



सत्यमेव जयते



भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
पूर्वी क्षेत्रीय विद्युत समिति

Eastern Regional Power Committee

14, गोल्फ क्लब रोड, टॉलीगंज, कोलकाता-700033
14 Golf Club Road, Tollygunj, Kolkata-700033

स./NO. पू.क्षे.वि.स./PROTECTION/2024/ 313

दिनांक /DATE:16/05/2024

सेवा में / To,

संलग्न सूची के अनुसार / As per list enclosed.

विषय : दिनांक – 16.04.2024 को आयोजित 134 वीं पीसीसी बैठक का कार्यवृत्त ।

Sub: Minutes of the 134th PCC meeting held on 16.04.2024

महोदय/ Sir,

16.04.2024 को आयोजित 134वीं पीसीसी बैठक का कार्यवृत्त पू.क्षे.वि.स. की वेबसाइट (<http://www.erpc.gov.in/>) पर उपलब्ध है। कृपया देखें।

Please find the minutes of the 134th PCC meeting of ERPC held on 16.04.2024 available at ERPC website (<http://www.erpc.gov.in/>).

यदि कोई अवलोकन हो, तो कृपया इस कार्यालय को यथाशीघ्र भेजा जाए।

Observations, if any, may please be forwarded to this office at the earliest.

यह सदस्य सचिव, पू. क्षे. वि. स. के अनुमोदन से जारी किया जाता है।

This issues with approval of Member Secretary, ERPC.

भवदीय / Yours faithfully,

P.P. Jena
16.05.24

(पी. पी. जेना / P.P.Jena)

कार्यपालक अभियंता(पी.एस)

Executive Engineer (PS)

LIST OF ADDRESSES:

Chief Engineer, Trans (O&M) Bihar State Power Transmission Limited, Vidyut Bhawan, Bailey Road, Patna-800021	Chief Engineer (CRITL) Bihar State Power Transmission Limited, Vidyut Bhawan, Bailey, Road, Patna-800021
Chief Engineer(System Operation), SLDC , BSPTCL, Patna-800021	
Chief Engineer (SLDC) Damodar Valley Corporation, GOMD-I Premises, P.O.- DaneshSeikh Lane, Howrah- 711109	Chief Engineer (CTC) Damodar Valley Corporation, P.O. Maithon Dam, Dist. Dhanbad,Jharkhand-828207
Chief Engineer, (CRITL) Jharkhand Urja Sancharan Nigam Limited Kusai Colony, Doranda, Ranchi-834002	Chief Engineer (CLD) Jharkhand UrjaSancharan Nigam Limited, Kusai Colony,Doranda, Ranchi-834002
Chief General Manager (O&M), OPTCL, Janpath, Bhubaneswar, Odisha – 751 022. FAX: 0674-2542932 cgm.onm@optcl.co.in	Sr. General Manager (PPA), Technical Wing, OHPCL, Orissa State Police Housing & Welfare Corp. Bldg. VaniviharChowk, Janpath, Bhubaneswar-752022
Chief Load Dispatcher, SLDC OPTCL, P.O. Mancheswar Rly. Colony Bhubaneswar-751017	Chief Engineer (Testing), WBSETCL Central Testing Laboratory, Abhikshan, Salt Lake, Kolkata-700091 (Fax no. 2367-3578/1235)
Chief Engineer (CLD) WBSETCL, P.O.Danesh Sheikh Lane, AndulRoad, Howrah-711109	Addl. Chief Engineer (ALDC) West Bengal Electricity Distribution Company Ltd VidyutBhavan, 7 th Floor, Bidhannagar, Sector-I Salt Lake City, Kolkata-700091(Fax-033-2334-5862)
Dy. Chief Engineer (Testing)/ Sr. Manager (Testing) CESC Ltd.,4, SasiSekhar Bose Road, Kolkata-700025	General Manager (O&M) KhSTPS, NTPC Ltd., P.O. Deepti Nagar, Dist. Bhagalpur, Bihar-813203
General Manager(O&M) FSTPS, NTPC Ltd., P.O. Nabarun, Dist. Murshidabad, West Bengal-742236	Dy. General Manager (Engineering), WBPDC, OS Dept. Corporate Office, 3/C, L.A Block, Salt Lake-III, Kolkata-700098 (Fax-033-23350516)
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General Manager(O&M), TSTPS, NTPC Ltd., P.O.Kaniha, Dist. Angul, Orissa-759117	General Manager (AM), POWERGRID, Odisha Projects, Sahid Nagar, Bhubaneswar – 751 007
General Manager (OS), ERHQ-I, NTPC Ltd., LoknayakJaiprakashBhawan, (2 nd Floor), DakBunglowChawk, Patna-800001	Manager (Electrical), Adhunik Power & Natural Resources Ltd. “Lansdowne Towers, Kolkata-700020 (Fax No. 033-2289 0285)
Executive Director (O&M) NHPC Ltd., NHPC Office Complex, Sector-33, Faridabad, Haryana-121003 (Fax-01292272413)	Electrical Superintending Engineer, TTPS, TenughatVidyut Nigam Ltd.,Lalpania, Dist. Bokaro, Jharkhand-829149
Dy. General Manager (Electrical) IB Thermal Power Station, OPGCL Banhapalli, Dist. Jharsuguda-768234, Orissa	General Manager (AM), ER-I Power Grid Corporation of India Ltd., Alankar Place, Boring Road, Patna-800001
Chief Engineer (Trans.) Power Deptt., Govt. of Sikkim, Gangtok-731010	Sr. Manager (CTMC) Durgapur Projects Limited,Durgapur-713201
Executive Director, ERLDC, POSOCO, Tollygunge, Kolkata-700033	Head –Regulatory and contracts, IndiGrid Limited , 247 Embassy, Office No 107, ‘B’ Wing, Hindustan Co. Bus Stop, Gandhi Nagar, L.B.S. Road, Vikhroli West, Mumbai – 400 079. Ph : +91 845509 96408
General Manager (AM), ER-II Power Grid Corporation of India Ltd., J-I-15, Block-EP, Sector-V,Salt Lake,Kolkata-91	The Plant Head, Maithon Power Limited, Maithon Office, MA 5 Gogna, Dist. Dhanbad, Jhankand State, PIN-828207
General Manager (P&O), PTC Ltd., Kanchanjunga Bldg.,18, Barakhamba Road,	

New Delhi-110001	
Managing Director, Bhutan Power Corporation Post Box no. 580, Thimpu, Bhutan.	Managing Director, Druk Green Power Corprn. P.O. Box-1351, Thimpu, Bhutan.
Associate Director (Commercial and Regulatory) Darbhanga-Motihari Transmission Company Limited (DMTCL),503,Windsor, Off CST Road, Kalina, Santacruz(E), Mumbai-400098	The Plant Head, JITPL. (FAX:011-26139256-65)
General Manager, Sikkim Urja Limited, New Delhi (FAX:011-46529744)	President , TPTEL, Bhikaji Cama Place, New Delhi , 110066
Director (NPC), CEA, NRPC Building, KatwariaSarai, New Delhi- 110016	President, Dans Energy Pvt. Ltd, 5th Floor, DLF Building No. 8, Tower-C, Gurgaon - 722002
Director, Shiga Energy Pw. Ltd., 5th Floor, DLF Building No. 8, Tower-C, Gurgaon - 722002	DGM (E&I), HALDIA ENERGY LIMITED, BARIK BHAWAN, KOKATA-700072, FAX: 033-22360955
The Plant Head, Dikchu HEP, Sikkim	



Minutes
of
134th PCC Meeting

Date: 16.05.2024
Eastern Regional Power Committee
14, Golf Club Road, Tollygunge
Kolkata: 700 033

EASTERN REGIONAL POWER COMMITTEE

MINUTES OF 134th PROTECTION COORDINATION SUB-COMMITTEE MEETING HELD ON 16TH APRIL 2024 AT 11:00 HRS AT ERPC, KOLKATA

Member Secretary Chaired the Meeting. List of Participants is attached at **Annexure A**. ERLDC representative highlighted the protection performance of the ER utilities for the month of March 2024 which is enclosed at **Annexure A.1**.

PART – A

ITEM NO. A.1: Confirmation of Minutes of 133rd Protection Coordination sub-Committee Meeting held on 12th March 2024 through MS Teams.

The minutes of 133rd Protection Coordination sub-Committee meeting held on 12.03.2024 was circulated vide letter dated 28.03.2024.

Members may confirm the Minutes of the Meeting.

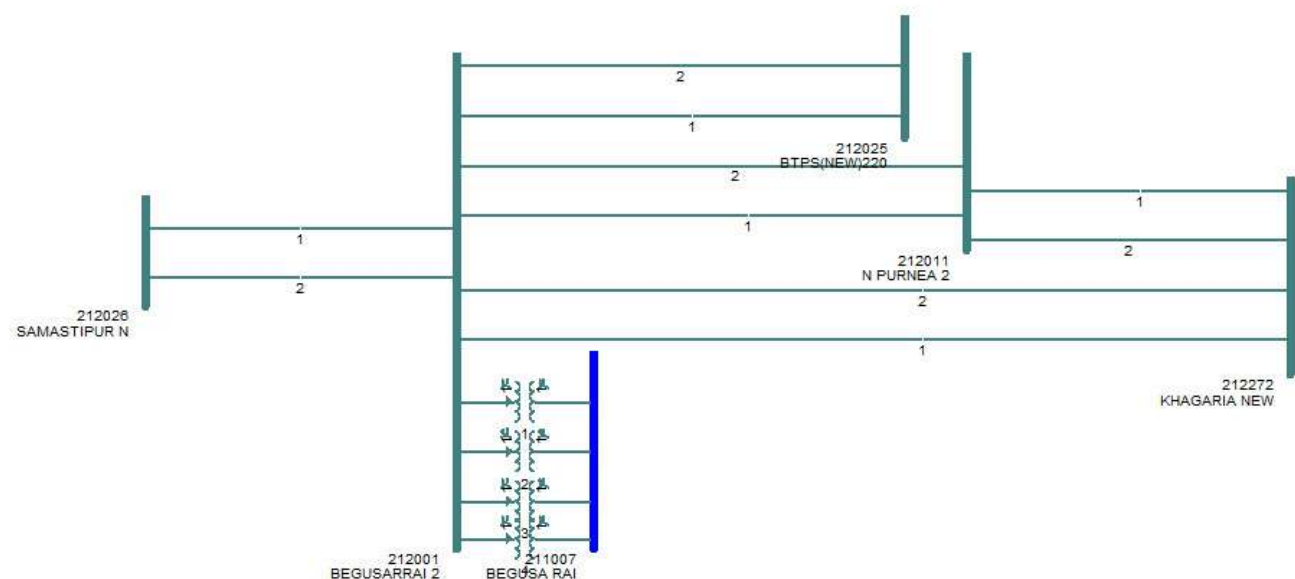
Deliberation in the meeting

Members confirmed the minutes of 133rd PCC Meeting.

PART – B

ITEM NO. B.1: Total Power Failure at 220 kV Begusarai(BSPTCL) S/s on 05.03.2024 at 11:56 Hrs

At 11:56 hrs, a fault(Y-B-N) occurred in 220 kV Begusarai-IOCL-1, which was kept idle charged from Begusarai end. The distance protection operated at Begusarai end but the breaker didn't open. Since LBB and bus bar protection is not available for 220 kV Begusarai S/s, other feeders got tripped from remote ends resulting in total power failure at Begusarai S/s.



Disturbance Report from ERLDC is attached at **Annexure B.1.**

Load Loss: 100 MW

Outage Duration: 00:29 Hrs

BSPTCL may explain.

Deliberation in the meeting

ERLDC representative briefed the event.

- *On 05.03.2024, 220 kV Begusarai-IOCL-1 was kept idle charged from Begusarai end. At 11:56 hrs, a Y_B_N fault developed in 220 kV Begusarai-IOCL-1 at 10 km from Begusarai end. Relay at Begusarai sensed the fault in Zone-1 and issued trip command however the breaker failed to open and the fault persisted.*
- *Since Bus bar protection and LBB protection is not available at Begusarai end, fault was cleared by tripping of the connected feeders from remote ends.*
- *220 kV Begusarai-Saharsa D/c tripped from Saharsa end after 800 msec in Zone-3 and 220 kV Begusarai-BTPS(Barauni) D/c tripped from Barauni after 1.5 seconds in Zone-3. After opening of 220 kV Begusarai-BTPS(Barauni) D/C line, total power failure occurred at Begusarai as other lines, i.e. 220 kV Begusarai-Khagaria D/c, 220 kV BegusaraiSamastipur D/c and 220 kV Begusarai-IOCL-2 were kept idle charged from Begusarai end.*

BSPTCL representative informed that on day of incident, weather was rainy and windy. He stated that a bamboo tree came in range of the 220 kV Begusarai-IOCL circuit-1 at approx.10km from Begusarai end which resulted in development of fault. Subsequently relay operated correctly on Z1 and gave output command to the Circuit Breaker, but the B-pole of the circuit breaker (make-CGL) failed to open due to leakage issue.

He informed that due to communication gap between execution agency (M/s ABN Tower) and CGL, execution agency charged the line even though leakage issue was present in the B-pole. He added that breaker is in warranty period and the executing agency has been asked to investigate the issue.

PCC observed that lack of coordination among BSPTCL, executing agency and the vendor had resulted the disturbance and there was no SOP available for charging of the line. PCC took serious note of the above and advised BSPTCL to devise and follow an SOP for charging of the line so that similar incidents shall not be repeated in future.

On non-availability of busbar protection, BSPTCL updated that the proposal for busbar protection has already been approved and the work will be started tentatively in the month of June-24.

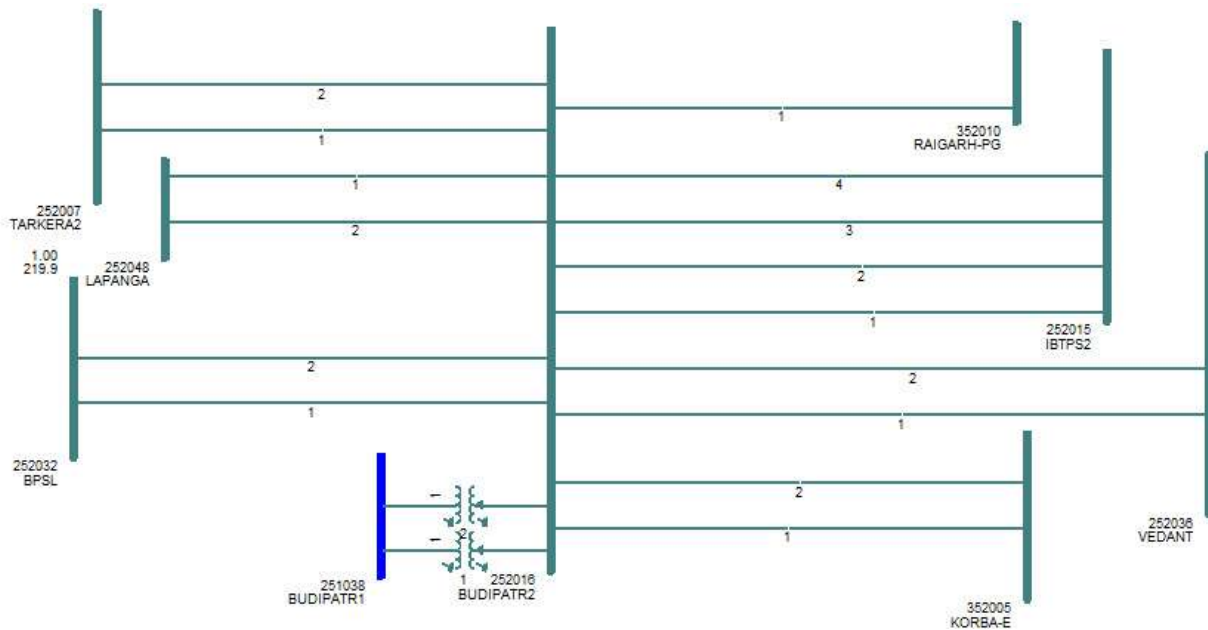
For delayed tripping of 220 kV Begusarai-BTPS(Barauni) D/c in 1.5 ms in zone 3 from Barauni end, BSPTCL representative replied that as per communication received from Barauni end, timer settings of zone 3 had been revised to 1 second.

BSPTCL was advised to follow ERPC Guidelines for protection settings of idle-charged line.

ITEM NO. B.2: Disturbance at 220 kV Budhipadar (OPTCL) S/s on 09.03.2024 at 14:07 Hrs

On 9th March 2024, at 13:45 Hrs, 220 kV Budhipadar-Lapanga-2 got tripped due to B phase-Earth fault. Subsequently at 14:00 hrs, Budhipadar-Lapanga-1 was hand tripped as the loading of the line had reached 350 MW. Thus, entire Budhipadar complex generation with IBTPS and Vedanta, SMC, Bhushan Steel, AAL, Concast CPPs had started evacuating through remaining

interconnection with grid through 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba D/C line, which got tripped further one by one due to high loading and subsequently at 14:07 Hrs, this complex was isolated from the grid and formed an island which didn't survive due to large load generation imbalance.



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

Load Loss: 100 MW, Gen. Loss: 620 MW

Outage Duration: 00:45 Hrs

OPTCL & SLDC Odisha may explain.

Deliberation in the meeting

The presentation by OPTCL on the above disturbance is attached at **Annexure B.2.1**.

The disturbance was explained as below:

- Prior to the incident 220 kV Budhipadar-Kuarmunda, 220 kV Budhipadar-Bamra, 132 kV Budhipadar-Kalunga, 132 kV Bamra-Rajgangpur were under shutdown and remaining feeders were in live conditions.
- At 13:45 Hrs, a B phase fault developed in 220 kV Budhipadar-Lapanga-2 line due to snapping of conductor between gantry and first tower at Lapanga end. Thereafter, due to increased loading of 220 kV Budhipadar-Lapanga-1 line to around 350 MW, line was hand tripped from Budhipadar end at 14:00 Hrs. Subsequently cascaded tripping occurred for other feeders at 220 kV Budhipada S/s and there was total power failure.
- All running units of IBTPS tripped on over frequency due to loss of evacuation path.
- Among the CPPs, Vedanta and Bhusan got islanded but did not survive however 220 kV Aditya Alumina islanded successfully.

On enquiry on permission received from SLDC Odisha regarding hand tripping done for Lapanga-1, OPTCL representative replied that no instruction was received from SLDC, and it was done by operator at site to avoid overloading of line.

After deliberation, PCC observed that n-1 criteria was not fulfilled in case of the multiple shutdown from Budhipadar and therefore SLDC Odisha should have done proper system study before allowing the shutdown and should have devised SOP for contingency cases.

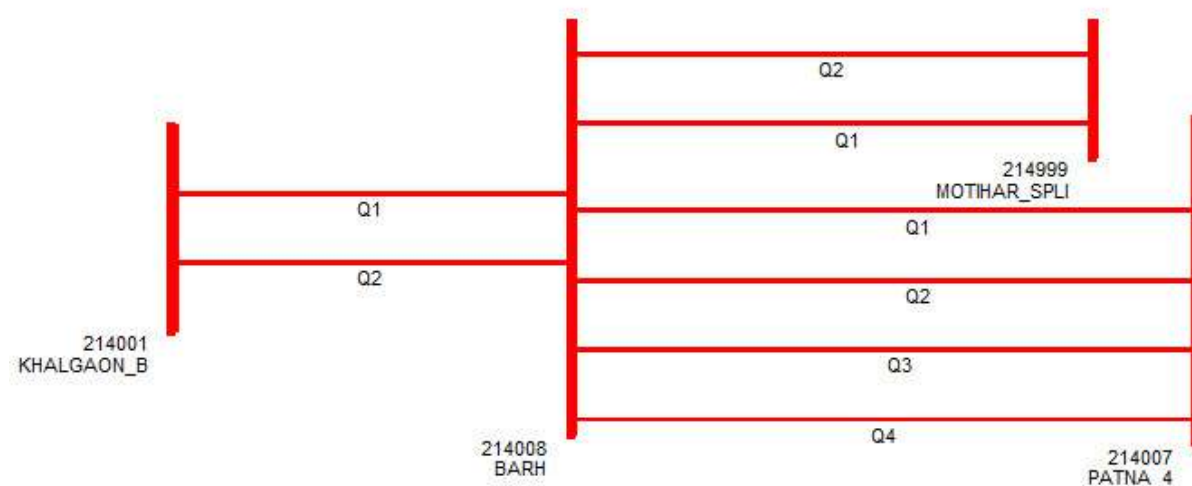
SLDC Odisha representative replied that shutdown was asked in emergency from Powergrid and therefore they did not get sufficient time for the study. However they informed that OPGC was communicated in real-time for generation backdown after the disturbance. OPGC representative submitted that no such information was received from SLDC Odisha for generation backdown.

PCC observed that there was communication gap between SLDC Odisha and OPGC/OPTCL. The generation backdown instruction was not received to OPGC as well as the line(Lapanga-1) was opened at Budhipadar end without any instructions from SLDC Odisha. PCC advised SLDC Odisha to investigate the matter in detail so that similar incidents shall not occur in future. Further SLDC was advised to draft SOP for planned line shutdown at Budhipadar S/s.

ITEM NO. B.3: Disturbance at 400 kV Barh (NTPC) S/s on 31.03.2024 at 07:29 Hrs

As per the information received, B phase CT of main bay of Barh-Patna-2 got burst at Barh end and at that time 400 kV Bus-3 & Bus-4 and all associated elements tripped including Unit 4 & Unit 5 (660 MW each).

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



Gen. Loss: 1251 MW
Outage Duration: 02:19 Hrs

NTPC Barh may explain the event in detail.

Deliberation in the meeting

The disturbance analysis report received from NTPC Barh is enclosed at **Annexure B.3.1**.

- It was informed that due to bursting of B phase CT of main Bay of 400 kV Barh-Patna-2, bus bar protection operated for bus-4 at Barh end and operation of Teed protection of the bay. Subsequently, all breakers connected to 400 kV Bus-4 got tripped.
- Secondary impact of CT burst of 400 kV Barh-Patna-2 resulted in failure of adjacent R phase CT of 400 kV Barh-Patna 1 main bay which resulted in tripping of bus-3.

- *Regarding tripping of units, Barh representative informed that stage-2 having units # 4&5 got tripped on class-A protection, Generator Relay Protection operated on 'Bus Bar trip to GRP operation' and turbine overspeed was also observed in both the units.*
- *Regarding issues associated with CT and remedial measures, NTPC representative informed that CT was dead tank type Areva make of manufacturing year 2007 and first time burst of CT was observed in 2012 during which 4 CTs got damaged in total (actual and bursting caused due to secondary effect) and afterwards 4 CTs had tripped in this incident in total. He informed that extent of damage occurred in the CT prohibited any further investigation. However, recommendations and corrective measures ensued after the incident which are highlighted as below.*
 - *All AREVA make CTs are undergoing oil sampling for DGA purpose.*
 - *To avoid the extent of secondary damages, procurement of around 60 no's of polymer insulator housing CTs (Line/Dead Tank) is in process for which response had been received from M/s GE T&D, M/s CG Power & Industrial Solutions*
 - *Frequency of CT oil DGA had been increased.*
 - *OEM had been contacted for further assistance regarding future planning of the installed CTs.*
 - *To ensure correct operation of relays and EHV equipment, annual testing and laid down guidelines to be followed.*

ERLDC enquired about receipt of DT at Patna end to which Powergrid representative replied that DT was received only once at delay of 350 ms. ERLDC requested NTPC Barh to analyze discrepancy regarding carrier communication to Barh.

On tripping of 400 kV Barh-Kahalgaon-2 from Kahalgaon end, NTPC Kahalgaon representative replied that details will be confirmed from site and will be shared to ERPC/ERLDC.

ITEM NO. B.4: Multiple disturbances at 220 kV Garhwa (JUSNL)S/s

- **On 30.03.2024 at 22:27 Hrs**

On 30.03.2024, at 22:27 hrs , 220 kV Daltongunj - Garhwa (New) D/C tripped due to single Phase to ground fault leading to total power failure at 220 kV Garhwa S/s.

Disturbance Report is attached at **Annexure B.4.1.**

Load Loss: 80 MW

Outage Duration: 01:08 Hrs

- **Disturbance at 220 kV Garhwa (JUSNL)S/s on 31.03.2024 at 07:29 Hrs**

220 kV Daltonganj-Garhwa (New)-2 was already under breakdown prior to the event. 220 kV Daltonganj-Garhwa(New)-1 got tripped due to B phase fault which led to total power failure at 220 kV Garhwa(New) S/s.

Disturbance report is attached at **Annexure B.4.2.**

Load Loss: 30 MW

Outage Duration: 00:07 Hrs

JUSNL may explain.

Deliberation in the meeting

- **On 30.03.2024 at 22:27 Hrs**

JUSNL representative informed that on 30th March 2024 and on 31st March 2024, heavy thunderstorm was reported in the area. On 30th March 2024, at 22:27 hrs, 220 kV Daltonganj-Garhwa-2 tripped due to B phase fault. During the incident, A/r was successful from both ends. However, the line tripped after 600 ms and three phases opened at both ends.

After 40 seconds, 220 kV Daltonganj-Garhwa-1 tripped from Daltonganj end due to B phase fault. A/R was successful from Daltonganj end, however, line tripped again within reclaim time after 7 seconds resulting in total power failure.

- **on 31.03.2024 at 07:29 Hrs**

It was informed that fault occurred due to tower collapse of 220 kV Daltonganj-Garwah line.

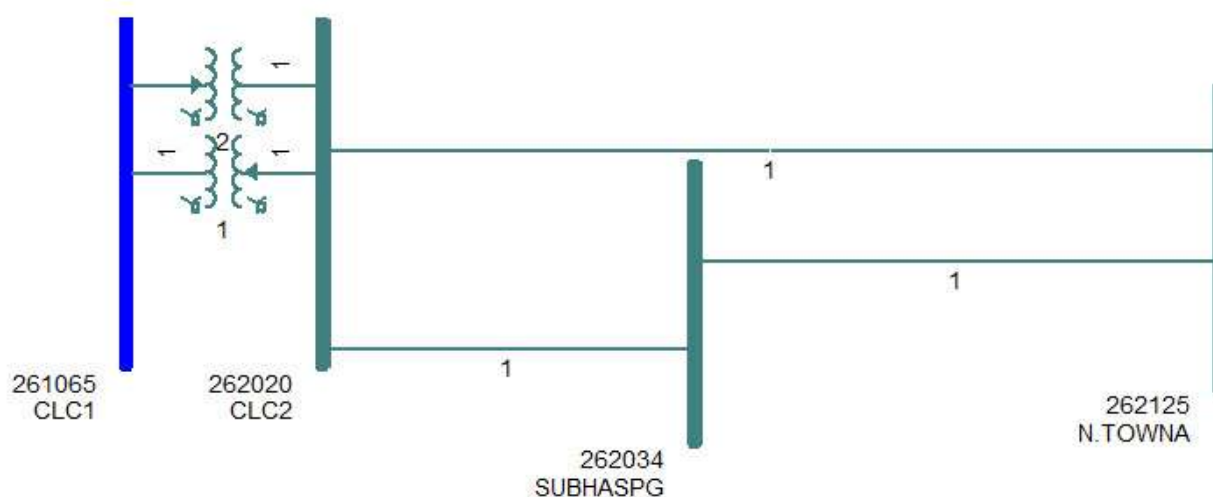
JUSNL representative replied that on 30th March 2024, tower at loc. 198 got partially damaged and on 31.03.2024, this tower got completely collapsed along with 5 other towers.

PCC advised JUSNL to analyze the reason for failure of towers for this line and the report shall be sent to PSETD division of CEA for further analysis and recommendation.

On enquiry from PCC regarding status of restoration, JUSNL representative replied that restoration will be completed by first week of May 2024.

ITEM NO. B.5: Total Power Failure at 220 kV Bantala S/s on 31.03.2024 at 21:49 Hrs

Y Phase CT of 220 kV New Town AA3- Bantala line got burst at Bantala end leading to tripping of the said line. At the same time 220 kV Subhasgram- Bantala also got tripped from Subhasgram end with Y phase fault leading to total power failure at 220 kV Bantala S/s.



Detailed report from ERLDC is attached at **Annexure B.5.**

Load Loss: 78 MW

Outage Duration: 00:11 Hrs

WBSETCL & Powergrid may explain.

Deliberation in the meeting

The event was explained by ERLDC as below:

Disturbance occurred due to bursting of Y phase CT of 220 kV NewTown AA III-Bantala at Bantala end. The fault was seen in Zone-1 from Bantala end and breaker got opened within 100 msec and line tripped in Zone-2 time (350 msec) from NewTown AA III due to non-receipt of carrier signal. During this fault, Zone-4 distance protection got picked for 220 kV Subhashgram-Bantala at Bantala end and Zone-2 protection got picked at Subhashgram. When 220 kV Bantala-NewTown AA III got tripped from Bantala end, Subhashgram was still feeding around 500 A in all three phases suggesting some evolving fault at Bantala bus.

After 500 msec, autorecloser attempt was taken by the relay at Bantala for 220 kV NewTown AA-III -Bantala line, which got failed due to permanent nature of fault. During this event, 220 kV Subhashgram-Bantala tripped in Zone-1 from Subhashgram end as it remained the only source radially feeding Bantala. Three phases tripping occurred in this line as carrier channel was unhealthy and total power failure occurred at Bantala S/s.

WBSETCL representative informed that due to faulty SDH panel at New Town end, the carrier was not received to New Town end during the disturbance.

On busbar protection, they submitted that as the KLC substation is in the vicinity of tannery, severe chemical contamination is a common phenomenon which causes frequent failure of numerical relays, puncture of Terminal blocks etc.

PCC suggested that WBSETCL may explore implementing some preventative methods to avoid chemical contamination of the relays in consultation with experts/ OEM.

Regarding non time synchronisation of DR /EL at Bantala /Newtown end, WBSETCL representative replied that GPS is not working at these s/s for which agency had been communicated and the issue will be resolved soon.

ITEM NO. B.6: Bus tripping occurred in Eastern Region during March'24

Element Name	Tripping Date	Reason	Utility
220 kV Bus-2 at Laukahi	17.03.24 at 18:30 Hrs	Bus bar protection operated	BSPTCL

BSPTCL may explain.

Deliberation in the meeting

*BSPTCL representative explained the event with help of report which is attached at **Annexure B.6**. He informed that due to CT burst of Y-Phase of 220 kV DMTCL-Laukahi (BSPTCL)-2 at Laukahi end, a bus fault developed.*

220 kV DMTCL-Laukahi (BSPTCL) -2 tripped on zone-1 protection. For 220 kV DMTCL-Laukahi (BSPTCL) -1, relay at Laukahi end sensed the fault in zone 4 but tripping occurred in 160 ms, though the time delay for zone 4 was set at 500 ms.

For 220 kV Madhepura-Laukahi D/C, relay at remote end sensed the fault in zone 2 and got tripped. ICTs had tripped in overcurrent earth fault protection.

PCC advised BSPTCL representative to share last test report of failed CT to ERPC/ERLDC.

ERLDC representative informed that as per report received from BSPTCL, it is observed that all elements were kept on bus 1 and there is no loading on bus 2.

PCC advised BSPTCL following:

- *To review Protection settings of ICT*
- *To test the relay of Laukahi-DMTCL line-1*
- *To test the bus bar protection and submit details by 23rd April 2024.*
- *To segregate feeders on both bus in balanced way so that in case of one bus tripping, feeders on other bus can remain in charged condition.*

ITEM NO. B.7: Single Line Tripping Incidences in month of March 2024

Single line tripping incidents in the month of March 2024 which needs explanation from constituents of either end is attached.

Members may discuss.

Deliberation in the meeting

*Explanation from constituents of either end for single line tripping incidents in the month of March 2024 is attached at **Annexure B.7.***

PART- C: OTHER ITEMS

ITEM NO. C.1: Protection Philosophy of Eastern Region

In 129th PCC Meeting, ERPC Secretariat pointed out the relevant clauses of IEGC 2023 regarding Protection code which will be in force w.e.f. 01.10.2023. He intimated that the existing protection philosophy of ER is not comprehensive and have not been reviewed since long. In compliance to the IEGC regulation and to form a comprehensive protection philosophy, it was suggested to form a committee of protection experts from state transmission utilities, Powergrid, NTPC/NHPC, IPPs as well as representative from SLDCs, ERLDC & ERPC secretariat to review the existing protection philosophy of ERPC and suggest necessary changes to be incorporated in the philosophy.

PCC agreed for the formation of committee as mentioned above and requested concerned utilities to nominate member from their respective organization.

Subsequently ERPC Secretariat vide email dated 26th Feb 2024 had shared draft protection philosophy to committee members which is attached. However, no comments have been received till date.

Members may discuss.

Deliberation in the meeting

*ERPC Secretariat informed that in compliance to the IEGC 2023, protection protocol for Eastern Region had been prepared. The same is attached at **Annexure C.1.***

NHPC representative submitted following observations:

- i. For 220 kV D/C lines, the zone-2 reach setting may be defined similar to the 400 kV Lines.
- ii. Zone-4 setting where busbar protection is not available may be set to 160 msec.
- iii. Overvoltage setting may be kept at the 220 kV lines at generating station end where line is having cable section. The settings will be coordinated with unit overvoltage setting.
- iv. Cases for which direct trip intertripping command will be sent to remote end may be specified.

After discussion, PCC agreed for inclusion of point i, iii, and iv in the protection protocol.

PCC further advised all other utilities to go through the protocol and submit their observation at the earliest so that it can be finalized in next PCC Meeting.

ITEM NO. C.2: Furnishing and approval of protection settings by ERPC

As per clause 14(2) of IEGC 2023,

All users connected to grid shall:

- Furnish the protection settings implemented for each element to respective RPC in a format as prescribed by concerned RPC
- Obtain approval of concerned RPC for (i) any revision in settings, and (ii) implementation of new protection system
- Intimate to concerned RPC about the changes implemented in protection system or protection settings within a fortnight of such changes.

To comply the above it is proposed that

- Utilities may intimate nodal officer responsible for furnishing the protection settings implemented for each element to ERPC secretariat. Utilities may nominate more than one officers, if required.
- Utilities may send their proposal of revision in protection settings as well as new settings two weeks advance to ERPC secretariat for approval.
- Utilities may send intimation to ERPC secretariat after implementation of approved settings within a fortnight.

Members may discuss.

Deliberation in the meeting

ERLDC representative highlighted that it was observed in past that in case of charging of new line where multiple utilities are involved, it is difficult to get response from both ends and it is also difficult for owner at one end to get details from owner of other end so certain procedure needs to be drafted in order to comply above mentioned clause in order to avoid unnecessary delay.

After deliberation, it was decided that a detailed procedure would be prepared by ERPC Secretariat in consultation with ERLDC to comply with the above clauses of IEGC 2023.

ITEM NO. C.3: Submission of protection performance indices on monthly basis by users to RPC and RLDC for 220 kV and above lines

In 131st PCC meeting, all utilities were advised to submit mentioned protection performance indices of 220 kV and above system (132 kV and above for Sikkim) to ERPC/ERLDC every month in compliance to the Grid Code.

In 133rd PCC Meeting, The Protection indices in respect of Powergrid Odisha, NKSTPP, JUSNL has been received.

DVC representative informed that SLDC DVC must be communicated to get these data. PCC suggested that intra-state entities including state transmission utilities may submit protection performance incidences to SLDCs and further SLDC is advised to coordinate all concerned transmission and generating utilities in their control area for getting data and further submission to ERPC/ERLDC.

As representatives of SLDCs (except SLDC Odisha) are not present in the meeting, PCC decided to refer the issue to OCC meeting for discussion and compliance.

For the month of March'24, only NTPC NKSTPP and West Bengal had submitted the same, which are attached as **Annexure C.3**.

Other Utilities are requested to submit the details every month for necessary compliance.

Deliberation in the meeting

ERPC representative informed that for month of March 24, protection performance indices had been received from NTPC NKSTPP, West Bengal, PG Odisha and JUSNL.

PCC suggested that intra-state entities including state transmission utilities may submit protection performance incidences to SLDCs and further SLDC is advised to coordinate all concerned transmission and generating utilities in their control area for getting data and further submission to ERPC/ERLDC. PCC further advised generating stations, IPPs etc to submit protection performance indices on monthly basis.

ITEM NO. C.4: Internal Protection Audit Plan of Sub stations for the Year 2024-25

The Clause (5) of Regulation 15 of IEGC Regulations, 2023 envisages as below:

Quote

(1) All users shall conduct internal audit of their protection systems annually, and any shortcomings identified shall be rectified and informed to their respective RPC. The audit report along with action plan for rectification of deficiencies detected, if any, shall be shared with respective RPC for users connected at 220 kV and above (132 kV and above in NER).

(5) Annual audit plan for the next financial year shall be submitted by the users to their respective RPC by 31st October. The users shall adhere to the annual audit plan and report compliance of the same to their respective RPC."

Unquote

All utilities are requested to submit the annual audit plan for the substations 220kV and above voltage level for FY 2024-25 to ERPC by 31.10.2023. Annual audit plans for internal audit of their protection systems and third-party protection audit shall be furnished separately.

In 131st PCC Meeting, PCC advised all utilities to submit annual audit plan for the substations 220kV and above voltage level for FY 2024-25 to ERPC at earliest.

The audit plan was received from NHPC & JUSNL.

In 133rd PCC Meeting, It was informed that audit plan had been received from WBSETCL, NHPC and JUSNL.

OPTCL representative informed that detailed protection audit plan will be submitted soon.

BSPTCL representative informed that during winter maintenance activities, protection audit of substations was done however it had not been done as per prescribed format. He further informed that detailed protection audit plan will be submitted soon.

PCC advised Powergrid, NTPC, DVC and IPPs to share their protection audit plan at the earliest.

Concerned Utilities are requested to submit the audit plan at the earliest.

Deliberation in the meeting

ERPC representative informed that till date audit plan had been received from WBSETCL, NHPC, JUSNL, BSPTCL and PG Odisha.

PCC advised Powergrid (ER 1 and ER 2), NTPC, DVC and IPPs to share their protection audit plan at the earliest.

*WBPDCL representative enquired about the format to carry out protection audit. PCC decided that the prescribed format given in IEGC 2023 will be used to carry out protection audits. The format is also enclosed at **Annexure C.4**.*

ITEM NO. C.5: O/C Setting in 132 kV & 220 kV lines after reconductoring. --ERLDC

Reconductoring had been done in many 132 kV & 220 kV feeders in Eastern region. For 220 kV feeders wherever Main-1 & Main-2 protection is available, O/c setting needs to be disabled. For 132 kV feeders, O/c setting may be revised as per increased capacity of lines.

Members may note.

Deliberation in the meeting

ERLDC representative informed that in recent times, reconductoring had been completed in many 132 kV & 220 kV feeders in Eastern Region.

In this regard he stated that as per CEA guidelines, for 220 kV feeders wherever Main-1 & Main-2 protection is available, overcurrent setting needs to be disabled and for 132 kV feeders, overcurrent setting may be revised after the reconductoring as per increased capacity of lines provided the ratings of end equipment are matching as of the line.

PCC advised all state transmission utilities to furnish the list of feeders where reconductoring work had been completed during the last year along with the details of overcurrent protection settings, if any in those lines so that it can be discussed in next meeting and decision may be taken on case to case basis.

ITEM NO. C.6: Maintaining adequate relay spares

It has been observed that at some places adequate number of relay spares are not available which compromises with the reliability of protection schemes as many features will be lost in case of any faulty relay.

Members may discuss.

Deliberation in the meeting

ERLDC representative informed that It has been observed that at some places adequate number of relay spares are not available which compromises with the reliability of protection schemes and may affect reliability and security of the grid.

ERPC Secretariat representative informed that there is a guideline by CEA on spare management and the utilities shall strictly follow the guidelines for maintaining the spare.

PCC advised all the utilities to maintain sufficient relay spares to avoid unnecessary delay in replacement of faulty relay.

ITEM NO. C.7: Disturbance at Kahalgaon S/s on 30.01.2024

The disturbance occurred at NTPC Kahalgan on 30.01.2024 was discussed in 132nd PCC meeting and NTPC Kahalgaon was advised following:

- I. To submit action taken report on the observations made by the technical committee in its disturbance analysis report as well as for discrepancies discussed in this meeting. The report shall include compliance for all the observations/discrepancies as discussed along with the timeline.
- II. To submit last test report of failed circuit breakers and data regarding last successful operation of the breaker.
- III. To submit data of relay functionality test last carried out for the relays where discrepancies were observed during this disturbance, and the periodicity of testing of the relays followed at site
- IV. To carry out the testing of 400 kV busbar protection at the earliest
- V. To carry out periodical protection audit of all substations as per the IEGC 2023 and compliance of the audit observations in time bound manner.
- VI. To make the event logger of the station functional at the earliest
- VII.** To ensure time synchronization of all the relays with GPS clock and configuration DR with proper DR time length. After completion of the task, sample DR for all the relays shall be submitted for verification.

In 133rd PCC Meeting, NTPC representative updated that the site visit at Kahalgaon is going on and the report will be submitted after completion of the site visit.

Deliberation in the meeting

NTPC Kahalgaon representative presented action taken report on the disturbance occurred on 30.01.2024. The presentation is enclosed at Annexure C.7.1.

He informed that as per joint root cause analysis done with M/s Siemens, it was found out that scratches on heating chamber was caused due to interaction with dislodged material observed inside. Further, it was established that there might have some deficiency in supplied breaker which had resulted in failure of breaker in this incident and in earlier two occasions also. Few recommendations had been provided by M/s Siemens in this regard-

- *M/s Siemens had suggested to use standard circuit breaker having higher rated voltage.*
- *M/s Siemens had suggested to match DCRM characteristics of installed CB with factory value.*
- *M/s Siemens is agreed to supply 1 no of complete pole pf breaker to site as spare had been already used.*
- *M/s Siemens is agreed to carry out Dew point, DCRM, SF6 purity and other tests on yearly basis.*

He added that they are planning to replace all BHEL make 400&132KV Circuit Breakers due to spare availability issue and servicing support issue from OEM.

Regarding update in bus-splitting at Kahalgaon, he stated that the work is in advanced stage and it will be completed very soon.

*Regarding point-wise compliances of suggestions given by PCC, they had submitted a report which is attached at **Annexure C.7.2.***

ITEM NO. C.8: Follow-up of Decisions of the Previous Protection Sub-Committee Meeting(s)

The decisions of previous PCC meetings are attached.

Members may update the latest status.

Deliberation in the meeting

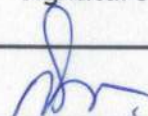

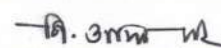
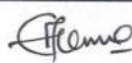








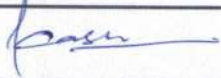

*Updated status of decisions of previous PCC meetings are attached at **Annexure C.8.***

Participants in 134th Protection Coordination Sub- Committee Meeting

Venue: ERPC Conference Hall, Kolkata

Time: 11:00 hrs

Date: 16.04.2024(Tuesday)

Sl No	Name	Designation/ Organization	Contact Number	Email	Signature
1	Shri N.S. Mondal	Member Secretary, ERPC	9958389967	mserpc-power@gov.in	
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5	Ch. Mohan Rao	DGM, PG-odisha	9437962193	mohan.rao@powergrid.in	
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10	VIVEK ANAND	Sr. Manager, NHPC 2nd	9805005215	v_anand@nhpc.nic.in	
11	SOMNATH CHATTERJEE	GROUP HEAD MPL	8235805653	schattejee@tatapower.com	
12	Debasali Basu	ED PRDC	95030 10743	debasali.basu@prdc.infoltek.com	
13	Alok Pratap Singh	Chief Manager, ERLDC	9007285390	aplsingh@grid-india.in	
14	Akash Kumar Mondal	Manager, ERLDC	8584072082	akmondal@grid-india.in	
15	Rajat K. Koley	Sr. Mgr(OS), WBPDC	9474860642	rajatkumar.koley@gmail.com	






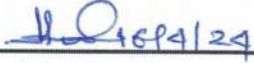

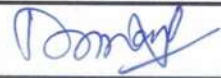


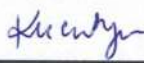
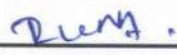
"Coming together is a beginning, staying together is progress, and working together is success." –Henry Ford

Participants in 134th Protection Coordination Sub- Committee Meeting

Venue: ERPC Conference Hall, Kolkata

Time: 11:00 hrs

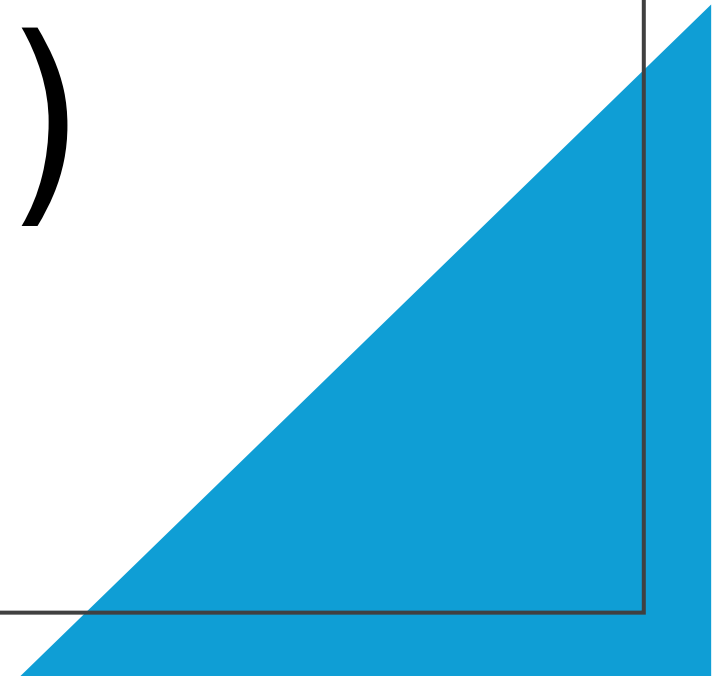
Date: 16.04.2024(Tuesday)

Sl No	Name	Designation/ Organization	Contact Number	Email	Signature
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28					
29					
30					

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

134th PCC Meeting (Eastern Region)

16.04.2024



March'24

6 GD/GI

CT blast at 4 places
(NTPC Barh,
Ramchandrapur,
Bantala, Laukahi)

Bus bar protection
not
available/Unhealthy

77 single
line tripping

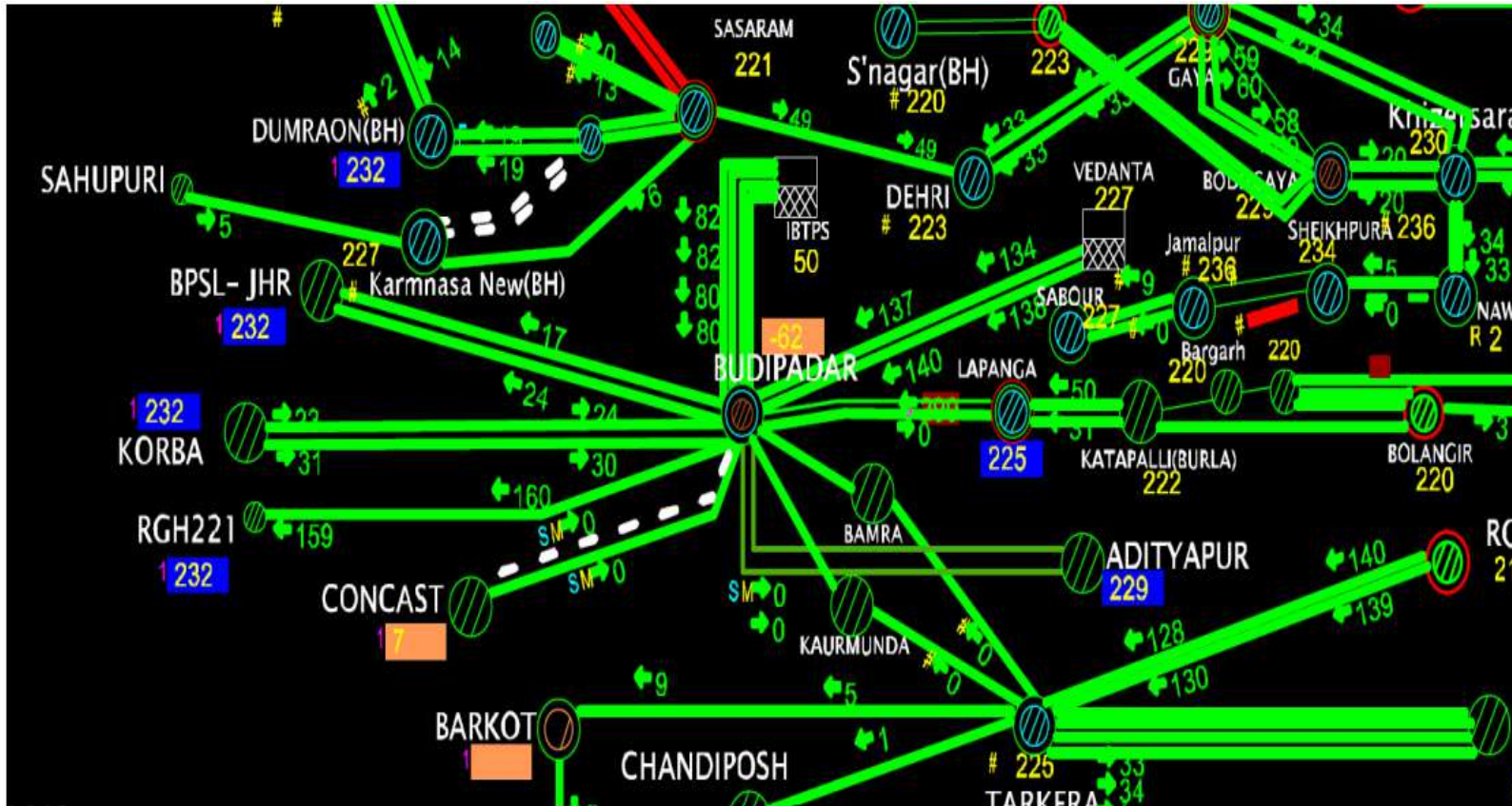
Unhealthy Carrier
communication
scheme-A/r issue

Many tripping
without any line fault
(20 Nos.)

Disturbance at Begusarai

- Fault in an idle charged 220 kV line. Breaker at Begusarai failed to open.
- No bus bar protection available.
- All lines tripped from remote end in Zone-3.
- Antitheft charging setting for distance protection to be implemented for idle charged lines.

Disturbance at Budhipadar



- 220 kV Budhipadar-Lapanga-1 was hand tripped after 15 minutes of the first fault in parallel circuit?
- Shutdown co-ordination? Proper SOP should be in place for heavily congested corridors while allowing any shutdown for accounting further contingency
- Later, 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba-1 tripped one by one. The root cause analysis for tripping may be shared. It is suspected line tripped due to increased sag or low clearance?
- Immediate SPS scheme may be planned for Budhipadar

Disturbance at Barh(NTPC)

- B_ph CT burst in 400 kV Patna-2 line at Barh. After 900 msec, R_ph CT of Patna-1 line damaged.
- Bus bar protection and Teed differential operated.
- Issue with communication scheme.
- Measures to be taken to avoid such incidents in future.

Disturbance at Garhwa

- Two incidents on consecutive days.
- Localized storm on both days reported.
- One tower damaged on the 1st day. Multiple Towers collapsed during localized storm on the 2nd day.
- Restoration status?

Disturbance at Bantala (KLC)

- Y_ph CT of 220 kV NewTown AA-III burst at Bantala.
- Bantala has single bus scheme. Bus bar protection not available.
- The faulty line tripped from remote end in Zone-2. A/r dead time was set at 500 msec. Carrier channel unhealthy.
- Carrier channel unhealthy in remaining 220 kV Subhashgram-Bantala also.



ग्रिड-इंडिया
GRID-INDIA

ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
GRID CONTROLLER OF INDIA LIMITED
(A Government of India Enterprise)
[formerly Power System Operation Corporation Limited (POSOCO)]




पूर्वी क्षेत्रीय भार प्रेषण केन्द्र / Eastern Regional Load Despatch Centre

कार्यालय : 14, गोल्फ क्लब रोड, टॉलिंगंज, कोलकाता - 700033
Office : 14, Golf Club Road, Tollygunge, Kolkata - 700033
CIN : U40105DL2009GOI188682, Website : www.erldc.in, E-mail : erldcinfo@grid-india.in, Tel. : 033 23890060/0061

पूर्वी क्षेत्र के 220/132 केवी बेगूसराय उप-केन्द्र में ग्रिड घटना पर विस्तृत रिपोर्ट / Detailed Report of grid event at 220/132 kV Begusarai S/s of Eastern Region

(To be submitted by RLDC/NLDC during Grid Disturbances/Grid Incidents/Near Miss Event as per IEGC section 37.2 (f))
(आई ई जी सी 37.2 (एफ) के अनुपालन में)

Date(दिनांक):22-03-2024

1. Event Summary (घटना का सारांश):

At 11:56 Hrs on 05.03.2024, Y_B_N fault occurred in 220 kV Begusarai-IOCL-1, which was kept idle charged from Begusarai end. Distance protection operated at Begusarai bu the breaker didn't open. Since LBB and bus bar protection is not available at Begusarai, other feeders tripped in Zone-3 from remote ends and total power failure occurred at Begusarai S/s. Around 100 MW load loss reported at Begusarai.

