भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
पूर्वी क्षेत्रीय विद्युत समिति
Eastern Regional Power Committee
14, गोल्फ क्लब रोड, टालीगंज, कोलकाता-700033
Tel. No.: 033-24239651,24239658 FAX No.:033-24239652, 24239653 Web: **www.erpc.gov.in**

सं./**NO.** पू.क्षे.वि.स./**PROTECTION/2022/** 1475 दिनांक /**DATE: 02.02.2022**

सेवा में / To,

संलग्न सूची के अनुसार / As per list enclosed.

विषय : दिनांक - 19.01.2022 को आयोजित 110वीं पीसीसी बैठक का कार्यवृत्त ।

Sub: Minutes of the 110th PCC meeting held on 19.01.2022.

Sir,

19.01.2022 को आयोजित **110वीं** 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 **110th PCC** meeting of ERPC held on **19.01.2022** 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.

भवदीय / Yours faithfully,

for Kumar Satyam
02/02/2022

(पी.पी.जेना / P.P.Jena)
Executive Engineer (PS)
कार्यपालक अभियंता(पी.एस)

LIST OF ADDRESSES:

Chief Engineer, Trans (O&M) Bihar State Power Transmission Limited, VidyutBhawan, Bailey Road, Patna-800021	Electrical Supeeerintending Engineer (CRITL) Bihar State Power Transmission Limited, VidyutBhawan,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 UrjaSancharan Nigam Limited Kusai Colony, Doranda, Ranchi-834002	Electrical Superintending Engineer (CLD) Jharkhand UrjaSancharan Nigam Limited, KusaiColony,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 Corpn. 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, 7th 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), WBPDCL, OS Dept. Corporate Office, 3/C, LA Block, Salt Lake-III, Kolkata-700098 (Fax-033-23350516)
General Manager (O&M) Barh STPS, NTPC Ltd., P.O. NTPC Barh, Dist. Patna, Bihar-803213	General Manager (OS), ERHQ-II, NTPC Ltd., 3rdflr. OLIC Building, Plot no. N 17/2, Nayapalli, Unit-8 Bhubaneswar- 751012 (Fax No. 0674-2540919)
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, (2nd 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	The Head Maithon Power Limited, Maithon Office, MA 5 Gogna, Dist. Dhanbad, Jhankand State, PIN-828207
General Manager (AM), ER-II Power Grid Corporation of India Ltd., J-I-15, Block-EP, Sector-V,Salt Lake,Kolkata-91	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 (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, Angul, Odisha (FAX:011-26139256-65)
Shri D. P. Bhagava, Chief Consultant (O&M), TeestaUrja Limited, New Delhi (FAX:011-46529744)	Director (GM Division), Central Electricity Authority Sewa Bhawan, R. K. Puram, New Delhi-110066
Director (NPC), CEA, NRPC Building, Katwaria Sarai, New Delhi- 110016	President, Dans Energy Pvt. Ltd, 5th Floor, DLF Building No. 8, Tower-C, Gurgaon - 722OO2
Director, Shiga Energy Pw. Ltd., 5th Floor, DLF Building No. 8, Tower-C, Gurgaon - 722OO2	DGM (E&I), HALDIA ENERGY LIMITED, BARIK BHAWAN, KOKATA-700072, FAX: 033-22360955
President , TPTL, BhikajiCama Place, New Delhi , 110066	

Minutes
of
110th PCC Meeting

Date:02.02.2022
Eastern Regional Power Committee
14, Golf Club Road, Tollygunge
Kolkata: 700 033

EASTERN REGIONAL POWER COMMITTEE

MINUTES OF 110th PROTECTION COORDINATION SUB-COMMITTEE MEETING HELD ON 19.01.2022 AT 10:30 HOURS

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

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

PART – A

ITEM NO. A.1: Confirmation of minutes of 109th Protection Coordination sub-Committee Meeting held on 16th December 2021 through MS Teams online platform.

The minutes of 109th Protection Coordination sub-Committee meeting held on 16.12.2021 was circulated vide letter dated 04.01.2022.

Members may confirm.

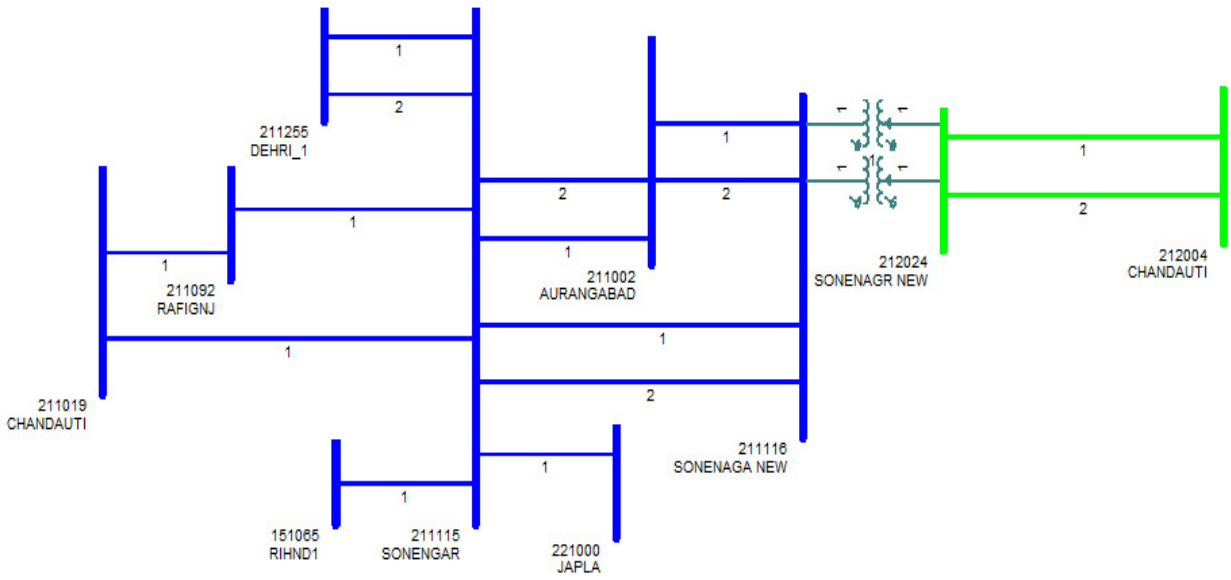
Deliberation in the meeting

Members confirmed the minutes of 109th PCC Meeting.

PART – B

ITEM NO. B.1: Total Power Failure at 220 kV Soneneagar S/s on 15.12.2021 at 15:28Hrs

At 15:28 Hrs, 220 kV Chandauti-Sonenagar-1 tripped from both end on R_Y fault. At the same time, 220 kV Chandauti-Sonenagar circuit-2 also got tripped on R_Y fault from Chandauti end only. This led to total power failure at 220/132 kV Sonenagar S/s. Power supply to Aurangabad, Sonengar, Rafiganj and Japla also got interrupted.



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

Relay Indications:

Time	Name	End 1	End 2	PMU Observation
15:28	220 KV Chandauti-Sonenagar-1	Chandauti: R_Y_N, 42.6 km, Ir: 4.4 kA, Iy: 4.2 kA	Sonenagar: R_Y_N, 29.93 km, Ir: 1,738 kA, Iy: 1.962 kA	
	220 KV Chandauti-Sonenagar-2	Chandauti: R_Y_N, 107.3 km, Ir: 1.8 kA, Iy: 1.6 kA	Didn't trip	

Load Loss: 101 MW
Outage duration: 00:30 Hrs

Powergrid & BSPTCL may explain.

Deliberation in the meeting

BSPTCL representative informed that the fault(R-Y-N) was in 220 kV Chandauti-Sonenagar circuit-1 and both end relay of the line operated and cleared the fault in zone-1 of distance protection. They added that during line patrolling insulators were found damaged at two number of tower locations at 29 km from Sonenegar end and the same had been replaced.

The 220 kV Chandauti-Sonenagar circuit-2 also got tripped at the same time from Chandauti end in zone-2 of distance protection. Powergrid replied that as per DR analysis, relay at Chandauti end sensed the fault in zone-2 and got tripped within 100 msec due to carrier receipt at their end. BSPTCL representative intimated that as per the PLCC counter at Sonenagar end, no carrier signal was send to Chandauti end during the disturbance.

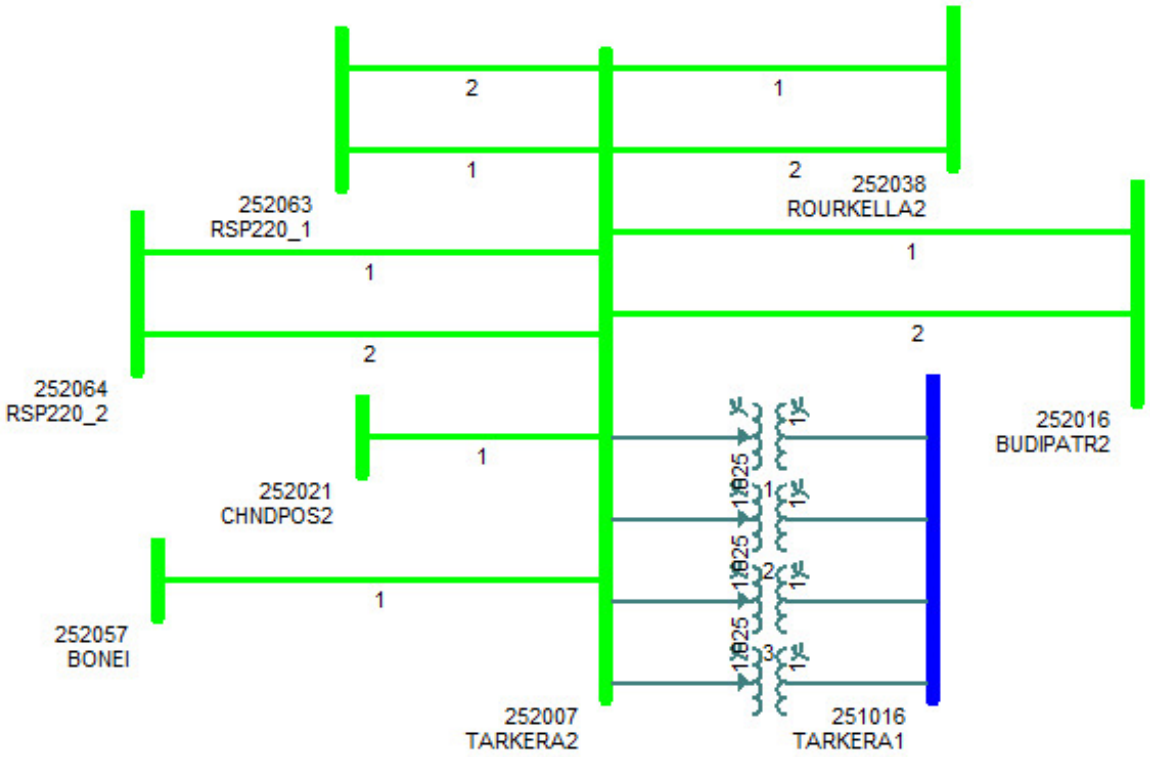
After detailed deliberation PCC advised BSPTCL following:

- *to investigate the root cause behind spurious receipt of carrier at Chandauti end by thorough checking of PLCC system at both the end in coordination with Powergrid. Further end to end testing may be done to ascertain the healthiness of PLCC.*
- *to check whether POTT scheme is present on both end and if so, then timer settings of current reversal guard may to be checked and revised.*

ITEM NO. B.2: Total Power Failure at 220 kV Tarkera S/s on 21.12.2021 at 19:38Hrs

Both 220 kV Buses at Tarkera S/s became dead resulting in total power failure at Rourkela, RSP (Rourkela Steel Plant) & Rajgangpur.

