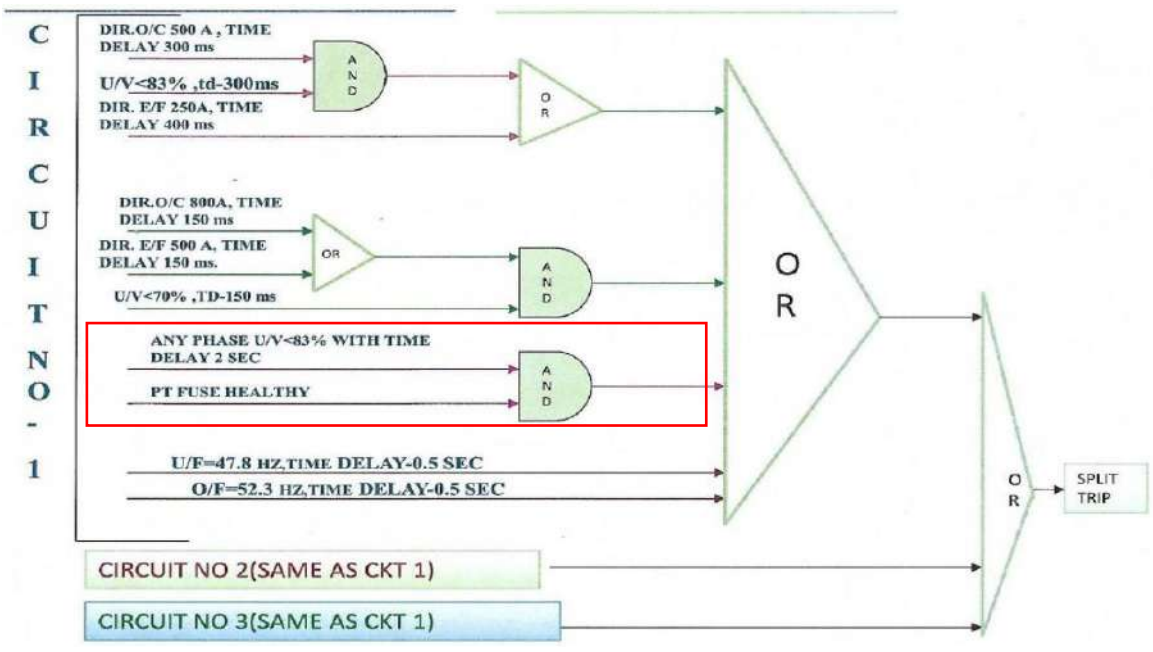
Unit Wise Variation:

- Unit 3 is in RGMO mode and Frequency was higher than 50.05 Hz hence not much variation observed from Budge-budge generation data while unit 1 & 2 in FGMO mode has observed variations.
- As can be seen below Unit 1 and 2 generation is increasing as frequency is decreasing and then again after 1 minute approx. generation is decreasing and frequency is increasing again and then as a Free governor mode response generation again started decreasing this process is keep on repeating leading to oscillating frequency with approx. 1 minute of cycle.
- There also Seems to be sluggish governor response and it appears to be governor associated variation. Steam pressure variation and other inputs are also further required for root cause analysis.
- After 3-4 Minutes manual intervention was done and generation variation was minimized ,still frequency is varying, this also needs to be looked .
- During PFR testing also, this point to be checked properly. Provision of Islanded signal to plants for isochronous mode or speed control mode may also be explored for better performance.
- CESC may also share how the switching operation (specially load variation related switching) was being performed during the islanded mode operation. This may be one probable cause of the frequency variation for which the FGMO for unit 1 and 2 has been responding.



Islanding Event 2:

- At 17:05 Hrs on 31.01.2022, CESC system got islanded from Howrah point. As reported, SPS-3 logic got satisfied.
- Southern Station is having Two Battery Two Charger System. One charger was off due to some issue.
- The AC input to second charger also failed however no alarm had generated. This resulted in DC voltage reduction gradually which remained unnoticed. Finally, the voltage selection and contactor for U/V relay got dropped and detected the situation as under voltage.
- There is PT fuse failure logic as well, however as all three phases got dropped, it could not sense this as PT fuse failure.
- There is current supervision relay also (I>100 A), which basically ensures that the CB are connected. During evening as current crossed 100A, SPS logic-3 got activated and all three lines tripped.
- Overall this islanding was mal-operation related to SPS logic and related sensors as there was no actual event in the system for islanding.



Annexure B.8

List of important transmission lines in ER which tripped in January-2022

Sl. No.	LINE NAME	TRIP DATE	TRIP TIME	RESTORATION DATE	RESTORATION TIME	Relay Indication LOCAL END	Relay Indication REMOTE END	Reason	Fault Clearance time in msec	Remarks	DR Configuration Discrepancy	DR/EL RECEIVED FROM LOCAL END	DR/EL RECEIVED FROM REMOTE END	UTILITY RESPONSE
1	315 MVA ICT-3 AT BIHARSHARIF	01-01-2022	16:27	01-01-2022	21:02	Master Trip relay operated		No fault	NA	OSR relay operated. Finding maybe shared by PG		Yes	NA	TRIPPED DUE TO OPERATION OF OSR RELAY DUE TO WEAKER INSULATION OF TB IN MB BOX.
2	400 KV RANCHI-SIPAT-2	02-01-2022	02:24	02-01-2022	04:23	Spurious tripping		No fault	NA	Details maybe shared by PG ER-1		No	No	Weaker insulation found in Tripping ckt cable.

