Agenda
for
111th PCC Meeting

Date:11.02.2022
Eastern Regional Power Committee
14, Golf Club Road, Tollygunge
Kolkata: 700 033

EASTERN REGIONAL POWER COMMITTEE

AGENDA FOR 111th PROTECTION COORDINATION SUB-COMMITTEE MEETING TO BE HELD ON 11.02.2022 AT 10:30 HOURS

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.

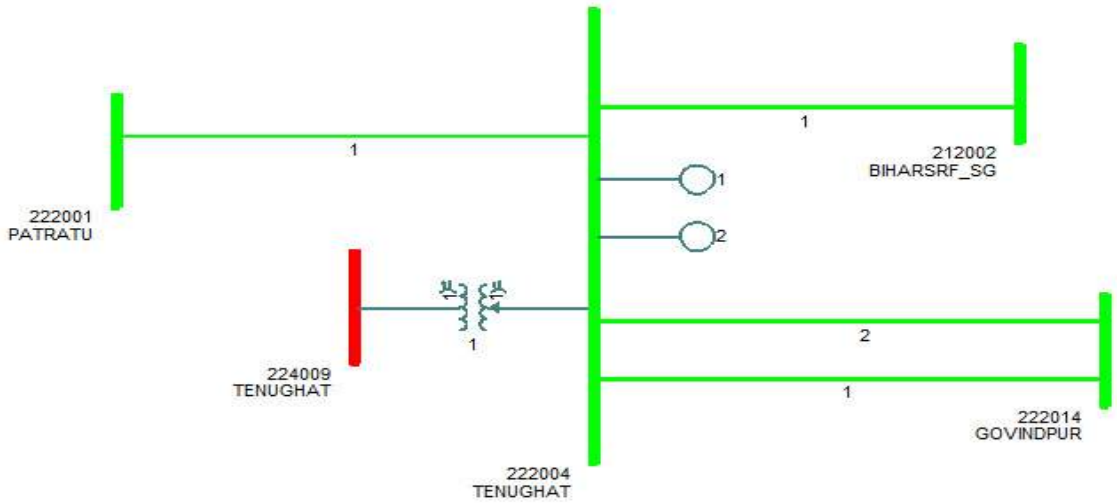
The minutes of 110th Protection Coordination sub-Committee meeting held on 19.01.2022 was circulated vide letter dated 02.02.2022.

Members may confirm.

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. Detailed report from ERLDC is attached at **Annexure B.1**.



Relay Indications:

Time	Name	End1	End2	PMU Observation
05:58	220 kV Tenughat-Patratu	Tenughat: B_N, 2.56 kA	Patratu: B_N, 55 km, 2.531 kA, Zone-2	6 kV dip in B_ph at Biharsharif. Fault Clearance time: 400 msec
	220 kV Tenughat-Bihar sharif	Didn't trip	Bihar sharif: B_N, 160 km, 1.4 kA, Zone-2	

	220 kV Tenughat-Govindpur	Didn't trip	Govindpur: B_N, Zone-2, 95 km, 0.8 kA	
	Tenughat U#1 & U#2	Tripped on overspeed protection		

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

TVNL, JUSNL & BSPTCL may explain.

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.

Detailed report from ERLDC is attached at **Annexure B.2**.

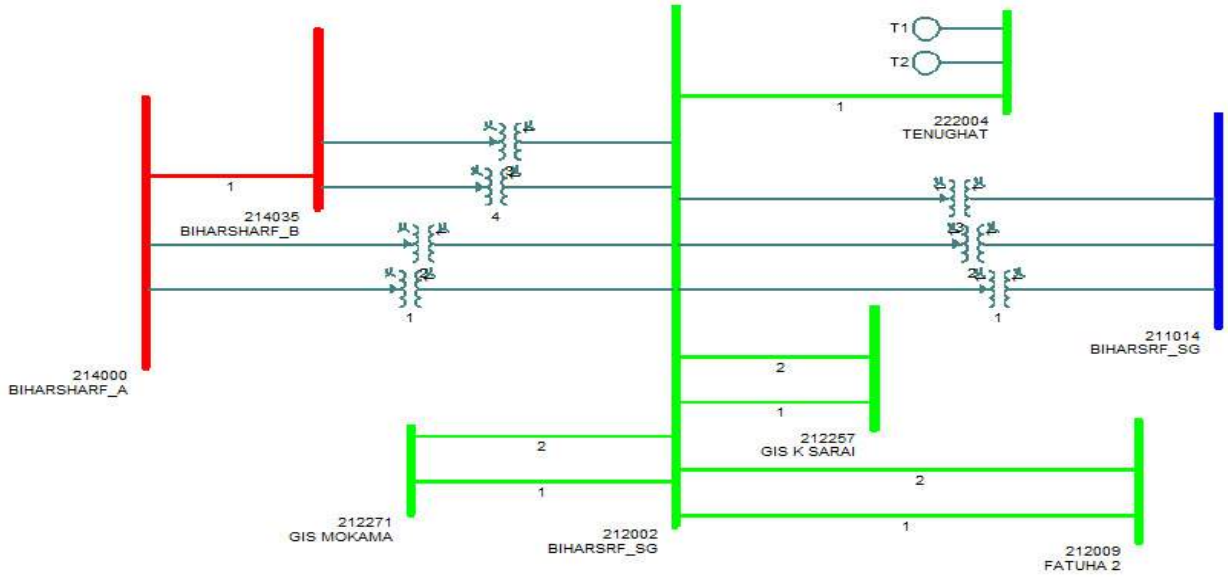
Gen. Loss: 320 MW
Outage Duration: 03:24 hrs

TVNL may explain.

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**.

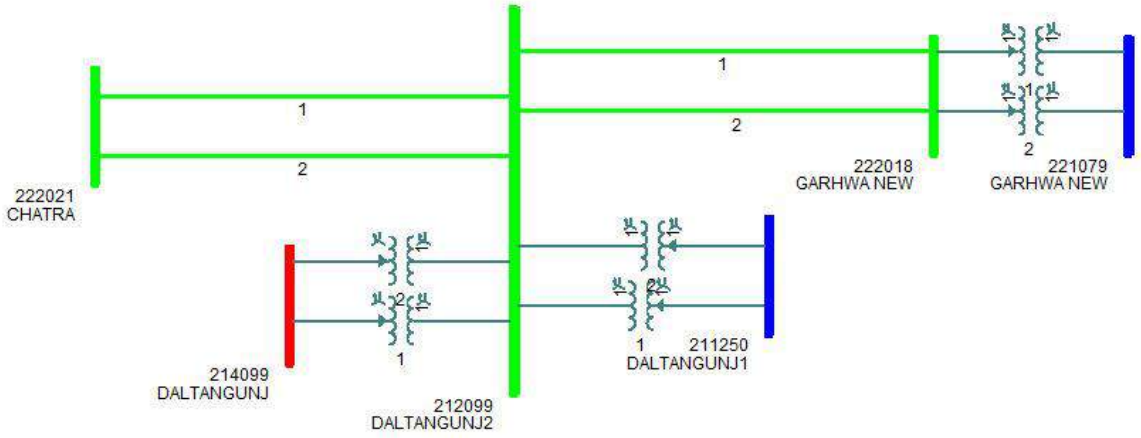
Load Loss: 147 MW
Outage Duration: 00:19 Hrs

BSPTCL & BGCL may explain.

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**.



Relay Indications:

Time	Name of Element	End 1	End 2	PMU Observation
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	-	

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

JUSNL may explain.

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:

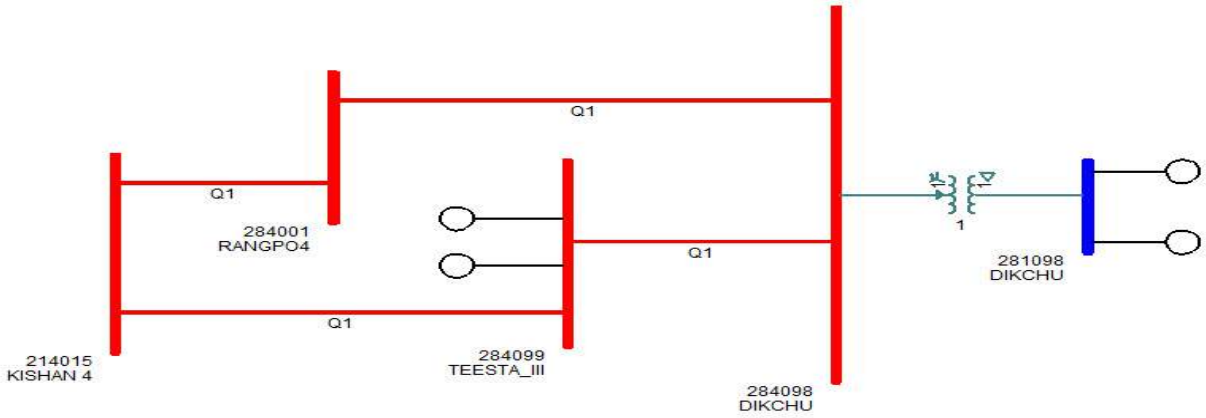
Time	Name	End1	End 2	PMU Observation
13:01	400 kV Teesta III-Dikchu	Teesta III: DT received	Dikchu: O/V stage 1	421 kV voltage at Kishanganj. 0.3 kV dip in all three phases after tripping

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

Dikchu & TUL may explain.

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.



Disturbance report is attached at **Annexure B.6**.

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.

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 Gantry between Main and Tie bay of ICT-2	PG ER-2

Concerned utilities may explain.

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.

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.

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 at **Annexure B.8.**

Concerned utilities may explain.

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.

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.

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.

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

The decisions of previous PCC meetings are attached at **Annexure C.4.**

Members may update the latest status.

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>
</table>
</td></tr>
</table>

<table>
<tr><th>Item</th><th colspan="4">Information</th></tr>
<tr><td></td><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></td><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></td><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></td><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>
<tr><td>Original In-Service Year</td><td colspan="4">October 2013</td></tr>
<tr><td>Recent Assessment Group</td><td colspan="4">NLDC, POSOCO</td></tr>
<tr><td>Recent Assessment Date</td><td colspan="4">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)</td></tr>
</table>

Members may note.

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.

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 C.7.**

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.

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.

- Status of carrier protection and PLCC channel in all above mentioned section to be ensured and same may be shared.
- Utilities should ensure that proper protection coordination are in place after charging of these lines/elements.

Concerned utilities may update.

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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: **01-01-2022/1** दिनांक: **04-02-2022**

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

1. Summary of the event (घटना का सारांश):

On 1st Jan 2022 at 05:58 hrs, all emanating lines from 220 kV Tenughat (TVNL) tripped. Two running units at Tenughat also tripped. Both 220 kV Buses at Tenughat tripped which resulted in 320 MW generation loss at Tenughat power plant. Prior to the event , foggy weather was prevailing at the Tenughat substation.

- **Date / Time of disturbance:** 01-01-2022 at 05:58 hrs.
- **Event type:** GD - 1
- **Systems/ Subsystems affected:** 220 kV Tenughat S/s
- **Load and Generation loss**.
  - 320 MW generation loss reported during the event.
  - No load loss was reported during the event.

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

- NIL

3. Major elements tripped (प्रमुख ट्रिपिंग)

- 220 kV Tenughat-Patratu
- 220 kV Tenughat-Biharsharif
- 220 kV Tenughat-Govindpur-1

4. Network across the affected area (प्रभावित क्षेत्र का नक्शा)

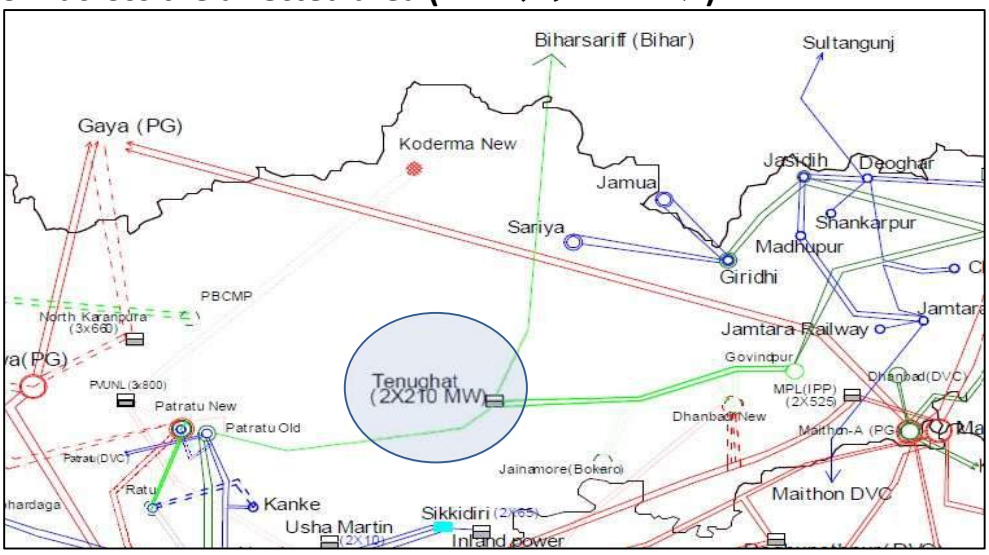


Figure 1: Network across the affected area

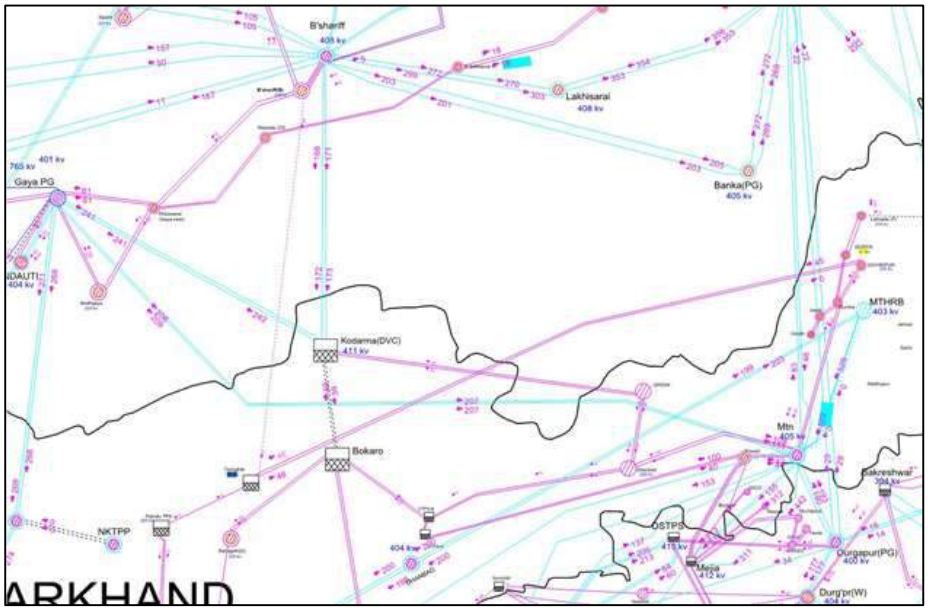


Figure 2: SCADA snapshot for of the system

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

समय	नाम	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	पीएमयू पर्यवेक्षण
05:58	220 kV Tenughat-Patratu	Tenughat: B_N, 2.56 kA	Patratu: B_N, 55 km, 2.531 kA, Zone-2	6 kV dip in B_ph at Biharsharif. Fault Clearance time: 400 msec
	220 kV Tenughat-Bihar sharif	Didn't trip	Bihar sharif: B_N, 160 km, 1.4 kA, Zone-2	
	220 kV Tenughat-Govindpur	Didn't trip	Govindpur: B_N, Zone-2, 95 km, 0.8 kA	
	Tenughat U#1 & U#2	Tripped on overspeed protection		

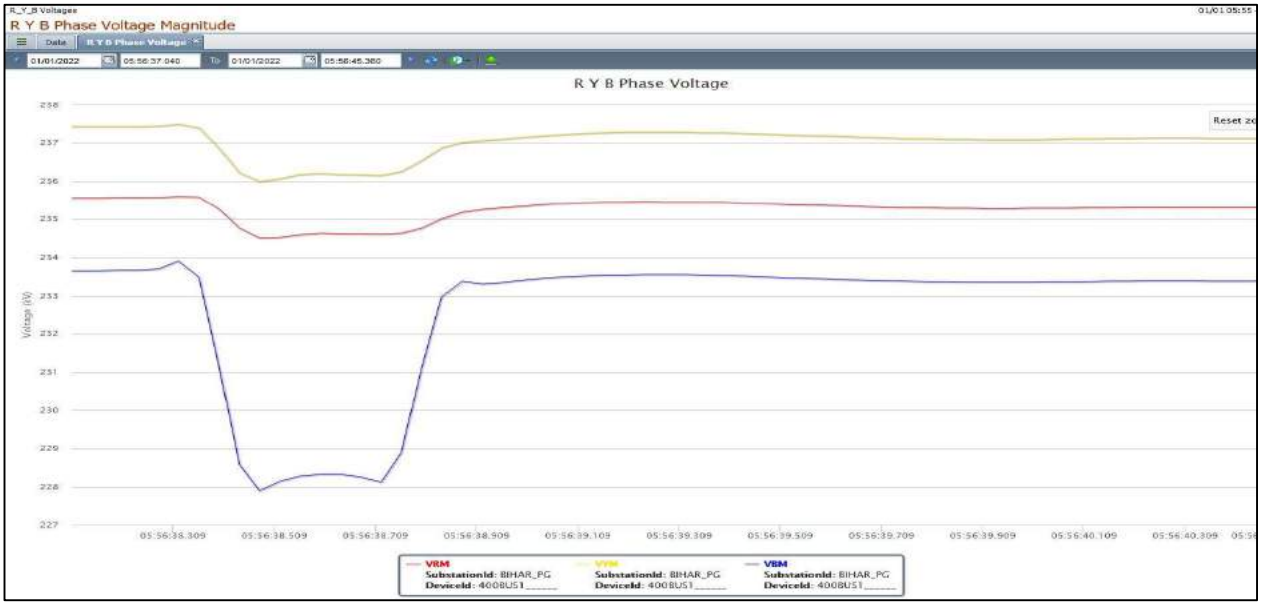


Figure 3: PMU voltage snapshot of 400/220 kV Bihar sharif S/s

5. Restoration (पूर्वावस्था की प्रप्ति)

Transmission/Generation element name	Restoration time
220 kV Tenughat-Patratu	10:39
220 kV Tenughat-Biharsharif	07:11
220 kV Tenughat-Govindpur-1	06:58
Tenughat U#1	20:56 (05.01.22)
Tenughat U#2	11:04

6. Analysis of the event (घटना का विश्लेषण):

220 kV Tenughat-Biharsharif

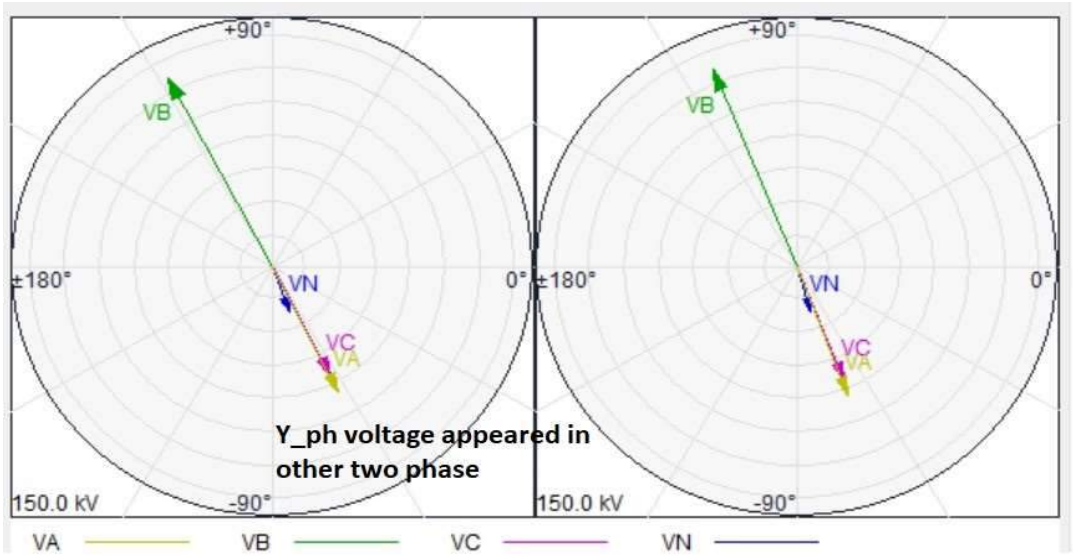
- Tenughat: Didn't trip from Tenughat. Zone-4 picked up till opening of breaker from Biharsharif.
- Biharsharif: Tripped in Zone-2 time (350 msec).

