सत्यमेव जयते

भारत सरकार Government of India
विद्युत मंत्रालय Ministry of Power
उत्तर पूर्वी क्षेत्रीय विद्युत समिति
North Eastern Regional Power Committee
एन ई आर पी सी कॉम्प्लेक्स, डोंग पारमाओ, लापालाङ, शिल्लोंग-७९३००६, मेघालय
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No. NERPC/SE (O)/PCC/2023/2986-3027 December 11, 2023

To
As per list attached

Sub: Minutes of 61st Protection Coordination Sub-Committee (PCC) Meeting.

Sir/Madam,

Please find enclosed herewith the minutes of the 61st PCC Meeting held at "Hotel Royale de' Casa", Guwahati on 20th November, 2023 for your kind information and necessary action. The minutes is also available on the website of NERPC: www.nerpc.gov.in.

Any comments/observations may kindly be communicated to NERPC Secretariat at the earliest.

भवदीय / Yours faithfully,

(शैशव रंजन / Shaishav Ranjan)
उपनिदेशक / Deputy Director

Encl: As above

Distribution List:

1. Managing Director, AEGCL, Bijuli Bhawan, Guwahati – 781 001
2. Managing Director, APGCL, Bijuli Bhawan, Guwahati – 781 001
3. Managing Director, APDCL, Bijuli Bhawan, Guwahati – 781 001
4. Managing Director, MSPCL, Electricity Complex, Keishampat, Imphal – 795 001
5. Managing Director, MSPDCL, Secure Office Bldg. Complex, South Block, Imphal – 795 001
6. Director (Transmission), MePTCL, Lumjingshai, Short Round Road, Shillong – 793 001
7. Director (Generation), MePGCL, Lumjingshai, Short Round Road, Shillong – 793 001
8. Director (Distribution), MePDCL, Lumjingshai, Short Round Road, Shillong – 793 001
9. Director (Tech.), TSECL, Banamalipur, Agartala -799 001.
10. Director (Generation), TPGCL, Banamalipur, Agartala -799 001.
11. GM (Transmission), TPTL, Banamalipur, Agartala -799 001.
12. Chief Engineer (WE Zone), Department of Power, Govt. of Arunachal Pradesh, Itanagar- 791111
13. Chief Engineer (TP&MZ), Department of Power, Govt. of Arunachal Pradesh, Itanagar- 791111
14. Chief Engineer (Commercial) -cum- CEI, DoP, Govt. of Arunachal Pradesh, Itanagar- 791111
15. Engineer-in-Chief, P&E Department, Govt. of Mizoram, Aizawl – 796 001
16. Engineer-in-Chief, Department of Power, Govt. of Nagaland, Kohima – 797 001
17. ED (O&M), NEEPCO Ltd., Brookland Compound, Lower New Colony, Shillong-793003
18. ED (O&M), NHPC, NHPC Office Complex, Sector-33, Faridabad, Haryana-121003
19. Group GM, NTPC, Bongaigoan Thermal Power Project, P.O. Salakati, Kokrajhar- 783369
20. Vice President (Plant), OTPC, Badarghat Complex, Agartala, Tripura - 799014
21. ED, PGCIL/NERTS, Dongtieh-Lower Nongrah, Lapalang, Shillong -793 006
22. AGM (BD), NVVN, Core 5, 3rd floor, Scope Complex, 7 Institutional Area, Lodhi Rd., N. Delhi-3
23. Vice President, PTCIL, 2nd Floor, NBCC Tower, 15, Bhikaji Cama Place, New Delhi – 110066
24. Dy. COO, CTUIL, "Saudamini", 1st Floor, Plot No. 2, Sector-29, Gurugram, Haryana – 122001
25. Chief Engineer, GM Division, Central Electricity Authority, New Delhi – 110066
26. Chief Engineer, NPC Division, Central Electricity Authority, New Delhi – 110066
27. Head & VP, (R&C), ENICL, IndiGrid, Windsor Building, Kalina, Santacruz (East), Mumbai- 98
28. ED, NERLDC, Dongtieh, Lower Nongrah, Lapalang, Shillong -793 006
29. CGM, AEGCL, Bijuli Bhawan, Guwahati – 781001
30. CGM, APGCL, Bijuli Bhawan, Guwahati – 781001
31. CGM, DISCOM, Bijuli Bhawan, Guwahati – 781001
32. Head of SLDC, Dept. of Power, Govt. of Arunachal Pradesh, Itanagar – 791111
33. CGM, (LDC), SLDC Complex, AEGCL, Kahilipara, Guwahati-781 019
34. Head of SLDC, MSPCL, Imphal – 795001
35. Head of SLDC, MePTCL, Lumjingshai, Short Round Road, Shillong – 793 001
36. Head of SLDC, P&E Deptt. Govt. of Mizoram, Aizawl – 796 001
37. Head of SLDC, Dept. of Power, Govt. of Nagaland, Dimapur – 797103
38. Head of SLDC, TSECL, Agartala – 799001
39. Chief Engineer (Elect), Loktak HEP, Vidyut Vihar, Kom Keirap, Manipur- 795124
40. DGM (O&M), OTPC, Badarghat Complex, Agartala, Tripura – 799014
41. Head, Transmission, KMTL, 7th Floor, Fulcrum, Sahar Road, Andheri (E), Mumbai-400099
42. Director, NETC, 2C, 3rdFloor, D21Corporate Park, DMRC Building Sector 21, Dwarka, Delhi-77.

Shaishav

(शैशव रंजन / Shaishav Ranjan)
उपनिदेशक / Deputy Director

North Eastern Regional Power Committee

Minutes of

61st Protection Coordination Sub-Committee Meeting

Date: 20/11/2023 (Monday)

Time: 12:00 hrs

Venue: Hotel Royale de' Casa, Guwahati

Member Secretary NERPC welcomed all the participants. He informed the forum that as per IEGC 2023 regulation, Power system analysis group (for analysis of important grid events and recommendation thereof) has been formed in NER region. He intimated the forum that Central Electricity Authority (CEA) is planning to organize a workshop in our region to sensitize the power utilities about the various regulation, guidelines and safety standards of CEA. He requested the constituents to effectively participate in the workshop.

He then requested Director NERPC to take up the agenda items

C O N F I R M A T I O N O F M I N U T E S

1. CONFIRMATION OF MINUTES OF THE 60th PROTECTION SUB-COMMITTEE MEETING OF NERPC.

Minutes of the 60th PCC Meeting held on 31st October, 2023 (Tuesday) at NERPC Conference Hall, Shillong was circulated vide no. No.: NERPC/SE (O)/PCC/2023/2599-2640 dated 9th November, 2023.

No comment(s)/observation(s) were received from the constituents.

The Sub-committee confirmed the minutes of 60th PCCM of NERPC

B. ITEMS FOR DISCUSSION

B.1 Protection Audit of NER:

As per the protection code of IEGC 2023 following roles and responsibilities, related to the subject mentioned, of constituents have been defined–

Description		Constituent	Responsibility	Timeline
Audit	Internal Audit	All users (132kV and above)	Shall conduct internal audit of protection system	Annually
			Audit report to be shared with RPC	Within 30 days of Audit
			Action plan for rectification of deficiencies to be shared with RPC	Within 30 days of Audit
	Third party Audit	All users (132kV and above)	Shall conduct audit for each SS	Once in five years
			Shall conduct audit on advice of RPC	Within three months of advice of RPC
			Audit report* to be submitted to RPC and NERLDC/SLDC	Within a month of submission of third-party audit report
			Action plan for rectification of deficiencies	Same as above
		RPC	Compliance to audit reports to be followed up regularly	Not specified
		RPC	After analysis of any event, shall identify substations where audit is required to be carried out	Conditional responsibility
	Annual audit plan	All users	Annual audit plan to be submitted to RPC by ***31st October***	Annual

In 60th PCCM the following points were discussed-

Member Secretary NERPC informed that third party protection audit has to be generally conducted by the utilities on their own. However, the 3rd party audit will be carried out by team constituted by NERPC at selected substations based on the criticality, analysis and requirement. In this regard, NERPC has already circulated an audit calendar and audit formats for reference of the constituents.

The audit formats will be circulated to the nodal officers 2 weeks prior to the date of audit and the nodal officers of respective State/power utilities have to fill the format and submit to the NERPC secretariat within 1 week.

Audit of Kohima, Wokha, Sanis, Chepouzou, Mokokchung and Dimapur Substations of Nagaland will tentatively be scheduled from date 20th – 24th Nov'23. Audit of Sonabil, Agia, Sarusajai, Samaguri & BTPS Substations of Assam will be tentatively from dates 15th – 20th Dec, 2023.

The forum decided that compliance to audit reports will be followed up regularly in PCC meeting of NERPC. NERLDC to submit a list of all 132 kV and above substations of the States to NERPC.

Information regarding substations that have already been audited will be provided by states to NERPC & NERLDC.
Forum agreed that all users (132 kV and above) have to conduct Internal Audit annually and submit audit report to RPC with action plan for rectification of deficiencies within 30 days of Audit.

AEGCL requested for a uniform guideline for maintenance of bay elements. Member Secretary requested POWERGRID to share their maintenance guideline with the states so that Assam and other utilities may adopt it after customizing to suit local requirement.

POWERGRID will make a ppt presentation in the meeting on their maintenance procedure/guidelines for benefit of all members.

Status of compliance of IEGC 2023 –

i)No Generating station, Transmission utility, STU, bulk consumer, etc. has submitted Annual audit plan for FY 2024-25 to NERPC. As discussed in 60th PCCM, Annual Audit Plan in respect of FY 2024-25 is to be submitted by 15th November 2023. For the upcoming years onwards, audit plan is to be submitted by 31st October.

Deliberation of the sub-committee

1. Forum noted that M/s Indigrid and M/s Sterlite have already sent the protection audit for FY 2024-25. Further the forum requested other utilities (generating units, ISTS and STUs) to furnish the audit plan to NERPC at the earliest.
2. Protection audit plan for next year to be submitted within 30th Nov, 2023.