3	400 KV BIHARSHARIF-PUSAULI-2	05-01-2022	02:08	07-01-2022	22:20	Biharsharif: B_N, 141.9 km, 3 kA		B-Earth	100	A/r didn't operate at both ends. Three phase tripping for single phase fault		Yes	Yes	Tripped in reclaim time
4	400 KV MERAMUNDALI-MENDHASAL-1	05-01-2022	13:00	05-01-2022	13:25	Meramundali: B_N, 80 km, 4.5 kA	Mendhasal: B_N, 34.9 km, 4.4 kA, A/r successful	B-Earth	100	A/r didn't operate. Three phase tripping for single phase fault at Meramudali.		Yes	Yes	400 kV Bus-1 was under shutdown, so its main bay was out of service. A/r was in blocked condition as per logic due to outage of main bay. OPTCL advised to modify the logic.
5	400 KV MERAMUNDALI-BOLANGIR-1	08-01-2022	01:29	08-01-2022	01:43	Meramundali: Y_N, 2.82 kA, 189 km	Bolangir: Y_N, 2.12 kA, 58.5 km	Y-Earth	100	A/r successful at Bolangir. Fault in Zone-2 from Meramundali and carrier not received, hence, all three phase tripped at Meramundali.		No	No	· Three phase tripping occurred at Meramundali. Fault was seen by relay in Zone-2 and not in Zone-1B. Thus PUTT logic didn't satisfy. OPTCL was asked why the relay saw the fault in Zone-2 only and not Zone-1B as both has same settings.

6	220 KV PATNA-KHAGAUL-1	10-01-2022	10:35	10-01-2022	11:05	Didn't trip	Khagaul: Zone-3	No fault	NA	VT failed at Khagaul. All three phase voltage became zero		NA	Yes	Bus coupler panel was being shifted. Input taken from bus PT, that's why VT fail appeared and line got tripped at Khagaul
7	220 KV DALTONGANJ-CHATRA-1	11-01-2022	16:01	11-01-2022	16:45	Daltonganj: R_N, 146.5 km, 1.14 kA	Chatra: R_N, 43.718 km, 1.02 kA	R-Earth	100	A/r didn't operate at Chatra. DR channels not configured		Yes	Yes	Problem in A/r circuit
8	400 KV BARH-PATNA-1	12-01-2022	14:45	12-01-2022	15:11	Barh: Y_N, 66.2 km		Y-Earth	100	A/r successful at Patna only. However, all three phase of tie CB tripped.		No	Yes	Breaker of BHEL make. CB not ready for A/r appeared. Hydraulic pressure of breaker went below 300 bar. Barh will do A/r testing of the breaker at the earliest
9	400 KV PATNA-BALIA-1	12-01-2022	14:45	12-01-2022	15:18	Patna: Didn't trip	Balia: Zone-3	No fault	NA	Tripped from Balia in Zone-3 for fault in 400 kV Barh-Patna-1		NA	NA	

10	400 KV NEW PURNEA-MUZAFFARPUR-1	12-01-2022	19:53	12-01-2022	20:06	New Purnea: Y_N	Muzaffarpur: Y_N, A/r successful	Y-Earth	100	A/r successful at Muzaffarpur, however, A/r dead time of tie CB at Muzaffarpur maybe checked (closed after 2.1 seconds). Zone-2 fault from New Purnea, however carrier signal not received, hence all three phases tripped.		Yes	Yes	PLCC card issue, matter taken up with OEM.
11	220 KV MAITHON-DHANBAD-1	14-01-2022	11:55	14-01-2022	12:14	Maithon: Didn't trip	Dhanbad: B_N	B-Earth	100	DR of Dhanbad end not available. Finding maybe shared		NA	No	
12	220 KV MAITHON-DHANBAD-2	14-01-2022	11:55	16-01-2022	18:05	Maithon: B_N, 35.57 km, 4 kA		B-Earth	100	A/r successful at Maithon. However, tripped again in reclaim time after 200 msec. Y_ph and B_ph opened for single phase fault at Dhanbad. A/r operated but failed. Broken conductor appeared. Findings maybe shared.		Yes	Yes	B_ph conductor of Ckt.2 snapped and A/r attempt failed.In ckt. 1, Voltage selection relay was found damaged at Maithon and line tripped through Zone-4. Relay was replaced.

13	220 KV CHANDIL-SANTALDIH (STPS)-1	18-01-2022	05:22	18-01-2022	05:44	Chandil: R_N, Zone-1, 89 km, 1.84 kA	Santaldih: R_N, Zone-1, 19.58 km, 4.95 kA	R-Earth	100	A/r not in service. Three phase tripping for single phase fault.	DR timelength less at Chandil /	Yes	Yes	· Tendering process for PLCC at JUSNL end started. WBSETCL advised to patrol the line to avoid tripping at a particular location
14	400 KV KHARAGPUR-KOLAGHAT-1	28-01-2022	16:50	28-01-2022	17:14	Kharagpur: DT received	Kolaghat: Didn't trip	No fault	NA	No fault observed in PMU. Details maybe shared.		NA	No	Problem in carrier channel
15	220 KV BARIPADA-BALASORE-2	31-01-2022	10:36	31-01-2022	11:29	Baripada: DT received	Balasore: Didn't trip	No fault	NA	No fault observed in PMU. Details maybe shared.		No	NA	DT received at Bariapda but not sent from OPTCL. OPTCL to take up with PG Odisha and rectify the issue