2. Time and Date of the Event (घटना का समय और दिनांक): 11:56 hrs of 05.03.2024

3. Event Category (ग्रिड घटना का प्रकार): Grid Disturbance (GD)-1

4. Location/Control Area (स्थान/नियंत्रण क्षेत्र): Bihar

5. Report submitted by Utility on: 20.03.2024

6. Antecedent Conditions (पूर्ववर्ती स्थिति):

	Frequency	Regional Generation	Regional Demand	State Generation	State Demand
				Bihar	Bihar
Pre-Event (घटना पूर्व)	50.03 Hz	25304 MW	19707 MW	347 MW	3032 MW
Post Event (घटना के बाद)	50.03 Hz	25304 MW	19607 MW	347 MW	2932 MW

**Pre and post data of 1 minute before and after the event*

Important Transmission Line/Unit if under outage (महत्वपूर्ण संचरण लाइने/ विद्युत उत्पादन इकाइयां जो बंद हैं)	Nil
Weather Condition (मौसम स्थिति)	Rainy weather

7. Load and Generation loss (लोड और जनरेशन हानि): Generation loss: NIL; Load loss: 100 MW.

8. Duration of interruption (स्कावट की अवधि): 00:29 Hrs

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

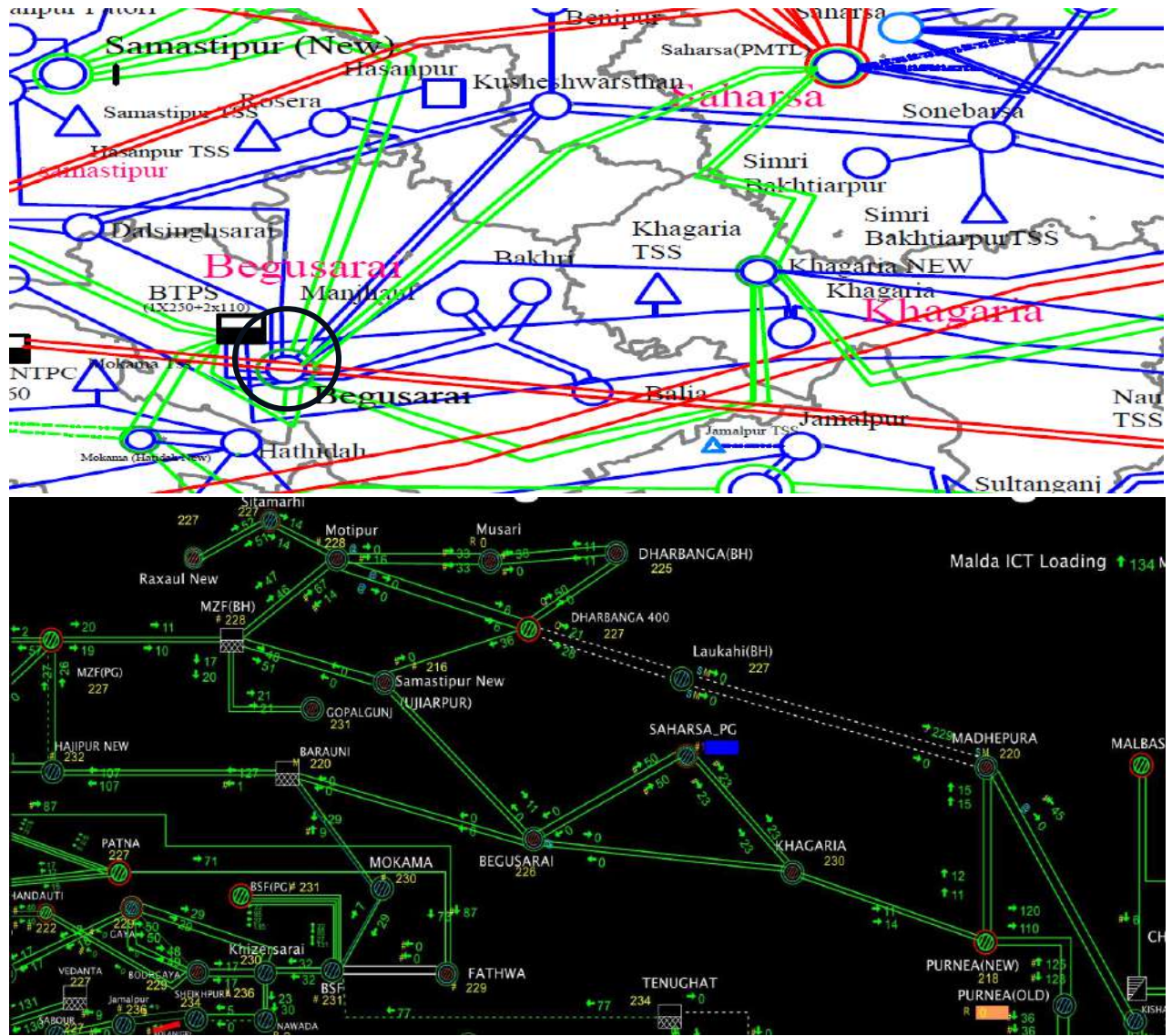


Figure 1: Network across the affected area

10. Details of Equipment Failure (if any during the event) (उपकरण विफलता का विवरण): NA

11. Major Elements Tripped (प्रमुख ट्रिपिंग)

क्र०सं०	नाम	Trip time (hh:mm:ss)	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	Restoration time
1	220 kV Begusarai-IOCL-1 (Idle charged from Begusarai)	11:56:39	Begusarai: Y_B_N, Zone-1, 10 km, Iy=Ib=11kA	-	-

2	220 kV Begusarai-IOCL-2 (Idle charged from Begusarai)		Didn't trip	-	15:45
3	220 kV Begusarai-Saharsa D/c	11:56:39	Didn't trip	Saharsa: Y_B_N, I _y =I _b =1.4 kA	15:50
4	220 kV Begusarai-BTPS D/c		Didn't trip	BTPS: Y_B_N, I _y =I _b =4.18 kA	13:35/13:36

12. Event Analysis (Based on PMU, SCADA & DR) (घटना का विश्लेषण):

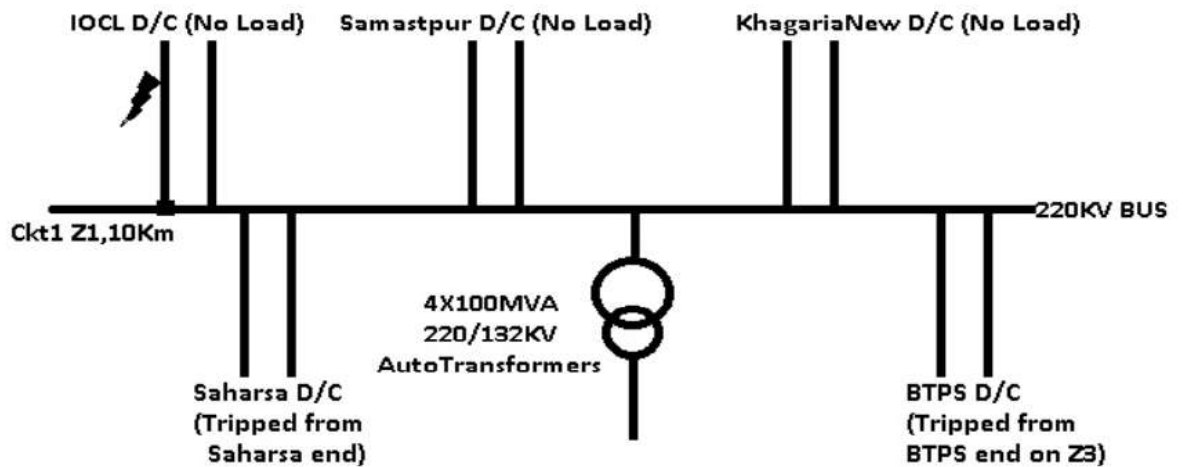


Figure 2: SLD of 220/132 kV Begusarai S/s (As shared by BSPTCL)

- At 11:56 Hrs, a Y_B_N fault struck 220 kV Begusarai-IOCL-1, which was kept idle charged from Begusarai at 10 km from Begusarai, which was in Zone-1. Distance relay gave tripping command at Begusarai but breaker failed to open and the fault persisted.
- As there is no LBB and Bus bar protection available at Begusarai, the fault was cleared by opening of all other feeders from remote end one by one.
- 220 kV Begusarai-Saharsa D/c tripped from Saharsa after 800 msec in Zone-3.
- 220 kV Begusarai-BTPS(Barauni) D/c tripped from Barauni after 1.5 seconds in Zone-3.
- With opening of 220 kV Begusarai-BTPS(Barauni) D/c, total power failure occurred at Begusarai as other lines, i.e. 220 kV Begusarai-Khagaria D/c, 220 kV Begusarai-Samastipur D/c and 220 kV Begusarai-IOCL-2 were kept idle charged from Begusarai end only.

- Power supply was restored by charging 220 kV Begusarai-Samastipur-1 at 12:25 Hrs.
- Report received from BSPTCL is attached at Annexure-3.

PMU Snapshot:

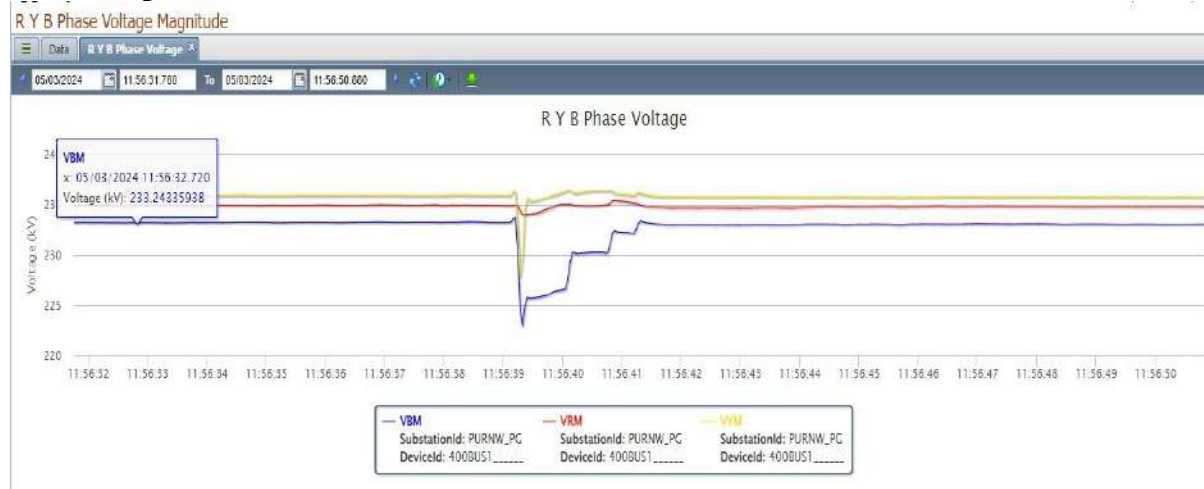


Figure 2: PMU Voltage snapshot of 400/220 kV New Purnea S/S

13. Protection/Operational issues observed (सुरक्षा/परिचालन संबंधी समस्या):

- Breaker of 220 kV Begusarai-IOCL-1 didn't open despite operation of distance relay in Zone-1, Zone-2 and Zone-3. The reason for the same may be explained.
- Since the faulty line was idle charged from Begusarai end only, time delay for Zone-2 and Zone-3 should be kept instantaneous as decided in ERPC PCC meeting. The same may be rectified.
- Zone-3 time delay of 220 kV Begusarai-Barauni D/c at Barauni is set at 1.5 seconds. The reason for the same may be explained.
- Expected timeline of commissioning of bus bar protection at Begusarai may be shared.

14. Action Taken/Remedial Measures (सुधारात्मक उपाय): Nil

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

S.No.	Issues	Regulation Non-Compliance	Utilities
2.	Whether DR/EL provided within 24 Hours?	1. IEGC section 37.2 (c) 2. CEA grid Standard 15.3	BSPTCL, PG ER-1 (No)

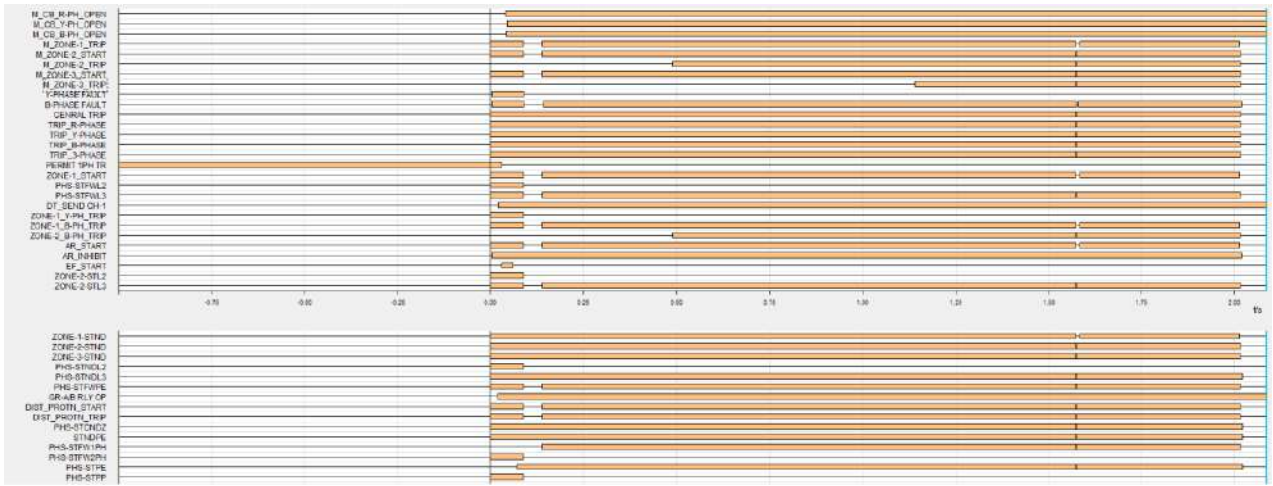
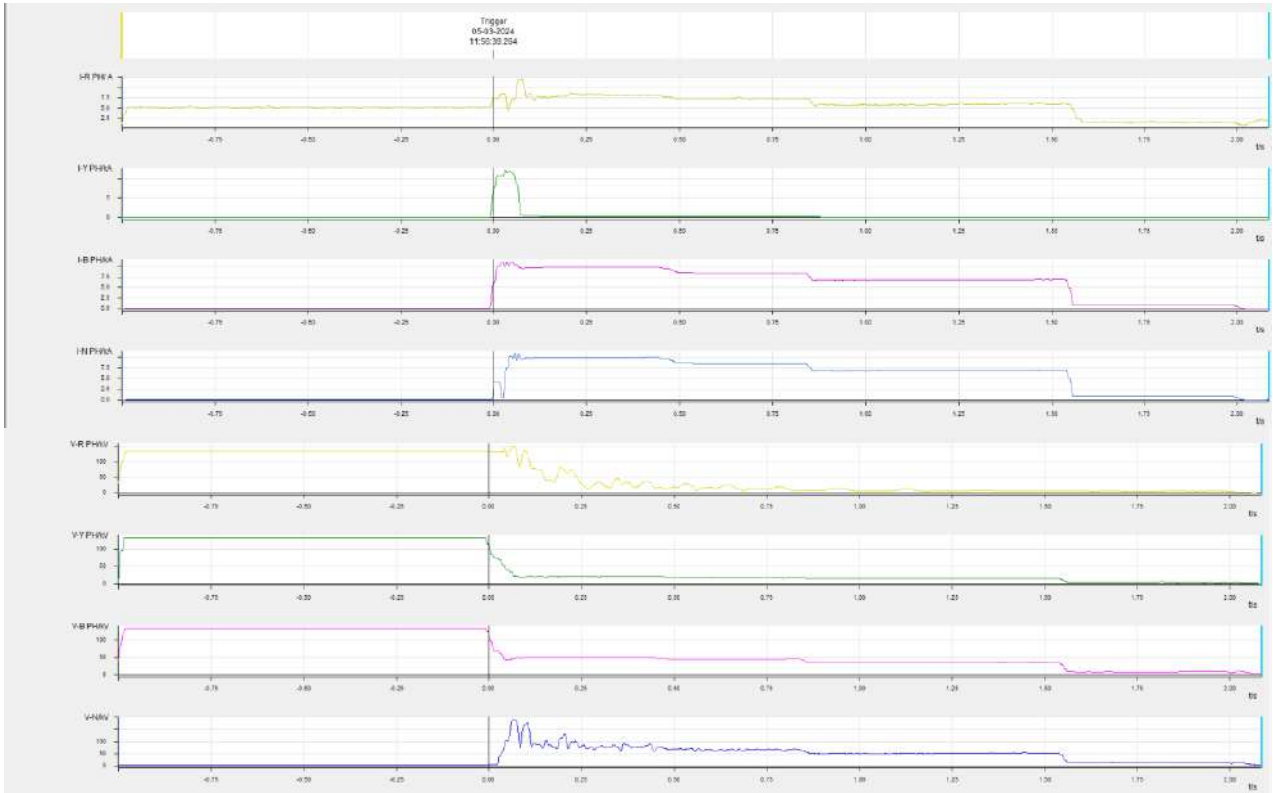
16. Key Lessons Learnt (प्रमुख अधिगम बिंदु): Nil

Annexure 1: (Sequence of Events-As per ERLDC SCADA)

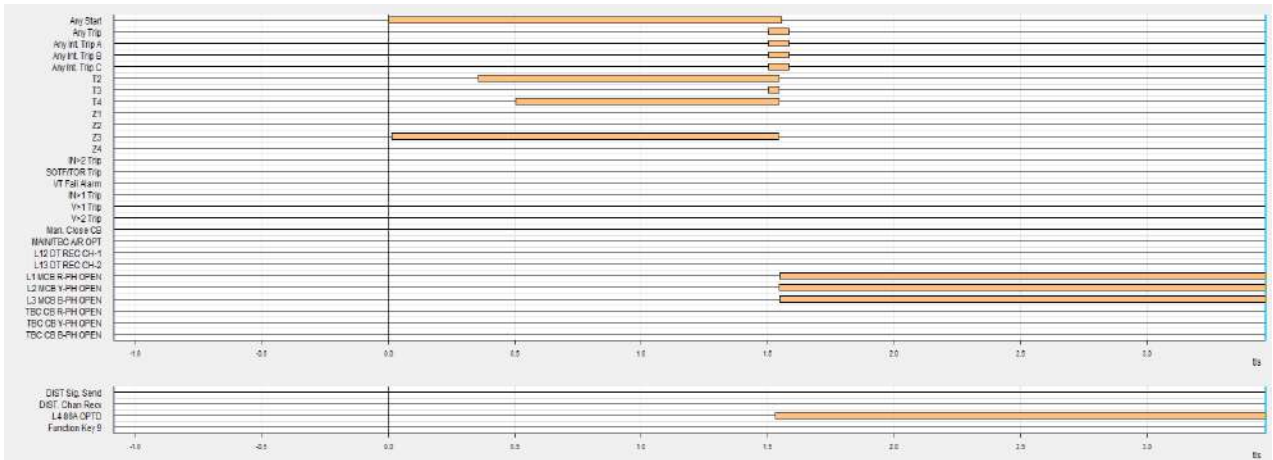
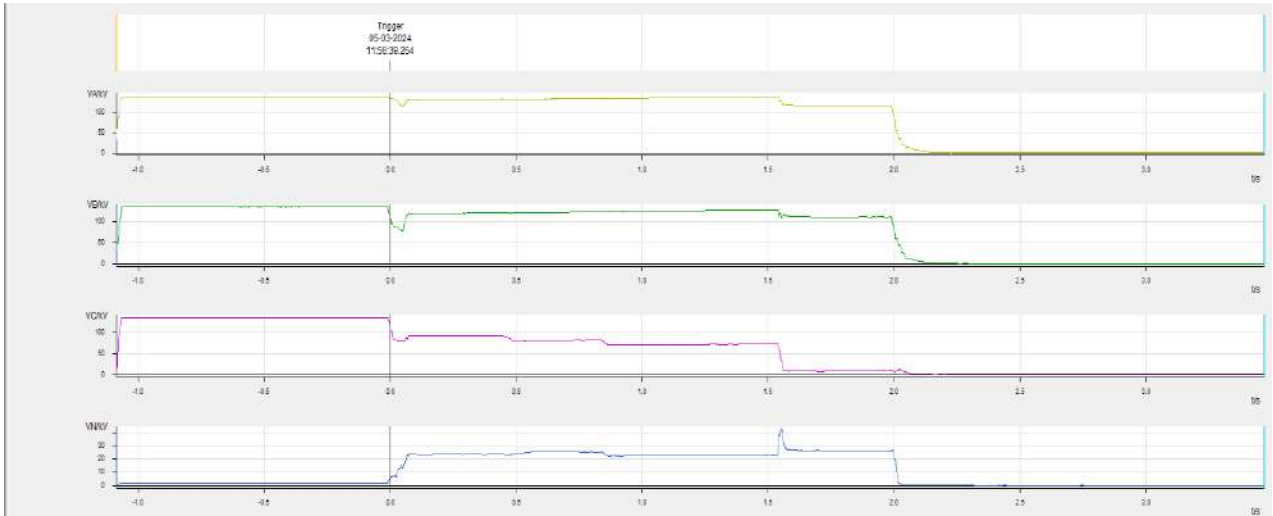
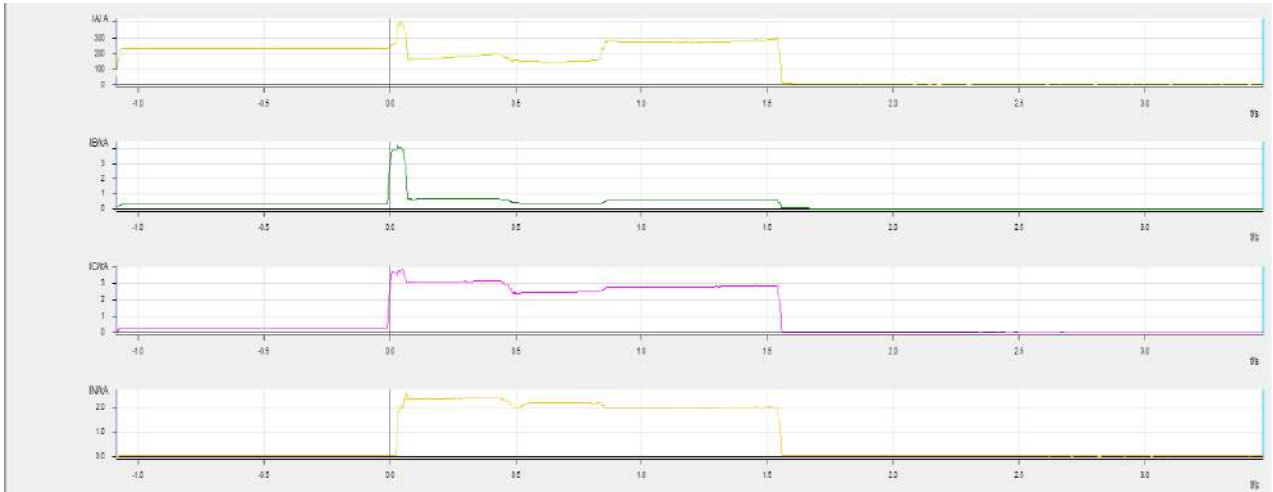
SoE data not available for the event.

Annexure 2:

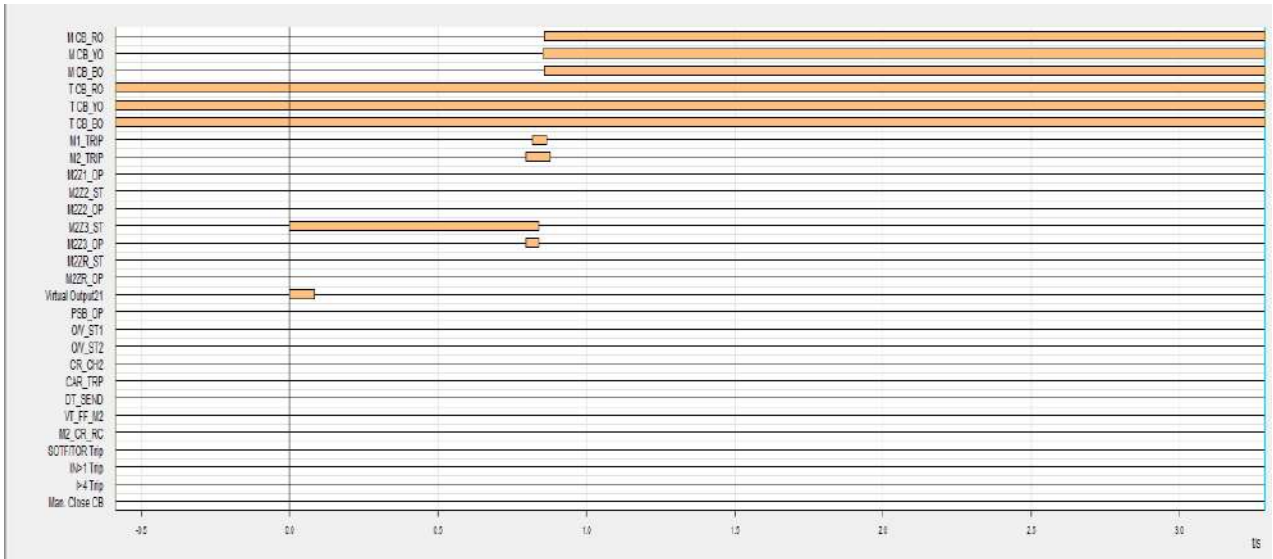
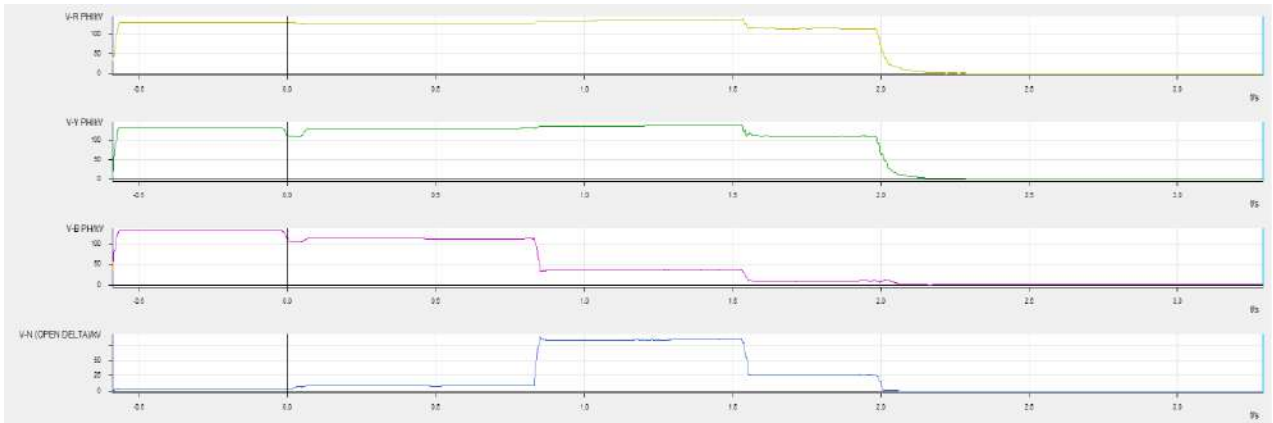
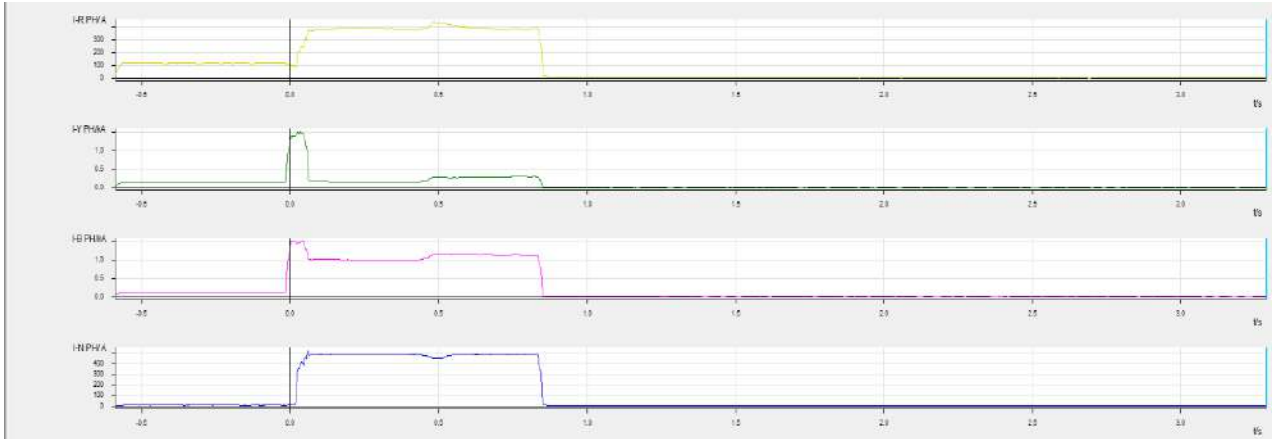
DR of 220 kV Begusarai-IOCL-1 (Begusarai)



DR of 220 kV Begusarai-BTPS-1 (BTPS-Barauni)



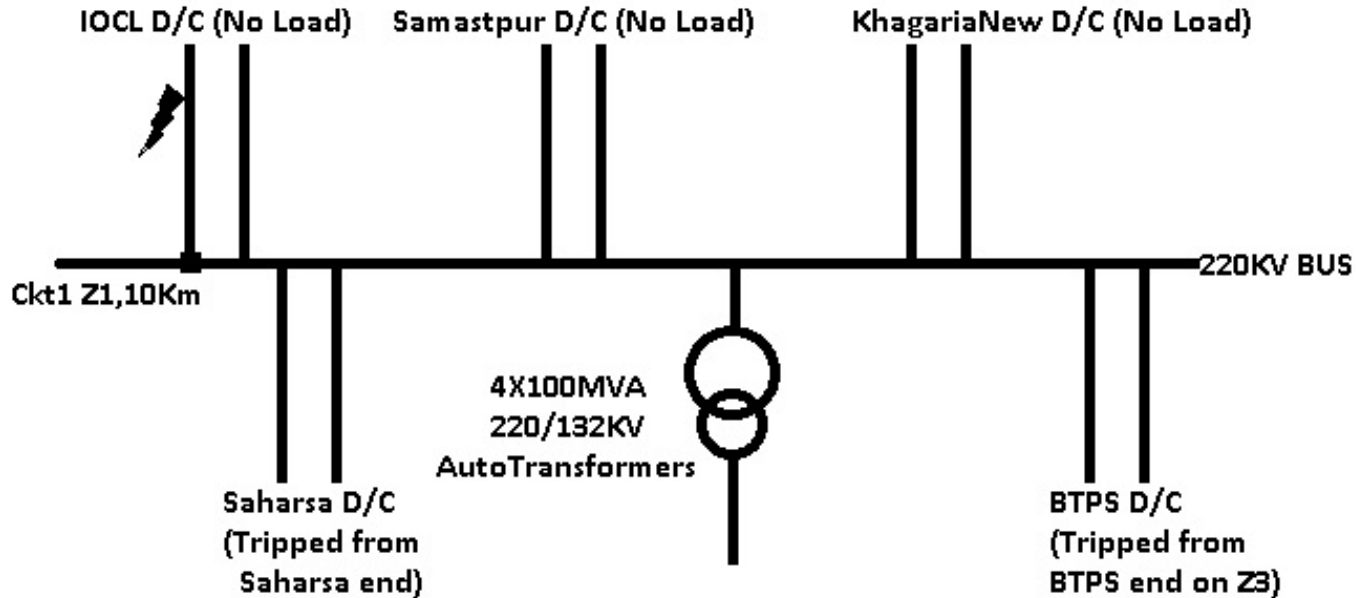
DR of 220 kV Begusarai-Saharsa-1 (Saharsa)



Report of TPF at 220/132/33KV Begusarai S/s(BSPTCL)

1. Date and Time of Incident:-Dt-05/03/2024; 11:56Hrs

2. SLD of 220KV Bus at Begusarai



3. Prefault Condition (11:00Hrs)

Sl. No.	Name of Element	Load(11:00Hrs)	Remarks
1	220KV IOCL D/C	0	No Load
2	220KV Samastipur D/C	0	No Load
3	220KV Khagaria New D/C	0	No Load
4	220KV Saharsa D/C	-(2X51 MW)	
5	4X100;220/132KV Autotransformers	-(4X26 MW)	
6	220KV BTPS D/C	2X104 MW	

4. Root Cause of Tripping and Analysis

A Bamboo tree came in range of the 220KV Begusarai-IOCL ckt1, approx.10KM from Begusarai. Weather was rainy and windy. The Relay operated correctly on Z1 and gave output command to the Circuit Breaker and the Breaker opened mechanically in approx. 30ms. But the Circuit Breaker (make-CGL) failed to clear the fault in B (Blue) phase. This caused tripping of 220KV Begusarai- Saharsa D/C lines and 220KV Begusarai-BTPS D/C lines from respective remote ends.

The Circuit Breaker (make-CGL) in 220KV IOCL Ckt1 bay is in warranty period. The Executing Agency M/s ABN Tower and Transmission Private Ltd. has been asked to investigate the issue of non-clearance of the Circuit Breaker on fault and take necessary measures to avoid any such incidents in future.

5. Relay indication

Sl. No.	Name of Element	Relay indication	Remarks
1	220KV IOCL Ckt1	Tripped from Begusarai end on (Z1,Iy=Ib=11KA,FD=10KM)	
2	220KV IOCL Ckt2	No Tripping	No Load
3	220KV Samastipur D/C	No Tripping	No Load
4	220KV Khagaria New D/C	No Tripping	No Load
5	220KV Saharsa D/C	Tripped from Saharsa End.	
6	220KV BTPS D/C	Tripped from BTPS end on (Z3)	

6. Restoration

Sl. No.	Name of Element	Restoration time
1	220KV BTPS- 1	13:35 Hrs
2	220KV BTPS- 2	13:36 Hrs
3	220KV Samastipur- 1	12:25 Hrs
4	220KV Samastipur- 2	14:00 Hrs
5	220KV Khagaria New- 1	Open from Beg. End
6	220KV Khagaria New- 2	Open from Beg. End
7	220KV Saharsa- 1	15:50 hrs
8	220KV Saharsa - 2	15:50 Hrs
9	220KV IOCL- 1	Not Charged till date
10	220KV IOCL- 2	15:45 Hrs
11	4 X 100MVA Transformer	12:40 Hrs

7. DRs

Following two DRs have been attached:-

- I) 220KV IOCL1(BEGUSARAI end) 05032024 1156
- II) 220KV BEGUSARAI 1(BTPS end) 05032024 1156



ग्रिड-इंडिया
GRID-INDIA

ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
GRID CONTROLLER OF INDIA LIMITED
(A Government of India Enterprise)
[formerly Power System Operation Corporation Limited (POSOCO)]

पूर्वी क्षेत्रीय भार प्रेषण केन्द्र / Eastern Regional Load Despatch Centre

कार्यालय : 14, गोल्फ क्लब रोड, टॉलिंगंज, कोलकाता - 700033
Office : 14, Golf Club Road, Tollygunge, Kolkata - 700033
CIN : U40105DL2009GOI188682, Website : www.erfdc.in, E-mail : erfdinfo@grid-india.in, Tel.: 033 23890060/0061




पूर्वी क्षेत्र के 220/132 केवी उप-केन्द्र में ग्रिड घटना पर विस्तृत रिपोर्ट / Detailed Report of grid event in 220/132 kV Budhipadar, 220 kV IBTPS, 220 kV Vedanta S/s of Eastern Region
(To be submitted by RLDC/NLDC during Grid Disturbances/Grid Incidents/Near Miss Event as per IEGC section 37.2 (f))
(आई ई जी सी 37.2 (एफ) के अनुपालन में)

Date(दिनांक):28-03-2024

1. Event Summary (घटना का सारांश):

At 13:45 Hrs on on 9th March 2024, 220 kV Budhipadar-Lapanga-2 tripped due to B-Earth fault. Loading of Budhipadar-Lapanga-1 reached around 350 MW, which was hand-tripped at 14:00 Hrs. Entire Budhipadar complex generation with IBTPS and Vedanta, SMC, Bhushan Steel, AAL, Concast CPPs started evacuating through remaining interconnection with grid through 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba D/c, which tripped one by one due to high loading and at 14:07 Hrs, this complex was isolated from the grid and formed an island which didn't survive due to large load generation imbalance. Net generation loss of around 600 MW occurred and load loss of around 100 MW occurred.

2. Time and Date of the Event (घटना का समय और दिनांक): 14:07 hrs of 22-03-2024

3. Event Category (ग्रिड घटना का प्रकार): Grid Disturbance (GD)-1

4. Location/Control Area (स्थान/नियंत्रण क्षेत्र): Odisha

5. Report Submitted by utility on: 22.03.2024

6. Antecedent Conditions (पूर्ववर्ती स्थिति):

	Frequency	Regional Generation	Regional Demand	State Generation	State Demand
Pre-Event (घटना पूर्व)	49.98 Hz	26093 MW	19888 MW	3095 MW	4967 MW
Post Event (घटना के बाद)	49.97 Hz	25473 MW	19788 MW	2475 MW	4867 MW

**Pre and post data of 1 minute before and after the event*

Important Transmission Line/Unit if under outage महत्वपूर्ण संचरण लाइने/ विद्युत उत्पादन इकाइयां जो बंद है	220 kV Budhipadar-Kuarmunda 220 kV Budhipadar-Bamra 132 kV Budhipadar-Kalunga 132 kV Bamra-Rajgangpur
Weather Condition (मौसम स्थिति)	Normal

7. Load and Generation loss (लोड और जेनरेशन हानि): Generation loss: 620 MW; Load loss: 100 MW.

8. Duration of interruption (रुकावट की अवधि): 00:45 Hrs

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

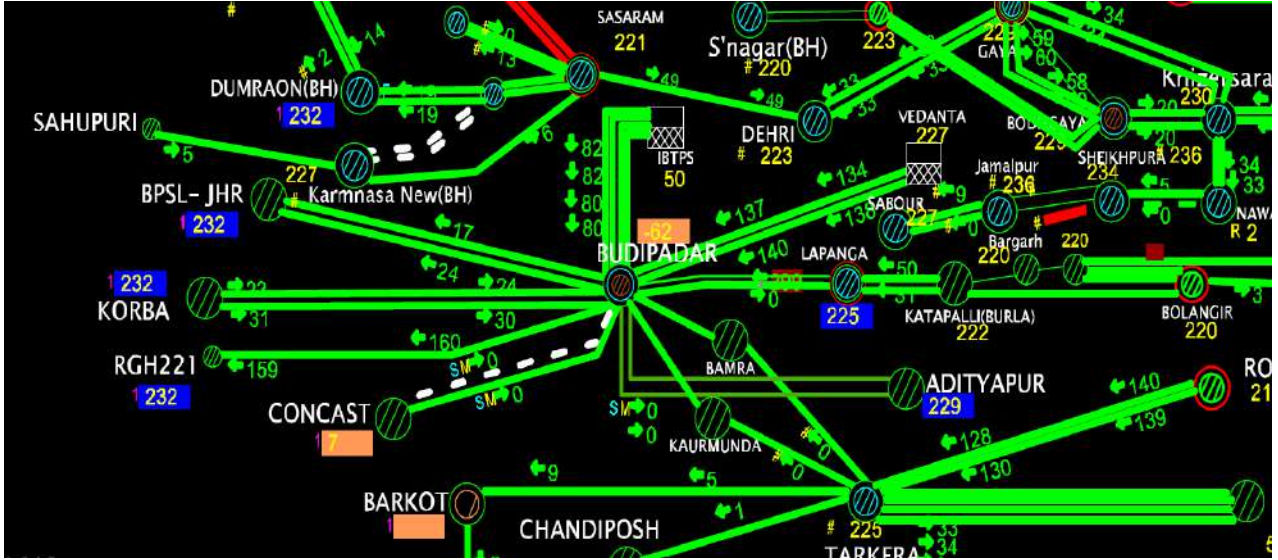


Figure 1: Network across the affected area

10. Details of Equipment Failure (if any during the event) (उपकरण विफलता का विवरण): NA

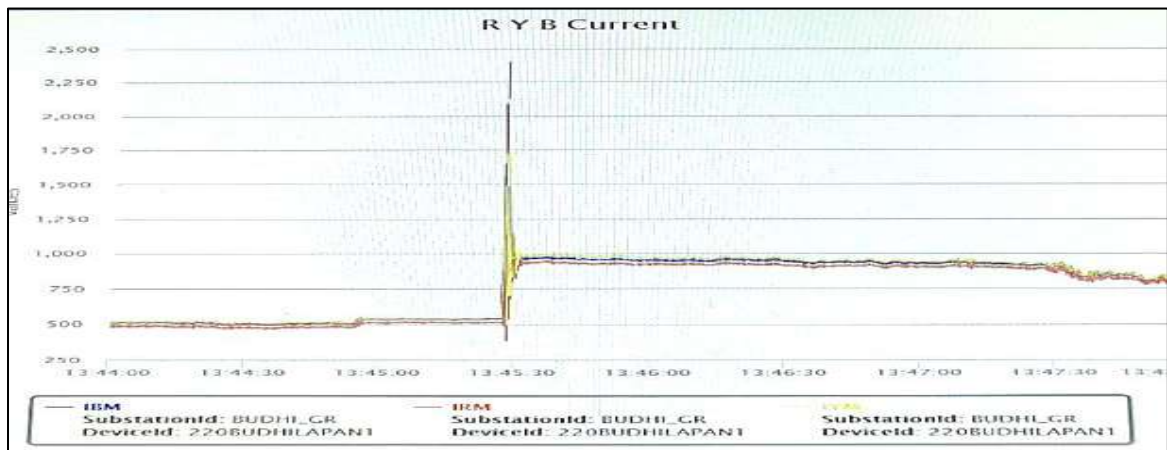
11. Major Elements Tripped (प्रमुख ट्रिपिंग):

क्र०स०	नाम	Trip time (hh:mm)	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	Restoration time
1	220 kV Budhipadar-Lapanga-2	13:45	Budhipadar: B_N, Zone-2, 15.25 km, 10.62 kA	Lapanga: B_N, 0.2 km, 22.16 kA	14:35 (10.03.24)
2	220 kV Budhipadar-Lapanga-1	14:00	Hand Tripped	-	14:52
3	132 kV Budhipadar-Lapanga-1	14:01	Budhipadar:Y_B_Earth, 9.9 km, Iy: 5.8 kA, Ib: 6.38 kA	Lapanga: Y_B_Earth, 6.8 km, Iy: 7.08 kA, Ib: 7.84 kA	19:26
4	220 kV Budhipadar-Raigarh-1	14:05	Budhipadar: B_N, 57.29 km, 2.448 kA	Raigarh: B_N, 20.38 km, 5.94 kA	22:24

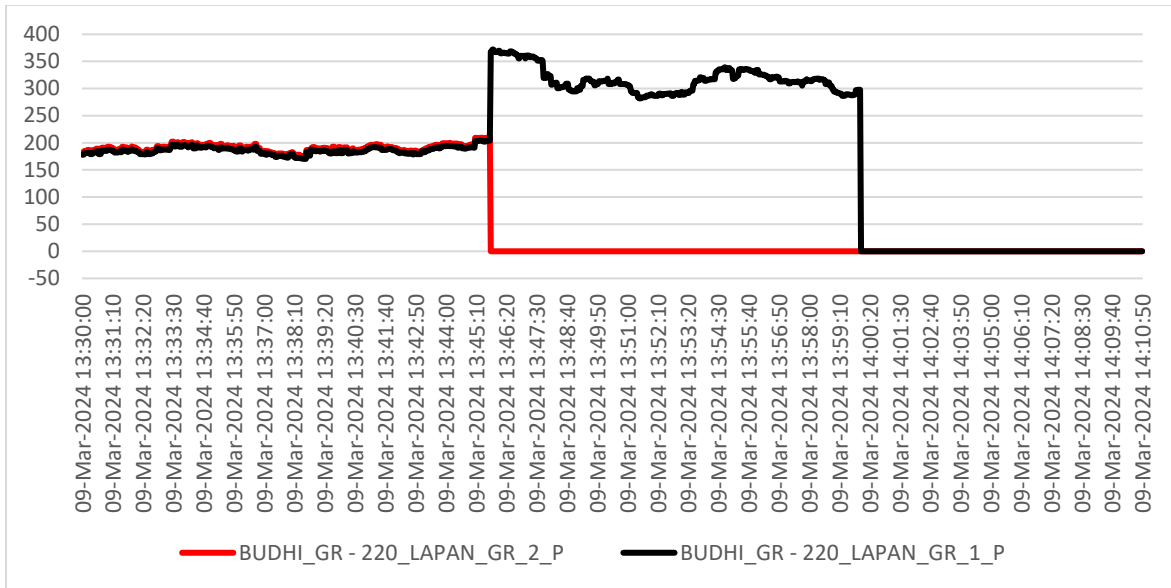
5	220 kV Budhipadar-Korba-1	14:07	Budhipadar: Didn't trip	Korba:B_N, 302.8 km, Zone-2	15:41
6	220 kV Budhipadar-Korba-2		Budhipadar: Y_N, 77.46 km, 1.75 kA, Power swing	Korba: R_Y_B_N, Zone-2, 181.9 km, Ir: 2.368 kA, Iy: 2.471 kA, Ib: 2.55 kA	21:35
7	220 kV Budhipadar- IBTPS-1&2		Budhipadar: DT received	IBTPS: OverVoltage	14:40/-
8	220 kV Budhipadar-IBTPS-3&4		Budhipadar: Didn't trip	-	-
9	220 kV Budhipadar-Vedanta-1&2		Budhipadar: Didn't trip	-	-
10	U#1 & U#2 at IBTPS		Overspeed		23:46/22:24

12. Event Analysis (Based on PMU, SCADA & DR) (घटना का विश्लेषण):

- Initially at 13:45 Hrs, a B-Earth fault struck 220 kV Budhipadar-Lapanga-2 which persisted for around 500 msec. B_ph Conductor snapping between gantry and First tower at Lapanga end reported.

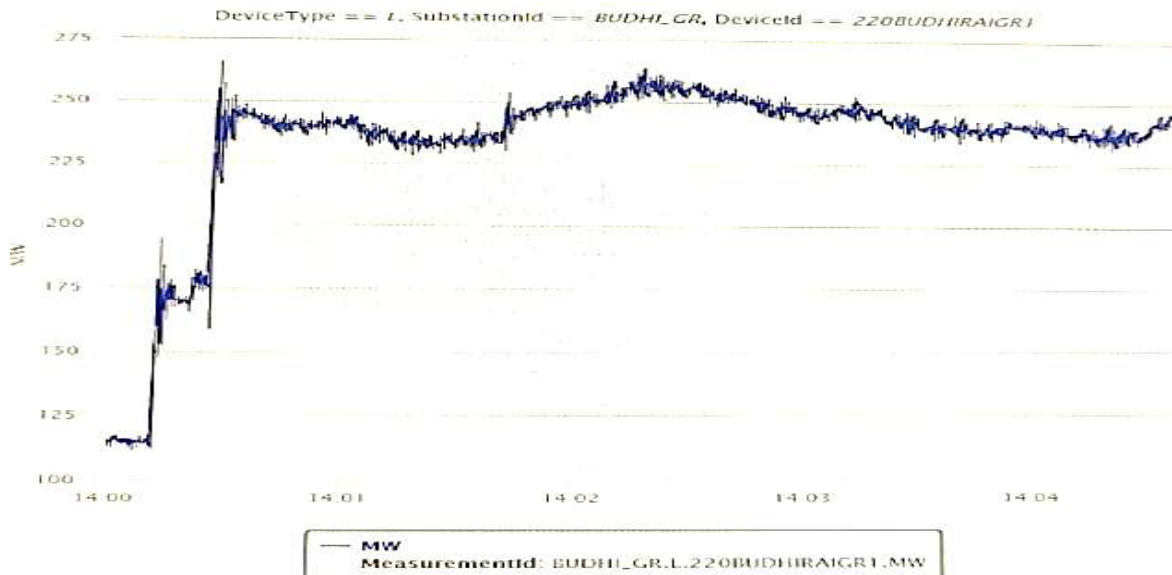


- Loading of 220 kV Budhipadar-Lapanga-1 reached around 350 MW. This line was hand-tripped at 14:00 Hrs.

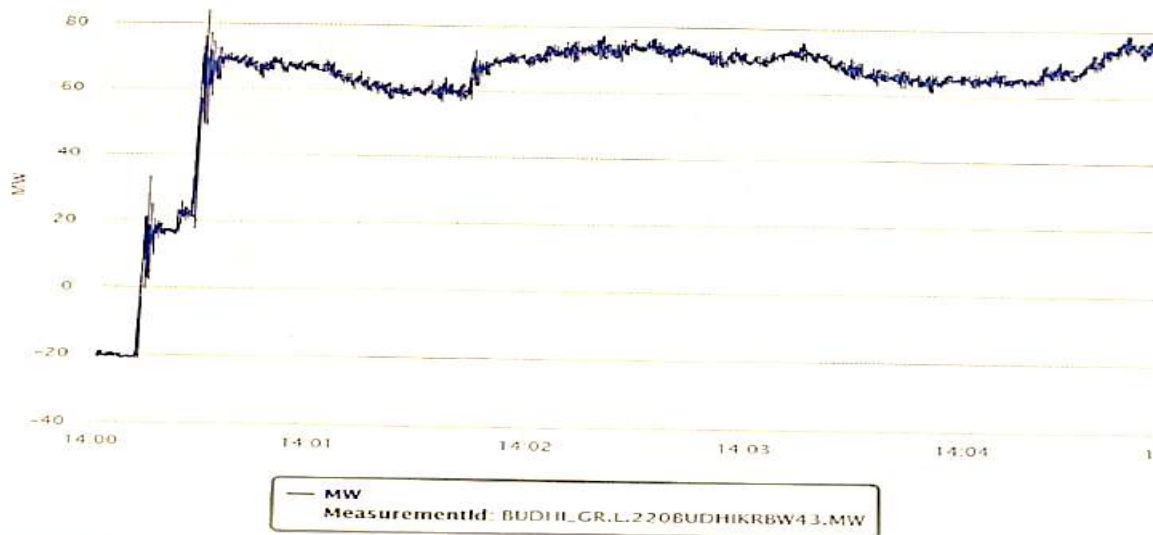


- 132 kV Budhipadar-Lapanga tripped at 14:01 Hrs due to Y_B-Earth fault. Line tripped due to snapping of B-phase conductor & jumper over Y-Phase conductor near SMC-1 plant.
- After tripping of 220 kV Budhipadar-Lapanga D/c, 132 kV Budhipadar-Lapanga and outage of 220 kV Budhipadar-Bamra and 220 kV Budhipadar-Kuarmunda, interconnection point with the grid was with 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba D/c.
- Entire generation of IBTPS (Around 320 MW) and surplus export from 220 kV Vedanta (280 MW), total around 600 MW started evacuating through 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba D/c with some exchange with other CPPs connected at Budhipadar.

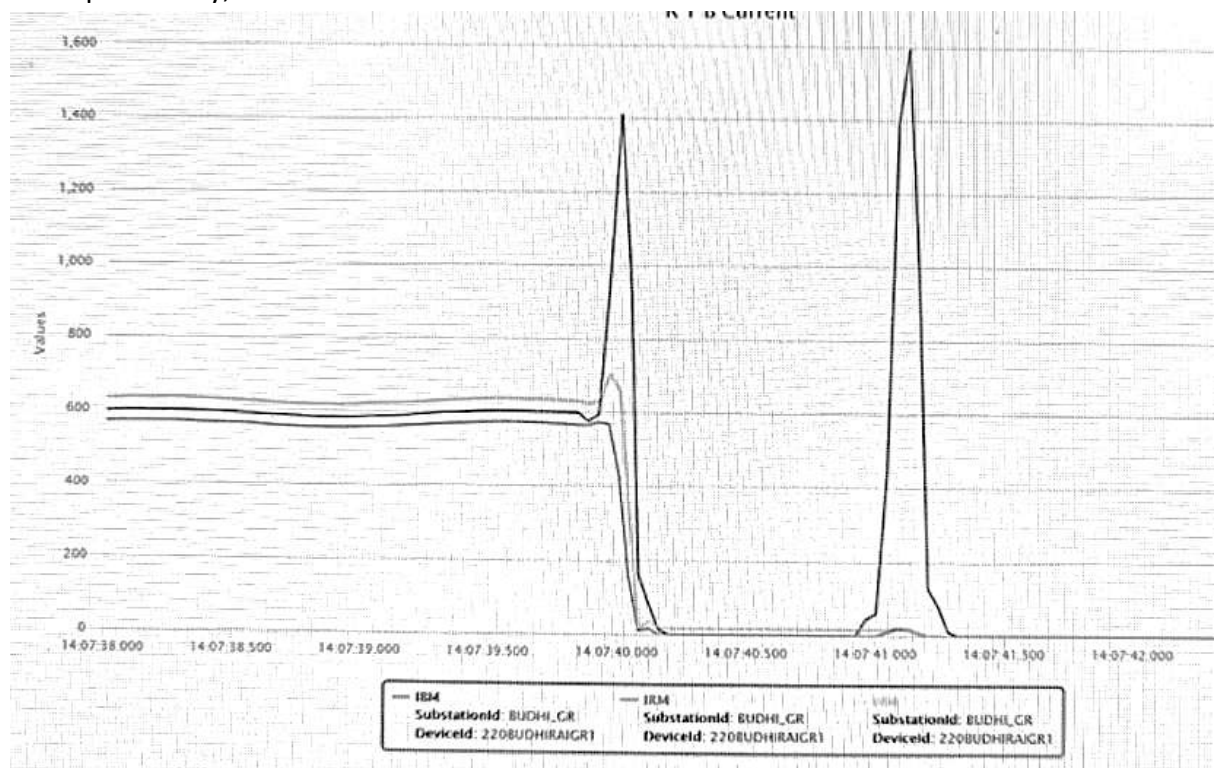
Flow of 220 kV Budhipadar-Raigarh



Flow of 220 kV Budhipadar-Korba-2



- At 14:07 Hrs, 220 kV Budhipadar-Raigarh tripped due to B-Earth fault. A/r attempted from Budhipadar only, however it was unsuccessful.

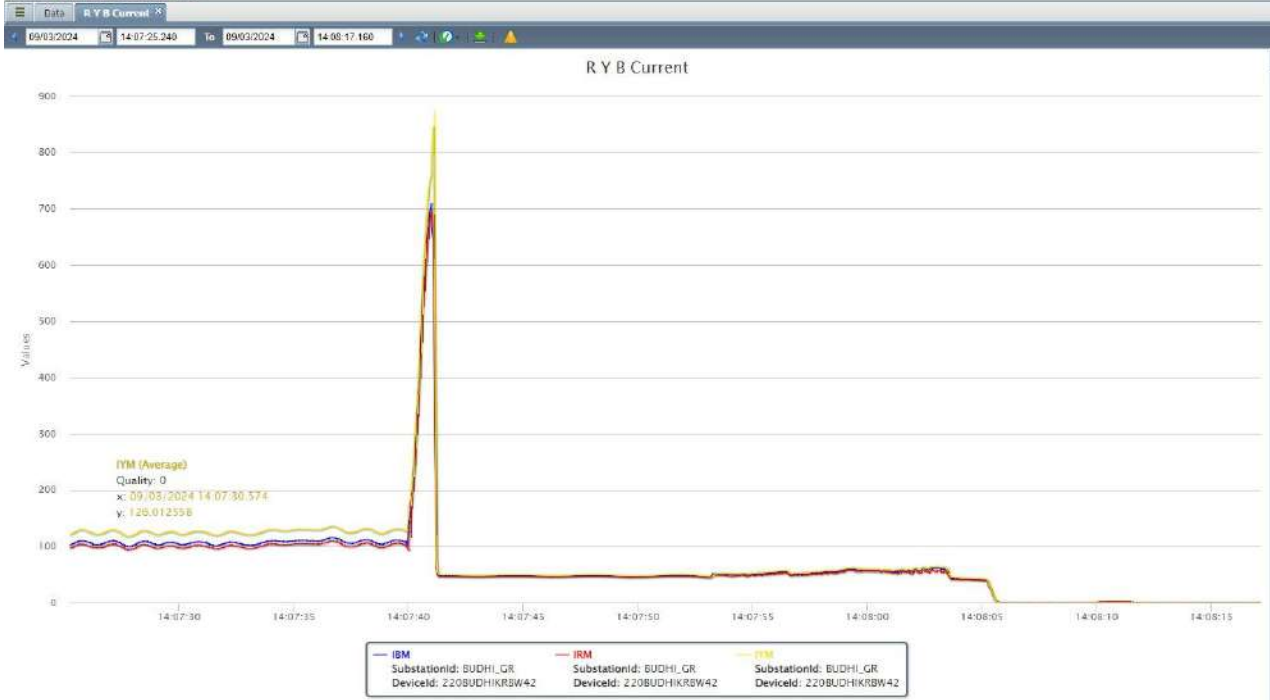


- After tripping of 220 kV Budhipadar-Raigarh line remaining 220 kV Budhipadar-Korba D/C loading increased to more than 200 MW each and Korba line 1 also encountered a 3-phase

fault and tripped, and other circuit observed large power swing up to 600 MW and tripped at 14:07:53 Hrs.

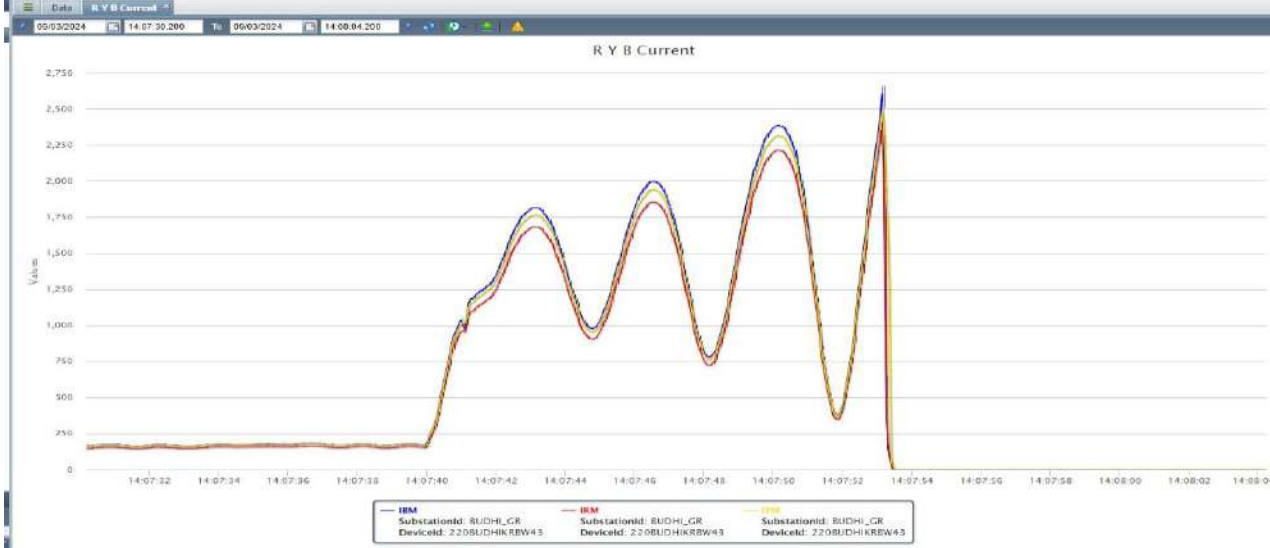
Tripping of 220 kV Budhipadar-Korba-1

R Y B Phase Current



Power Swing & Subsequent tripping of 220 kV Budhipadar-Korba-2

R Y B Phase Current



- After tripping of 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba D/C lines, IB TPS and Vedanta generation lost all grid interconnections only radial load of CPP was there.
- All units at IBTPS tripped on over-frequency due to large imbalance in load generation.