As per PMU data only 1 kV dip in Y &B phase was observed which indicates that there was no actual bus fault and tripping seem to be happened on spurious operation of busbar protection.



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

Load Loss: 450 MW
Outage duration: 01:02 Hrs

OPTCL may explain.

Deliberation in the meeting

OPTCL representative explained the event with help of a presentation which is attached at ***Annexure B.2.1.***

They informed that both 220 kV bus-1 and bus-2 at Tarkera S/s got tripped on operation of the bus bar protection. However on physical inspection of switchyard, no conclusive evidence of bus bar fault was detected. No DR was also triggered during the event in the busbar central unit relay.

They added that they had already communicated the issue to OEM (M/S Siemens) for analysis of the event and reason behind spurious operation of bus bar protection.

During analysis of the oscillography record of current value, it was noticed that though there was no fault current during the disturbance however bus differential current of 2.4 amp was recorded which is greater than incoming current of Powergrid Bisra feeder i.e. 2 amp. PCC advised OPTCL to test the bus bar relay in order to find out any issues on secondary circuitry of the busbar unit.

PCC stated that with available information, the reason for busbar operation at Tarkera cannot be explained and advised OPTCL/SLDC Odisha to submit event logger details as well as any other relevant information during the event which would help analyzing the event by PCC.

ITEM NO. B.3: Bus tripping occurred in Eastern Region during December 2021

During December 2021, following incidents of bus bar tripping have been observed in Eastern Region.

Element Name	Tripping Date	Reason	Utility
400 kV Main bus - 1 at Malda	17-12-2021 at 15:24 Hrs.	Spurious trip was initiated from old electromechanical LBB relay of 400KV TBC Bay (Presently 400KV Purnea CKt-I charged through TBC Bay)	PGCIL ER- 2
400 kV Main Bus-2 at Teesta-III HEP	11/12/2021 at 19:50 Hrs.	400kV Bus-2 Tripped during desyncing of Unit#6.	TUL
132KV Main Bus - 1 at Banka(PG)	04/12/2021 at 12:39 Hrs.	Not communicated	PGCIL ER-1

Concerned utility may explain.

Deliberation in the meeting

- ***Tripping of 400 kV Main bus - 1 at Malda S/S on 17/12/2021 at 15:24 Hrs***

Powergrid representative informed that on the day of disturbance 400 kV Malda-Purnea circuit-1 was charged through TBC bay. The disturbance occurred due to initiation of spurious trip signal from old electromechanical LBB relay of 400 kV TBC bay which resulted in tripping of 400 kV Main Bus-1 at Malda S/s. On investigation, it was found that contact of an auxiliary relay had become high resistive which resulted in initiation of tripping command to LBB relay.

They further informed that the defective auxiliary relay had already been replaced with spare relay and intimated that they are planning to replace all old electromechanical LBB relays with numerical relay at Malda S/s by next month.

- ***Tripping of 400 kV Main bus - 2 at Teesta-III S/S on 11/12/2021 at 19:50 Hrs***

TUL representative informed that during de-synchronization of unit#6 at Teesta-III HEP, the corresponding B-phase pole of circuit breaker got stuck and did not open. As a result, LBB protection operated and subsequently 400 kV Main bus 2 got tripped.

- ***Tripping of 132 kV Main bus - 1 at Banka(PG) S/S on 04/12/2021 at 12:39 Hrs***

Powergrid representative submitted that the tripping occurred due to mal-operation of LBB relay for main bay of ICT. During checking it was found that status of circuit breaker was not incorporated in LBB relay settings which resulted in mal-operation of the relay. They added that the settings had been rectified after the incident.

On enquiry regarding any increase in current during the incident which led to LBB operation, Powergrid representative replied that no DR was triggered during the event. PCC advised Powergrid to share the event logger data with ERPC/ERLDC.

ITEM NO. B.4: Repeated Tripping of 132 kV Banka -Sultanganj D/C line

It had been observed that 132 kV Banka -Sultanganj D/C is tripping repeatedly with fault in one circuit and other circuit on overload. The issue had already been raised several times in the past.

All tripping seems to be occurred due to vegetation, transient fault, as every time lines are getting charged within 30 Minutes.

It is advised that Bihar SLDC may either explore load shifting to other sources to fulfill N-1 of the lines or BSPTCL may implement Local SPS (load trim scheme) to avoid tripping of another circuit on overload.

Tripping incidences for concerned lines in month of December 2021 is mentioned below:

Element Name	Tripping Date	Tripping Time	Reason	Remarks	Revival Date	Revival Time
132KV-BANKA (PG)-SULTANGANJ-1	30/12/2021	08:07	Y-B,FC Iy 7.15KA,Ib 7.15KA,FD 14.3 KM @ Banka		30/12/2021	17:55
132KV-BANKA (PG)-SULTANGANJ-1	07/12/2021	10:50	Banka: R-n, 6.1 km, 10.9 kA; Sultanganj: R-n, z1, 29.2 km, 0.9 kA	Restored	07/12/2021	11:10
132KV-BANKA (PG)-SULTANGANJ-2	06/12/2021	11:28	Banka: R-N, 40.195Km, 2.942kA		06/12/2021	12:01
132KV-BANKA (PG)-SULTANGANJ-1	06/12/2021	11:28	Tripped from Sultanganj end only , details awaited		06/12/2021	11:41
132KV-BANKA (PG)-SULTANGANJ-2	04/12/2021	12:39	132 kV Bus tripped at Banka(PG)		04/12/2021	13:18
132KV-BANKA (PG)-SULTANGANJ-1	04/12/2021	12:39	132 kV Bus tripped at Banka(PG)		04/12/2021	13:18
132KV-BANKA (PG)-SULTANGANJ-1	02/12/2021	10:27	Banka: R-N,2.783 kA,34.143 kM, Sultanganj: Z-I, R-N,11.5 kM		02/12/2021	11:16
132KV-BANKA (PG)-SULTANGANJ-1	02/12/2021	04:20	Relay details awaited .	Tripped from Sultanganj end only . No relay indication .	02/12/2021	04:55
132KV-BANKA (PG)-SULTANGANJ-2	02/12/2021	04:20	Banka :- RN , 3.1 kA , 30.5 KM FD SULTANGANJ :- RN , 0.82 kA 13.1 KM		02/12/2021	05:05

BSPTCL and SLDC Bihar may explain.

Deliberation in the meeting

SLDC Bihar representative informed that as a part of load shifting, they had shifted 22 MW load of Jagdishpur(New) to Sabour and 20 MW load of Tarapur to Haveli Kharagpur before December 2021 in order to reduce line loading of 132 kV Banka -Sultanganj D/C line.

He further informed that most of the tripping in the month of Dec-21 was due to issue in LBB protection for which they had planned line shutdown of 132 kV Banka-Sultanganj D/C on 20/01/2022 and 21/01/2022 for detailed checking. The tower top patrolling of 132 kV Banka - Sultanganj D/C would also be carried out during the shutdown.

PCC advised BSPTCL to submit a report on LBB issue after carrying out breaker timer test along with tower top patrolling findings. PCC further advised BSPTCL to take corrective actions like insulator replacement work in the identified tower locations before the onset of summer season.

ITEM NO. B.5: Protection Audit in Eastern Region

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

substations and power plants in the Eastern Region. In view of this, following activities have been decided to streamline the audit process:

PCC activities

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

Pre-audit activities

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

Input to be obtained from protection database

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

On the day of Audit at Substation/Plants

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

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

Format for protection audit checklist isattachedat **Annexure B.5.**

In 109th PCC Meeting, the audit procedure was elaborated in the meeting.

- It was informed that 3-4 audit team will be constituted consisting members from state utility, central utility, ERLDC & ERPC secretariat. The list substations where the audit is to be carried out would be finalized beforehand in PCC meeting and the concerned utility needs to check and update the relay/protection settings available in the protection database (PDMS) before the field visit. Further the nodal officer has to coordinate with the audit teams to facilitate their visit in carrying out the substation audit.

- The audit team would submit their report and observation to ERPC secretariat and the same would be placed in PCC meeting for information and compliance, if any, by the auditee utility.

Members agreed to the proposal of requirement of periodic protection audit for the substationsand expressed their full cooperation in the audit activities.

PCC advised utilities to submit their comments, if any, regarding the procedure and format to be followed for carrying out the protection audit.

PCC also advised all state utilities including state generating utility, DVC, Powergrid, NTPC &NHPC to nominate at least 2-3 members from their organization who are looking after system

protection/testing related work for constitution of audit teams. Separately a nodal officer may be nominated for each utility to coordinate the audit activities for the substations in their system.

Nomination for audit team was received from WBSETCL.

Members may update.

Deliberation in the meeting

ERPC Secretariat informed that third party protection audit for the year 2022 would be commenced as soon as the current covid situation gets improved.

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

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

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

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

ITEM NO. B.6: Tripping Incidence in month of December2021

Tripping incidents in the month of December 2021 which needs explanation from constituents of either of the end is attached.

Concerned utilities may explain.

Deliberation in the meeting

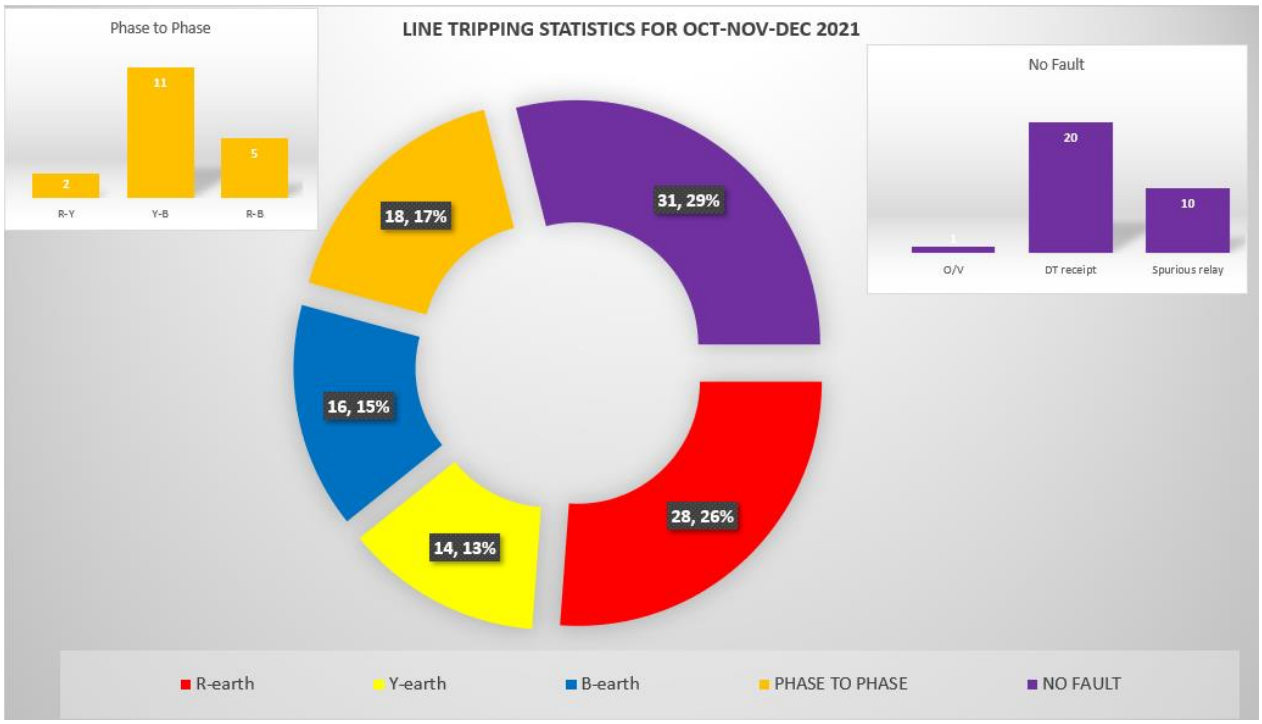
Members explained the tripping incidences. The updated status is enclosed at ***Annexure B.6.***

PART- C::OTHER ITEMS

ITEM NO. C.1: Protection Performance of Last Quarter Oct-Dec' 2021

From the last quarter statistics as shown below it can be observed that almost 30% of the total tripping's are occurring without any fault in line mostly due to spurious operation of relay, sending of DT to the remote end which is not desired at all from system security and resiliency.