ANNEXURE-C.4

Sl No.	Name of the incidence	PCC Recommendation	Latest status
106th PCC Meeting			
1.	Tripping of Bus-1 at 220 kV Ramchandrapur on 20/08/2021 at 20:24 Hrs.	In 106th PCC Meeting, PCC advised JUSNL following: ➢ To restore the busbar protection at 220 kV Ramchandrapur S/s within a month. In 109th PCC Meeting, JUSNL informed that they are in process to place fresh tender for implementation of PLCC as well as bus bar protection and it is expected that implementation of both would be completed by April 2022.	*JUSNL representative informed that PLCC card had been replaced.* *The bus bar protection implementation required extra cable to be laid for which purchase of cable had been initited.The cable laying work would be started in March 2022.* *It was informed that laying of OPGW for 220 kV Ramchandrapur-Joda line would commence from March'22.*
2.	Total Power Failure at Dumka S/s on 15/05/2021 at 12:01 Hrs	JUSNL intimated that there was card issue in PLCC panel. The OEM (M/s ABB) had been communicated regarding the issue and the same would be resolved by September' 21. In 110th PCC Meeting, JUSNL informed that approval had been received from higher authority and they are in process to issue the tender. They further informed that PLCC link would be restored by March-2022.	*There is no change in the status.*
3.	Grid event at 132 kV Motihari (DMTCL) S/S on 21-04-2021 at 20:19 hrs	In 109th PCC Meeting, PMTL representative informed that they are in process of placing the work order with TBEA authorized partners. The quotation has been received and work order would be placed by end of December 2021.	*PMTL representative informed that material supply is expected by first week of March 2022. He further informed that restoration work would be completed by end of March 2022.*

		In 110th PCC Meeting, PMTL representative informed that LOA had been awarded to vendor in last week of December 2021. The material supply is expected by first week of March 2022 and restoration work would be completed by end of March 2022.	
110th PCC Meeting			
4.	Total Power Failure at 220 kV Soneneagar S/s on 15.12.2021 at 15:28 Hrs	PCC advised BSPTCL following: ➢ to investigate the root cause behind spurious receipt of carrier at Chandauti end by thorough checking of PLCC system at both the end in coordination with Powergrid. Further end to end testing may be done to ascertain the healthiness of PLCC. ➢ to check whether POTT scheme is present on both end and if so, then timer settings of current reversal guard may to be checked and revised.	*BSPTCL informed that during recent incident happened on 09/02/2022, auto-reclose operation was successful and no tripping incident was observed after the incident of 15.12.2021.* *PCC advised BSPTCL to complete the action points as advised in 110th PCC Meeting in coordination with Powergrid.*
5.	Total Power Failure at 220 kV Tarkera S/s on 21.12.2021 at 19:38Hrs	PCC advised OPTCL to test the bus bar relay in order to find out any issues on secondary circuitry of the busbar unit. PCC stated that with available information, the reason for busbar operation at Tarkera cannot be explained and advised OPTCL/SLDC Odisha to submit event logger details as well as any other relevant information during the event which would help analyzing the event by PCC.	*OPTCL informed that requisite details were sent to M/S Siemens for analysing root cause behind operation of bus bar protection. They further informed that as per their investigation they had found mismatch in CT ratio between site and relay settings for 3-4 feeders which might had resulted in spurious operation of bus bar protection. They had revised the CT ratio in relay however during revision of CT ratio, the feeder bay units went out of order. The faulty units would be rectified when service engineer of OEM would visit S/s.*

6.	Repeated Tripping of 132 kV Banka -Sultanganj D/C line	PCC advised BSPTCL to submit a report on LBB issue after carrying out breaker timer test along with tower top patrolling findings. PCC further advised BSPTCL to take corrective actions like insulator replacement work in the identified tower locations before the onset of summer season.	*BSPTCL vide mail dated 11/02/2022 informed that breaker timer test had been done and result was found satisfactory. Further they added that in LBB relay delay was found to be set to low value which was revised to the standard delay time.* *Regarding tower top patrolling, they informed that patrolling had been done in said line and it was decided that approx. 200 disc insulators of the line would be replaced at earliest.*

PROTECTION AUDIT REPORT

General information

Substation name:	
SS voltage level:	
Fault level of all equipment (for that voltage level)	
Date of commissioning of the substation:	
Region:	
Audit date:	
Name of utility which owns the substation (e.g POWERGRID, MSETCL, ADANI POWER, etc.)	

Audit Team

Name	Company name

Regional representatives:

Name	Company name

Attached documents:

1. List of the faults that was/were not eliminated by the protection;
2. Record of previous trippings for last six months and associated fault analysis.
3. Single/three pole auto-recloser events, if any in last six months;
4. Details on periodicity of relay testing and latest relay test report
5. Communiction from concerned department for the revised settings and record for implementation of the revised settings.
6. CT characteristics at all taps in case of multi-ratio CTs
7. df/dt, UFR relay details and settings if its available
8. Special Protection Schemes details if applicable. (Including test results & last operation records), implemented schematic diagram for SPS
9. Single Line Diagram

CONCLUSIONS OF PROTECTION AUDIT REPORT

Item no.	Issues	Remarks
1	**Recommendations of last Protection Audit**	**Status of works&reason for pending/suggestions**
2	**Review of Existing Settings at Substations**	
	Any inadvertently enabled settings/functions observed. (Yes/No)	
3	**Disturbance recorder - list of 3 tippings in last 6 months**	**Recommended action**
3.a	DR as well as EL records for the trippings available (Yes/No)	
3.b	Records available for Tripping analysis and corrective actions taken (Yes/no)	
3.c	Time Synch Matched Between EL signals and DR signals (Yes/No)	
3.d	Digital Signals of DR named properly (main CB Trip, Z1 Trip etc.) (Yes/No)	
4	**Chronic reason of tipping, if any**	**Recommended action**

Item no.	Issues	Remarks
5	Existing process for record of changes incorporated in the relay settings	See attached corespondence
6	Overvoltage grading for parallel line (time&pick up grading, provided or not)	Recommended action
7	Other deficiences/Nonconformity observed (including the major non-conformaties mentioned in the audit format. ex: Single AC source etc.)	Recommended action