3. NERPC stated that the protection audit of Nagaland stands postponed to January'23 due to unavoidable reasons.
4. NERPC further stated that audit of substations of Assam (Sarusajai, Kahilipara, BTPS) will tentatively be carried out on 18-20 December 2023
5. Powergrid made a ppt presentation on the maintenance procedure for bay elements (**annexure B.1**)
6. Regarding nominations for the audit team, NERPC requested all the utilities to nominate persons for the audit and intimate NERPC through email.

Sub-committee noted as above

B.2 Submission of Protection performance indices by utilities

As per the protection code of IEGC 2023 following roles and responsibilities, related to the subject mentioned, of constituents have been defined–

Description		Constituent	Responsibility	Timeline
Performance indices **	1.Dependibility index (D) 2.Security index (S) 3.Reliability index (R	All users (132kV and above)	Shall submit the indices for previous month to RPC and RLDC	Monthly (by 10th of Next month)
		All users	Shall submit he reason for indices less than unity (element wise) and action plan for corrective measures	Not specified
		RPC	Action plan to be regularly followed up in RPC	

**definition of indices

(a) The Dependability Index defined as $D = \frac{Nc}{Nc+Nf}$

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 $S = \frac{Nc}{Nc+Nu}$

Where,

N_c is the number of correct operations at internal power system faults

N_u is the number of unwanted operations.

(c) The Reliability Index defined as $R = \frac{Nc}{Nc+Ni}$

Where,

N_c is the number of correct operations at internal power system faults

N_i is the number of incorrect operations and is the sum of N_f and N_u

In 60th PCCM it was decided that all users have to submit Performance indices (Dependability-D, Security-S, Reliability-R) to NERPC & NERLDC by 10th of every month for previous month indices. Users also have to submit reason for indices being less than unity and corrective action plan. Action plan will be regularly followed up in PCCM.

Status of compliance of IEGC 2023 –

i)No User has yet submitted the report on performance indices.

Deliberation of the sub-committee

Regarding submission of the report on performance indices, ISTS, ISGS and state utilities assured that they will start sending the report December'23 onwards. NERLDC presented the report prepared for ISTS element for the month of Sept'23.

Member secretary NEERPC stated that if clarification is required on any index, utilities may communicate with NERLDC and NERPC

Sub-committee noted as above

B.3 Protection protocol and protection philosophy of NER

In compliance with clause 12(2) and clause 13 of IEGC 2023, NERPC has prepared draft protection protocol for NER. The same was circulated to the constituents in 60th PCCM and all utilities were requested to provide comments within fifteen days. Comments were received form NERLDC only. The comments were incorporated in the protocol and the finalized Protection protocol is hereby attached as **Annexures B.3** and put up for deliberation of the sub-committee.

Deliberation of the sub-committee

Arunachal Pradesh and NERTS raised some queries on B/U OC time settings. They requested the forum to coordinate Overcurrent pickup with ZIII instead of ZII settings. However, forum agreed to do this on case-to-case basis. NERPC requested them to send the comments through email by 30th Nov, 2023.

Also, NERPC requested the member to submit the relay setting 15 days prior to the proposed date of commissioning (FTC).

Member secretary stated that all the comments will be deliberated and suitably included in the protocol and the final document will be put up in 25th TCC meeting for final endorsement.

Sub-committee noted as above

B.4 Analysis and Discussion on Grid Disturbances which occurred in NER grid in compliance with IEGC 2023:

TABLE 8 : REPORT SUBMISSION TIMELINE

Sr. No.	Grid Event^ (Classification)	Flash report submission deadline (users/ SLDC)	Disturbance record and station event log submission deadline (users/ SLDC)	Detailed report and data submission deadline (users/ SLDC)	Draft report submission deadline (RLDC/ NLDC)	Discussion in protection committee meeting and final report submission deadline (RPC)
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

^*The classification of Grid Disturbance (GD)/Grid Incident (GI) shall be as per the* CEA Grid Standards.

Based on the submission of draft reports on GD/GI by NERLDC/NLDC following events are put up for deliberation –

(**List of Events at Annexure-B.4**)

Deliberation of the sub-committee

1. DoP, AP informed the tripping occurred on 16-10-23 due to lightning. As a precautionary measure TFR measurement already carried out. ZI, 1-phase AR implemented in the line.
2. Installation of TLSA in lightning prone areas will be done by this FY.
3. Forum requested to implementation of 3-phase autoreclosure as the same practice is following in other lines.
4. Member secretary opined that a special sub-group meeting (VC) can be organized by NERPC one week prior to every PCC meeting to discuss the GD/GI/Near Miss events on the basis of draft report prepared by NERLDC and a final report will be prepared by NERPC and presented in PCC meeting.

Sub-committee noted as above

Agenda items from NERLDC

B.5 Status of submission of FIR and DR & EL outputs for the Grid Events for the month of October'2023

In line with regulation 12 (1) of CEA Grid Standards Regulations and IEGC-23 provision under clause 37.2 (c), FIR and DR & EL Outputs for each grid events are required to be submitted by concerned utilities to NERLDC for detailed investigation and analysis.

Status of uploading of FIR, DR & EL outputs in Tripping Monitoring Portal for events from 01-10-2023 to 31-10-2023 is given below:

Name of Utility	Total FIR/ DR/EL	Total FIR, DR & EL submitted			Total FIR, DR & EL not submitted			% Submission of		
		FIR	DR	EL	FIR	DR	EL	FIR	DR	EL
DoP, Arunachal Pradesh	8	6	5	5	2	2	3	75	71	63
AEGCL	45	21	27	25	24	12	12	47	69	69
APGCL	2	0	0	0	2	2	2	0	0	0
MSPCL	18	15	0	1	3	15	15	83	6	6
MePTCL	3	3	3	3	0	0	0	100	100	100
MePGCL	4	0	0	0	4	0	2	0	100	0
P&ED, Mizoram	1	0	0	0	1	0	0	0	100	100
DoP, Nagaland	7	7	3	3	0	1	1	100	86	86
TSECL	8	5	5	5	3	3	3	63	63	63
POWERGRID	24	21	18	19	3	1	1	88	100	95
NEEPCO	4	3	3	3	1	1	1	75	75	75
NHPC	1	0	0	0	1	1	1	0	0	0
IndiGrid	6	6	6	6	0	0	0	100	100	100

Concerned Utilities are requested to upload Disturbance Recorder (DR), Event Logger (EL) outputs for grid events along with a First Information Report (FIR) in Tripping Monitoring Portal (https://tripping.nerldc.in/Default.aspx) for analysis purpose. In light of the cybersecurity measures implemented by Grid India to safeguard sensitive information, NERLDC has created the email address nerldcso3@gmail.com . This new account has been specifically set up to facilitate the secure exchange of DR and EL files that have previously faced blockage when sent to nerldcprotection@grid-india.in.

In 60th PCCM, Arunachal Pradesh stated that at some locations due to non-availability of Numerical Relays, DR/EL data could not be furnished. The forum requested DoP Arunachal Pradesh to replace the Electromechanical Relay with Numerical Relay in line with the CEA regulations. The forum suggested DOP, Arunachal Pradesh to regularly check the lines for vegetation infringement clearance.

Manipur intimated that DR/EL could not be uploaded due to continuous internet shutdown in the state due to prevailing law and order situation. Manipur further informed that whitelisting of Substation for internet connectivity already submitted to higher management.

MePTCL stated that issue related to Siemens make relays have now been resolved and DR/EL is now downloadable.

The forum asked all the utilities to submit a list of substations where numerical relay is not available and expedite the implementation of the same as stipulated under IEGC Regulation 2023.

Member Secretary stated that each entity should send the DR, EL, FIR in standard format. He also opined that State can take help of PSDF funding to replace all the mechanical relay with Numerical relay.