Performance in this aspect needs to be improved a lot by each utility so that no such trippings occur in future.



Members may discuss.

Deliberation in the meeting

ERLDC representative appraised to the forum that around 30% of the total line tripping in last quarter were occurred without any fault in line and the trippings were mostly due to spurious operation of relay, sending of DT to the remote end due to communication/PLCC issue. They added that this type of tripping of lines without any fault is not desirable as it affects the system security and resiliency.

PCC raised concern on the above issue of tripping of lines without any actual fault in the line and advised all concerned utilities to identify root cause behind spurious tripping of lines in their concerned zone and rectify the issue so that such type of trippings can be avoided in future.

ITEM NO. C.2: Follow-up of Decisions of the Previous Protection Sub-Committee Meeting(s)

The decisions of previous PCC meetings are attached.

Members may update the latest status.

Deliberation in the meeting

Updated status for decisions of previous PCC meetings is given at ***Annexure C.2.***

ITEM NO. C.3: Implementation of Differential protection for shorter lines

As per the CEA standard, transmission line protection can have either have distance or differential protection scheme as main protection scheme. It has been observed that for short lines distance protection scheme tends to over reach and pose protection coordination issues with other elements

from the substation. Further many a times due to this short line distance protection the longer lines from remote ends have to increase their zone-2-time delays to higher values (500-600 ms).

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

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

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

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

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

In 110th PCC Meeting,

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

The views of utilities are given below:

- *WBSETCL representative informed that as per their adopted practice criteria of line length < 10 km is considered for implementing line differential protection.For line length > 10 km, distance protection scheme gives satisfactory results as such they do not require implementing line differential protection for line length of 10-20 km.*
- *DVC representative informed that they had considered the criteria of line length < 10 km for implementing line differential protection scheme in their system.*

- *ERPC secretariat opined thatin general for very short lines having line length less than 10 km, limitations are imposed by R/X of the relay in accurate setting of zone-1 of distance protection so the criteria of implementing line differential protection for line length of less than 10 km may be adoptedby the utilitiesfor lines at 220 kV & above voltage level.However, in critical and important lines as recommended by PCC forum, utility shall provide line differential protection irrespective of length of line. Members agreed to the above proposal.*

Regarding status of implementation of differential protection for existing short lines in Eastern Region, PCC advised BSPTCL, OPTCL, DVC & WBSETCL to submit the required details for the lines as listed in the annexure. Further PCC advised all the utilities to furnish the list of the lines where line differential has been proposed for implementation over and above the list of lines mentioned in the annexure.

Regarding 220 kV Rangpo-Rongnichu D/C line, Rongnichu informed that OPGW carrier communication is available in the line and the relays have facility for implementing differential

protection. PCC advised Powergrid & Rongnichu HEP to implement line differential protection for the line.

Similarly, for 400 kV Rangpo-Teesta V D/C line, NHPC stated that OPGW carrier communication is present in the line. PCC advised Powergrid to implement line differential protection for 400 kV Rangpo-Teesta V line.

For other 400 & 220 kV lines in the Sikkim complex, line differential protection would be implemented after commissioning of OPGW communication link.

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

Members may update.

Deliberation in the meeting

The updated list of short lines where line differential protection is to be implemented is attached at ***Annexure C.3****.*

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

****

Annexure A

LIST OF PARTICIPANTS IN 110TH PCC MEETING HELD ON 19/01/2022 (WEDNESDAY)

Full Name	Join Time	Email
ERPC Kolkata	1/19/2022, 10:16:20 AM	ERPC@KolkataMST.onmicrosoft.com
MS ERPC (Guest)	1/19/2022, 10:16:30 AM	
Kumar Satyam, AE, ERPC (Guest)	1/19/2022, 10:16:30 AM	
BD Kumar	1/19/2022, 10:16:31 AM	devendra.b@teestaurja.com
Laldhari Kumar	1/19/2022, 10:16:48 AM	laldhari@erldc.onmicrosoft.com
GAUTAM NAYAK (Guest)	1/19/2022, 10:19:51 AM	
Amresh Mallick	1/19/2022, 10:19:55 AM	amareshmallick@erldc.onmicrosoft.com
Gopal Mitra	1/19/2022, 10:20:23 AM	gopalmitra@erldc.onmicrosoft.com
SMS SAHOO, DGM(ELECT), OPTCL (Guest)	1/19/2022, 10:22:55 AM	
SUDIPTA MAITI	1/19/2022, 10:24:22 AM	sudiptamaiti@dvcindia.onmicrosoft.com
Sougato Mondal	1/19/2022, 10:26:44 AM	saugato@erldc.onmicrosoft.com
Sukdev (PG/ER2) (Guest)	1/19/2022, 10:27:25 AM	
DILSHAD ALAM	1/19/2022, 10:29:03 AM	
Deepak v	1/19/2022, 10:29:17 AM	
D.PATEL OPTCL EMR MERAMUNDALI	1/19/2022, 10:30:00 AM	
Vijay chandra TEESTA-III	1/19/2022, 10:30:36 AM	
madan mohan	1/19/2022, 10:31:19 AM	
shadab hasan	1/19/2022, 10:32:16 AM	
Rajiv Kumar Singh CESC	1/19/2022, 10:32:28 AM	
Aman	1/19/2022, 10:32:34 AM	
B Sarkar	1/19/2022, 10:32:56 AM	
CRITL	1/19/2022, 10:33:17 AM	
debdas mukherjee	1/19/2022, 10:33:50 AM	
DEBDAS MUKHERJEE WBPDCL (Guest)	1/19/2022, 10:34:02 AM	
Nishant Kumar Shankwar	1/19/2022, 10:34:19 AM	Nishant.Kumar@SEKURA.IN
Dilip kant Jha Eee Bsptcl	1/19/2022, 10:34:44 AM	
Uma Kanta Mishra	1/19/2022, 10:35:03 AM	
rajendra prasad (Guest)	1/19/2022, 10:35:23 AM	
Akash Kumar Modi	1/19/2022, 10:35:38 AM	akmodi@erldc.onmicrosoft.com
Arindam Bsptcl	1/19/2022, 10:36:10 AM	
SUDIPTA DVC	1/19/2022, 10:36:40 AM	
Deepak Thakur, BSPTCL	1/19/2022, 10:37:15 AM	
Alok Pratap Singh	1/19/2022, 10:37:18 AM	apsingh@erldc.onmicrosoft.com
A Shukla AEE CRITL JUSNL (Guest)	1/19/2022, 10:37:42 AM	
Saibal Ghosh	1/19/2022, 10:38:20 AM	saibal@erldc.onmicrosoft.com

Ankur Kumar (Guest)	1/19/2022, 10:39:56 AM	
Chandan Mallick	1/19/2022, 10:40:52 AM	chandan.mallick@erldc.onmicrosoft.com
ele.ummishra (Guest)	1/19/2022, 10:40:56 AM	
Shabari Pramanick	1/19/2022, 10:41:58 AM	
Purn Prakash Chand	1/19/2022, 10:42:07 AM	purnprakash@erldc.onmicrosoft.com
GULSHAN MBPCL RONGNICHU (Guest)	1/19/2022, 10:42:18 AM	
ER-1 (Guest)	1/19/2022, 10:42:36 AM	
P P CHAND (ERLDC) (Guest)	1/19/2022, 10:42:50 AM	
Saurav Kr Sahay Ch Mgr ERLDC (Guest)	1/19/2022, 10:42:59 AM	
madan mohun prasad (Guest)	1/19/2022, 10:43:49 AM	
Rajdeep Bhattacharjee, RE, BSPHCL, Kolkata	1/19/2022, 10:44:54 AM	rekolbsphcl@gmail.com
Gagan Kumar EEE	1/19/2022, 10:45:05 AM	
Gautam Nayak (Guest)	1/19/2022, 10:47:07 AM	
Aman (Guest)	1/19/2022, 10:48:26 AM	
Prabhat Anand	1/19/2022, 10:50:35 AM	
SLDC ODISHA (Guest)	1/19/2022, 10:52:16 AM	
Pallavi Kansal	1/19/2022, 10:53:24 AM	pallavi.k@tvptl.com
TVNL (Ashish Kr Sharma) (Guest)	1/19/2022, 10:53:55 AM	
BSPTCL	1/19/2022, 10:57:53 AM	
Deepak Kumar Singh (Guest)	1/19/2022, 11:02:03 AM	
Chandan Kumar	1/19/2022, 11:02:38 AM	admin@POSOCO965.onmicrosoft.com
Teesta III (Guest)	1/19/2022, 11:04:48 AM	
DHARM DAS MURMU, CRITL, JUSNL (Guest)	1/19/2022, 11:06:42 AM	
saibal erldc	1/19/2022, 11:09:25 AM	
Dilip kant Jha Eee Bsptcl	1/19/2022, 11:09:39 AM	
"prabhat k (TPTL) (Guest)	1/19/2022, 11:12:47 AM	
RAHUL RAJ	1/19/2022, 11:16:23 AM	
Uma Kanta Mishra	1/19/2022, 11:18:14 AM	
Rajiv	1/19/2022, 11:19:56 AM	
emr meramundali (Guest)	1/19/2022, 11:21:34 AM	
Pritam Mukherjee	1/19/2022, 11:23:38 AM	pritam@erldc.onmicrosoft.com
Biplob Sarkar (Guest)	1/19/2022, 11:25:20 AM	
SANJEEV KUMAR (Guest)	1/19/2022, 11:26:33 AM	
D.PATEL OPTCL EMR MERAMUNDALI	1/19/2022, 11:30:53 AM	
DKS	1/19/2022, 11:46:54 AM	
Santosh Ghodekar DANS Energy Jorethang (Guest	1/19/2022, 11:56:36 AM	
Abhinaba basu	1/19/2022, 11:59:32 AM	

TEESTA-III Vijay Chandra (Guest)	1/19/2022, 12:47:16 PM
bsptcl (Guest)	1/19/2022, 12:48:44 PM

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

घटना संख्या: **15-12-2021/1** दिनांक: **03-01-2022**

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

Summary of the event (घटना का सारांश):

At 15:28 hrs, 220 kV Chandauti-Sonenagar-1 tripped from both ends on R_Y fault. At the same time, 220 kV Chandauti-Sonenagar-2 also tripped on R_Y fault from Chandauti end only. This led to total power failure at 220/132 kV Sonenagar S/s. Power supply to Aurangabad, Sonengar, Rafiganj and Japla interrupted. Total 101 MW load loss occurred.

- **Date / Time of disturbance:** 15-12-2021 at 15:28 hrs.
- **Event type:** GD - 1
- **Systems/ Subsystems affected:** 220/132 KV Sonenagar S/s
- **Load and Generation loss**.
    - No generation loss was reported during the event.
    - 101 MW load loss reported during the event at Sonenagar, Aurangabad, Rafiganj and Japla.