220 kV Tenughat-Govindpur-1

- Tenughat: Didn't trip
- Govindpur: Tripped in Zone-2 time.

220 kV Tenughat-PTPS

- PTPS: Tripped in Zone-2 however, Y_ph CB didn't open and was feeding Tenughat through single phase supply. (Trip coil of Y_ph found burnt).
- Tenughat: As per DR timestamp, 220 kV Tenughat-Patratu tripped from Tenughat after 51 seconds. All three phases at Tenughat were closed and Y_ph voltage was available from Patratu. It appeared in other two phases (R and B ph) at Tenughat with almost half magnitude and 180 degrees out of phase. After around 50 msec, current in neutral became more than 140 A and O/C E/F picked up and tripped all three phases at Tenughat after 1.3 seconds.



220 kV Tenughat-PTPS (Tenughat end DR)

Tenughat Units and Station transformer

- **Both running units tripped on over-speed protection.**
- **CW transformer-2 tripped on Y_ph O/c protection.**

From above information, it seems that fault was in Tenughat switchyard due to which emanating 220 kV lines had observed the fault in Zone 4. TVNL may explain.

7. Protection issue (सुरक्षा समस्या):

- Exact fault location details are required to be shared from TVNL for detailed analysis of the event. **TVNL may explain.**
- Based on line current in B phase , it is observed that 5 kA fault current was being fed from remote end. Net current at Tenughat would be further higher as generating unit 1 and 2 also will be feeding the same fault. Yet with such high fault current electromechanical Bus bar protection at Tenughat didn't operate. **TVNL may explain.**
- At Patratu, Y_ph of 220 kV Tenughat-Patratu remained close as trip coil of Y_ph burnt. LBB protection at Patratu didn't operate. JUSNL may state on bus bar protection aspect and shifting of these feeder to newly charged 400/220 kV Patratu substation. **If JUSNL is going to continue with 220/132 kV existing Paratu substation in future also then status of bus bar and LBB to be provided to ERLDC/ERPC**. **JUSNL and Jharkhand SLDC to explain.**
- DR Digital channels not configured properly- JUSNL, TVNL to include digital status (all three phase) of breaker.

8. Recommendations (सुझाव):

- At present Tenughat Bus bar protection scheme installed during retrofitting work carried out in 2018 is of Electromechanical type. However, as per CEA standard as quoted below, numerical Bus Bar protection should have been installed at Tenughat during R&M / bus retrofitting work. Further due to non-numerical nature bus bar scheme, disturbance recorder for bus bar protection is also not available due to which it's non-operation during event could not be analysed. TVNL may explore installation of numerical bus bar protection as well as associated disturbance recorder in line with CEA standards.
- As bus bar protection has not operated even with such high fault current at Tenughat during this event, all bus bar circuitry should be properly checked along with complete bus bar scheme at Tenughat with injection kit. In addition complete substation should also be inspected for any insulator tracking or flashover as the event had occurred during fog condition in early morning hours.
- U#2 of Tenughat has electromechanical relay. Numerical relay maybe installed for the unit to ensure security and reliability in line with CEA standard.
- DR channels should be configured properly as per DR standards ratified in PCC and these DRs should be time synchronised.

9. 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, TVNL, BSPTCL**
Incorrect/ mis-operation / unwanted operation of Protection system	1. CEA Technical Standard for Construction of Electrical Plants and Electric Lines: 43.4.A. 2. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1. (6.1, 6.2, 6.3)	**JUSNL and TVNL**
Non-Availability of Numerical Bus Bar/LBB Protection at 220 kV and above S/s	1. CEA Technical Standard for Construction of Electrical Plants and Electric Lines 43.4.A 2. CEA Technical Standard for Construction of Electrical Plants and Electric Lines 43.4.C.4 3. CEA (Technical standards for connectivity to the Grid) Regulation, 2007 – 6.1, 6.4.	**JUSNL, TVNL**
DR/EL are not time synchronized	1. Indian Electricity Grid Code 4.6.3 2. CEA Technical Standard for Construction of Electrical Plants and Electric Lines: 43.4.D. 3. CEA (Technical standards for connectivity to the Grid) Regulation, 2007: Schedule Part 1.7.	**JUSNL, TVNL**

10. Status of Reporting (रिपोर्टिंग की स्थिति):

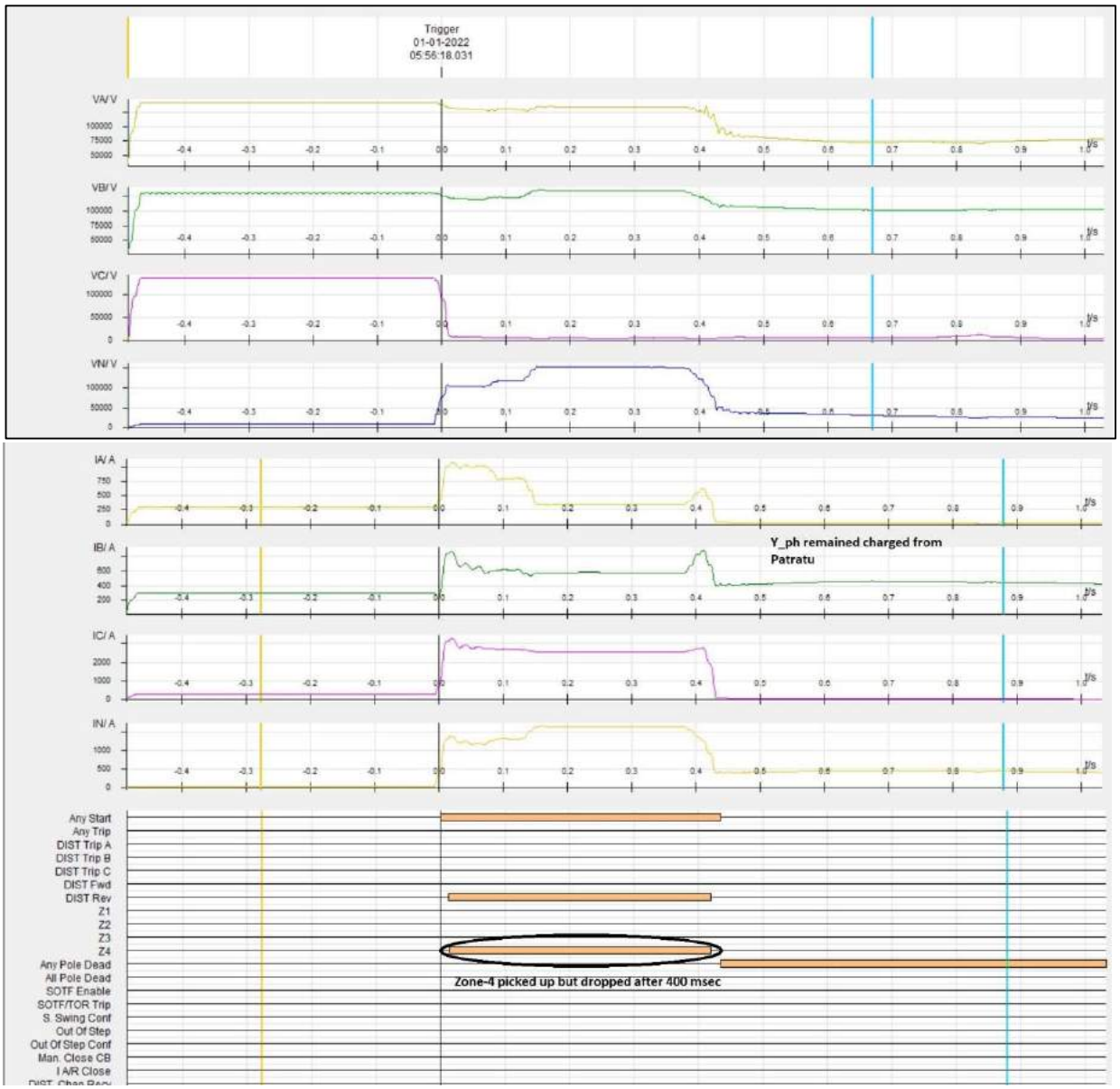
- DR/EL received from JUSNL, TVNL, BSPTCL.

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

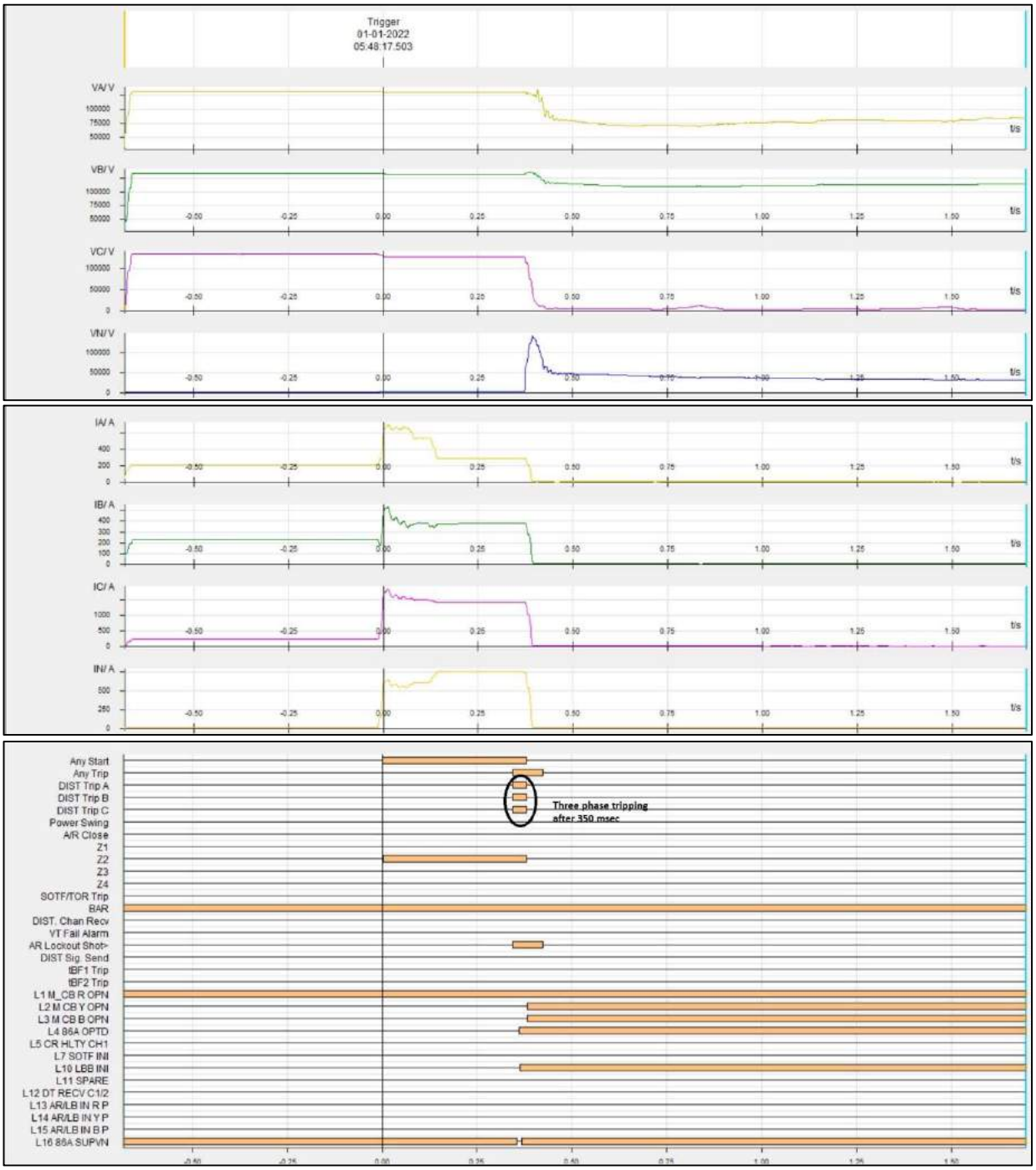
Sequence of event not recorded at time of event.

Annexure 2: DR recorded

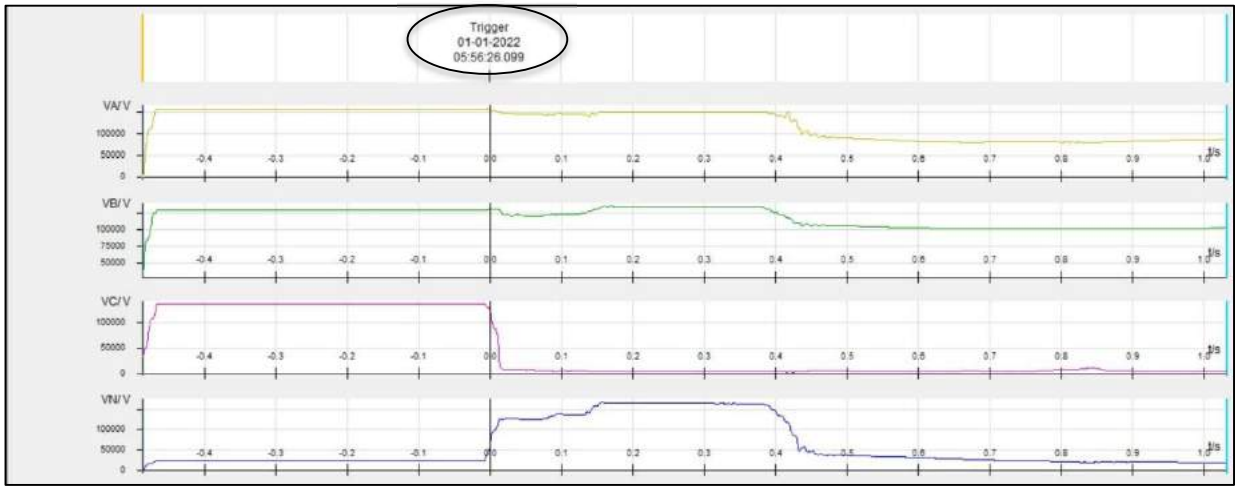
DR of 220 kV Tenughat-Bihar sharif (Tenughat end)

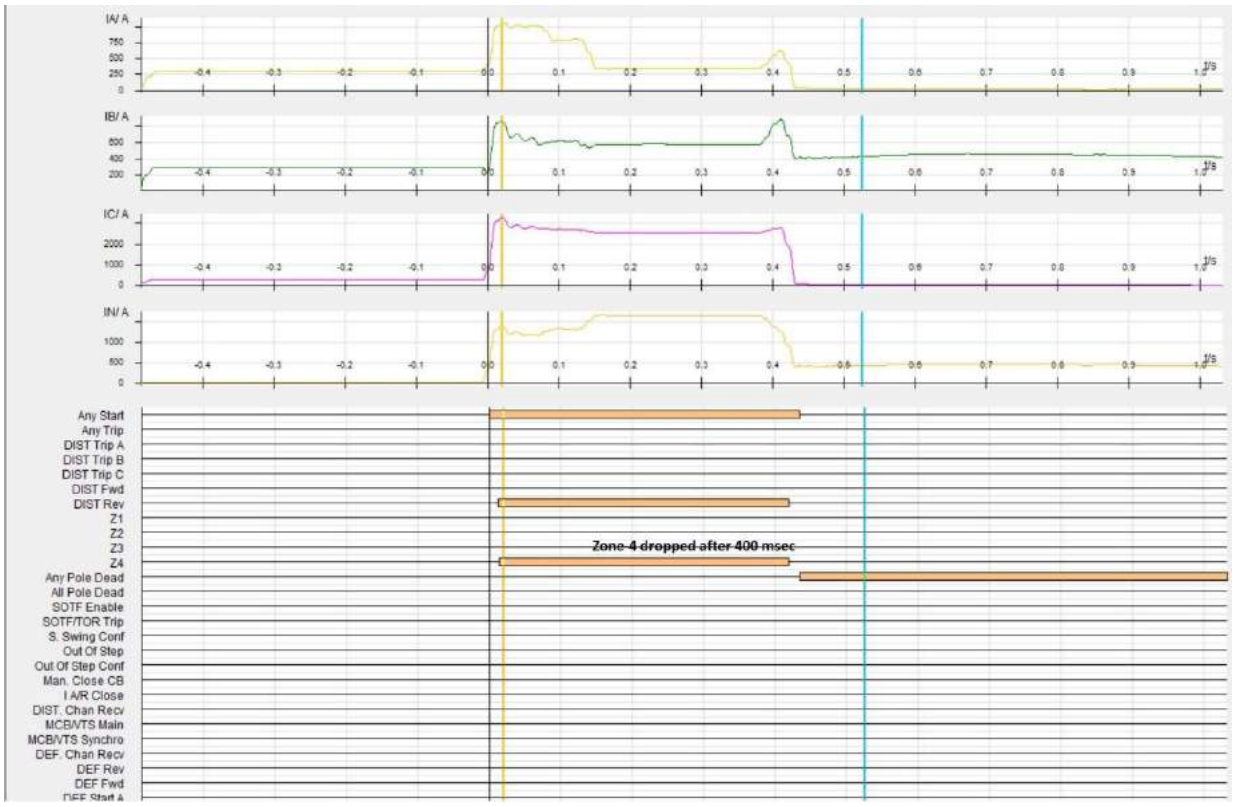


DR of 220 kV Tenughat-Bihar sharif (Bihar sharif end)