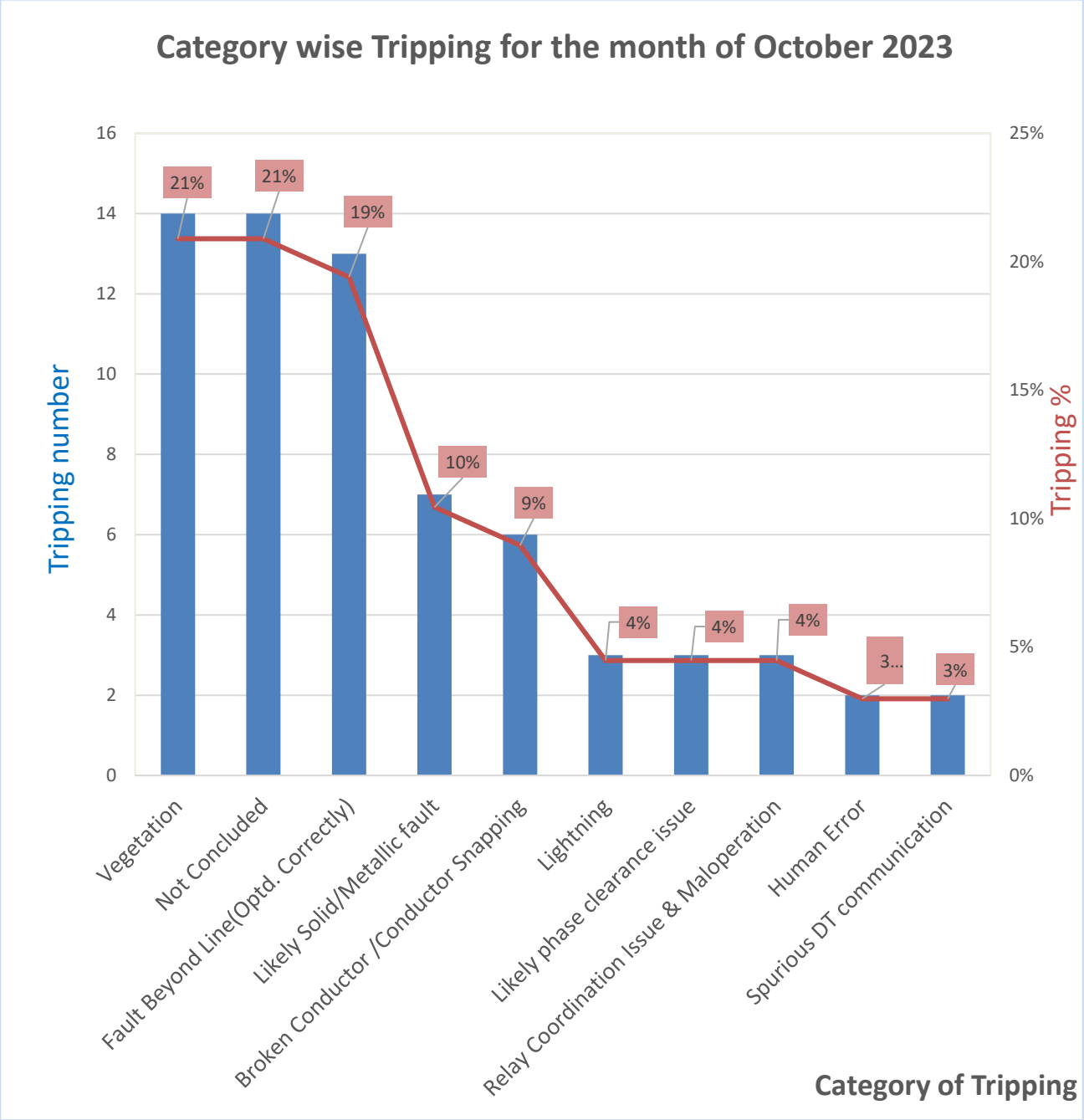
Forum suggested NERLDC to submit a tripping list based on tripping categories such as vegetation, lightning, etc. and requested constituents to try to reduce tripping of element.

Deliberation of the sub-committee

The forum noted the improvement in submission of data by utilities of NER and appreciated the same. After detailed deliberation the forum requested Assam, Manipur and Tripura to further improve the submission percentage.

B.6 Category wise Tripping for the month of October 2023:

There were a total of 67 numbers of Line & ICT tripping during the month of October'23. A plot showing number of tripping and tripping percentage in each category such as vegetation, Solid fault, Broken conductor, etc is shown below. It is observed that for around 21% of tripping, root cause could not be concluded due to non-submission of DR/EL.



Deliberation of the sub-committee

NERLDC highlighted all types of trippings occurred in Oct'23.

After discussing the category wise tripping, Member Secretary NERPC requested to reduce all the tripping occurred due to vegetation. Forum requested to submit all the details to conclude all the grid events.

B.7 Submission of Flash Report and Detailed Report by User/SLDC as per IEGC-2023:

As per IEGC-2023, all User/SLDCs are requested to prepare and share **Flash Report** and **Detailed Report** with NERLDC and NERPC following any Grid Events. Status of submission of the same for the month of October'23 is shown below:

Sl. No.	GD/GI/Near Miss	Affected Areas	Date & Time	Flash/Detailed report to be submitted by User/SLDC	Flash Report By User { IEGC section 37.2 (b)}	Detailed report by User within 7 Days { IEGC section 37.2 (e)}	Detailed Report submitted By NERLDC	Root Cause	Non Compliance observed
1	GD-I	Tenga, Khupi areas and Dikshi HEP of Arunachal Pradesh Power System	03-10-2023 03:00	DoP,AP	No	No	16-10-2023	3 phase fault of Solid nature appears in the line and cleared from both the end in 90 msecs.	IEGC section 17.3 - DR Time Synchronization IEGC section 37.2 (b)- Flash Report By User IEGC section 37.2 (e)- Detailed Report By User
2	GD-I	Sarupathar and Golaghat areas of Assam Power System	04-10-2023 13:58	P&ED, Mizoram	No	No (submitted on 28-10-2023)	16-10-2023	R- phase jumper snapping of 132 kV Dimapur – Bokajan Line.	IEGC section 37.2 (b)- Flash Report By User **IEGC section 37.2 (e)- Detailed Report By User**
3	GD-I	Zuangtui, and radially connected 132 kV Saitual,Vankal, Serchhip and Lunglei substations of Mizoram Power System	04-10-2023 19:57	P&ED, Mizoram	No	No	16-10-2023	Fault in the downstream of Zuangtui SS caused the tripping of 132 kV Melriat(PG)- Zuangtui Line. NERTS has changed the OC & EF settings of Main relay at Melriat (PG) end on 29.09.2023. Requirement of relay setting modification at Zuangtui as suggested by NERPC vide email dated 21-09-2023.	IEGC section 37.2 (b)- Flash Report By User IEGC section 37.2 (e)- Detailed Report By User IEGC section 37.2 (c) & CEA grid Standard 15.3- DR/EL provided within 24 Hours? - **NERTS & P & ED, Mizoram**
5	GD-I	Margherita(Ledo), Rupai and Chapakhowa areas of Assam Power system and Roing, Pasighat areas of Arunachal Pradesh Power System	15-10-2023 09:38	AEGCL	Yes	No (submitted on 28-10-2023)	26-10-2023	B- Phase Jumper snapping of 132 kV Tinsukia-Margherita Line at loc.no. 174.	**IEGC section 37.2 (e)- Detailed Report By User** IEGC section 37.2 (c) & CEA grid Standard 15.3- DR/EL provided within 24 Hours?
6	GD-I	Lakwa area of Assam Power System	17-10-2023 19:32	AEGCL	Yes	No (submitted on 28-10-2023)	31-10-2023	Y-phase bus jumper snapped and flashover with R-phase conductor of Generator Transformer (48MVA) of WHRP	**IEGC section 37.2 (e)- Detailed Report By User** IEGC section 37.2 (c) & CEA grid Standard 15.3- DR/EL provided within 24 Hours?
7	GD-I	Dharmanagar area of Tripura Power system	19-10-2023 01:47	TPTL	Yes	No	27-10-2023	Protection system at Dharmanagar fails to isolate the fault even after issuance of Z-1 Trip. Fault is due to clearance issue between Y and B-Phase. Likely solid fault.	IEGC section 37.2 b,c,e & section 17.3 CEA grid Standard 15.3
10	GD-I	Mokokchung area of Nagaland Power System	27-10-2023 11:56	DoP Nagaland	Yes	No	10-11-2023	Fault in 132 kV Mokokchung(NL)-Longnak line. CB at Mokokchung(NL) did not operate due to SF6 pressure low which was rectified after the event by DoP Nagaland.	IEGC section 37.2 .c,e & section 17.3 CEA grid Standard 15.3
11	GD-I	Pailapool area of Assam Power system	30-10-2023 12:47	Assam	Yes	No (submitted on 08-11-2023)	07-11-2023	Fault due to "Tree Branch decreased vicinity towards R-Yph conductor" at a distance of 6.9km. Necessary restoration work was carried out and the line was restored at 18:53Hrs	**IEGC section 37.2 (e)- Detailed Report By User** IEGC section 37.2 c & section 17.3 CEA grid Standard 15.3
	Novemver 2023								
1	GD-I	Tinsukia and Margherita areas of Assam Power System	07-11-2023 12:48	Assam	No (submitted on 09-11-2023)	No	-	Detailed Report awaited from AEGCL. Also, requested to submit the DR&EL.	**IEGC section 37.2 (b)- Flash Report By User** IEGC section 37.2 e & 17.3 CEA grid Standard 15.3

Deliberation of the sub-committee:

The forum observed that in some cases flash report and detailed report have not been submitted by the utilities within stipulated timeline. After detailed deliberation the forum requested all the utilities to furnish the required reports as per the IEGC timeline and the cases of non-compliance will be monitored closely. NERPC informed a Sub-group meeting can be conducted for discussion of every grid event one week prior to PCC meeting.

B.8 Non-operation of auto recloser in Important Grid Elements for transient faults in October 2023:

Sl No	Element Name	Time	Relay End1	Relay End2	A/R not Operated	Remarks from Utility
1	220 kV NTPS - Tinsukia 1 Line	26-10-2023 16:37	DP,Z1,Earth fault,39km	B-Eph, Z-1, LA burst	No details provided	
2	220 kV Azara - Sarusajai 2 Line	24-10-2023 23:38	DP, ZII, B-E, Carrier Aided tripping	DP, ZI, B-E, AR successful	Azara	
3	220 kV Jawaharnagar - Samaguri Line	25-10-2023 11:11	DP, ZI, B-E, FD: 35.9 km	DP, ZI, R-E, FD: 71.8km, AR successful	Jawahar nagar	
4	132 kV Jiribam - Pailapool Line	30-10-2023 12:47	DP, ZI, R-Y, FD: 6.49 km, AR successful	DP, ZI, R-Y	Pailapool	