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

- NIL

Major elements tripped (प्रमुख ट्रिपिंग):

- 220 kV Chandauti-Sonenagar D/c

Network across the affected area (प्रभावित क्षेत्र का नक्शा)

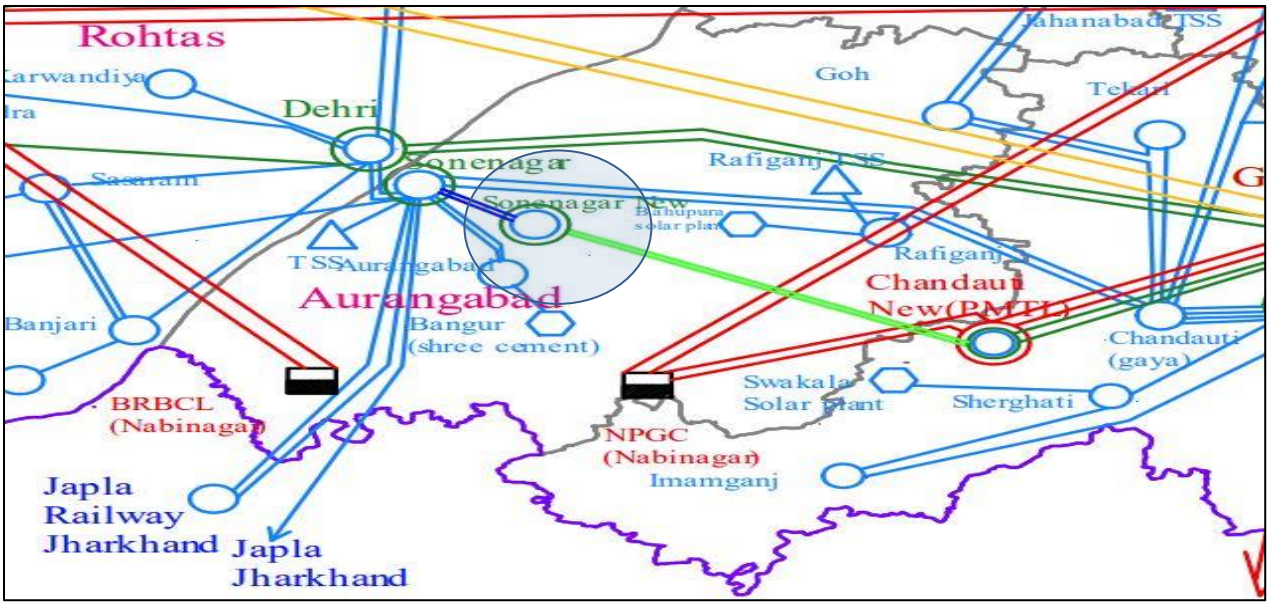


Figure 1: Network across the affected area

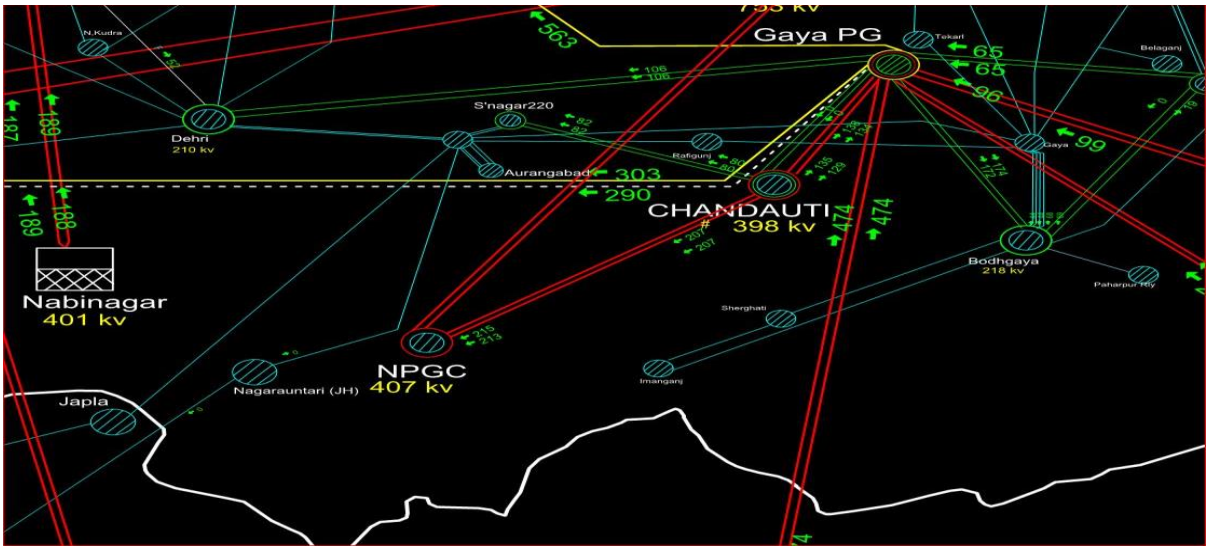


Figure 2: SCADA snapshot for of the system

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

समय	नाम	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	पीएमयू पर्यवेक्षण
15:28	220 KV Chandauti-Sonenagar-1	Chandauti: R_Y_N, 42.6 km, Ir: 4.4 kA, Iy: 4.2 kA	Sonenagar: R_Y_N, 29.93 km, Ir: 1,738 kA, Iy: 1.962 kA	
	220 KV Chandauti-Sonenagar-2	Chandauti: R_Y_N, 107.3 km, Ir: 1.8 kA, Iy: 1.6 kA	Didn't trip	

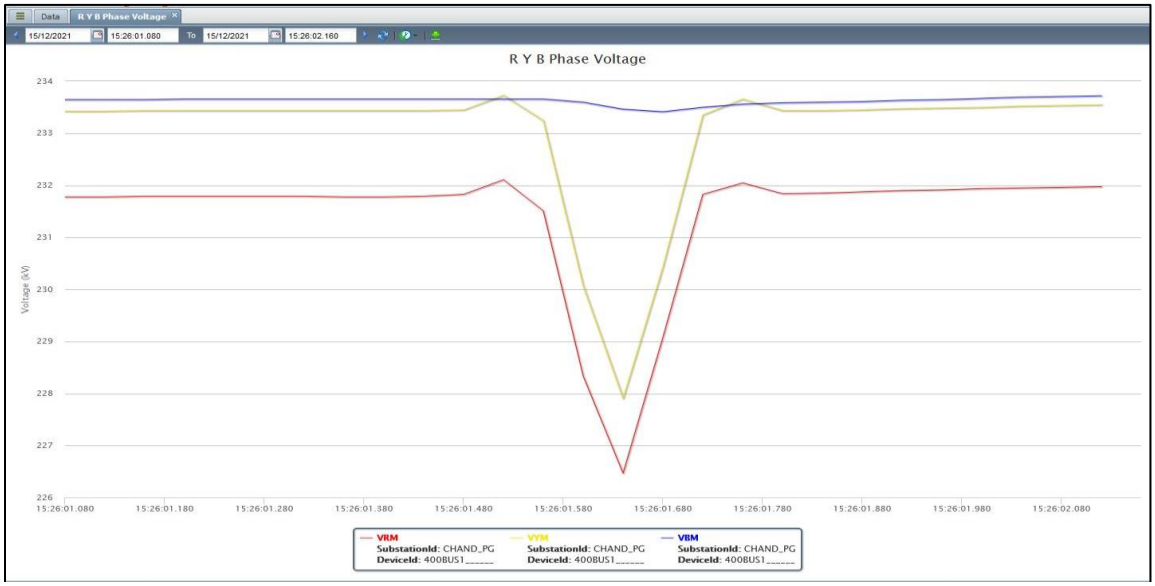


Figure 3: As per Gaya PMU snapshot 0.5 kV dip observed in Y_ph and B_ph

Restoration (पूर्वावस्था की प्रप्ति)

Transmission/Generation element name	Restoration time
220kV Chandauti-Sonenagar 1	15:58
220 KV Chandauti-Sonenagar 2	16:07

Analysis of the event (घटना का विश्लेषण):

- 220 kV Chandauti-Sonenagar-1 tripped on R_Y fault. At the same time ckt -2 also tripped from Chandauti end in zone -2 which led to total power loss of Sonnagar .

Protection issue (सुरक्षा समस्या):

- Repeated Tripping of both the lines have been observed with R phase involved in each case at distance of 20-40 km from Sonenagar. Row, clearance issues needs to be resolved as tripping of lines leads to total power failure to radially connected downstream loads, thus affecting reliability. **BSPTCL to explain.**
- 220 kV Chandauti-Sonenagar-2 tripped in zone-2 from chandauti end sensing the fault of line 1, which should not occur as the line 1 opened with 100ms from Sonnagr end .DR/EL not received yet from Chadauti**.** From PMU plot also it appears fault got cleared within 100ms **. Powergrid ER-1 to explain.**

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

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

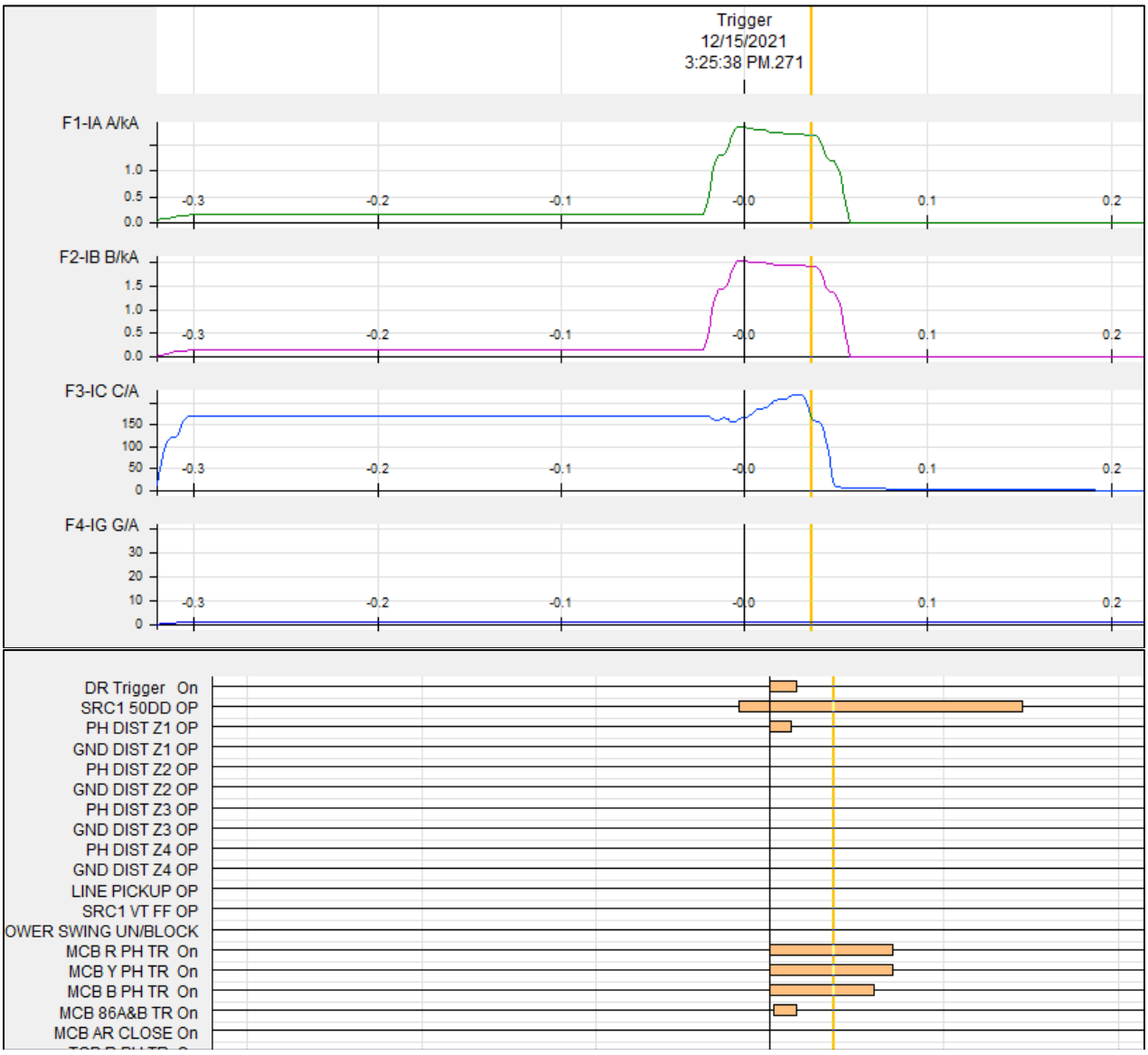
Status of Reporting (रिपोर्टिंग की स्थिति):

- DR/EL yet to be received from PMTL.