Frequency of the islanded system



- Vedanta and BPSL got islanded but did not survive.
- As reported, 220 kV AAL islanded successfully. Details of islanding of other CPPs not available.

13. Protection/Operational issues observed (सुरक्षा/परिचालन संबंधी समस्या):

- 220 kV Budhipadar-Lapanga-2 tripped in Zone-2 time from Budhipadar. No carrier received at Budhipadar. No A/r attempt taken at Lapanga. OPTCL may explain.
- After tripping of 220 kV Budhipadar-Lapanga-2, line loading of parallel circuit reached to around 350 MW. 220 kV Budhipadar-Lapanga-1 was hand tripped after 15 minutes of the first fault in parallel circuit. Reason for hand-tripping may be explained. Also, whether any instruction given to IB TPS and Vedanta to reduce generation or not?
- Later, 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba-1 tripped one by one. The root cause analysis for tripping may be shared. It is suspected line tripped due to increased sag or low clearance. 220 kV Budhipadar-Korba-1 tripped from Korba end only on Zone-2.
- Power swing of around 600 MW observed in 220 kV Budhipadar-Korba-2 and line tripped later on power swing when impedance came in Zone-1.
- Islanding performance of all CPPs may be submitted and reason for non-survival of islands may be furnished.

- Immediate SPS scheme may be planned for Budhipadar as one single line tripping along with planned outage in one corridor led to a cascading event and loss of around 600 MW net generation. Whether any SOP was prepared before allowing shutdown of 220 kV Budhipadar-Bamra and 220 kV Budhipadar-Kuarmunda?
- PLCC scheme of 220 kV Budhipadar-Raigarh and 220 kV Budhipadar-Korba D/c is not in service. A/r is enabled at Budhipadar end only without PLCC communication. This may be taken up immediately.

14. Action Taken/Remedial Measures (सुधारात्मक उपाय):

- Preventive maintenance to be done at regular intervals to avoid tripping of line during overloading for short duration.
- SPS should be planned immediately for pockets which are heavily congested.
- Proper SOP should be in place for heavily congested corridors while allowing any shutdown for accounting further contingency.
- SLDC should intimate RLDC of instar-state line shutdowns, outage of which is affecting reliability of tie lines.
- Proactive response from generators is needed in following SLDC instructions.

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

S.No.	Issues	Regulation Non-Compliance	Utilities
2.	Whether DR/EL provided within 24 Hours?	1. IEGC section 37.2 (c) 2. CEA grid Standard 15.3	OPTCL (Not

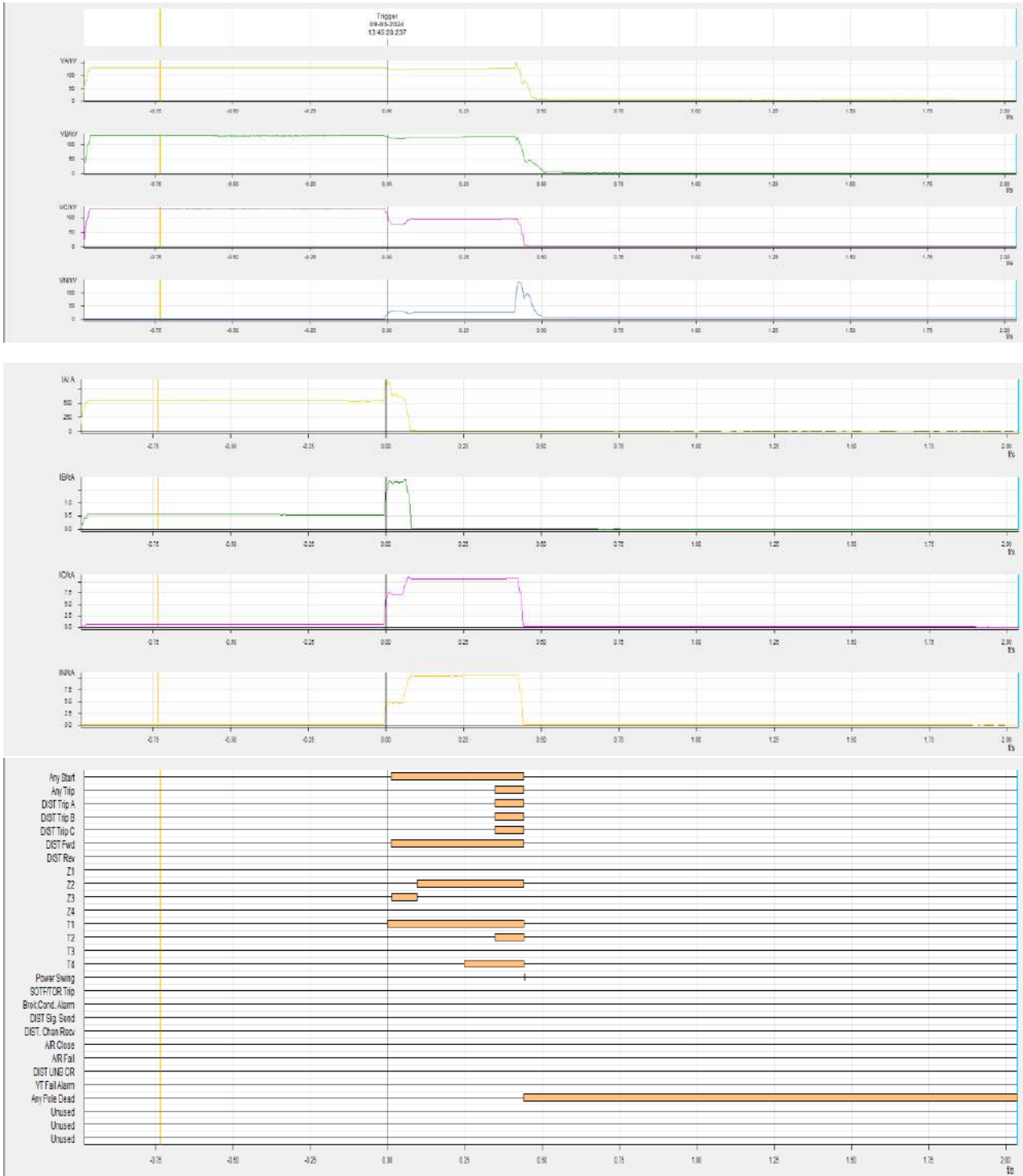
16. Key Lessons Learnt (प्रमुख अधिगम बिंदु): Nil

Annexure 1: (Sequence of Events-As per ERLDC SCADA):

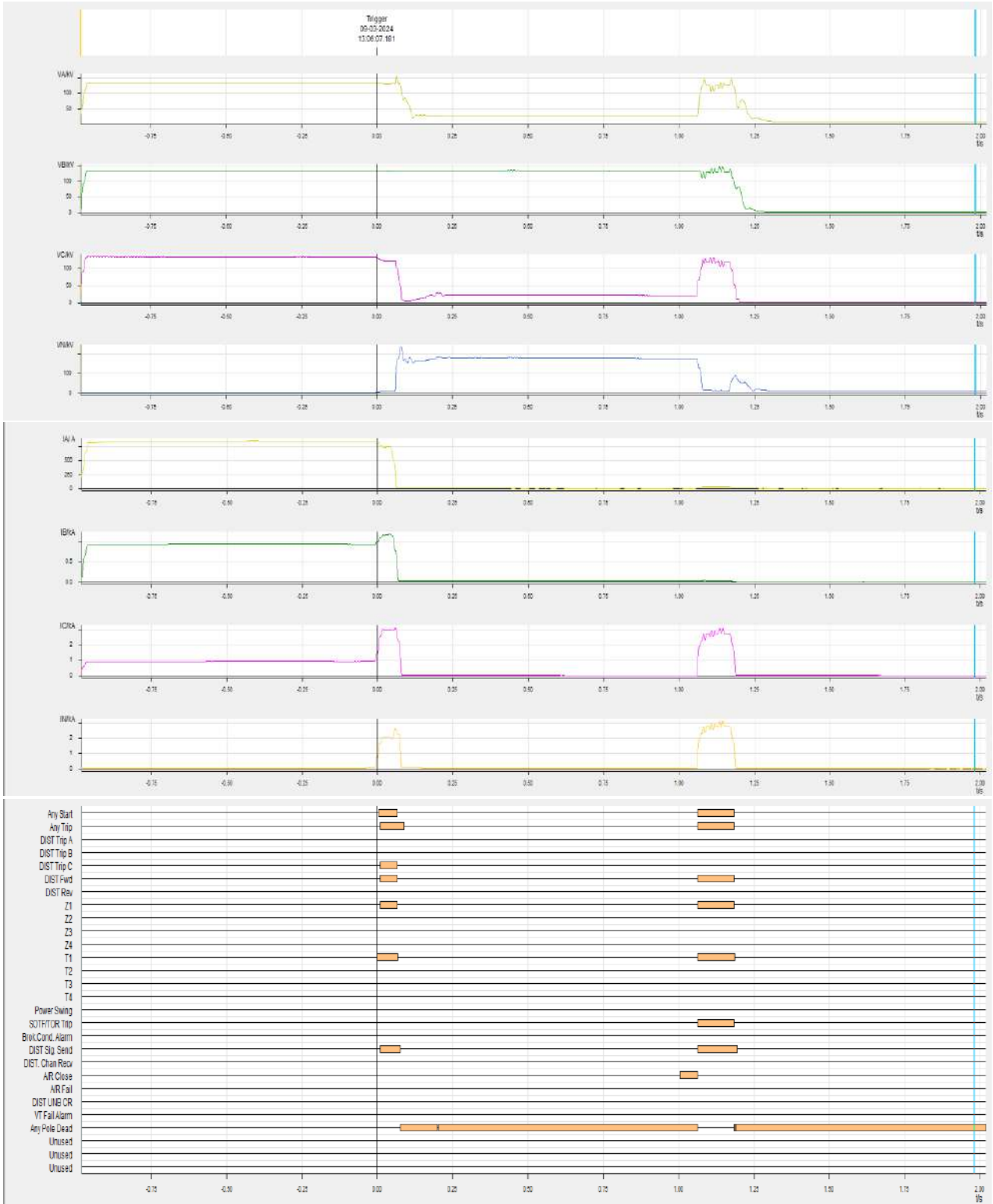
SoE data not available for the event.

Annexure 2:

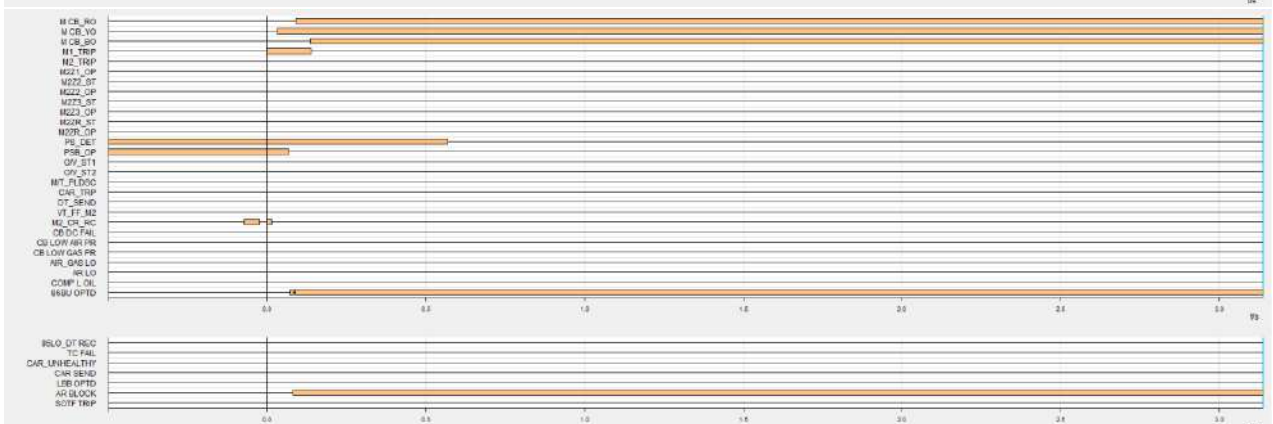
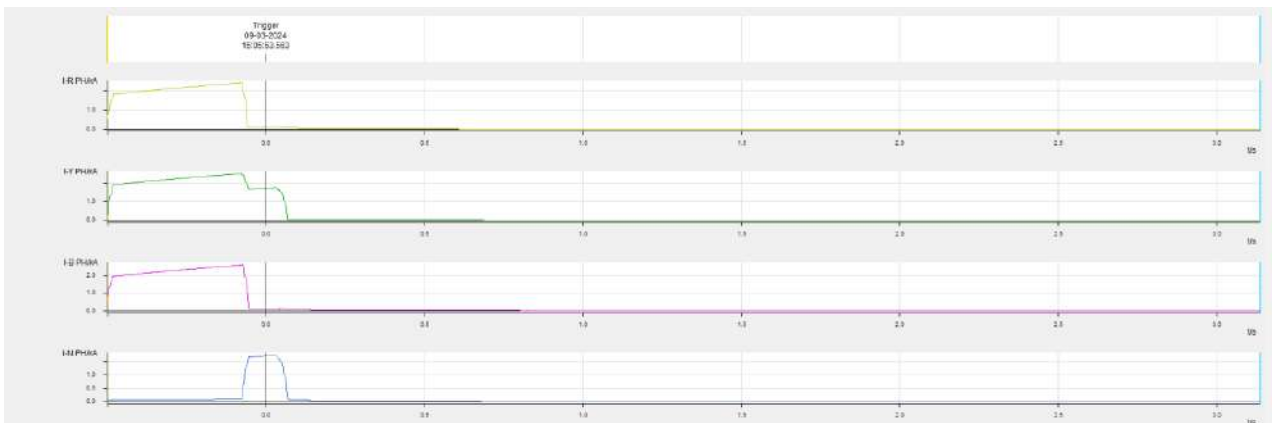
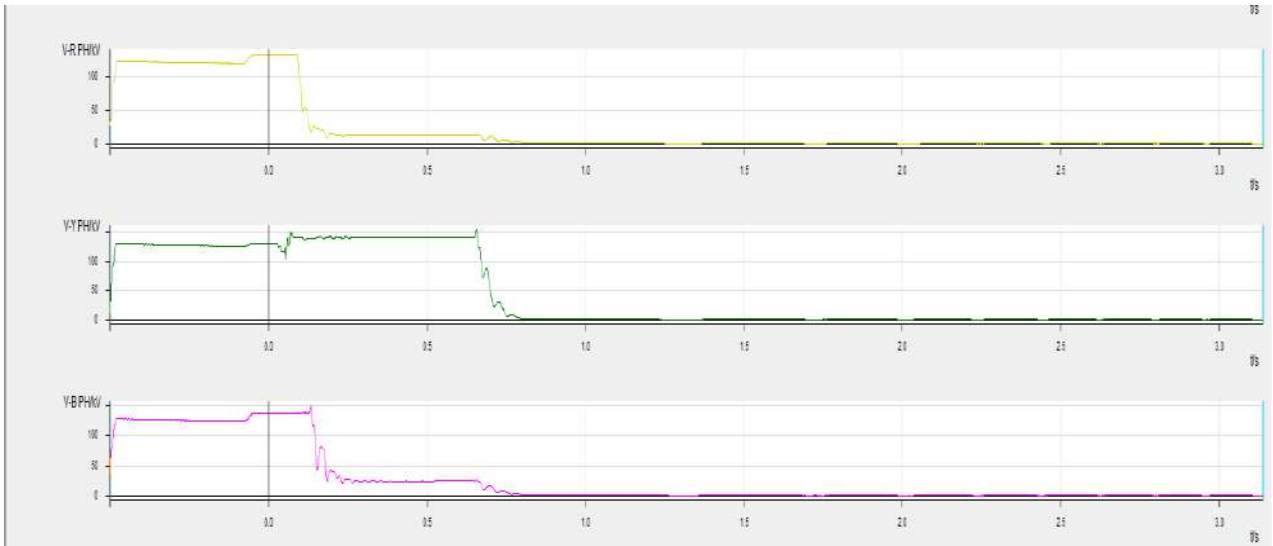
DR of 220 kV Budhipadar-Lapanga-1 (Budhipadar)



DR of 220 kV Budhipadar-Raigarh-1 (Budhipadar)



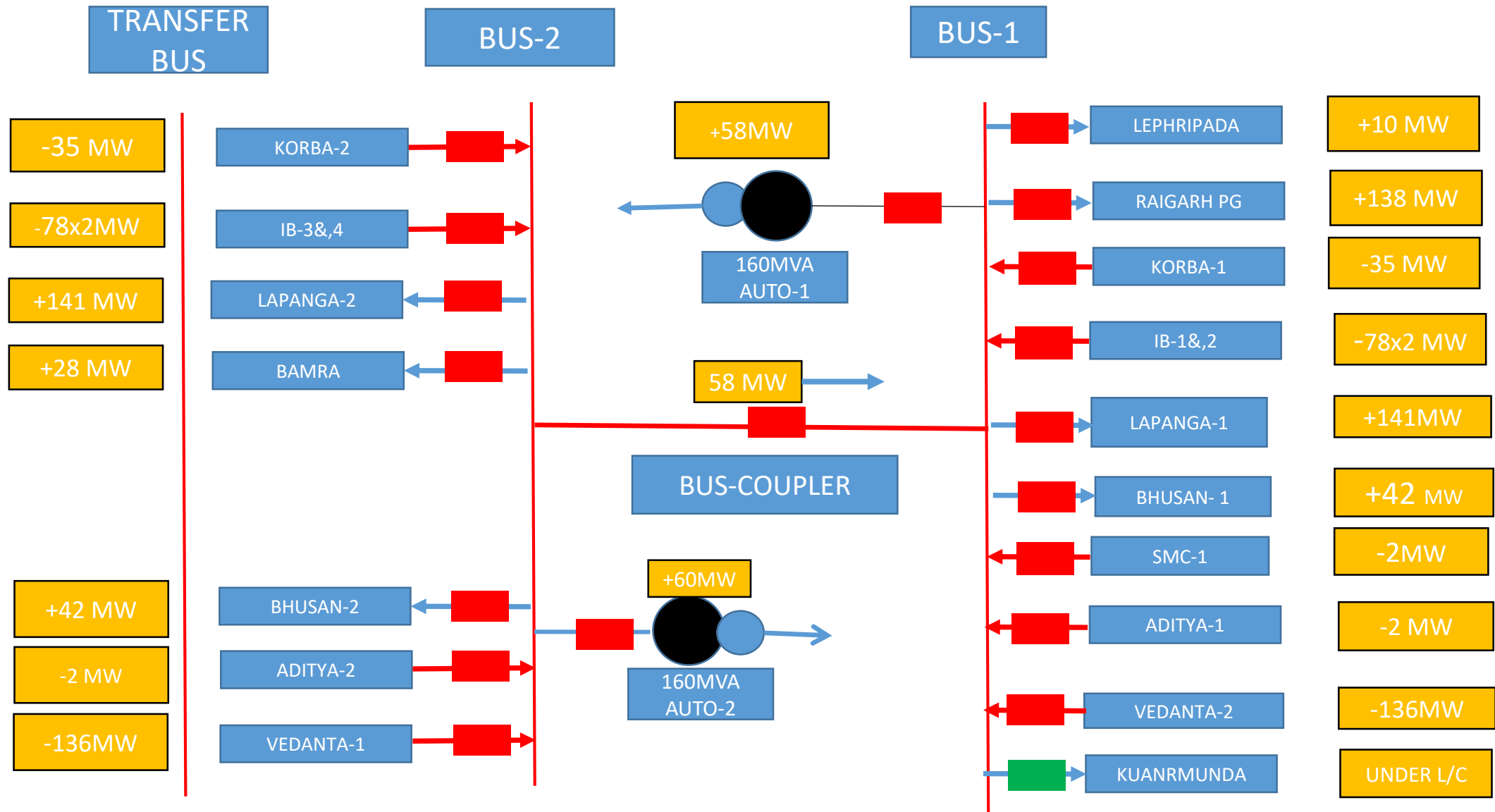
DR of 220 kV Budhipadar-Korba-2 (Budhipadar)



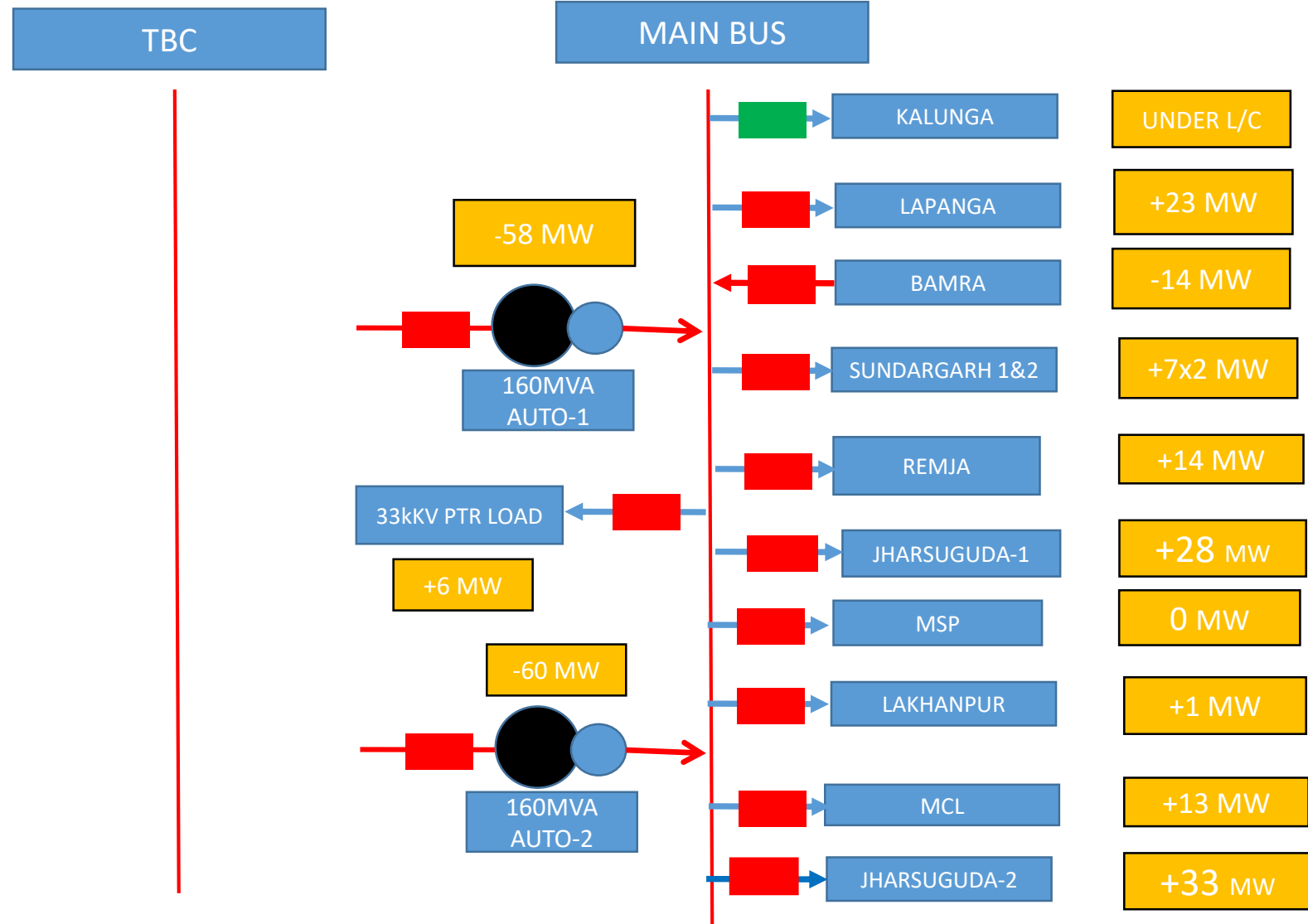
Disturbance and black out occurrence at Budhipadar Grid S/s on dtd 09.03.2024.

- **Date 09.03.2024 ,Time- 13.45 Hrs.**
- **Station : Budhipadar 220/132/33kV GSS**
- **Weather : Sunny.**
- **220KV Kuanrunda feeder ,132KV Kalunga feeder were under L/C for HTLS stringing by Power Grid in 400KV Sundargarh-Rourkela D.C line.**
- **220KV Bamra-Tarkera & 132KV Bamra-Rajgangpur were on L/C for HTLS stringing by Power Grid in 400KV Sundargarh-Rourkela D.C line.**
- **TBC was in free condition and BC was in closed condition.**
- **System disturbance and black out occurred due to mis-match of Generation and load after fault tripping of 220KV Budhipadar-Lapanga ckt-2, 132KV Budhipadar-Lapanga ckt and subsequent hand tripping of 220KV Budhipadar-Lapanga ckt-1 and other feeders.**

PRE-FAULT CONDITION (220KV) @ 13:00 Hrs

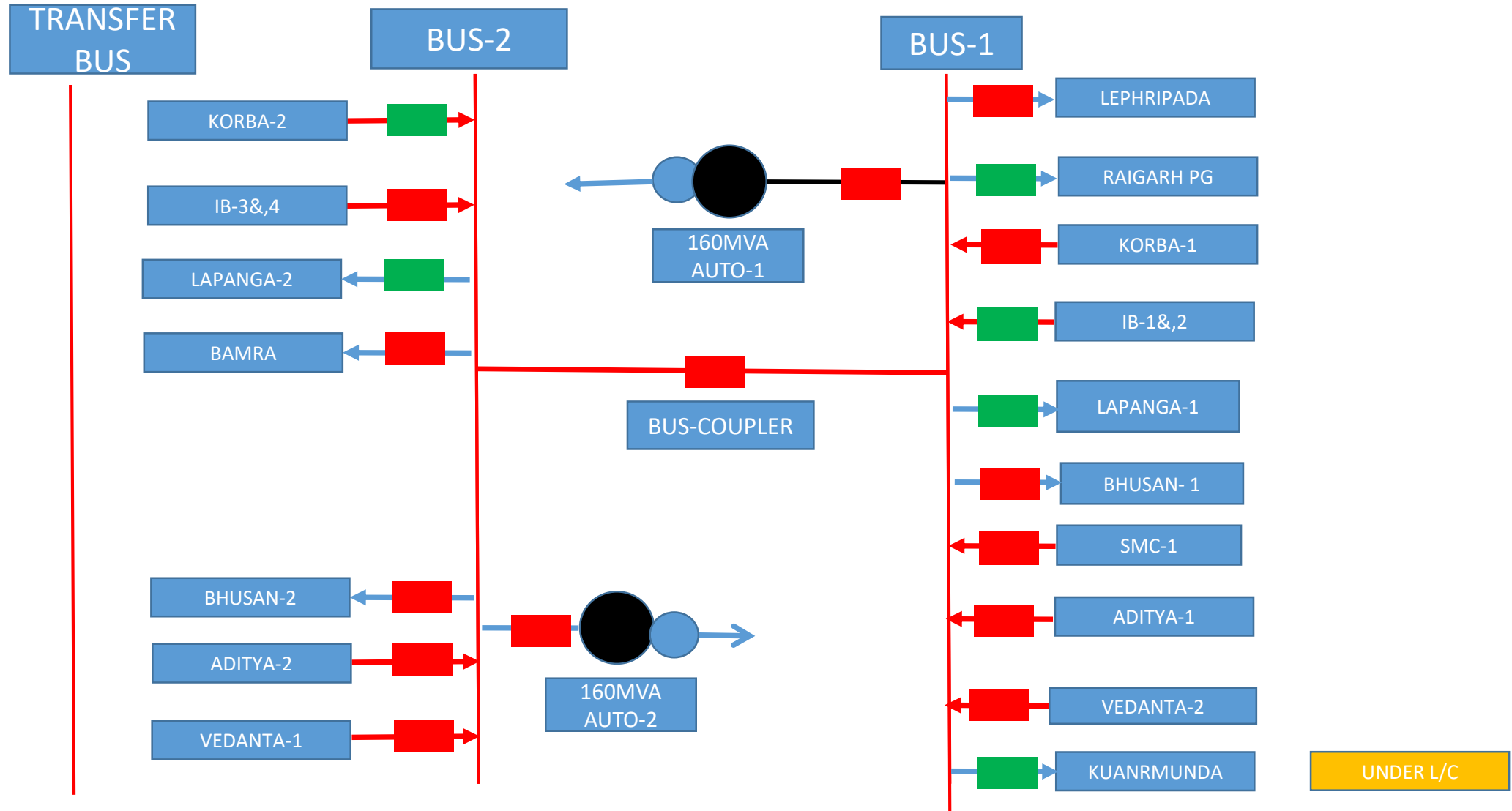


PRE-FAULT CONDITION (132KV) @ 13:00 Hrs



POST-FAULT CONDITION @ 14:05Hrs

(At 13:45Hrs 220 KV Lapanga-2 tripped, At 14:05Hrs 220 KV Raigarh, Korba-2 tripped from Budhipadar end, 220 KV Korba-1 tripped from Korba end & all other feeders were hand tripped at 14:15Hrs)



Date & Time of Occurrence: 09.03.24 at 13:45 Hrs.

Sl.No		Relay Indication		Remarks
		B.Padar End	Remote End	
1	220 KV Budhipadar- Lapanga Ckt- 2 @ 13:45Hrs	DP1(P444): FL=L3-E, Z2, FD=15.25Km, IL3=10.62KA DP2(7SA522): FL=L3-E, Z2, FD=15.2Km, IL3=10.55KA	DP1: FL=L3-E, Z1, FD=0.2Km, IL3=22.16KA DP2: FL=L3-E, Z1, FD=0.2Km, IL3=22.16KA	Tripped due to snapping of B-phase conductor between gantry and First tower at Lapanga end.
2	132KV Budhipadar- Lapanga @ 14:01 Hrs	DP(7SA522): FL=L2-L3, FD=9.9kM, IL1=0.77KA, IL2=5.8KA, IL3=6.38KA	DP: FL=L2-L3, FD=6.8kM, IL1=0.77KA, IL2=7.08KA, IL3=7.84KA	Tripped due to snapping of B-phase conductor & jumper over Y-Phase conductor near SMC-1 plant.
3	220KV Budhipadar- Raigarh @ 14:05 Hrs	DP1(P444): FL=L3-E, Z1, FD=57.29Km, IL3=2.448KA DP2(7SA522): FL=L3-E, Z1, FD=57.2Km, IL3=2.57KA	DP: FD=20.38Km, FL=L3-E, IL3=5.94KA	
4	220KV Budhipadar- korba-1 @	No Trip	DP: Zone-2,FD=302.8Km, FL=L3-E,	

Sl.No.	Name of feeder	Relay Indication		Remarks
		B.Padar End	Remote End	
5	220 KV Budhipadar- IB1 &IB-2@14:05 Hrs	D.T Received	DP: Over Voltage Trip	
7	220 KV Budhipadar - Korba-2 @ 14:07 Hrs	Zone-1, IL2-E, FD=77.46Km IL2=1.75KA,Power Swing trip.	DP: Z2, Tripped phase=ABCN, FD=181.9Km,Ia=2.368KA, Ib=2.471KA, Ic=2.55KA	
8	220KV VAL-1&2 tripped at their end, 220KV AAL-1 & 2 , BSPL-1 & 2 Lines were islanded from remote end . All other 220KV, 132KV and 33 KV feeders were hand tripped at 14:15 Hrs to initiate restoration of power Supply.			

Analysis:-

- 1. At 13:45Hrs 220KV Budhipadar- Lapanga ckt-2 tripped at both end due to fault(Snapping of B-ph conductor) between gantry and First tower near Lapanga GSS. After such tripping, load of 220 KV Budhipadar- Lapanga feeder-2 (around 141MW) shifted to 220KV Budhipadar-Lapanga Ckt-1 & 132KV Budhipadar-Lapanga Ckt through Auto TRFs of Budhipadar GSS.**
- 2. Due to heavy load, fault in Y-B phase developed (resulted in snapping of conductor & jumper) in 132KV Budhipadar - Lapanga ckt and tripped at both end. Further, load increased to > 300MW in 220KV Budhipadar-Lapanga ckt-1. In the mean time to maintain balance between generation and load, 220KV Budhipadar - Lapanga ckt-1 was hand tripped .**
- 3. The connected industries i.e. 220KV Vedanta and Bhusan tripped at their end but 220KV AAL was islanded successfully.**
- 4. 220KV interstate lines i.e. Raigarh, Korba-1 and Korba-2 also tripped due to excess power flow and consequent fault developed in the line.**
- 5. 220KV IBTPS ckt-1 & ckt-2 tripped at both end but ckt-3 and ckt-4 breakers were in ON condition at Budhipadar end. But due to sudden change in load, the Generators of IBTPS tripped on Over Frequency.**
- 6. Finally, black out situation occurred after Generation out from IBTPS and Vedanta at Budhipadar GSS. The system was collapsed due to heavy unbalance in supply and demand.**

REMEDIAL MEASURES:

- 1. 220KV Budhipadar-Lapanga ckt-2 and 132KV Budhipadar-Lapanga ckt brought back into service at 14.35hrs & 19.26 hrs on dt.10.03.2024 respectively after rectification work.**
- 2. The tightening of jumpers at different affected points have been attended.**


ग्रिड-इंडिया
GRID-INDIA

ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड
 (भारत सरकार का उद्यम)
GRID CONTROLLER OF INDIA LIMITED
 (A Government of India Enterprise)
 [formerly Power System Operation Corporation Limited (POSOCO)]

पूर्वी क्षेत्रीय भार प्रेषण केन्द्र / Eastern Regional Load Despatch Centre

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400 केवी बाढ़ (एनटीपीसी) उपकेंद्र पूर्वी क्षेत्र में ग्रिड घटना की विस्तृत रिपोर्ट / Detailed Report of grid event at 400 kV Barh (NTPC) Substation in Eastern Region

(To be submitted by RLDC/NLDC during Grid Disturbances/Grid Incidents/Near Miss Event as per IEGC section 37.2 (f))
(आई ई जी सी 37.2 (एफ) के अनुपालन में)

Date(दिनांक):09-04-2024

1. Event Summary (घटना का सारांश):

At 04:41 Hrs on 31.03.2024, 400 kV Bus-3 & Bus-4 at Barh tripped. As reported, B_ph CT of main bay of Barh-Patna-2 burst at Barh and 400 kV Bus-4 tripped. After 910 msec, R_ph CT of main bay of 400 kV Barh-Patna-1 got damaged at Barh and 400 kV Bus-3 tripped. Consequently, all elements associated with 400 kV Bus-3 & Bus-4 tripped including U#4 & U#5 (660 MW each). Total generation loss of around 1251 MW occurred.

2. Time and Date of the Event (घटना का समय और दिनांक): 04:41 hrs of 31.03.2024

3. Event Category (ग्रिड घटना का प्रकार): Grid Incident (GI)-2

4. Location/Control Area (स्थान/नियंत्रण क्षेत्र): Barh

5. Report submitted by Utility on: Not received yet.

6. Antecedent Conditions (पूर्ववर्ती स्थिति):

	Frequency	Regional Generation	Regional Demand	Barh St-II Generation
Pre-Event (घटना पूर्व)	50.03 Hz	29220 MW	20609 MW	1251 MW
Post Event (घटना के बाद)	49.91 Hz	27969 MW	20609 MW	0 MW

**Pre and post data of 1 minute before and after the event*

Important Transmission Line/Unit if under outage (महत्वपूर्ण संचरण लाइने/ विद्युत उत्पादन इकाइयां जो बंद हैं)	NIL
Weather Condition (मौसम स्थिति)	Normal

7. Load and Generation loss (लोड और जेनरेशन हानि): No load loss and Generation loss was 1251 MW.

8. Duration of interruption (रुकावट की अवधि): 04:41 hrs to 07:00 hrs.

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

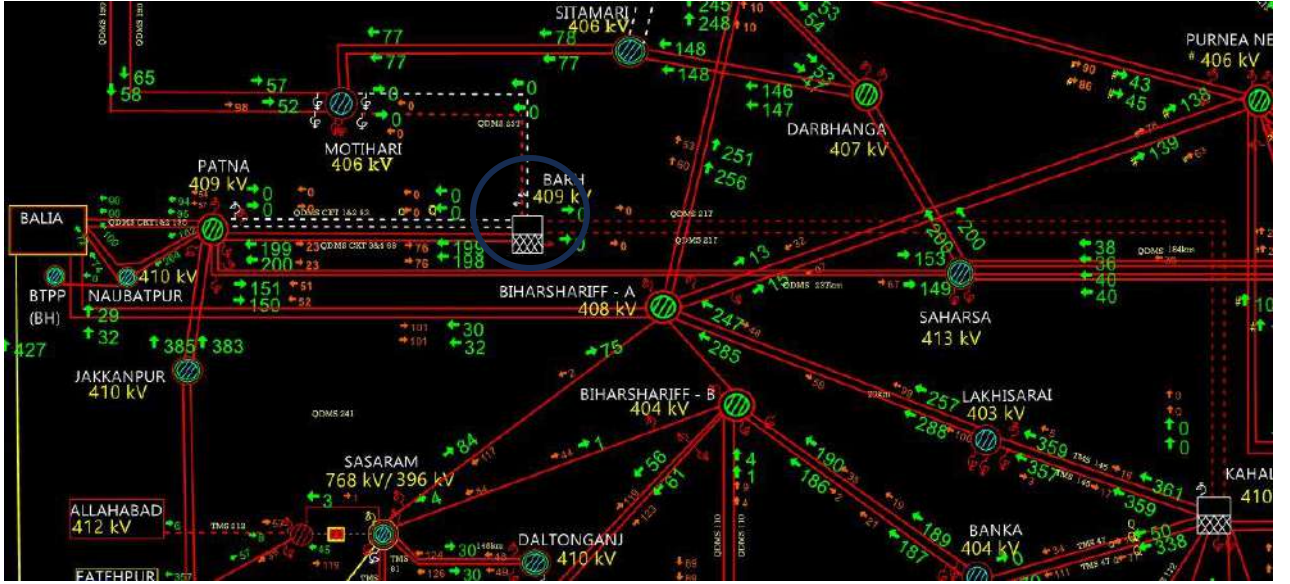


Figure 1: Scada Network Snapshot of affected area

10. Details of Equipment Failure (if any during the event) (उपकरण विफलता का विवरण): B_ph CT of main bay of 400 kV Barh Patna-2 at Barh and R_ph CT of main bay of 400 kV Barh-Patna-1 at Barh failed.

11. Major Elements Tripped (प्रमुख ट्रिपिंग):

क्र०सं०	नाम	Trip time (hh:mm:ss)	उप केंद्र 1 रिसे संकेत	उप केंद्र 2 रिसे संकेत	Restoration time
1	400 kV Barh-Patna-2	04:41:05.680	Barh: Bus bar protection operated; Teed protection operated	Patna: DT received	18:28 (02.04.24)
2	400 kV Bus-4 at Barh		Barh: Bus bar protection operated		07:00
3	400 kV Bus-3 at Patna	04:41:06.520	Barh: Bus Bar protection operated		07:24
4	400 kV Barh-Kahalgaon-1		Barh: Bus bar protection & Teed protection operated	Kahalgaon: Didn't trip	08:32
5	400 kV Barh-Motihari-1		Barh: Bus bar protection operated	Motihari: DT received	07:00
6	U#4 & U#5 at Barh		Barh: Bus bar protection operated		14:00/13:02
7	400 kV Barh-Patna-1		04:41:06.957	Barh: LBB operated after bus bar protection	Patna: DT received
8	400 kV Barh-Motihari-2	04:41:11.600	Barh: O/V St.1	Motihari: DT received	07:24
9	400 kV Barh-Kahalgaon-2		Barh: DT received	Kahalgaon: O/V St.1	08:25

12. Event Analysis (Based on PMU, SCADA & DR) (घटना का विश्लेषण):

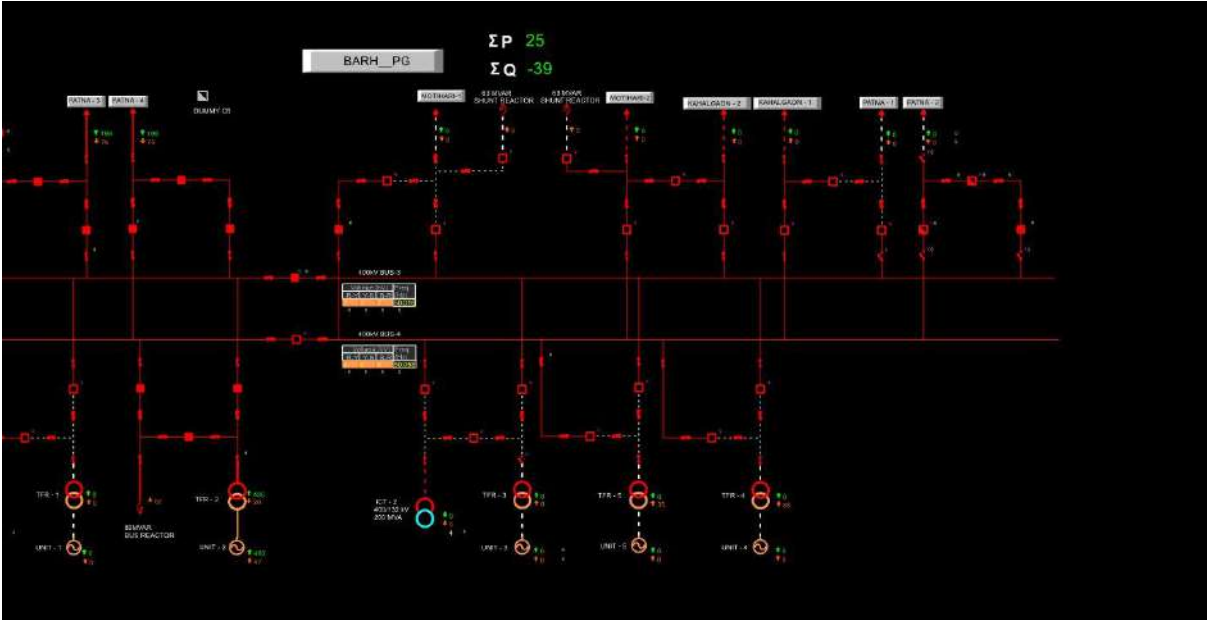


Figure 2: SLD of 400 kV Barh S/s

- At 04:41:05.680 Hrs, B_ph CT of Main Bay of 400 KV Barh-Patna-2 at Barh burst leading to operation of Bus bar protection of Bus-4 at Barh and operation of Teed protection of the bay. Consequently, all breakers connected to 400 kV Bus-4 tripped. Due to operation of Teed differential, DT was sent to Patna for 400 kV Barh-Patna-2.

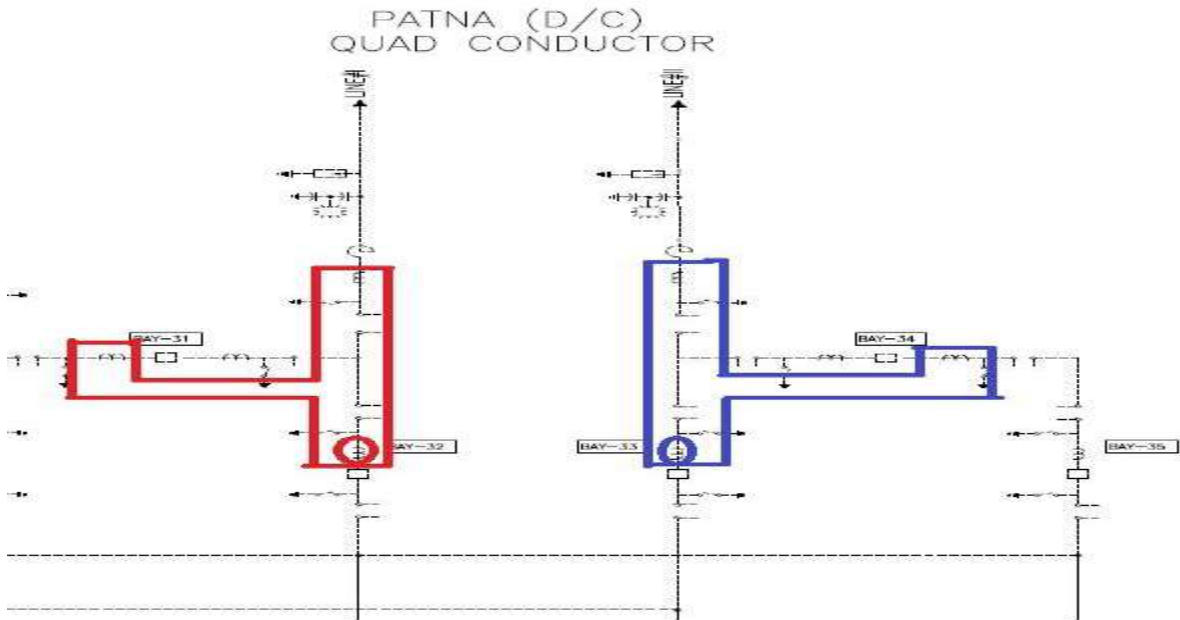


Figure 3: Fault in Barh Switchyard & operation of TEED

- At 04:41:06.520 Hrs, R_ph CT of Main Bay of 400 kV Barh-Patna-1 at Barh damaged leading to operation of Bus bar protection of Bus-3 at Barh and operation of Teed protection of the bay. Consequently, all breakers connected to 400 kV Bus-3 tripped.
- However, during teed operation of this bay, DT was not received at remote end immediately and since fault was in CT, remote end continued feeding the fault which can be confirmed by reversal of current direction as in below figure at Barh end. LBB signal got high at Barh, however all breakers already opened on bus bar protection. After 350 msec, DT was received at Patna and all three phases at Patna opened. Barh may confirm when DT was sent and the reason for delay in DT receipt may be examined.

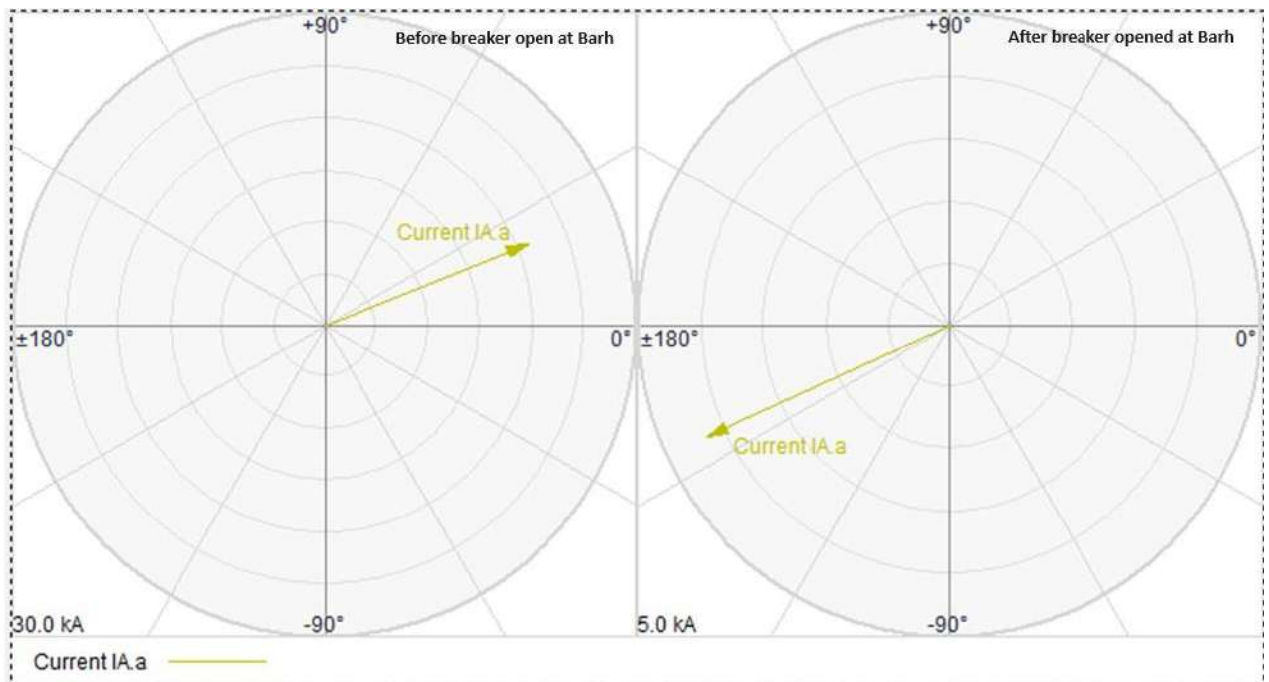


Figure 4:R_ph current of 400 kV Barh-Patna-1 at Barh (Pre and Post opening of breaker at Barh)

- 400 kV Barh-Kahalgaon-1(from Barh only), 400 kV Barh-Motihari-1, U#4 and U#5 tripped.
- During fault in 400 kV Barh-Patna-1, 400 KV Barh-Kahalgaon-2 tripped from Kahalgaon. Reason for the same may be explained by NTPC.
- The dia with 400 kV Kahalgaon-2 and Motihari-2 remained charged from Motihari with tie bay being closed at Barh. Both lines later tripped at 04:41:11.600 on O/V St.1.
- Root cause analysis of failure of the 2 CTs may be done at the earliest.

PMU Snapshot: R Y B Phase Current

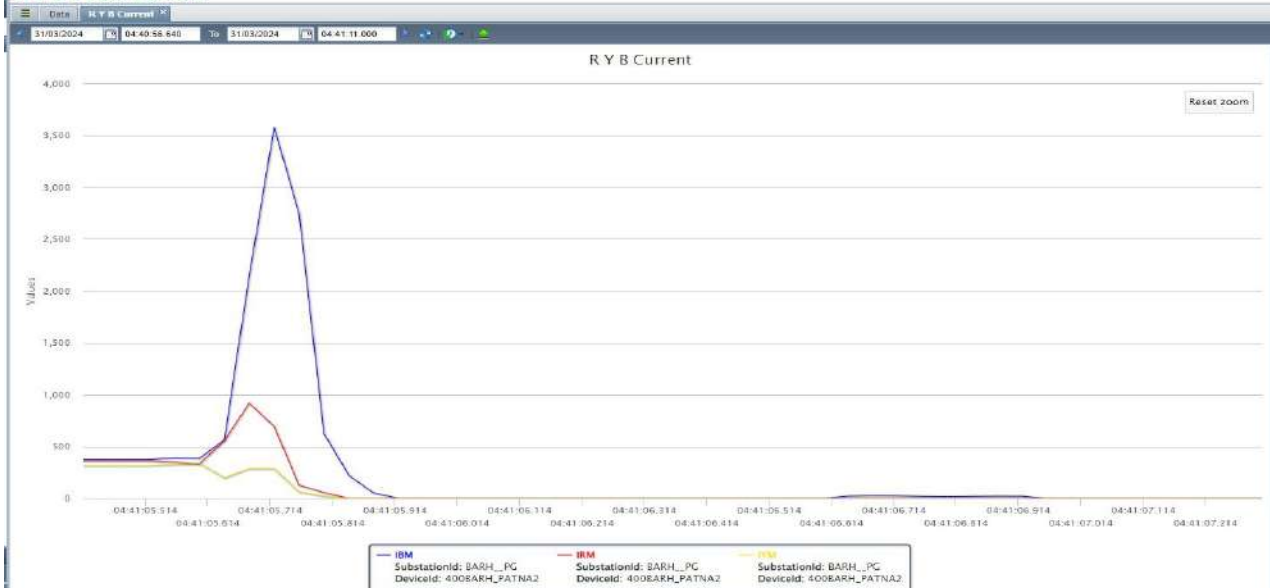


Figure 5 : PMU Current snapshot of 400 KV Barh-Patna-2 at Barh

R Y B Phase Current

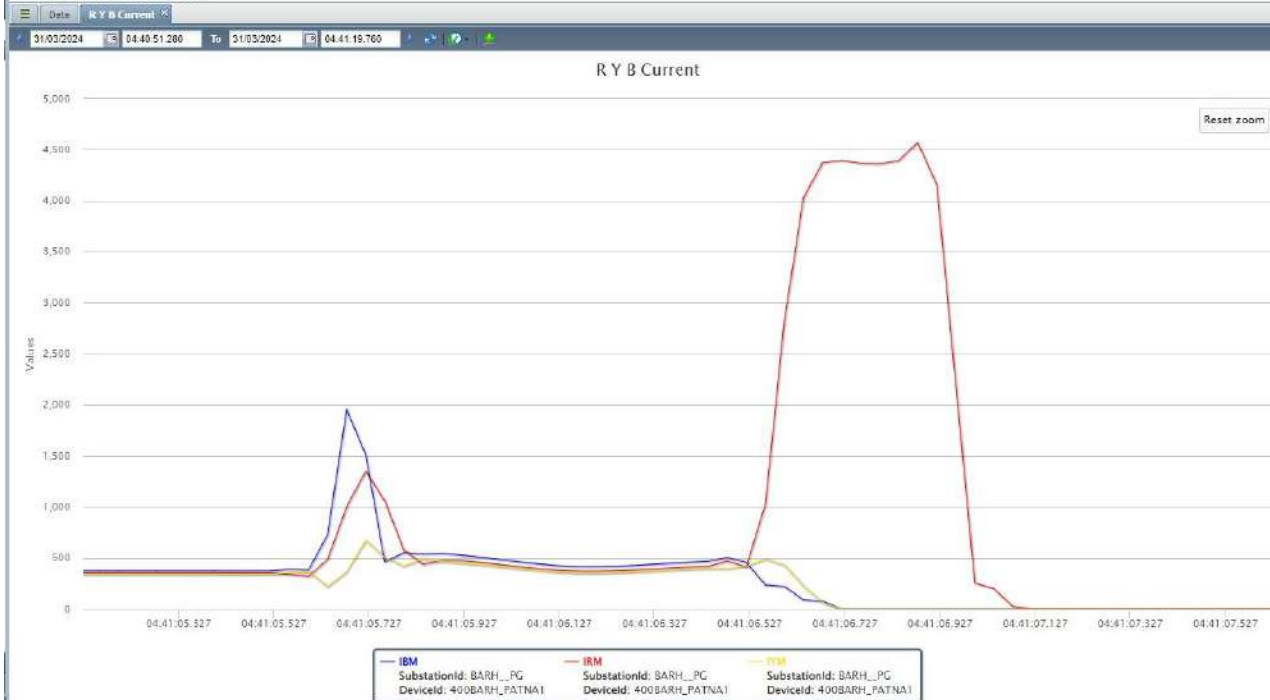


Figure 6: PMU Current snapshot of 400 KV Barh-Patna-1 at Barh

R Y B Phase Current

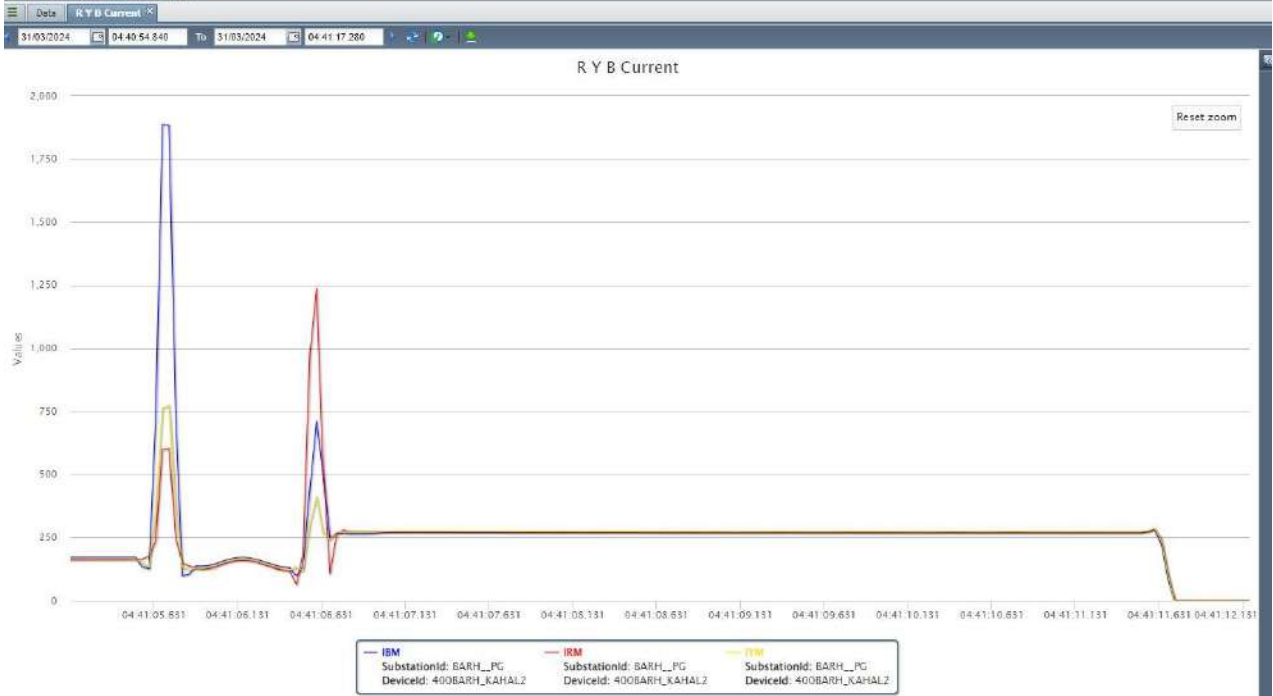


Figure 7: PMU Current snapshot of 400 KV Barh-Kahalgaon-2 at Barh

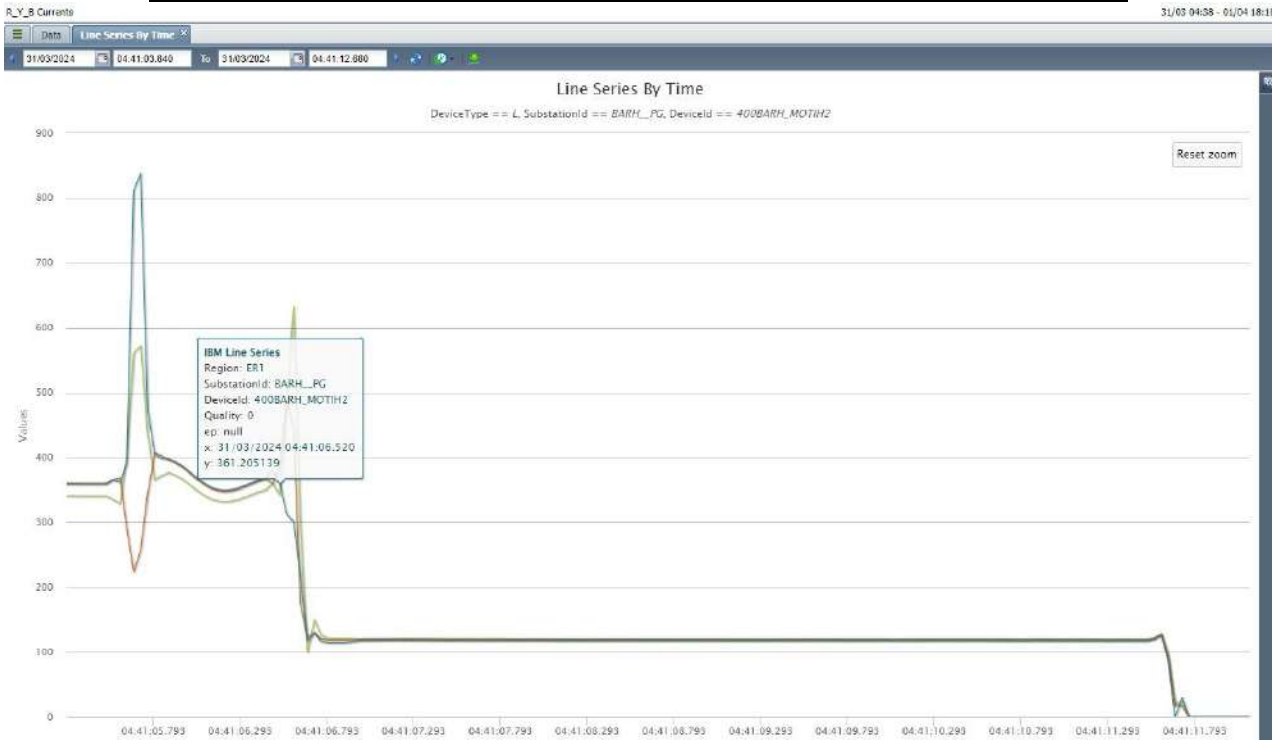


Figure 8: PMU Current snapshot of 400 KV Barh-Motihari-2 at Barh

13. Protection/Operational issues observed (सुरक्षा/परिचालन संबंधी समस्या):

- Delayed DT receipt is suspected for 400 kV Barh-Patna-1 after TEED operation. Reason for the same may be examined.
- 400 kV Barh-Kahalgaon-2 tripped from Kahalgaon end during bus bar operation at Barh end. It is in separate dia and shouldn't have tripped from Kahalgaon. NTPC may explain.
- DR from NTPC Kahalgaon is yet to be received.
- Detailed report from Barh is also awaited.