Deliberation of the sub-committee

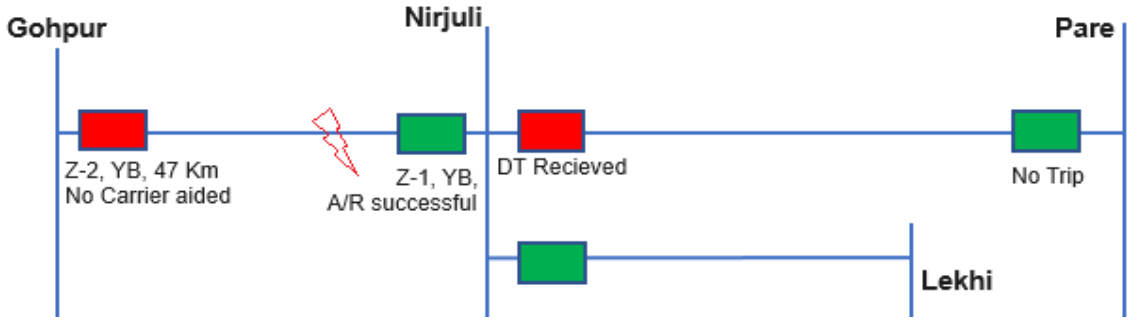
As updated by the utilities -

Sl No	Element Name	Time	Relay End1	Relay End2	A/R not Operated	Remarks from Utility
1	220 kV NTPS - Tinsukia 1 Line	26-10-2023 16:37	DP,Z1,Earth fault,39km	B-Eph, Z-1, LA burst	No details provided	AEGCL updated that AR has not been configured at both ends, will be completed in next scheduled shutdown
2	220 kV Azara - Sarusajai 2 Line	24-10-2023 23:38	DP, ZII, B-E, Carrier Aided tripping	DP, ZI, B-E, AR successful	Azara	AR setting issue, now resolved
3	220 kV Jawaharnagar - Samaguri Line	25-10-2023 11:11	DP, ZI, B-E, FD: 35.9 km	DP, ZI, R-E, FD: 71.8km, AR successful	Jawahar nagar	GIS work underway. Waiting for OEM support, will complete by Dec'23
4	132 kV Jiribam - Pailapool Line	30-10-2023 12:47	DP, ZI, R-Y, FD: 6.49 km, AR successful	DP, ZI, R-Y	Pailapool	By Dec'23

Sub-committee noted as above

B.9 <u>Tripping of 132 kV Gohpur - Nirjuli-Pare Line:</u>

At 15:28 Hrs of 09-Nov-2023, the following element tripped as shown below:-



Sl No	Element Name	Owner	Outage Date	Outage Time	Revival Date	Revival Time	Indication Details (End1)	Indication Details (End2)
1	132 kV Pare - Nirjuli	MUML	09-Nov-23	15:28	09-Nov-23	16:33	No tripping	DT received
2	132 kV Gohpur - Nirjuli	NERTS	09-Nov-23	15:28	09-Nov-23	17:27	Zone-II,YB(2.2 kA), FD: 47 km	Z-1 ,Y-B(4.5KA), FD: 0.98KM, A/R successful,

Preliminary Event Analysis:

As per Relay indication, at 15:28 Hrs, Ph to Ph fault occurred in 132 kV Nirjuli-Gohpur Line at a distance of 0.98 Km from Nirjuli and it was cleared from Nirjuli on Z-1(within 80 msec as per PMU) and Gohpur on Z-2 within 600 msec (As per PMU data).

At the same time healthy 132 kV Pare line tripped on DT received at Nirjuli only which is the matter of serious concern.

Due to the non-submission of FIR, DR (Disturbance Recorder), and EL (Event Logger) data by the relevant parties, a comprehensive analysis of the event could not be conducted.

Observation:

1. Reason for non-operation of Z-2, carrier aided tripping at Gohpur for Nirjuli Line to be checked by AEGCL/PGCIL

Reason for DT signal transmission from Pare HEP for 132 kV Nirjuli line needs to be checked by NEEPCO team.

Deliberation of the sub-committee

1. As initiated by PGCIL no fault found at the site. However, it has been suspected that during the paying out of the conductor from loc. no 134 to ERS, some foreign object might have sticked on the conductor and due to less clearance between the middle & bottom conductor, it caused Ph-Ph fault
2. AEGCL stated that the Y-B fault occurred due to touching by creeper between two phases.
3. NERTS intimated that carrier was sent form Nirjuli end to Gohpur but no carrier received at Gohpur.
4. AEGCL updated that Carrier aided tripping and Auto- reclosure have to be configured in the relay at Gohpur which will be completed by mid-December'23
5. Regarding DT sent from Pare end, NEEPCO stated they will coordinate with M/s MUML to rectify the issue

Sub-committee noted as above

Agenda from PGCIL

B.10 <u>High voltage rise at HVDC BNC during Bipolar Reverse Power Flow</u>

During the winter season, monopole operation in reverse direction (Agra to BNC) is being carried out as per instruction of NLDC with metallic return mode through the conductor of the other pole. In view of negligible voltage on metallic return conductor during monopole operation, line becomes vulnerable for theft of line materials (spacer, corona ring etc.) and theft of hundreds of spacer–damper has been experienced in the past which leads to damage of conductor fittings and accessories and chance of conductor snapping increases.

<u>Solution proposed</u>: Operating of Bipole HVDC during Reverse Power flow (Agra to BNC) during winter season.

<u>Challenge</u>: As per system studies carried out internally by POWERGRID, it is observed that during Bipole operation of NEA HVDC in reverse power direction, about 18kV voltage rise is calculated in 400kV bus at BNC for 500MW Bipole operation in comparison without HVDC power flow. Based on the above study, an additional 125 MVAR Reactor is required at HVDC BNC to absorb the increase in voltage during Bipole operation of Reverse Power.

Deliberation of the sub-committee

After detailed deliberation the forum decided that NERLDC & CTU may carry out studies to verify the findings and validate the requirement of 125 MVAR Reactor at HVDC,BNC. The forum noted that the matter pertains to transmission planning of ISTS elements and referred it to CMETS for further discussion.

C. Follow-up Agenda items

C.1 Non-Operation of A/R at Doyang HEP for 132 kV Dimapur- Doyang 1&2 line:

Sl. No.	Element Name	Time	Relay End1	Relay End2	Remarks
1	132 kV Dimapur - Doyang 1	19-09-2023 14:53	DP, ZI, R-Y-E, FD: 86.192 Kms, AR Successful	DP, ZI, R-Y-E, AR Not Operated	Lightning
2	132 kV Dimapur - Doyang 2	07-08-2023 19:35	DP, ZI, B-E, FD:23.84 kms, AR Successful	DP, ZI, B-E, AR Not Operated	Lightning
3	132 kV Dimapur - Doyang 2	19-08-2023 02:19	DP, ZII, Y-E, FD: 91.14 Kms; carrier aided, AR Successful	DP, ZI, Y-E, AR Not Operated	Lightning

Numerous instances of tripping have been noted, primarily attributed to the transient nature of the fault. The Autorecloser at the Dimapur (PG) end has consistently performed successfully. Nevertheless, it is apparent that no Autorecloser operation was recorded in the submitted Disturbance Recorder (DR) from the Doyang end, indicating that there is need of checking of Autorecloser function at Doyang HEP.

In 60th PCCM NERLDC updated the forum that CBs at Doyang are spring closed and air operated (pneumatic type). As soon as breaker gets open, air pressure goes down below 15Kg/cm2 and the breakers goes to non-operative mode. After running the compressor when air pressure is achieved to 15Kg/cm2, that condition goes off, by that time AR time becomes over. They have called CGL, OEM of the breakers, to attend the problem. The OEM has assured that they will report within this month. In case, OEM is not able to resolve this matter, all the CBs of Doyang SY needs to be replaced (CBs were procured during commissioning of the Plant i.e., 2000).

Deliberation of the sub-committee

NEEPCO intimated that the OEM will visit on 08th December, 2023 and suggest the resolution. If resolution not possible then NEEPCO will replace CB.

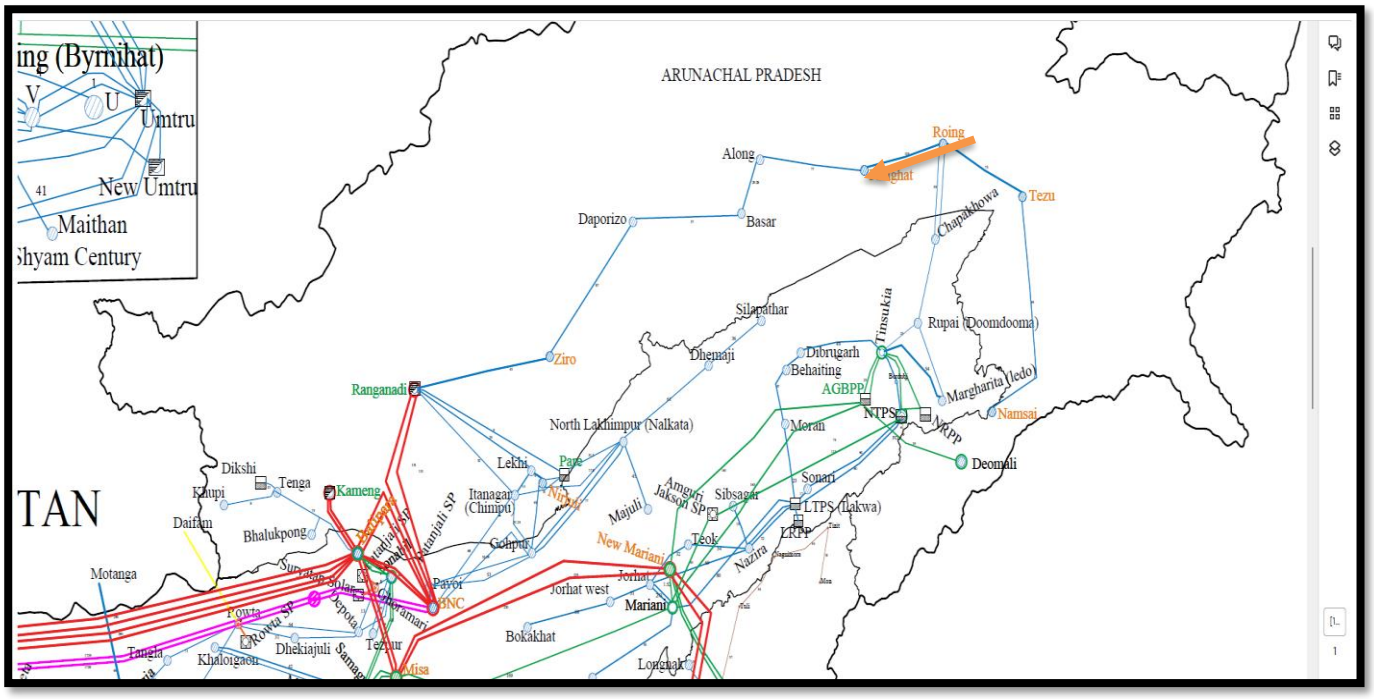
NERTS suggested that since AR at Doyang end is non-operational it is better that AR at Dimapur end is also kept off to avoid affecting healthiness of the CBs.