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

Sequence of event not recorded at time of event.

Annexure 2: DR recorded



पावर सिस्टम ऑपरेशन करपोरेशन लिमिटेड
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POWER SYSTEM OPERATION CORPORATION LIMITED
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फ़ोन: 033- 24235755, 24174049 फैक्स : 033-24235809/5029 Website:www.erldc.org, Email ID- erldc@posoco.in

घटना संख्या: **21-12-2021/1** दिनांक: **03-01-2022**

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

Summary of the event (घटना का सारांश):

At 19:38 hrs, both 220 kV Bus at Tarkera became dead, resulting in total power failure at Tarkera. Power supply to Rourkela, RSP, Rajgangpur interrupted. Total 450 MW load loss occurred.

- **Date / Time of disturbance:** 21-12-2021 at 19:38 hrs.
- **Event type:** GD - 1
- **Systems/ Subsystems affected:** 220/132 KV Tarkera S/s
- **Load and Generation loss**.
    - No generation loss was reported during the event.
    - 450 MW load loss reported during the event at Rourkela, RSP and Rajgangpur.

Area/ Region /Substation/Traction (जगह/क्षेत्र/ सबस्टेशन/कर्षण)	Amount of Load Loss (MW) भार क्षति की मात्रा	Amount of Generation Loss (MW) उत्पादन क्षति की मात्रा
ROURKELA	220	Nil
RSP	200	Nil
RAJGANGPUR	30	Nil
Total	**450**	**Nil**

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

- NIL

Major elements tripped (प्रमुख ट्रिपिंग):

- 220 kV Bus-1 & Bus-2 at Tarkera
- 220 kV Rourkela-Tarkera D/c
- 220 kV Budhipadar-Tarkera D/c
- 220 kV RSP-Tarkera Q/c
- 220 kV Barkot-Tarkera
- 220 kV Chandiposh-Tarkera
- 4*100 MVA 220/132 kV ATR at Tarkera

All 132 kV feeders were later handtripped.

Network across the affected area (प्रभावित क्षेत्र का नक्शा)

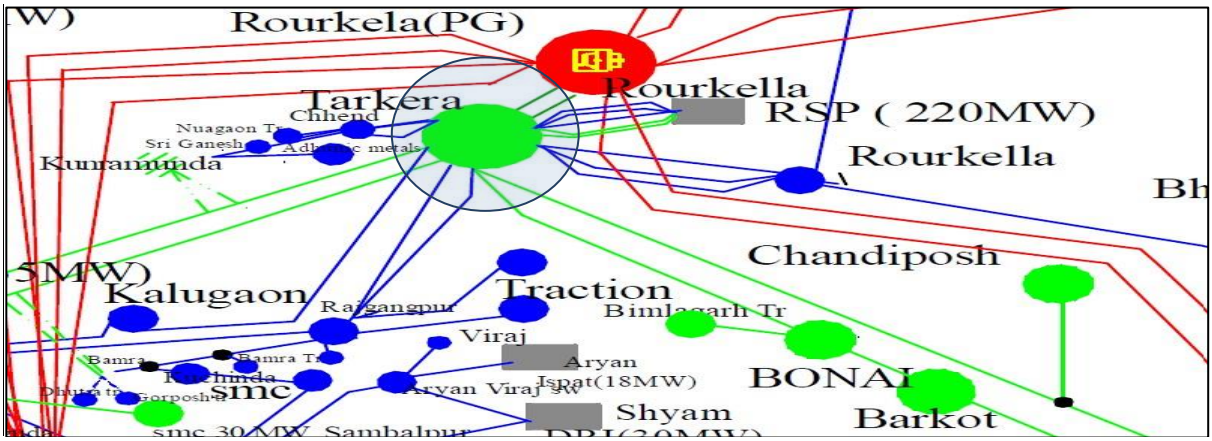


Figure 1: Network across the affected area

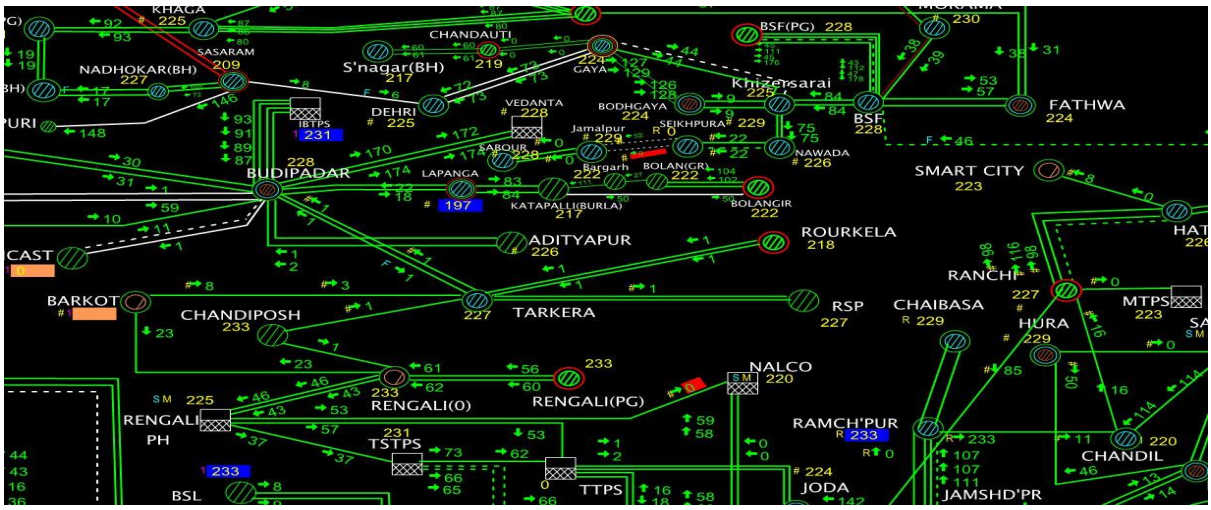


Figure 2: SCADA snapshot for of the system

Tripping and Restoration :

Transmission/Generation element name संचरण लाइन / विधुत उत्पादन इकाईं का नाम	Trip Date बंद होने की तिथि	Trip Time बंद होने का समय	Restoration Date वापस आने की तिथि	Restoration time वापस आने का समय
220kV Tarkera-Rourkela-1	21-12-2021	19:37	20:50	21-12-2021
220kV Tarkera-Rourkela-2	21-12-2021	19:37	20:58	21-12-2021
220kV Tarkera-RSP-1	21-12-2021	19:37	21:00	21-12-2021
220kV Tarkera-RSP-2	21-12-2021	19:37	20:46	21-12-2021
220kV Tarkera-RSP-3	21-12-2021	19:37	21:09	21-12-2021
220kV Tarkera-RSP-4	21-12-2021	19:37	21:09	21-12-2021
220KV Tarkera-Budhipadar-1	21-12-2021	19:37	20:40	21-12-2021
220KV Tarkera-Budhipadar-2	21-12-2021	19:37	20:43	21-12-2021
220kV Tarkera-Chandiposh-	21-12-2021	19:37	21:22	21-12-2021

Transmission/Generation element name संचरण लाइन / विधुत उत्पादन इकाईं का नाम	Trip Date बंद होने की तिथि	Trip Time बंद होने का समय	Restoration Date वापस आने की तिथि	Restoration time वापस आने का समय
Rengali				
220/100KV 100 MVA ICT-1	21-12-2021	19:37	20:41	21-12-2021
220/100KV 100 MVA ICT-2	21-12-2021	19:37	20:49	21-12-2021
220/100KV 100 MVA ICT-3	21-12-2021	19:37	21:01	21-12-2021

PMU observation (रिले संकेत और पीएमयू पर्यवेक्षण):

Only 1 kv dip in Y &B phase was observed ,which indicates the no such bus fault was there and tripping seems to be on spurious operation of Busbar.

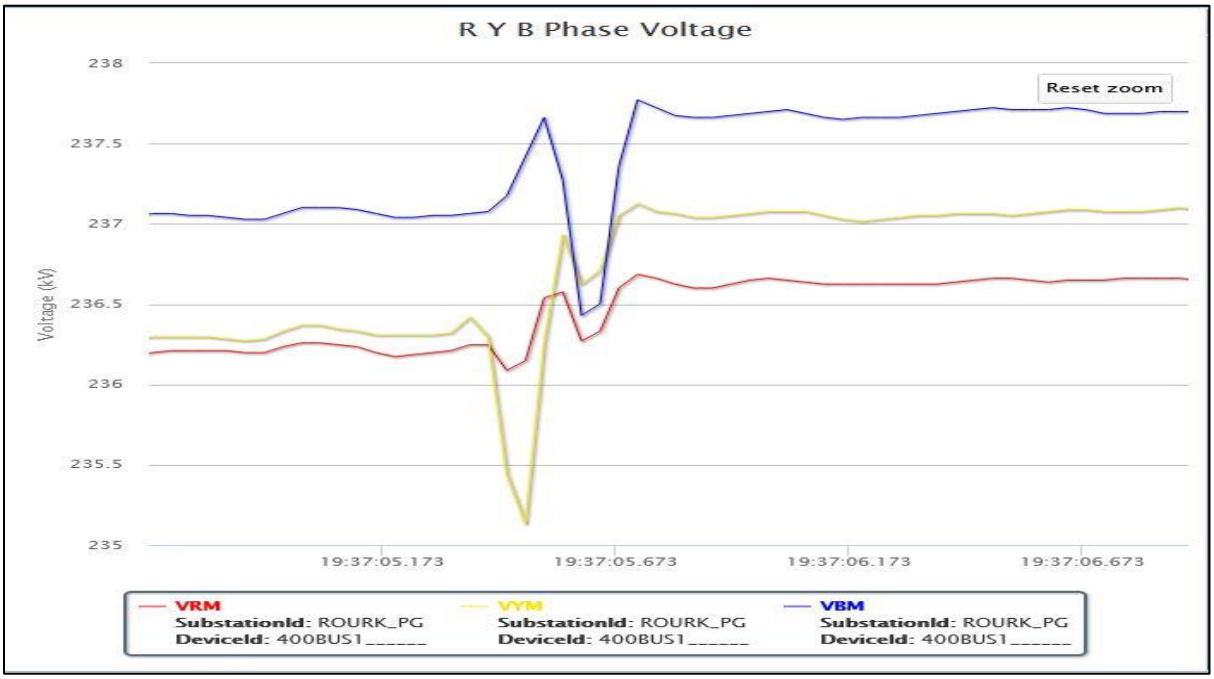


Figure 3: PMU snapshot of Rourkela Voltage

Analysis of the event (घटना का विश्लेषण):

- Busbar operated at Tarkera substation which led to tripping of all the lines emanating from Tarkera substation which led to load loss .
- In PMU Only 1 kv dip in Y &B phase was observed, which indicates that no such bus fault was there and tripping seems to be on spurious operation of Busbar.