14. Action Taken/Remedial Measures (सुधारात्मक उपाय):

- Root cause analysis of CT failure may be done and possibility of avoiding such failure may be explored.

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

S.No.	Issues	Regulation Non-Compliance	Utilities
1.	DR/EL not provided within 24 Hours	1. IEGC section 37.2 (c) 2. CEA grid Standard 15.3	NTPC Barh, PG ER-1, DMTCL, NTPC Kahalgaon
2.	Submission of detailed report by user	1. IEGC section 37.2 (f)	NTPC Barh

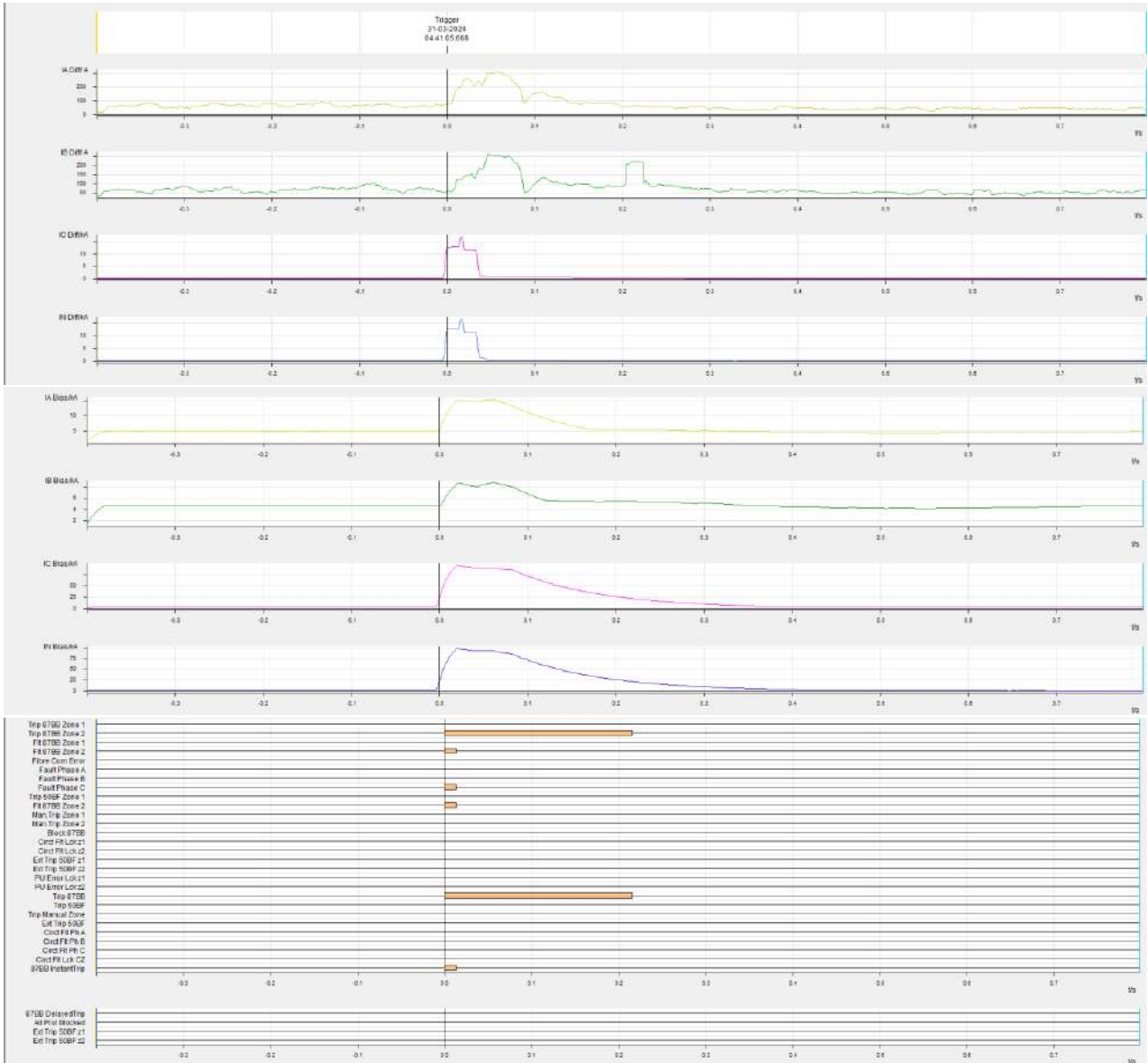
16. Key Lessons Learnt (प्रमुख अधिगम बिंदु): Nil

Annexure 1: (Sequence of Events-As per ERLDC SCADA)

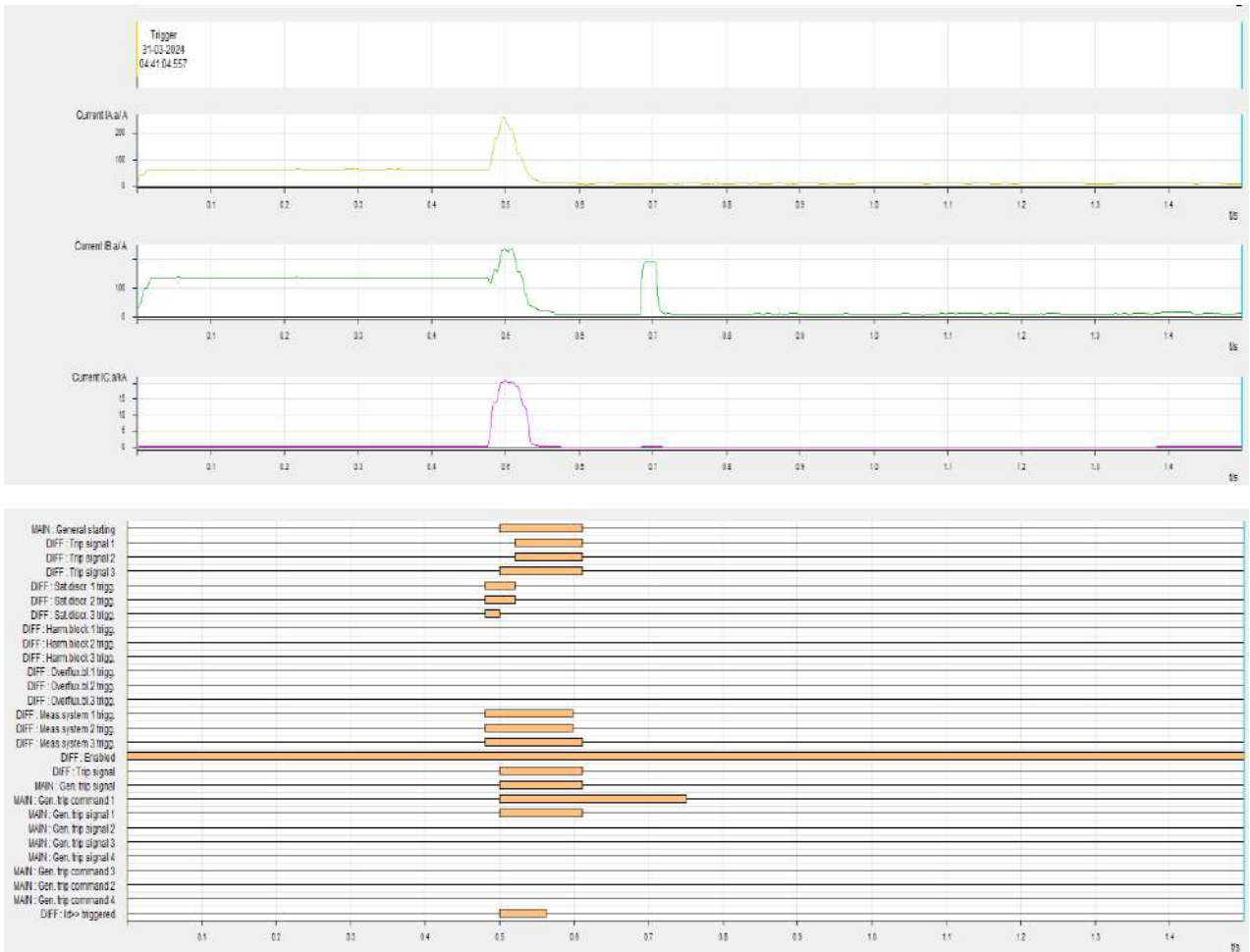
TIMESTAMP	STATION	DESCRIPTION	STATUS
04:41:05.754	PATNA_PG	400_BALIA_NR_1_BARH_PG_2_Tie	Open
04:41:05.759	PATNA_PG	400_BARH_PG_2_Main_CB	Open
04:41:05.764	PATNA_PG	400_BARH_PG_2_R_CB	Open
04:41:06.662	MOTIH_PG	400_BARH_PG_1_Main_CB	Open
04:41:06.666	MOTIH_PG	400_BARH_PG_1_R2_Tie	Open
04:41:06.673	MOTIH_PG	400_BARH_PG_1_R_CB	Open
04:41:06.957	PATNA_PG	400_BARH_PG_1_Main_CB	Open
04:41:06.958	PATNA_PG	400_BALIA_NR_2_BARH_PG_1_Tie	Open
04:41:06.966	PATNA_PG	400_BARH_PG_1_R_CB	Open
04:41:11.720	MOTIH_PG	400_BARH_PG_2_Main_CB	Open
04:41:11.724	MOTIH_PG	400_BARH_PG_2_R1_Tie	Open
04:41:11.725	MOTIH_PG	400_BARH_PG_2_R_CB	Open

Annexure 2:

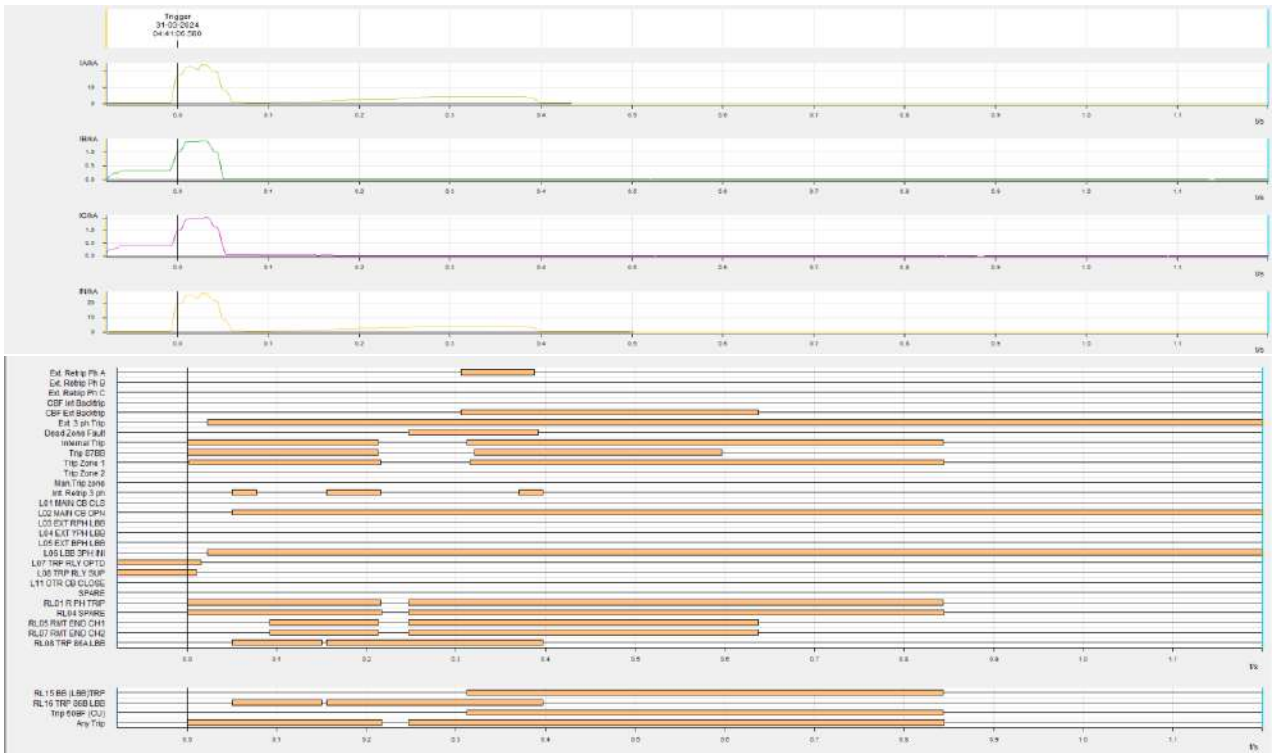
DR of 400 kV Bus-4 at Barh (Differential)



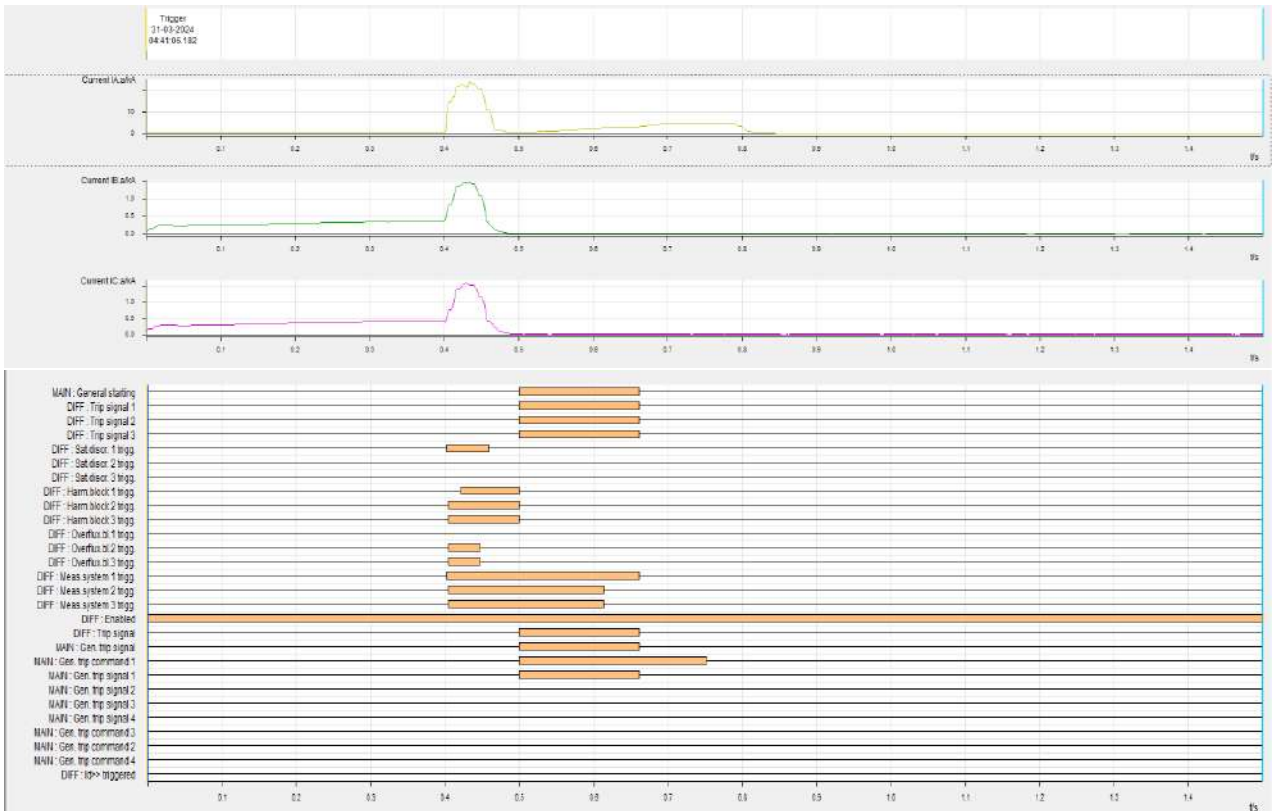
DR of Teed operation of 400 kV Barh-Patna-2 main bay at Barh



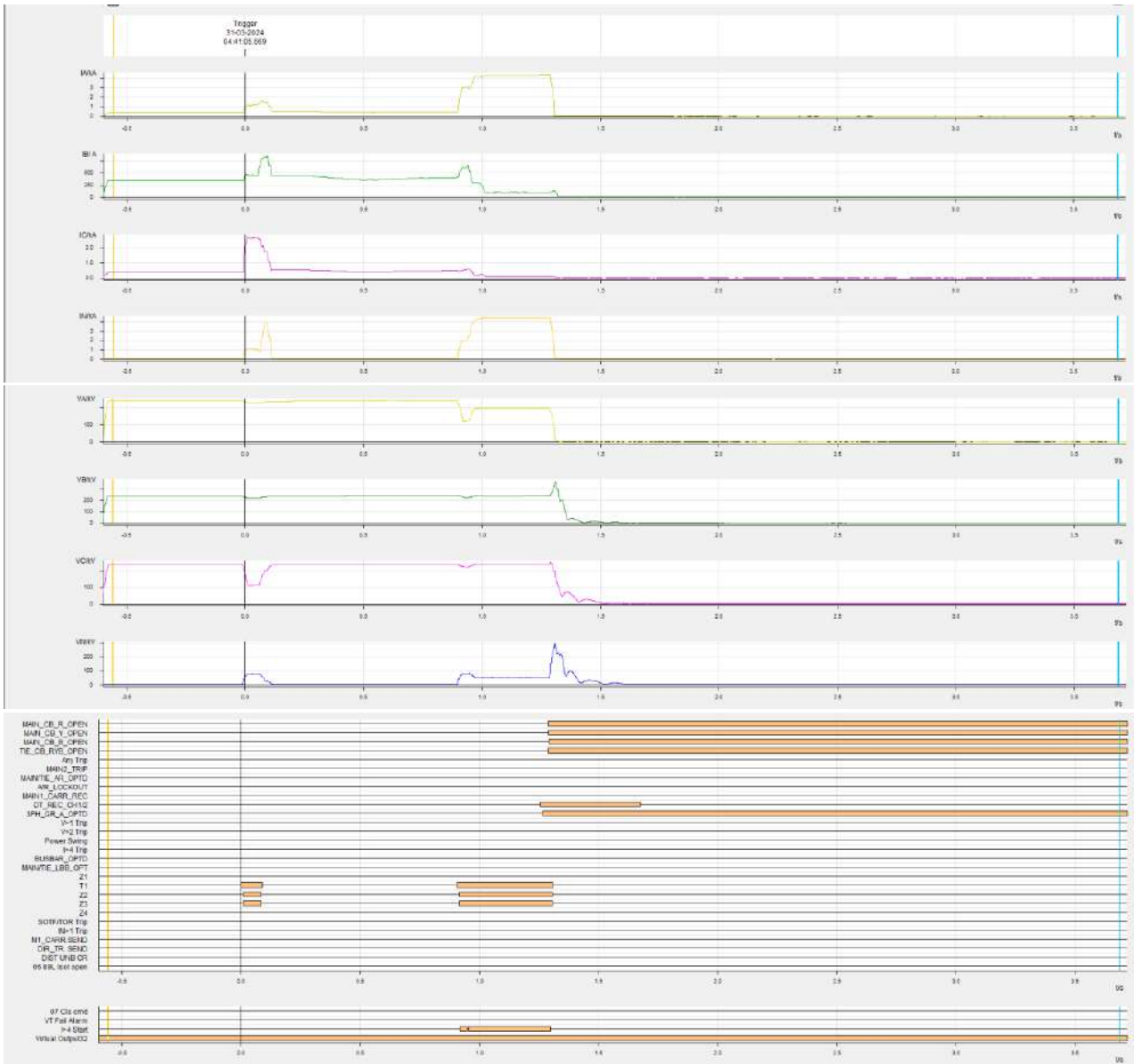
DR of 400 kV Barh-Patna-1 at Barh (Bus bar differential for 400 kV Bus-3)



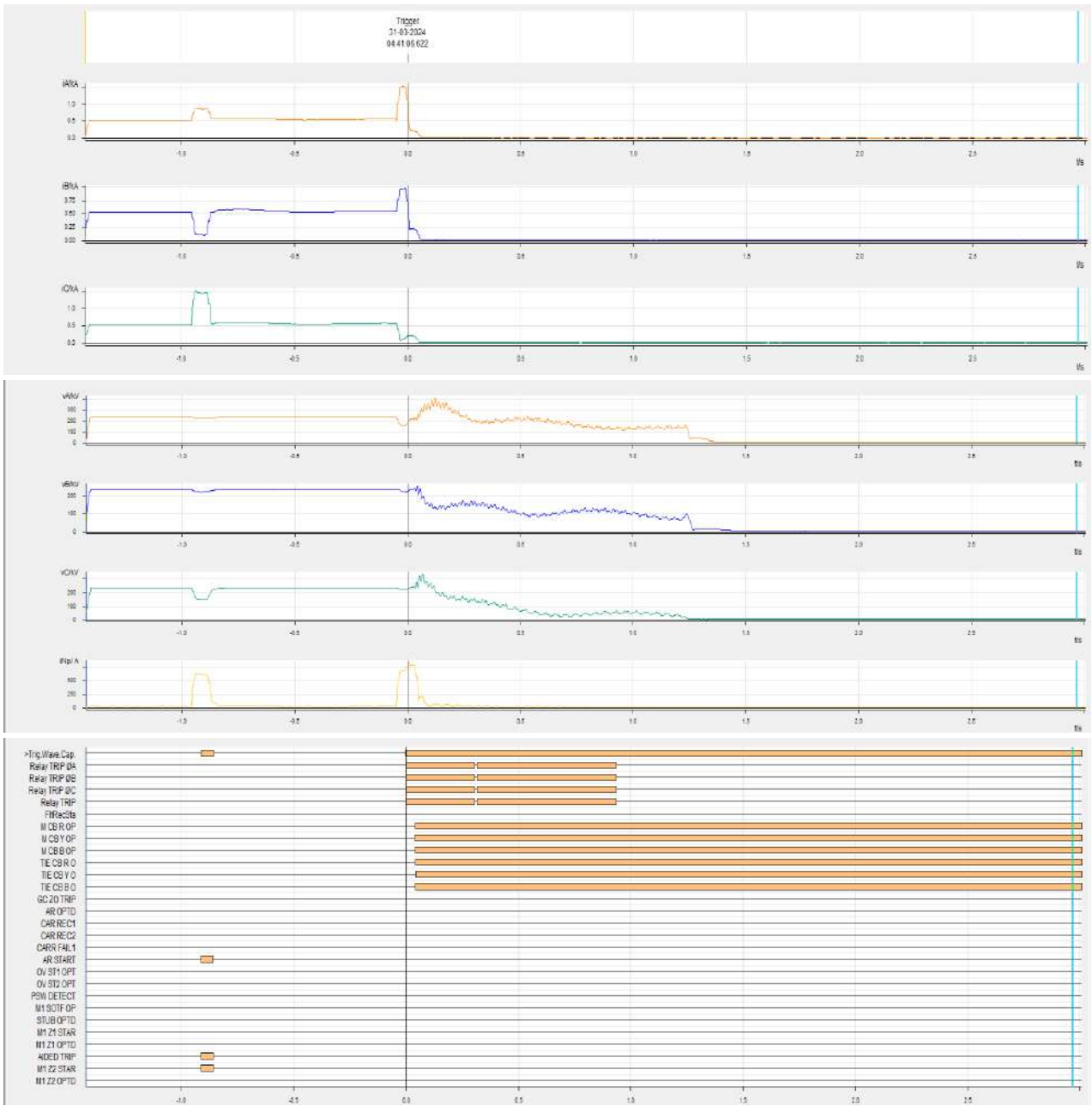
DR of Teed operation of 400 kV Barh-Patna-1 main bay at Barh



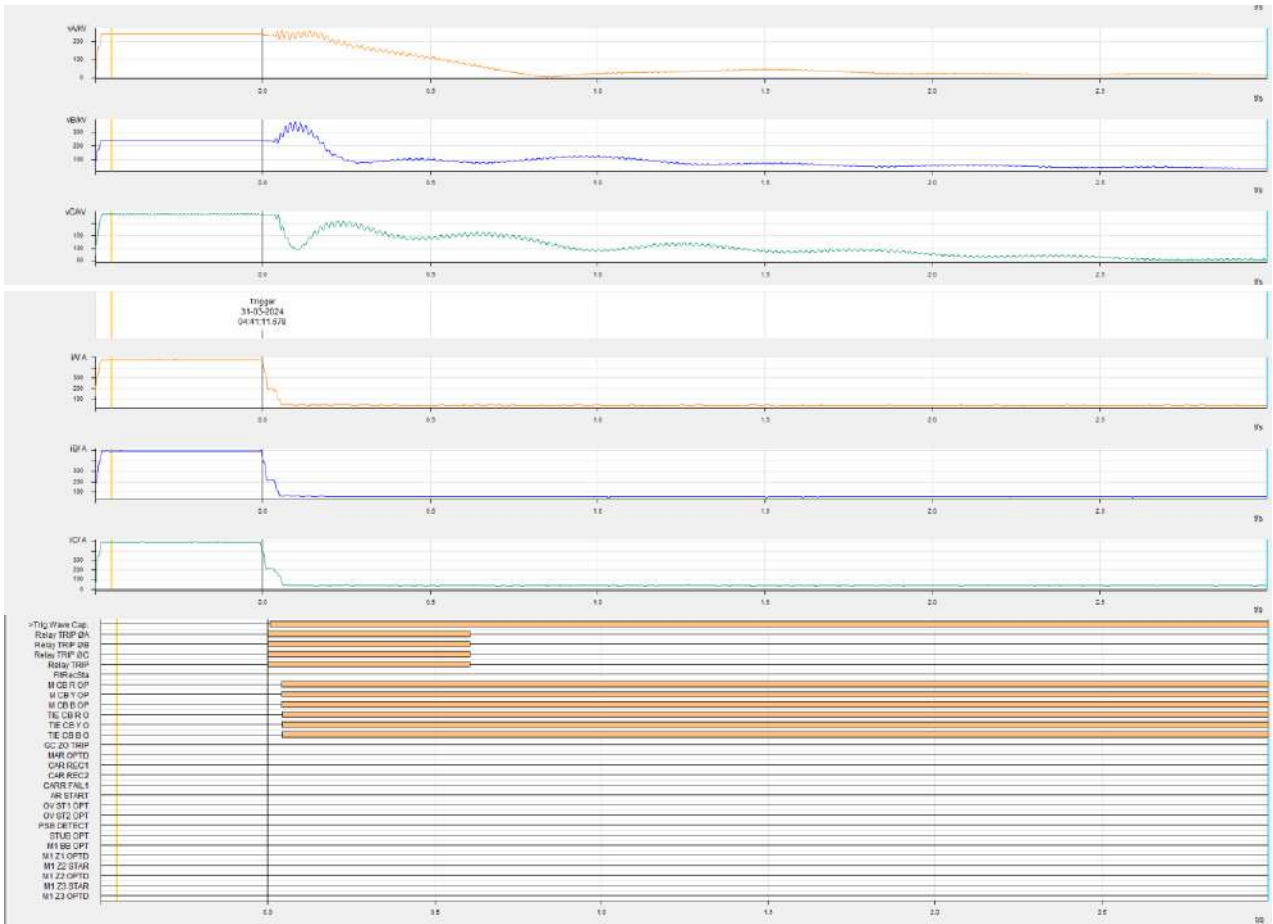
DR of 400 kV Barh-Patna-1 (Patna)



DR of 400 kV Barh-Motihari-1 (Motihari)



DR of 400 kV Barh-Motihari-2 (Motihari)



Grid Incident Report at NTPC Barh on 31.03.2024

Location: 400 kV NTPC Barh substation

Time: 04:41:05.669 hours

Elements outage

1. 400 kV Bus-III, IV
2. 400 kV Barh-Patna Line I, II
3. 400 kV Barh-Kahalgaon Line I, II
4. 400 kV Barh-Motahari I, II
5. 400 kV Bus sectionalizer (Between Bus-I, III; Bus II, IV)
6. Generating Units: IV, V (660 MW each)
7. 400/132 kV Interconnecting Transformer-2

Station survived on

1. Generating Unit-II
2. 400 kV Bus-I, II
3. 400 kV Barh-Patna- III, IV
4. 400/132 kV Interconnecting Transformer-3 (Charging entire 132 kV switchyard)

SLD of 400 kV switchyard at NTPC Barh

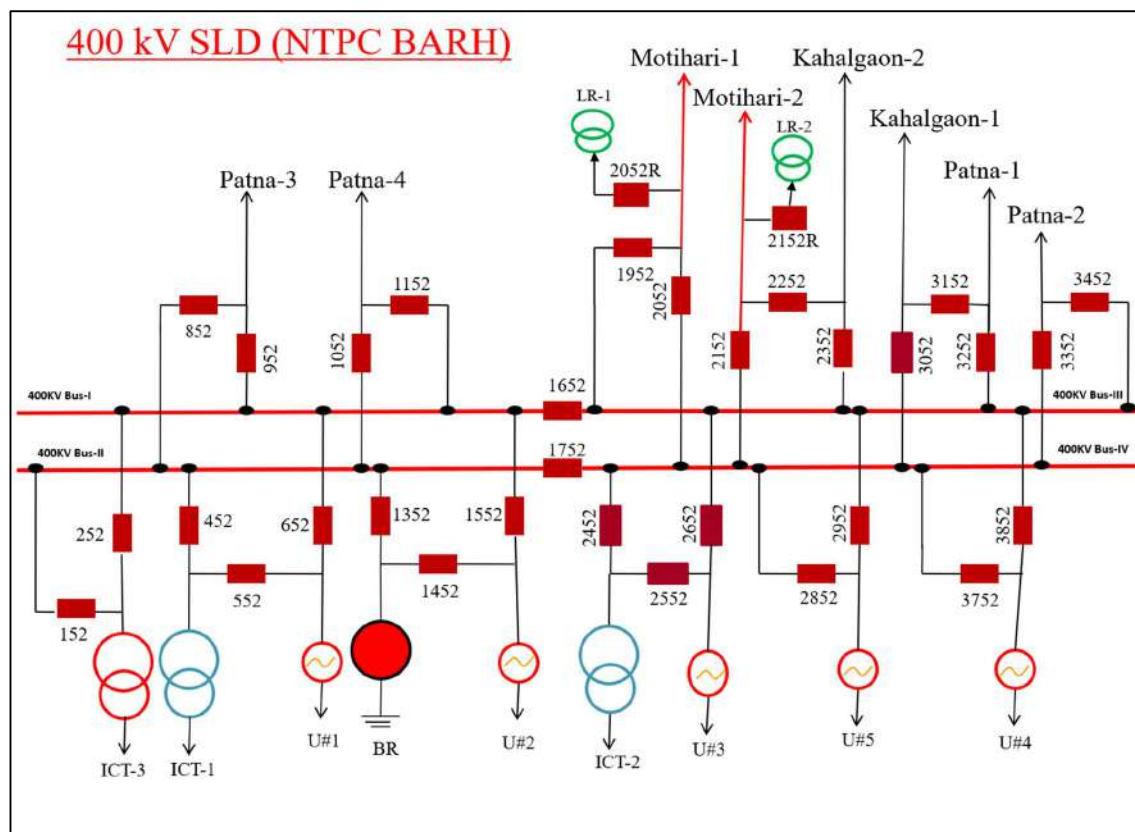
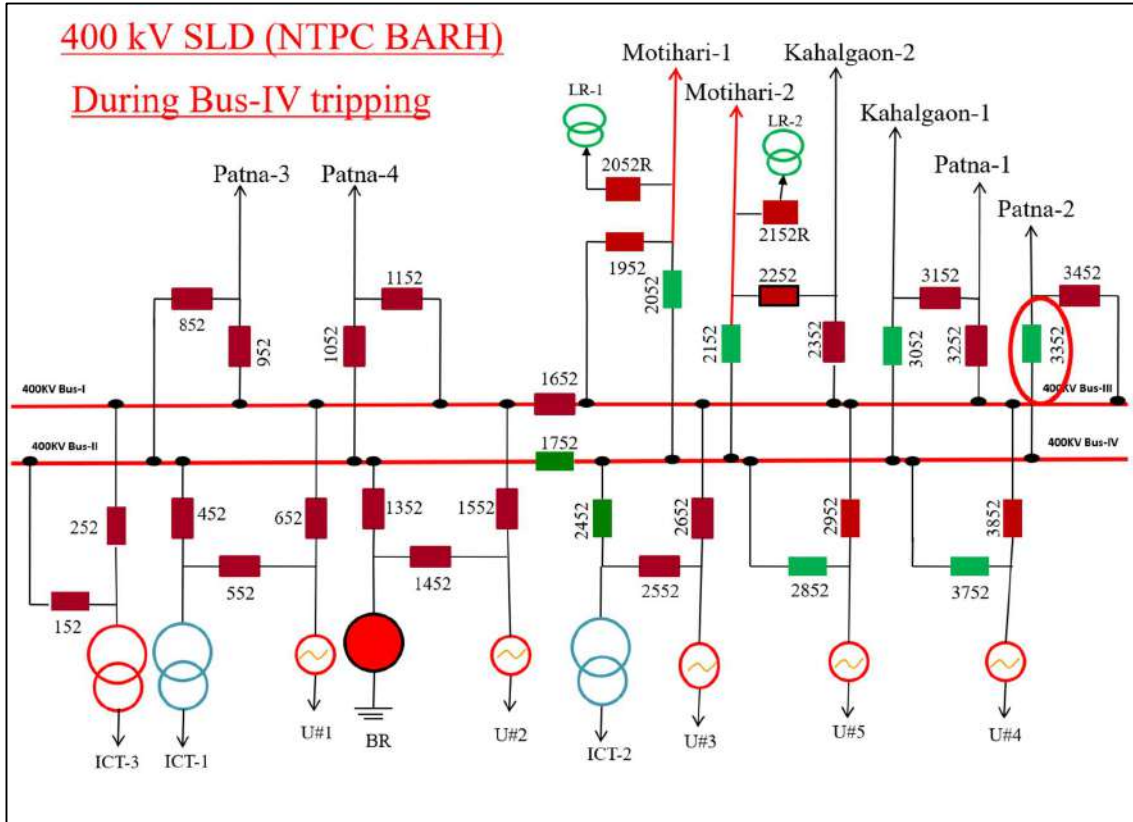


Figure:1 SLD of one and a half breaker scheme 400 kV switchyard

Initiation of grid incident

400 kV Bus-IV tripped due to failure of B-phase CT in Bay 33 (Barh-Patna-2 Main-highlighted in red). Subsequently Barh-Patna-2 tie bay tripped on TEE-differential protection and 400 kV Bus-IV tripping. All breakers connected to Bus-IV tripped as shown in figure-2.



Consequences:

Due to the impact of the CT blast, catastrophic damages took place in multiple equipments. Adjacent to Patna line-2 is Barh-Patna Line-1 main bay which is approximately at a distance of 5 metres. The blast radius of 33CT-B phase engulfed the R phase CT of 400 kV Barh-Patna Line 1 main bay (32CT-R phase). In addition to this, R, Y phase CTs of Barh-Patna Line 2 main bay also got damaged. The R, Y phase circuit breakers (BHEL manufactured: 3AT3 model) installed in Bay 33 experienced severe damages. Both the breaker poles got uprooted from the base leading to damage in both DAC and operating rod assembly.

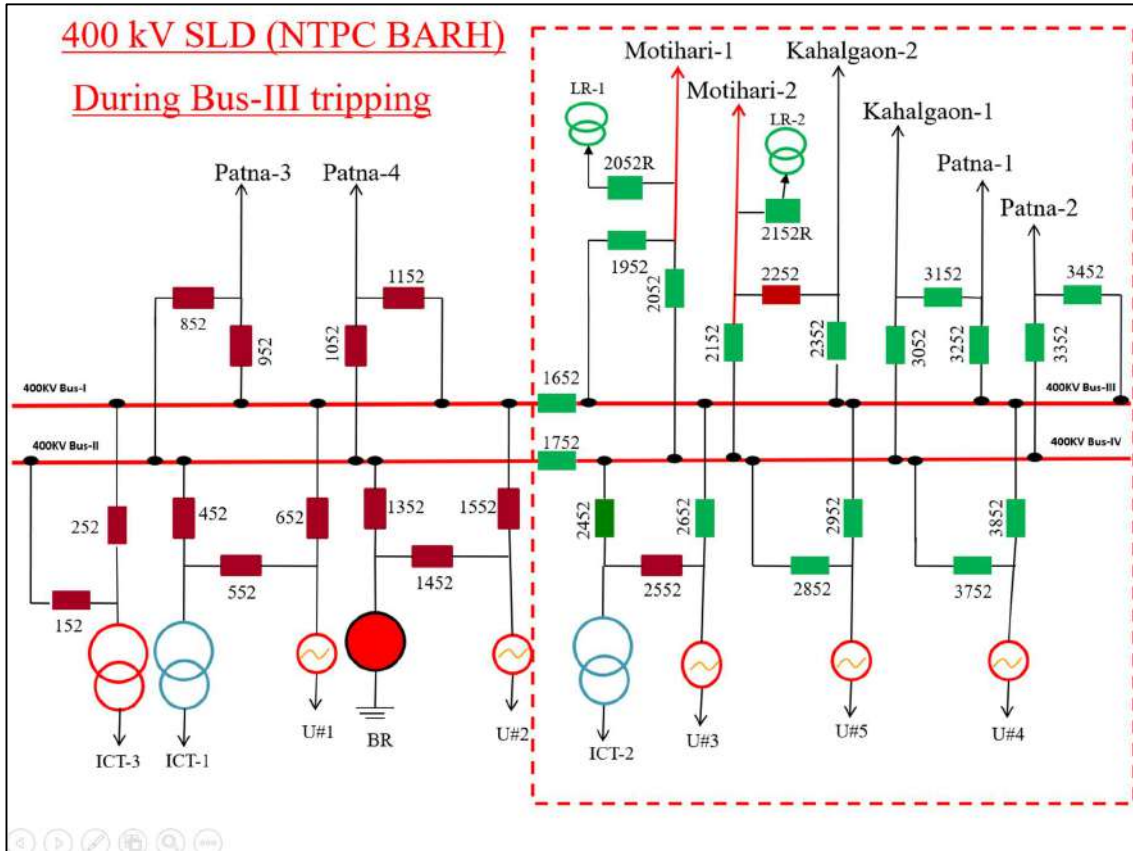


Figure-3: Status of switchyard after 400 kV Bus-III, IV tripping

Tripping analysis element wise

1. **400 kV Barh-Patna Line 2:** After CT failure in B phase, tie bay of 400 kV Barh-Patna 2 tripped on TEE-differential protection. Figure-4 reflects the zone of TEE-differential protection. DT was sent to remote end resulting in line tripping. Disturbance recorder showed bus bar operation for main bay and TEE-differential for tie bay.

Event	Time Stamp	Remarks
Bus-IV tripping	04:41:05.669	CT-B phase blast in Barh-Patna 2 main bay
Barh-Patna-2-line tripping	04:41:05.675	TEE-Differential operated resulted line tripping

2. **400 kV Barh-Patna Line 1:** Secondary impact of Barh-Patna Line 2 resulted in failure of R-phase CT of Barh-Patna 1 main bay. This resulted in Bus-III tripping. Tie breaker of Barh-Patna Line 1 and Barh-Kahalgaon Line 1 tripped on TEE-differential protection.

Event	Time stamp	Remarks
Bus Bar III differential	4.41:6.579	87BB started, Any Trip

Breaker 4-3252 open	4.41:6.619	Main breaker connected to bus-III opened due to 87BB
Tie breaker 4-3152 open	4.41:6.682	Teed protection main bay 32 operated
Remote end DT send CH01/CH02	4.41:6.672-4.41:6.790	Remote end DT send from Barh end in the first instance
Current reversal observed in R phase after main breaker opening. Suspected remote end feeding from Patna end and fault in CT-R phase of main bay at NTPC Barh end. DR shows current persisting in R phase even after main & tie breaker open at NTPC Barh end.		
Remote end DT send CH01/CH02	4.41:6.852-4.41:7.215	Remote end DT send from Barh end in second instance
PLCC counter readings for Barh-Patna 1 showed increase in counter readings two times.		

3. **Barh-Motihari Line 1** tripped due to bus bar differential operation of Bus III, IV.
4. **Barh-Motihari Line 2** main bay & **Barh-Kahalgaon Line 2** main bay tripped on Bus IV, Bus III differential protection operation respectively. Tie breaker of this complete dia remained in closed condition connecting Kahalgaon to Motihari. The tie breaker eventually tripped on Stage-I overvoltage protection (delay of 5 seconds)
5. **Generation Unit IV, V** tripped on class-A protection. Generator Relay Protection operated on 'Bus Bar trip to GRP operation'. Turbine overspeed was observed in both the units.
6. NTPC Barh has de-centralized low impedance bus bar differential scheme. As per disturbance recorded in peripheral units, Bus IV fed a fault current of 20 kA, Bus III fed a fault current of 31 kA.

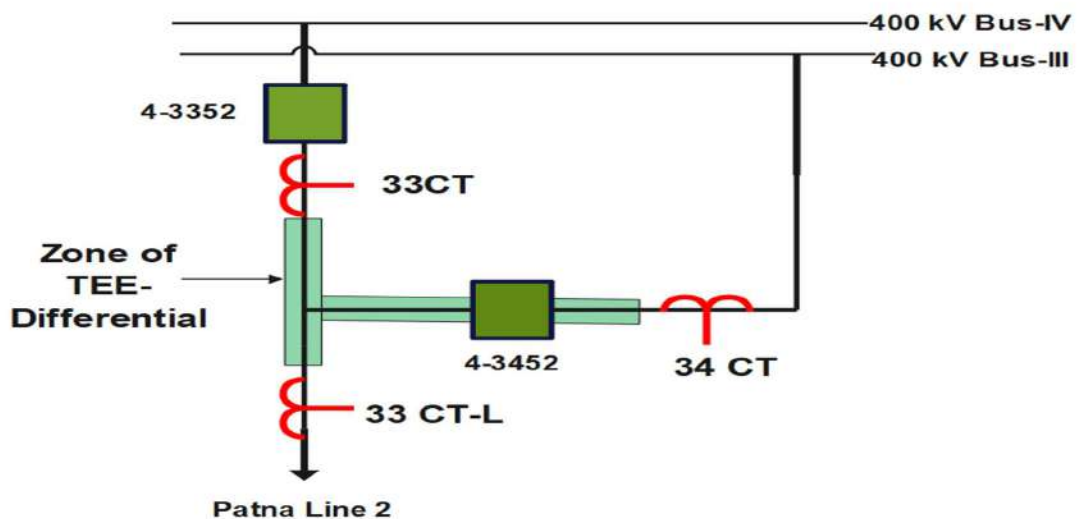


Figure:4- TEE-Differential protected Zone

PLCC counter readings during grid incident as recorded at NTPC Barh end
(Counter readings recorded at the beginning of each shift)

Date & Time	Patna Line 1					
	CH-01			CH-02		
	A	B	C	A	B	C
	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx
30.03.2024/10:00 pm	14/32	13/27	06/42	14/18	68/39	57/36
31.03.2024/08:00 am	14/32	13/27	08/42	14/18	68/39	57/36

Date & Time	Patna Line 2					
	CH-01			CH-02		
	A	B	C	A	B	C
	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx
30.03.2024/10:00 pm	06/34	04/28	27/26	08/25	09/29	28/49
31.03.2024/08:00 am	06/34	04/28	28/26	08/25	09/29	31/49

Date & Time	Kahalgaon Line 1					
	CH-01			CH-02		
	A	B	C	A	B	C
	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx
30.03.2024/10:00 pm	31/70	39/46	14/39	31/56	31/56	67/77
31.03.2024/08:00 am	31/70	39/46	14/40	31/56	31/56	67/78

Date & Time	Kahalgaon Line 2					
	CH-01			CH-02		
	A	B	C	A	B	C
	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx
30.03.2024/10:00 pm	29/70	79/50	18/48	37/10	72/26	09/45
31.03.2024/08:00 am	29/70	79/50	20/48	37/10	72/26	11/45

Date & Time	Motihari Line 1					
	CH-01			CH-02		
	A	B	C	A	B	C
	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx
30.03.2024/10:00 pm	63/29	63/25	15/32	63/26	63/29	90/33

31.03.2024/08:00 am	63/29	63/25	17/32	63/26	63/29	92/33
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Date & Time	Motihari Line 2					
	CH-01			CH-02		
	A	B	C	A	B	C
	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx	Tx/Rx
30.03.2024/10:00 pm	76/19	76/19	25/26	76/26	76/22	25/34
31.03.2024/08:00 am	76/19	76/19	26/26	76/26	76/22	26/34

Root cause analysis of damaged CTs

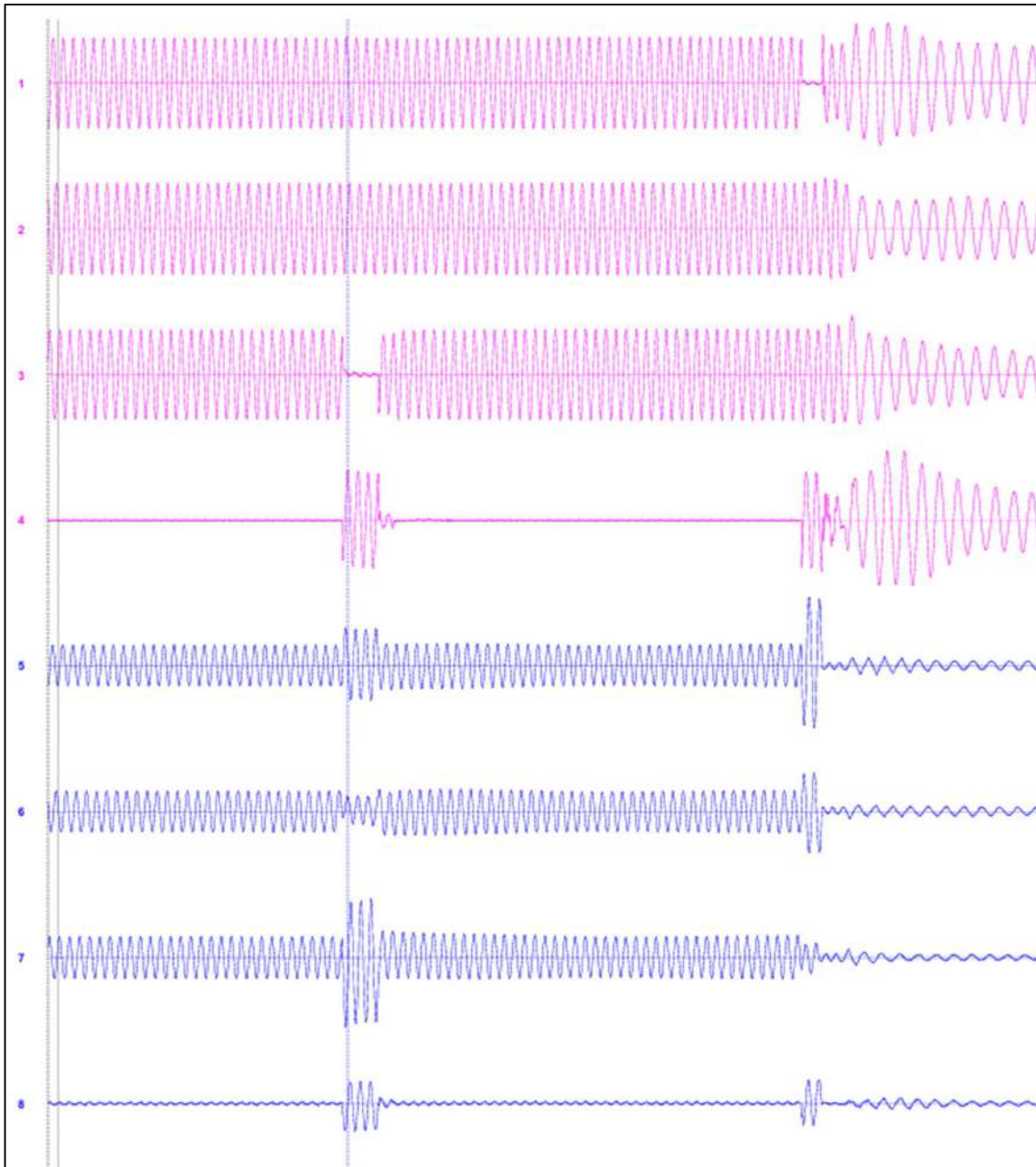
The failed CT was AREVA make, dead tank type. Manufacturing year was 2007. The extent of damage occurred in the CT prohibited any further investigation. However, recommendations and corrective measures ensued after the incident which are highlighted as below.

1. All AREVA make CTs are undergoing oil sampling for DGA purpose.
2. To avoid the extent of secondary damages, we are in process of procuring polymer insulator housing CTs (Line/Dead Tank). Response received from M/s GE T&D, M/s CG Power & Industrial Solutions
3. Frequency of CT oil DGA has been increased.
4. OEM has been contacted for further assistance regarding future planning of the installed CTs.
5. To ensure correct operation of relays and EHV equipments, annual testing and laid down guidelines to be followed.