The forum requested NEEPCO to resolve the issue at the earliest.

Sub-committee noted as above

C.2 SPS for tripping of 132 kV Panyor-Ziro line:

The reliability of Ziro, Daporijo, Along, Pasighat, Roing, Tezu, Namsai, Chapakhowa, Ledo and Rupai area has been increased after commissioning of 132 kV Roing-Chapakhuwa DC in the month of July 2023.



Since its integration into the grid on 4th July 2023, the 132kV Chapakhowa-Roing D/C line has successfully prevented multiple number grid disturbance in Arunachal Pradesh. The details are given below.

Sl. No	Elements Tripping	Tripping count
1	132 kV Daporijo – Basar- Along Line	6 Times
2	132 kV Along - Pasighat Line	30 Times
3	132 kV Daporijo - Ziro Line	9 Times

Study suggests that a severe low voltage issue may arise on tripping of 132 kV Panyor-Ziro line and may lead to cascading tripping in Arunachal Pradesh powers system. In such case, SPS may be designed to isolate the downstream load of Ziro substation on tripping of 132 kV Panyor-Ziro line.

In 60th PCCM, DoP Ar. Pradesh agreed to proposal of SPS at Ziro and assured that downstream lines will be identified shortly.

The forum asked NERLDC to prepare the SPS scheme logic and submit to NERPC /concerned Utilities for further implementation at the earliest. The SPS will be implemented by POWERGRID at Ziro and Paynor HEP by NEEPCO.

Action taken by NERLDC

NERLDC updated that SPS logic shared on 02-Nov-2023. The same is attached in ***Annexure C.2***

Deliberation of the sub-committee

DoP Arunachal Pradesh stated that the entire load at Ziro has been identified for tripping. Also, the forum noted that after tripping of PLHPS-Ziro lines and downstream at Ziro, Arunachal Pradesh may re-distribute the loads at Ziro, Daporijo, Basar, Along and Pashighat depending on the real time condition and voltage profile along the network

After detailed deliberation the SPS was approved by the forum requested NEEPCO, PGCIL and Arunachal Pradesh to implement it at the earliest.

C.3 Details of tripping of lines due to spurious DT signal transmission:

Sl. No	Element Name	Outage Date and Time	DT Sent from	Root cause and remedial measures
1	132 kV Agartala - Bodhjannagar	28-09-2023 09:11	Agartala (TSECL)	
2	132 kV AGTCCPP - PK Bari (TSECL) 1 Line	11-10-2023 18:03	PK Bari (TSECL)	
3	132 kV AGTCCPP - PK Bari (TSECL) 2 Line	11-10-2023 18:03	PK Bari (TSECL)	

Utilities are requested to share the ***root cause and remedial measures*** taken

Deliberation of the sub-committee

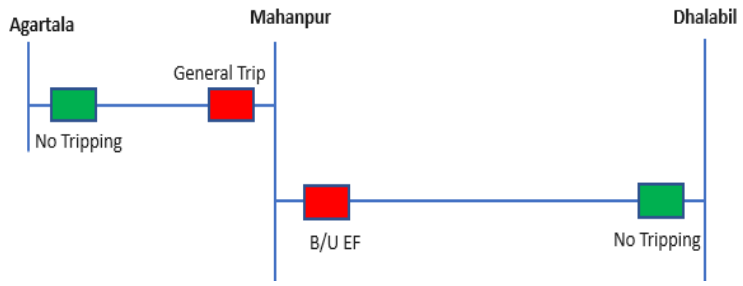
Utilities updated as follow -

Sl. No	Element Name	Outage Date and Time	DT Sent from	Root cause and remedial measures
1	132 kV Agartala - Bodhjannagar	28-09-2023 09:11	Agartala (TSECL)	PLCC panel cable damaged, corrective action taken & currently working
2	132 kV AGTCCPP - PK Bari (TSECL) 1 Line	11-10-2023 18:03	PK Bari(TSECL)	Will intimate through email
3	132 kV AGTCCPP - PK Bari (TSECL) 2 Line	11-10-2023 18:03	PK Bari(TSECL)	Will intimate through email

Sub-committee noted as above

C.4 <u>Grid Disturbance at Mohanpur on 29-Sept-2023:</u>

Mohanpur area of Tripura system was connected with rest of NER grid through 132 kV Mohanpur-Dhalabil and 132 kV Mohanpur-Agartala Line.



At 02:33 Hrs on 29-Sept-2023, both 132 kV Agartala- Mohanpur Line & 132 kV Dhalabil - Mohanpur line tripped from the **Mohanpur end** on operation of **Earth Fault** and **General Trip which led to blackout of Mohanpur Substation**. No tripping was observed from the other end such as Agartala & Dhalabil.

Root cause cannot be concluded due to non-submission of DR and EL by TPTL.

TPTL is requested to share the root cause of tripping and remedial measures taken.

Deliberation of the sub-committee

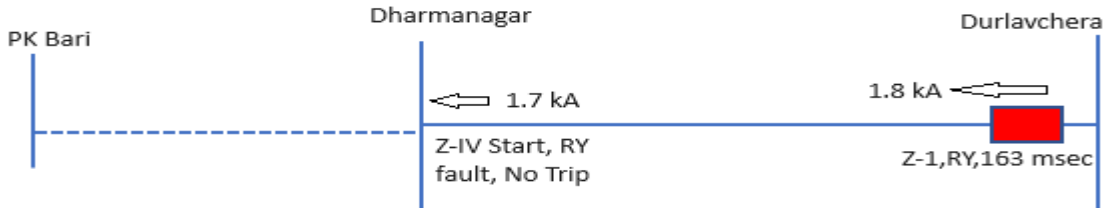
Tripura informed that the Backup setting was low, required correction done and the same will be informed to NERPC and NERLDC.

NERLDC requested to Tripura to provide DR & EL for root cause analysis. Same agreed by Tripura.

C.5 Blackout of Dharmanagar area of Tripura power system:

Event 1(15-09-2023):

Dharmanagar area was radially connected with rest of NER grid through 132 kV Dharmanagar - Dullavchera line.



At 10:40 Hrs of **15-09-2023**, 132 kV Dharmanagar – Dullavchera Line tripped from Dullavchera on Z-1 operation within 163 msec. No tripping recorded from Dharmanagar end as it detects fault in Z-IV. It seems that Phase-to-Phase fault was in downstream side of Dharmanagar.

Following needs to be intimated-

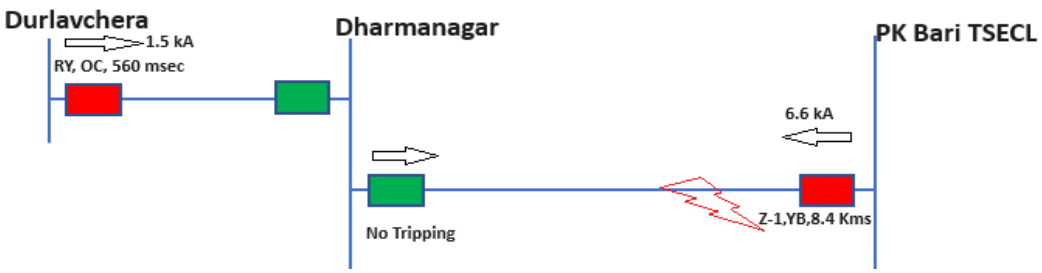
Exact location of fault and its action taken by **TPTL**.

Reason of Tripping on Zone I by **AEGCL** (***if there is any over-reaching***) and actions taken.

Event-2(19-10-2023):

Dharmanagar area was connected with rest of NER grid through 132 kV Dharmanagar - Dullavchera line and 132 kV Dharmanagar-PK Bari Line.

At 01:47 Hrs, 132 kV P K Bari -Dharmanagar Line and 132 kV Dharmanagar – Dullavchera Line tripped which led to blackout of Dharamanagar area of Tripura Power system. Load loss of **22 MW** recorded at Dharmanagar area of Tripura power system, which is the matter of concern.



Phase to Phase fault was in 132 kV PK Bari-Dharmanagar Line and fault was cleared from PK Bari within 60 msec. Protection system at Dharmanagar **fails to isolate** the fault, due to which fault was feeding continuously from adjacent healthy Line 132 kV Durlavchera-Dharmanagar from Durlavcherra end and finally clear the fault within 560 msec on B/U O/C protection.

TPTL is requested to intimate the following-

1. The reason of non-clearing of fault from Dharmanagar and its remedial measures.
2. Reason of non-Submission of DR and EL from Dharmanagar S/S

Deliberation of the sub-committee

Event – 1

AEGCL will check the distance protection settings at Dullavchhera and update shortly

Event - 2

TPTL updated that at Dharmanagar, Zone 1 operated but CB not operated as one pole got stuck, the same has been replaced.

C.6 Requirement of SPS for 132 KV Khliehriat (PG)-Khliehriat D/C line

With expected availability of at least two machines of Kopili and one machine of Khandong during peak hours of the coming winter months of 2023-24 and considering the anticipated increase in demand, it is expected that total power flow along 132 KV Khliehriat (PG)-Khliehriat D/C line would be between 90-110 MW under different conditions. Load flow studies had been carried out by SLDC and shared with NERLDC. The matter had also been discussed with DGM, NERTS since 132 KV Khliehriat (PG)-Khliehriat line 1 is under POWERGRID. The scheme envisages shedding of 20-25 MW load at 132 KV Mustem substation in the event of tripping of any circuit of 132 KV Khliehriat (PG)-Khliehriat D/C line.