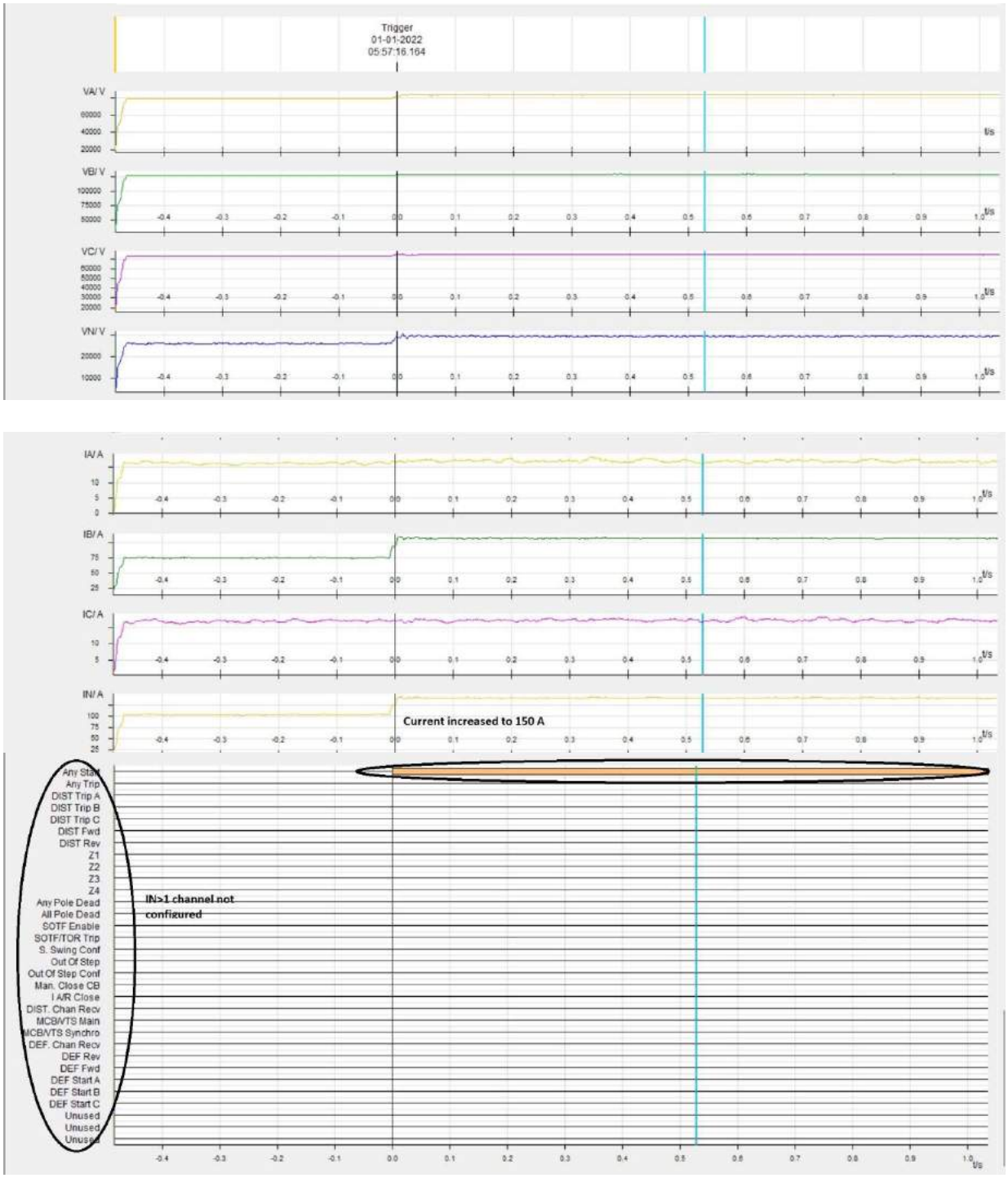


DR of 220 kV Tenughat-PTPS (Tenughat end)- 05:56:26 Hrs

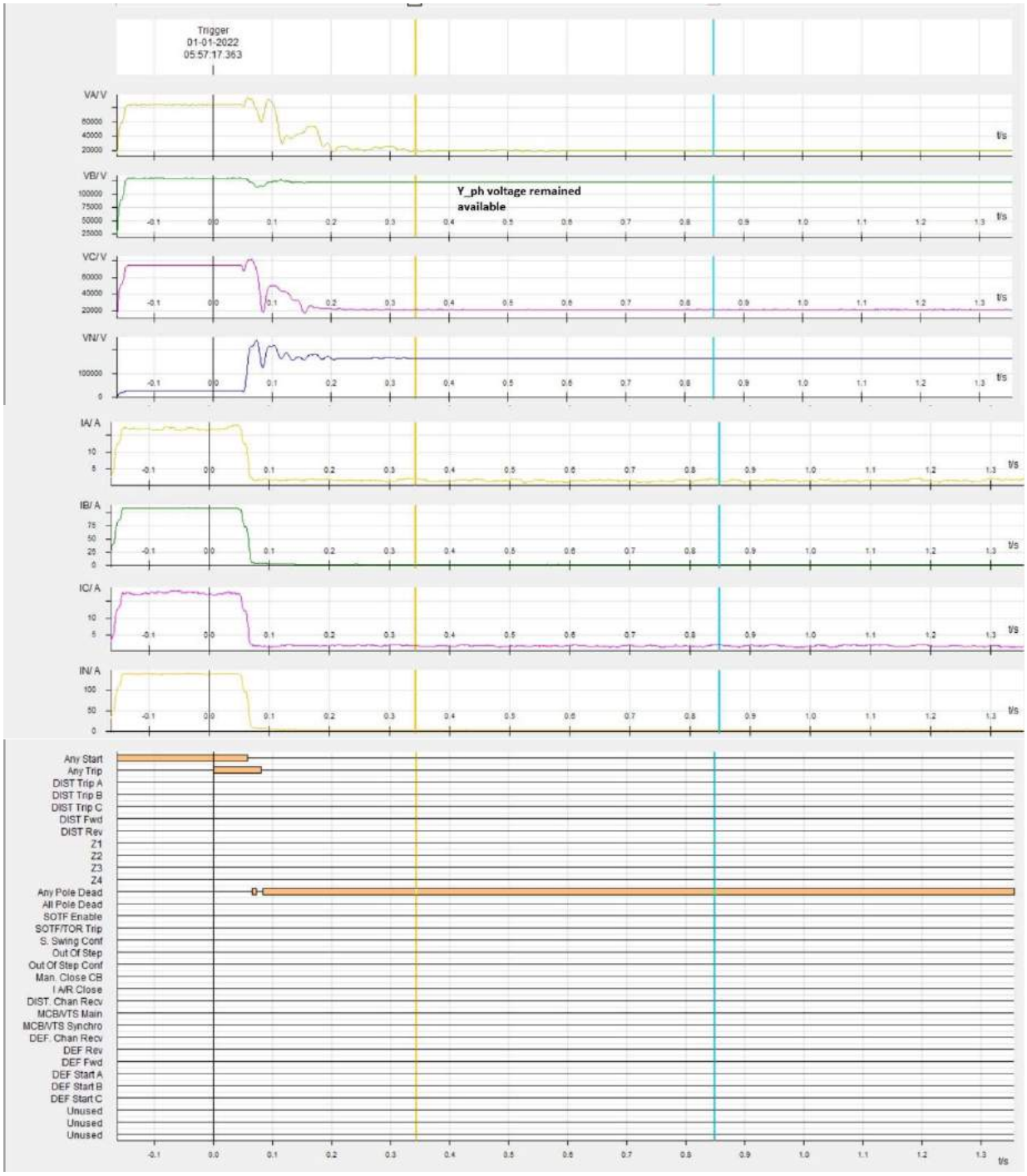




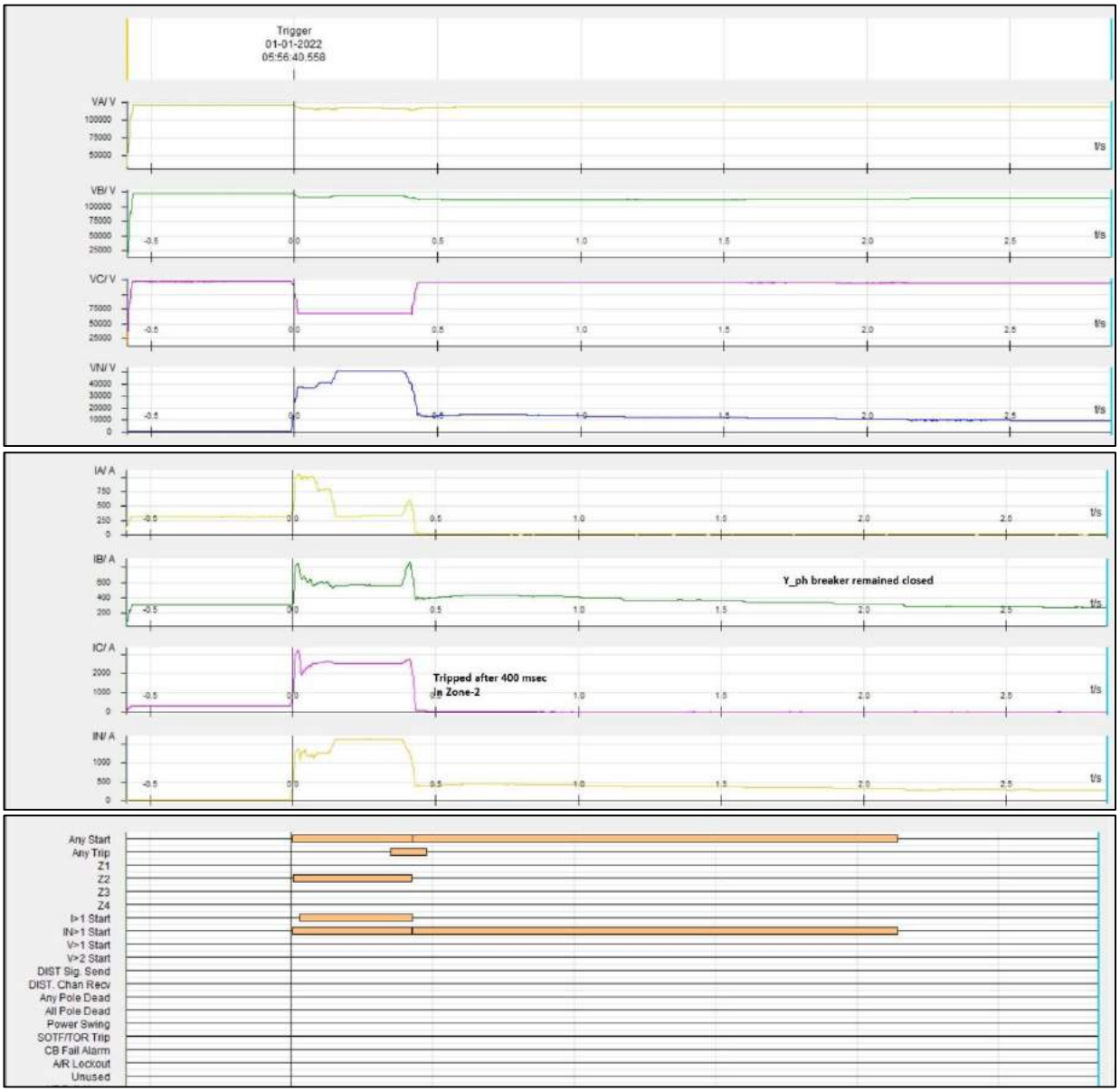
DR of 220 kV Tenughat-PTPS (Tenughat end) 05:57:16 hrs



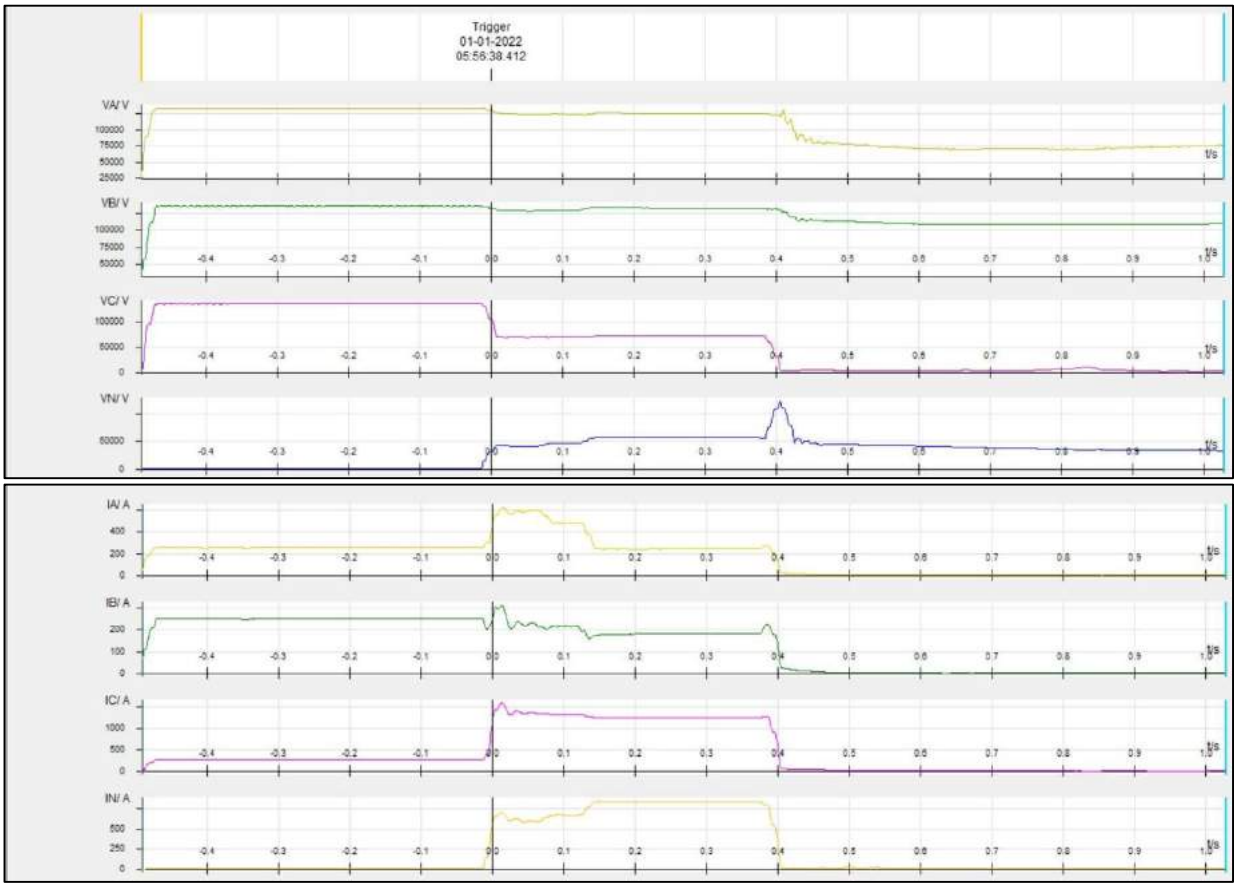
DR of 220 kV Tenughat-PTPS (Tenughat end) 05:57:17 Hrs



DR of 220 kV Tenughat-PTPS (PTPS end)



DR of 220 kV Tenughat-Govindpur-1 (Govindpur end)



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: **25-01-2022/1** दिनांक: **04-02-2022**

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

1. Summary of the event (घटना का सारांश):

At 10:24 Hrs on 25th January 2022, both running units at Tenughat tripped due to loss of auxiliary supply. 320 MW generation loss occurred.

- **Date / Time of disturbance:** 14-01-2022 at 13:01 hrs.
- **Event type:** GI- 1
- **Systems/ Subsystems affected:** 2*210 MW units at Tenughat
- **Load and Generation loss**.
  - 320 MW generation loss reported during the event.
  - No load loss was reported during the event.