Snapshots of the damaged equipments

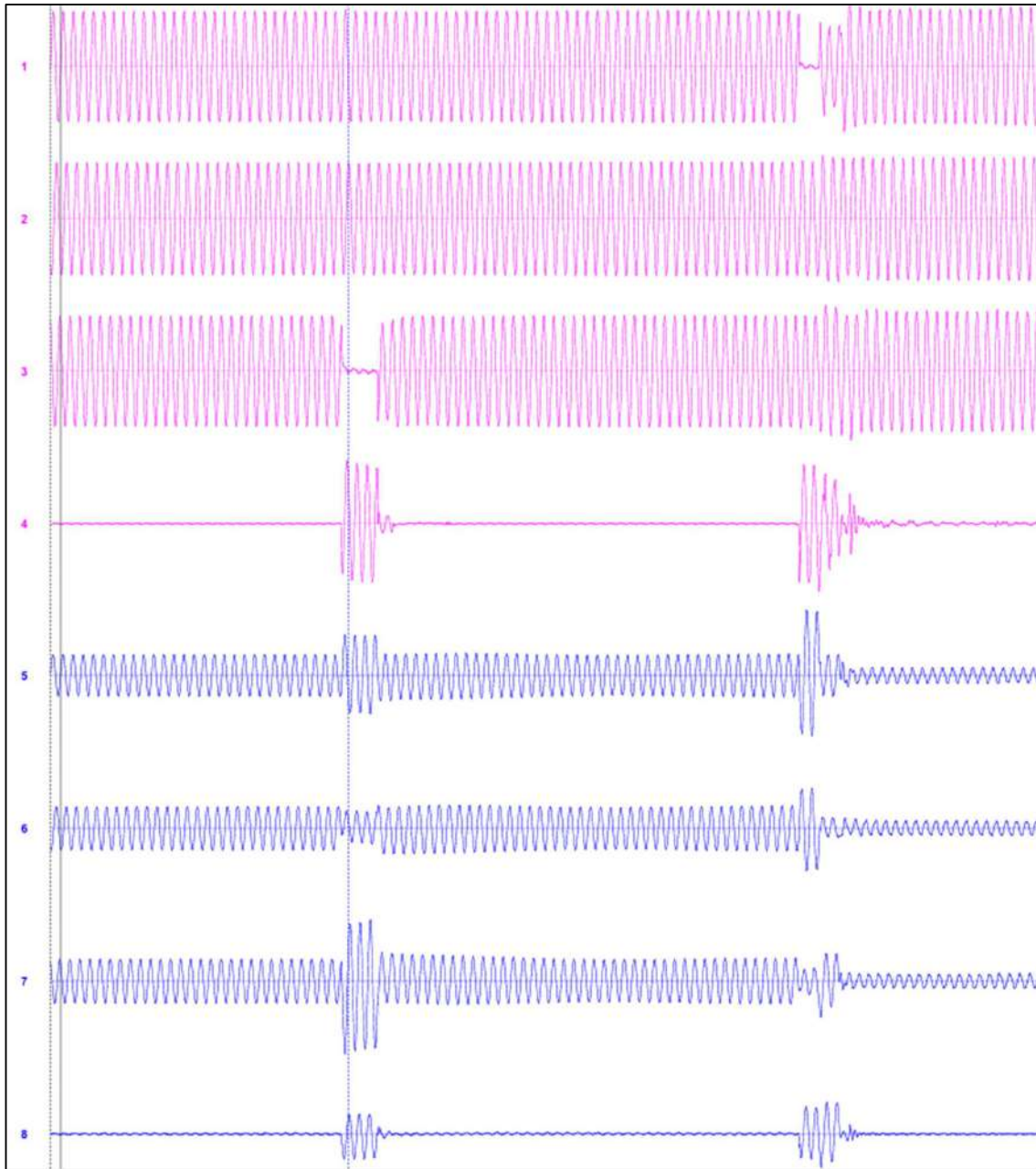


400 kV Barh-Motihari I



	N	N	04:41:05.671096	04:41:06.797120	022
	A	A			000
	N	N	04:41:06.618958		001
	N	N	04:41:06.617132		001
	N	N	04:41:06.618958		001
	N	N	04:41:05.679425	04:41:06.632185	004

400 kV Barh-Motihari II



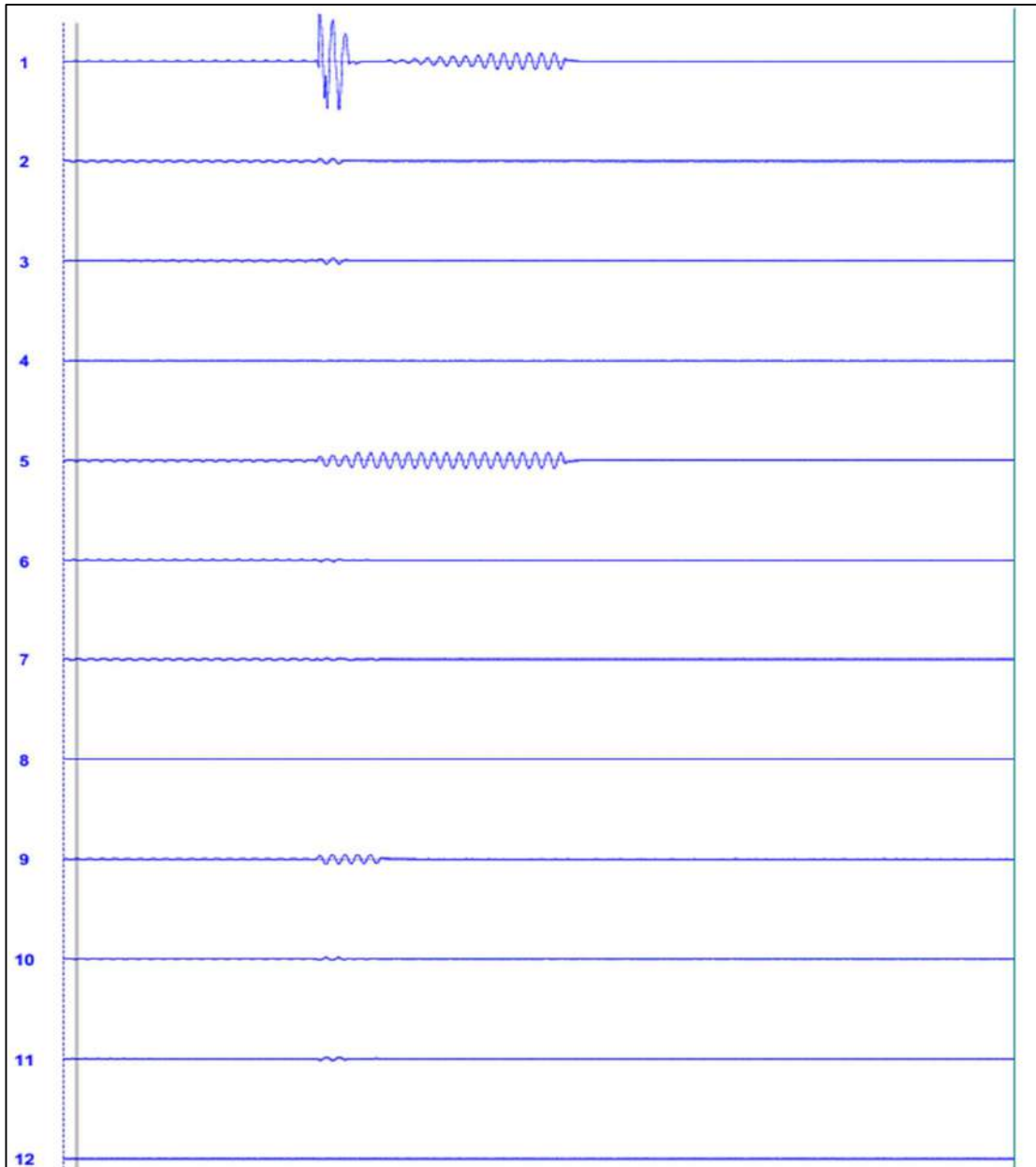
	N	A	04:41:05.674764	04:41:06.584328	003
	A	A			000
	N	A	04:41:05.713082		001
	N	A	04:41:05.713082		001
	N	A	04:41:05.714748		001
	N	N	04:41:05.688426	04:41:06.634308	004

400 kV Barh-Patna II



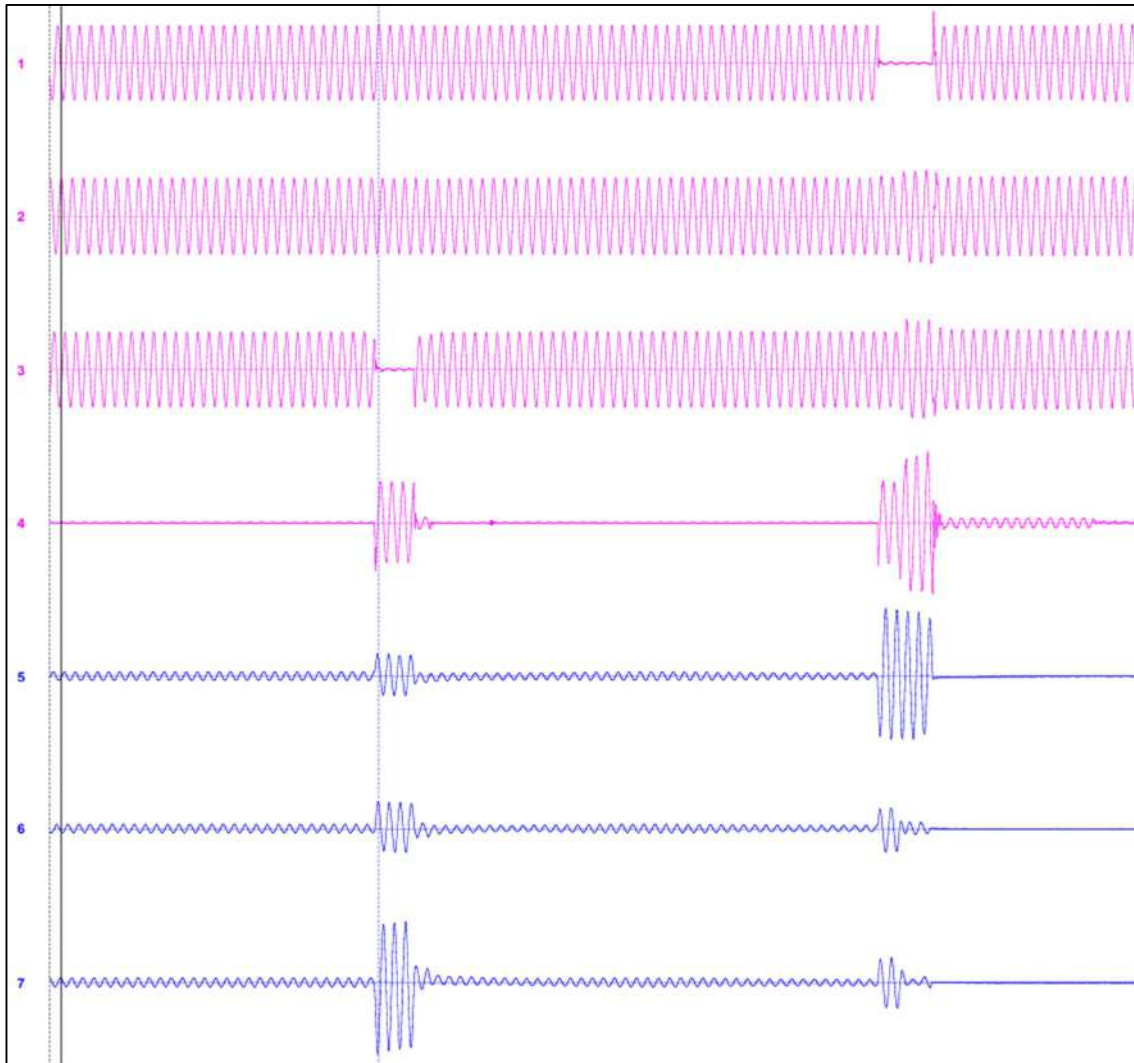
	N	N	04.01.05.691.356	04.01.05.784858	002
	N	A	04.01.05.713604		001
	N	A	04.01.05.726144		001
	N	A	04.01.05.723016		001
	N	A	04.01.05.705696		001
	N	A	04.01.05.714696		001
	N	A	04.01.05.746340		001
	N	A	04.01.05.744674		001
	N	A	04.01.05.777894		001
	N	N	04.01.05.829332	04.01.05.699612	002
	A	N	04.01.05.707392		001
	A	N	04.01.05.711254		001
	N	N	04.01.05.691.356	04.01.05.782992	002
	A	A			000

400 kV Barh-Patna I TEED operation



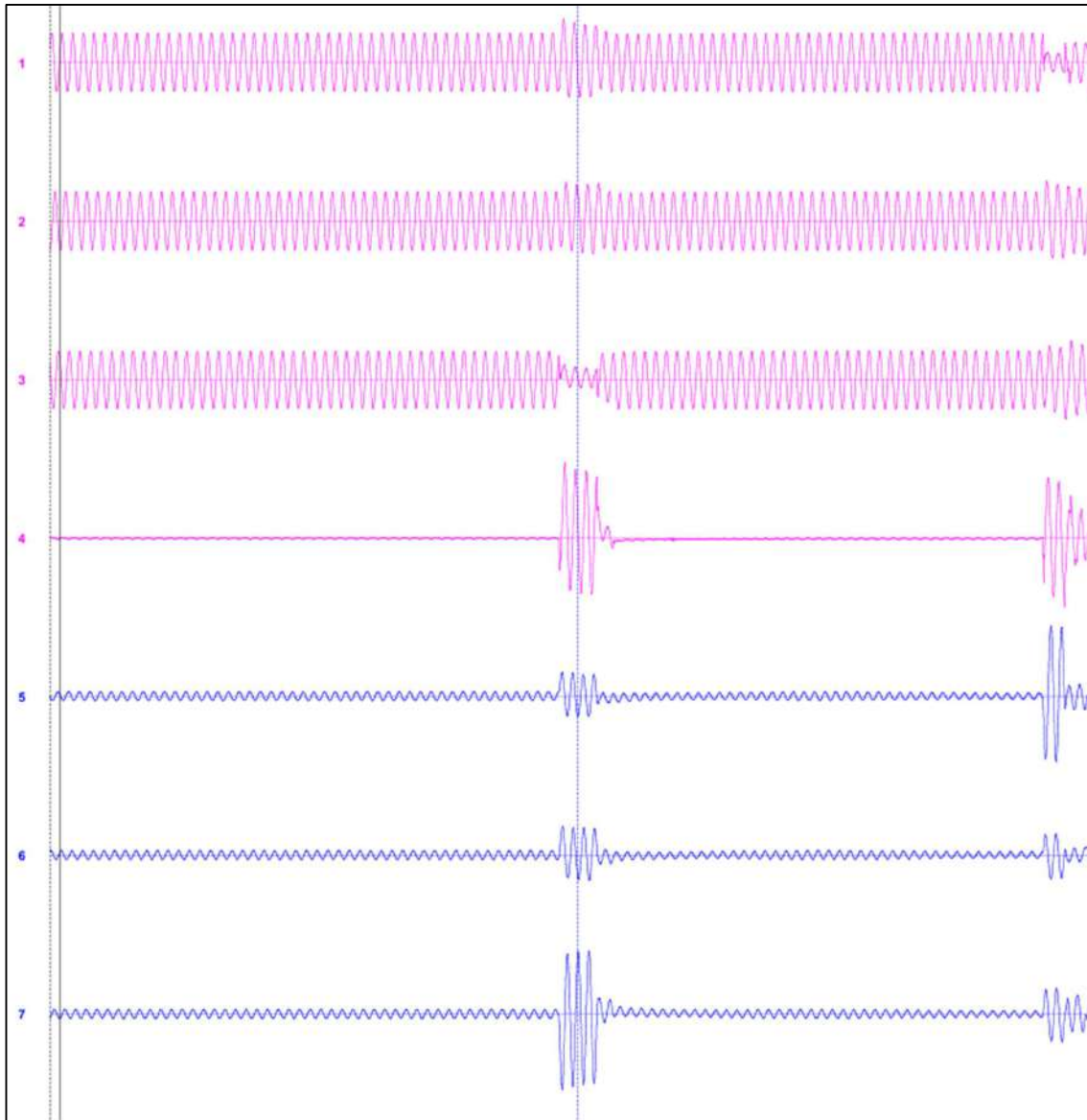
			N DIFF Starting	N	N	04:41:06.682000	04:41:06.843000	002
			A MAIN Protect not ready	A	A			000
			A MAIN Blocked/faulty	A	A			000
			A MAIN Trip ord blocked	A	A			000
			N FT RC Record in progress	N	N	04:41:06.682000	04:41:06.890000	002
			N MAIN General Staffing	N	N	04:41:06.682000	04:41:06.843000	002
			N DIFF Trip signal 1	N	N	04:41:06.682000	04:41:06.843000	002
			N DIFF Trip signal 2	N	N	04:41:06.682000	04:41:06.843000	002
			N DIFF Trip signal 3	N	N	04:41:06.682000	04:41:06.843000	002
			A DIFF 2af discr 1 triac	N	N	04:41:06.584000	04:41:06.641000	002
			N DIFF Harm block 1 triac	N	N	04:41:06.602000	04:41:06.659000	002
			N DIFF Harm block 2 triac	N	N	04:41:06.599000	04:41:06.656000	002
			N DIFF Harm block 3 triac	N	N	04:41:06.599000	04:41:06.652000	002
			N DIFF Overflux bl 2 triac	N	N	04:41:06.599000	04:41:06.629000	002
			N DIFF Overflux bl 3 triac	N	N	04:41:06.599000	04:41:06.629000	002
			A DIFF Meas system 1 triac	N	N	04:41:06.584000	04:41:06.643000	002
			N DIFF Meas system 2 triac	N	N	04:41:06.599000	04:41:06.726000	002
			N DIFF Meas system 3 triac	N	N	04:41:06.599000	04:41:06.736000	002
			A DIFF Enabled	A	A			000
			N DIFF Trip signal	N	N	04:41:06.682000	04:41:06.843000	002
			N MAIN Gen trip signal	N	N	04:41:06.682000	04:41:06.843000	002
			N MAIN Gen trip command 1	N	N	04:41:06.682000	04:41:06.843000	002
			N MAIN Gen trip signal 1	N	N	04:41:06.682000	04:41:06.843000	002
			N FT RC System disrupt, users	N	N	04:41:06.682000	04:41:06.830000	002
			A OUTF Outp relay blocked	A	A			000
			A LOGIC Enabled	A	A			000
			N LOGIC Outout 5	N	N	04:41:06.636000	04:41:06.856000	002
			N LOGIC Outout 6	N	N	04:41:06.636000	04:41:06.856000	002
			A LOGIC 1 set externally	A	A			000
			A LOGIC 2 set externally	A	A			000
			A LOGIC 3 set externally	A	A			000
			A LOGIC 4 set externally	A	A			000
			A LOGIC 5 set externally	A	A			000
			A LOGIC 6 set externally	A	A			000
			A LOGIC 7 set externally	A	A			000

400 kV Barh-Kahalgaon Line 1



	A Arr Start	N	04:01:05.672096	04:01:06.691496	004	
	N L2 M CB Y PH	N	A	04:01:05.732072	001	
	A L3 M CB B PH	N	A	04:01:05.725408	001	
	N L8 T CB R PH	N	A	04:01:06.699826	001	
	N L9 T CB Y PH	N	A	04:01:06.699164	001	
	N L10 T CB B PH	N	A	04:01:06.699164	001	
	A L13 M LB81/20PTD	N	N	04:01:05.695424	04:01:05.901764	002
	A L15 GA 96A SUPN	A	A		000	
	A L16 96AX SUPVSN	A	A		000	
	A L11 CAR HLTY CH1	A	A		000	
	A Z4	N	04:01:05.690426	04:01:06.699630	004	

400 kV Barh-Kahalgaoon Line II



	N	L1 M CB R PH	N	A	04:41:06.643892		001
	N	L2 M CB Y PH	N	A	04:41:06.630564		001
	N	L3 M CB B PH	N	A	04:41:06.646890		001
	A	L15 GA 06A SUPN	A	A			000
	A	L16 06AX SUPVSN	A	A			000
	N	Z4	N	N	04:41:05.697504	04:41:06.633896	004
	A	CB Discrepancy	A	A			000



ग्रिड-इंडिया
GRID-INDIA

ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
GRID CONTROLLER OF INDIA LIMITED
(A Government of India Enterprise)



[formerly Power System Operation Corporation Limited (POSOCO)]

पूर्वी क्षेत्रीय भार प्रेषण केन्द्र / Eastern Regional Load Despatch Centre

कार्यालय : 14, गोल्फ क्लब रोड, टालिगंज, कोलकाता - 700033
Office : 14, Golf Club Road, Tollygunge, Kolkata - 700033

CIN : U40105DL2009GOI188682, Website : www.erldc.in, E-mail : erldcinfo@grid-india.in, Tel.: 033 23890060/0061

ग्रिड घटना की विस्तृत रिपोर्ट 220 केवी गढ़वा (न्यू) पूर्वी क्षेत्र का सबस्टेशन / Detailed Report of grid event 220 kV Garhwa (New) Substation of Eastern Region

(To be submitted by ERLDC/NLDC during Grid Disturbances/Grid Incidents/Near Miss Event as per IEGC section 37.2 (f)
(आई ई जी सी 37.2 (एफ) के अनुपालन में)

Date(दिनांक):10-04-2024

1. Event Summary (घटना का सारांश):

At 22:27 Hrs on 30.03.2024, 220 kV Daltonganj – Garhwa(New) D/C tripped due to consecutive B_N fault leading to complete power failure at 220 kV Garhwa(New) S/s with a load loss of around 80 MW. As per SLDC Jharkhand, the lines tripped due to inclement weather conditions in the area.

2. Time and Date of the Event (घटना का समय और दिनांक): 22:27 hrs of 30.03.2024

3. Event Category (ग्रिड घटना का प्रकार): Grid Disturbance (GD)-1

4. Location/Control Area (स्थान/नियंत्रण क्षेत्र): Jharkhand

5. Name of the Substation/Generating Station/Pooling Station Affected (सब-स्टेशन का नाम):

(Along with LV/HV voltage level): 220 kV Garhwa (New) Substation

6. Report submitted by Utility on: 08.04.2024

7. Antecedent Conditions (पूर्ववर्ती स्थिति):

	Frequency	Regional Generation	Regional Demand	State Generation	State Demand
				Jharkhand	Jharkhand
Pre-Event (घटना पूर्व)	50.01 Hz	31097 MW	26025 MW	321 MW	1543 MW
Post Event (घटना के बाद)	50.01 Hz	31097 MW	25945 MW	321 MW	1463 MW

*Pre and post data of 1 minute before and after the event

Important Transmission Line/Unit if under outage (महत्वपूर्ण संचरण लाइने/ विद्युत उत्पादन इकाइयां जो बंद हैं)	NIL
Weather Condition (मौसम स्थिति)	Severe dust storms and gusty winds

8. Load and Generation loss (लोड और जेनरेशन हानि): Approximate load loss of 80 MW and Generation loss is nil.

9. Duration of interruption (रूकावट की अवधि): 22:27 hrs to 23:35 hrs.

10. Details of Equipment Failure (if any during the event) (उपकरण विफलता का विवरण): Tower damaged at loc. 198.

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

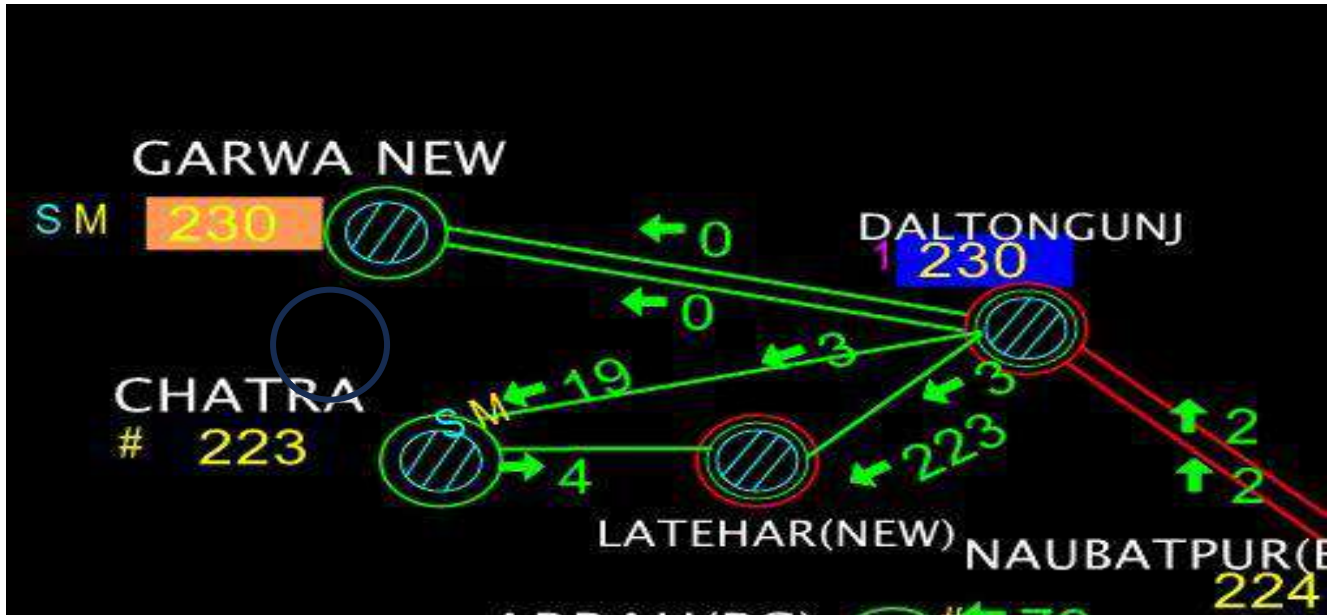


Figure 1: Network across the affected area

12. Transmission/Generation element Tripped during the event (संचरण लाइन / विद्युत उत्पादन इकाई जो घटना के दौरान बंद हो गयी):

क्र०स०	नाम	Trip time (hh:mm:ss)	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	Restoration time
1	220 kV Daltonganj-Garhwa (New)-1	22:27:50	Daltonganj: B_N, 36 km, 2.26 kA	Garhwa: B_N, 58.271 km	23:34
2	220 kV Daltonganj-Garhwa (New)-2	22:27:02	Daltonganj: B_N, 35.4 km, 2.27 kA	Garhwa: B_N, 0.6 kA, 148.645 km	Not restored yet.

13. Event Analysis (Based on PMU, SCADA & DR) (घटना का विश्लेषण):

- At 22:27:02 Hrs, 220 kV Daltonganj-Garhwa-2 tripped due to B_N fault. A/r was successful from both ends. After 600 msec, line tripped again and three phase opened at both ends.

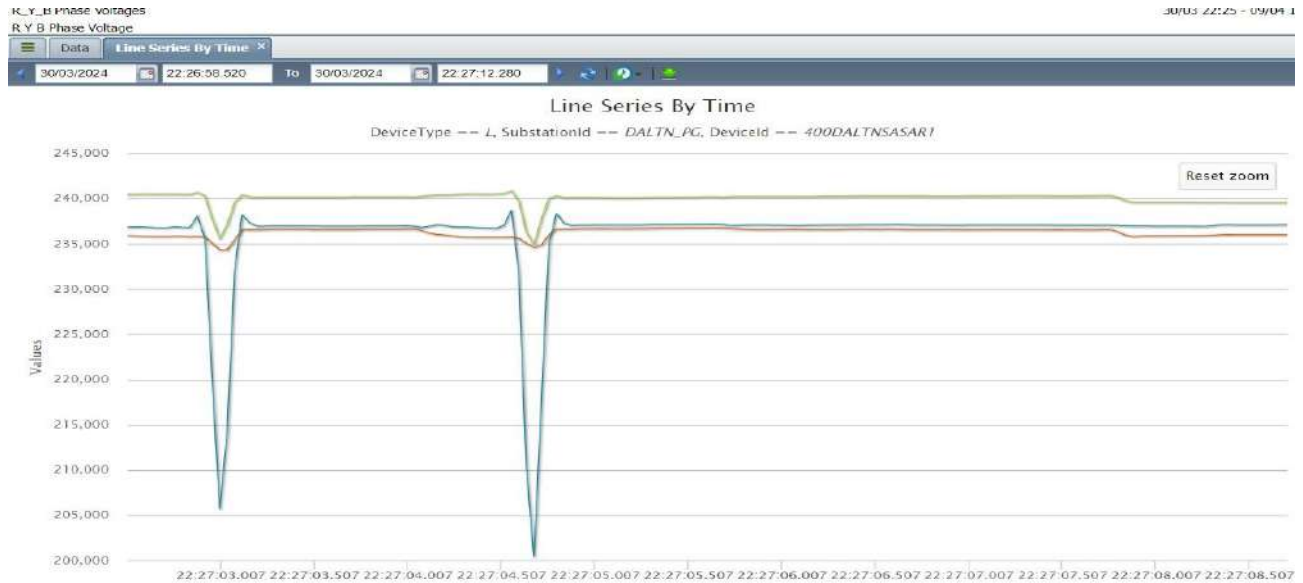


Figure 2: PMU voltage snapshot of 400/220 kV Daltonganj S/s

- At 22:27:43 Hrs, 220 kV Daltonganj-Garhwa-1 tripped due to B_N fault. Line tripped from Daltonganj end only. From DR of Garhwa, it seems that no breaker opened at Garhwa. Whether bus bar protection is available at Garhwa. JUSNL may confirm.
- A/r was successful from Daltonganj after 1 second. However, line tripped again within reclaim time after 7 seconds.

PMU Snapshot:

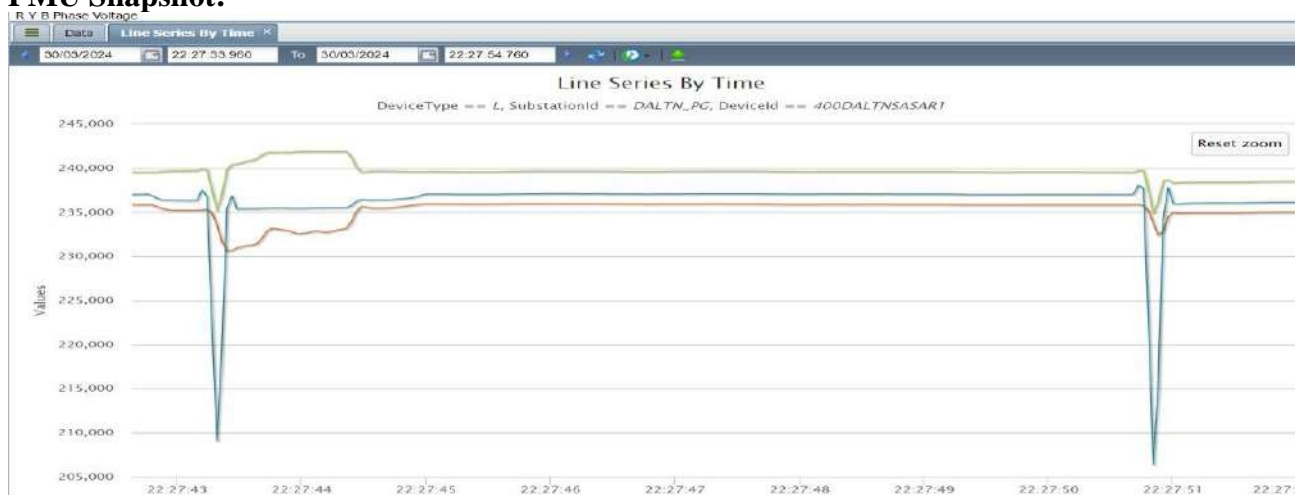


Figure 3: PMU Voltage snapshot of 400/220 kV Daltonganj S/S

14. Protection/Operational issues observed (सुरक्षा/परिचालन संबंधी समस्या):

- Breaker of faulty phase of 220 kV Daltonganj-Garhwa-1 didn't open despite getting trip command. Reason for the same may be ascertained.

15. Action Taken/Remedial Measures (सुधारात्मक उपाय): Nil

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

S.No.	Issues	Regulation Non-Compliance	Utilities
1.	DR/EL not provided within 24 Hours	1. IEGC section 37.2 (c) 2. CEA grid Standard 15.3	JUSNL, PG ER-1

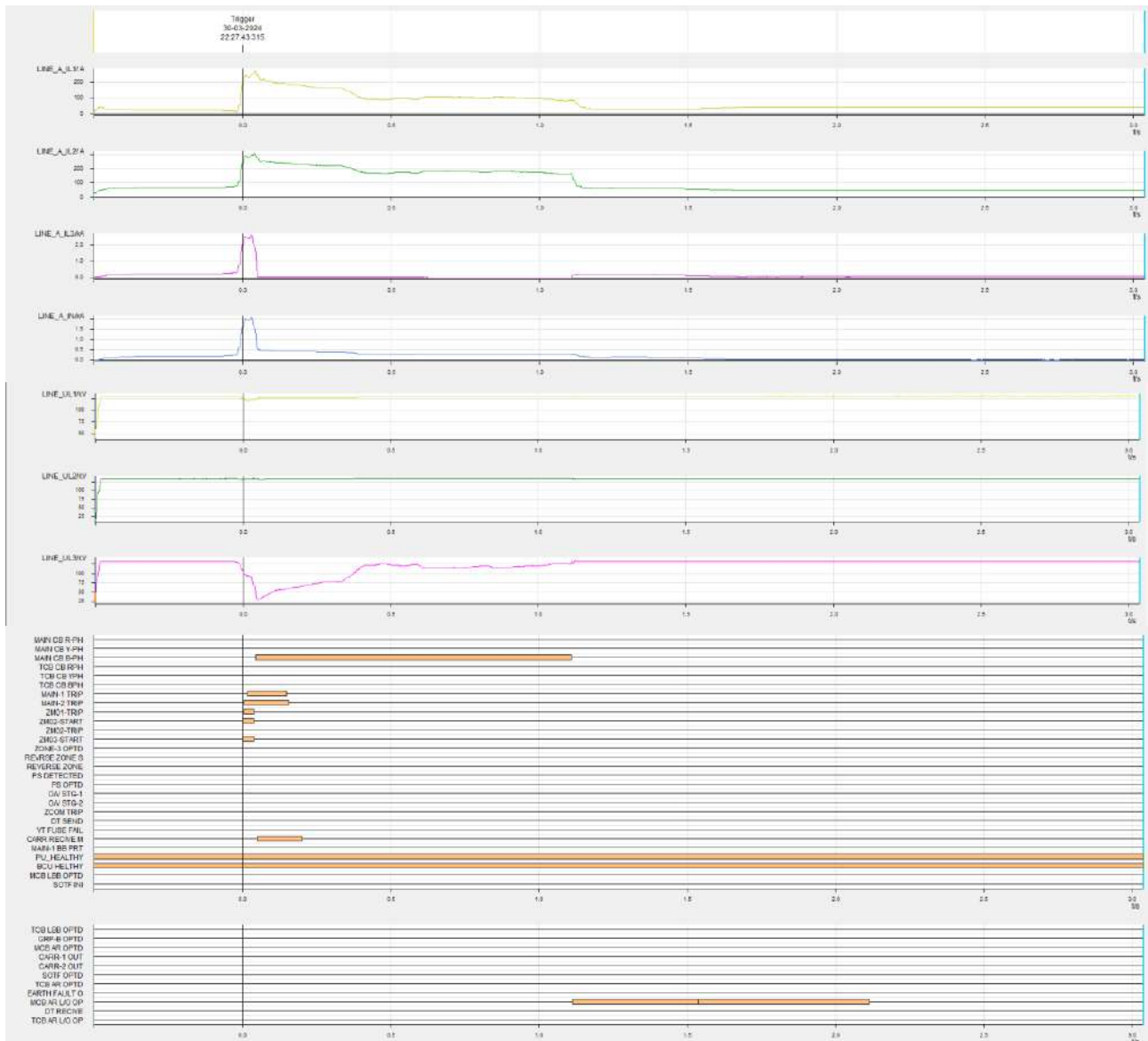
17. Key Lessons Learnt (प्रमुख अधिगम बिंदु): Nil

Annexure 1: (Sequence of Events-As per ERLDC SCADA)

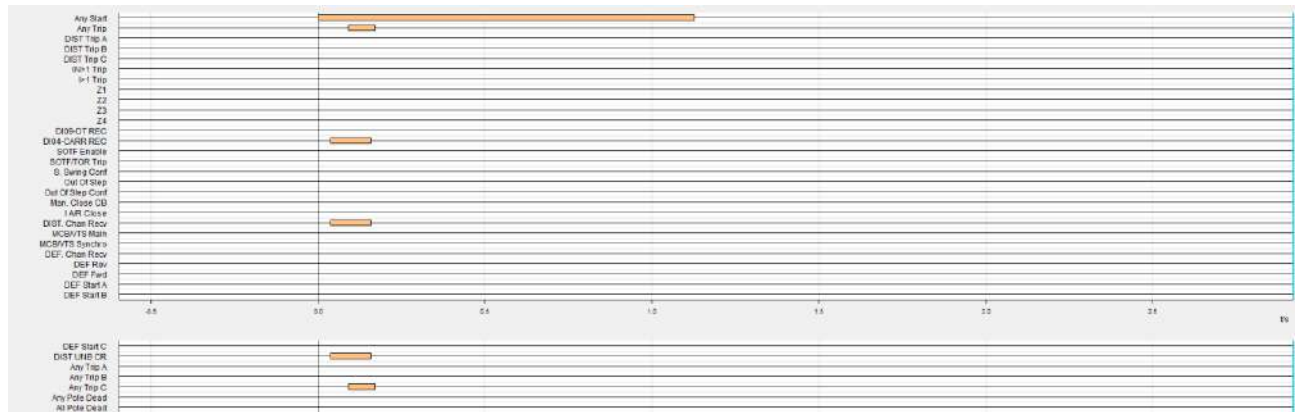
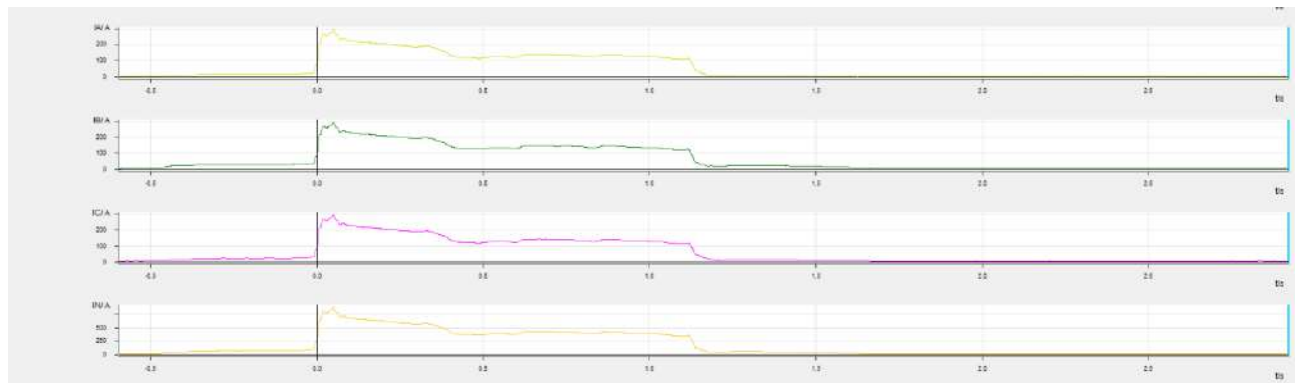
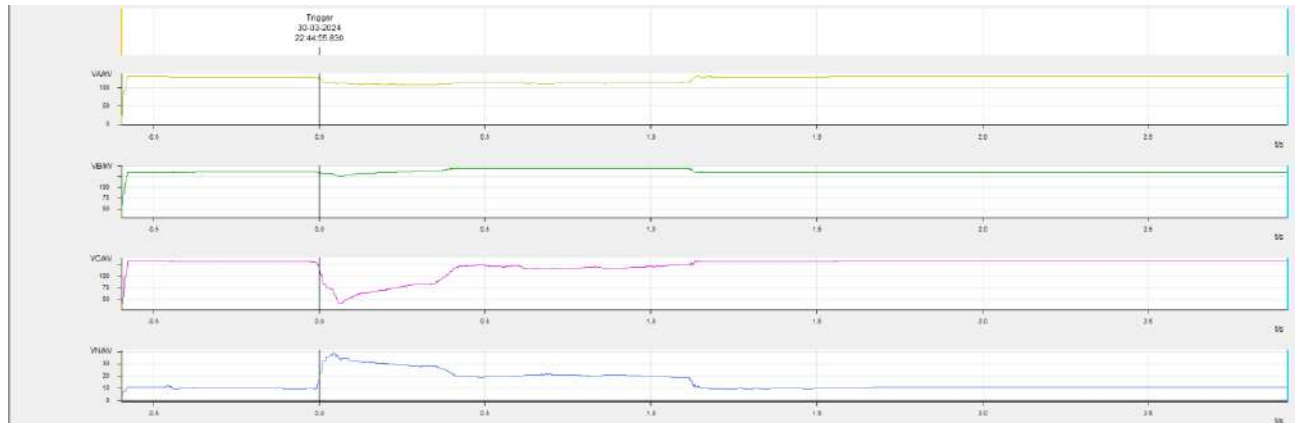
TIMESTAMP	STATION	DESCRIPTION	STATUS
22:27:03.024	DALTN_PG	220_GARHWA_2_CB	Travel
22:27:04.104	DALTN_PG	220_GARHWA_2_CB	Closed
22:27:04.694	DALTN_PG	220_GARHWA_2_CB	Open
22:27:43.346	DALTN_PG	220_GARHWA_1_CB	Travel
22:27:44.424	DALTN_PG	220_GARHWA_1_CB	Closed
22:27:50.912	DALTN_PG	220_GARHWA_1_CB	Open

Annexure 2:

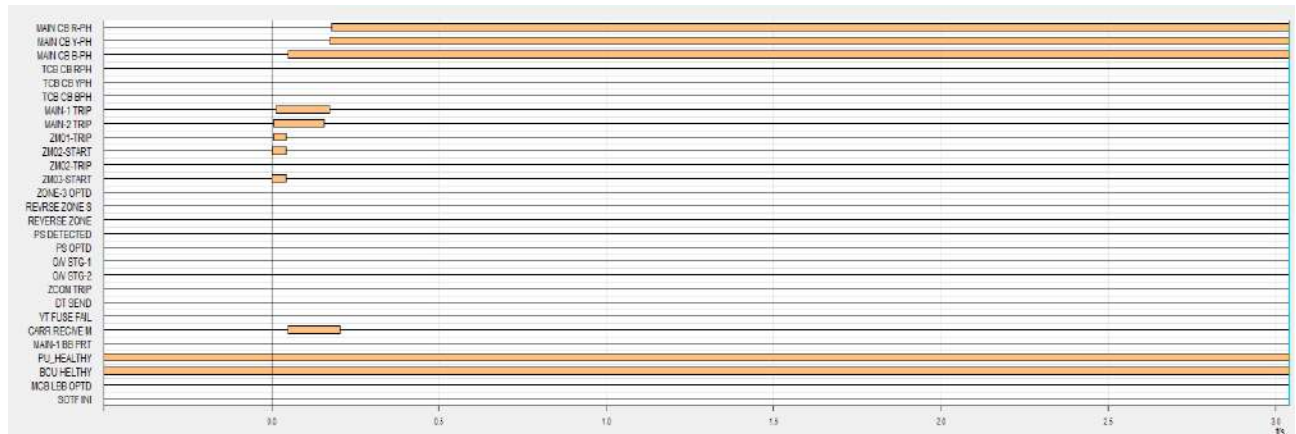
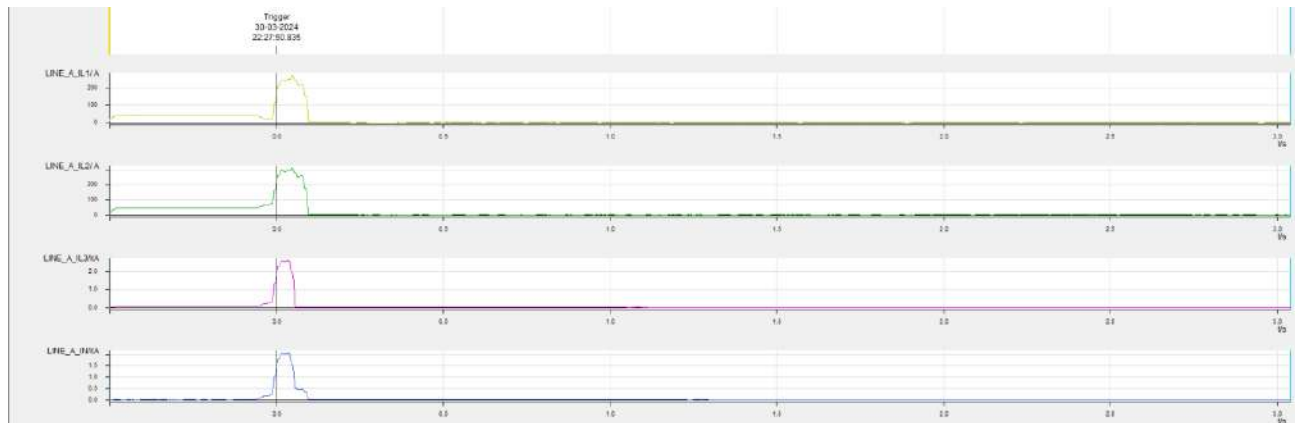
DR of 220 kV Daltonganj-Garhwa-1 (Daltonganj)-1st instance



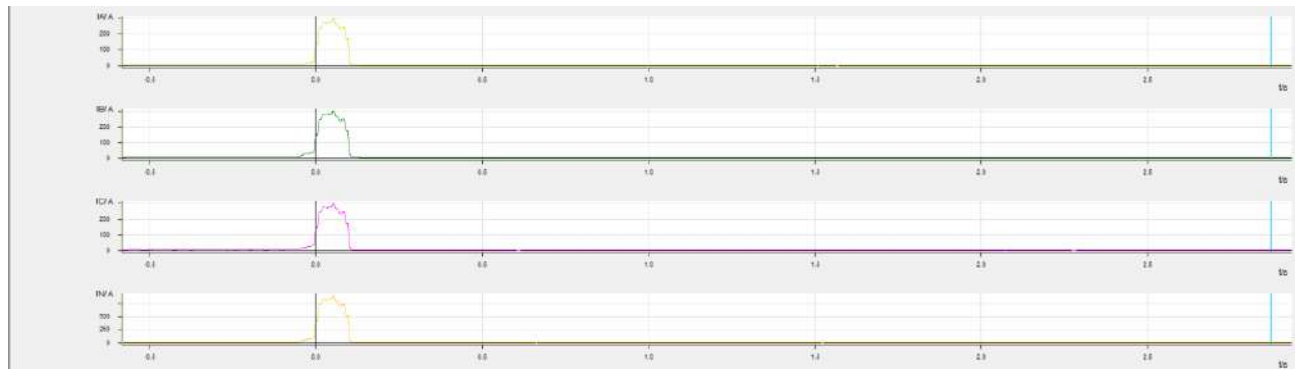
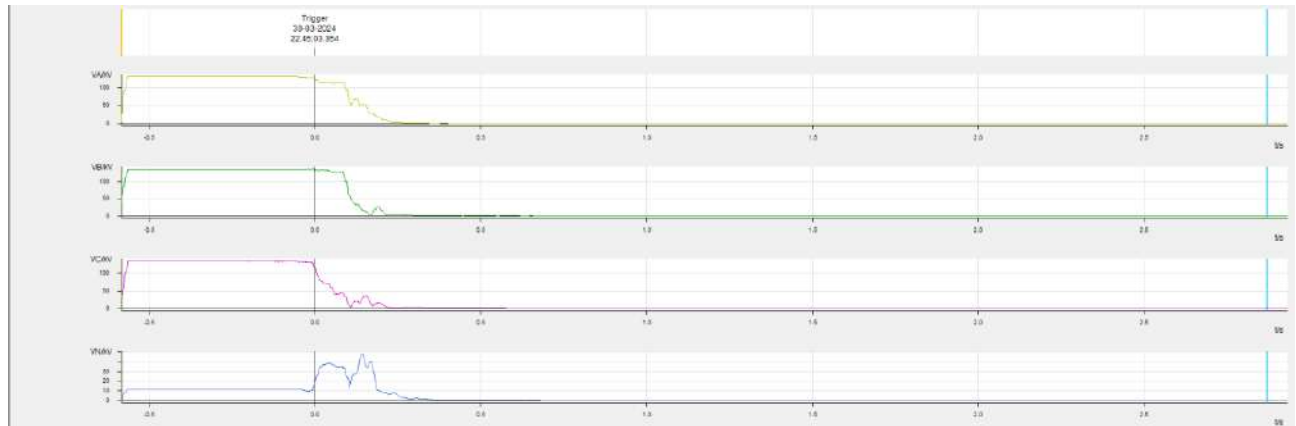
DR of 220 kV Daltonganj-Garhwa-1 (Garhwa)-1st instance.



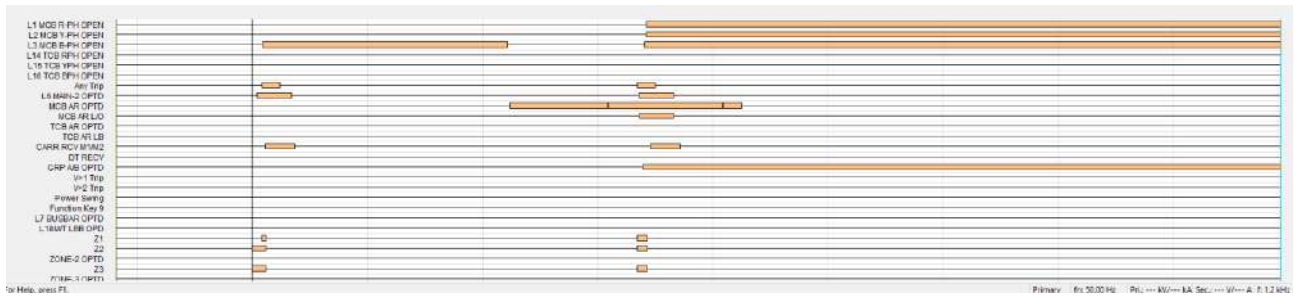
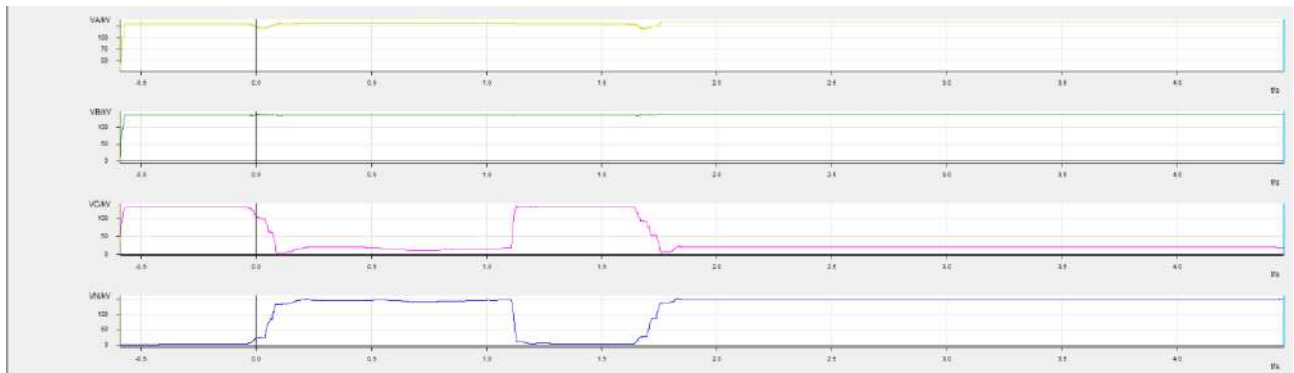
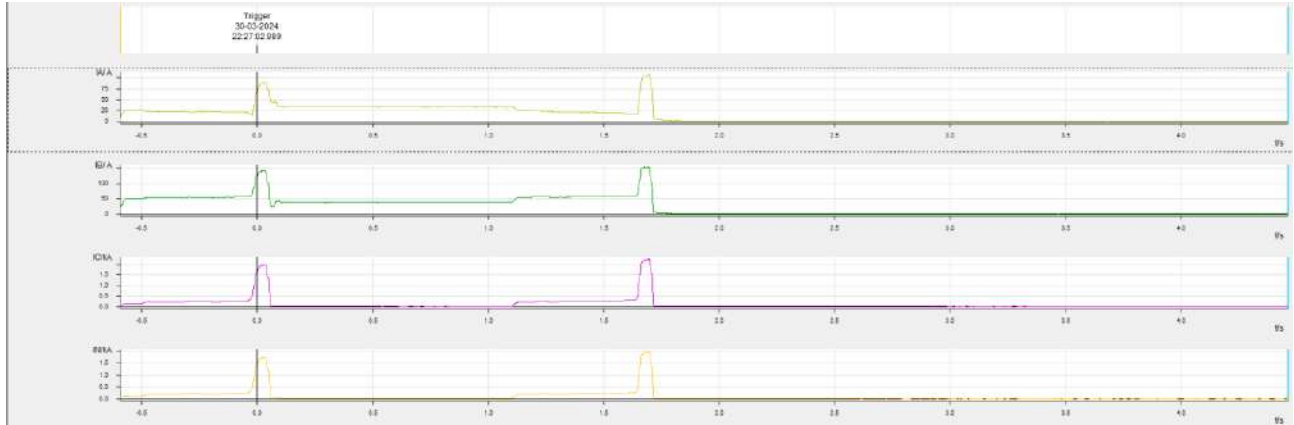
DR of 220 kV Daltonganj-Garhwa-1 (Daltonganj)-2nd instance (Reclaim time)



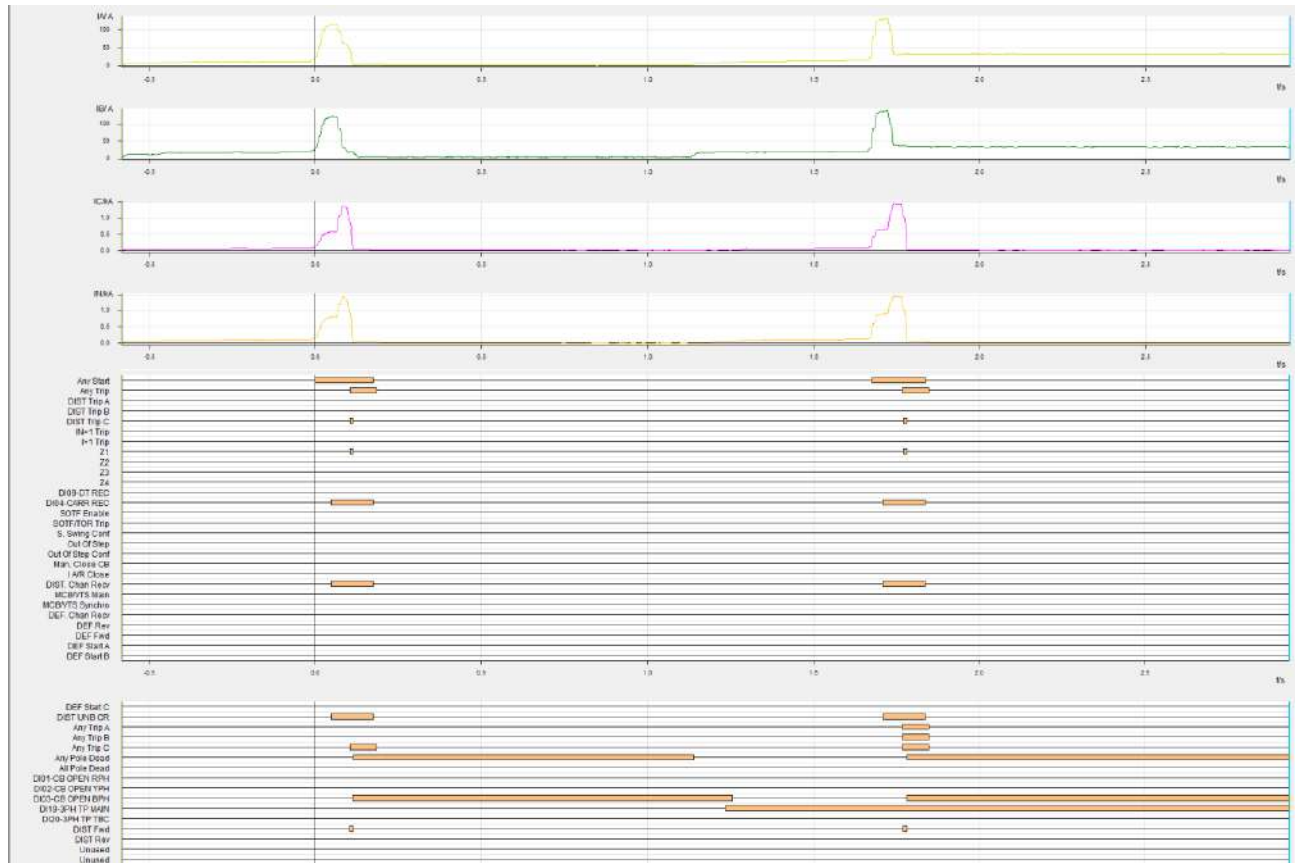
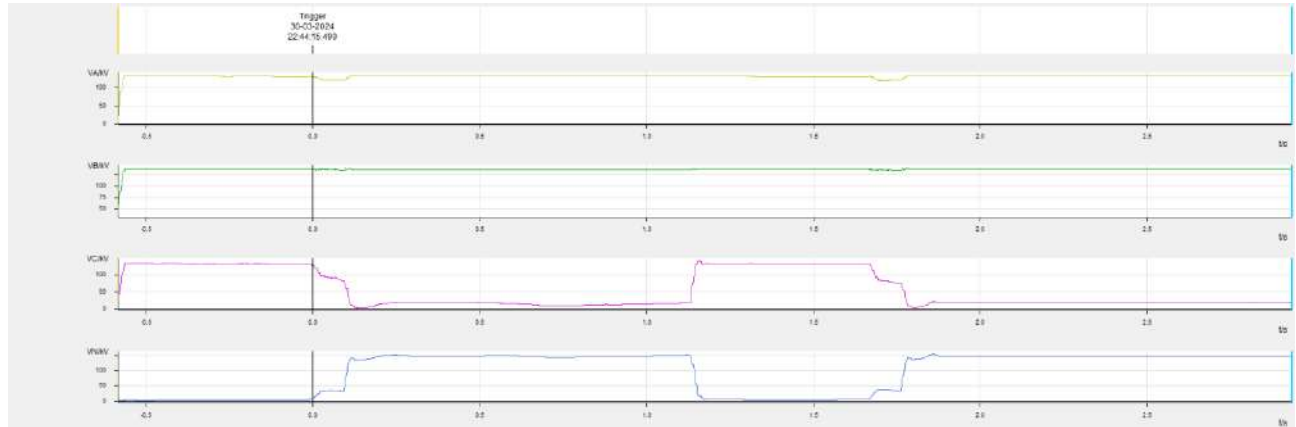
DR of 220 kV Daltonganj-Garhwa-1 (Garhwa)-2nd instance (Reclaim time)



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



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





ग्रिड-इंडिया
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CIN : U40105DL2009GOI188682, Website : www.erldc.in, E-mail : erldcinfo@grid-india.in, Tel.: 033 23890060/0061

ग्रिड घटना की विस्तृत रिपोर्ट 220 केवी गढ़वा (न्यू) पूर्वी क्षेत्र का सबस्टेशन / Detailed Report of grid event 220 kV Garhwa (New) Substation of Eastern Region

(To be submitted by ERLDC/NLDC during Grid Disturbances/Grid Incidents/Near Miss Event as per IEGC section 37.2 (f))
(आई ई जी सी 37.2 (एफ) के अनुपालन में)

Date(दिनांक):09-04-2024

1. Event Summary (घटना का सारांश):

At 07:29 Hrs on 31.03.2024, 220 kV Daltonganj – Garhwa(New)-1 tripped due to B_N fault leading to complete power failure at 220 kV Garhwa(New) S/s with a load loss of around 30 MW as Ckt-2 was already under breakdown.