Appendix-9.4

CHECK LIST TO ENABLE AUDIT OF PRACTICES FOLLOWED IN PROTECTION APPLICATION & CRITERIA USED FOR SETTING CALCULATIONS IN 220KV, 400KV & 765KV SUBSTATIONS

CHECK-LIST: Check list for different protected objects & elements in fault clearance system are as under:

(put √ mark in the appropriate box)

A. Transmission Lines (OHL and Cables)

1.	Independent Main-I and Main-II protection (of different make OR different type) is provided with carrier aided scheme	☐ YES ☐ NO
2.	Are the Main-I & Main-II relays connected to two separate DC sources (Group-A and Group-B)	☐ YES ☐ NO
3.	Is the Distance protection (Non-switched type, suitable for 1-ph & 3-ph tripping) as Main1 and Main2 provided to ensure selectivity & reliability for all faults in the shortest possible time	☐ YES ☐ NO
4.	Is both main-I & Main-II distance relay are numerical design having Quadrilateral or Polygon operating characteristic	☐ YES ☐ NO
5.	In the Main-I / Main-II Distance protection, Zone-I is set cover 80% of the protected line section	☐ YES ☐ NO
6.	In the Main-I / Main-II distance protection, Zone-2 is set cover 120% of the protected line section in case of Single circuit line and 150% in case of Double circuit line	☐ YES ☐ NO
7.	In the Main-I / Main-II distance protection, Zone-3 is set cover 120% of the total of protected line section plus longest line at remote end as a minimum.	☐ YES ☐ NO
8.	Resistive reach for Ground fault element set to give maximum coverage considering fault resistance, arc resistance & tower footing resistance. (In case, It is not possible to set the ground fault and phase fault reaches separately, load point encroachment condition imposed on Phase fault resistive reach shall be applied)	☐ YES ☐ NO
9.	Resistive reach for Phase fault element set to give maximum coverage subject to check of possibility against load point encroachment considering minimum expected voltage and maximum load.	☐ YES ☐ NO
10.	In case of short lines, is manufacturers recommendation considered in respect of resistive setting vis a vis reactance setting to avoid overreach.	☐ YES ☐ NO
11	Is Zone-2 time delay of Main-I / Main-II distance relay set to 0.350 seconds ? In case any other value has been set for Zone-II timer, kindly specify the value and justification thereof.	☐ YES ☐ NO
12	Is Zone-3 timer is set to provide discrimination with the operating time of relays at adjacent sections with which Zone-3 reach of relay is set to overlap. Please specify the Zone-3 time set.	☐ YES ☐ NO
13.	Is Zone-4 reach set in reverse direction to cover expected levels of apparent bus bar fault resistance, when allowing for multiple in feeds from other circuits?	☐ YES ☐ NO
14.	Is reverse looking Zone-4 time delay set as Zone-2 time delay?	☐ YES ☐ NO

15.	Is Switch on to fault (SOTF) function provided in distance relay to take care of line energisation on fault? Whether SOTF initiation has been implemented using hardwire logic In case of Breaker and half switching scheme, whether initiation of line SOTF from CB closing has been interlocked with the other CB	☐ YES ☐ NO ☐ YES ☐ NO ☐ YES ☐ NO
16.	Whether VT fuse fail detection function has been correctly set to block the distance function operation on VT fuse failure	☐ YES ☐ NO
17.	Is the sensitive IDMT directional E/F relay (either separate relay or built-in function of Main relay) for protection against high resistive earth faults?	☐ YES ☐ NO
18.	Is additional element (Back-up distance) for remote back-up protection function provided in case of unit protection is used as Main relay for lines?	☐ YES ☐ NO
19.	In case of Cables, is unit protection provided as Main-I & Main-II protection with distance as back-up.	☐ YES ☐ NO
20.	Are the line parameters used for setting the relay verified by field testing	☐ YES ☐ NO
21.	Is Two stages Over-Voltage protection provided for 765 & 400kV Lines? Do you apply grading in over-voltage setting for lines at one station. Please specify the setting values adopted for: Stage-I : (typical value - 106 to 112 % , delay : 4-7 Sec) Stage-II: (typical value - 140 to 150%, delay: 0 to 100msec.)	☐ YES ☐ NO ☐ YES ☐ NO ……
22.	Is 1-ph Auto –reclosing provided on 765, 400 & 220kV lines? Please specify the set value: Dead time: (typical 1 Sec) Reclaim time: (typical 25 Sec)	☐ YES ☐ NO …… ……
23.	Is the Distance communication. Scheme Permissive Over Reach (POR) applied for short lines and Permissive Under Reach (PUR) applied for long lines? If any other communication scheme has been applied, please provide the detail with justification thereof.	☐ YES ☐ NO ……
24.	Is the Current reversal guard logic for POR scheme provided on Double circuit lines?	☐ YES ☐ NO
25.	In case the protected line is getting terminated at a station having very low fault level i.e. HVDC terminal, whether week end-infeed feature has been enabled in respective distance relay or not	☐ YES ☐ NO
26.	In case of protected line is originating from nuclear power station, are the special requirement (stability of nuclear plant auxiliaries) as required by them has been met	☐ YES ☐ NO
27.	What line current , Voltage and Load angle have been considered for Load encroachment blinder setting and what is the resultant MVA that the line can carry without load encroachment. (In the absence of Load encroachment blinder function, this limit shall be applied to Zone-3 phase fault resistive reach.)	I= V= Angle: S=
28.	a) What are the Zones blocked on Power swing block function: b) Setting for Unblock timer: (typical 02 second) c) Out of Step trip enabled	Z1 / Z2 / Z3 / Z4 Time: ☐ YES ☐ NO
29.	Whether the location of Out of step relay has been identified on the basis of power system simulation studies	☐ YES ☐ NO