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

- NIL

3. Major elements tripped (प्रमुख ट्रिपिंग)

- 2*210 MW units at Tenughat

4. Network across the affected area (प्रभावित क्षेत्र का नक्शा)

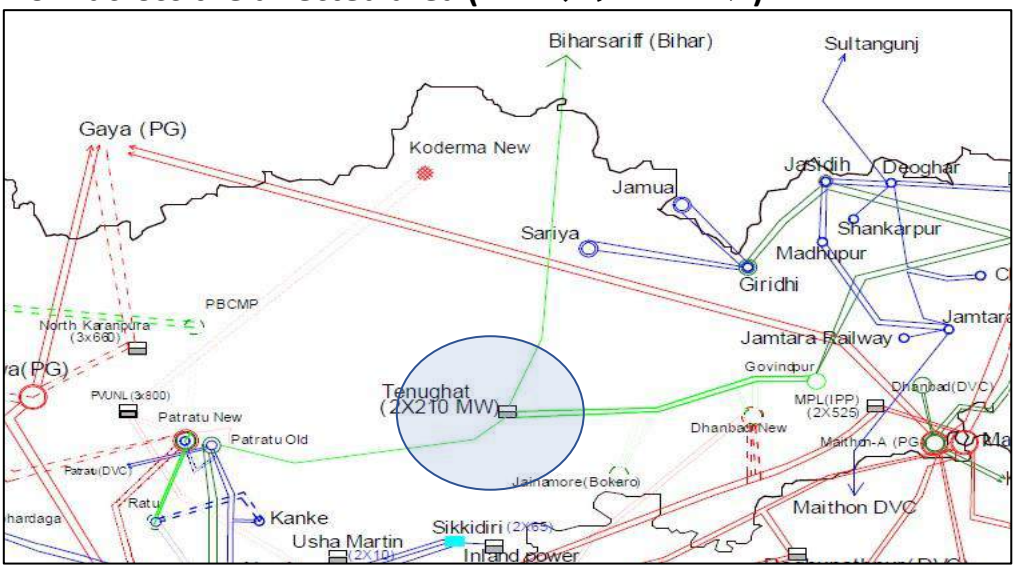


Figure 1: Network across the affected area

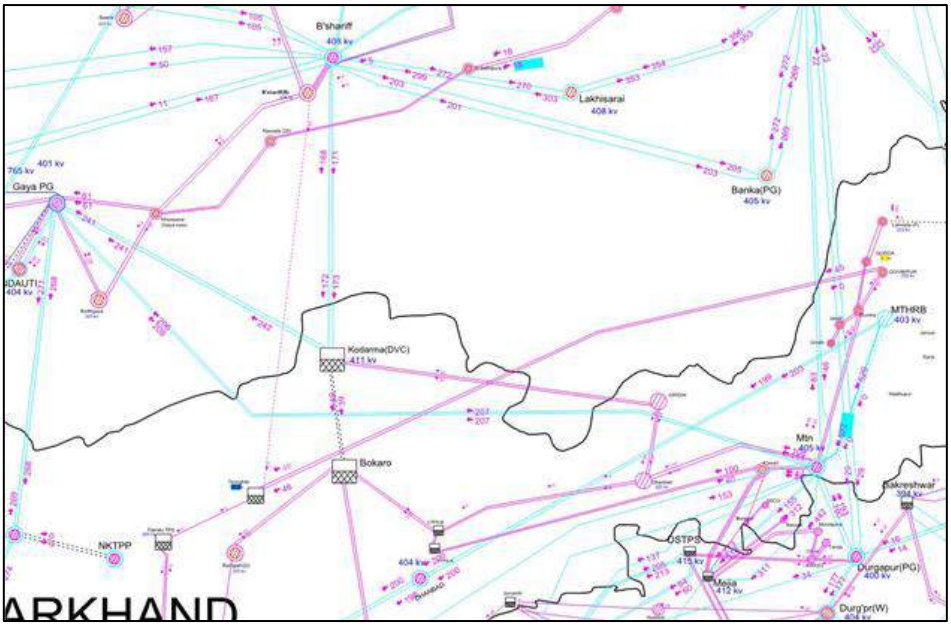


Figure 2: SCADA snapshot for of the system

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

समय	नाम	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	पीएमयू पर्यवेक्षण
10:24	210 MW U#1 & U#2 at Tenughat	Loss of auxiliary supply		0.5 kV dip observed in all three phase at Biharsharif
	Station Transformer#1	O/C E/F		

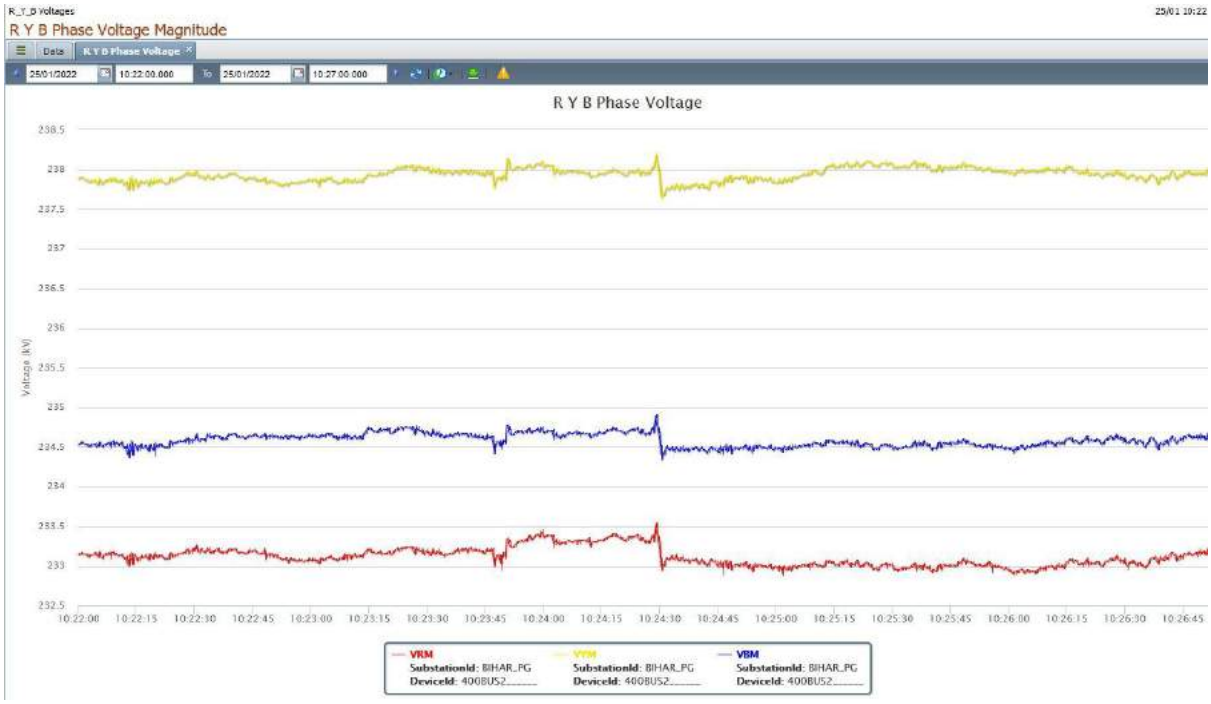


Figure 3: PMU voltage snapshot of 400/220 kV Biharsharif S/s

5. Restoration (पूर्वावस्था की प्रप्ति)

Transmission/Generation element name	Restoration time
210 MW U#1 at Tenughat	13:48
210 MW U#2 at Tenughat	11:22 (29-01-22)

6. Analysis of the event (घटना का विश्लेषण):

- Both running units tripped due to loss of auxiliary supply. Flashover occurred in 6.6 kV bus and station transformer tripped.
- Auxilliary supply to both units are being fed from single station transformer.

7. 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	**TVNL**

8. Status of Reporting (रिपोर्टिंग की स्थिति):

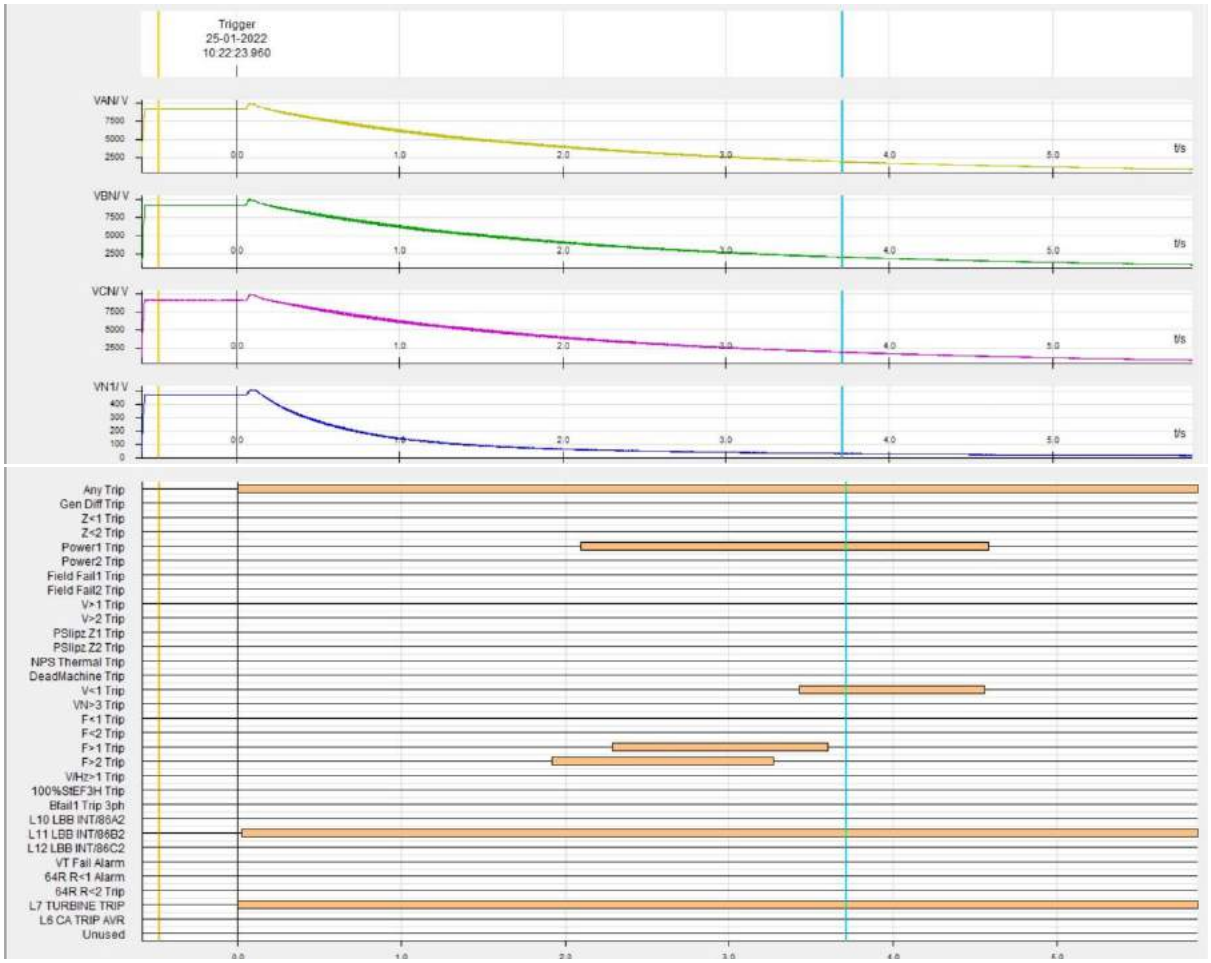
- DR/EL received from Tenughat for U#1.

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 Tenughat U#1



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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)

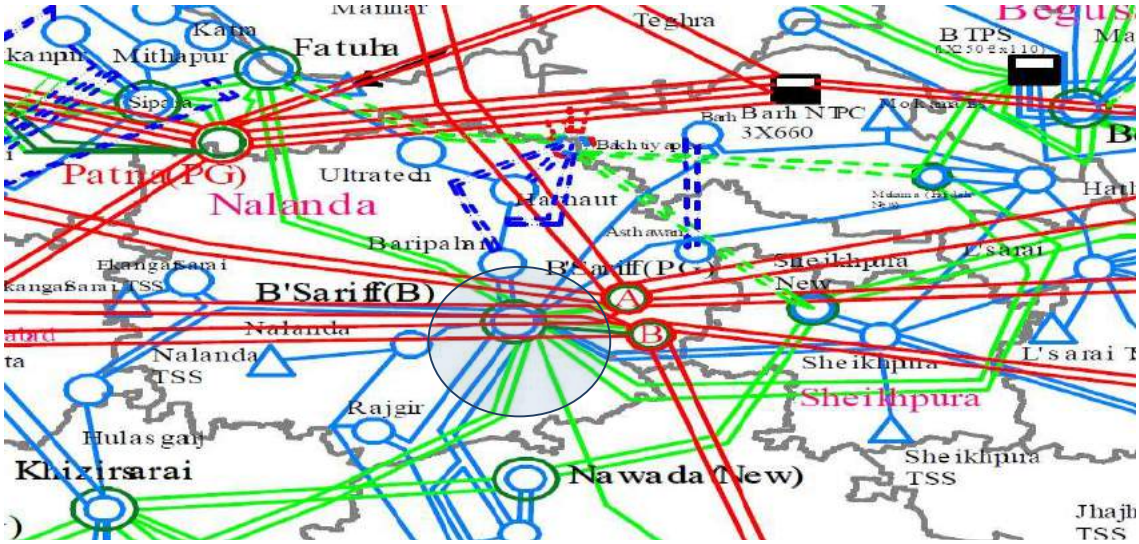


Figure 1: Network across the affected area

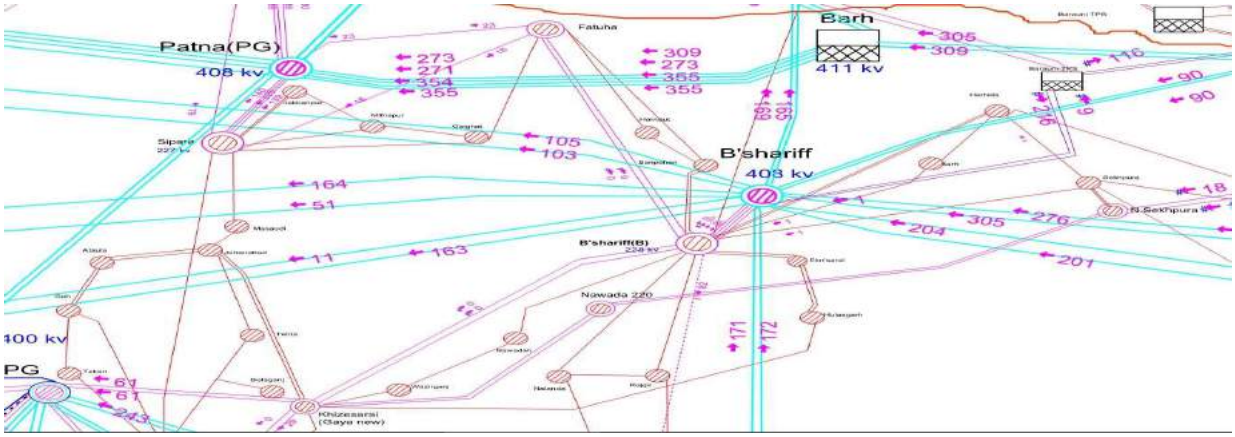


Figure 2: SCADA snapshot for of the system

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	-	

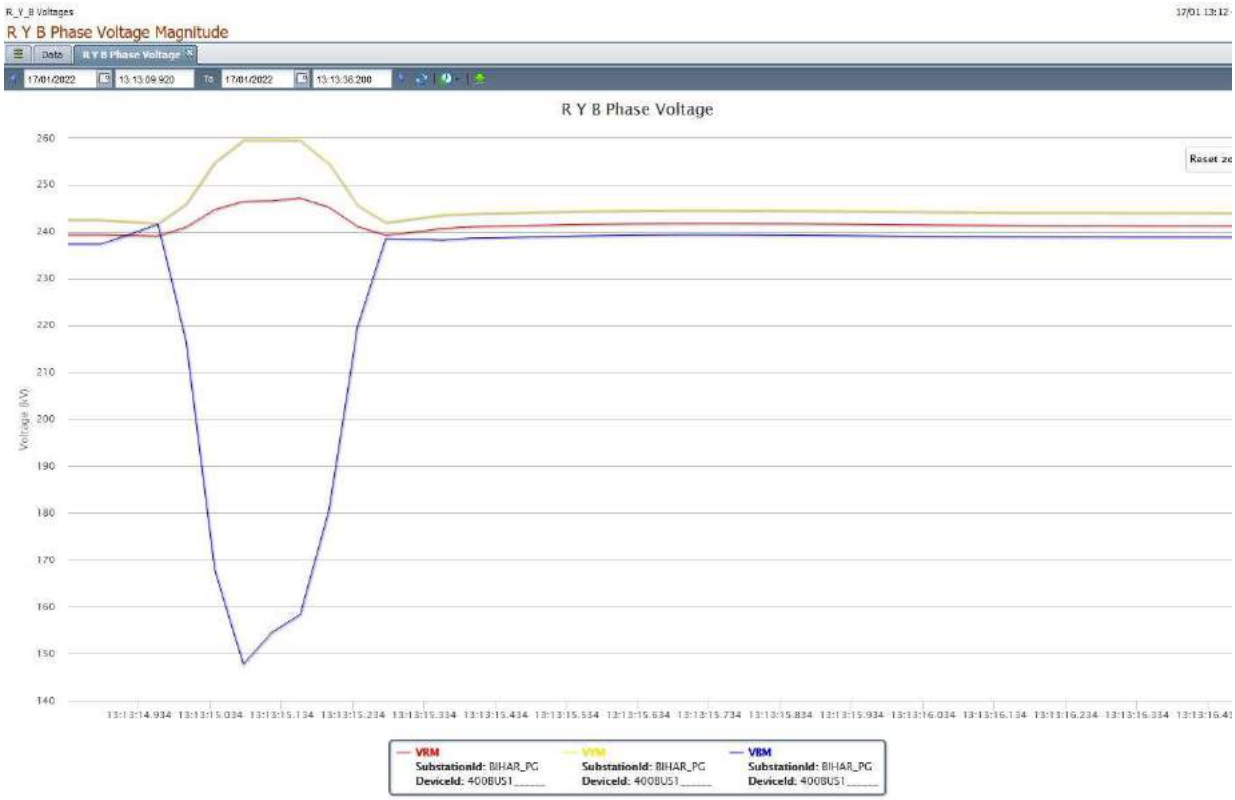


Figure 3: PMU snapshot of 400/220 kV Biharsharif S/s

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):

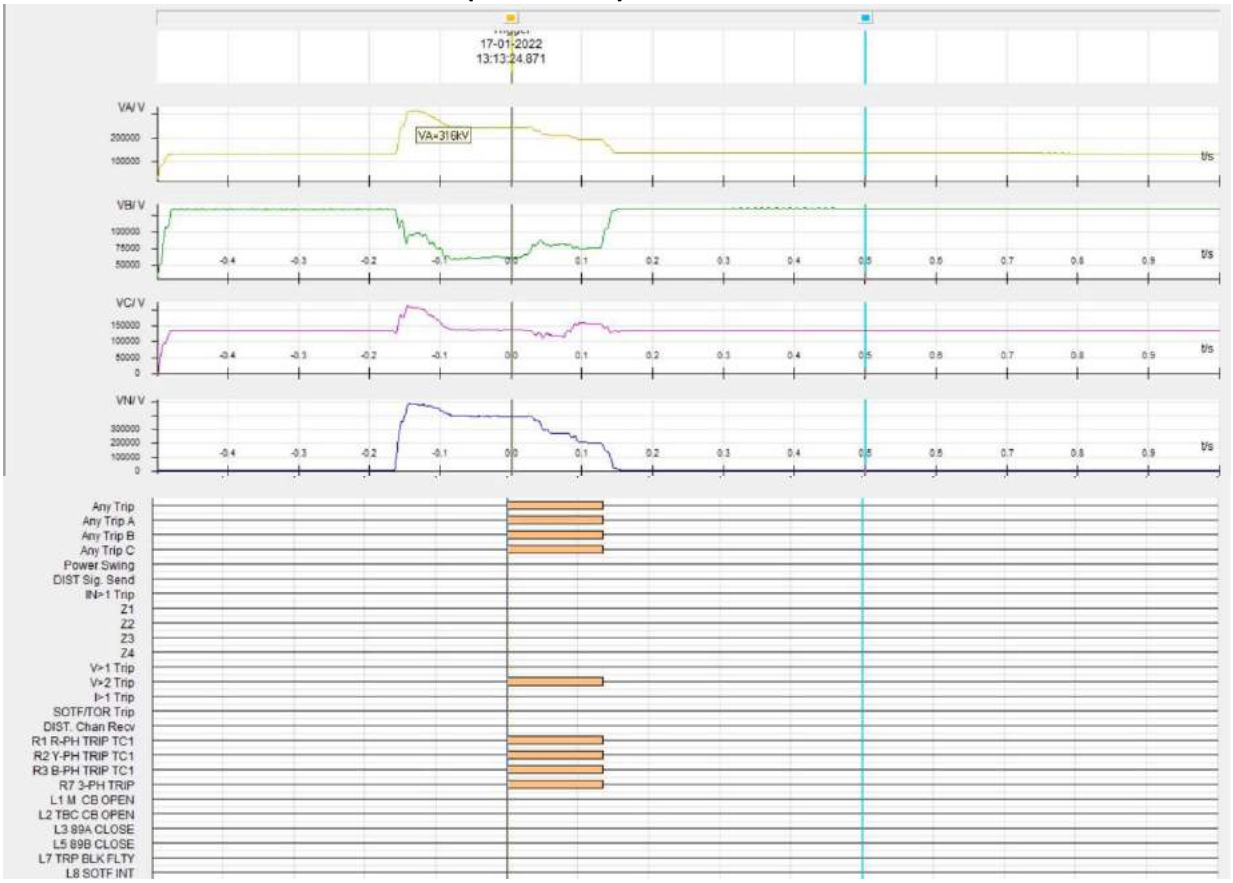
- DR/EL received from BSPTCL
- DR/EL received from PG ER-1