2. Time and Date of the Event (घटना का समय और दिनांक): 07:29 hrs of 31.03.2024

3. Event Category (ग्रिड घटना का प्रकार): Grid Disturbance (GD)-1

4. Location/Control Area (स्थान/नियंत्रण क्षेत्र): Jharkhand

5. Name of the Substation/Generating Station/Pooling Station Affected (सब-स्टेशन का नाम):

(Along with LV/HV voltage level): 220 kV Garhwa (New) Substation

6. Report submitted by Utility on: 08.04.2024

7. Antecedent Conditions (पूर्ववर्ती स्थिति):

	Frequency	Regional Generation	Regional Demand	State Generation	State Demand
				Jharkhand	Jharkhand
Pre-Event (घटना पूर्व)	50.09 Hz	27709 MW	19938 MW	403 MW	1200 MW
Post Event (घटना के बाद)	50.09 Hz	27709 MW	19908 MW	403 MW	1170 MW

**Pre and post data of 1 minute before and after the event*

Important Transmission Line/Unit if under outage महत्वपूर्ण संचरण लाइने/ विद्युत उत्पादन इकाइयां जो बंद हैं)	NIL
Weather Condition (मौसम स्थिति)	Severe dust storms and gusty winds

8. Load and Generation loss (लोड और जेनरेशन हानि): Approximate load loss of 30 MW and Generation loss is nil.

9. Duration of interruption (रूकावट की अवधि): 00:07 Hrs (Partial load supplied through alternate arrangement)

10. Details of Equipment Failure (if any during the event) (उपकरण विफलता का विवरण): Tower collapsed at loc. 198, 195,196,197 & 202.

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

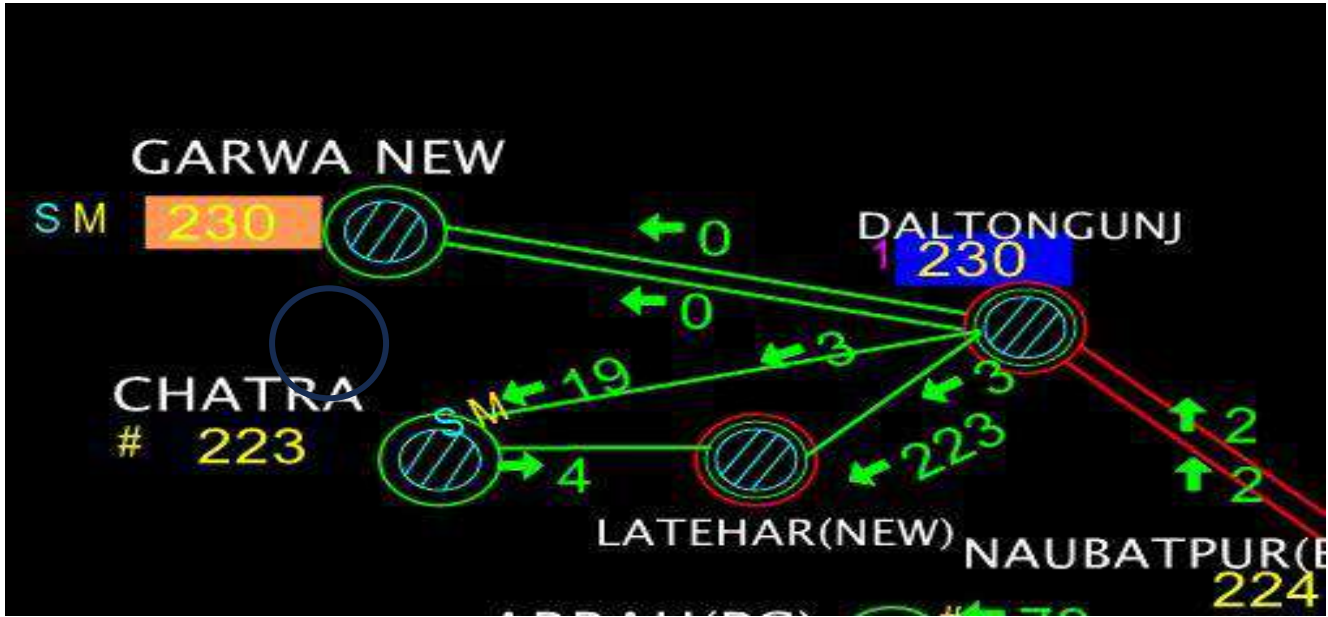


Figure 1: Network across the affected area

12. Transmission/Generation element Tripped during the event (संचरण लाइन / विद्युत उत्पादन इकाई जो घटना के दौरान बंद हो गयी):

क्र०स०	नाम	Trip time (hh:mm:ss)	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	Restoration time
1	220 kV Daltonganj-Garhwa (New)-1	07:29:01	Daltonganj: B_N, 33.29 km, 2.724 kA	Garhwa: B_N, O/c E/f, 0.93 kA	Not restored yet.

13. Event Analysis (Based on PMU, SCADA & DR) (घटना का विश्लेषण):

- A B-Earth fault struck 220 kV Daltonganj-Garhwa-1. Single phase tripping occurred at Garhwa within 100 msec. After 875 msec, O/C E/f operated at Garhwa end and DT sent to Daltonganj.
- Fault current seen from Garhwa was very less. However, resultant sum of all three phase current was much higher as current was almost in phase due to tower damage and E/f picked up and line tripped after 875 msec from Garhwa.

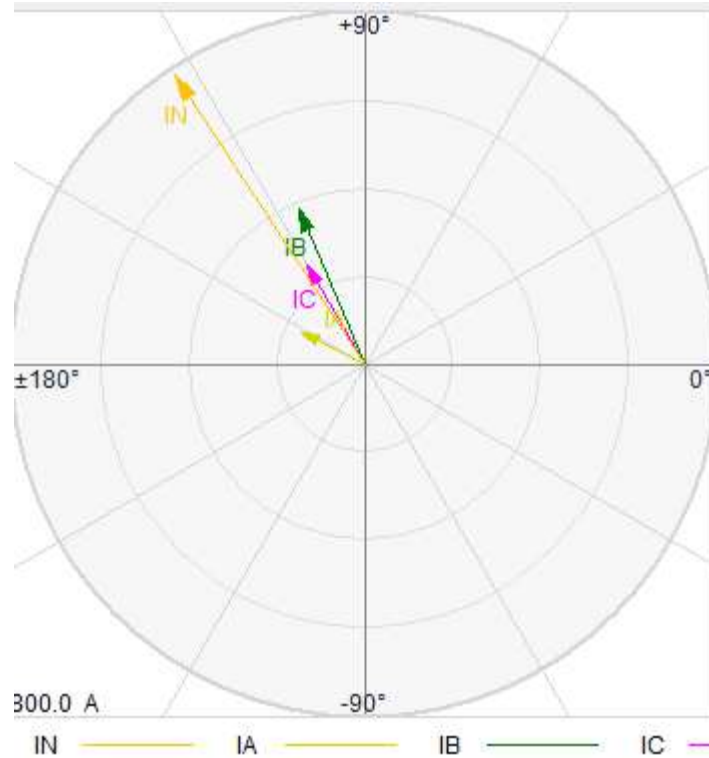


Figure 2: Phasor diagram of current at Garhwa during fault

- As reported, tower at loc. 198 which was partially damaged on 30.03.24 night due to localised thunderstorm, completely collapsed during morning of 31.03.24. Alongwith this tower, towers at loc. 195, 196, 197 & 202 also collapsed.
- 220 kV Daltonganj-Garhwa (New) D/c are under breakdown and loads are being fed through 132 kV Sonenagar-Japla-Garhwa and 132 kV Rihand-Garhwa.

PMU Snapshot:

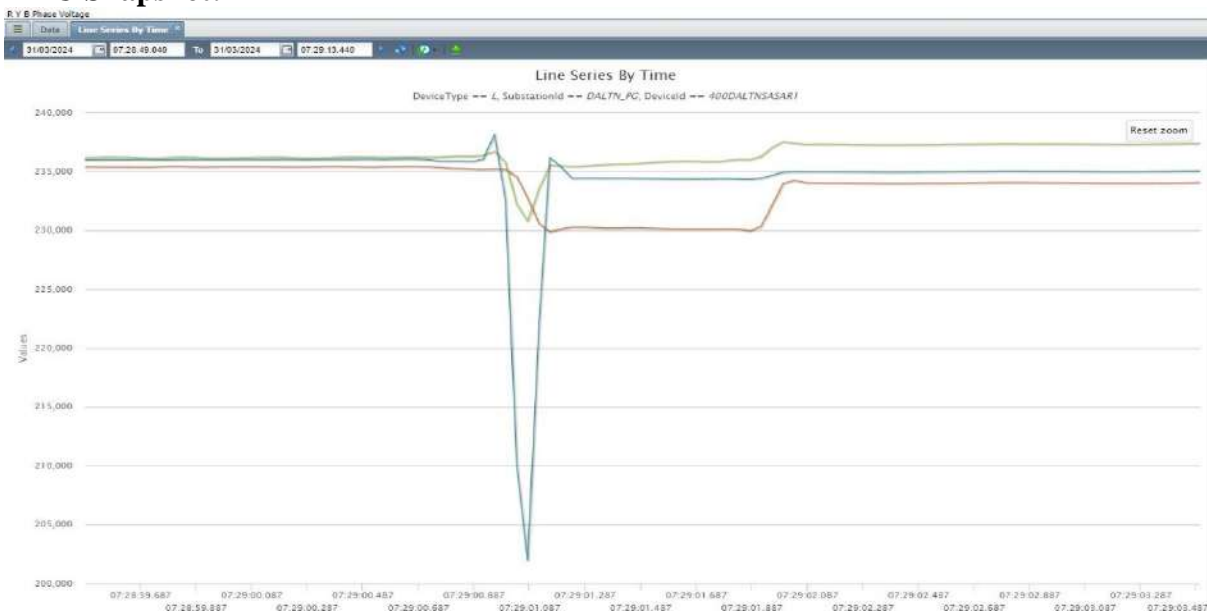


Figure 3: PMU Voltage snapshot of 400/220 kV Daltonganj S/S

14. Protection/Operational issues observed (सुरक्षा/परिचालन संबंधी समस्या): Nil

15. Action Taken/Remedial Measures (सुधारात्मक उपाय):

- Tower restoration work may be completed at the earliest and possibilities of sourcing ERS may be explored.

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

S.No.	Issues	Regulation Non-Compliance	Utilities
2.	DR/EL provided within 24 Hours?	1. IEGC section 37.2 (c) 2. CEA grid Standard 15.3	JUSNL, PG ER-1

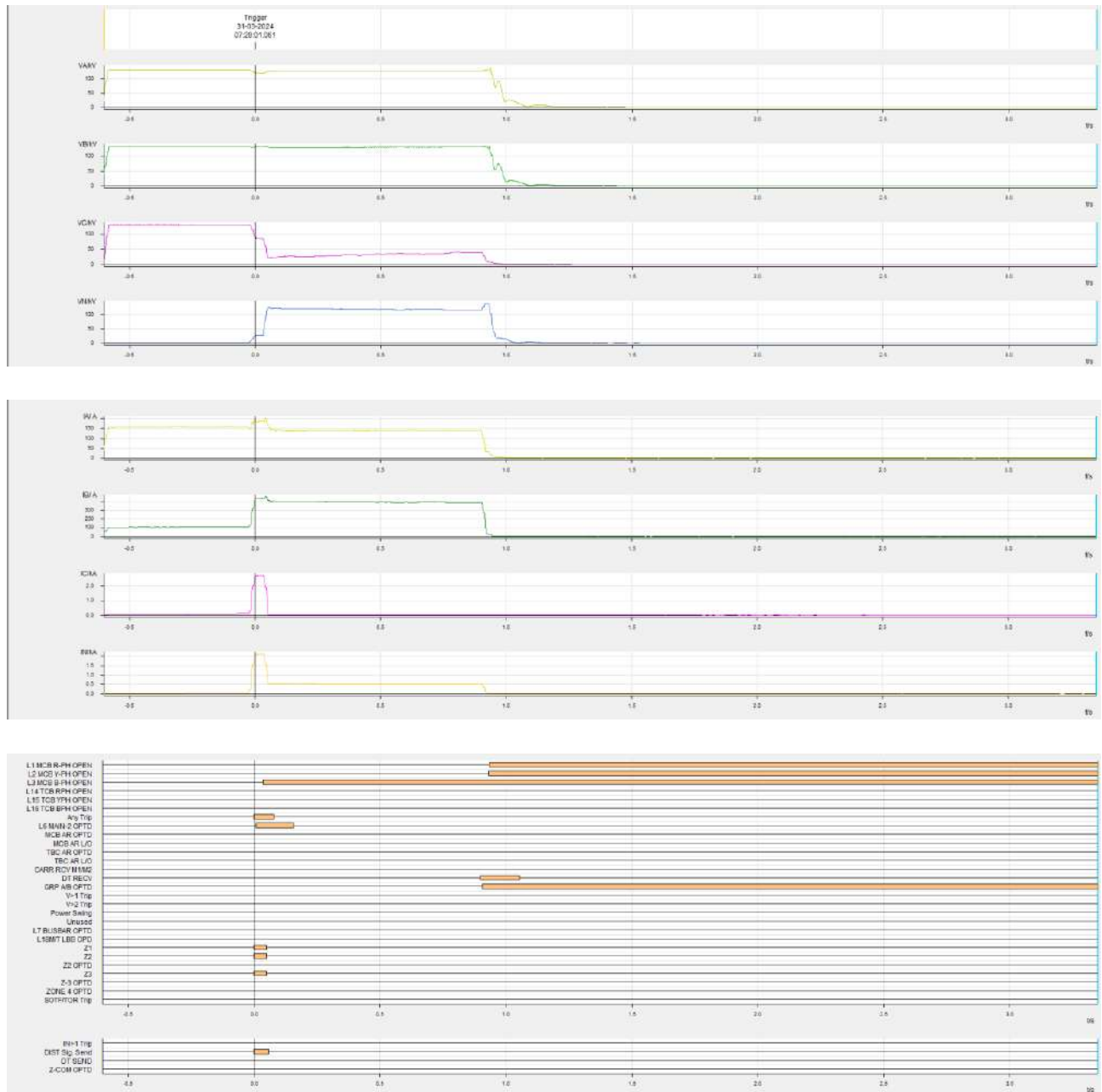
17. Key Lessons Learnt (प्रमुख अधिगम बिंदु): Nil

Annexure 1: (Sequence of Events-As per ERLDC SCADA)

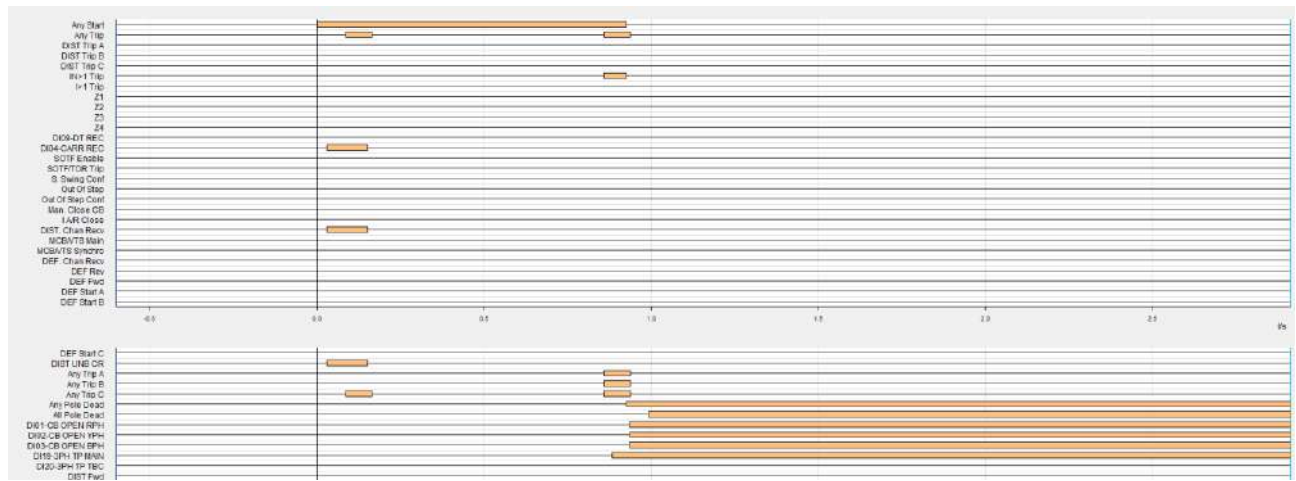
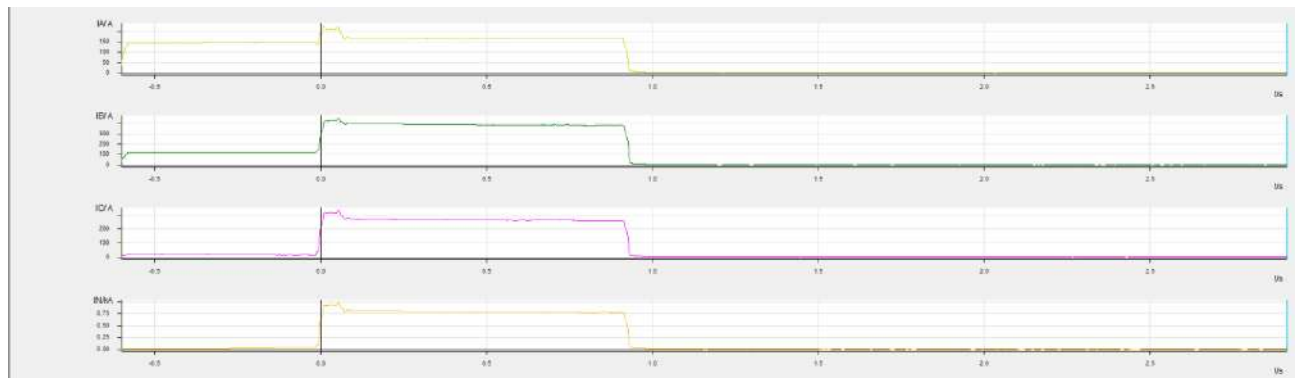
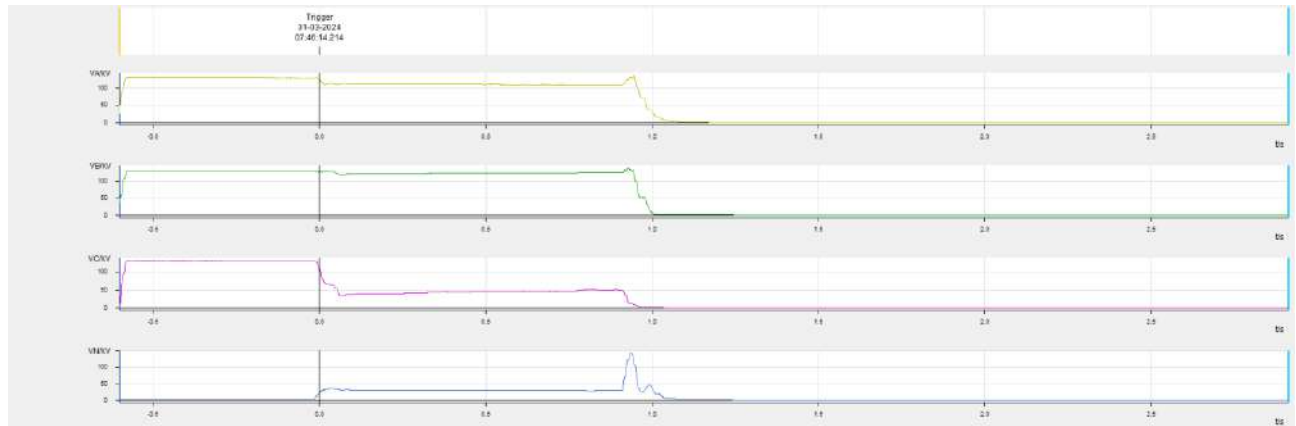
TIMESTAMP	STATION	DESCRIPTION	STATUS
07:29:01.088	DALTN_PG	220_GARHWA_1_CB	Travel
07:29:01.987	DALTN_PG	220_GARHWA_1_CB	Open

Annexure 2:

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



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




ग्रिड-इंडिया
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ग्रिड कंट्रोलर ऑफ इंडिया लिमिटेड
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पूर्वी क्षेत्र के 220/132 केवी बानतला एस/एस में ग्रिड घटना की विस्तृत रिपोर्ट / Detailed Report of grid event at 220/132 kV Bantala S/s of Eastern Region

(To be submitted by RLDC/NLDC during Grid Disturbances/Grid Incidents/Near Miss Event as per IEGC section 37.2 (f))

(आई ई जी सी 37.2 (एफ) के अनुपालन में)

Date(दिनांक):09-04-2024

1. Event Summary (घटना का सारांश):

At 21:49 Hrs of 3103.2024, Y-Ph CT of 220 kV New Town AA3- Bantala(KLC) at Bantala end burst leading to tripping of the said line. At the same time, 220 kV Subhasgram- Bantala line also tripped from Subhasgram end with Y-Ph fault leading to total power failure at 220 kV Bantala(KLC) S/s with a load loss of 78 MW.

2. Time and Date of the Event (घटना का समय और दिनांक): 21:49 hrs of 31.03.2024

3. Event Category (ग्रिड घटना का प्रकार): Grid Disturbance (GD)-1

4. Location/Control Area (स्थान/नियंत्रण क्षेत्र): 220 kV Bantala (West Bengal) Substation

5. Report submitted by Utility on: 04-04-2024

6. Antecedent Conditions (पूर्ववर्ती स्थिति):

	Frequency	Regional Generation	Regional Demand	State Generation	State Demand
				West Bengal	West Bengal
Pre-Event (घटना पूर्व)	49.99 Hz	32052 MW	25701 MW	6817 MW	9146 MW
Post Event (घटना के बाद)	49.99 Hz	32052 MW	25623 MW	6817 MW	9068 MW

**Pre and post data of 1 minute before and after the event*

Important Transmission Line/Unit if under outage (महत्वपूर्ण संचरण लाइने/ विद्युत उत्पादन इकाइयां जो बंद हैं)	Nil
Weather Condition (मौसम स्थिति)	Normal

7. Load and Generation loss (लोड और जेनरेशन हानि): Approximate load loss of 78 MW and Generation loss is nil.

8. Duration of interruption (रूकावट की अवधि): 21:49 Hrs to 22:00 hrs.

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

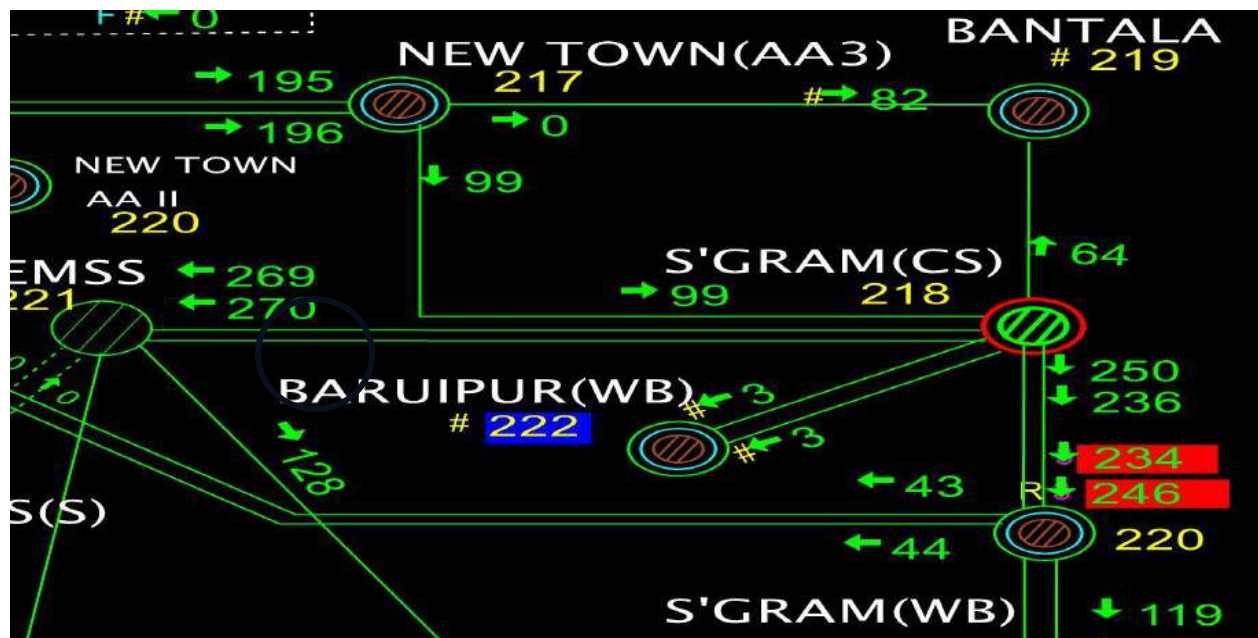


Figure 1: Network across the affected area

10. Details of Equipment Failure (if any during the event) (उपकरण विफलता का विवरण): Y_{ph} CT of 220 kV Bantala(KLC)-NewTown AA III at Bantala burst.

11. Major Elements Tripped (प्रमुख ट्रिपिंग):

क्र०स०	नाम	Trip time (hh:mm:ss.ms)	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	Restoration time
1	220 kV New Town AA-III-KLC(Bantala)	21:49:25:720	NewTown AA III: Y _N , Zone-2, 10.1 kA	KLC: Y _N , Zone-1, 0.157 km, 8.18 kA	17:47 (01.04.24)
2	220 kV Subhashgram-KLC (Bantala)	21:49:26.290	Subhashgram: Y _N , Zone-1, 13.7 kA	KLC: Didn't trip	22:22

12. Event Analysis (Based on PMU, SCADA & DR) (घटना का विश्लेषण):

- Y_ph CT of 220 kV NewTown AA III-Bantala burst at Bantala. This fault was seen in Zone-1 from Bantala end and breaker opened within 100 msec and line tripped in Zone-2 time (350 msec) from NewTown AA III due to non-receipt of carrier signal.
- Despite the breaker got opened from Bantala end, its CT still had the fault current as its CT was damaged and NewTown was feeding the fault. The current became zero after opening of breaker from NewTown AA III.
- During this fault, Zone-4 picked for 220 kV Subhahsgram-Bantala at Bantala and Zone-2 picked at Subhashgram. When Bantala-NewTown AA III tripped from Bantala, Subhashgram was still feeding around 500 A in all three phases suggesting some evolving fault at Bantala bus.
- After 500 msec, A/r attempt was taken by Bantala for 220 kV NewTown AA-III line, which failed. During this event, 220 kV Subhashgram-Bantala tripped in Zone-1 from Subhashgram end as it remained the only source radially feeding Bantala. Three phase tripping occurred in this line as carrier channel was unhealthy and total power failure occurred at Bantala S/s.
- Report received from West Bengal is attached at Annexure-3.

PMU Snapshot:

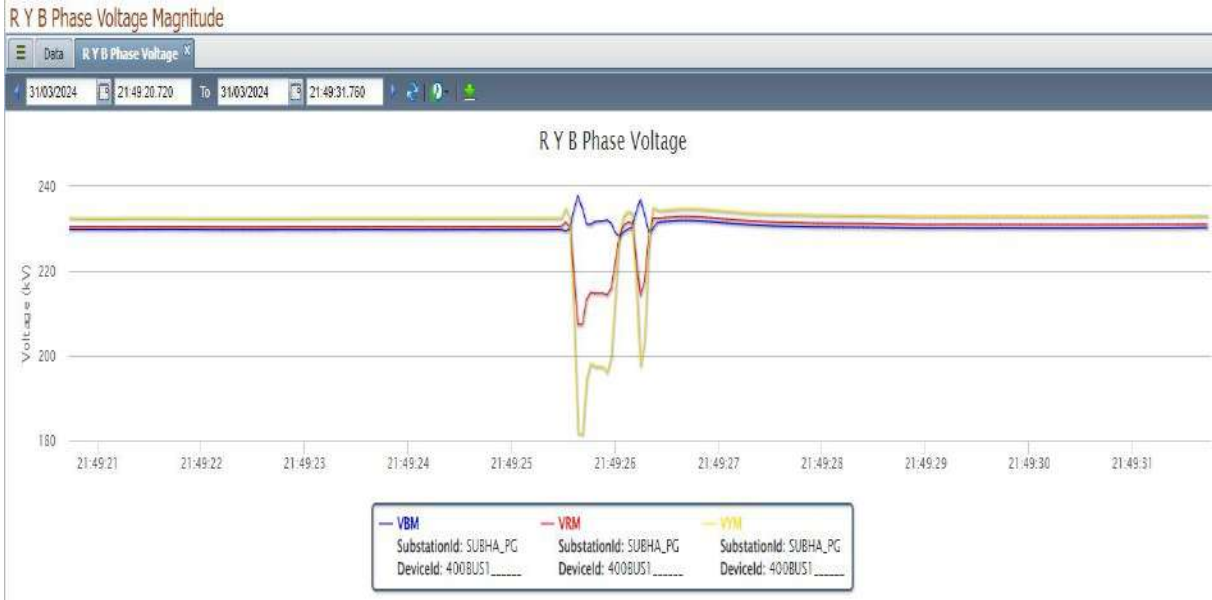


Figure 2: PMU Voltage snapshot of 400/220 kV Subhashgram S/S

13. Protection/Operational issues observed (सुरक्षा/परिचालन संबंधी समस्या):

- 220 kV Bantala has single main bus and transfer scheme and its bus bar protection is out of service. Status of the same may be updated.
- Carrier signal was sent from Bantala for 220 kV NewTown AA III feeder but not received at remote end.
- Carrier channels of 220 kV Subhashgram-Bantala were also not healthy.
- DR/EL of Bantala, NewTown AA III are not time synchronized.

14. Action Taken/Remedial Measures (सुधारात्मक उपाय):

- Bus bar protection may be commissioned at Bantala at the earliest.
- Periodic checking of carrier signal may be planned to ensure its healthiness.
- Root cause analysis of CT failure may be done.

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

S.No.	Issues	Regulation Non-Compliance	Utilities
1.	DR/EL provided within 24 Hours	1. IEGC section 37.2 (c) 2. CEA grid Standard 15.3	WBSETCL, PG ER-2

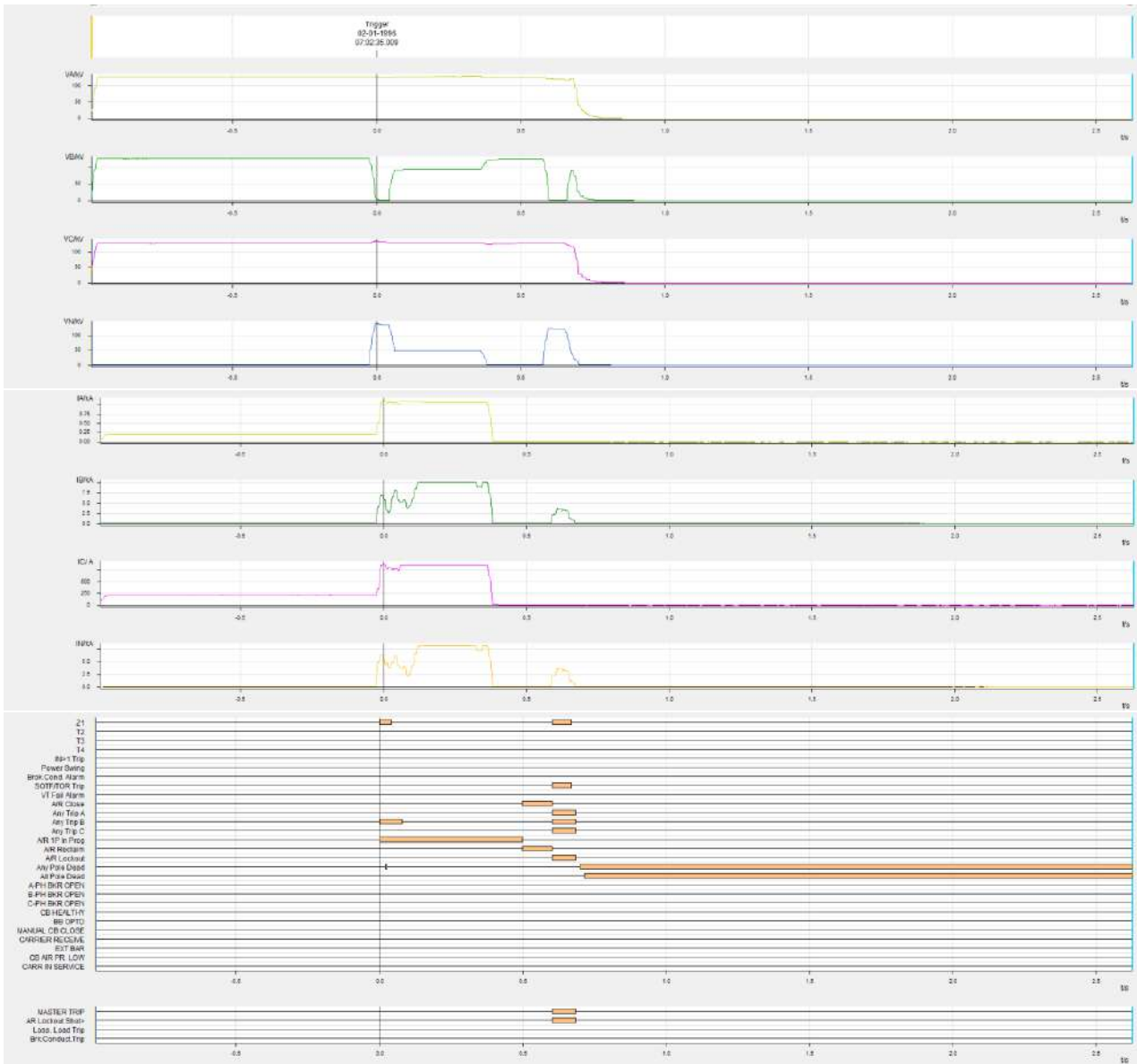
16. Key Lessons Learnt (प्रमुख अधिगम बिंदु): Nil

Annexure 1: (Sequence of Events-As per ERLDC SCADA)

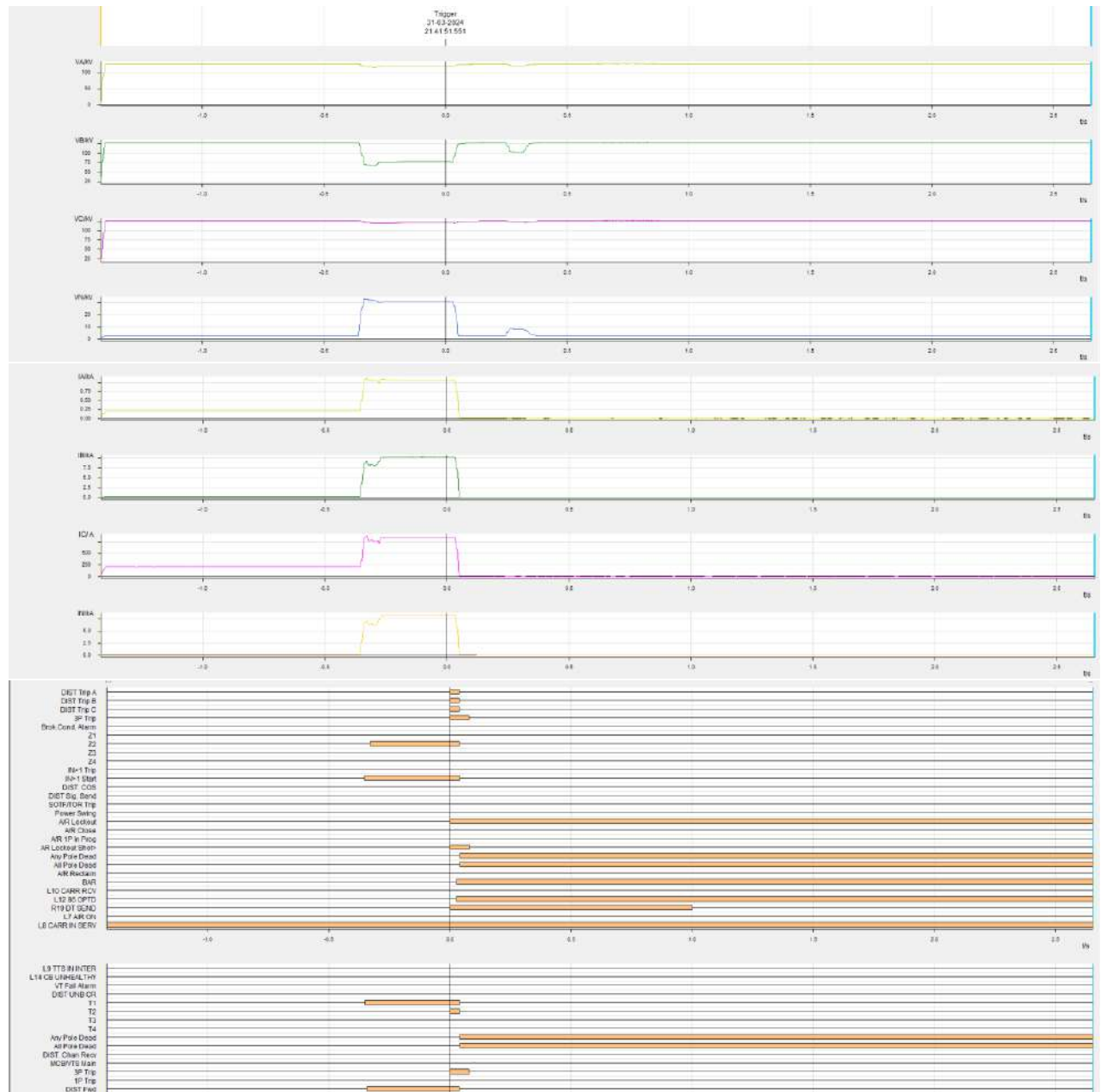
TIMESTAMP	STATION	DESCRIPTION	STATUS
21:49:25.358	SUBHA_PG	220_KLCBN_WB_CB	Open

Annexure 2:

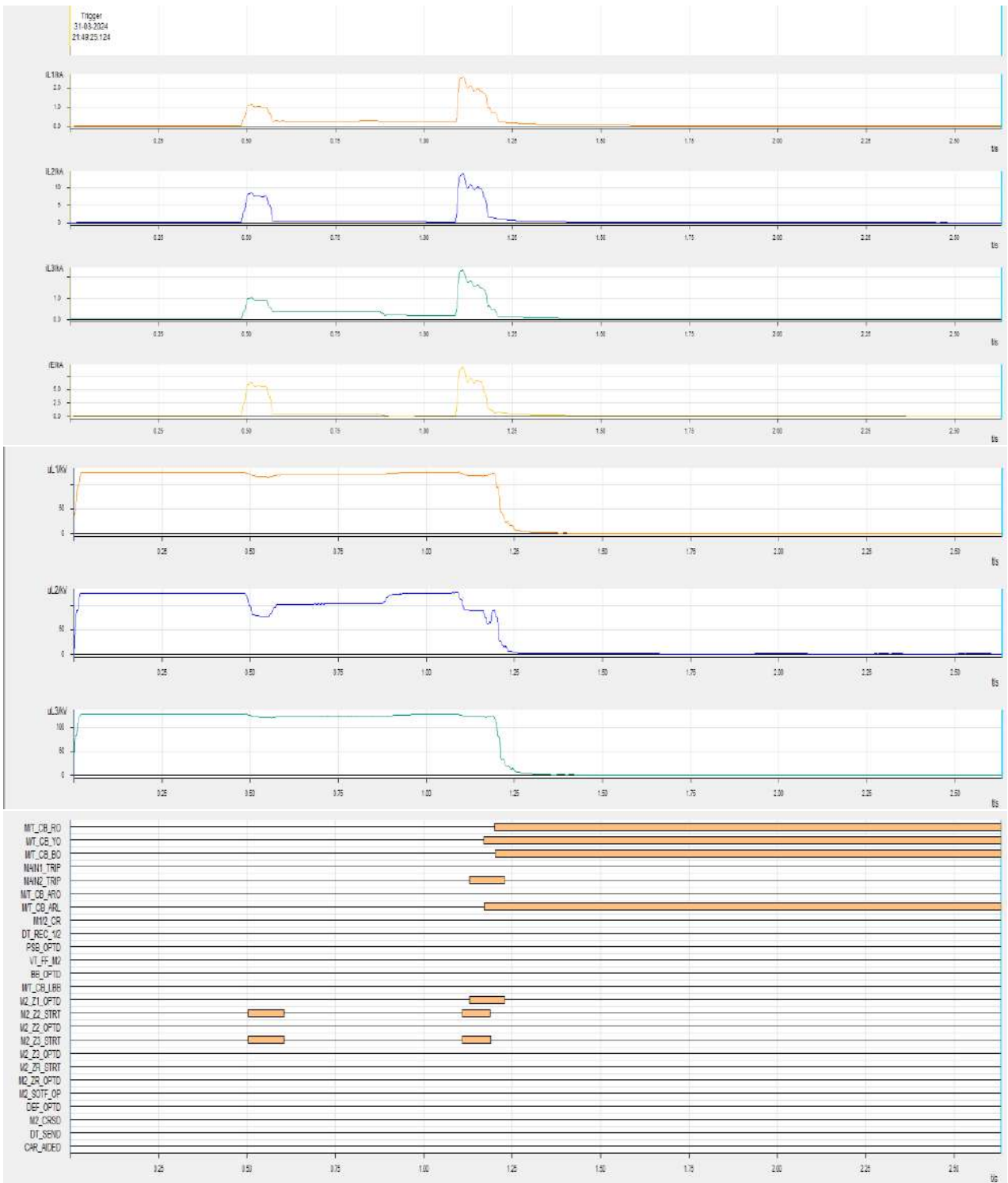
DR of 220 kV Bantala (KLC)-NewTown AA III (Bantala)



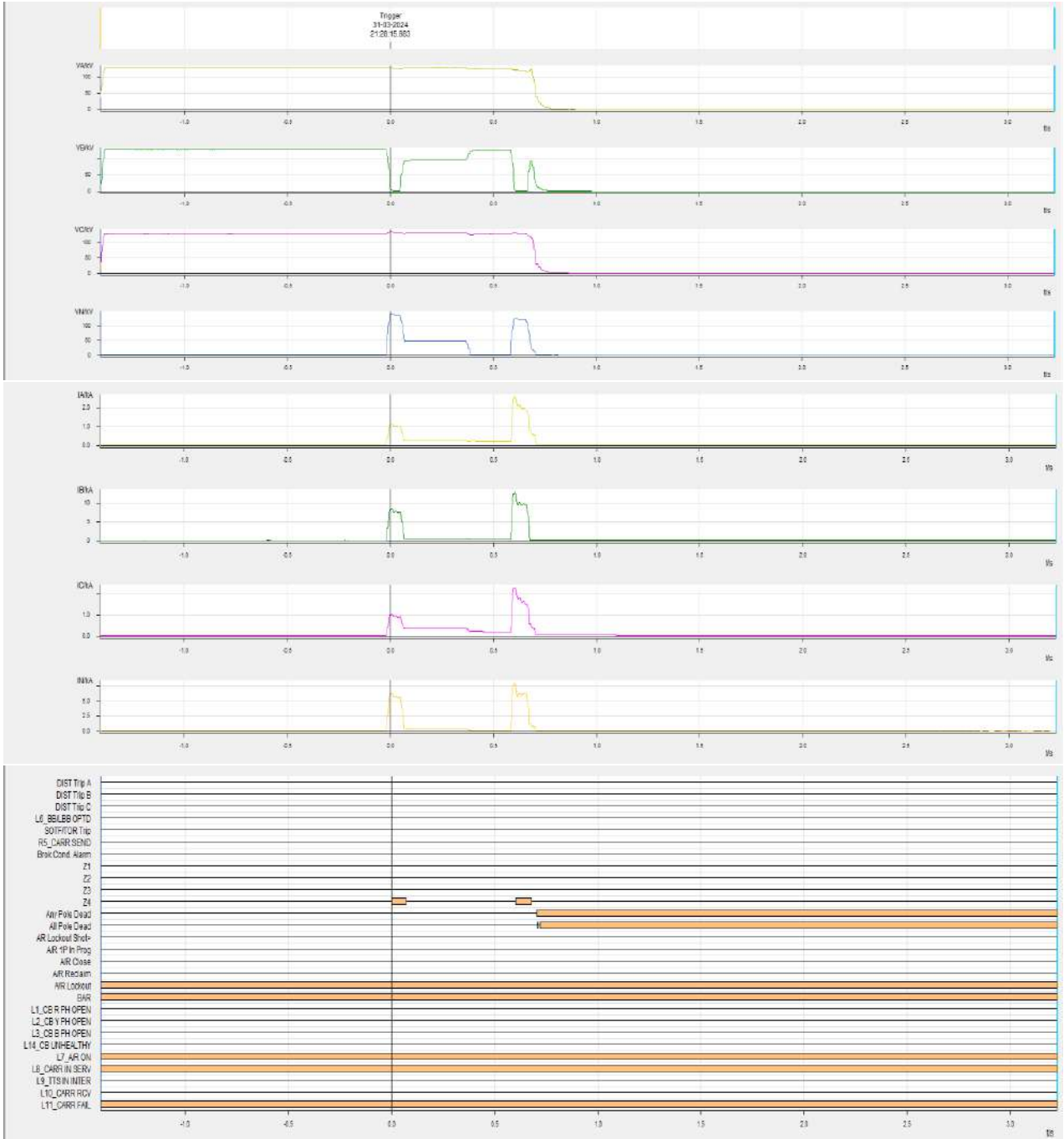
DR of 220 kV Bantala (KLC)-NewTown AA III (NewTown AA III)



DR of 220 kV Subhashgram-Bantala (KLC)-(Subhashgram)



DR of 220 kV Subhashgram-Bantala (KLC)-(Bantala)



Annexure-3

INCIDENT / EVENT REPORTING

SUB: Tripping of 220KV KLC-NAA-III Ckt. along with 220KV KV KLC-PGCL Ckt. at KLC-220KV substation end on 31.03.2024.

	DETAILS	REMARKS
(i)	Time and date of event	21:47 Hr. on31.03.2024
(ii)	Location	KLC-Bantala220 KV Sub-Station.
(iii)	Plant and/or Equipment directly involved	220KV KLC-NAA-III Feeder bay at KLC end.
iv)	List of Lines tripped during the event	220 KV KLC-AA3 & 220 KV KLC-SUBG. PG circuit tipped
(v)	Description and cause of event	220KV Y-PH CT Burst out i.r.o.220KV KLC-NAA-III Ckt resulting total power failure at 220KV bus. 220KV KLC-PGCL Ckt tripped at PGCL end with Zone-1 , yellow phase fault.
(vi)	Antecedent conditions	KLC-220KV substation was drawing power through 220KV KLC-PGCL ckt and 220KV KLC-NAA-III ckt. 200MVA Tr-I and 200MVA Tr-II was under normal condition.220kv bus transfer bus was completely free.Load flow was 40MW through 220KV KLC-NAA-III Ckt and 12MW was through 220KV KLC-PGCL ckt.
(vii)	Demand and/or Generation (in MW) interrupted and duration of interruption	PLS Occurred from 21:47 hrs to 22:04 approx. 76MW.
(viii)	All Relevant system data including copies of records of all recording instruments including Disturbance Recorder, Event, Logger, DAS etc.	220KV KLC-PGCL Ckt tripped only at PGCL end. As discussed from far end relay details given below Tripped Phase-BN, Zone -1 tripped,Dist-11.42km. No tripping at KLC end.
(ix)	Sequence of trippings with time	220KV KLC-NAA-III Ckt tripped at both end on 21:47 hrs. 220KV KLC-PGCL Ckt tripped at PGCL end . KLC 220KV Substation received power from 132KV Kasba-KLC-Saltlakeckt on 22:04 hrs. After obtaining charging code from SLDC the 220KV KLC-PGCL ckt was charged on 22:22 hrs.
(x)	Details of Relay Flags	Active Group-I,Started Phase-BN,Started element distance, E/F start IN1,Dist trip Z1, Yellow-phase,Fault location-157.3 mtr(At KLC end)
(xi)	Remedial measure	Failure of 220KV Y-PH CT i.r.o.220KV KLC-NAA-III Ckt
(xii)	Estimate of time to return to service	At 17:47 HRS on 01.04.24 entire system was normalized after replacement of CT.

(xiii))	Recommendation for Future Improvement/Repeat Incident	Carrier scheme check at KLC-NTAA3 CKT
(xiv))	Analysis of the event	<p>1) 220 KV KLC- NTAA3 feeder tripped with Y-Phase, Zone-1 fault at KLC end. A/R initiates and A/R close. As fault persists , A/R L/O operates. Y-Phase 220 KV CT of NTAA3 circuit burst-out.Carrier channel was healthy as per both end DR.Carrier was sent from KLC end but it was not received to New town end.We have to check carrier panel to find out the issue.</p> <p>2) During dead time KLC end CT was seeing current after Y phase CB pole open.Busbar should have to operate at KLC end but Busbar relay was faulty which was intimated earlier and Z4 time was reduced to 250 ms. As the KLC substation is the vicinity of tannery, severe chemical contamination is a common phenomenon which causes frequent faulty of numerical relays, puncture of Terminal blocks etc.</p> <p>3) Dead time on KLC-NTAA3 ckt at KLC end was found 500 relay, which is rectified .</p> <p>4) 220 KV NTAA3-KLC feeder tripped with Zone-2 relay indication from Newtown end.</p> <p>5) 220 KV KLC- Subhasgram PG circuit tripped with Zone-1 relay indication from PG end only. No tripping at KLC end. KLC end found zone-4 start. It seems that during A/R close at KLC-NTAA3 circuit , PG—KLC feeds the fault current and PG circuit trips on Zone-1(suspected maltripping), causing no power at KLC.</p>

Clarification of Single Line Tripping which is listed at S.No. 43 & 44 of Annexure 1 of 134th PCC Meeting Agenda:

220 kV DMTCL-Laukahi (BSPTCL) Ckt-1 & ckt-2 outage on 17/03/2024 at 18:30 hrs.

220 kV DMTCL-Laukahi (BSPTCL) ckt-2:

- Y-Phase CT blast occurred at 18:30 hrs.
- Zone-1 operated as per DR. (DR submitted)
- Total Power was on MB-1 at the time of incident.

220 kV DMTCL-Laukahi (BSPTCL) ckt-1:

- Zone-4 operated as per DR. (DR submitted)
- Fault clearing time= 160 ms, but Time Delay for Zone-4 is set to 500 ms.

160 MVA ATR-1:

- LV E/F operated.

160 MVA ATR-2:

- LV E/F operated.

220 kV Madhepura-Laukahi ckt-1:

- Tripped on Zone-2 at Madhepura end.

220 kV Madhepura-Laukahi ckt-2:

- Tripped on Zone-2 at Madhepura end.

Note: As reported from field, Bus Bar Protection Operation only observed in Annunciator (Facia) but in actual it did not operate.

Action to be taken:

- Bus Bar Protection is to be checked after availing shutdown.

List of important transmission lines in ER which tripped in March-2024

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 REMOTE END	LOCAL END UTILITY	REMOTE END UTILITY	UTILITY RESPONSE
3	400KV-IBEUL-OPGC-1	01-03-2024	16:04	01-03-2024	17:08	IBEUL: Didn't trip	OPGC: DT received	No fault	NA	OPGC may explain. DT not sent from IBEUL	NA	No	IBEUL	OPGC	No abnormalities found. Detailed checking will be done after availing shutdown.
13	220KV-SUBHASHGRAM(PG)-BANTALA-1	08-03-2024	08:39	08-03-2024	08:56	Subhashgram: Didn't trip		No fault	NA	WBSETCL may explain. No fault observed from PMU.	No	No	PG ER-2	WBSETCL	No fault at the Line. CB Control switch contact found damage and remote trip send from this path.Rectify the same.

15	400KV-RAJARHAT-GOKARNA-1	10-03-2024	15:32	10-03-2024	19:38	Rajarhat: B_N, 2.67 kA	Gokarna: B_N, 15.8 km, 12 kA	B-Earth	100	A/r failed after 1 second. DT received at both ends during A/r attempt. WBSETCL/PG ER-2 may explain	Yes	Yes	PG ER-2	WBSETCL	Earth wire snapped.
17	400KV-DURGAPUR-BIDHANNAGAR-1	12-03-2024	06:59	12-03-2024	08:03	Durgapur: Didn't trip	Bidhannagar: Tripped on Pole Discrepancy.	No fault	NA	R_ph opened from Bidhannagar without any fault. Other two phase tripped on PD after 1.6 seconds. WBSETCL may explain.	No	No	PG ER-2	WBSETCL	Pole discrepancy timer relay found burnt .Replace the same on date
19	400KV-RANCHI-RAGHUNATHPUR-2	13-03-2024	01:25	13-03-2024	02:35	Ranchi: R_N, 38.434 km, 10.965 kA, A/r successful	Raghunathpur: R_N, 155 km, 2.335 kA	R-Earth	500	Tripped in Zone-2 time from Raghunathpur despite carrier sent from Ranchi. DVC may explain.	Yes	Yes	PG ER-1	DVC	Carrier was not received at RTPS End. Some problem with PLCC panel at Ranchi End. BPL panel needs to be replaced. Procurement action going on at HQ level.
20	400KV-ARAMBAGH-BAKRESWAR-1	13-03-2024	06:03	13-03-2024	16:19	Arambagh: Y_N, 92 km, 4.65 kA	Bakreshwar : Y_N, 47 km, 4.29 kA	Y-Earth	100	Whether A/r attempt was successful at Arambagh? After 1.25 seconds, DT received at Arambagh. WBSETCL/WBPDCL may explain.	Yes	No	WBSETCL	WBPDCL	WBPDCL Response- Arambag trip initiation also trigger DT as per scheme due to presence of line reactor.

27	220KV-PARULIA-PARULIA(PG)-1	14-03-2024	13:42	14-03-2024	15:50	DVC: Broken conductor trip	Parulia(PG): Didn't trip	No fault	NA	DVC may explain		No	No	DVC	PG ER-2	Broken Conductor Trip had become wrongly enabled in M2 relay. Same has been set right.
28	220KV-PARULIA-PARULIA(PG)-2	14-03-2024	13:42	14-03-2024	15:50	DVC: Broken conductor trip	Parulia(PG): Didn't trip	No fault	NA	DVC may explain		No	No	DVC	PG ER-2	Broken Conductor Trip had become wrongly enabled in M2 relay. Same has been set right.
30	220KV-MAITHON-DUMKA-1	15-03-2024	13:34	15-03-2024	14:22	Maithon: B_N, Zone 1, 1.98 kA, 13 km	Dumka: B_N, 46.04 km	B-Earth	1600	Resistive Fault. Three phase tripping from Maithon when it came in Zone-1. PG ER-2/JUSNL may explain.		Yes	Yes	PG ER-2	JUSNL	Fault was single phase type. However, old static type RAAM relay failed to execute AR process.
31	400KV-JEERAT-SAGARDIGHI-2	15-03-2024	11:57	15-03-2024	23:11	Jeerat: Z1, B_N, 75.406 km, 3.5 kA	Sagardighi: Z1, B_N, 113 km	B-Earth	100	A/r attempted from Sagardighi after 700 msec and failed. From Jeerat, A/r attempted after 1 second and failed		Yes	No	WBSE TCL	WBDC L	WBPDCL Response- A/R Dead time is 700 msec. A/R attempted but line tripped in reclaim time.
33	400KV-JAMSHEDPUR-MEJIA-1	16-03-2024	17:36	16-03-2024	18:33	Jamshedpur: B_N, 7.15 km, 16.83 kA, A/r successful	Mejia: B_N, Zone-2, 166.3 km, 2.402 kA	B-Earth	100	Other two phase at Mejia opened after 1.5 seconds. No A/r attempted. DVC may explain		Yes	Yes	PG ER-1	DVC	DR file could not be downloaded from M2 relay which was responsible for AR operation. OEM has been contacted for solving the matter.