30.	a) Is Disturbance recorder and Fault locator provided on all line feeder ? b) Whether standalone or built in Main relay c) Whether DR is having automatic fault record download facility to a central PC d) Whether DR is time synchronised with the GPS based time synchronising equipment e) Whether DR analog channels contain line phase & neutral current and line phase & neutral voltage. f) Whether DR digital channel as a minimum contain the CB status, Main-I & II trip status, LBB trip status, Over-voltage trip status, Stub protn trip status, Permissive and direct carrier receive status, Line reactor trip status.	☐ YES ☐ NO Standalone / built-in ☐ YES ☐ NO ☐ YES ☐ NO ☐ YES ☐ NO ☐ YES ☐ NO
31.	Does the Setting document for the numerical relays (IED) contain all the settings for all functions that are used and indicates clearly the functions not used (to be Blocked / Disabled). Are all default settings validated or revised settings given in the setting document?	☐ YES ☐ NO

B. Power Transformers

1.	Do you use Group A and Group B protections connected to separate DC sources for power transformers	☐ YES ☐ NO
2.	Do you follow CBIP guideline (274 & 296) for protection setting of transformer	☐ YES ☐ NO
3.	Do you use duplicated PRD and Bucholtz initiating contact for power transformers at 765kV and 400kV levels	☐ YES ☐ NO
4.	Do you classify transformer protections as below in groups: Group A Group B • Biased differential relay Restricted earth fault (REF) relay •PRD , WTI Buchholz Protection, OTI • Back up Protection(HV) Back up Protection(MV) • Over fluxing protection(HV) Over fluxing protection(MV)	☐ YES ☐ NO Group A or B
5.	In case of Breaker & half switching scheme, whether CT associated with Main & Tie Breakers are connected to separate bias winding of the low impedance Biased differential protection in order to avoid false operation due to dissimilar CT response.	☐ YES ☐ NO
6.	Is Restricted earth fault (REF) protection used a high impedance type	☐ YES ☐ NO
7.	Are Main protection relays provided for transformers are of numerical design.	☐ YES ☐ NO
8.	a) Are directional over current & earth fault relays provided as back-up protection of Transformer are of numerical design. b) Do the back-up earth fault relays have harmonic restrain feature	☐ YES ☐ NO ☐ YES ☐ NO
9.	Is Fire protection system (HVW type) provided for power transformer and functioning	☐ YES ☐ NO
10.	a) Is the Disturbance recorder provided for Transformer feeder b) Whether standalone or built in Main relay c) Whether DR is having automatic fault record download facility to a central PC d) Whether DR is time synchronised with the GPS time synchronising equipment	☐ YES ☐ NO Standalone/built-in ☐ YES ☐ NO ☐ YES ☐ NO

11.	Does the Setting document for the numerical relays (IED) contain all the settings for all functions that are used and indicates clearly the functions not used (to be Blocked / Disabled). Are all default settings validated or revised settings given in the setting document?	☐ YES ☐ NO

C. Shunt Reactors

1.	Do you use Group A and Group B protections connected to separate DC sources for reactors	☐ YES ☐ NO
2.	Do you follow CBIP guideline (274 and 296) for protection setting of reactors	☐ YES ☐ NO
3.	Do you use duplicated PRD and Bucholtz initiating contact for Reactors at 765kV and 400kV levels	☐ YES ☐ NO
4.	Do you classify Reactor protections as below in groups: Group A / Group B • Biased differential relay / R.E.F Protection • PRD , WTI / Buchholz Protection, OTI • Back up impedance protection / Direction O/C & E/F relay	☐ YES ☐ NO Group A or B
5	In case of Breaker & half switching scheme, whether CT associated with Main & Tie Breakers are connected to separate bias winding of the low impedance Biased differential protection in order to avoid false operation due to dissimilar CT response.	☐ YES ☐ NO
6	Is Restricted earth fault (REF) protection used a high impedance type	☐ YES ☐ NO
7	Are Main & back-up protection relays provided for Reactor are of numerical design.	☐ YES ☐ NO
8	Is Fire protection system (HVW type) provided for Reactor and functioning	☐ YES ☐ NO
9	a) Is the Disturbance recorder and Fault locator provided on all the Shunt Reactors used in 765 kV, 400 kV substations? b) Whether standalone or built in Main relay c) Whether DR is having automatic fault record download facility to a central PC	☐ YES ☐ NO Standalone/built-in ☐ YES ☐ NO
10.	Does the Setting document for the numerical relays (IED) contain all the settings for all functions that are used and indicates clearly the functions not used (to be Blocked / Disabled). Are all default settings validated or revised settings given in the setting document?	☐ YES ☐ NO

D. Bus bars

1.	Bus Bar protection for 765, 400 & 220kV buses is provided	☐ YES ☐ NO
2.	Duplicated Bus bar protection is provided for 765kV and 400kV buses	☐ YES ☐ NO
3.	CBIP guideline for Protection (274 and 296) settings is followed	☐ YES ☐ NO
4	In an existing substation if CTs are of different ratios, is biased type bus protection provided.	☐ YES ☐ NO
5	In stations where single bus bar protection is provided, is backup provided by reverse looking elements of distance relays or by second zone elements of remote end distance relays?	☐ YES ☐ NO

6	In case of GIS where burn through time of SF6 is shorter than remote back up protection is the bus bar protection duplicated irrespective of voltage level?	☐ YES ☐ NO
7	Since it is difficult to get shutdowns to allow periodic testing of bus protection, numerical bus protections with self-supervision feature is an answer. Is this followed?	☐ YES ☐ NO
8	Does the Setting document for the numerical relays (IED) contain all the settings for all functions that are used and indicates clearly the functions not used (to be Blocked / Disabled). Are all default settings validated or revised settings given in the setting document?	☐ YES ☐ NO