The above requirement was agreed in principle during the 205th OCC meeting and NERLDC and MePTCL were requested to develop the tripping logic and to present it in the next PCC meeting. The schematics of the SPS is attached for reference.

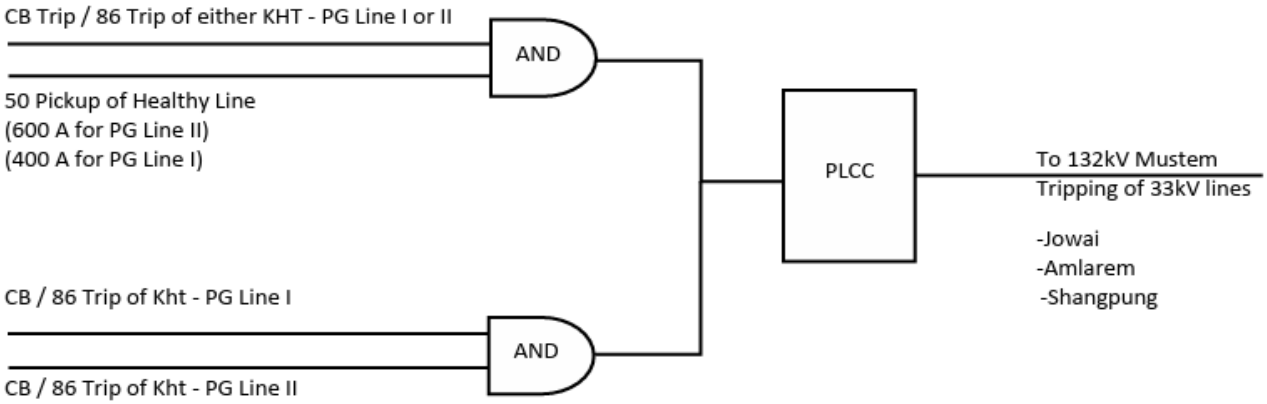
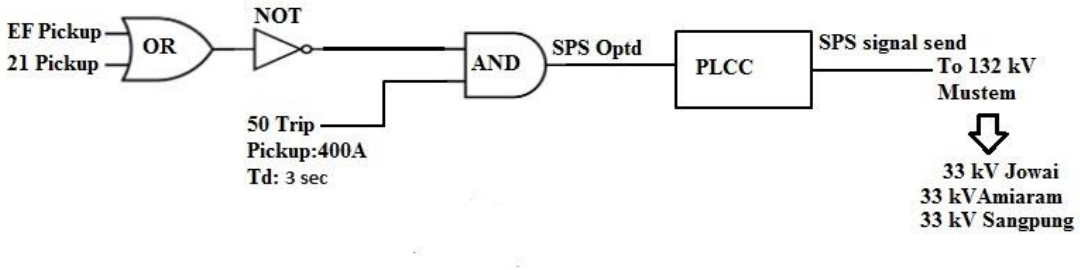


Fig: SPS Schematics at 132kV Khliehriat S/S for 132kV PG Line I & II

In 60th PCCM, NERLDC provided the modified logic (as below) and same need to be implemented by MePTCL. MePTCL agreed the same.

SPS Logic Diagram



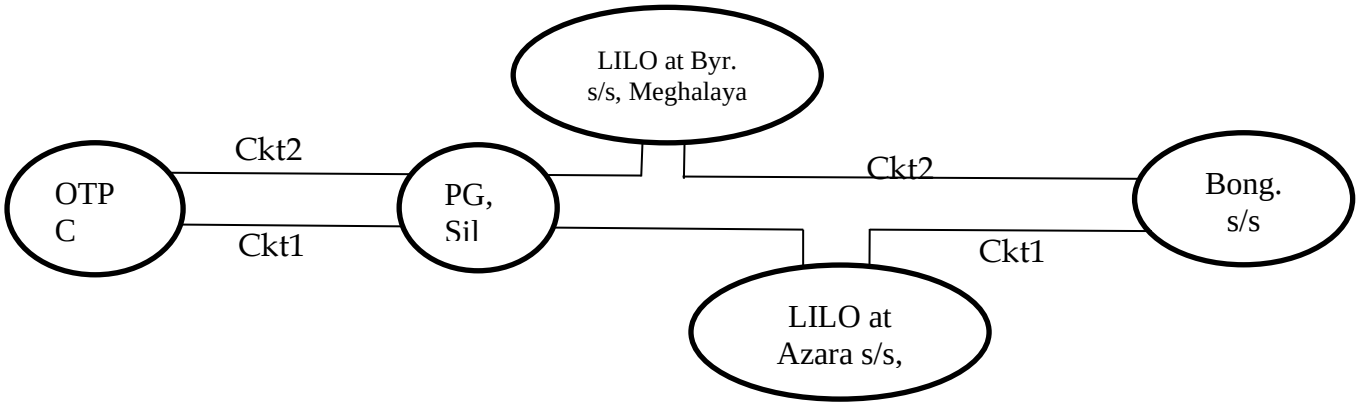
Deliberation of the sub-committee

SLDC, Meghalaya informed that the scheme has been put up for approval of higher authorities and the logic will tentatively be implemented by December'23 end.

C.7 <u>Correction of the settings of the relays associated with NETC transmission line elements and installation of TWFL in connected S/S.</u>

North East Transmission Company Limited (NETC) is currently operating the 400 kV D/C Palatana-Silchar and Silchar-Bongaigaon T/L with connectivity through LILO line at Byrnihat (Meghalaya) and at Azara (Assam) for evacuation of power from OTPC power plant located at Palatana, Tripura to NER States.

A Single line diagram showing the connectivity of the 400 kV Palatana-Bongaigaon Transmission system is as follows:



During the last financial year (FY 2022-23), there were instances of tripping in the 400 kV D/C Palatana-Bongaigaon Transmission System. Due to inaccurate fault calculations of the relays, difficulties were faced in detection of fault location. In normal scenarios, we expect to locate the faults within a range of +/- 5 km from the relay distance measurement. However, during post-fault patrolling, we discovered fault locations approximately 10-15 km away from the relay's calculated distance. The same issue persisted for the tripping instances during the current Financial Year (2023-24) as well. Here is a brief overview of such tripping instances:

SL. No.	Name of line element	No. of tripping occurred during		Remarks
		FY 2022-23.	FY 2023-24 till Sept 2023	
1	Palatana-Silchar line 1	12	2	During the all these tripping(s), the distance indications of the relay were wrong.
2	Palatana-Silchar line 2	4	4	
3	Silchar-Azara	7	2	
4	Silchar-Byrnihat	10	8	
5	Byrnihat-Bongaigaon	2	1	
6	Azara-Bongaigaon	0	0	

In view of above, we propose the following for detail deliberation by the forum:

i) A comprehensive review of the relay setting arrangements and implementation of the modified setting in conformity with the actual line parameters at all the connecting substations.
ii) Installation of the travelling Wave-Based Fault Locators (TWFL) at all the aforementioned connecting substations to ensure smooth and effective operation of the lines by precisely locating faults in cases of the line tripping.

In 60th PCCM, following decisions were taken

AEGCL representative stated that there is no issue with relay settings and line parameters. Further he stated that some error in fault distance is inevitable in case the fault involves the ground. He suggested to adopt some kind of methodology by which such error may be minimized.

Forum decided that RPC, NERLDC, NERTS, AEGCL and NETC will jointly discuss to address the issue as suggested by AEGCL. A comprehensive review of the line parameters and relays settings will also be undertaken jointly by NERPC, NERLDC NETC and concerned bay owners.

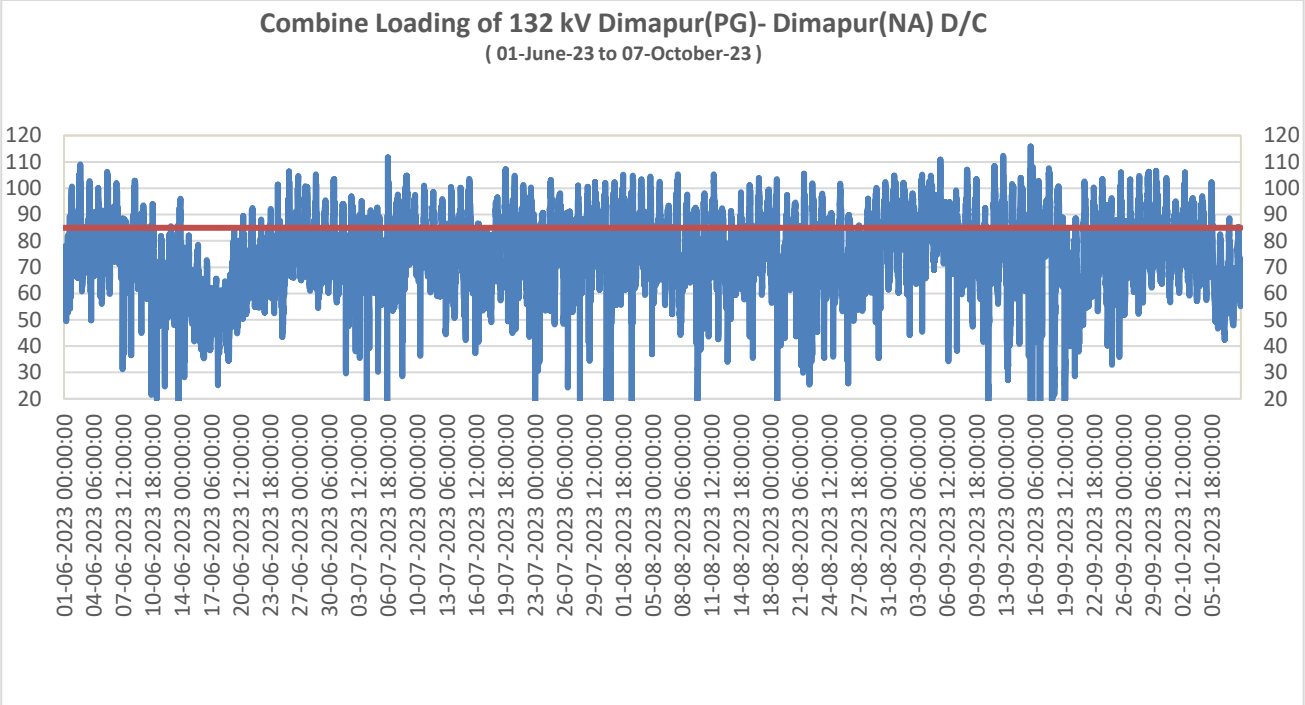
To research the fault location, DR data from Azara/Byrnihat needs to be reviewed by AEGCL/NERLDC during tripping of any one line of 400 kV Azara-Silchar and Byrnihat-Silchar line as there is no mutual compensation wiring at LILO Azara & Byrnihat SS.