Protection issue (सुरक्षा समस्या):

- It appears that there was no such BUS fault , but busbar operated , root cause analysis to be done for operation of busbar and remedial measures for the same to be shared .DR/EL not yet shared .**OPTCL to explain.**

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

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

Status of Reporting (रिपोर्टिंग की स्थिति):

- DR/EL yet to be received from OPTCL.

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

Sequence of event not recorded at time of event.

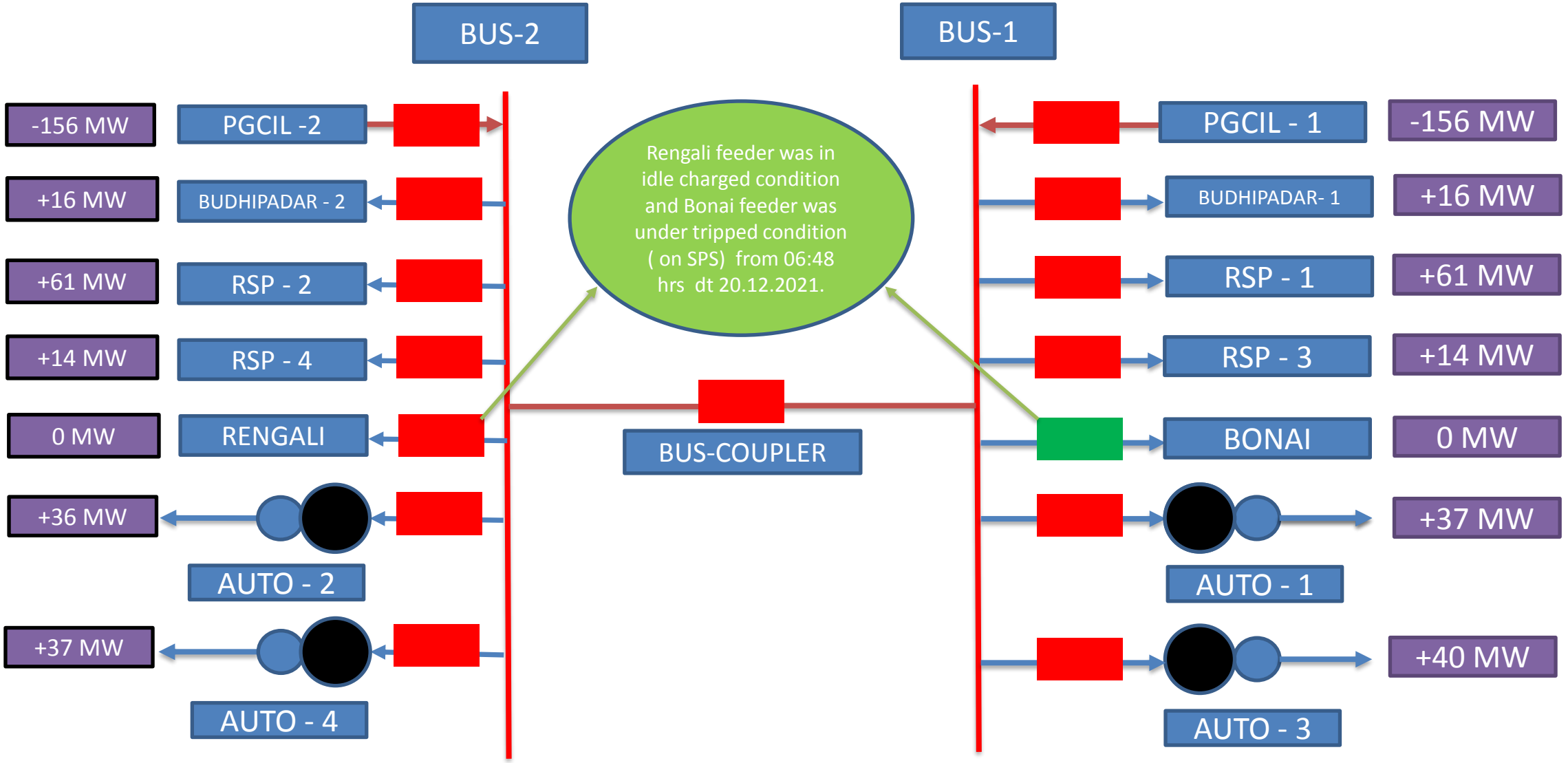
Annexure 2: DR recorded

Outage of 220KV system at Tarkera Grid S/s on dt 21.12.2021.

- Date 21.12.2021 ,Time- 19:38 Hrs.
- Station : 220/132 KV Tarkera GSS
- Weather : Clear
- 220kV Bus-1 and Bus-2 were in charged condition, 220kV Bus Coupler C.B was ON.
- Bus bar protection was in ON condition.

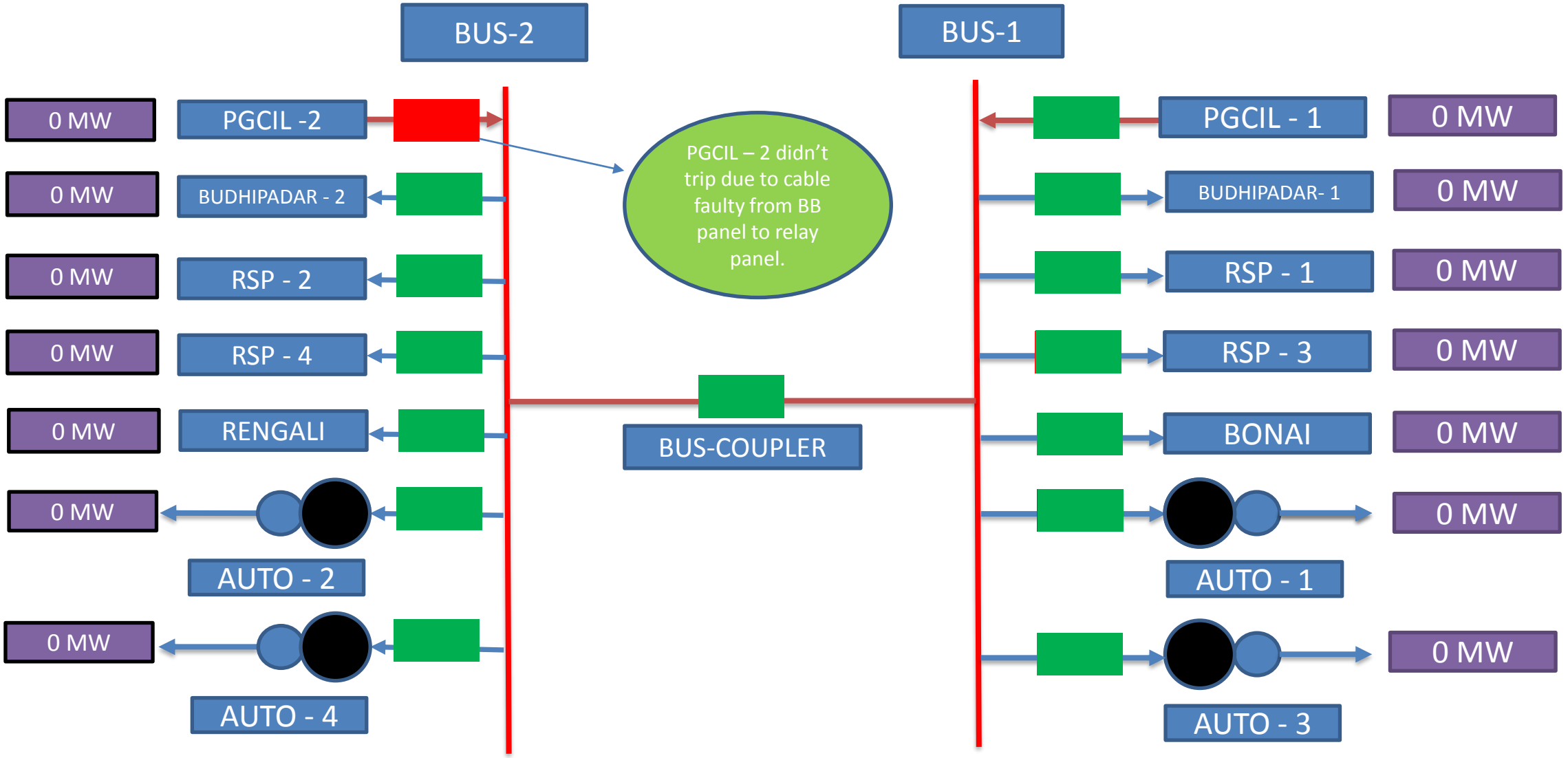
PRE-FAULT CONDITION

LOAD PATTERN OF DIFFERENT FEEDERS AT 19.00 HRS. DT. 21.12.2021



POST-FAULT CONDITION

OUTAGE OF 220KV SYSTEM AT 19:38 HR DATED :- 21.12.2021



Date & Time of Occurrence:21.12.2021 at 19:38 hrs

Sl.No.	Relay	Relay Indication
1	BUSBAR Protection Central unit SIEMENS SIPROTEC 7SS522	TRIP BUS ZONE 1- L2 TRIP BUS ZONE 2- L2 TRIP BUS ZONE 2- L3
2	All other Bay unit Relays in Busbar Protection Panel SIEMENS SIPROTEC 7SS523	Busbar protection: Trip in phase L123
3	Trip relay 96 for all bays in Busbar Protection Panel	Operated. Flag okay.
4	Trip relay 86 in individual relay panel of 220 kv bays	Operated. Flag okay Except 220kv Tarkera PGCIL-2 (due to control cable fault)

No Distance Protn. or Transformer Differential or O/C & E/F relay both at local end and remote end had operated.

Analysis:-

1. **Relay indication in Bus Bar protection panel shows Y phase fault in Bus Zone-1 and Y and B phase fault in Bus Zone-2. From physical inspection in switchyard, no conclusive evidence of Bus bar fault could be detected. However, oscillograph fault record reveals that there was huge variation in primary current magnitude and phase for all 220 KV bays in service.**
2. **Mentioned below are the major observations during fault(from oscillograph record)**

- **Surge in Y-phase current of both 220 KV Tarkera- PGCIL Ckt -1 and 2 compared to R and B phase.**
- **Dip in Y-phase current in both 220 KV Tarkera- RSP Ckt -1 and 2 compared to R and B phase.**
- **Surge in Y-phase current of both 220 KV Tarkera- Budhipadar Ckt -1 and 2 compared to R and B phase.**
- **All Auto Tfrs have also experienced significant unbalance of current in both magnitude and phase**

3. To ensure that the results were valid and not spurious, currents at 100 ms before fault instance were compared from oscillograph record. The currents were generally balanced in magnitude and phase and parallel ckts like PGCIL-1 & 2, Budhipadar 1 & 2, RSP 1 & 2 , Auto 1, 2, 3, 4 had same current. Even during fault parallel ckts had same current.