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

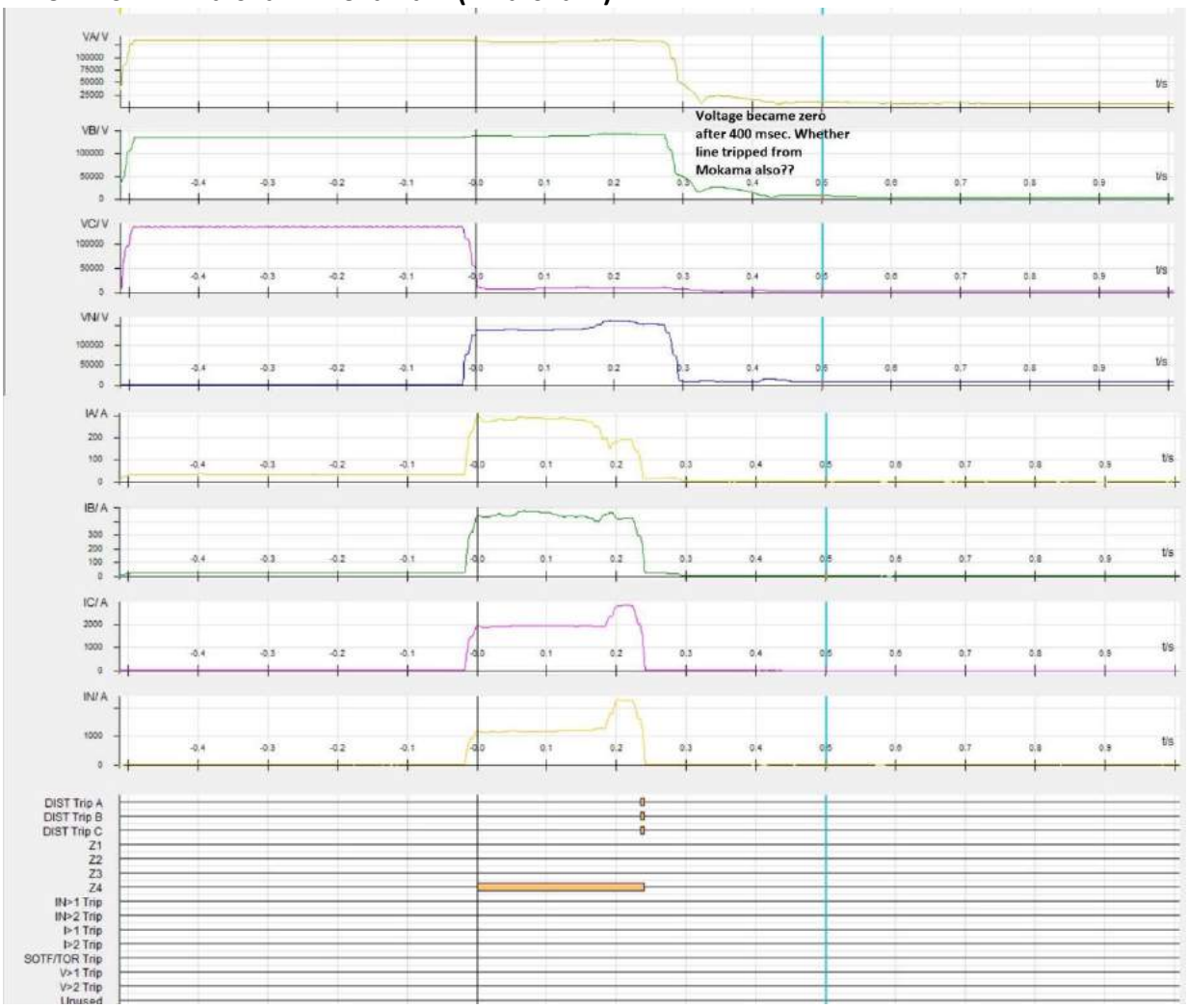
Sequence of event not recorded at time of event.

Annexure 2: DR recorded

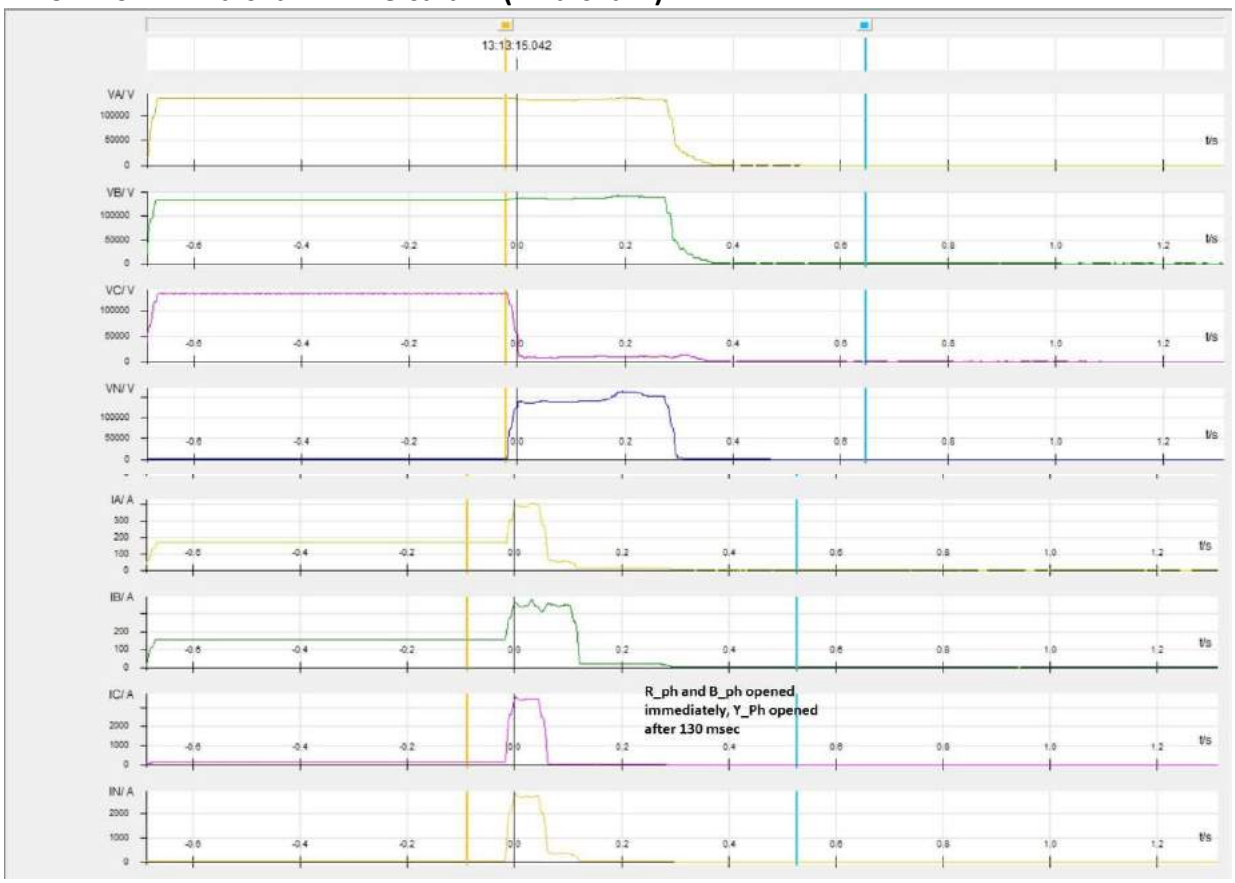
DR of 220 kV Biharsharif-Mokama 2(Biharsharif)



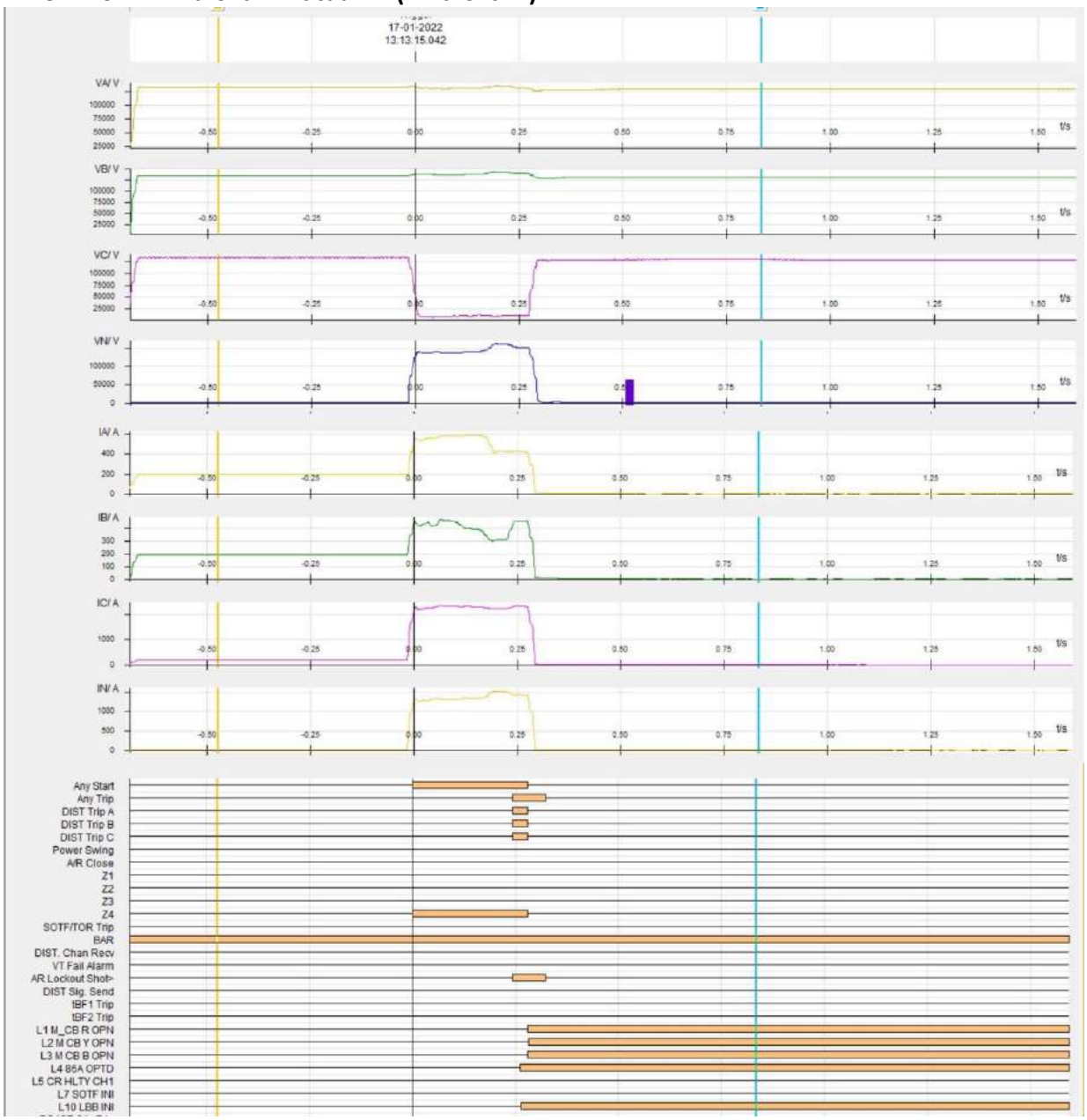
DR of 220 kV Biharsharif-Mokama-1 (Biharsharif)



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



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



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)

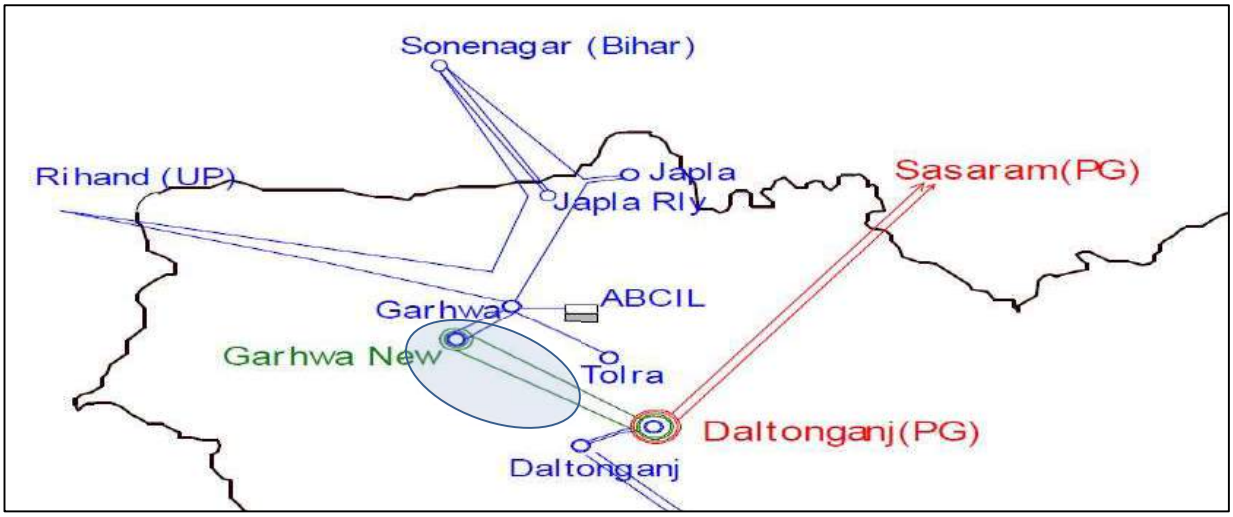


Figure 1: Network across the affected area

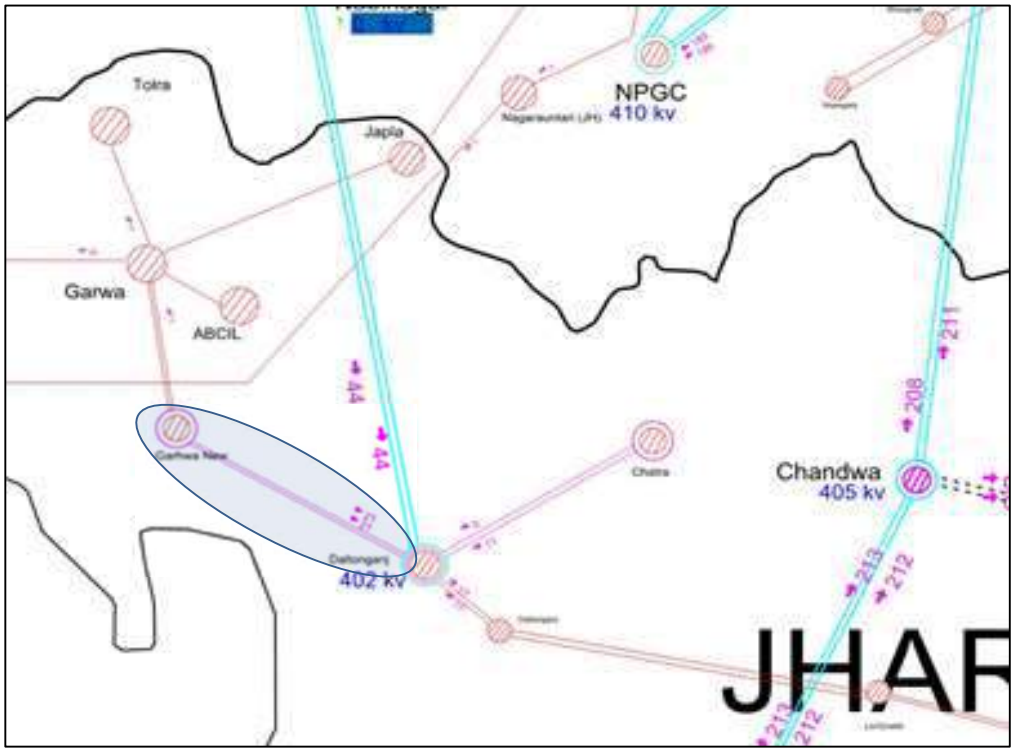


Figure 2: SCADA snapshot of the system prior to event

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	-	

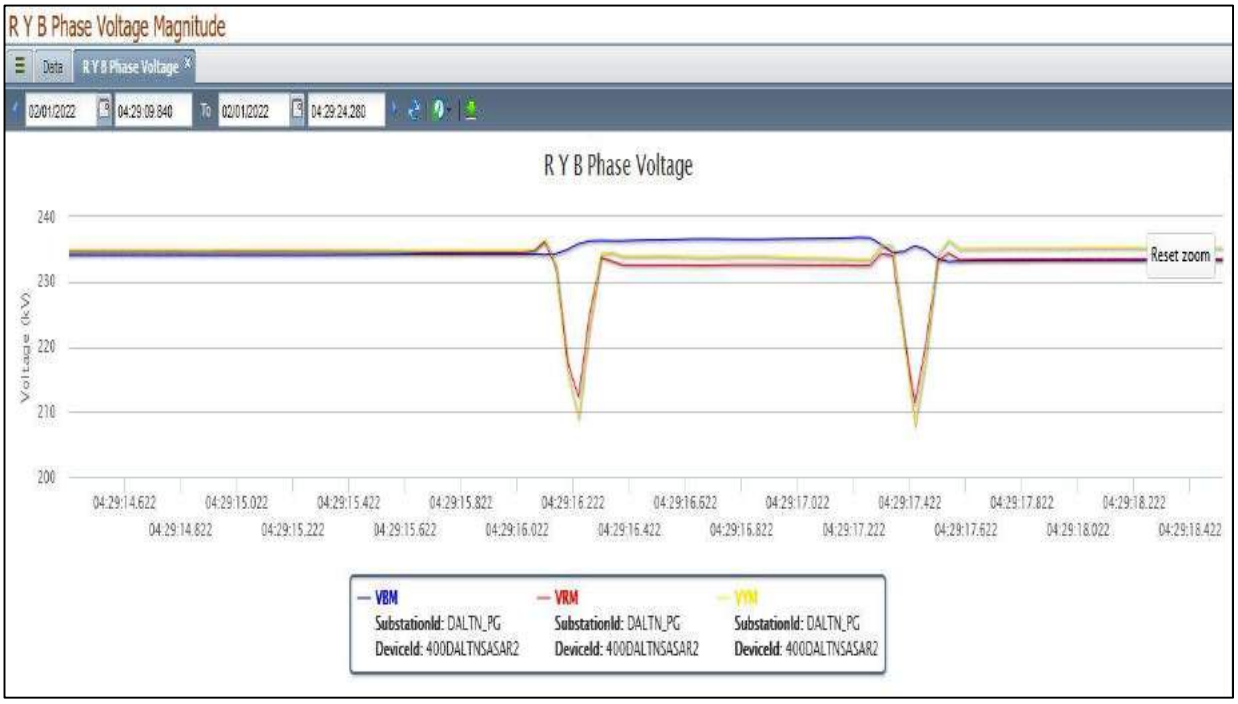


Figure 3: PMU snapshot of 400/220 kV Daltonganj S/s

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):