Regarding TWFL, the forum decided that proposal may be considered only after the measures, as suggested above are not fruitful.

Deliberation of the sub-committee

Forum decided that a special online meeting of NERPC, NERLDC, NERTS, AEGCL and NETC to be held in the month of December 23 to address the issue.

C.8 Requirement of SPS implementation at Dimapur to for ensuring reliable power in Dimapur area of Nagaland:



Loading profile of Dimapur shows N-1 contingency of any one circuit not satisfied most of the time as the combine loading was above 85 MW for 22% of times and above 80 MW for 35% of times.

Hence, to satisfy the N-1 contingency at Dimapur (NL) and to avoid load loss in the Dimapur area, DoP, Nagaland is requested to implement suitable System Protection Scheme (SPS) with following criteria-

If the loading of any one circuit current exceeds more than 415A, the SPS will trigger and it will shed 25-30 MW load at Nagarjan area, which will increase the reliability of Nagarjan area of Nagaland system.

In 60th PCCM, DoP Nagaland updated that reconductoring of the line is under process, DPR is in final stage.

Regarding the SPS, forum requested DoP Nagaland to identify 25-30 MW load at Nagarjan area for the implementation of the SPS scheme at the earliest.

Deliberation of the sub-committee

Nagaland stated that feeders have been identified to cut around 40MW in 66kV Power House and 33kV Metha Further he stated that internal approval for the same has also been taken.

C.9 Providing PLCC in State owned lines /bays:

a. 132kV Dimapur Kohima line (Length – 58 km): DoP informed that currently PLCC ABB, ETL-41 is working at Kohima which supports Speech & data only. OPGW has already been laid. Nagaland will implement carrier scheme through DTPC (Digital tele-protection coupler).

b. 132 kV Melriat-Zemabawk line (Length – 10.12 km): Mizoram not present. However, the forum requested DoP Mizoram to arrange the 48V dc supply at Zemabawk to commission the PLCC link.

c. 132 kV Nirjuli-Lekhi line (Length – 11 km): Forum requested DoP Ar. Pradesh to implement the PLCC link on the said line and the option of PSDF funding under reliable communication may be explored. Ar. Pradesh informed that it will be installed in the next FY 2024-25.

Deliberation of the sub-committee

a. DoP Nagaland stated that DPR is being prepared for implementation of DTPC for tele-protection. Also, DoP Nagaland will explore the possibility of MPLS for carrier communication.
b. Mizoram stated that 48V DC supply is present at the substation. NERTS to commission the link soon.
c. DoP Ar. Pradesh stated that OPGW is available on the line. Forum requested DoP Ar. Pradesh to implement DTPC on the line

Sub-committee noted as above

C.10 Protection System Analysis Group (PSAG):

In 60th PCCM, it was agreed that as per SoP for GI/GD/Trippings, a Protection System Analysis Group (PSAG) shall be constituted consisting of members from RPC, NLDC, RLDC, PGCIL, a Protection Expert from the region along with the Entity under whose jurisdiction GD/GI occurred to analyse the GD/GI in detail by visiting the respective substation(s) physically and conducting the meetings. PSAG would finalize the remedial actions and recommendations after deliberations and detail analysis. The progress of implementation of the PSAG shall be followed up in the PCC meetings.

Member Secretary, NERPC suggested that one Protection Expert could be from the academia or industry. He further requested to nominate members from concerned utilities at the earliest.

Forum requested concerned utilities to send nominations for PSAG within 15 days.

The concerned organisation/Utilities ie., NERPC, NLDC, RLDC & PGCIL are requested to nominate (if not yet nominated already) suitable officer(s) at the earliest.

Deliberation of the sub-committee

Following is the list of Nominees

1. RLDC: - Shri Bimal Swargiary and Shri Utpal Das
2. PGCIL: - Shri Manas
3. NEEPCO: - Shri Ashim Sharma
4. NHPC: - not yet received
5. Assam: - Shri Abhishek Kalita
6. Arunachal Pradesh: - Shri Himu Bama
7. PGCIL - Sh.Manash Jyoti Baishya, Chief manager, NERTS

NERLDC to provide nomination from NLDC for the same

Sub-committee noted as above

D. Items for Status Update

D.1. Status of auto-reclosure on *z*-1 operation for important lines:

In the discussions of the Sub-group on 12-04-2021 the following points were noted:

a. Auto-Reclosure is very much required for maintaining system stability, reliability and uninterrupted power supply.

b. Presently it will take some time for the state utilities to implement the PLCC and establish carrier communication between stations.

c. The operation of Auto-Reclosure on Z-I operation at the local end independent of carrier healthiness is required.

In the 57th and 56th PCC meeting the forum approved the implementation of Auto-Reclosure on Z-1 without carrier check for all lines except the lines with generating stations at both the ends and requested the utilities to implement the AR scheme at the earliest.

Status as per 60th PCCM –

Sl no	State	Important Transmission lines where AR has to be enabled at the earliest	Lates status
1.	Arunachal Pradesh	132kV Balipara-Tenga, 132kV Ziro-Daporijo-Along-Pashighat link	PLCC installation on the line underway
2.	Assam	All 220kV and 132kV lines	For 220kV sub stations- At Sonapur, GIS work underway, support of OEM required At Kathalguri, procurement of relays underway At Jawaharnagar, WIP All works at three substations to be completed by Nov'23 For 132kV substations- 80% work completed, by Nov'23 90% to be completed
3.	Manipur	132kV Imphal-Ningthounkong	-

4.	Meghalaya	**Annexure (D.1)**	AR put in place for 5 lines but approval of MERC is still awaited. The forum suggested MePTCL to do double jumpering at critical locations to ensure integrity of the old lines Meghalaya requested MS, NERPC to write a letter to higher authorities to expedite the commissioning of the AR in the intra-state lines
5.	Mizoram	132kV Turial-Kolasib line	No representative
6.	Nagaland	132kV Dimapur-Kohima line (from Kohima end)	Procurement done. AR enabled
7.	Tripura	132kV Agartala-S M Nagar (TSECL), 132kV Agartal-Rokhia DC, 132kV, 132kV Agartala-Budhjungnagar	No representative

Deliberation of the sub-committee

Utilities updated as follow-

Sl no	**State**	**Important Transmission lines where AR has to be enabled at the earliest**	**Lates status**
1.	Arunachal Pradesh	132kV Balipara-Tenga, 132kV Ziro-Daporijo-Along-Pashighat link	For Balipara-Tenga and Along-Pasighat PLCC will be implemented under PSDF. However SPAR have been enabled on the lines without PLCC and 3-Ph AR will be enabled soon.
2.	Assam	All 220kV and 132kV lines	For 220kV sub stations-

			At Sonapur, GIS work underway, support of OEM required At Kathalguri, procurement of relays underway At Jawaharnagar, WIP All works at three substations to be completed by DEC'23 For 132kV substations- 80% work completed, by Dec'23 90% to be completed Assam informed all work at three substations will be completed by Jan/Feb 2024.
3.	Manipur	132kV Imphal-Ningthounkong	-
4.	Meghalaya	**Annexure (D.1)**	AR put in place for 5 lines but approval of MERC is still awaited. MePTCL agreed to do double jumpering and improve strength at critical locations to ensure integrity of the old lines Meghalaya requested MS, NERPC to write a letter to higher authorities to expedite the commissioning of the AR in the intra-state lines
5.	Mizoram	132kV Turial-Kolasib line	AR implemented (OPGW not available, PLCC available)
6.	Nagaland	132kV Dimapur-Kohima line (from Kohima end)	AR enabled
7.	Tripura	132kV Agartala-S M Nagar (TSECL), 132kV Agartal-Rokhia DC, 132kV, 132kV Agartala-Budhjungnagar	Will complete by Dec'23

Sub-committee noted as above

D.2. Installation of line differential protection for short lines:

As per sub-regulation3 of Regulation 48 of Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022-

"For short line (less than 10 km) or cable or combination of overhead line and cable, line differential protection shall be used with built-in backup distance protection."