E. Disturbance Recorder (DR) and Event Logger (EL)

1	a) Is the Disturbance recorder and Fault locator provided on all line feeders of 765, 400 & 220kV substations? b) Whether standalone or built in Main relay c) Whether DR is having automatic fault record download facility to a central PC d) Whether Central PC for DR , EL are powered by Inverter (fed from station DC)	☐ YES ☐ NO Standalone / built-in ☐ YES ☐ NO ☐ YES ☐ NO
2.	Whether DR is having the following main signals for lines: <u>Analogue signals</u>: • From CT: IA, IB, IC, IN • From VT: VAN, VBN, VCN • From Aux. VT: V0 <u>Digital Signals</u> • Main 1 Carrier receive • Main 1 Trip • Line O/V Stage I / Stage II • Reactor Fault Trip • Stub Protection Operated. • Main II Trip • Main II Carrier Receive • Direct Trip CH I / II • CB I Status (PH-R, Y & B) • CB II Status (PH R, Y & B) • Bus bar trip • Main / Tie CB LBB Operated • Main / Tie Auto-reclose operated. DR for Transformer / Reactor feeder should contain analog channel like input currents & voltage. Binary signal include all protection trip input, Main & Tie CB status, LBB trip	☐ YES ☐ NO
3.	Whether substation (765, 400 , 220kV) is having Event logger facility (standalone or built-in-SAS)	☐ YES ☐ NO
4.	Whether GPS based time synchronizing equipment is provided at the substation for time synchronizing of Main relays / DR/ Event logger / SAS/ PMU / Line Current Differential Relays	☐ YES ☐ NO

F. Circuit Breakers

1.	Is breaker fail protection (LBB / BFR) provided for all the Circuit Breakers at 220kV , 400kV & 765kV rating	☐ YES ☐ NO
3.	For Circuit Breaker connected to line feeder / transformer feeder, whether operation of LBB / BFR sends direct trip signal to trip remote end breaker ?	☐ YES ☐ NO

4.	For lines employing single phase auto reclosing, Is start signal from protection trip to LBB / BFR relay is given on single phase basis?	☐ YES ☐ NO
5.	Is separate relay provided for each breaker and the relay has to be connected from the secondary circuit of the CTs associated with that particular breaker?	☐ YES ☐ NO
6.	Is LBB relay provided with separate DC circuit independent from Group-A and Group-B Protections?	☐ YES ☐ NO
7.	Is the LBB initiation provided with initiating contact independent of CB trip relay contact?	☐ YES ☐ NO
8.	Is Separation maintained between protective relay and CB trip coil DC circuit so that short circuit or blown fuse in the CB circuit will not prevent the protective relay from energizing the LBB scheme?	☐ YES ☐ NO
9.	Is LBB relay initiated by Bus bar protection in addition to other fault sensing relays, since failure of CB to clear a bus fault would result in the loss of entire station if BFP relay is not initiated?	☐ YES ☐ NO
10.	Is tripping logic of the bus bar protection scheme used for LBB protection also?	☐ YES ☐ NO
11.	Are the special considerations provided to ensure proper scheme operation by using Circuit Breaker contact logic in addition to current detectors in cases breaker-fail relaying for low energy faults like buckholz operation?	☐ YES ☐ NO
12.	Are the Current level detectors set as sensitive as the main protection? (Generally setting of 0.2 A is commonly practiced for lines and transformers)	☐ YES ☐ NO
13.	Is timer set considering breaker interrupting time, current detector reset time and a margin? (Generally a timer setting of 200ms has been found to be adequate)	☐ YES ☐ NO
14.	Is the back-up fault clearance time is shorter than the operating time of the remote protections (distance relay Zone-2) ?	☐ YES ☐ NO
15.	Is the breaker failure protection provided with two steps (First stage – retrip own CB, Second stage- Trip all associated CBs) . This mitigates unwanted operation of breaker failure protection during maintenance and fault tracing.	☐ YES ☐ NO
16.	Is the breaker failure protection hardware provided is separate from line /transformer feeder protection?	☐ YES ☐ NO

G. Communication systems

1.	a) Do you use PLCC for tele-protection of distance relays at 765, 400 & 220kV feeders b) Specify type of coupling c) Whether redundant PLCC channels provided for 400 & 765kV lines d) Specify number of PLCC channels per circuit : e) Whether dependability & security of each tele-protection channel measured & record kept ?	☐ YES ☐ NO (Ph-Ph / Ph-G/ Inter-ckt) ☐ YES ☐ NO (One / two) ☐ YES ☐ NO

2.	a) In case you use OPGW for tele-protection, are they on geographically diversified route for Main-I and Main-II relay? b) Whether dedicated fibre is being used for Main-I / Main-II relay or multiplexed channel are being used.	☐ YES ☐ NO Dedicated / multiplexed

H. Station DC supply systems

1.	Do you have two separate independent DC system (220V or 110V) (Source-A and Source-B)	☐ YES ☐ NO
2.	Do you have two independent DC system (48V) for PLCC (source-A and source-B)	☐ YES ☐ NO
3.	There is no mixing of supplies from DC source-A and DC source-B	☐ YES ☐ NO
4.	Whether the protection relays and trip circuits are segregated into two independent system fed through fuses from two different DC source	☐ YES ☐ NO
5.	Whether Bay wise distribution of DC supply done in the following way: a) Protection b) CB functions c) Isolator / earth switch functions d) Annunciation / Indications e) Monitoring functions	☐ YES ☐ NO
6	Whether following has been ensured in the cabling: a) Separate cables are used for AC & DC circuits b) Separate cables are used for DC-I & DC-II circuits c) Separate cables are used for different cores of CT and CVT outputs to enhance reliability & security	☐ YES ☐ NO
7	Is guidelines prescribed in CBIP manual 274 & 296 followed in general	☐ YES ☐ NO