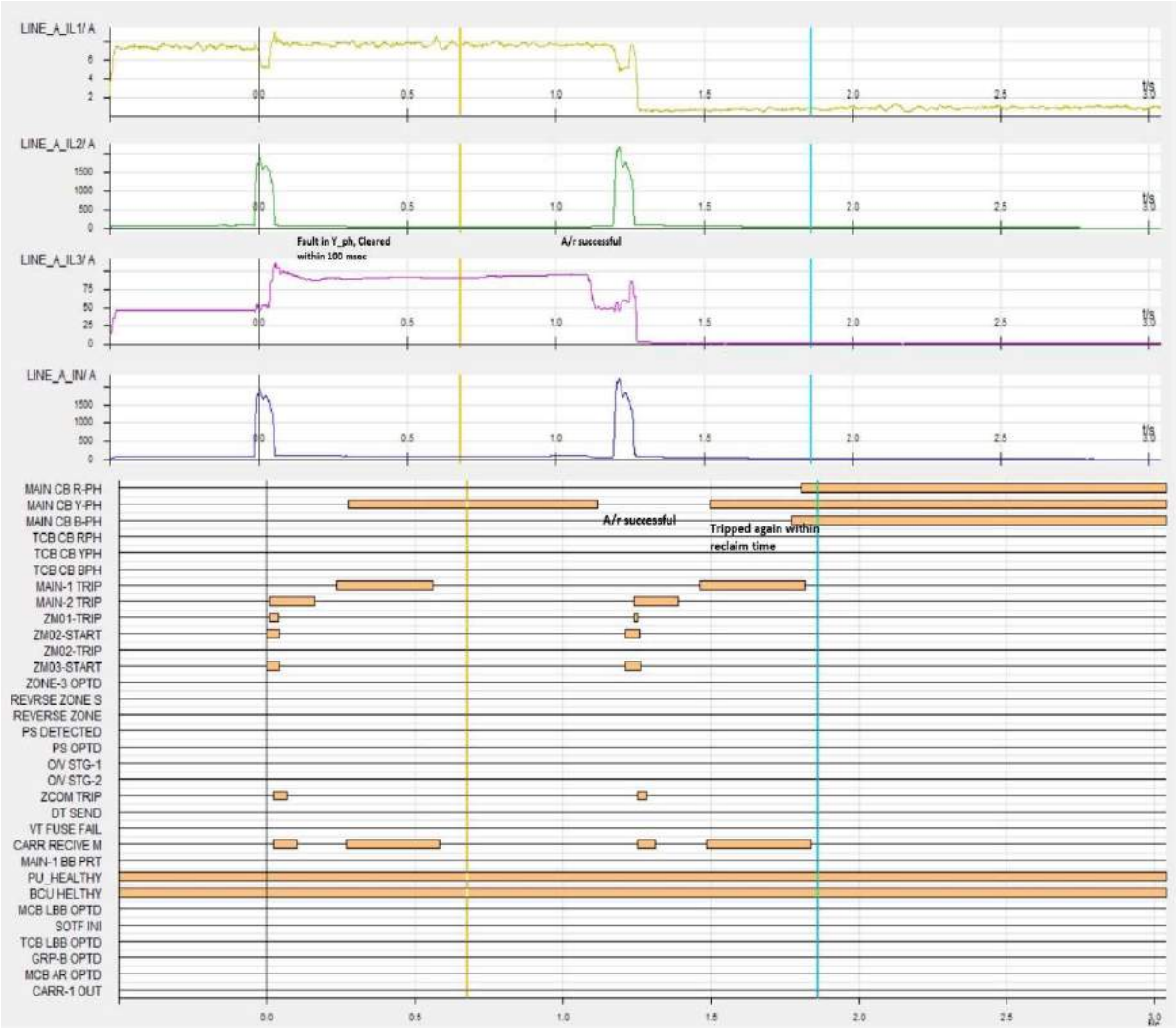
- DR/EL received from JUSNL
- DR/EL received from PG ER-I

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

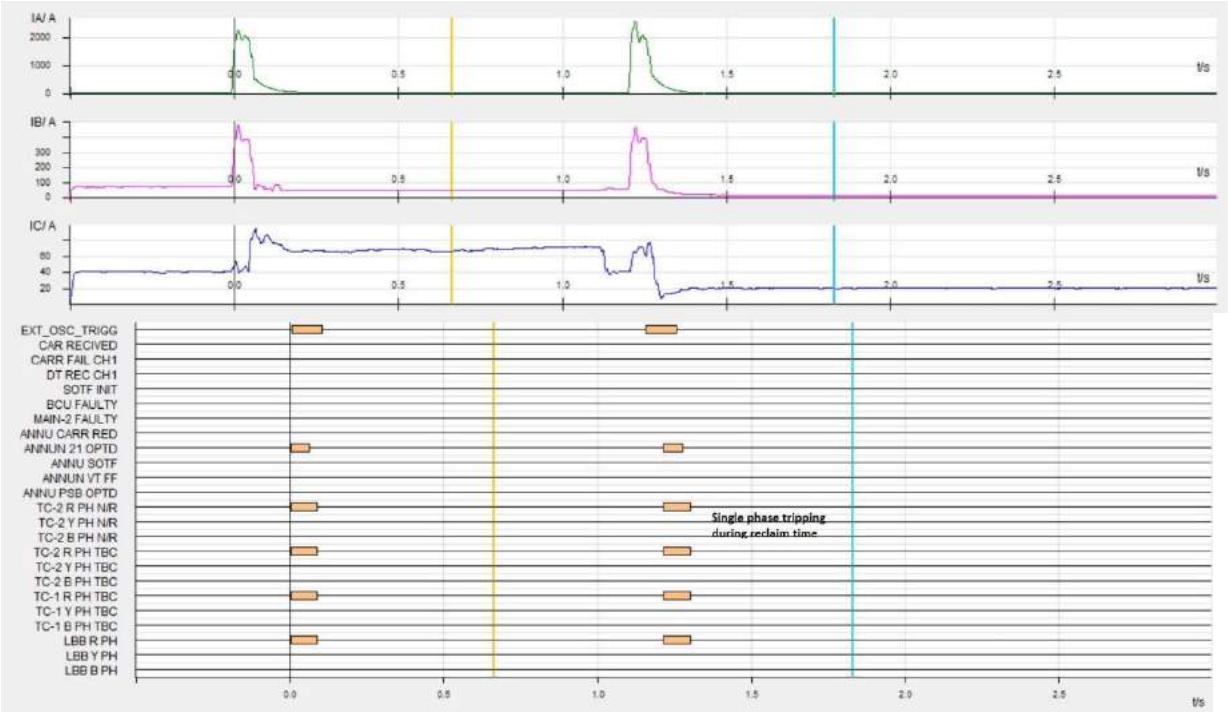
Sequence of event (SOE) not recorded at time of event.

Annexure 2: DR recorded

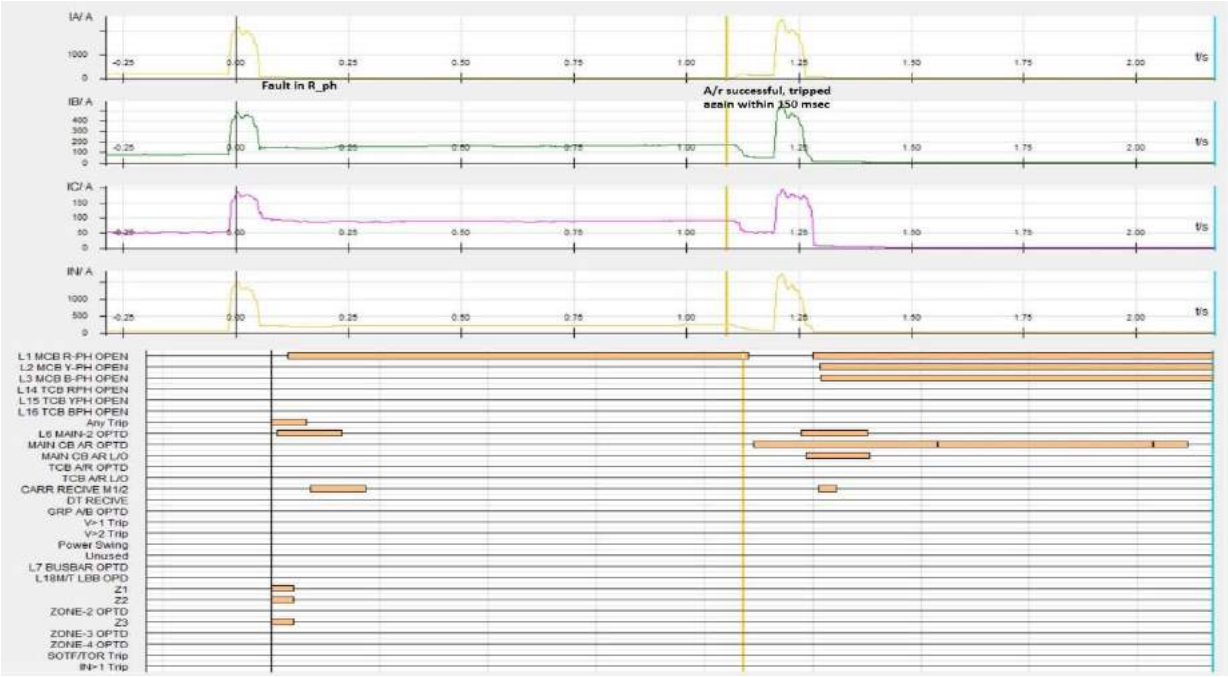
DR of 220 kV Daltonganj-Garhwa 1 (Daltonganj end)



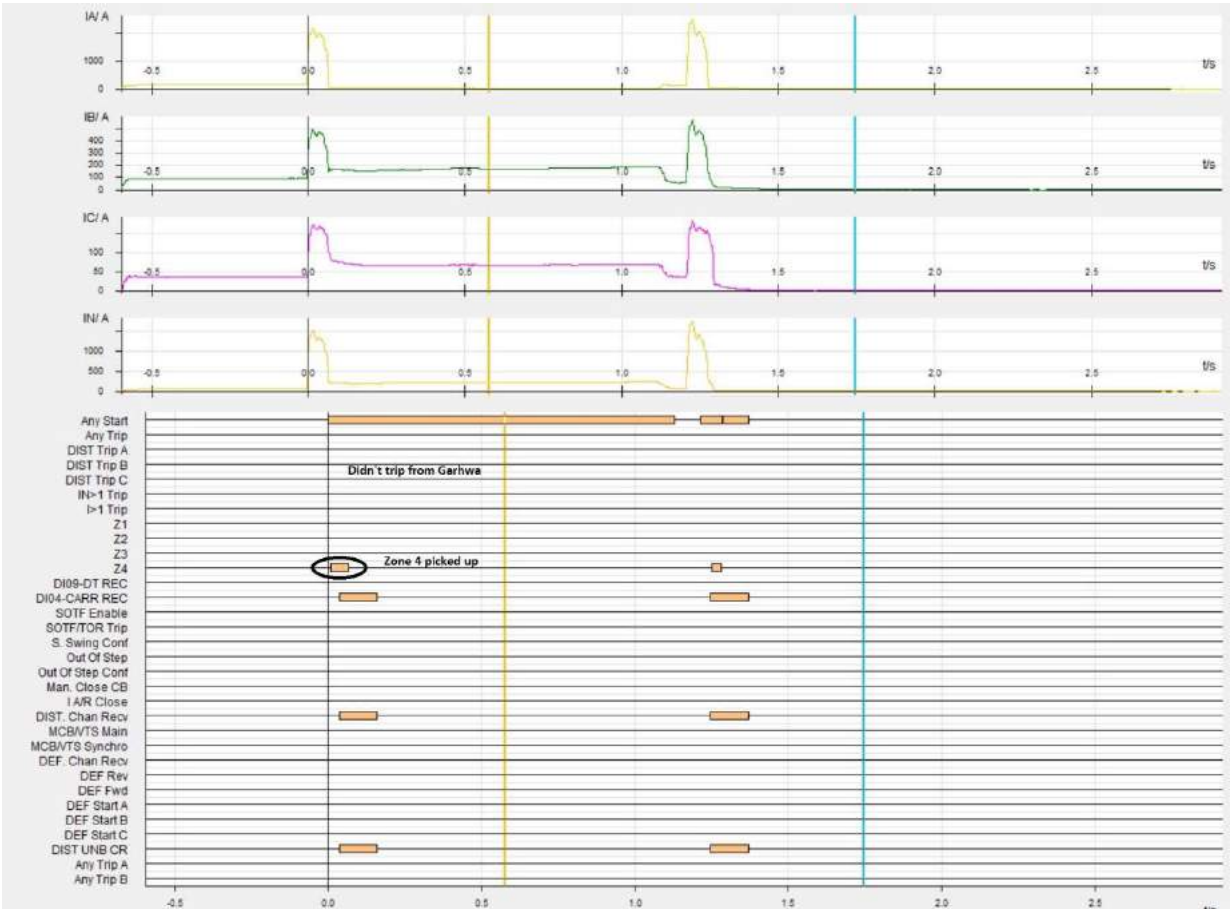
DR of 220 kV Daltonganj-Garhwa 1 (Garhwa end)



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



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



पावर सिस्टम ऑपरेशन करपोरेशन लिमिटेड
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घटना संख्या: **16-01-2022/1** दिनांक: **04-02-2022**

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

1. Summary of the event (घटना का सारांश):

At 14:01 Hrs on 16th January 2022, 400 kV Teesta 3-Kishanganj tripped at Teesta 3 on O/V and DT sent to Kishanganj. 400 kV Teesta-3 & 400 kV Dikchu S/s became dead as 400 kV Rangpo-Dikchu was under planned shutdown. No generation or load loss occurred.

- **Date / Time of disturbance:** 16-01-2022 at 14:01 hrs.
- **Event type:** GD - 1
- **Systems/ Subsystems affected:** 400 kV Teesta 3, Dikchu S/s
- **Load and Generation loss**.
  - No generation loss reported during the event.
  - No load loss was reported during the event.

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

- 400 kV Rangpo-Dikchu

3. Major elements tripped (प्रमुख ट्रिपिंग)

- 400 kV Teesta 3-Kishanganj

4. Network across the affected area (प्रभावित क्षेत्र का नक्शा)

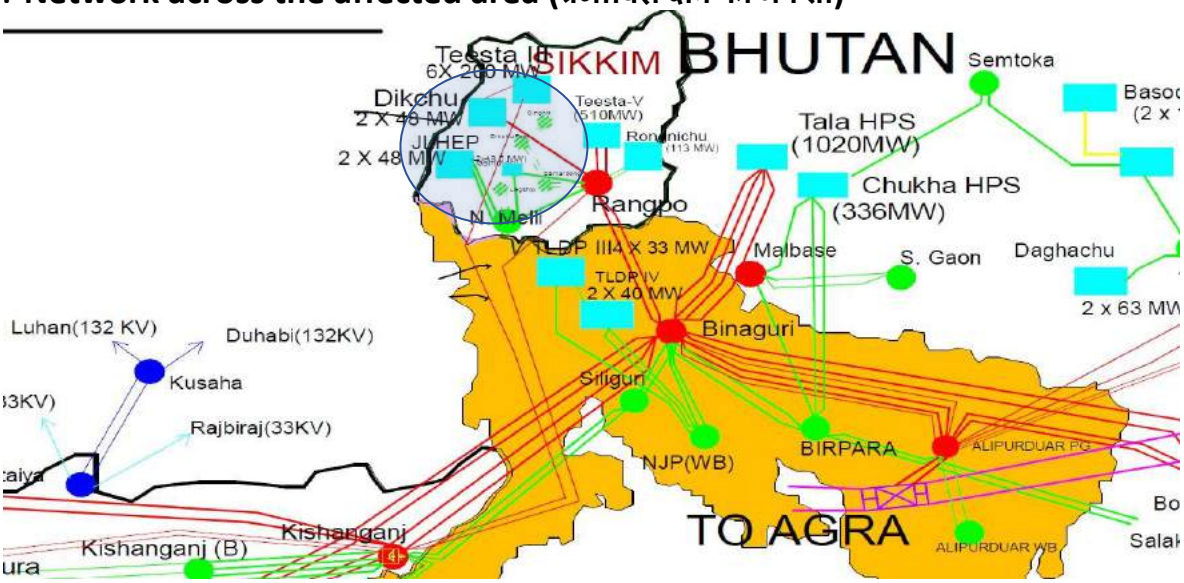


Figure 1: Network across the affected area

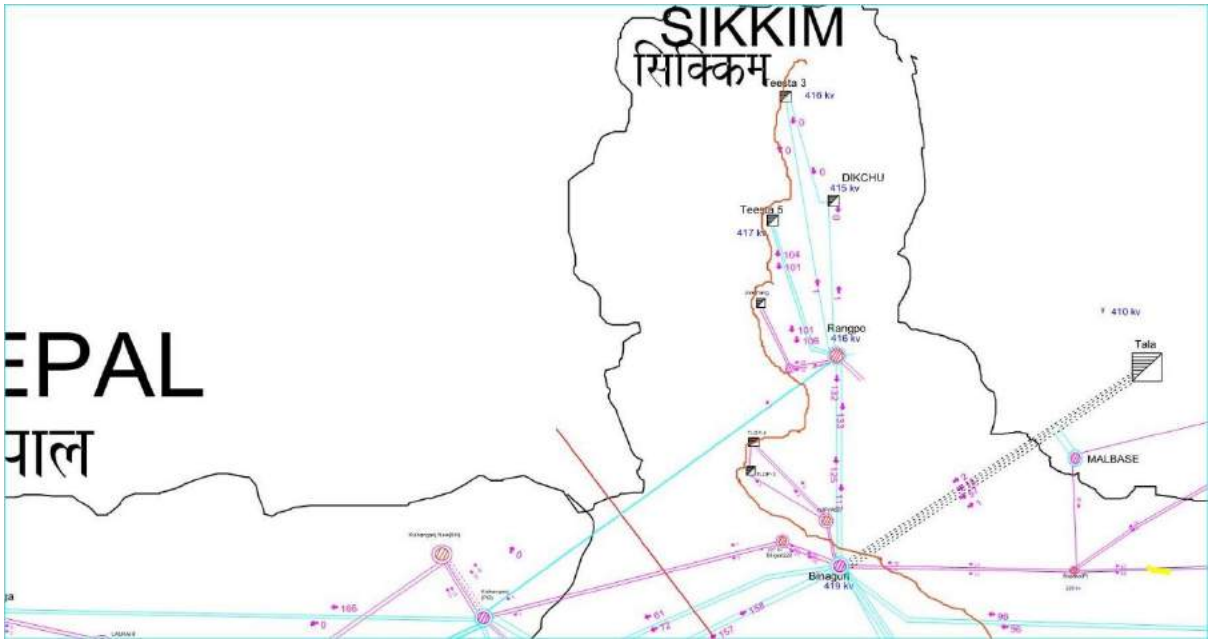


Figure 2: SCADA snapshot for of the system

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

समय	नाम	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	पीएमयू पर्यवेक्षण
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