DIFFERENTIAL, RESTRAIN AND INDIVIDUAL BAY CURRENTS AT 100 ms PRIOR TO FAULT (secondary values)

Cursor 1: -100.0 ms

Measuring Signal	Fundamental / Sub-Harm.	Phase
CZ iD1_7SS522 V4.7 VAR	0.00001 I/Ino	
CZ iD2_7SS522 V4.7 VAR	0.00002 I/Ino	
CZ iD3_7SS522 V4.7 VAR	0.07018 I/Ino	
CZ kiS1_7SS522 V4.7 VAR	0.9035 I/Ino	
CZ kiS2_7SS522 V4.7 VAR	0.8947 I/Ino	
CZ kiS3_7SS522 V4.7 VAR	0.8421 I/Ino	
Z01 iD1_7SS522 V4.7 VAR	0.03509 I/Ino	
Z01 iD2_7SS522 V4.7 VAR	0.01755 I/Ino	
Z01 iD3_7SS522 V4.7 VAR	0.1053 I/Ino	
Z01 kiS1_7SS522 V4.7 VAR	1.2544 I/Ino	
Z01 kiS2_7SS522 V4.7 VAR	1.2895 I/Ino	
Z01 kiS3_7SS522 V4.7 VAR	1.1053 I/Ino	
Z02 iD1_7SS522 V4.7 VAR	0.05264 I/Ino	
Z02 iD2_7SS522 V4.7 VAR	0.02632 I/Ino	
Z02 iD3_7SS522 V4.7 VAR	0.1404 I/Ino	
Z02 kiS1_7SS522 V4.7 VAR	1.1228 I/Ino	
Z02 kiS2_7SS522 V4.7 VAR	1.1228 I/Ino	
Z02 kiS3_7SS522 V4.7 VAR	0.9912 I/Ino	

Cursor 1: -100.0 ms

Measuring Signal	Fundamental / Sub-Harm.	Phase
Current_RSP-1 iL1	260.17 mA	0.0°
Current_RSP-1 iL2	260.67 mA	-119.4°
Current_RSP-1 iL3	269.16 mA	120.0°
Current_RSP-1 3i0	6.9690 mA	-59.7°
Current_RSP-2 iL1	266.68 mA	-0.7°
Current_RSP-2 iL2	256.27 mA	-119.5°
Current_RSP-2 iL3	262.02 mA	119.2°
Current_RSP-2 3i0	11.753 mA	-156.3°
Current_PGCIL-1 iL1	0.6532 A	-152.9°
Current_PGCIL-1 iL2	0.6899 A	82.9°
Current_PGCIL-1 iL3	640.25 mA	-37.6°
Current_PGCIL-1 3i0	12.935 mA	172.2°
Current_PGCIL-2 iL1	0.6606 A	-153.8°
Current_PGCIL-2 iL2	0.6575 A	83.0°
Current_PGCIL-2 iL3	0.6278 A	-38.4°
Current_PGCIL-2 3i0	0.03521 A	61.2°
Current_BONAI iL1	0.00000 mA	-10.1°
Current_BONAI iL2	0.00000 A	88.6°
Current_BONAI iL3	0.00000 mA	-10.0°
Current_BONAI 3i0	0.6175 mA	160.6°
Current_RENGALI iL1	2.2121 mA	129.6°
Current_RENGALI iL2	2.3199 mA	-10.4°
Current_RENGALI iL3	1.2197 mA	-154.4°
Current_RENGALI 3i0	0.00000 mA	-10.0°
Current_BUDHIPADAR-2 iL1	89.920 mA	70.7°
Current_BUDHIPADAR-2 iL2	97.839 mA	-51.6°
Current_BUDHIPADAR-2 iL3	97.728 mA	-177.1°
Current_BUDHIPADAR-2 3i0	4.4632 mA	-26.2°
Current_BUDHIPADAR-1 iL1	90.375 mA	88.0°
Current_BUDHIPADAR-1 iL2	98.399 mA	-34.3°
Current_BUDHIPADAR-1 iL3	98.394 mA	-159.9°
Current_BUDHIPADAR-1 3i0	6.1619 mA	-6.6°

Cursor 1: -100.0 ms

Measuring Signal	Fundamental / Sub-Harm.	Phase
Current_AUTO-4 iL1	0.3239 A	-1.4°
Current_AUTO-4 iL2	0.3578 A	-132.1°
Current_AUTO-4 iL3	0.2985 A	111.2°
Current_AUTO-4 3i0	0.02240 A	-6.8°
Current_AUTO-3 iL1	323.52 mA	39.4°
Current_AUTO-3 iL2	323.58 mA	-94.3°
Current_AUTO-3 iL3	281.67 mA	152.4°
Current_AUTO-3 3i0	29.100 mA	-27.9°
Current_BUSCOUPLER-A iL1	34.036 mA	121.4°
Current_BUSCOUPLER-A iL2	15.428 mA	88.6°
Current_BUSCOUPLER-A iL3	26.093 mA	-115.5°
Current_BUSCOUPLER-A 3i0	32.127 mA	-37.9°
Current_BUSCOUPLER-B iL1	33.561 mA	-58.8°
Current_BUSCOUPLER-B iL2	14.933 mA	-92.7°
Current_BUSCOUPLER-B iL3	25.947 mA	65.3°
Current_BUSCOUPLER-B 3i0	33.163 mA	142.7°
Current_AUTO-2 iL1	325.90 mA	37.5°
Current_AUTO-2 iL2	343.21 mA	-75.7°
Current_AUTO-2 iL3	278.36 mA	151.7°
Current_AUTO-2 3i0	98.038 mA	-177.9°
Current_AUTO-1 iL1	322.00 mA	39.7°
Current_AUTO-1 iL2	319.88 mA	-94.3°
Current_AUTO-1 iL3	282.48 mA	152.7°
Current_AUTO-1 3i0	32.726 mA	-27.7°
Current_RSP-3_BAY14 iL1	0.00000 mA	-10.1°
Current_RSP-3_BAY14 iL2	0.00000 A	88.6°
Current_RSP-3_BAY14 iL3	0.00000 mA	-10.0°
Current_RSP-3_BAY14 3i0	0.6175 mA	160.6°
Current_RSP-4_BAY15 iL1	2.2121 mA	129.6°
Current_RSP-4_BAY15 iL2	2.3199 mA	-10.4°
Current_RSP-4_BAY15 iL3	1.2197 mA	-154.4°
Current_RSP-4_BAY15 3i0	0.00000 mA	-10.0°

DIFFERENTIAL, RESTRAIN AND INDIVIDUAL BAY CURRENTS DURING FAULT (secondary values)

Cursor 1: 0.0 ms

Measuring Signal	Fundamental / Sub-Harm.	Phase
CZ iD1_7SS522 V4.7 VAR	0.6140 I/Ino	
CZ iD2_7SS522 V4.7 VAR	2.4912 I/Ino	
CZ iD3_7SS522 V4.7 VAR	0.5439 I/Ino	
CZ kiS1_7SS522 V4.7 VAR	1.0175 I/Ino	
CZ kiS2_7SS522 V4.7 VAR	0.6754 I/Ino	
CZ kiS3_7SS522 V4.7 VAR	0.7281 I/Ino	
Z01 iD1_7SS522 V4.7 VAR	0.1930 I/Ino	
Z01 iD2_7SS522 V4.7 VAR	1.7544 I/Ino	
Z01 iD3_7SS522 V4.7 VAR	0.2193 I/Ino	
Z01 kiS1_7SS522 V4.7 VAR	1.4649 I/Ino	
Z01 kiS2_7SS522 V4.7 VAR	1.6404 I/Ino	
Z01 kiS3_7SS522 V4.7 VAR	1.1140 I/Ino	
Z02 iD1_7SS522 V4.7 VAR	0.3772 I/Ino	
Z02 iD2_7SS522 V4.7 VAR	1.5790 I/Ino	
Z02 iD3_7SS522 V4.7 VAR	0.3948 I/Ino	
Z02 kiS1_7SS522 V4.7 VAR	1.4035 I/Ino	
Z02 kiS2_7SS522 V4.7 VAR	1.5176 I/Ino	
Z02 kiS3_7SS522 V4.7 VAR	0.9912 I/Ino	

Cursor 1: 0.0 ms

Measuring Signal	Fundamental / Sub-Harm.	Phase
Current_RSP-1 iL1	300.46 mA	10.0°
Current_RSP-1 iL2	143.73 mA	-72.8°
Current_RSP-1 iL3	286.41 mA	108.8°
Current_RSP-1 3i0	305.73 mA	-142.7°
Current_RSP-2 iL1	303.60 mA	10.6°
Current_RSP-2 iL2	140.19 mA	-72.3°
Current_RSP-2 iL3	275.52 mA	107.1°
Current_RSP-2 3i0	317.94 mA	-144.6°
Current_PGCIL-1 iL1	0.7729 A	-157.2°
Current_PGCIL-1 iL2	1.0511 A	62.7°
Current_PGCIL-1 iL3	651.38 mA	-36.8°
Current_PGCIL-1 3i0	378.20 mA	-138.9°
Current_PGCIL-2 iL1	0.7853 A	-158.5°
Current_PGCIL-2 iL2	0.9895 A	63.0°
Current_PGCIL-2 iL3	0.6409 A	-39.1°
Current_PGCIL-2 3i0	0.2848 A	-137.0°
Current_BONAI iL1	0.00000 mA	-10.2°
Current_BONAI iL2	0.00000 A	88.6°
Current_BONAI iL3	0.00000 mA	-10.2°
Current_BONAI 3i0	0.6175 mA	-109.4°
Current_RENGALI iL1	1.2198 mA	115.6°
Current_RENGALI iL2	1.2202 mA	-10.4°
Current_RENGALI iL3	1.7920 mA	-127.4°
Current_RENGALI 3i0	0.6180 mA	-1.4°
Current_BUDHIPADAR-2 iL1	90.266 mA	114.9°
Current_BUDHIPADAR-2 iL2	209.33 mA	-5.5°
Current_BUDHIPADAR-2 iL3	128.20 mA	-164.9°
Current_BUDHIPADAR-2 3i0	57.293 mA	-141.5°
Current_BUDHIPADAR-1 iL1	93.782 mA	134.5°
Current_BUDHIPADAR-1 iL2	213.76 mA	11.7°
Current_BUDHIPADAR-1 iL3	128.67 mA	-147.2°
Current_BUDHIPADAR-1 3i0	58.685 mA	-124.9°

Cursor 1: 0.0 ms

Measuring Signal	Fundamental / Sub-Harm.	Phase
Current_AUTO-4 iL1	0.3780 A	4.1°
Current_AUTO-4 iL2	0.2352 A	-113.2°
Current_AUTO-4 iL3	0.2994 A	98.2°
Current_AUTO-4 3i0	0.2637 A	-155.7°
Current_AUTO-3 iL1	389.02 mA	41.4°
Current_AUTO-3 iL2	246.53 mA	-65.3°
Current_AUTO-3 iL3	252.51 mA	137.9°
Current_AUTO-3 3i0	287.72 mA	-134.9°
Current_BUSCOUPLER-A iL1	13.783 mA	97.0°
Current_BUSCOUPLER-A iL2	36.106 mA	71.4°
Current_BUSCOUPLER-A iL3	17.662 mA	-145.9°
Current_BUSCOUPLER-A 3i0	37.070 mA	-83.5°
Current_BUSCOUPLER-B iL1	13.973 mA	-82.4°
Current_BUSCOUPLER-B iL2	35.924 mA	-110.0°
Current_BUSCOUPLER-B iL3	17.832 mA	34.6°
Current_BUSCOUPLER-B 3i0	38.702 mA	97.0°
Current_AUTO-2 iL1	376.59 mA	39.5°
Current_AUTO-2 iL2	312.73 mA	-51.2°
Current_AUTO-2 iL3	250.85 mA	140.1°
Current_AUTO-2 3i0	333.71 mA	-151.3°
Current_AUTO-1 iL1	386.59 mA	41.1°
Current_AUTO-1 iL2	247.58 mA	-65.2°
Current_AUTO-1 iL3	249.04 mA	138.3°
Current_AUTO-1 3i0	285.19 mA	-136.5°
Current_RSP-3_BAY14 iL1	0.00000 mA	-10.2°
Current_RSP-3_BAY14 iL2	0.00000 A	88.6°
Current_RSP-3_BAY14 iL3	0.00000 mA	-10.2°
Current_RSP-3_BAY14 3i0	0.6175 mA	-109.4°
Current_RSP-4_BAY15 iL1	1.2198 mA	115.6°
Current_RSP-4_BAY15 iL2	1.2202 mA	-10.4°
Current_RSP-4_BAY15 iL3	1.7920 mA	-127.4°
Current_RSP-4_BAY15 3i0	0.6180 mA	-1.4°