I. PERFORMANCE INDICES

1.	Is there a system of periodically measuring Dependability & Security of Protection system (as given in CBIP manual 296) and recorded	☐ YES ☐ NO
2.	Is there a system of periodically measuring Dependability of switchgear associated with Protection system and recorded	☐ YES ☐ NO
3.	Is there a process of Root cause analysis of unwanted tripping events	☐ YES ☐ NO
4.	Are improvement action like revision of relay setting, better maintenance practices, modernising & retrofitting of switching & protection system taken based on above data.	☐ YES ☐ NO
5.	Is attention also given to DC supply system, tele-protection signalling, healthiness of tripping cables, terminations etc. in order to improve the performance of fault clearance system	☐ YES ☐ NO

J. ADDITIONAL CHECKS FOR SERIES COMPENSATED LINES

1.	What is the operating principle of Main protection employed	☐ Distance ☐ Line Current diff.

2.	Are both main-I & Main-II distance relay are numerical design	☐ YES ☐ NO
3.	Are both main-I & Main-II distance relay suitable for Series compensated lines	☐ YES ☐ NO
4.	Are POR tele-protection scheme employed for distance relays	☐ YES ☐ NO
5.	Position of Line VT provided on series compensated line	☐ Between Capacitor and line ☐ Between Capacitor and Bus
6.	What is the under reaching (Zone 1) setting used in teleprotection schemes (Local & Remote end)	% of line length Rationale:
7.	What is the overreaching (Zone 2) setting in used teleprotection schemes	% of line length Rationale:
8.	What kinds of measurement techniques are used to cope with voltage inversion?	☐ Phase locked voltage memory ☐ Intentional time delay Other, specify:
9.	Whether system studies carried out to check the possibility of current inversion due to series compensation	☐ YES ☐ NO
10.	Whether any system studies conducted to find the impact of series compensation on the performance of protections installed on adjacent lines? If yes, how many lines were found to be affected. Pl. specify _____	☐ YES ☐ NO
11	If YES, are the affected protections on adjacent lines changed / setting revised after the introduction of series compensation?	☐ YES ☐ NO
12.	Is dynamic simulation done to fine tune settings of distance relay installed on series compensated double circuit lines?	☐ YES ☐ NO
13.	Whether performance of directional earth fault relay verifies by simulation studies	☐ YES ☐ NO
14.	When is flashover of spark gaps expected?	☐ For protected line Faults up to ohms ☐ For external faults an adjacent lines
15.	Whether measures taken for under/overreach problems at sub-harmonic oscillations?	☐ YES ☐ NO
16.	Whether MOV influence considered while setting the distance relay reach	☐ YES ☐ NO
17.	Have you experienced any security problems (Relay mal-operation) with high frequency transients caused by ☐ Flashover of spark gaps ☐ Line energisation Other, specify:	☐ YES ☐ NO
18.	If YES, how the above problem has been addressed?	