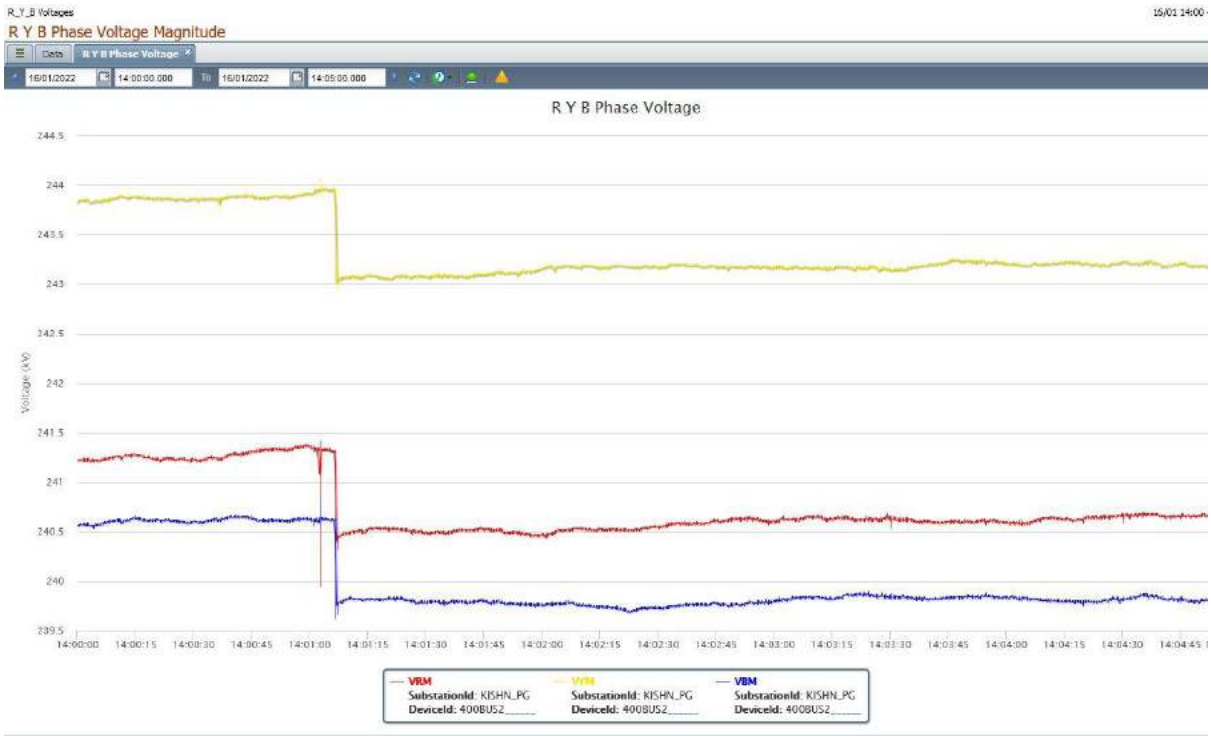


Figure 3: PMU voltage snapshot of 400/220 kV Kishanganj S/s

5. Restoration (पूर्वावस्था की प्रप्ति)

Transmission/Generation element name	Restoration time
400 kV Teesta 3-Kishanganj	15:58

6. Analysis of the event (घटना का विश्लेषण):

- 400 kV Rangpo-Dikchu was under shutdown. 400 kV Teesta 3-Dikchu was charged through 400 kV Kishanganj-Teesta 3 link.
- High voltage was prevailing in all nodes in Sikkim complex.
- This long length line combined with no generation at either Teesta 3 or Dikchu. 400 kV Teesta 3-Kishanganj also tripped on O/C St.1 from Teesta 3 and DT sent to Kishanganj.
- Dikchu S/s also became dead as a result of tripping of 400 kV Teesta 3-Kishanganj.

7. Protection issue (सुरक्षा समस्या):

- 400 kV Teesta 3-Kishanganj tripped before tripping of 400 kV Teesta 3-Dikchu. Time delay set for O/V St.1 at Teesta 3 may be checked. **TUL to explain.**

8. 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	**Teesta 3, PG ER-1**

9. Status of Reporting (रिपोर्टिंग की स्थिति):

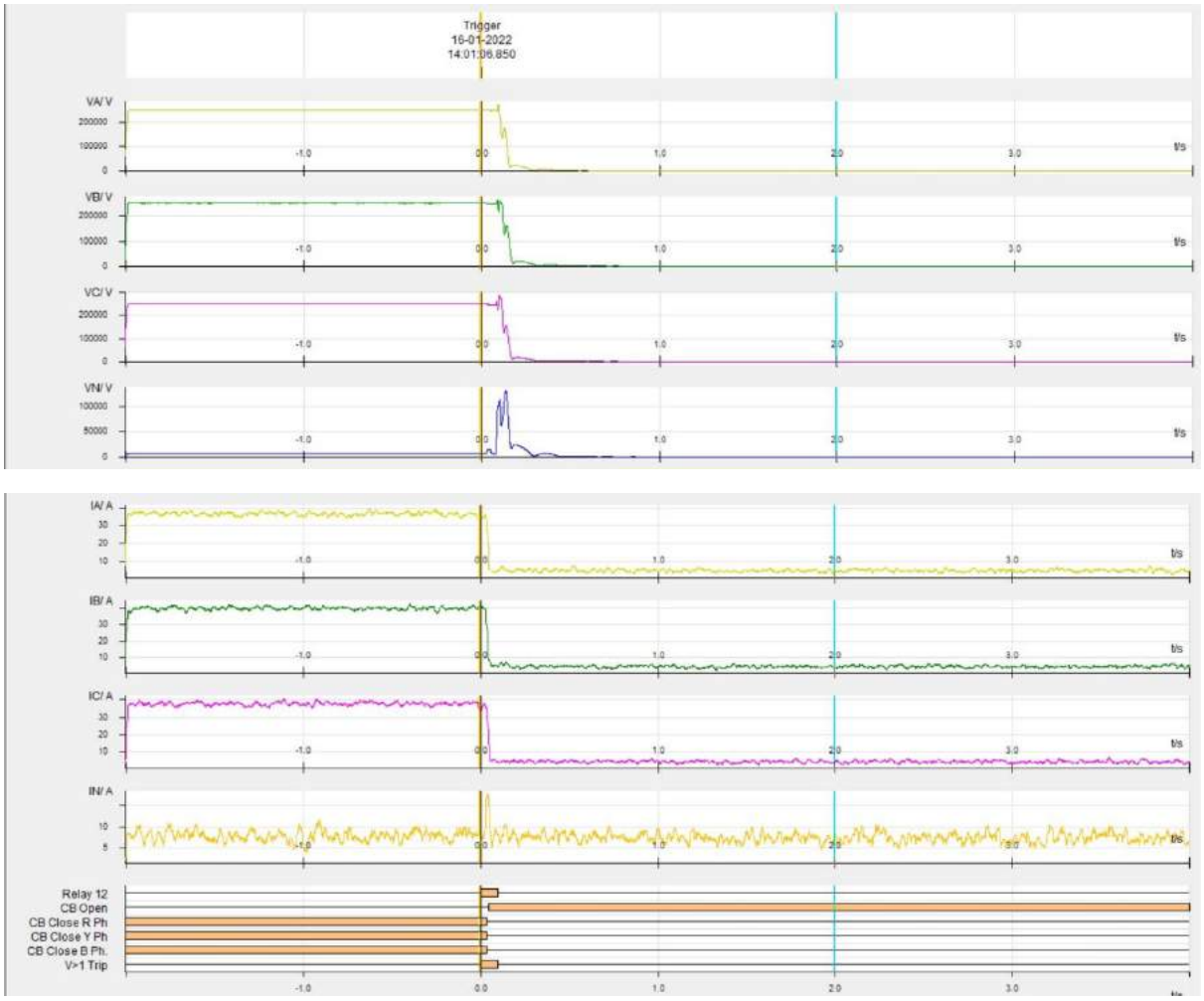
- DR/EL received from Teesta 3
- DR/EL yet to be received from Kishanganj

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 400 kV Teesta 3-Kishanganj (Teesta 3)



Islanding Event:

3.1 CESC Islanding Event:

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

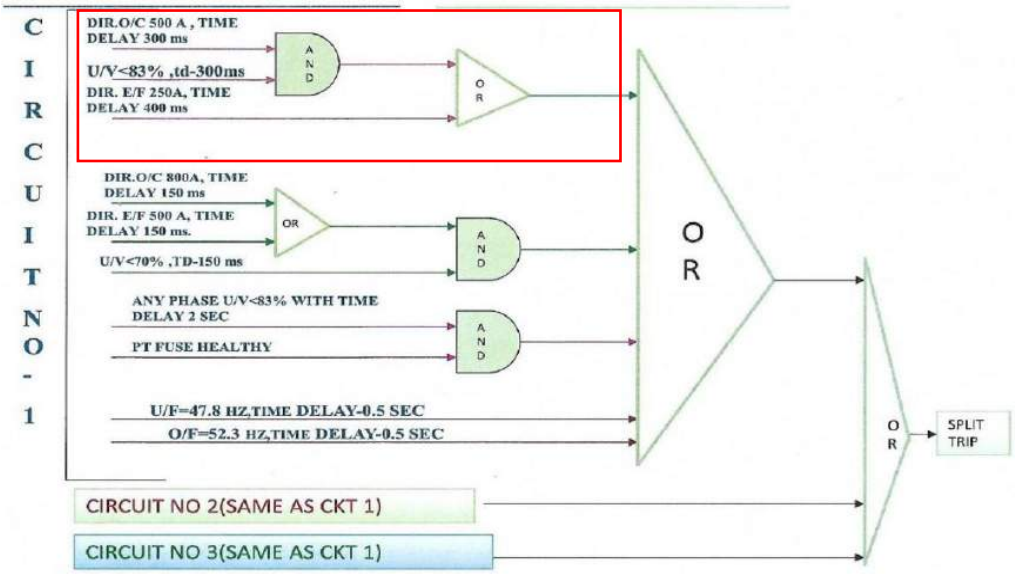
Islanding Event 1: 13:25 Hrs on 14.01.2022

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.

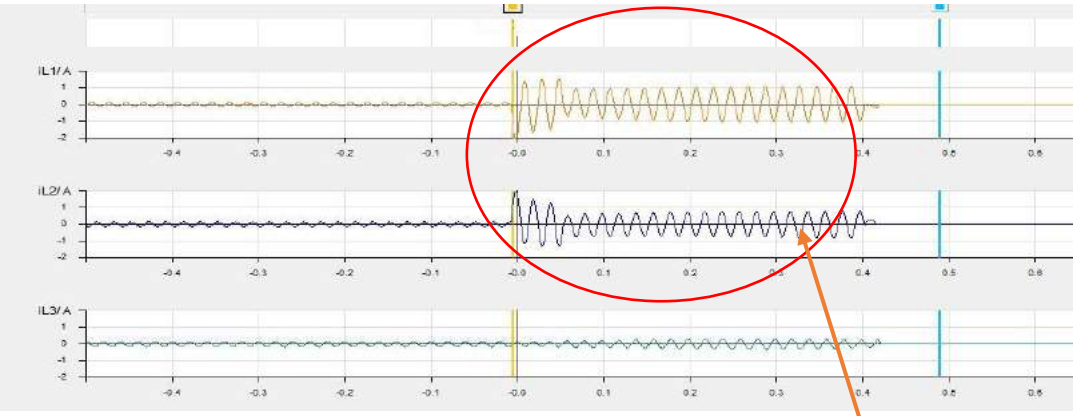


FIG: BOT3 CURRENT WAVEFORM

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

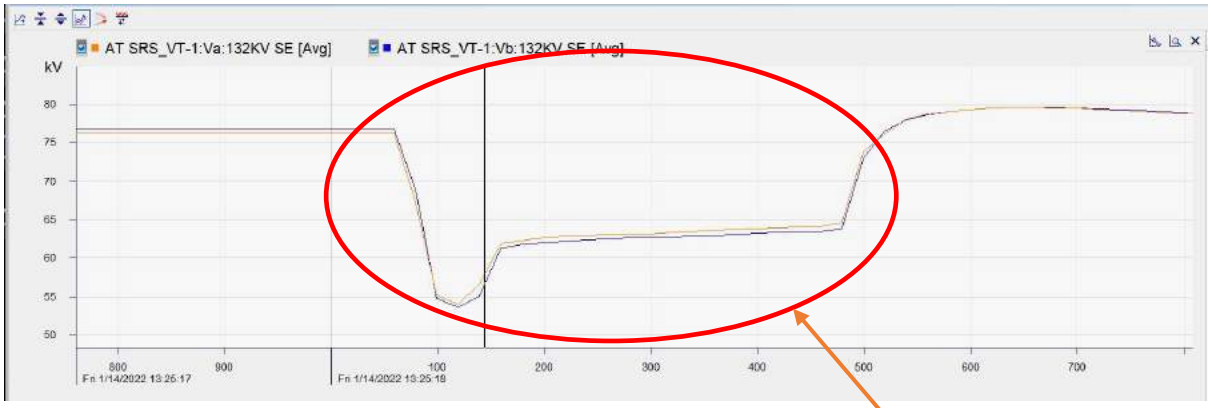
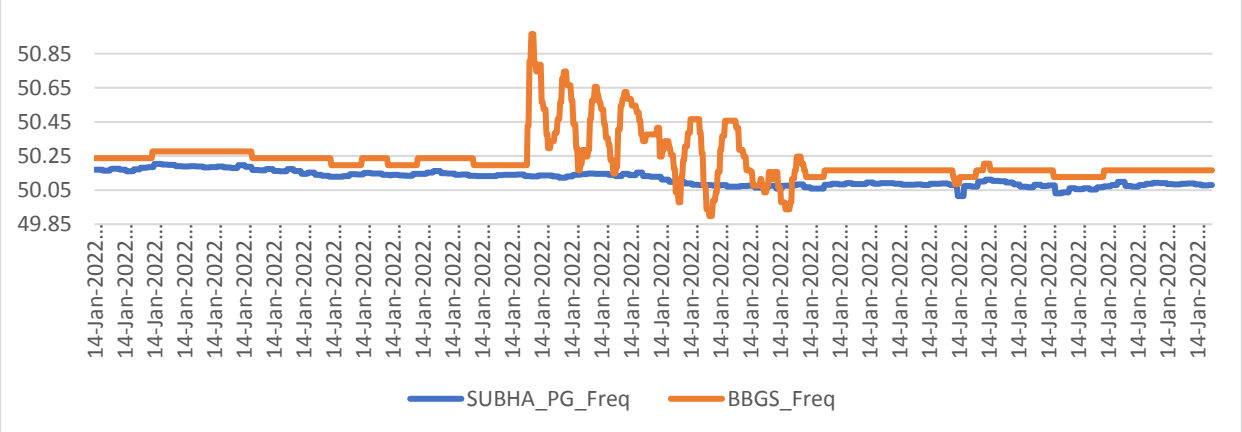


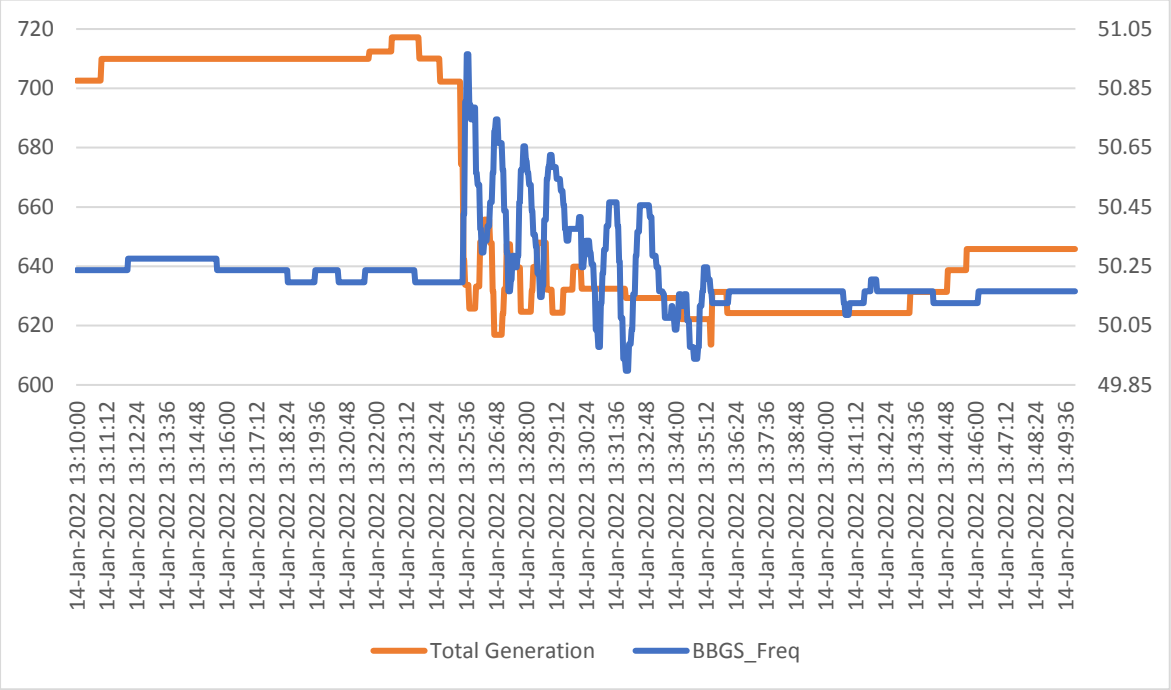
FIG: 132 kV VOLTAGE WAVEFORM

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.