36	220KV-PARULIA-PARULIA(PG)-1	16-03-2024	18:58	16-03-2024	19:35	DVC: Broken conductor trip	Parulia(PG): Didn't trip	No fault	NA	DVC may explain	No	NA	DVC	PG ER-2	Broken Conductor Trip had become wrongly enabled in M2 relay. Same has been set right.
37	220KV-PARULIA-PARULIA(PG)-2	16-03-2024	18:58	16-03-2024	19:35	DVC: Broken conductor trip	Parulia(PG): Didn't trip	No fault	NA	DVC may explain	No	NA	DVC	PG ER-2	Broken Conductor Trip had become wrongly enabled in M2 relay. Same has been set right.
42	400KV-BINAGURI-MALBASE-3	17-03-2024	17:58	17-03-2024	19:02		Binaguri : Y-N, Z-2, 3.175 kA, 113.2 km	Y-Earth	500	Tripped in Zone-2 time from Binaguri. No carrier received.	Yes	Yes	PG ER-2	Bhutan	Fault was in Z2 and carrier was not received from Bhutan end. Hence, AR did not happen at Binaguri end.
43	220KV-DARBHANGA(DMTCL)-LAUKAHI-1	17-03-2024	18:30	17-03-2024	21:49		Laukahi: Bus bar protection operated to Y_ph CT blast of Darbhanga-Laukahi-2 at Laukahi end	B-Earth	100	Bus bar protection operated at Laukahi. BSPTCL may explain.	No	Yes	DMTCL	BSPTCL	
44	220KV-DARBHANGA(DMTCL)-LAUKAHI-2	17-03-2024	18:30	20-03-2024	17:56		Laukahi: Bus bar protection operated to Y_ph CT blast of Darbhanga-Laukahi-2 at Laukahi end	B-Earth	100	Bus bar protection operated at Laukahi. BSPTCL may explain.	No	Yes	DMTCL	BSPTCL	Y-Phase CT line-2 DMTCL blast occurred at 18:30 hrs.As reported from field, Bus Bar Protection Operation only observed in Annunciator (Facia) but in actual it did not operate.Madhepura lines tripped in zone-2 form madhepura end , and DMTCL line -2 tripped on Zone-1 ,even though after breaker opening as it created bus Fault. Line 1 tripped in Zone-4 in 160ms,timings needs to be checked.

58	220KV- SUBHASGRAM(PG)-BANTALA-1	21-03-2024	15:26	22-03-2024	20:52	Subhasgram : R-N, Z1, 14.6 km, 8.8 kA	Bantala:R-N, Z1, 2.25 km, 7.8 kA	R- Ea rth	100	Three phase tripping at Bantala. Carrier fail signal high in DR	Yes	Yes	PG ER- 2	W B S E T C L	Due to carrier fail, AR LO situation persisted as per scheme and 3 phase trip happended during a single phase fault. PLCC system belongs to WBSETCL end.
59	400KV- SUBHASGRAM(PG)-RAJARHAT-1	21-03-2024	15:37	21-03-2024	15:52	Subhasgram : B-N, Z1, 11.5 kA, 8.6 km	Rajarhat: B-N, Z1, 6.8 kA, 18.9 km (A/R successful)	B- Ea rth	100	A/r lockout appeared at Subhashgram during the fault. Still only faulty pahse opened. Other two phase of main CB opened after 1.6 second and of tie CB oopened after 2.3 second. PG ER-2 may explain.	Yes	Yes	PG ER- 2	PG ER- 2	Fault was single phase type. However, during the fault time, CB air pressure at Subhasgram SS went below the AR healthy pressure level. Both Main & Tie CB is of CGL make and spring- pneumatic type. CB ready signal was found low in DR for CB. Air pressure switch sensitivity issue observed and because of failure of air pressure switch, CB ready signal got low. Hence, AR LO happended. Same has been attended and rectified.
70	400KV-BARIPADA- TISCO-1	27-03-2024	13:24	27-03-2024	14:17	Baripada: Didn't trip	Direct trip signal received at TISCO end.	No fau lt	NA	DT sent from Baripada. PG Odisha may explain.	No	No	PG Odisha	TIS CO	Tripping is caused due to Bus Bar opted. Signal which is meant for DR purpose in Main-1 Relay was wrongly configured for DT sent also. After identifying the problematic signal matrix. The signal is used only for DR purposes.

71	400KV-KODERMA-BOKARO-1	31-03-2024	00:22	31-03-2024	03:40	Koderma: B_N, 15.65 km, 9.6 kA	Bokaro: B_N, A/r successful	B-Earth	100	A/r not attempted at Koderma. Other two phase tripped on PD	not time synchronized and DR length	Yes	No	DVC	DVC	At KTPS End CB Ready was not present as Gas Pressure was Low. Problem rectified now.
73	220KV-MAITHON-DUMKA-1	31-03-2024	02:17	31-03-2024	03:37	Maithon: B_N, 6.33 kA	Dumka : B_N, 46.39 km, 2.139 kA	B-Earth	100	Three phase tripping at both ends. PG ER-2/JUSNL may explain		Yes	Yes	PG ER-2	JUSNL	Fault was single phase type. However, old static type RAAM relay failed to execute AR process.
76	400KV-ALIPURDUAR (PG)-BONGAIGAON-2	31-03-2024	15:48	31-03-2024	17:50	Alipurduar: Y-N, Z-1, 13 KA, 1 km	Bongaigaon: Y-N, Z-2, 4.93 KA, 105.7 Km	Y-Earth	100	Three phase tripping for single phase fault		Yes	NA	PG ER-2	NER	Line auto-reclosed in R_N phase fault just before this tripping. 3 phase tripping happened due to fault within reclaim time.

EASTERN REGIONAL POWER COMMITTEE
KOLKATA

PROTECTION PROTOCOL OF EASTERN REGION

Prepared in Compliance to

Clause 12(2) and Clause 13 of Central Electricity Regulatory
Commission Indian Electricity Grid Code Regulations, 2023

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- 1. Background**
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PROTECTION PROTOCOL OF EASTERN REGION

1. Background

1.1. The Protection Protocol of Eastern region is prepared in accordance with Clauses 12(2) & 13 of the Indian Electricity Grid Code, 2023 (IEGC 2023) notified by the Central Electricity Regulatory Commission.

1.1.1. The clause 12(2) of the IEGC 2023:

“There shall be a uniform protection protocol for the users of the grid:

- a) for proper co-ordination of protection system in order to protect the equipment/system from abnormal operating conditions, isolate the faulty equipment and avoid unintended operation of protection system;*
- b) to have a repository of protection system, settings and events at regional level;*
- c) specifying timelines for submission of data;*
- d) to ensure healthiness of recording equipment including triggering criteria and time synchronization; and*
- e) to provide for periodic audit of protection system.”*

1.1.2. The clause 13 of the IEGC 2023:

“13. Protection protocol

- (1) All users connected to the integrated grid shall provide and maintain effective protection system having reliability, selectivity, speed and sensitivity to isolate faulty section and protect element(s) as per the CEA Technical Standards for Construction, the CEA Technical Standards for Connectivity, the CEA (Grid Standards) Regulations, 2010, the CEA Technical Standards for Communication and any other applicable CEA Standards specified from time to time.*
- (2) Back-up protection system shall be provided to protect an element in the event of failure of the primary protection system.*
- (3) RPC shall develop the protection protocol and revise the same, after review from time to time, in consultation with the stakeholders in the concerned region, and in doing so shall be guided by the principle that minimum electrical protection functions for equipment connected with the grid shall be provided as per the CEA Technical Standards for Construction, the CEA Technical Standards for Connectivity, the CEA Technical Standards for Communication, the CEA (Grid Standards) Regulations, 2010, the CEA (Measures relating to Safety and Electric Supply)*

Regulations, 2010, and any other CEA standards specified from time to time.

- (4) The protection protocol in a particular system may vary depending upon operational experience. Changes in protection protocol, as and when required, shall be carried out after deliberation and approval of the concerned RPC.*
- (5) Violation of the protection protocol of the region shall be brought to the notice of concerned RPC by the concerned RLDC or SLDC, as the case may be.”*

1.2. The Protection Protocol of Eastern Region stipulates General Protection Philosophy of Protection System, Protection Schemes for Generators & various Transmission Elements in Power System, Protection Settings & their Coordination among entities, Disturbance Monitoring, Analysis and Reporting, Time Synchronization of Protection Systems, Protection Audit Plan, Performance of Protection Systems & Compliance Monitoring.

2. Applicability

The Protection Protocol of Eastern Region shall be applicable to all Eastern Regional entities, State/Central/Private Generating Companies/ Generating Stations including REGs, RHGS, integrated RE with Pumped Storage Plant (PSP), SLDCs, ERLDC, CTU, STUs, Transmission Licensees and ERPC.

3. Definitions

Words and expressions used in this Protection Protocol are defined in the Act or any other regulations specified by the Central Commission or Central Electricity Authority shall, unless the context otherwise requires, have the meanings assigned to them under the Act or other regulations specified by the Central Commission, as the case may be.

4. General Philosophy of Protection System

4.1. Protection philosophy shall be in accordance with below mentioned objectives, design criteria and other details. However, protection design in a particular system may vary depending upon judgment and experience in the broad contours of the protection philosophy. Consideration must also be given to the type of equipment to be protected as well as the importance of this equipment to the system. Further, protection must not be defeated by the failure of a single component.

4.1.1. Objectives:

The basic objectives of any protection schemes should be to:

- (i) Automatically isolate the faulty element.
- (ii) Mitigate the effect of short circuit and other abnormal conditions in minimum possible time and area.
- (iii) Indicate the location and type of fault and

- (iv) Provide effective tools to analyses the fault and decide remedial measures.

4.1.2. **Design Criteria:**

To accomplish the above objectives, the four design criteria for protection that should be considered are:

- (i) fault clearance time/speed;
- (ii) selectivity;
- (iii) sensitivity and
- (iv) reliability (dependability and security)

4.1.2.1.**Fault clearance time/speed:** To minimize the effect on customers and maintain system stability, Fault clearance time shall be as per CEA Grid Standard Regulations 2010, as amended to date.

4.1.2.2.**Selectivity:** To ensure Selectivity, coordination shall be ensured with the adjacent protection schemes including breaker failure, transformer downstream relays, generator protection and station auxiliary protection.

4.1.2.3.**Sensitivity:** To ensure Sensitivity, the settings must be investigated to determine that they will perform correctly for the minimum fault current envisaged in the system, yet remain stable during transients and power swings from which the system can recover.

4.1.2.4.**Reliability:** To ensure Reliability, two independent auxiliary direct current-supplies shall be provided for Main-I and Main-II relays. The Main-I and Main-II relays should be from two different makes or operating with different algorithm. The CB's shall have two independent trip coils and two independent trip circuits. Each protection device should trip at least one of them by independent auxiliary DC- supplies.

4.1.2.5.**Security:** To ensure Security, the protection shouldn't limit the maximum transmission capacity of the element. Distance protection in particular could cause spurious tripping due to specific grid conditions, in case of high load operation. Therefore, any special topologies must be known and considered for protection parameterization. For parallel Over Head Lines it is necessary to consider the rapid increase of load current in the healthy line when the faulty line trips and the protection operation must allow such conditions The load encroachment detection function of the relays must be used, when the highest distance zone resistance reach conflicts with the maximum transmitted load on the protected element.

4.2. All generating units shall have standard protection system to protect the units not only from faults within the units and within the Station but also from faults in sub-stations and transmission lines.

4.3. The generator, generator transformer, unit auxiliary transformer shall be provided with protection systems connected to two independent channels or groups, such that one

channel or group shall always be available for any type of fault in the generator and these transformers;

- 4.4. Protection relays shall be configured in such a way that digital input points shall not pick up due to stray voltages.
- 4.5. Protective relays shall be used to detect electrical faults, to activate the alarms and disconnect or shut down the faulted apparatus to provide for safety of personnel, equipment and system.
- 4.6. Electrical faults shall be detected by the protective relays arranged in overlapping zones of protection.
- 4.7. The protection relays for the generators, motors, transformers and the transmission lines shall generally be of numerical type.
- 4.8. All relays used shall be suitable for operation with CTs secondary rated for one ampere or five amperes as per relevant Indian Standards or International Electrotechnical Commission or Institute of Electrical and Electronics Engineers standards.
- 4.9. Relevant Indian Standards or International Electrotechnical Commission or Institute of Electrical and Electronics Engineers standards shall be applied for protection of generators, transformers and motors.

5. Protection Schemes

The electrical protection functions for equipment connected with the grid shall be provided as per the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date, the CEA (Technical Standards for connectivity to the Grid) Regulations 2007 amended to date, the CEA (Technical Standards for Communication System in Power System Operation) Regulations 2020 amended to date, the CEA (Grid Standards) Regulations 2010 amended to date, the CEA (Measures relating to Safety and Electric Supply) Regulations 2023 amended to date, and any other CEA standards specified from time to time.

5.1. Thermal Generating Units

The electrical protection functions for generator, generator transformer, unit auxiliary transformer and station transformer shall be provided in accordance with but not limited to the list given in **SCHEDULE-I** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.

5.2. Hydro Generating Units

- 5.2.1. For the generating units with a rating of more than one hundred megawatt, protection system shall be configured into two independent sets of protection (Group A and B) acting on two independent sets of trip coil fed from independent DC supplies, using separate sets of instrument transformers, and segregated cables of current transformers and voltage transformers.

5.2.2. The protection functions for Generator, Excitation Transformer, Generator Transformer, Generator and Generator Transformer, Unit Auxiliary Transformer, and Station Auxiliary Transformer shall be provided in accordance with but not limited to the list given in SCHEDULE-IV of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date except for variable speed units which will have specialized protection functions.

5.3. REGs/RHGS/BESS

Protection Schemes for Renewable Energy (RE) Power Plants of Solar power generation, Wind power generation, Battery Energy Storage System (BESS) and Hybrid of these connected with grid at voltage level above 650 volts shall be in accordance with the Central Electricity Authority (Technical Standards for Construction of Renewable Energy Power Plants) Regulations, 2023 from the date as & when these regulations are notified (Presently the finalization of these Standards by CEA is under progress).

5.4. Substations & Transmission System Elements

5.4.1. All major protection relays for the Voltage levels 66 kV and above shall be of numerical type and communication protocol shall be as per IEC-61850.

5.4.2. Grouping of Protection systems for the voltage level 66 kV and above:

- i. The protection circuits and relays shall be electrically and physically segregated into two groups each being independent and capable of providing uninterrupted protection even in the event of one of the protection group fails or taken out for maintenance.
- ii. Interconnection between these two groups shall not generally be attempted. However, such interconnection shall be kept to the bare minimum, if found absolutely necessary.

5.4.3. The protections required in respect of transmission lines, transformers, reactors and bus bars but not limited to shall be in accordance with **SCHEDULE-V** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.

5.4.4. **Bus Bar Protection and Local Breaker Backup Protection (breaker failure protection):**

- i) Bus bar protection and local breaker backup protection shall be provided in 220 kV and higher voltage interconnecting sub- stations as well as in all generating station switchyards.
- ii) Duplication of bus bar protection shall be done for all main buses of 400kV and above voltage class.
- iii) The bus bar protection scheme shall be centralized or distributed type and have provision for planned future expansion.

5.5. HVDC Terminals/ Stations

5.5.1. Classical HVDC Terminals/ Stations

- i) HVDC system protection shall consist of two parts:

(A) AC side protection:

AC side protection function shall cover the zone for converter transformer, AC filters, shunt capacitors, shunt reactors, and bus bars. These protections shall generally follow the same philosophy as in a typical substation i.e. detection of fault by relay and tripping of circuit breaker.

(B) DC side protection:

DC side protection shall cover the zones consisting of the valve hall, DC switchyard including smoothing reactor and DC filters, DC line, DMR line / electrode line and ground electrode. The protection equipment shall be designed to be fail safe and shall ensure high security to avoid mal-operation/ unwanted shutdown due to protection equipment failures.

- ii) Following a DC Line fault, the HVDC System shall have the facility to restart, one or more times, the faulted pole at a variable pre-selected DC voltage level(s), not below 80% of the nominal voltage rating. The DC transmission system shall be capable of recovery in a controlled and stable manner without commutation failures during recovery following ac and dc system faults. The post fault power order shall be equal to the pre-fault power order unless AC/ DC systems dictate otherwise.
- iii) Protection system required in respect of Classical HVDC Terminals/ Stations but not limited to shall be in accordance with 13 (b) of Part A of **SCHEDULE-VI** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.
- iv) Software based controls and protection shall be used to permit flexibility in effecting modifications. Protection and controls shall be duplicated for reliability. The control & protection shall provide fast controllability of the HVDC system.

5.5.2. Voltage Source Converter (VSC) based HVDC Terminals/Stations

- i) The protection equipment shall be designed to be fail-safe and shall ensure high security to avoid mal-operation/ unwanted shutdown due to protection equipment failures.
- ii) Protection system required in respect of Voltage Source Converter (VSC) based HVDC Terminals/ Stations but not limited to shall be in accordance with 8 (b) of Part B of **SCHEDULE-VI** of CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date.
- iii) Software based controls and protection shall be used to permit flexibility in effecting modifications. Protection and controls shall be duplicated for

reliability. Protection shall be provided by numerical relays to suit the requirement of the HVDC system.

5.6. Philosophy of Transmission Line Protection

5.6.1.

Sl. No.	Zone	Direction	Protected Line Reach Settings	Time Settings (in Seconds)	Remarks
1	Zone-1	Forward	80%	Instantaneous (0)	As per CEA
2a	Zone-2	Forward	For single ckt- 120 % of the protected line	0.5 to 0.6 - if Z2 reach overreaches the 50% of the next shortest line ; 0.35- otherwise	As per CEA
			For double ckt- 150 % of the protected line		As per CEA
2b	Zone-2 (for 220 kV and below voltage Transmission lines of utilities)	Forward	120 % of the protected line, or 100% of the protected line + 50% of the adjacent shortest line	0.35	As per CEA with minor changes
3	Zone-3	Forward	120 % of the (Protected line + Next longest line)	0.8 - 1.0	As per CEA
4	Zone-4	Reverse	10%- for long lines (for line length of 100 km and above) 20%- for shot lines (for line length of less than 100 km)	0.5 (Where Busbar Protection is not available: 0.25)	As per CEA

Note:

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

5.6.2.

<p>Lines with Series and other compensations in the vicinity of Substation</p>	<ul style="list-style-type: none"> • Zone-1: 80% of the protected line with 100ms-time delay. POR Communication scheme logic is modified such that relay trips instantaneously in Zone-1 on carrier receive. • Zone-2: 120 % of uncompensated line impedance for single circuit line. For Double circuit line, settings
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	<p>may be decided on basis of dynamic study in view of zero sequence mutual coupling.</p> <ul style="list-style-type: none"> Phase locked voltage memory is used to cope with the voltage inversion. Alternatively, an intentional time delay may be applied to overcome directionality problems related to voltage inversion. over-voltage stage-I setting for series compensated double circuit lines may be kept higher than 113%.
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5.6.3.

	Power Swing Blocking	<p>For all lines, block tripping in all zones except zone-1.</p> <p>Out of Step tripping to be applied on all inter regional tie lines. Deblock time delay = 2s</p>
	Protection for broken conductor	<p>Negative Sequence current to Positive Sequence current ratio more than 0.2 (i.e. $I_2/I_1 \geq 0.2$)</p> <p>Only for alarm: Time delay = 3-5 sec</p>
	Switch on to fault (SOTF)	<p>Switch on to fault (SOTF) function to be provided in distance relay to take care of line energization on fault</p>
	VT fuse fail detection function	<p>VT fuse fail detection function shall be correctly set to block the distance function operation on VT fuse failure.</p>
	Carrier Protection	<p>To be applied on all 220kV and above lines with the only exception of radial feeders.</p>
	Back up Protection	<p>On 220kV and above lines with 2 Main Protections:</p> <ul style="list-style-type: none"> Back up Earth Fault protections alone to be provided. No Over current protection to be applied.

		At 132kV and below lines with only one Main protection: <ul style="list-style-type: none"> • Back up protection by IDMT O/C and E/F to be applied.

5.6.4. Overvoltage Protection:

FOR 765kV LINES:	Low set stage (Stage-I): 106% - 109% (typically 108%) with a time delay of 5 seconds. High set stage (Stage-II): 140% - 150% with a time delay of 100 milliseconds.
400kV LINES/CABLE:	Low set stage (Stage-I): 110% - 112% (typically 110%) with a time delay of 5 seconds. High set stage (Stage-II): 140% - 150% with a time delay of 100 milliseconds.
FOR 220 KV LINES:	No over-voltage protection shall be used in general. If necessary, may be enabled on case-to-case basis after due approval from SLDC/ERLDC.
FOR 220 KV CABLE:	Low set stage (Stage-I): 110% - 112% (typically 110%) with a time delay of 5 seconds. High set stage (Stage-II): 140% - 150% with a time delay of 100 milliseconds.

- The lines emanating from same substation shall be provided with pick-up as well as time grading to avoid concurrent trippings. Grading to be done in such a way that inter-regional lines and lines with generation evacuation should trip last, as far as practicable.
- The overvoltage relay shall have better than 98% drop-off to pick-up ratio.
- To achieve required discrimination for OVR grading on account of limitation imposed by voltage resolution of the relay, Ph-to-Ph voltage to be used for Over Voltage detection.

5.6.5. Resistive Reach Setting

Setting for Phase-earth fault:

- a. Calculation of minimum load impedance shall be as per Ramkrishna Committee Recommendations.
- b. Maximum load current (I_{max}) may be considered as 1.5 times the thermal rating of the line or 1.5 times the associated bay equipment current rating (the minimum of the bay equipment individual rating) whichever is lower. Minimum voltage (V_{min}) to be considered as 0.85pu (85%).
- c. Minimum setting for resistive reach shall be such that it must cover fault resistance, arc resistance and the tower footing resistance.
- d. In general, maximum reach setting shall be 80% of the minimum load impedance.
- e. Utility should try to set Resistive reach setting < 4.5 times the zone reactive reach setting, however if there is any limitation from relay manufacturer's side then recommendation of OEM may be followed for maximum resistive reach setting.

Resistive reach shall be the maximum of the value determined by the above rules.

Setting for Phase-Phase fault:

- a. Calculation of minimum load impedance as per the method mentioned above for phase earth fault.
- b. Minimum setting for resistive reach shall be such that it must cover fault resistance and arc resistance.
- c. In general, the resistive reach of zone-3 is set less than 80% of minimum load impedance. For power swing consideration, a margin of DR is given. Therefore, it is essential that load should not encroach this DR. In view of this, R3ph-R4ph may be set 60% of minimum load impedance. R2ph and R1ph may be set 80% of R3ph-R4ph respectively.
- d. Utility should try to set Resistive reach setting < 3 times the zone reactive reach setting, however if there is any limitation from relay manufacturer's side then recommendation of OEM may be followed for maximum resistive reach setting.

Resistive reach shall be the maximum of the value determined by the above rules.

- e. For underground cable, as the fault mechanism and earthing resistance of sheath are different from tower footing resistance of overhead lines, the resistive reach setting of cable may be set as per OEM recommendation. However, effort shall be made to keep the setting within the above-mentioned range as far as possible honoring OEM guidelines.

5.6.6. Auto Reclosing:

The single-phase high-speed auto-reclosure (HSAR) at 220 kV level and above (except for the composite feeders: overhead plus underground) shall be implemented, including on lines emanating from generating stations. If 3-phase auto reclosure is adopted in the application of the same on lines emanating from generating stations should be studied and decision to be taken on case to case basis.

i) Scheme Special Requirements:

- a) Modern numerical relays (IEDs) have AR function as built-in feature. However, standalone AR relay or AR function of Bay control unit (BCU) for 220kV and above voltage lines may be used. For 132kV/110kV lines, AR functions built-in Main distance relay IED can be used.
- b) Fast simultaneous tripping of the breakers at both ends of a faulty line is essential for successful auto-reclosing. Therefore, availability of protection signalling equipment is a pre-requisite.
- c) Starting and Blocking of Auto-reclose Relays:

Some protections start auto-reclosing and others block. Protections which start A/R are Main-I and Main-II line protections. Protections which block A/R are:

- i. Breaker Fail Relay
- ii. Line Reactor Protections
- iii. O/V Protection
- iv. Received Direct Transfer trip signals
- v. Busbar Protection
- vi. Zone 2/3 of Distance Protection
- vii. Carrier Fail Conditions
- viii. Circuit Breaker Problems.
- ix. Phase to Phase Distance Trip
- x. AR selection switch in OFF position
- xi. Logic AR OFF in SAS
- xii. Phase Distance Start (when Auto reclosure is in progress)

When a reclosing relay receives start and block A/R impulse simultaneously, block signal dominates. Similarly, if it receives 'start' for 1-phase fault immediately followed by multi-phase fault the later one dominates over the previous one.

ii) **Requirement for Multi breaker Arrangement:**

Following schemes shall be adhered to multi-breaker arrangements of one and half breaker or double breaker arrangement:

- a) In a multi-Circuit Breaker (C.B.) arrangement one C.B. can be taken out of operation and the line still be kept in service. After a line fault only those CBs which were closed before the fault shall be reclosed.
- b) In multi-C.B. arrangement it is desirable to have a priority arrangement so as to avoid closing of both the breakers in case of a permanent fault.
- c) A natural priority is that the C.B. near the busbar is reclosed first. In case of faults on two lines on both sides of a tie C.B. the tie C.B. is reclosed after the outer C.Bs. The outer C.Bs. do not need a prioritizing with respect to each other.

iii) **Setting Criteria:**

- a) Auto reclosing requires a dead time which exceeds the de-ionising time. The circuit voltage is the factor having the predominating influence on the de-ionising time. Single phase dead time of 1.0 sec. is recommended for 765 kV, 400 kV and 220 kV system. For the lines emanating from generating stations single-phase dead time upto 1.5 sec may be adopted.
- b) According to IEC 62271-101, a breaker must be capable of withstanding the following operating cycle with full rated breaking current:

O - 0.3 s - CO - 3 min - CO

O stands for Open

CO stands for Close-Open

The rated operating cycle of the circuit breaker consisting of an opening, a holding time of 0.3 seconds, a CO cycle, a 3-minute wait, and another CO cycle.

The recommended operating cycle at 765kV, 400 kV and 220 kV is as per the IEC standard. Therefore, reclaim time of 25 Sec. is recommended.

5.7. Transmission Relay Loadability

Transmission Relay Loadability means the loading permitted in the transmission line by the relay including a security margin. The relay loadability is to be arrived in such a way as far as possible not to interfere with system operator actions, while allowing for short-term overloads, with sufficient margin to allow for inaccuracies in the relays and instrument transformers. Transmission relay do not prematurely trip the transmission elements out-of-service and allow the system operators from taking controlled actions consciously to alleviate the overload.

5.7.1. Protective relay settings shall

- i) Not limit transmission loadability;

- ii) Not interfere with system operators' ability to take remedial action to protect system reliability and;
- iii) Be set to reliably detect all fault conditions and protect the electrical network from the faults.

5.7.2. The protective functions which could trip with or without time delay, on load current i.e. load responsive phase protection systems including but not limited to:

- i) Phase distance.
- ii) Out-of-step tripping.
- iii) Switch-on-to-fault.
- iv) Overcurrent relays.
- v) Communications aided protection schemes including but not limited to:
 - Permissive overreach transfer trip (POTT).
 - Permissive under-reach transfer trip (PUTT).
 - Directional comparison blocking (DCB).
 - Directional comparison unblocking (DCUB).
- vi) Phase overcurrent supervisory elements (i.e., phase fault detectors) associated with current based, communication-assisted schemes (i.e., pilot wire, phase comparison, and line current differential) where the scheme is capable of tripping for loss of communications.

5.7.3. Each Transmission Licensee and Generating Company shall use any one of the following criteria for any specific circuit terminal to prevent its phase protective relay settings from limiting transmission system loadability while maintaining reliable protection of the Grid for all fault conditions. Relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees shall be evaluated.

- i) For Distance protection relays of transmission lines, the Zone-3 shall prevent load encroachment, considering the following criteria:
 - a) Maximum load current (I_{max}) may be considered as 1.5 times the thermal rating of the line or 1.5 times the associated bay equipment current rating (the Minimum of the bay equipment individual rating) whichever is lower.

(The rating considered is approximately 15 minutes rating of the Transmission facility).
 - b) For setting angle for load blinder, a value of 30 degree may be adequate in most cases.
 - c) The Distance protection relays shall have provision for load blinder characteristic or load encroachment detection.
- ii) For Directional Overcurrent relays, wherever used in a transmission line (132/110 kV level), the following shall be adopted:

- a) An overload alarm shall be set at 110% of the thermal rating of the line with sufficient delay. This alarm shall allow the operator to take corrective action.
- b) The Directional Overcurrent relay shall allow the line to carry 1.2 times of the thermal rating of the associated line or bay equipment (whichever is lower) at least 10 minutes.
- iii) For transformer protection relays the following shall be adopted:
 - Set the definite time transformer overload relay at 105% of the transformer ratings with sufficient delay. It shall be wired for alarm purpose only to allow the operator to take corrective action. No tripping shall be issued from this relay.
 - The back-up overcurrent relays shall use IDMT characteristics and be suitably coordinated with the upstream transmission network.
 - Install supervision for the transformer using either a top oil or simulated winding hot spot temperature element. The alarm and trip settings for these relays shall be set by individual entities based on the manufacturer's recommendation.

Thermal ratings as specified in the prevailing CEA's Manual on Transmission Planning Criterion shall be used for above requirement.

6. Protection Settings & Coordination

The purpose is to ensure system protection is coordinated among the grid connected entities. The Protection systems coordination comprises the following:

- i) Each Transmission Licensee, Load Dispatch Centre (LDC) and Generating Company shall keep themselves familiarized with the purpose and limitations of Protection System schemes applied in its area of control.
- ii) Each Transmission licensee shall coordinate its Protection System schemes with concerned transmission system, sub-transmission system and generators.
- iii) Each Generating Company shall coordinate its Protection System schemes with concerned transmission system and station auxiliaries.
- iv) Each Transmission Licensee and Generation Company shall be responsible for settings calculations for protection of elements under its ownership. It shall be the responsibility of the respective asset owner to obtain the inputs (adjacent line settings, infeed values etc.) from STU/Generating Company/ Transmission Licensee necessary for calculation of the settings.
- v) STU/Generating Company/Transmission Licensee shall provide the infeed values/latest network model to the requesting entity, within 15 days of receipt of such a request from the entity.
- vi) Each Generating Company and Transmission Licensee, for voltage levels 400kV and above and interstate lines, shall submit the protection settings as per the format

prescribed, along with the calculation sheets, co-ordination study reports and input data, in advance, to ERPC/ERLDC for every new element to be commissioned. The mentioned information shall be submitted to the ERPC/ERLDC two months in advance for all the elements proposed to be commissioned. ERPC shall furnish the approved settings within forty days from the date of submission of the settings by the entity.

- vii) The PCC of ERPC shall review the settings to ensure that they are properly coordinated with adjacent system and comply with the existing guidelines. The onus to prove the correctness of the calculated settings shall lie with the respective Transmission licensee/Generation Company. In case, the PCC feels that the adjacent transmission system settings need to be changed, in view of the new element, it shall inform the concerned entity for revision of the existing settings.
- viii) The PCC of ERPC shall review and approve the settings based on the inputs /report submitted by the entities.
- ix) The approved settings shall be implemented by the entity and proper record of the implemented settings shall be kept. The modern numerical relays have several settings for various features available in the relay. It shall be ensured that only the approved features and settings are enabled in the relay. No additional protection/setting shall be enabled without the prior approval of ERPC.
- x) Each Transmission licensee and Generating Company shall co-ordinate the protection of its station auxiliaries to ensure that the auxiliaries are not interrupted during transient voltage decay.
- xi) Any change in the existing protection settings, for voltage levels 400kV and above & interstate lines, shall be carried out only after prior approval from the ERPC. The owner entity shall inform all the adjacent entities about the change being carried out.
- xii) In case of failure of a protective relay or equipment failure, the Generating Company and Transmission Licensee shall inform appropriate SLDC/ERLDC/ERPC. The Generating Company and Transmission Licensee shall take corrective action as soon as possible.
- xiii) Each Transmission Licensee shall coordinate Protection Systems on major transmission lines and interconnections with neighbouring Generating Company, Transmission Licensee and appropriate LDC.
- xiv) ERPC in consultation with the ERLDC & Eastern Regional entities shall undertake review of the protection settings, assess the requirement of revisions in protection settings and revise protection settings, from time to time and at least once in a year. The necessary studies in this regard shall be carried out by the ERPC. The modifications/changes, if any, in protection settings shall be advised to the respective users and STUs.
- xv) ERPC shall maintain a centralized database and update the same on periodic basis in respect of their respective region containing details of relay settings for grid elements connected to 220 kV and above. ERLDC also shall maintain such database.

Respective Transmission licensee/Generating Company/Entities are responsible for ensuring to make available the implemented protection settings in the centralized database within fifteen days from the date of commissioning.

- xvi) If System Protection Schemes (SPS) is recommended to be implemented by the appropriate forum/Sub-Committee of ERPC on account of operational & system constraints, the same shall be implemented by the concerned Transmission licensee/Generating Company/Entities within the specified timelines.

7. Disturbance Monitoring, Analysis and Reporting

The Purpose is to ensure that adequate disturbance data is available to facilitate Grid event analysis. The analysis of power system disturbances is an important function that monitors the performance of protection system, which can provide information related to correct behavior of the system, adoption of safe operating limits, isolation of incipient faults,

7.1. The Disturbance Monitoring Requirements include the following:

- i) Each Transmission Licensee and Generating Company shall provide Sequence of Event (SOE) recording capability by installing Sequence of Event recorders or as part of another device, such as a Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU), a generator plants Digital (or Distributed) Control System (DCS) or part of Fault recording equipment.

This capability shall be provided at all substations and at locations to record all the events in accordance with CEA Grid Standard Regulations, 2010 amended to date. The following shall also be monitored at each location:

- a) Transmission and Generator circuit breaker positions
 - b) Protective Relay tripping for all Protection Groups that operate to trip circuit breakers identified in (a) above.
 - c) Tele protection keying and receive
- ii) In either case, a separate work station PC shall be identified to function as the event logger front end. The event logger work-station PC should be connected to UPS (Uninterrupted Power Supply).

The event logger signals shall include but not limited to

- All Circuit Breaker and isolator switching Operations
- Auxiliary supply (AC, DC and DG) supervision alarms
- Auxiliary supply switching signals
- Fire-fighting system operation alarms
- Operation signals (Alarm/Trip from all the protection relays.)
- Communication Channel Supervision Signals.
- Intertrip signals receipt and send.
- Global Positioning System (GPS) Clock healthiness.

- Control Switching Device healthiness (if applicable).
 - RTU/Gateway PC healthiness
 - All Circuit Breaker Supervision Signals.
 - Trip Circuit Supervision Signals.
- iii) Each Transmission Licensee/Generating Company/Users shall provide Disturbance recording capability for the following Elements at facilities:
- All transmission lines (Each line shall be provided with facility for distance to fault locator)
 - Autotransformers or phase-shifters connected to busses.
 - Shunt capacitors, shunt reactors.
 - Individual generator line interconnections.
 - Dynamic VAR Devices.
 - HVDC terminals.
 - Bus Bars
- iv) The Disturbance recording feature shall be enabled and configured in all the numerical relays installed. Disturbance recording system shall have minimum recording time of 3 seconds (0.5 seconds for pre-fault and 2.5 seconds for post fault).
- v) Each Generating Company shall provide Disturbance recording capability for Generating Plants in accordance with Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2022 amended to date, the CEA (Technical Standards for connectivity to the Grid) Regulations 2007 amended to date.
- vi) Each Transmission Licensee and Generating Company shall record for Faults, sufficient electrical quantities for each monitored Element to determine the following:
- Three phase-to-neutral voltages. (Common bus-side/line side voltages may be used for lines.)
 - Three phase currents and neutral currents.
 - Polarizing currents and voltages, if used (As applicable).
 - Frequency (As applicable).
 - Real and reactive power (As applicable).

The Minimum parameters to be monitored in the Fault record is given at Annexure.

- vii) Each Transmission Licensee and Generating Company shall provide Disturbance recording with the following capabilities:
- The Disturbance recorders shall have time synchronization and a standard format for recording analogue and digital signals (DR labels to be standardized

as per the Report of FOLD Working Group - 3 on DR Parameter Standardization). The data files shall be capable of being viewed, read, and analyzed with a generic COMTRADE analysis tool as per the latest revision of IEEE Standard C37.111.

- Each Fault record duration and the trigger timing shall be settable and set for a minimum 3 second duration including 0.5 seconds for pre-fault and 2.5 seconds for post fault
 - Each Fault recorder shall have sampling frequency of 1 kHz or better.
 - Each Fault recorder shall be set to trigger for at least the following:
Internal protection trip signals, external trigger input and additional triggers may be assigned as necessary.
- viii) Each Transmission Licensee and Generating Company shall keep the recording instruments (disturbance recorder and event logger) in proper working condition and shall establish a maintenance and testing program for Disturbance Recorder (DR) that includes
- Maintenance and testing intervals and their basis.
 - Summary of maintenance and testing procedures.
 - Monthly verification of communication channels used for accessing records remotely (if the entity relies on remote access and the channel is not monitored to a control centre staffed around the clock, 24 hours a day, 7 days a week (24/7)).
 - Monthly verification of time synchronization (if the loss of time synchronization is not monitored to a 24/7 control centre).
 - Monthly verification of active analog quantities.
 - A requirement to return failed units to service within 90 days. If a Disturbance Recorder (DR) will be out of service for greater than 90 days, the Transmission Licensee and Generating Company shall keep a record of efforts aimed at restoring the DR to service.
- ix) The time synchronization of the disturbance recorders shall be corroborated with the PMU data or SCADA event loggers by ERLDC. ERLDC shall list out for Disturbance recorders which are non-compliant for discussion in PCC meetings of ERPC.
- x) Each Transmission Licensee and Generating Company shall submit the data files to the ERLDC conforming to the following format requirements:
- The data files shall be submitted in COMTRADE and PDF format.
 - File shall have contained the name of the Relay, name of the Bay, station name, date, time resolved to milliseconds, event point name, status.

The DR archives shall be retained for a period of three years.

xi) A separate work-station PC, powered through UPS (Uninterrupted Power Supply) shall be identified with access to all the relays for extraction of DR. Auto-Download facility shall be established for automatic extraction of the DR files to a location on the work- station PC.

xii) **Time Synchronization Equipment**

- a) Time Synchronizing Equipment complete with antenna, all cables and processing equipment shall be provided to receive synchronizing pulse through Global Positioning System or Indian Regional Navigation Satellite System Navic compatible for synchronization of event logger, disturbance recorder, Phasor Measurement Units, and Supervisory Control and Data Acquisition System or Substation Automation System.
- b) Each substation shall have time synch equipment to synchronize all the numerical relays installed. Before any extension work, the capability of the existing Time-sync equipment shall be reviewed to ensure the synchronization of upcoming numerical relays.
- c) The status of healthiness of the time-sync device shall be wired as “Alarm” to SCADA and as an “Event” to Event Logger.
- d) The time synch status of all the installed numerical relays and event logger shall be monitored monthly and recorded. The Monthly records for relays not in time-sync shall be reported to ERLDC and ERPC. This record shall be archived for a period of three years by each concerned agency.
- e) Remedial action shall be taken by the concerned substation/ Protection department immediately to make the relays in time synchronization with reference to external time source.
- f) All the new Grid elements/Bay extension shall have accurate and precise Time synchronization equipment.

7.2. Disturbance Analysis and Reporting

- i) Immediately following an event (grid disturbance or grid incidence as defined in the CEA Grid Standards) in the system, the concerned user or SLDC shall inform ERLDC through voice message.
- ii) Written flash report shall be submitted to ERLDC and appropriate SLDC by the concerned Transmission Licensee/Generating Company/User within eight (8) hours from Grid event.
- iii) Disturbance Recorder (DR), station Event Logger (EL), Data Acquisition System (DAS) shall be submitted by the respective Transmission licensee and Generating Company within twenty-four (24) hours from Grid event. These records shall be uploaded by the respective Transmission licensee and Generating Company in the Web Based Tripping Portal of ERLDC.
- iv) ERLDC shall classify the grid incidents and grid disturbances according to CEA (Grid Standards) Regulations, amended to date. ERLDC shall report the event (grid

disturbance or grid incidence) to CEA, ERPC and all regional entities within twenty-four (24) hours of receipt of the flash report.

- v) After a complete analysis of the event, the Transmission licensee and Generating Company/User shall submit a detailed report in the case of grid disturbance or grid incidence within one (1) week of the occurrence of event to ERLDC and ERPC.
- vi) ERLDC shall prepare a draft report of each grid disturbance or grid incidence including simulation results and analysis which shall be discussed and finalized in the PCC meetings of ERPC as per the timeline specified in Table below.

Sl. No	Grid Event (GD/GI Classification as per the CEA Grid Standards)	Flash report submission deadline (Users/SLDC)	Disturbance record and station event log submission deadline by Users/SLDC)	Detailed report and data submission deadline by Users/SLDC)	Draft report submission deadline by ERLDC	Discussion in PCC and final report submission deadline by ERPC
1	GI-1/GI-2	8 hours	24 hours	+7 days	+7 days	+60 days
2	Near miss event	8 hours	24 hours	+7 days	+7 days	+60 days
3	GD-1	8 hours	24 hours	+7 days	+7 days	+60 days
4	GD-2/GD-3	8 hours	24 hours	+7 days	+21 days	+60 days
5	GD-4/GD-5	8 hours	24 hours	+7 days	+30 days	+60 days

vii) The analysis reports submitted by ERLDC shall be discussed in the Protection Coordination Sub-Committee (PCC) meetings of the ERPC. The PCC shall identify the lessons learnt during the events being discussed. The PCC shall scrutinize the correctness of operation of subject protection systems put in place by the concerned Constituents and the final analysis report along with the recommendations shall be concluded. It shall also recommend the appropriate remedial measures for system improvement.

viii) The implementation of the recommendations of the final report shall be monitored by the PCC of ERPC.

ix) Any additional data such as

- Single line diagram (SLD)
- Protection relay settings,
- HVDC transient fault record,
- Location of fault with distance
- Fault details with type & relay indications
- CT/PT/CVT rating details with location
- Bus-bar arrangement/ Configuration of feeders
- CB positions (OPEN/ CLOSE) at the time of fault

- Isolator & Earth-switch positions (OPEN/CLOSE)
- Voltage, frequency & power flows with direction at the time of fault
- DR&EL records
- switchyard equipment

and any other relevant station data required for carrying out analysis of an event by ERPC, ERLDC and concerned SLDC shall be furnished by the Users including ERLDC and respective SLDC, as the case may be, within forty- eight (48) hours of the request. All Users shall also furnish high-resolution analog data from various instruments including power electronic devices like HVDC, FACTS, renewable generation (inverter level or WTG level) on the request of ERPCs, NLDC, ERLDCs or SLDCs.

- x) Triggering of STATCOM, TCSC, HVDC run-back, HVDC power oscillation damping, generating station power system stabilizer and any other controller system during any event in the grid shall be reported to the ERLDC and ERPC if connected to ISTS and to the concerned SLDC if connected to an intra-state system. The transient fault records and event logger data shall be submitted to the ERLDC or concerned SLDC within 24 hours of the occurrence of the incident. Generating stations shall submit 1 second resolution active power and reactive power data recorded during oscillations to ERLDC or concerned SLDC within 24 hours of the occurrence of the oscillations.
- xi) A monthly report on events of unintended operation or non-operation of the protection system shall be prepared and submitted by each user/owner of important elements in the regional grid, as identified by the appropriate forum of ERPC including those in the State grids that are critical for regional grid operation to ERPC and ERLDC within the first week of the subsequent month.
- xii) The detailed analysis reports shall be archived periodically. The archive shall be retained for a period of three years by each concerned agency.

8. Protection Audit Plan

- i) All Users/Entities connected at 220 kV and above, shall conduct internal audit, as per the prescribed audit checklist, of their protection systems annually, and any shortcomings identified shall be rectified and informed to ERPC. The audit report along with action plan for rectification of deficiencies detected, if any, shall be shared with ERPC.
- ii) All Users /Entities shall also conduct third party protection audit of each sub-station at 220 kV and above once in five years.
- iii) After analysis of any event, PCC of ERPC may identify a list of substations / and generating stations where third-party protection audit is required to be carried out and accordingly advise the respective users to complete third party audit within three months.
- iv) The third party audit report shall contain all the information as in *Annexure-1(Third*

Party Protection System Checking & Validation Template for a Substation) of CERC (Indian Electricity Grid Code), Regulations 2023). The protection audit reports, along with action plan for rectification of deficiencies detected, if any, shall be submitted to the respective ERPC and ERLDC or respective SLDC, as the case may be, within a month of submission of third party audit report. The necessary compliance to such protection audit report shall be followed up regularly in the PCC meetings of ERPC.

- v) ERPC shall keep all compliance monitoring reports/audit reports at least for five years.
- vi) Annual audit plan for the next financial year shall be submitted by the Users/entities to ERPC by 31st October of every year. The users shall adhere to the annual audit plan and report compliance of the same to ERPC.

9. Performance Monitoring of the Protection Systems

9.1. Users/Entities shall submit the following protection performance indices of previous month to ERPC and ERLDC on monthly basis for 220 kV and above by 15th of the subsequent month and the same shall be reviewed in the ensuing PCC meeting of ERPC.

- a) The Dependability Index defined as $D = N_c / (N_c + N_f)$

Where, N_c is the number of correct operations at internal power system faults and N_f is the number of failures to operate at internal power system faults.

- b) The Security Index defined as $S = N_c / (N_c + N_u)$

Where, N_c is the number of correct operations at internal power system faults and N_u is the number of unwanted operations.

- c) The Reliability Index defined as

$$R = N_c / (N_c + N_i)$$

Where, N_c is the number of correct operations at internal power system faults and N_i is the number of incorrect operations and is the sum of N_f and N_u

9.2. Users/Entities shall furnish the reasons for performance indices less than unity of individual element wise protection system to the ERPC and action plan for corrective measures. The action plan will be followed up regularly in the PCC Meetings.

10. Compliance Monitoring

10.1. The Protection Protocol of ER shall be reviewed as and when required, in consultation with the stakeholders of the Eastern Region.

10.2. Violation of the Protection Protocol of the Eastern Region shall be brought to the notice of ERPC by the ERLDC or concerned SLDC, as the case may be.

10.3. In case any User/Entity fails to comply with the Protection Protocol or fails to undertake remedial action identified by the PCC of ERPC within the specified timelines, the ERPC would approach the Commission with all relevant details for suitable directions.

Protection Performance Indices for the month of March '24 (In compliance of Clause 15(6) of IEGC 2023)																	
NAME OF STATION:			NTPC NORTH KARANPURA SUPER THERMAL POWER PROJECT (3 X 660MW)														
S. No.	Name of the element	Tripping Date	Tripping Time	Restoration Date	Restoration Time	Reason (Relay)		Nc		Nu		Nf		Dependability index (Nc/(Nc+Nf))	Security Index (Nc/(Nc+Nu))	Reliability Index (Nc/(Nc+Nu+Nf))	Remarks (Reason for performance indices less than 1)
						End A	End B	End A	End B	End A	End B	End A	End B				
1	Unit-2	20.03.2024	10:03 Hrs	20.03.2024	21:23:00 Hrs	64RUT2A	NA	1	NA	1	NA	0	NA	1	1	1	Unit-2 tripped on Electrical Protection (UT-2A Restricted E/F) in month of March 2024

Protection Performance Indices for the month of March'24 (In compliance of Clause 15(6) of IEGC 2023)

Sl. No.	Name of the element	Tripping Date	Tripping Time	Restoration Date	Restoration Time	Reason (Relay indication)		Nc		Nu		Nf		Dependability index (Nc/(Nc+Nf))	Security Index (Nc/(Nc+Nu))	Reliability Index (Nc/(Nc+Nu+Nf))	Remarks (Reason for performance indices less than 1)	Analysis of the event
						End A	End B	End A	End B	End A	End B	End A	End B					
1	New Chanditala-Durgapur 400 KV #1	04.03.24	12:01:00	04.03.24	12:40:00	R-phase, Zone-1, A/r optd., A/R L/O	R-phase, Zone-1, A/r optd., A/R L/O	1	1	0	0	0	0	1	1	1		A/R L/O operate due to persistent of fault.
2	New Chanditala-Durgapur 400 KV #1	04.03.24	13:08:00	04.03.24	18:25:00	R-phase, Zone-1, A/r optd., A/R L/O	R-phase, Zone-1, A/r optd., A/R L/O	1	1	0	0	0	0	1	1	1		Tree fault found around dist. 80 Km. from Durgapur and clear the same
3	Durgapur- PPSP 400 KV # 2	04.03.24	16:54:00	04.03.24	17:47:00	R-phase, Zone-1, CS,CR, 3-Phase trip		1		0		0		1	1	1		A/R switch kept OFF as recommendation of OEM of PPSP GIS
4	Kolkata Leather Complex-Subhasgram PG	08.03.24	08:39:00	08.03.24	08:57:00	No relay indication		0		1		0		0	**	**	burn of Contrl switch contact	No fault at the Line. CB Control switch contact found damage and remote trip send from this path.Rectify the same.
5	Gokarna-Rajarhat 400 KV #1	10.03.24	15:32:00	10.03.24	19:38:00	B-phase, Zone-1, A/r optd., A/R L/O		1		0		0		1	1	1		Earth wire snapped.
6	Durgapur-Durgapur PG #2	12.03.24	06:59:00	12.03.24	07:59:00	Tripped with pole discrepancy.		0		1		0		0	**	**	PD timer Relay replaced	Pole discrepancy timer relay found burnt .Replace the same on date
7	Arambag- BKTPP	13.03.24	06:03:00	13.03.24	16:19:00	Y-phase, Zone-1, A/r optd., A/R L/O		1		0		0		1	1	1		Y-phase Suspension disc failure around 66 Km from Arambag.
8	Arambag- New-PPSP #1	14.03.24	20:32:00	14.03.24	20:56:00	B-phase, Zone-1, A/r optd., A/R L/O		1		0		0		1	1	1		A/R L/O operate due to persistent of fault.
9	Jeerat -sagardighi #2(GIS)	15.03.24	11:57:00	15.03.24	23:08:00	B-phase, Zone-1, A/r optd., A/R L/O		1		0		0		1	1	1		A/R L/O operate due to persistent of fault.
10	Arambag-NEW-PPSP#1	16.03.24	18:32:00	18.03.24	18:49	B-phase, Zone-1, A/r optd., A/R L/O	B-phase, Zone-1, A/r optd., A/R L/O	1		0		0		1	1	1		A/R L/O operate due to persistent of fault.

11	Jeerat -sagardighi #1(AIS)	16.03.24	20:48:00	16.03.24	20:48:00	Y-phase, Zone-1		0	0	1	**	0	**	NO A/R OPERATED AT JEERAT	AS the Bays are the control of Powergrid ,the matter is discussed with PG and they are taking care about the matter.
12	Arambag 315 MVA -ICT-4	16.03.24	20:12:00	16.03.24	22:39:00	Flashing observed at HV side R-phase isolator and manual		0	1	0	**	**	**	tripping of the CB due to flashing of 400 KV	Due to sudden heavy storm, R-phase HV isolator of ICT-4 dislocated and heavy flashing observed. Rectified the same and put into service at 22:39
13	Arambag-NEW-PPSP#1	18.03.24	18:48:00	18.03.24	19:15:00	B-phase, Zone-1, A/r optd., A/R L/O	B-phase, Zone-1, A/r optd., A/R L/O	1	0	0	1	1	1		A/R L/O operate due to pesistent of fault.
14	Arambag-NEW-PPSP#1	18.03.24	23:37:00	18.03.24	23:59:00	B-phase, Zone-1, A/r optd., A/R L/O	B-phase, Zone-1, A/r optd., A/R L/O	1	0	0	1	1	1		A/R L/O operate due to pesistent of fault.
15	Arambag- New-PPSP #1	19.03.24	18:14:00	19.03.24	18:31:00	B-phase, Zone-1, A/r optd., A/R L/O		1	0	0	1	1	1		During patrolling of line it is found that due to the eccessive sag of OPGW earthwire between TL no. 255 to 258 , it touches the phase conductor due to wind. (O&M)
16	KLC-Subhasgram PGCIL	21.03.24	15:26:00	22.03.24	19:36	R-phase, Zone-1, Carrier Fail		1	0	0	1	1	1		phase and at the same time cross arm of Y-phase and B-phase broken. Replaced the same and normalise at 00:00 on 22.03.24 . SDH panel of KLC found defective
17	Kharagpur- Chaibasa#1	24.03.24	13:59:00	24.03.24	14:57:00	Y-phase, Zone-1, A/r optd., A/R L/O		1	0	0	1	1	1		
18	Kharagpur- KTPP #1	25.03.24	18:28:00	25.03.24	19:23:00	B-phase, Zone-1, A/r optd., A/R L/O		1	0	0	1	1	1		
19	Arambag-New-Chanditala#1	25.03.24	18:45:00	25.03.24	19:21:00	R-phase, Y-phase, Zone-1, A/R L/O	R-phase, Y-phase, Zone-1, A/R L/O	1	0	0	1	1	1		
20	Durgapur-PPSP #1	31.03.24	02:20:00	31.03.24	02:24:00	Y-phase, Zone-1, A/R L/O		1	0	0	1	1	1		
21	KLC-Subhasgram PGCIL	31.03.24	21:49:00	31.03.24	22:22:00	No Tripping at KLC End									
22	KLC-NT AA3	31.03.24	21:49:00	01.04.24	17:47:00	Y-phase, Zone-1, A/r optd., A/R L/O	Y-phase, Zone-2, A/R L/O	1	0	0	1	1	1		Y-phase 220 KV CT burst out at KLC which causes tripping of NT-KLC in Zone-2 from NT end and PG end tripped in Zone-1(Not desirable).

ANNEXURE - 1

THIRD PARTY PROTECTION SYSTEM CHECKING & VALIDATION TEMPLATE FOR A SUBSTATION

1. INTRODUCTION

- (1) The audit reports, along with action plan for rectification of deficiencies found, if any, shall be submitted to RPC or RLDC within a month of submission of report by auditor.
- (2) The third-party protection system checking shall be carried at site by the designated agency. The agency shall furnish two reports:
 - (a) Preliminary Report: This report shall be prepared on the site and shall be signed by all the parties present.
 - (b) Detailed Report: This report shall be furnished by agency within one month after carrying out detailed analysis.