Annexure-C7

ISTS				
Name of the element	Length (km)	Main	BackUp	Remarks
400 kV Durgapur-Bidhannagar D/c	11	Distance	Distance	Differential will be installed. Order placed
400 kV Dikchu-Teesta-III		Distance	Distance	
400 kV Teesta III-Rangpo		Distance	Distance	
400 kV Rangpo-Dikchu		Distance	Distance	
400 kV Rangpo-Teesta V-D/c	11.6	Distance	Distance	
400 kV Teesta-III- Dikchu	15.1	Distance	Distance	
400 kV Gaya-Chandauti D/c	**17.73**	Differential	Differential	
220 kV Subhashgram-Subhashgram (WB) D/c	**0.6**	Differential	Distance	Diff. Rly(P545) already installed by M/S GE except communication.
220 kV Dalkhola-Dalkhola (WB)-D/c	1.1	Differential	Differential	
220 kV Alipurduar-Alipurduar (WB) D/c	6.34	Distance	Distance	Differential will be installed. Order placed
220 kV Rajarhat-NewTown D/c	**7.2**	Distance	Distance	To be finalizaed after discussion with PGCIL
220 kV Binaguri-Siliguri D/c	**5.6**	Differential	Distance	
220 kV Rourkela-Tarkera D/c	15.3	Distance	Dir. O/c & E/F	
Odisha				
Name of the element	Length (km)			
400 kV Indravati-Indravati (Gridco)	3.7	Distance	Distance	OHPC
400 kV Meramundali GMR T/c	8	Distance	Distance	
400 kV New Duburi-TSL D/c	8.65	Differential	Distance	
220 kV Chandka-Chandka B	1	Differential	Distance	
220 kV Rengali-Rengali D/c	1	NA	Dir. O/c & E/F	Pilot Wire Protection in Main are in Default Condition.
220 kV Balimela-Balimela T	1.38		Dir.O/C & E/F	
220 kV Meramundali-BSL D/c	2.4	Distance	Distance	In the process of implementation of differential
220 kV Bolangir-New Bolangir D/c	2.8	Distance	Distance	
220 kV Tarkera-RSP D/c (3&4)	4.07	Differential	Distance	
220 kV Sterlite-Vedanta D/c	4.15			Vedanta
220 kV New Duburi-Jindal Steel D/c	4.8	Distance	Distance	
220 kV Rengali-Rengali PH D/c	5	Distance	Dir. O/c & E/F	
220 kV Mendhasal-Infocity	5.5	Distance	Distance	
220 kV Katapalli-Hindalco D/c	**15**	Line-1:Line Diff., Line2:Distance	Distance	Line Diff. in Line-2 will be implemented soon.
220 kV Jaynagar-Upper Kolab D/c	**5.8**	Distance	Dir. O/c & E/F	
220 kV Mendhasal-Chandaka D/c	**19.4**	Distance	Distance at Mendhas	No backup available at Chandaka
220 kV Keonjhar-Keonjhar D/c	7.48	Distance	Distance	
220 kV Jeypore-Jaynagar D/c	**8.8**	Distance	Distance	
220 kV New Duburi-TSL D/c	8.65	Differential	Distance	
220 kV Jeypore-Jaynagar D/c	8.8	Distance	Dir. O/c & E/F	
220 kV Tarkera-RSP D/c	**10.2**	**Distance**	**Differential**	
220 kV Bidansi-Cuttack D/c	**10**	Distance	Distance	
220 kV Jaypatna-Indravati	**19.3**	Distance	Distance	
220 kV Meramundali-TTPS D/c	11.2	Distance	Distance	
220 kV Meramundali-NALCO D/c	11.5	Distance	Distance	In the process of implementation of differential
220 kV Joda-Jindal	14.6	Distance	Distance	
220 kV Mendhasal-Atri	**26**	Distance	Distance	
220 kV TSTPP-Rengali PH	16.78	Distance	Dir. O/c & E/F	
220kV Budhipadar-Lapanga D/C	17	Distance	Distance	
220kV Budhipadar-BSL D/C	14.9	Distance	Distance	
220kV Budhipadar-VAL D/C	16.8	Distance	Distance	
220kV Budhipadar-SMC D/C	6.7	Distance	Distance	
West Bengal				
Name of the element	Length (km)			
400 kV PPSP-New PPSP D/c	2	Differential	Differential	
220 kV Kasba-Eastern Metropolitan	**0.7**	Differential	Differential	
220 kV New Haldia-IPCHL D/c	3.6	Differential	Differential	
220 kV Bidhannagar-DPL D/c	8	Distance	Distance	The Line will be reconfigured to upcoming 220KV DPL-AB Zone S/S. Diff. Rly will be installed after reconfiguration.
220 kV Bakreswar-Sadaipur D/c	**4.6**	Distance	Distance	Differential will be installed.
220 kV Eastern Metropolitan-Princep Street	8.2	Differential	Differential	
220 kV Domjur-New Chanditala D/c	**8.6**	Distance	Distance	Differential will be installed.
220 kV New Cossipore-Princep Street	8.8	Differential	Differential	
220 kV NewTown-CLC Bantala	13	Distance	Dir. O/c & E/F	
220 kV Sagardighi-New Sagardighi D/c	14.38	Distance	Distance	
220 kV Subhashgram-CLC Bantala	15	Distance	Distance	
220 kV Domjur-Foundry Park D/c	15	Distance	Distance	
220 kV New Cossipore-Eastern Metropolitan South	16.2	Differential	Differential	
220 kV Jeerat-Dharampur D/c	17	Distance	Distance	
Bihar				
Name of the element	Length (km)			
220 kV Patna-Sipara-3	**0.55**	Differential	Differential	
220 kV Patna-Sipara-D/c	**0.55**	Differential	Differential	
220 kV Purnea-New Purnea D/c	**1.087**	Differential	NA	

220 kV Darbhanga-Darbhanga (DMTCL) D/c	2.9	Distance	Distance	
220 kV Kishanganj-Kishanganj Q/c	4.4	Distance	Distance	
220 kV Pusauli-New Sasaram (Nadokhar) D/c	**6.25**	Distance	Distance	
220 kV Gaya-BodhGaya D/c	**17.5**	Distance	Distance	
220 kV Barauni (BTPS)-Mokama D/c	11.65	Distance	Distance	
220 kV Barauni (BTPS)-Begusarai D/c	15	Distance	Dir. O/c & E/F	
220 kV Muzaffarpur-MTPS D/c	**24**	Distance	Distance	
220 kV Gaya-Chandauti D/c	**17.73**	Distance	Distance	To be LILOED at BodhGaya (Gaya-Bodhgaya line is around 31 km)
DVC				
Name of the element	Length (km)			
220 kV Durgapur-Parulia (DVC) D/c	1	Differential	Differential	
220 kV Burnpur-IISCO D/c	1.2	Differential	Differential	
220 kV Chandrapura-Chandrapura-1	1.5	Differential (Distance as BackUp in same relay)	Differential (Distance as BackUp in same relay)	
220 kV Chandrapura-Chandrapura-2	3.5	Differential (Distance as BackUp in same relay)	Differential (Distance as BackUp in same relay)	
220 kV Parulia (DVC)-Tamla DSP T/c	**15.5**	Distance	Distance	
220 kV Maithon-Kalyaneshwari D/c	7.6	Distance	Distance	
220 kV Chandrapura-BSL	**18**	Distance	Distance	
220 kV Chandrapura-MSMDBSL	10	Differential	Distance	
220 kV Waria-DSTPS D/c	11.14	Distance	Distance	
220 kV Parulia (DVC)-Muchipara D/c	14.75	Distance	Distance	
220 kV Mejia-Barjora D/c	16.7	Distance	Distance	
220 kV Waria-Bidhannagar D/c	17.2	Distance	Distance	
220 kV Parulia (DVC)-DSTPS D/c	17.34	Distance	Distance	
Jharkhand				
Name of the element	Length (km)			
220 kV Chaibasa-Chaibasa (JUSNL) D/c	0.7	Differential	Distance	
220 kV Ranchi Smart City-Hatia	6	Differential	Differential	
IPP				
Name of the element	Length (km)			
400 kV Adhunik (APNRL)-Jamshedpur D/c	0.3	Differential	Differential	
400 kV Sterlite-Lapanga D/c	18.64	Distance	Distance	
220 kV Rangpo-Rongnichu D/c	7.26	Distance	Distance	Differential available but not installed due to non-availability of communication