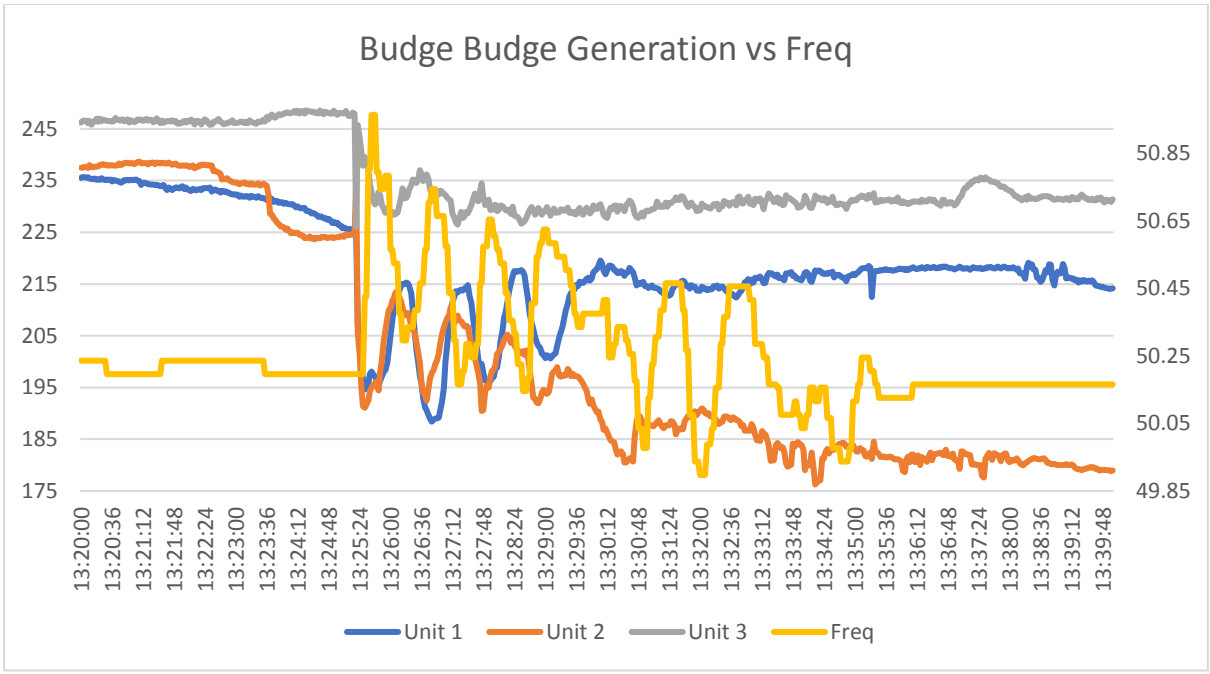
Generation Variations: Frequency variation appears to be due to variation in generation as seen from below plot.25 Mw variation observed in total generation of budge-budge periodically.



Root cause analysis for frequency variation:

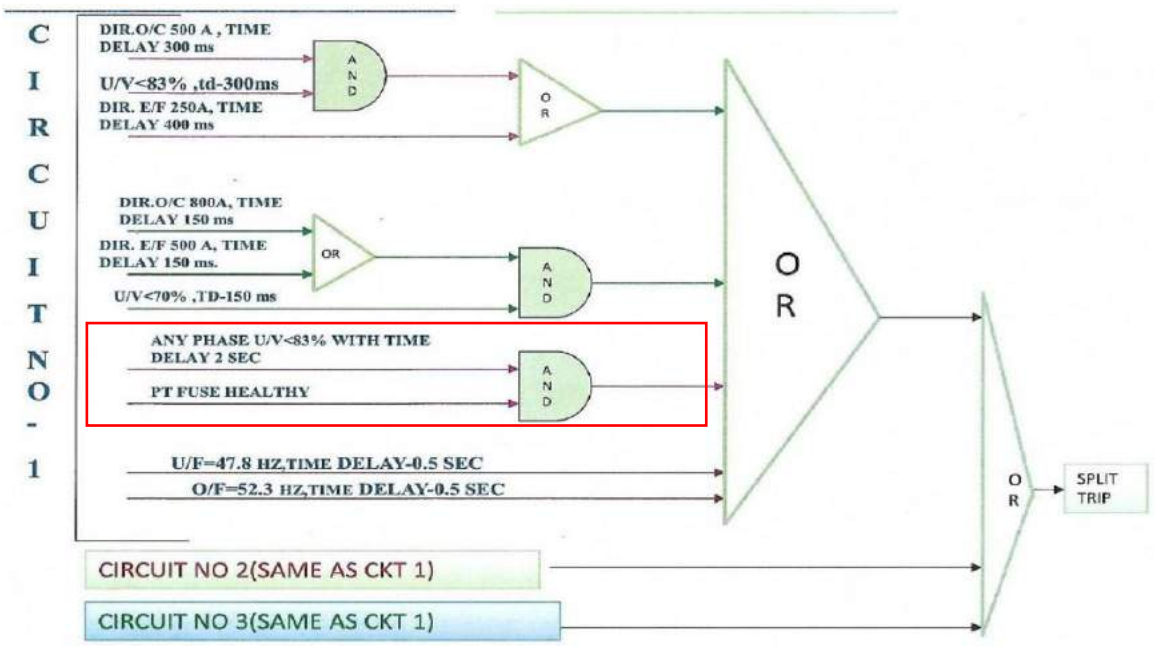
Unit Wise Variation:

- 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
1	315 MVA ICT-3 AT BIHARSHARIF	1/1/2022	16:27	1/1/2022	21:02	Master Trip relay operated		No fault	NA	OSR relay operated. Finding maybe shared by PG		Yes	NA
2	400 KV RANCHI-SIPAT-2	1/2/2022	2:24	1/2/2022	4:23	Spurious tripping		No fault	NA	Details maybe shared by PG ER-1		No	No
3	400 KV KISHANGANJ-RANGPO-1	1/3/2022	1:31	1/3/2022	6:56	Kishanganj: DT received	Rangpo: O/V	O/V	NA	O/V in Y_ph at Rangpo. DT received at Kishanganj		Yes	Yes
4	400 KV TEESTA 3-DIKCHU -1	1/4/2022	13:14	1/4/2022	16:03	Teesta 3: DT received	Dikchu: O/V St.-1	O/V	NA	O/V in Y_ph		Yes	Yes

5	400 KV PPSP-BIDHANNAGAR-1	1/4/2022	23:34	1/5/2022	0:07	PPSP: B_N, 112.5 km	Bidhannagar: B_N, 63.95 km, 4.985 kA	B-Earth	100	A/r not in service as per OEM advise		No	Yes
6	400 KV BIHARSHARIF-PUSAULI-2	1/5/2022	2:08			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
7	400 KV TEESTA 3-DIKCHU -1	1/5/2022	12:58	1/5/2022	16:41	Teesta 3: DT received	Dikchu: O/V St.-1	O/V	NA	Tripped on O/V		Yes	Yes
8	400 KV MERAMUNDALI-MENDHASAL-1	1/5/2022	13:00	1/5/2022	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
9	400 KV JEYPORE-GAZUWAKA-2	1/5/2022	13:37	1/5/2022	15:54	Jeypore: R_N, 10.2 km, 7 kA	Gazuwaka: R_N, 172.2 km, 1.48 kA	R-Earth	100	A/r was in s/d		No	NA
10	400 KV RANCHI-ROURKELA-1	1/6/2022	6:40			Ranchi: R-B, 2.25 km, Ir: 29.48 kA, Ib: 29.95 kA	Rourkela: R_B, 139.6 km, Ir: 3.613 kA, Ib: 3.085 kA	R-B	100	Phase-to-phase fault		Yes	No

11	220 KV SUBHASHGRAM-SUBHASHGRAM-2	1/10/2022	2:55	1/10/2022	4:02	Didn't trip at PG end	Tripped from WB end due to bus tripping	Y-Earth	100	Bus fault at Subhashgram (WB) in Y_ph		No	Yes
12	220 KV PATNA-KHAGAUL-1	1/10/2022	10:35	1/10/2022	11:05	Didn't trip	Khagaul: Zone-3	No fault	NA	VT failed at Khagaul. All three phase voltage became zero		NA	Yes
13	220 KV DALTONGANJ-CHATRA-1	1/11/2022	16:01	1/11/2022	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
14	400 KV ALIPURDUAR-BONGAIGAON-1	1/12/2022	5:10	1/12/2022	9:23	Alipurduar: O/V St. 1 in R_ph	Bongaigaon: DT received	No fault	NA	Voltage at Alipruduar was around 427 kV. PG may explain.		No	No
15	400 KV BINAGURI-RANGPO-1	1/12/2022	12:54	1/12/2022	13:23	Binaguri: Y_N, A/r successful	Rangpo: Y_B, Iy: 2 kA, Ib: 5 kA	Y_B	100	Binaguri saw fault in Y_ph only and A/r operated successfully. However, all three phases of tie bay		Yes	Yes

16	400 KV BINAGURI-RANGPO-2	1/12/2022	12:54	1/12/2022	13:58		Rangpo: Y_B, 64.3 km, Iy: 1.8 kAm Ib: 2.7 kA	Y_B	100	Y_ph of Tie CB didn't open at Binaguri.		Yes	Yes
17	400 KV BARH-PATNA-1	1/12/2022	14:45	1/12/2022	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
18	400 KV PATNA-BALIA-1	1/12/2022	14:45	1/12/2022	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
19	400 KV NEW PURNEA-MUZAFFARPUR-1	1/12/2022	19:53	1/12/2022	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

20	220 KV CHAIBASA-CHAIBASA (JUSNL)-1	1/13/2022	22:50	1/14/2022	23:59	Chaibasa (PG): Didn't trip	-	No fault	NA	CT SF6 operated. Loose contact in C&R panel		NA	Yes
21	220 KV MAITHON-DHANBAD-1	1/14/2022	11:55	1/14/2022	12:14	Maithon: Didn't trip	Dhanbad: B_N	B-Earth	100	DR of Dhanbad end not available. Finding maybe shared		NA	No
22	220 KV MAITHON-DHANBAD-2	1/14/2022	11:55	1/16/2022	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
23	400 KV TEESTA 3-DIKCHU -1	1/14/2022	13:01	1/14/2022	15:26	Teesta 3: DT received	Dikchu: O/V St.-1	O/V	NA	Tripped on O/V		Yes	Yes

24	400 KV JHARSUGUDA-STERLITE-2	1/14/2022	21:17	1/14/2022	22:37	Didn't trip	Sterlite: Y_N, 86.6 km, Zone-3, 3.42 kA	No fault	NA	As per PMU fault was in one of the line from Jharsuguda where A/r operated successfully. Details maybe shared.		NA	No
25	400 KV MUZAFFARPUR-GORAKHPUR-2	1/15/2022	12:00	1/15/2022	17:26	Muzaffarpur: R_Y, 125.47 km		R_Y-Earth	100	Phase-to-phase fault		Yes	NA
26	400 KV TEESTA 3-KISHANGANJ-1	1/16/2022	14:01	1/16/2022	15:58	Teesta 3: O/V St.1	Kishanganj: DT received	O/V	NA	Tripped on O/V		Yes	No
27	400 KV TEESTA 3-DIKCHU-1	1/16/2022	14:01	1/16/2022	17:49	Teesta 3: DT received	Dikchu: O/V St.-1	O/V	NA	Tripped on O/V		Yes	No
28	400 KV BIHARSHARIF-VARANASI-2	1/17/2022	15:54	1/17/2022	18:15	Biharsharif: R_Y, 50.75 km, Ir: 8.78 kA, Iy: 8.68 kA		R_Y	100	Phase-to-phase fault		Yes	NA
29	220 KV CHANDIL-SANTALDIH (STPS)-1	1/18/2022	5:22	1/18/2022	5:44	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
30	400 KV BIHARSHARIF-VARANASI-2	1/18/2022	5:28	1/18/2022	7:30	Biharsharif: R_N, Zone-1, 126.3 km, 3.14 kA		R-Earth	100	Phase-to-phase fault		Yes	NA

31	220 KV CHAIBASA-CHAIBASA (JUSNL)-1	1/19/2022	5:30	1/19/2022	7:34	Didn't trip	-	No fault	NA	CT SF6 operated. Loose contact in C&R panel		NA	Yes
32	220 KV CHANDIL-SANTALDIH (STPS)-1	1/21/2022	5:21	1/21/2022	5:45	Chandil: B_N, 88.2 km	Santaldih: B_N, 19.5 km, 4.24 kA	B-Earth	100	A/r not in service. Three phase tripping for single phase fault.		Yes	Yes
33	400 KV DURGAPUR-SAGARDIGHI-1	1/24/2022	10:49	1/24/2022	21:56	Durgapur: Y_N, 95 km, 3.35 kA, SOTF	Line was out of service under voltage regulation	Y-Earth	100	SOTF at Durgapur, DT sent to remote end		Yes	NA
34	400 KV DARBHANGA - KISHANGANJ-2	1/25/2022	18:48	1/25/2022	20:02		DT received at Kishanganj	No fault	NA	B_ph voltage was available at Kishanganj. It seems B_ph breaker remained closed at Darbhanga. Details maybe shared.		No	Yes
35	220 KV CHUKHA-BIRPARA-1	1/26/2022	14:09	1/26/2022	14:52	Birpara: Y_B, 43.512 km, 5.38 kA	Chukha: Y_B, 25.52 km, 4.05 kA	Y_B	100	Phase-to-phase fault		NA	Yes
36	400 KV KHARAGPUR-KOLAGHAT-1	1/28/2022	16:50	1/28/2022	17:14	Kharagpur: DT received	Kolaghat: Didn't trip	No fault	NA	No fault observed in PMU. Details maybe shared.		NA	No

37	220 KV CHAIBASA-CHAIBASA (JUSNL)-1	1/29/2022	7:55	1/29/2022	9:35			No fault	NA	CT SF6 operated. Loose contact in C&R panel		NA	No
38	220 KV CHAIBASA-CHAIBASA (JUSNL)-1	1/30/2022	6:10	1/30/2022	10:44	Chaibasa (PG): Didn't trip		No fault	NA	CT SF6 operated. Loose contact in C&R panel		NA	No
39	220 KV NEW PURNEA-MADHEPURA-2	1/30/2022	20:38	1/30/2022	21:38		UFR relay operated	No fault	NA	UFR relay operated at Madhepura. To be reviewed immediately.		NA	Yes
40	220 KV BARIPADA-BALASORE-2	1/31/2022	10:36	1/31/2022	11:29	Baripada: DT received	Balasore: Didn't trip	No fault	NA	No fault observed in PMU. Details maybe shared.		No	NA

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.	
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.	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.
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 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.	
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.	
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.	

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 C.7

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 Rangpo-Teesta V-D/c	11.6			
400 kV Teesta-III- Dikchu	15.1			
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	9			
220 kV Rourkela-Tarkera D/c	15.3			
Odisha				
Name of the element	Length (km)			
400 kV Indravati-Indravati (Gridco)	3.7			
400 kV Meramundali GMR T/c	8			
400 kV New Duburi-TSL D/c	8.65			
220 kV Chandka-Chandka B	1			
220 kV Rengali-Rengali D/c	1			
220 kV Balimela-Balimela T	1.38			
220 kV Meramundali-BSL D/c	2.4			
220 kV Bolangir-New Bolangir D/c	2.8			
220 kV Tarkera-RSP D/c	4.07			
220 kV Sterlite-Vedanta D/c	4.15			
220 kV New Duburi-Jindal Steel D/c	4.8			
220 kV Rengali-Rengali PH D/c	5			
220 kV Mendhasal-Infocity	5.5			
220 kV Katapalli-Hindalco D/c	5.5			Line differential protection scheme was implemented in 220 kV Katapalli-Hindalco circuit-1 on 31/12/2021.
220 kV Jaynagar-Upper Kolab D/c	6			
220 kV Mendhasal-Chandaka D/c	7			
220 kV Keonjhar-Keonjhar D/c	7.48			
220 kV Jeypore-Jaynagar D/c	7.7			
220 kV New Duburi-TSL D/c	8.65			
220 kV Jeypore-Jaynagar D/c	8.8			

220 kV Tarkera-RSP D/c	10.2			
220 kV Bidansi-Cuttack D/c	10.42			
220 kV Jaypatna-Indravati	11.13			
220 kV Meramundali-TTPS D/c	11.2			
220 kV Meramundali-NALCO D/c	11.5			
220 kV Joda-Jindal	14.6			
220 kV Mendhasal-Atri	15			
220 kV TSTPP-Rengali PH	16.78			
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			
220 kV Domjur-New Chanditala D/c	**8.6**	Distance	Distance	Differential will be installed.
220 kV New Cossipore-Princep Street	8.8			
220 kV NewTown-CLC Bantala	13			
220 kV Sagardighi-New Sagardighi D/c	14.38			
220 kV Subhashgram-CLC Bantala	15			
220 kV Domjur-Foundry Park D/c	15			
220 kV New Cossipore-Eastern Metropolitan	16.2			
220 kV Jeerat-Dharampur D/c	17			
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			Communication had been given to DMTCL and OEM for implementing line differential protection scheme in 220 kV Darbhanga-Darbhanga (DMTCL) D/c
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			

220 kV Barauni (BTPS)-Begusarai D/c	15			
220 kV Muzaffarpur-MTPS D/c	**24**	Distance	Distance	
220 kV Gaya-Chandauti D/c	**17.73**			To be LILOED at BodhGaya
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-Hatia	6	Distance	Distance	
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			
220 kV Rangpo-Rongnichu D/c	7.26			