REMEDIAL MEASURES:

1. **Event log, Trip log, Oscillographic record and settings file of SIEMENS 7SS522 Busbar protection relay have been mailed to SIEMENS representative for further analysis and necessary action.**
2. **Fault in Cable from Bus bar panel to PGCIL-2 Relay panel was rectified.**

PROTECTION AUDIT REPORT

General information

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

Audit Team

Name	Company name

Regional representatives:

Name	Company name

Attached documents:

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

CONCLUSIONS OF PROTECTION AUDIT REPORT

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

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

Appendix-9.4

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

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

(put √ mark in the appropriate box)

A. Transmission Lines (OHL and Cables)

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

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

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

B. Power Transformers

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

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

C. Shunt Reactors

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

D. Bus bars

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

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

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

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

F. Circuit Breakers

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

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

G. Communication systems

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

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

H. Station DC supply systems

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

I. PERFORMANCE INDICES

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

J. ADDITIONAL CHECKS FOR SERIES COMPENSATED LINES

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

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

Annexure B.6

List of important transmission lines in ER which tripped in December-2021

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/EL RECEIVED FROM LOCAL END	DR/EL RECEIVED FROM REMOTE END	Utility Remarks
1	220 KV JAMSHEDPUR (DVC)-JINDAL-1	04-12-2021	21:28	04-12-2021	21:54	Jamshedpur: R_N, 24.2 km, 3 kA	JSPL: R_N, Zone-2, 124 km, 1.18 kA	R-Earth	350	Tripped in z-2 time from JSPL seems carrier based protection not operated properly.	NO	NO	Carrier protection not available in line
2	400 KV JEERAT-BAKRESWAR-1	05-12-2021	23:57	06-12-2021	18:29	Jeerat: R_N, Zone-1, 0.47 km, 23 kA	Bakreswar: R_N, Zone-2, 147 km	R-Earth	100	No a/r OBSERVED REASON MAY BE EXPALINED.	YES	YES	Problem in main bay. While transferring to TBC, fault occurred. A/r was blocked while transferring to TBC
3	220 KV MUZAFFARPUR-HAZIPUR-2	09-12-2021	16:14	09-12-2021	17:14	Didn't trip	Hazipur: B_N, 1.8 kA	B-Earth	100	Should not trip	NO	NO	BackUp O/c operated at Hazipur, Settings modified

4	220 KV DARBHANGA (DMTCL)-MOTIPUR-1	25-12-2021	18:34	26-12-2021	12:45		Motipur: R_Y, 31.83 km, Ir: 6.401 kA, Iy: 4.691 kA	R-Earth	100	R_ph Jumper snapped at loc. 278,No A/R operated and tripped on PD oiperation after 2 second	YES	YES	A/r didn't occur at DMTCL as PLCC was unhealthy
5	400 KV NEW RANCHI-NEW PPSP-2	28-12-2021	11:07	28-12-2021	11:36	New Ranchi: Didn't trip	New PPSP: DT received	NO FAULT	NA		NO	NO	Main bay BCU at New Ranchi was faulty, therefore main bay CB status was not not available. Patratu-2 is in its dia, which was going under shutdown. As it's tie bay was opened, DT sent to New PPSP. Logic changed.

ANNEXURE-C.2

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

107th PCC Meeting			
4.	Repeated Tripping of 220 kV Joda- Ramchandrapur	In 108th PCC Meeting, JUSNL informed that line patrolling was carried out for however no vegetation or clearance issues were found in the line. Regarding PLCC, they updated that issue had been communicated to OEM but they were facing difficulty in getting the availability of service engineers at site. In 109th PCC Meeting, JUSNL informed that they are in process of placing fresh tender for implementation of PLCC as well as bus bar protection and it is expected that implementation of both would be completed by April 2022.	
108th PCC Meeting			
5.	Total Power Failure at 220 kV Ronginchu HEP on 20.10.2021 at 12:42 Hrs	PCC advised Rongnichu HEP to review the overcurrent relay settings at their end. It was suggested to review the directional feature and definite time settings of the O/C relay.	*Rongnichu vide email dated 22.01.2022 confirmed that the settings had been revised as suggested by PCC.*

Annexure C.3

ISTS				
Name of the element	Length (km)	Main	BackUp	Remarks
400 kV Durgapur-Bidhannagar D/c	11	Distance	Distance	Differential will be installed. Order placed
400 kV Rangpo-Teesta V-D/c	11.6			
400 kV Teesta-III- Dikchu	15.1			
400 kV Gaya-Chandauti D/c	**17.73**	Differential	Differential	
220 kV Subhashgram-Subhashgram (WB) D/c	**0.6**	Differential	Distance	Diff. Rly(P545) already installed by M/S GE except communication.
220 kV Dalkhola-Dalkhola (WB)-D/c	1.1	Differential	Differential	
220 kV Alipurduar-Alipurduar (WB) D/c	6.34	Distance	Distance	Differential will be installed. Order placed
220 kV Rajarhat-NewTown D/c	**7.2**	Distance	Distance	To be finalizaed after discussion with PGCIL
220 kV Binaguri-Siliguri D/c	9			
220 kV Rourkela-Tarkera D/c	15.3			
Odisha				
Name of the element	Length (km)			
400 kV Indravati-Indravati (Gridco)	3.7			
400 kV Meramundali GMR T/c	8			
400 kV New Duburi-TSL D/c	8.65			
220 kV Chandka-Chandka B	1			
220 kV Rengali-Rengali D/c	1			
220 kV Balimela-Balimela T	1.38			
220 kV Meramundali-BSL D/c	2.4			
220 kV Bolangir-New Bolangir D/c	2.8			
220 kV Tarkera-RSP D/c	4.07			
220 kV Sterlite-Vedanta D/c	4.15			
220 kV New Duburi-Jindal Steel D/c	4.8			
220 kV Rengali-Rengali PH D/c	5			
220 kV Mendhasal-Infocity	5.5			
220 kV Katapalli-Hindalco D/c	5.5			Line differential protection scheme was implemented in 220 kV Katapalli-Hindalco circuit-1 on 31/12/2021.
220 kV Jaynagar-Upper Kolab D/c	6			
220 kV Mendhasal-Chandaka D/c	7			
220 kV Keonjhar-Keonjhar D/c	7.48			
220 kV Jeypore-Jaynagar D/c	7.7			
220 kV New Duburi-TSL D/c	8.65			
220 kV Jeypore-Jaynagar D/c	8.8			

220 kV Tarkera-RSP D/c	10.2			
220 kV Bidansi-Cuttack D/c	10.42			
220 kV Jaypatna-Indravati	11.13			
220 kV Meramundali-TTPS D/c	11.2			
220 kV Meramundali-NALCO D/c	11.5			
220 kV Joda-Jindal	14.6			
220 kV Mendhasal-Atri	15			
220 kV TSTPP-Rengali PH	16.78			
West Bengal				
Name of the element	Length (km)			
400 kV PPSP-New PPSP D/c	2	Differential	Differential	
220 kV Kasba-Eastern Metropolitan	**0.7**	Differential	Differential	
220 kV New Haldia-IPCHL D/c	3.6	Differential	Differential	
220 kV Bidhannagar-DPL D/c	8	Distance	Distance	The Line will be reconfigured to upcoming 220KV DPL-AB Zone S/S. Diff. Rly will be installed after reconfiguration.
220 kV Bakreswar-Sadaipur D/c	**4.6**	Distance	Distance	Differential will be installed.
220 kV Eastern Metropolitan-Princep Street	8.2			
220 kV Domjur-New Chanditala D/c	**8.6**	Distance	Distance	Differential will be installed.
220 kV New Cossipore-Princep Street	8.8			
220 kV NewTown-CLC Bantala	13			
220 kV Sagardighi-New Sagardighi D/c	14.38			
220 kV Subhashgram-CLC Bantala	15			
220 kV Domjur-Foundry Park D/c	15			
220 kV New Cossipore-Eastern Metropolitan	16.2			
220 kV Jeerat-Dharampur D/c	17			
Bihar				
Name of the element	Length (km)			
220 kV Patna-Sipara-3	**0.55**	Differential	Differential	
220 kV Patna-Sipara-D/c	**0.55**	Differential	Differential	
220 kV Purnea-New Purnea D/c	**1.087**	Differential	NA	
220 kV Darbhanga-Darbhanga (DMTCL) D/c	2.9			Communication had been given to DMTCL and OEM for implementing line differential protection scheme in 220 kV Darbhanga-Darbhanga (DMTCL) D/c
220 kV Kishanganj-Kishanganj Q/c	4.4	Distance	Distance	
220 kV Pusauli-New Sasaram (Nadokhar) D/c	**6.25**	Distance	Distance	
220 kV Gaya-BodhGaya D/c	**17.5**	Distance	Distance	
220 kV Barauni (BTPS)-Mokama D/c	11.65			

220 kV Barauni (BTPS)-Begusarai D/c	15			
220 kV Muzaffarpur-MTPS D/c	**24**	Distance	Distance	
220 kV Gaya-Chandauti D/c	**17.73**			To be LILOED at BodhGaya
DVC				
Name of the element	Length (km)			
220 kV Durgapur-Parulia (DVC) D/c	1	Differential	Differential	
220 kV Burnpur-IISCO D/c	1.2	Differential	Differential	
220 kV Chandrapura-Chandrapura-1	1.5	Differential (Distance as BackUp in same relay)	Differential (Distance as BackUp in same relay)	
220 kV Chandrapura-Chandrapura-2	3.5	Differential (Distance as BackUp in same relay)	Differential (Distance as BackUp in same relay)	
220 kV Parulia (DVC)-Tamla DSP T/c	**15.5**	Distance	Distance	
220 kV Maithon-Kalyaneshwari D/c	7.6	Distance	Distance	
220 kV Chandrapura-BSL	**18**	Distance	Distance	
220 kV Chandrapura-MSMDBSL	10	Differential	Distance	
220 kV Waria-DSTPS D/c	11.14	Distance	Distance	
220 kV Parulia (DVC)-Muchipara D/c	14.75	Distance	Distance	
220 kV Mejia-Barjora D/c	16.7	Distance	Distance	
220 kV Waria-Bidhannagar D/c	17.2	Distance	Distance	
220 kV Parulia (DVC)-DSTPS D/c	17.34	Distance	Distance	
Jharkhand				
Name of the element	Length (km)			
220 kV Chaibasa-Chaibasa (JUSNL) D/c	0.7	Differential	Distance	
220 kV Ranchi-Hatia	6	Distance	Distance	
IPP				
Name of the element	Length (km)			
400 kV Adhunik (APNRL)-Jamshedpur D/c	0.3	Differential	Differential	
400 kV Sterlite-Lapanga D/c	18.64			
220 kV Rangpo-Rongnichu D/c	7.26			