2. CHECKLIST

- (1) The protection system checklist shall contain information as per this Regulation.
 - (a) General Information (to be provided prior to the checking as well as to be included in final report):
 - (i) Substation name
 - (ii) Name of Owner Utility
 - (iii) Voltage Level (s) or highest voltage level?
 - (iv) Short circuit current rating of all equipment (for all voltage level)
 - (v) Date of commissioning of the substation
 - (vi) Checking and validation date
 - (vii) Record of previous tripping's (in last one year) and details of protection operation
 - (viii) Previous Relay Test Reports

- (ix) Overall single line diagram (SLD)
- (x) AC aux SLD
- (xi) DC aux SLD
- (xii) SAS architecture diagram
- (xiii) SPS scheme implemented (if any)

(b) The preliminary report shall inter-alia contain the following:

TABLE A: FORMAT OF PRELIMINARY REPORT

S. No.	Issues	Remarks
1	Recommendation of last protection checking and validation	Status of works and pending issues if any
2	Review of existing settings at substation	Recommended Action
3	Disturbance Recorder out available for last 6 tripping's (Y/N)	Recommended Action
4	Chronic reason of tripping, if any	Recommended Action
5	Major non-conformity/deficiency observed	Recommended Action

(c) The relay configuration checklist for available power system elements at station:

- (i) Transmission Line
- (ii) Bus Reactor/Line Reactor
- (iii) Inter-connecting Transformer
- (iv) Busbar Protection Relay
- (v) AC auxiliary system
- (vi) DC auxiliary system
- (vii) Communication system
- (viii) Circuit Breaker Details

- (ix) Current Transformer Details
 - (x) Capacitive Voltage Transformers Details
 - (xi) Any other equipment/system relevant for protection system operation
- (d) The minimum set of points on which checking and validation shall be carried out is covered in this clause. The detailed list shall be prepared by checking and validation team in consultation with concerned entity, RLDC and RPC.
- (i) Transmission Line Distance Protection/Differential Protection
 - a. Name and Length of Line
 - b. Whether series compensated or not
 - c. Mode of communication used (PLCC/OPGW)
 - d. Relay Make and Model for Main-I and Main-II
 - e. List of all active protections & settings
 - f. Carrier aided scheme if any
 - g. Status of Power Swing/Out of Step/SOTF/Breaker Failure/Broken Conductor/STUB/Fault Locator/DR/VT fuse fail/Overvoltage Protection/Trip Circuit supervision/Auto-reclose/Load encroachment etc.
 - h. Relay connected to Trip Coil-1 or 2 or both
 - i. CT ratio and PT ratio
 - j. Feed from DC supply-1 or 2
 - k. Connected to dedicated CT core (mention name)
 - l. Other requirements for protection checking and validation
 - (ii) Shunt Reactor & Inter-connecting Transformer Protection
 - a. Whether two groups of protections used (Group A and Group B)
 - b. Do the groups have separate DC sources
-

- c. Relay Make and Model
- d. List of all active protections along with settings
- e. Status of Differential Protection/Restricted Earth Fault Protection/Back-up Directional Overcurrent/Backup Earth fault/ Breaker Failure
- f. Status of Oil Temperature Indicator/Winding Temperature Indicator/Bucholz/Pressure Release Device etc.
- g. Relay connected to Trip Coil-1 or 2 or both
- h. CT ratio and PT ratio
- i. Feed from DC supply-1 or 2
- j. Connected to dedicated CT core (mention name)
- k. Other requirements for protection checking and validation

(iii) Busbar Protection Relay

- a. Busbar and redundant relay make and model
- b. Type of Busbar arrangement
- c. Zones
- d. Dedicated CT core for each busbar protection (Yes/No)
- e. Breaker Failure relay included (Yes/No), if additional then furnish make and model
- f. Trip issued to both Busbar protection in case of enabling
- g. Isolator indication and check relays
- h. Other requirements for protection checking and validation

(iv) AC auxiliary system

- a. Source of AC auxiliary system

- b. Supply changeover between sources (Auto/Manual)
 - c. Diesel generator (DG) details
 - d. Maintenance plan and supply changeover periodicity in DG
 - e. Single Line Diagram
 - f. Other requirements for protection checking and validation
- (v) DC auxiliary system
- a. Type of Batteries (Make, vintage, model)
 - b. Status of battery Charger
 - c. Measured voltage (positive to earth and negative to earth)
 - d. Availability of ground fault detectors
 - e. Protection relays and trip circuits with independent DC sources
 - f. Other requirements for protection checking and validation
 - g. Communication system
 - i. Mode of communication for Main-1 and Main-2 protection
 - ii. Mode of communication for data and speech communication
 - iii. Status of PLCC channels
 - iv. Time synchronization equipment details
 - v. 7OPGW on geographically diversified paths for Main-1 and main-2 relay
 - vi. Other requirements for protection checking and validation
- (vi) Circuit Breaker Details
- a. Details and Status
 - b. Healthiness of Tripping Coil and Trip circuit supervision relay
 - c. Single Pole/Multi pole operation
-

- d. Pole Discrepancy Relay available(Y/N)
- e. Monitoring Devices for checking the dielectric medium
- f. Other requirements for protection checking and validation

(vii) Current Transformer (CT)/Capacitive Voltage Transformer (CVT) Details

- a. CT/CVT ID name and voltage level
- b. CT/CVT core connection details
- c. Accuracy Class
- d. Whether Protection/Metering
- e. CT/CVT ratio available and ratio adopted
- f. Details of last checking and validation of CT/CVT healthiness
- g. Other requirements for protection checking and validation
- h. Other protections: Direction earth fault, negative sequence, over current, over voltage, over frequency, under voltage, under frequency, forward power, reverse power, out of step/power swing, HVDC protection etc.

3. SUMMARY OF CHECKING:

The summary shall specifically mention minimum following points:

- (1) The settings and scheme adopted are in line with agreed protection philosophy or any accepted guidelines (e.g. Ramakrishna guidelines or CBIP manual based).
- (2) The deviations from the RPC protection philosophy, if any and reasons for taking the deviations shall be recorded.
- (3) All the major general deficiency shall be listed in detail along with remedial recommendations.

- (4) The relay settings to be adopted shall be validated with simulation based or EMTP studies and details shall be enclosed in report.
- (5) The cases of protection maloperation shall be analysed from protection indices report furnished by concerned utility, the causes of failure along with corrective actions and recommendations based on the findings shall be noted in the report.

134th PCC, ERPC KOLKATA KAHALGAON POINTS

JOINT RCA JOINTLY WITH SIEMENS for Failed Circuit Breaker

Probable Root Causes:

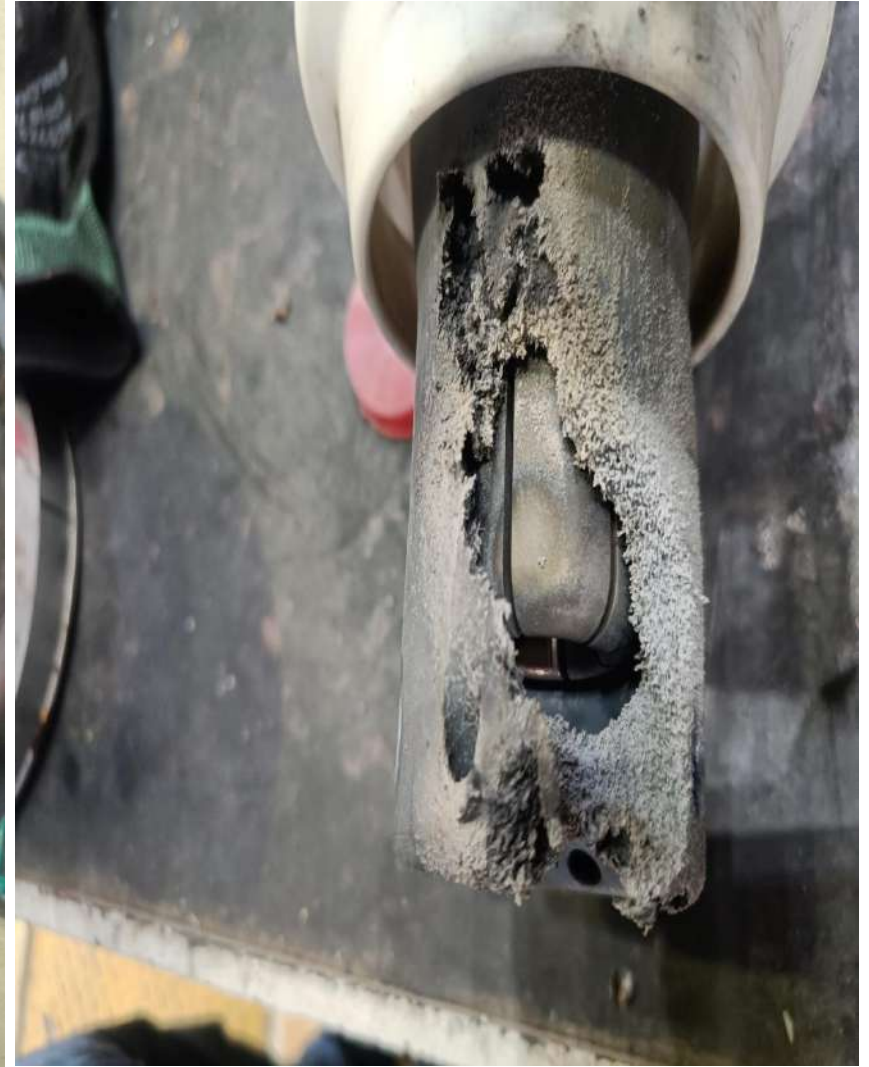
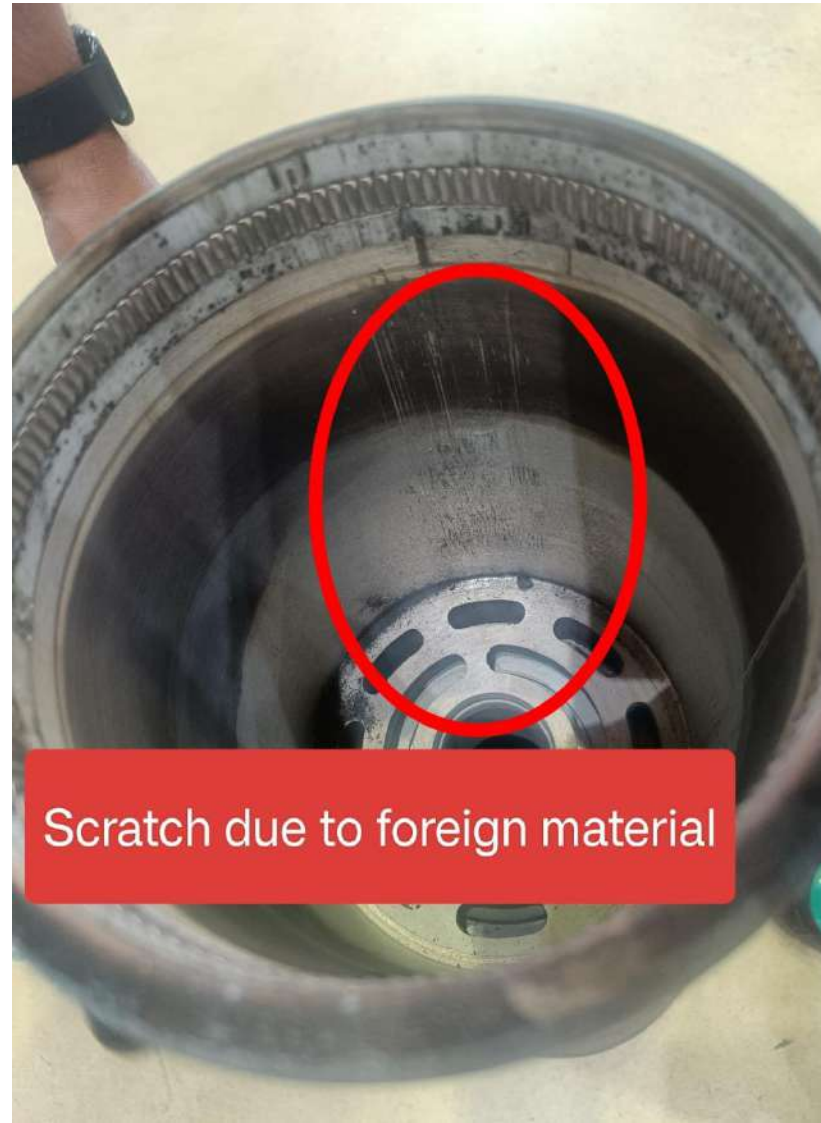
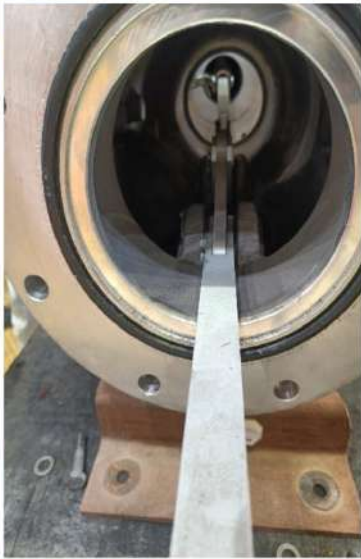
Based on the above observations and subsequent discussions with Siemens, the probable root causes for circuit breaker Interrupter Unit internal flashover are as below:

1. It is apparent that the Scratches on the heating chamber were due to interaction with dislodged multilam material observed inside. NTPC requested Siemens to furnish to share analysis on its impact on breaker performance.
2. In view of the joint observations above and earlier failure on two occasions also, it is suspected that there might have some deficiency in the supplied breakers during this period.
3. Siemens informed they will review and revert on the same. NTPC will provide the relevant data (DR, Sequence of events etc) as required by Siemens through mail.

Recommendations:

Recommendation for existing Siemens make CBs installed at NTPC stations:

1. As per IEC62271-100, clause 9-102-2, For circuit-breakers with $U_r > 245$ kV for use in synchronisation operations simultaneously with a substantial transient or temporary overvoltage, the insulation of a standard circuit-breaker may be insufficient. In such cases, Siemens suggested to use a standard circuit-breaker having a higher rated voltage.
2. As an additional precautionary measure for already installed 400KV Siemens make CB, Siemens recommended to match the DCRM characteristics of installed CB with the factory value. Siemens shall share factory DCRM and timing report for CB supplied to NTPC. NTPC to share CB Sr.Nos accordingly.
3. Siemens shall supply 01 complete pole of circuit breaker to NTPC Kahalgaon as spare within 01 month free of cost (including transportation), as the spare at site already got consumed while replacing with the damaged CB pole. Siemens informed to revert to NTPC after their internal discussion within 3 weeks time.
4. Siemens advised to carry out Dew point, DCRM, SF6 purity & other routine tests on a yearly basis for health assessment of already installed and in-service CBs. In case of any query or guidance, station team may contact Siemens.



Earlier Siemens Breaker Failure Incidents

- 1. External Flashover was observed in the 420kV NTPC Kahalgaon substation-**
This may be informed that Unit-4 TIE breaker (24-52) has been retrofitted by M/s SIEMENS Limited-CS & taken into service on 10:37 hrs dated: 20-12-2021. External arc flash has been observed at Interrupter assembly (at the surface of interrupter insulators) of B phase (C pole) breaker while inspection of switchyard on 5:00 am 21.12.2021, however, this breaker was already on trip condition since 22:05 hrs, dated: 20-12-2021 with Bus side HCB Isolator in close position
- 2. CB Sr.No 2022/32772 of 420kV Circuit Breaker installed at NTPC dadri substation,**
Y phase Interrupter Unit internal On 05.12.2022, unit -6 generator excited to synch generator with 400 KV bus. Same time generator tripped on dead machine energisation protection before reaching generator terminal voltage to rated value and fault current observed in DR of this 400 KV bay-18 PU in Y phase . High SO₂ content observed during SF₆ gas analysis of Y pole after this incidence .This was clearly indicate Y phase pole conducted in breaker open condition while voltage appeared on both side of breaker

PROGRESS OF ICT ERECTION AND COMMISSIONING



**2 Nos. 200MVA ICTs Erection and Commissioning
Manufacturer- BHEL
FDPS – M/s GE T&D (I) Limited**

400 kv line PM Report

S.No.	Bay Name	Bay No	PM Date
1	DGP 2	18	21-12-2023
2	Unit 6	36	27-12-2023
3	DGP 1	19	22-12-2023
4	UNIT 1	3	24-12-2023
5	UNIT 3	13	23-12-2023
6	BARH 2	33	20-01-2024
7	LKS 2	7	30-01-2024
8	ICT 1 & IBT 1	1	16-12-2023
9	BANKA 2	43	16-12-2023
10	BANKA 1	42	09-12-2023
11	MTN 2	21	08-12-2023
12	LKS 1	6	02-12-2023
13	FKK 1	31	30-11-2023
14	BUS REACTOR 2	37	
15	MTN 1	28	21-11-2023
16	FKK 2	30	06-11-2023

400 KV line PM Report

S.No.	Bay Name	Bay No	Tripping Date	Tripping Time	Charging Date	Charging Time
1	DGP 2	18	21-12-2023	08:38	21-12-2023	20:15
2	Unit 6	36	27-12-2023	17:53	29-12-2023	10:24
3	DGP 1	19	22-12-2023	08:25	22-12-2023	19:35
4	UNIT 1	3	24-12-2023	09:47	24-12-2023	22:05
5	UNIT 3	13	23-12-2023	11:12	24-12-2023	16:20
6	BARH 2	33	20-01-2024	09:34	20-01-2024	18:24
7	LKS 2	7	30-01-2024	06:48	30-01-2024	20:31
8	ICT 1 & IBT 1	1	16-12-2023	12:24	16-12-2023	15:08
9	BANKA 2	43	16-12-2023	08:51	16-12-2023	19:32
10	BANKA 1	42	09-12-2023	08:57	09-12-2023	18:33
11	MTN 2	21	08-12-2023	09:36	09-12-2023	01:48
12	LKS 1	6	02-12-2023	10:59	02-12-2023	20:24
13	FKK 1	31	30-11-2023	08:30	30-11-2023	18:30
14	BUS REACTOR 2	37			25-11-2023	12:41
15	MTN 1	28	21-11-2023	08:56	22-11-2023	00:29
16	FKK 2	30	06-11-2023	10:11	07-11-2023	19:42

**STANDARD OPERATING PROCEDURE FOR FUNCTIONAL CHECKING OF 400KV BUS -2
BUSBAR TRIP RELAYS**

(By picking up of 96A & 96B Trip Relays in Bay Peripheral Units)

1. Check 400KV Bus – 2 three phase PT secondary voltage and record the same as per Annexure – 1.
2. Check DC voltage and record the same.
3. Also check 400KV Bus- 2 CU – A, CU – B current values and record the same.
4. Check Isolator status, CB status & current flow in the respective PU's and record the same as per Annexure - 2.
5. 400KV Bus 2 to be shut down by switching OFF all Bus – 2 connected Circuit Breakers.

Following breaker to be made OFF:

SL.NO	BAY DESCRIPTION	CB NO	Busbar Drawing Ref Sheet No: Drg No: CPD KX4R SC10
i.	ICT – 1 Main Bay	152	SHT 12 of AI
ii.	ICT – 2 Main Bay	452	SHT 23 of AI
iii.	LKR Line – 2 Main Bay	752	SHT 33 of AI
iv.	GT – 2 Tie Bay	1152	SHT 43 of AI
v.	GT – 3 Main Bay	1352	SHT 53 of AI
vi.	OLD Banka Bay	1652	SHT 63 of AI
vii.	DGP-1 Main Bay	1952	SHT 73 of AI
viii.	GEN – 4 Main Bay	2252	SHT 83 of AI
ix.	Bus Section - 2	5352	SHT 98 of AI

6. After ensuring CB Open status in Local, open all the Isolators of the respective bay.
7. Check Isolator status, CB status & current flow in the respective PU's and record the same.
8. Check for DR trigger in PU with CB open status and record the same.
9. After Isolation of all the respective Bus – 2 bay Circuit Breakers, check 400KV Bus – 2 PT secondary voltage prior to closing of Bus Earth Switch and record the same.
10. Check Bus – 2 CU – A, CU – B current prior to connection of Bus – 2 Earth Switch and record the same.
11. 400KV Bus – 2 Earth Switch to be closed after ensuring Bus – 2 is completely dead. Note down Bus – 2 induction voltage level in all 3 phases after connecting Bus E/S
12. Functional Checking of 400KV Bus – 2 Trip Relays to be done as per following:
 - a) Short PU Output contacts of each PU to Pick Up respective 96A & 96B relays
 - b) Test & record all data for each bay as per Annexure – 2.
13. Prior to system normalization, ensure Bus Earth Switch is opened. Check voltage and match with the earlier noted value.
14. Close all isolators and check for Isolator status in respective PU's and note it down.
15. 400KV Bus – 2 to be charged by charging of 400KV Durgapur Line – 1 Main Bay (CB 2252). After charging of 400KV Bus – 2, check three phase PT secondary voltage and record the same.
16. After charging of each CB, Check CB close status in each PU and note down the respective current in each PU.
17. After normalization of all the bays, check current of Bus – 2 CU- A & CU-B and record the same.

Annexure – 1
CHECKLIST FOR BUS VOLTAGE & CU STATUS

Date: _____ 400KV BUS: _____

DC VOLTAGE (V)	P-E:	N-E:	P-N
----------------	------	------	-----

A. Before Bus shut down

1) 3 phase PT Secondary Voltage

Phase	R-N	Y-N	B-N	R-Y	Y-B	B-R
Voltage						

2) 3 phase Differential Current Observed in CU- A & CU - B

CU	IR	IY	IB
CU - A			
CU - B			

B. After Isolation/Opening of all connected Circuit Breakers in Bus & Prior to Closing of Bus E/S

1) 3 phase PT Secondary Voltage

Phase	R-N	Y-N	B-N	R-Y	Y-B	B-R
Voltage						

2) 3 phase Differential Current Observed in CU- A & CU - B

CU	IR	IY	IB
CU - A			
CU - B			

C. After Closing of Bus E/S

3 phase PT Secondary Voltage (Induced Voltage)

Phase	R-N	Y-N	B-N	R-Y	Y-B	B-R
Voltage						

D. After removal of Bus E/S post completion of testing

3 phase PT Secondary Voltage

Phase	R-N	Y-N	B-N	R-Y	Y-B	B-R
Voltage						

E. After charging of bus

1) 3 phase PT Secondary Voltage

Phase	R-N	Y-N	B-N	R-Y	Y-B	B-R
Voltage						

2) 3 phase Differential Current Observed in CU- A & CU – B

CU	IR	IY	IB
CU - A			
CU - B			

F. After charging of all Bus Connected Bay Circuit Breakers

3 phase Differential Current Observed in CU – A & CU - B

CU	IR	IY	IB
CU - A			
CU - B			

Signature: _____

NTPC KAHALGAON

Annexure - 2

CHECKLIST FOR FUNCTIONAL CHECKING OF 400KV BUS -2 BUSBAR TRIP RELAYS

(THROUGH 96A & 96B REALYS)

DATE: _____

BUS _____ BAY NO: _____ BAY DESCRIPTION _____

A. PRE-SHUTDOWN CHECKS

SL.NO	DESCRIPTION	PU - A			PU - B		
		IR	IY	IB	IR	IY	IB
1.	CB close/open status						
2.	ISOLATOR close/open status						
3.	Any alarm present						
4.	3 phase Current Observed in PU						

B. POST - SHUTDOWN CHECKS

SL.NO	DESCRIPTION	PU - A			PU - B		
		IR	IY	IB	IR	IY	IB
1.	CB close/open status after Opening CB						
2.	ISOLATOR close/open status after opening isolator - A						
3.	ISOLATOR close/open status after opening isolator - B						
4.	Any alarm present						
5.	3 phase Current Observed in PU						

C. TRIP CHECKING OF CB

TRIP COMMAND	TRIP CONTACT (for shorting in PU)	PICKED UP RELAY (96A/96B)	CB TRIP STATUS	DR TRIGGER STATUS	CB TRIP TIME (ms) (From DR)
Trip Command to 96A Relay	PU - A F9, F10				
Trip Command to 96B Relay	PU - A , F15, F14				

Deviation Observed (if any):

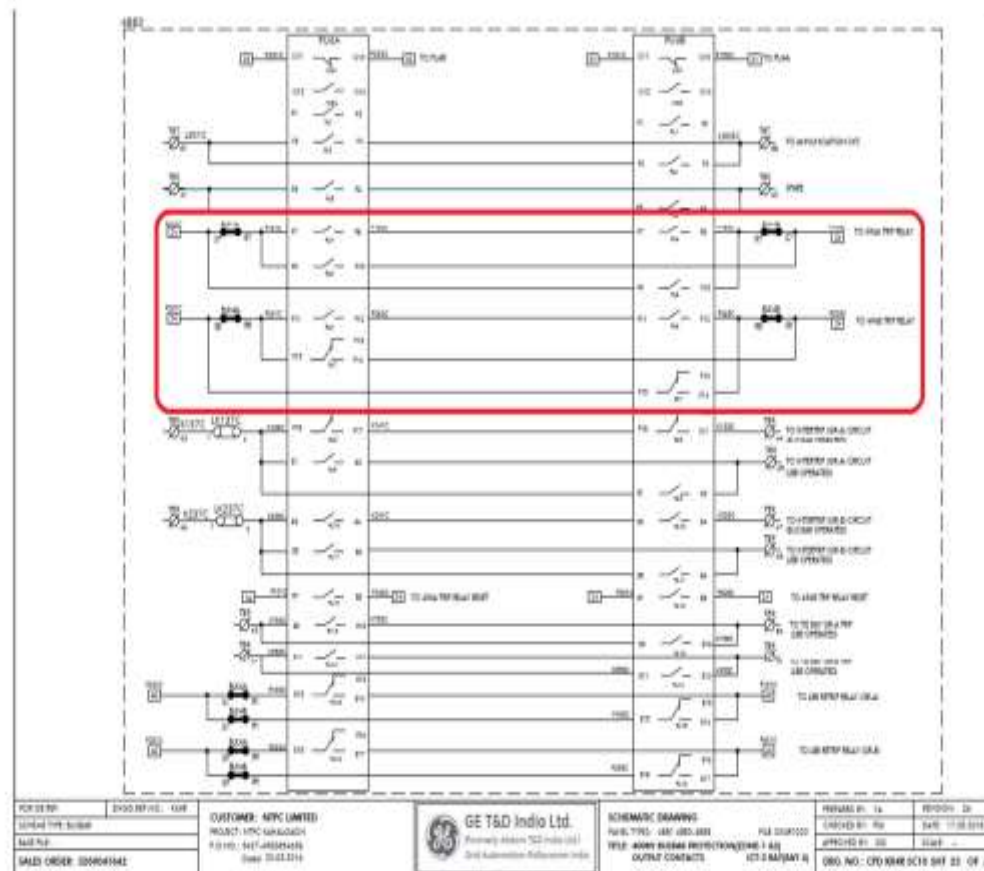
D. NORMALIZATION CHECKS

SL.NO	DESCRIPTION	PU - A			PU - B		
		IR	IY	IB	IR	IY	IB
1.	ISOLATOR close/open status after Closing Isolator - A						
2.	ISOLATOR close/open status after Closing Isolator - B						
3.	CB close/open status after closing CB						
4.	Any alarm present						
5.	3 phase Current Observed in PU						

Signature: _____

NTPC KAHALGAON

Typical PU Drawing enclosed for reference



PROJECT: _____ DRAWING NO: _____ DATE: _____ SAID ORDER: _____	CUSTOMER: NTPC LIMITED PROJECT: NTPC KAHALGAON P.O. NO: 147-4825445 DATE: 01.11.2014	GE T&D India Ltd. Power Systems Division 2nd Suburban, Hyderabad, India	SCHEMATIC DRAWING: FILE: T96 - 447 - 000 - 000 P&ID: 000000 TITLE: 400KV BUSBAR TRIP RELAY (THROUGH 96A & 96B) OUTPUT CONTACTS: 107 & 108 (BAY A)	REVISION: 14 LAYOUT BY: 06 APPROVED BY: 00 080 NO - 00 000 001 001 01 01 01
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PRELIMINARY REPORT ON
DISTURBANCE AT 400 KV
SWITCHYARD, NTPC KAHALGAON ON
30.01.2024

PRELIMINARY INCIDENT

- At 06:48Hrs, dtd. 30.01.2024, 400KV bay 11 (Unit # 2 TIE CB) SIEMENS make circuit breaker failed. B-Pole of the 400KV SF6 Circuit Breaker installed in the Unit-2 Tie Bay found to be damaged with shattering of interrupter porcelain towards 400KV Bus – II side.
- The Unit-2 Tie Bay was connected with 400KV Main -Bus-II. Unit-2 was under shutdown and its main breaker (Bay No. 12-52) and tie breaker (Bay No. 11-52) was in open condition.
- 400KV Bus – II Busbar Differential protection operated and accordingly all Circuit Breakers connected to Bus – II got tripped.
- Additionally, Bus sectionalizer – 2 and 400KV Bus – IV also got tripped. All Circuit Breakers connected to Bus – IV also got tripped.

400KV Bus-II Circuit Breakers

Bay	• 152	ICT-1 CB
Bay	• 452	ICT-2 CB
Bay	• 752	Lakhisarai Line-2 CB
Bay	• 1152	Unit-2 Tie CB
Bay	• 1352	Gen-3 Main CB
Bay	• 1752	Old Banka-2 CB
Bay	• 1952	Farakka-4 CB
Bay	• 2252	Gen-4 Main CB

400KV Bus-IV Circuit Breakers

Bay	• 2552	Gen-5 Tie CB
Bay	• 2852	Maithon Line -1 CB
Bay	• 3152	Farakka Line-1 CB
Bay	• 3452	Gen-6 Tie CB
Bay	• 3752	B/R -2 Main CB
Bay	• 4052	Barh Line -1 CB
Bay	• 4352	Banka Line - 2 CB

PROBLEMS FACED WITH SIEMENS MAKE CIRCUIT BREAKERS

- U # 2 , SIEMENS make Tie Circuit Breaker (1152 CB) retrofitted on 30.12.2022 was in OPEN condition and B pole suddenly bursted at 06:47am on 30.01.2024 without any operation of CB.

(VIDEO ENCLOSED)

- Similar incidence was observed in U # 4 SIEMENS make TIE Circuit Breaker(2452 CB) at NTPC Kahalgaon. External flashover was observed at Interrupter assembly of B phase at 5:00 am on 21.12.2021. This breaker was also in OFF condition.
- Similar problem has also been reported at NTPC Dadri & NTPC Vindhyanchal retrofitted 400KV SIEMENS make Circuit Breakers.

Hence, Reliability of SIEMENS make Circuit Breaker has become doubtful.

RCA REPORT PROVIDED BY SIEMENS FOR U#4 TIE CB (2452)

D5: Define Corrective Actions		
Actions Planned / Taken	Resp.	Target Date
1. Visual check through SIEMENS Filter COWL of other interrupter units for verification of oxidation and rusty parts.	Siemens team at site	30.05.22
2. Dew point and purity to be measured.	Siemens team at site	Continuous before commissioning of individual breaker.
D6: Implement Corrective Actions		
Actions Planned / Taken	Resp.	Target Date
1. Interrupter to be stored on Concrete or above ground level.	Siemens team at site	Continuous
2. Circuit breaker synchronization time to be recorded to avoid stress on the interrupter unit.	NTPC customer	Continuous before commissioning of individual Unit and Tie breaker.

Corrective measures suggested by SIEMENS has been followed during Commissioning of U#2 Circuit Breakers

TRIPPINGS OBSERVED ON 30.01.2024

Expected Tripping as per Scheme:

All 400KV Bus – II connected Circuit Breakers along with Bus Sectionalizer – 2 breaker should have cleared the said fault.

Anomalous Tripping Observed :

- 400KV Bus – IV also got tripped. (This happened due to delayed opening of Bus Sectionalizer – 2 Circuit Breaker-5352 CB)
- U#6 got tripped
- 400KV Kh- Lakhisarai Line – 2 got tripped

DETAILS OF MAINTENANCE ACTIVITIES of U#2 TIE CB , BUS SECTIONALIZER – 2 CB & BUSBAR

1. U#2 TIE CB:

U# 2 old BHEL make Tie Circuit Breaker was replaced with new SIEMENS make Circuit Breaker on 30.09.2022 (Commissioning Reports enclosed).

NB: Old BHEL make CB was replaced due to obsolescence and non support from OEM(BHEL)

2. BUS SECTIONALIZER – 2

PM activity of Bus Sectionalizer – 2 was carried out on 18.11.2023

3. BUSBAR PROTECTION CHECKING

Checking was done during 400KV Bus – 1 & Bus – 2 splitting activities in the year 2019.

(Reports enclosed)

SYSTEM IMPROVEMENT ACTIVITIES IN PROGRESS

1. All BHEL make 400&132KV Circuit Breaker has been envisaged for replacement due to spare availability and servicing support issue from OEM.
Phase -1 – PO already awarded to M/s Siemens for 14 nos. 400KV and 12 Nos. 132KV Circuit Breaker replacement. 9 nos. 400KV and 11 nos. 132KV Circuit Breaker has been replaced and taken in service.
2. 400/132KV Switchyard Extension Package Cum Bus Splitting Package is under progress. Earlier existing 400KV Bus-1 & Bus-2 has been split due to increase in Fault level. Presently, there are 4 nos. 400KV Buses namely, Bus-1&3 and Bus-2&4. The Station systems has been planned to get segregated for Stage-I & II and presently under advance stage of completion.

NB: Subsequent to this incident on 30.01.2024, mail was given to SIEMENS and representative from SIEMENS is visiting NTPC Kahalgaon site on 03.02.2024



THANK YOU

**REPORT ON ACTION TAKEN BASED ON ERPC COMMITTEE REPORT FOR TRIPPING EVENT
ON 30.01.2024 IN 400KV SWITCHYARD OF NTPC KAHALGAON**

A. REPORT OF ACTION TAKEN ON RECOMMENDATIONS PROVIDED BY COMMITTEE

1. NTPC is requested to take up with OEM M/s Siemens for Root Cause Analysis of the failure of Circuit Breaker and replacement of the interrupter pole at the earliest. The RCA report may be shared with ERPC.

Action Taken:

- Joint RCA with M/s Siemens is done on 12-13th March 2024 at Siemens factory, Aurangabad, (M.H.). Accordingly, report is enclosed.
 - Damaged B phase interrupter pole replacement work completed. However, B - phase bus side isolator contacts also got damaged during the incident. Accordingly, 400KV Bus – 2 shut down will be taken for replacement of the B phase isolator arm and further charging of U#2 Tie CB (1152)
2. NTPC is requested to carry out Busbar Protection Checking to identify and rectify the anomalies at the earliest. Reason for delayed opening time/non-opening of aforesaid breakers is required to be checked.

Action Taken:

- It is planned to check protection tripping checking from respective PUs (A&B) on 400kV Bus – 2 connected circuit Breakers one by one for identification of anomalies and identification for reason of such delayed opening of breakers. This activity is planned during 400KV Bus-2 Shutdown for restoration of Isolator of U#2 Tie CB (1152).
3. NTPC is requested to replace the non-functional Event Logger on immediate basis.

Action Taken:

- Initial online inspection of the existing event logger system is taken up with the vendor for its analysis. Vendor representatives will be visiting the Kahalgaon site soon for rectification of the issue with the present event logger.
 - In the meantime, process for procurement of new event logging system is in progress.
4. NTPC is requested to synchronize all the Disturbance Recorders with GPS clock for proper understanding of events in future. Besides the DR time window to be configured to minimum of 3 seconds and mandatory DR signals to be mapped as per ER protection philosophy.

Action taken:

- Some Disturbance Recorders are time synchronized at present and they are kept under monitoring. Some of the Disturbance Recorders will be time synchronized soon.

- DR time window is being increased to 3 seconds for all the relays.
5. NTPC needs to expedite commissioning of 400/132KV ICT – 3&4 and make bus-splitting scheme operational in Kahalgaon at the earliest to limit the fault level.

Action taken: The said work will be tentatively completed by 31.03.2025.

6. DT send Channel – 1 logic for 400KV Kh – Lakhisarai Ckt – 2 in PU – B needs to be corrected. Forward direction in 400KV Kh- Lakhisarai Ckt – 1 & 400KV Kh- Lakhisarai Ckt – 2 by Main – 2 Siemens Relay at Kahalgaon needs to be checked.

Action Taken:

Detailed analysis of DR and trip log was done, and observation is as mentioned below. Main – 2 relay settings are sent for review to Siemens as well as our NTPC/Engineering Team. Accordingly, the settings will be revised after availing line shutdown or during opportunity shutdown. Subsequently, both Main-I & Main II relays functional check will be done, and their test reports shall be shared to ERPC.

7. For cooling of Screw Compressor, a standby option may be explored by some mechanical modifications during overhauling of units for redundancy.

Action taken: Possibilities are being explored for feasibility of mechanical modification. Also, the station system for stage – 1&2 will be segregated once the new ICT's are commissioned.

B. DETAILED ANALYSIS OF DISCREPANCIES OBSERVED IN TRIPPING OF OUTGOING LINES

1. 400KV Kahalgaon Durgapur Line - 1:

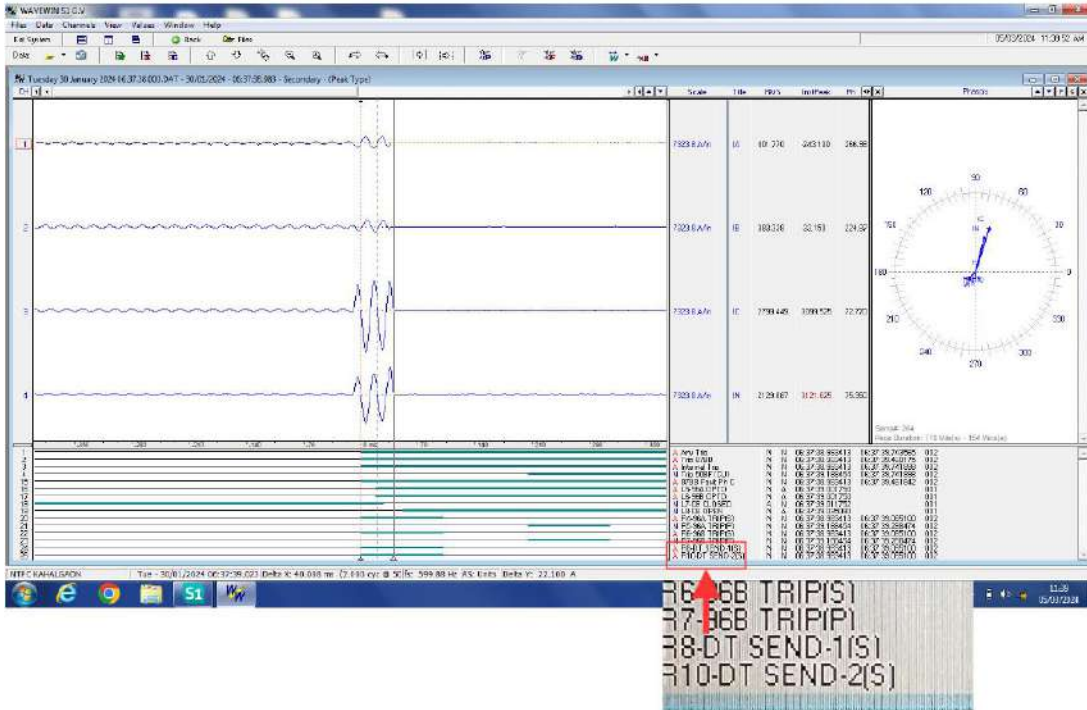
Observation by the committee:

DT sent from KHSTPP (Tie CB was closed. So, DT should not have been sent. Bus bar scheme to be checked). PSL logic in PUA & PUB may be checked for ascertaining the reason of DT send.

Analysis & Action taken by NTPC:

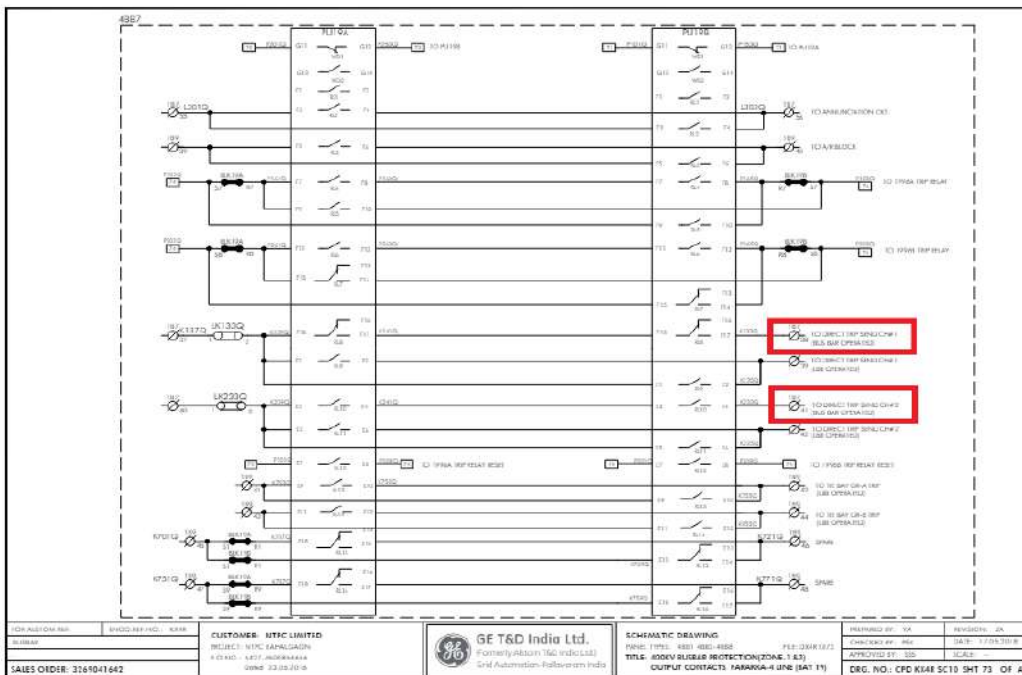
Main Bay of Kh- Durgapur Line - 1 (400KV Bay 19) is connected to 400KV Bus - II. Upon operation of 400KV Main Bus - II Busbar differential protection on 30.01.24, DT send channel - 1(S) & Channel - 2 (S) is generated as per logic. This is the Busbar contact used in series with TIE CB OPEN STATUS for sending DT to remote end. (Drawing enclosed for reference).

REPORT ON ACTION TAKEN BASED ON ERPC COMMITTEE REPORT FOR TRIPPING EVENT ON 30.01.2024 IN 400KV SWITCHYARD OF NTPC KAHALGAON



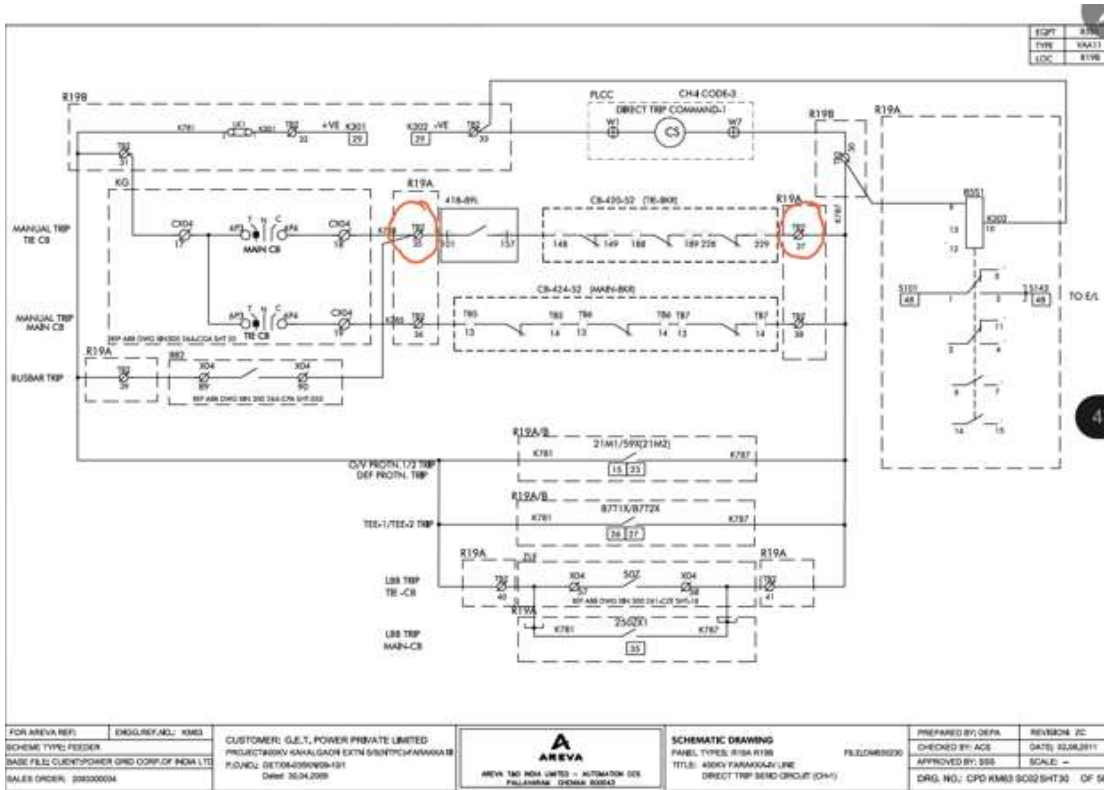
As per report, Tie CB 2052 was in closed condition during the event still DT was sent to remote end. Upon checking, it is observed that even though **Tie CB is in closed condition, the circuit for DT send is through.**

The TIE CB STATUS issue (OFF Status in series with Bus bar contact) will be checked and rectified during Opportunity.



Busbar Protection Contact use for DT send Logic.

**REPORT ON ACTION TAKEN BASED ON ERPC COMMITTEE REPORT FOR TRIPPING EVENT
ON 30.01.2024 IN 400KV SWITCHYARD OF NTPC KAHALGAON**



BB trip contact used in series with TIE CB status for DT send logic

2. 400 KV Kahalgaon - Durgapur Line - 2:

Observation by the Committee:

It is on 400KV Bus - I. Main - 2 OV operated (Y ph). Breaker opened before 400KV Desired OV trip time delay. DT sent to remote end. Reason for DT send may be ascertained to check whether it is from OV or PUA/PUB. Earthing at Kahalgaon to be checked as there was voltage rise in the healthy phase.

Analysis & Action taken by NTPC:

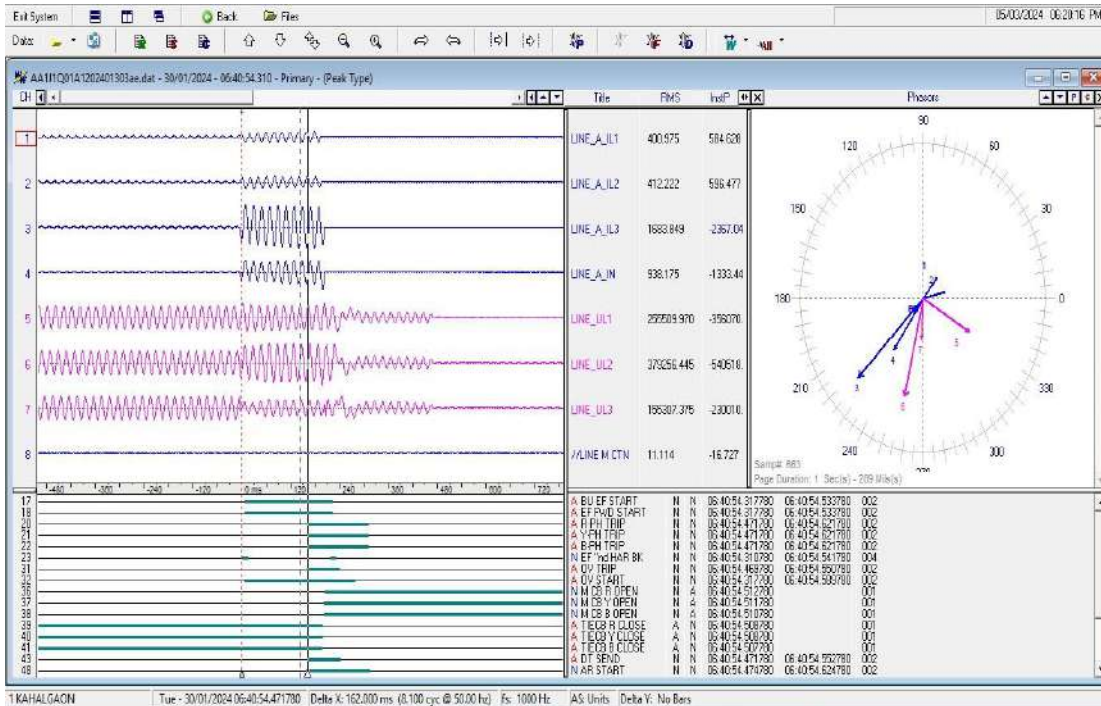
Main Bay of 400KV Kh- Durgapur Line - 2 (400KV Bay 18) is connected to 400KV Bus - I. As observed in the DR, the breaker opened after almost 45ms of Over-Voltage (O/V) trip command (Breaker Trip Time). Also, DT is sent after O/V trip.

O/V >> start	54.357 (values as seen from DR)
O/V >> Trip	54.469(102ms after O/V >> start as per setting)
DT SEND	54.471
MAIN CB OPEN	54.512(44ms after O/V trip)
TIE CB OPEN	54.513 (45ms after O/V trip)

REPORT ON ACTION TAKEN BASED ON ERPC COMMITTEE REPORT FOR TRIPPING EVENT ON 30.01.2024 IN 400KV SWITCHYARD OF NTPC KAHALGAON

Accordingly, it can be observed from the DR that,

- Breaker has opened after Desired O/V Trip time delay.
- DT send was from O/V trip as per logic.



Detailed Earthing analysis will be done. Line Reactors installation in the line is in progress.

3. 400KV Kahalgaon - LakhiSarai Line - 1:

Observation by the Committee:

It is on Bus 1. Carrier Received at Lakhisarai due to Main 2 forward direction fault detection at Kahalgaon end. Line opened due to Main 2 operation. M/s NTPC may check distance forward logic.

Analysis & Action taken by NTPC:

- Main 2 (Siemens Relay) setting was checked. It was observed that Z1, Z2, Z3 are set in Forward Zone and Z4 is set in Reverse Zone.
- Main – 1 relay (Mi-com Relay) has sensed fault in Reverse zone as observed in DR.
- As observed in Main - 2 Relay Trip Report, Main – 2 relay has sensed the distance as well earth fault protection in forward zone though fault distance observed is on Negative Side. However, on analysing the DR it is observed that the fault is sensed in the overlapping region of Zone – 1 & Zone – 3 instead of Zone – 4.
- Setting of Main – 2 relay is provided to Siemens and NTPC Engineering for further verification. Accordingly, the Main 2 (Siemens Relay) settings will be reviewed and revised.

REPORT ON ACTION TAKEN BASED ON ERPC COMMITTEE REPORT FOR TRIPPING EVENT ON 30.01.2024 IN 400KV SWITCHYARD OF NTPC KAHALGAON

Trip Log - 000430 / 30-01-2024 06:47:47.591 - 400 KV LINE DIST RELAY / LAKHISARAI 1 / 7SA611 V4.7 Var/7SA611 V04.70.07

Trip Log - 000430 / 30-01-2024 06:47:47.591 - 400 KV LINE DIST RELAY / LAKHISARAI 1 / 7SA611 V4.7 Var/7SA611 V04.70.07

Number	Indication	Value	Date and time	Cause	State
00301	Power System fault	430 - ON	30.01.2024 06:47:47.591		
00302	Fault Event	434 - ON	30.01.2024 06:47:47.591		
03689	Distance Pickup L31	ON	0 ms		
03706	Distance Loop L31 selected forward	ON	0 ms		
03805	Distance TRIP command Phases L123	ON	0 ms		
04056	Dis. Telep. Carrier SEND signal	ON	0 ms		
00533	Primary fault current IL1	1.42 kA	4 ms		
00534	Primary fault current IL2	0.62 kA	4 ms		
00535	Primary fault current IL3	1.72 kA	4 ms		
03671	Distance PICKED UP	OFF	54 ms		
03706	Distance Loop L31 selected forward	OFF	54 ms		
01370	E/F Inrush picked up	ON	60 ms		
00302	Fault Event	435 - ON	30.01.2024 06:47:47.661		
01358	E/F picked up FORWARD	ON	70 ms		
01355	E/F 3I0>> PICKED UP	ON	70 ms		
01336	E/F phase selector L1 selected	ON	80 ms		
00511	Relay GENERAL TRIP command	OFF	100 ms		
01370	E/F Inrush picked up	OFF	100 ms		
01336	E/F phase selector L1 selected	OFF	100 ms		
01345	Earth fault protection PICKED UP	OFF	100 ms		
01128	Fault Locator Loop L3L1	ON	42 ms		
01117	Fit Locator: secondary RESISTANCE	18.48 Ohm	42 ms		
01118	Fit Locator: secondary REACTANCE	-7.21 Ohm	42 ms		
01114	Fit Locator: primary RESISTANCE	67.17 Ohm	42 ms		
01115	Fit Locator: primary REACTANCE	-26.21 Ohm	42 ms		
01119	Fit Locator: Distance to fault	-85.3 km	42 ms		
01120	Fit Locator: Distance [%] to fault	-58.9 %	42 ms		

4. 400KV Kahalgaon - Lakhisarai Line - 2:

Observation by the Committee:

Carrier received at Lakhisarai due to Main 2 forward direction fault detection at KHSTPP. DT Received at remote end, due to incorrect logic in PUB relay at Kahalgaon end. M/s NTPC may check DT send and distance forward logic.

Analysis & Action taken by NTPC:

- Main 2 (Siemens Relay) setting was checked. It was observed that Z1, Z2, Z3 are set in Forward Zone and Z4 is set in Reverse Zone.
- As observed in Main - 2 Relay Trip Report, Main – 2 relay has sensed the E/F protection in Reverse zone but Distance Protection is in forward Zone. However, on analysing the DR it is observed that the fault is sensed in the overlapping region of Zone – 1 & Zone – 3 instead of Zone – 4.
- Setting of Main – 2 (Siemens relay) is provided to Siemens and NTPC Engineering for further verification. Accordingly, the M2 settings will be reviewed and revised.

REPORT ON ACTION TAKEN BASED ON ERPC COMMITTEE REPORT FOR TRIPPING EVENT ON 30.01.2024 IN 400KV SWITCHYARD OF NTPC KAHALGAON

1.1 Trip Log - 000610 / 30-01-2024 06:47:47.480 - 400 KV LINE DIST RELAY / LAKHISARAI 2 / 7SA522 V4.7 Var/7SA522 V04.70.07

Trip Log - 000610 / 30-01-2024 06:47:47.480 - 400 KV LINE DIST RELAY / LAKHISARAI 2 / 7SA522 V4.7 Var/7SA522 V04.70.07

Number	Indication	Value	Date and time	Cause	State
00301	Power System fault	610 - ON	30.01.2024 06:47:47.480		
00302	Fault Event	613 - ON	30.01.2024 06:47:47.480		
01359	E/F picked up REVERSE	ON	0 ms		
01338	E/F phase selector L3 selected	ON	0 ms		
01356	E/F 3I0> PICKED UP	ON	0 ms		
01370	E/F Inrush picked up	OFF	10 ms		
03688	Distance Pickup L3E	ON	185 ms		
03703	Distance Loop L3E selected forward	ON	185 ms		
03804	Distance TRIP command - Only Phase L3	ON	185 ms		
00535	Primary fault current IL3	2.18 kA	189 ms		
00593	Single pole open detected in L3	ON	219 ms		
14081	E/F 3I0>> is blocked	ON	219 ms		
14082	E/F 3I0> is blocked	ON	219 ms		
01332	Earth fault protection is BLOCKED	ON	219 ms		
01338	E/F phase selector L3 selected	OFF	220 ms		
01345	Earth fault protection PICKED UP	OFF	220 ms		
03671	Distance PICKED UP	OFF	235 ms		
03703	Distance Loop L3E selected forward	OFF	235 ms		
01132	Fault location invalid	ON	263 ms		

- Incorrect logic identified in PSL in Channel – 1 of DT sent logic in PUB relay. The same will be rectified during opportunity shutdown.

SI No.	Name of the incidence	PCC Recommendation	Latest status
133rd PCC Meeting			
1.	Status of Busbar Protection at 220 kV Substations-reg	PCC advised state transmission utilities to share the present status of bus bar protection at 220 kV and above substations to ERPC as per the format.	
2.	Review of SPS at Sterlite (Vedanta)	SLDC Odisha representative informed that the meeting to discuss the modalities of implementation of proposed SPS scheme will be convened within a week.	
132nd PCC Meeting			
3.	Disturbance at 220 kV Biharsharif S/s on 14.01.2024	<ul style="list-style-type: none"> ➤ PCC advised Powergrid and BSPTCL to jointly review the highset overcurrent protection considering the present network configuration and fault level. ➤ PCC advised BSPTCL to review E/F setting of the ICTs as well as lines at 220 kV Biharsharif S/s ➤ DR configuration to be done by BSPTCL for the relays of ICT-1 & 2 and relays of Mokama lines. 	<p><i>In 133rd PCC, BSPTCL representative informed that Powergrid had been already communicated to revise overcurrent settings at their end and settings at their end will be revised consequently. He further informed that shutdown of ICT 1 and 2 is applied for 18th March 2024 in order to rectify DR and other issues.</i></p> <p><i>Powergrid representative replied that settings will be reviewed shortly.</i></p>
130th PCC Meeting			
4.	Tripping of 220 kV Main Bus-2 at Budhipadar on 06.10.23 at 16:14 Hrs	<p>PCC advised to replace the defective bay unit at the earliest and restore the busbar protection for bus-2 thereafter.</p> <p><i>In 132nd PCC Meeting, OPTCL representative informed that OEM M/s Siemens had been communicated for this issue. He</i></p>	<p><i>In 133rd PCC, OPTCL representative informed that M/s Siemens had been communicated to submit estimate for procurement of new relay.</i></p>

		<i>further informed that bus bar protection for bus 2 is in off condition and for bus 1 is in service at present.</i>	
125th PCC Meeting			
5.	Repeated Line tripping of 220 kV Ramchandrapur - Joda in April 2023	<p>Regarding status of commissioning of DTPC in the line, PCC advised the matter may be taken with their telecom wing for early commissioning of the same.</p> <p><i>In 132nd PCC Meeting, JUSNL representtative informed that the tendering for procurement of DTPC is in process.</i></p>	