As per discussion in 60th PCC meeting the status for different STUs/ISTS licensees are as follows:

Name of utility	Last updated status	Latest status
AEGCL	DPR sent back by PSDF secretariat. Third party protection audit reports have to attached with the DPR	Third party protection audit reports have to be attached with the DPR. WIP
MSPCL	Revised DPR for 132kV Imphal-Imphal-III to be submitted.	To be submitted soon
MePTCL	Work completed Aug'21, but not commissioned yet. Report on line-wise status on progress of LDP commissioning work submitted to NERPC and NERLDC	OPGW to be installed on some lines. LDP will be commissioned after OPGW link is established.
P&ED Mizoram	Lines identified viz. 132kV Aizawl - Luangmual and 132kV Khamzawl - Khawiva. DPR submitted. PSDF approval awaited.	No representative
DoP Nagaland	LDP on Dimapur-Dimpaur lines completed. Regarding Doyang-Sanis line, NEEPCO to install LDR at Sanis end.	Regarding Doyang-Sanis line, NEEPCO to install LDR at Sanis end. No representative from NEEPCO
TSECL	132kV 79 Tilla-Budhjungnagar. DPR to be prepared. Cost estimate submitted to TIDC to arrange for ADB funding.	No representative

Deliberation of the sub-committee

Utilities updated as follow -

Name of utility	Last updated status	Latest status
AEGCL	DPR sent back by PSDF secretariat. Third party protection audit reports have to attached with the DPR	DPR being prepared as per new format and will be done by Nov, 2023
MSPCL	Revised DPR for 132kV Imphal-Imphal-III to be submitted.	To be submitted soon
MePTCL	Work completed Aug'21, but not commissioned yet. Report on line-wise status on progress of LDP commissioning work submitted to NERPC and NERLDC	OPGW to be installed on some lines. LDP will be commissioned after OPGW link is established. Line with OPGW commissioned the protection
P&ED Mizoram	Lines identified viz. 132kV Aizawl - Luangmual and 132kV Khamzawl - Khawiva. DPR submitted. PSDF approval awaited.	For Aizawl – Luangmual line Power grid will complete the task by Dec'23 and for other PSDF approval still awaited,
DoP Nagaland	LDP on Dimapur-Dimpaur lines completed. Regarding Doyang-Sanis line, NEEPCO to install LDR at Sanis end.	Regarding Doyang-Sanis line, NEEPCO to install LDR at Sanis end will be done by Jan'24.
TSECL	132kV 79 Tilla-Budhjungnagar. DPR to be prepared. Cost estimate submitted to TIDC to arrange for ADB funding.	TIDC approval is awaited for fund.

Sub-committee noted as above

D.3. Status for SPS

Status (60th PCCM) as provided by utilities –

	Name of SPS	SPS Trigger/Action	Utility	Latest Status/Discussion points
1.	SPS related to secure & reliable	Upon tripping of one circuit of 132kV Leshka-Khliehriat D/C,	MePGCL	Communication with M/s Hitachi is under way. Cost estimate will be finalized soon

	operation of Leshka HEP	Leshka generation to be reduced		

Deliberation of the sub-committee

Utilities updated as follow –

	Name of SPS	SPS Trigger/Action	Utility	Latest Status/Discussion points
1.	SPS related to secure & reliable operation of Leshka HEP	Upon tripping of one circuit of 132kV Leshka-Khliehriat D/C, Leshka generation to be reduced	MePGCL	Meeting held last week with M/s Hitachi and M/s Andritz. Hitachi to give price details soon

Sub-committee noted as above

D.4. Status against remedial actions for important grid events:

Sl No	Details of the events(outage)	Remedial action suggested	Name of the utility	Latest status
1.	132 kV Balipara-Tenga line in May and June	Carrier aided inter-tripping to be implemented for 132kV Balipara-Tenga-Khupi at the earliest (PLCC has to be installed on the link. Under consideration of the higher authorities)	DoP, Arunachal Pradesh. As per previous updates, Work covered under PSDF. In progress	PLCC work underway, covered under PSDF
2.	132 kV DoyangMokokchung line 132 kV Mokokchung - Mokochung (DoP, Nagaland) D/C lines on 30th July	Carrier inter-trip for 132kV DHEP-Mokokchung to be implemented by DoP Nagaland (NO PLCC on the line. Matter under consideration of Higher authorities)	DoP Nagaland (Work under progress. Will be completed soon.)	Same status
3.	Leshka-Khleihriat DC multiple tripping in April to September	TLSA installation along the line to be done by MePTCL	MePTCL	Same status

			(DPR submitted, Approval pending.)	
4.	132 kV Loktak-Jiribam line, 132 kV Loktak-Imphalline,132 kV Loktak-Ningthoukhong line, 132 kV Loktak-Rengpang line &Loktak Units 1,2 and 3 on 3rdAug	> 5MVA TRAFO (Aux. Transformer) to be repaired ->5MVA Auxiliary TRAFO panel to be repaired by NHPC	NHPC (Order to be placed soon. Will take 6months after placing the order)	
5.	Grid disturbance of category GD-1 (Load loss: 13MW) occurred at Karong areas of Manipur Power System at 07:41 Hrs on 4th August'22	MSPCL to check the following1. Protection setting at Karong along with circuit wirings from DPR to CB mechanism 2. Z-III setting at Imphal and its healthiness of correct operation by relay testing.	MSPCL	
7.	Grid Disturbance at Loktak HEP on 03rd Aug'22	NHPC-Loktak informed that LBB has been included under R&U scheme and the same shall be commissioned by Mar'23	NHPC (LBB to be commissioned under R&U project and by the end of Nov'23)	
10.	Review of SPS at Monarchak (item 2.22 of the sub-group held on4th May 23)	NERLDC requested NEEPCO and Tripura to implement the revised logic at Monarchak (as provided by NERLDC) and Udaipur Rokhia ends respectively	NEEPCO, TSECL (SLDC TSECL intimated that logic 1(to be configured at Udaipur and Rokhia to send DT to Monarchak) could not be implemented as there is no PLCC/OPGW connectivity in the LILO portion of Monarchak. NERLDC requested	

			TSECL to explore installation of PLCC/FO for smooth functioning of SPS scheme for the reliability of Monarchak system)	
13.	132 kV Aizawl - Tipaimukh Line tripped at Aizawl end only on received of spurious DT signal on 16th and 26th Feb'23	rectification of PLCC issues at Tipaimukh end by MSPCL	MSPCL 48V DC battery issue. WIP	
14.	Outage of 220 KV Bus Bar Protection Scheme at 400/220/132 KV Killing SS	Bus-Bar protection of 220kV bus at Killing SS	MePTCL M/S ABB has given offer. Board's approval awaited. To be completed in 3-4 months	
15.	Retrip configuration in LBB scheme in AEGCL Hailakandi station:	In previous sub group meeting The forum opined that the retrip scheme in the LBB protection will increase reliability of the protection system and will help in preventing mal operations in connecting feeders. AEGCL agreed to the suggestion and assured that the Retrip scheme, with time delay of 100msec will be configured in the LBB scheme in Silchar-Hailakandi Ckt 1 & 2 at Hailakandi end.	AEGCL Logic finalized, need to be tested. Whole work may be completed within Nov23	

16	Non-operation of AR for various lines at Byrnihaat end on 25th and 26th June'23	Rectification of PLCC issues by MePTCL Consultation with OEM underway for resolution	MePTCL	
17	Non-operation of AR for various lines at Sonapur end in July and August	GIS related issues, coordination with OEM required	AEGCL Coordination with OEM underway. WIP	
18	Grid disturbance in Umtru & New Umtru areas of Meghalaya Power System on 23th July'23	O/C and E/F high set settings for Umtru and EPIP-II lines at New Umtru to be disabled	MePGCL Matter to be discussed in next OCC	
19	On 02-08-2023 at 16:35 Hrs, 132 kV Dimapur (PG)- Dimapur (NL) II line tripped on Zone I due to snapping of Y-Phase jumper	DoP, Nagaland to make B/U OC direction forward from non-directional, for Dimapur-Dimpaur line from state end NERTS to set the OC pick up setting to 600A (100%) at their end	DoP Nagaland NERTS	
20	Tripping of 132kV Kahilipara- Sarusajai 1, 2 and 3 line, 132kV Kahilipara Main bus 1, 132kV Kahilipara transfer Bus 1 and 132kV Kahilipara-Kamalpur line on 2.08.2021	BB protection to be implemented at Kahilipara with procurement of 5 core CTs	AEGCL (will be done by April23)	

DATE AND VENUE OF NEXT PROTECTION SUB- COMMITTEE MEETING

The next Protection Sub-Committee meeting will be held in the month of December, 2023. The date and venue will be intimated separately.

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Annexure-I

List of Participants in the 61st PCC Meeting held 20.11.2023

SN	Name & Designation	Organization	Contact No.
1	Sh. Moli Kamki, AE (E)	Ar. Pradesh	09863703539
2	Sh. Nishante Baruah, DM, AEGCL	Assam	08473036988
3	Sh. A.G.Tham, AEE (MRT), MePTCL	Meghalaya	09774664034
4	Sh. A.Shullai, AEE (G&PSD), MePGCL	Meghalaya	09436334458
5	Sh. Thanglura Sailo, Sr.E.E	Mizoram	09366269162
6	Sh. Lalsangliana, JE	Mizoram	06009605796
7	Sh. Rokobeito Iralu, S.D.O	Nagaland	09436832020
8	Sh. Akuntemjen Jamir, S.D.O	Nagaland	07085961125
9	Sh. P.Tiakaba Yinchunger, JE (SLDC)	Nagaland	08974020151
10	Sh. Ratan Dhar, Manager, TPTL	Tripura	09436582838
11	Sh. Amresh Mallick, CGM (I/C)	NERLDC	09436302720
12	Sh. S C De, Sr GM	NERLDC	09436335369
13	Sh. Utpal Das, AM	NERLDC	07005504075
14	Ms. Subhra Ghosh, Engineer	NERLDC	08415857079
15	Sh. Manash Jyoti Baishya, CM	PGCIL	09435555740
16	Sh. Joypal Roy, GM (T)	NEEPCO	08837200069
17	Sh. C.L.Khayuingam, Sr. Manager	NHPC, Loktak	07085916006
18	Sh. Niranjan Rabha, AM	NETC	07002022736
19	Sh. K.B.Jagtap, Member Secretary	NERPC	-
20	Sh. S.M.Aimol, Director	NERPC	08974002106
21	Sh. Vikash Shankar, AEE	NERPC	09455331756
22	Sh. Somraj, AEE	NERPC	-

Annexure B.1

Condition monitoring of EHV substation equipments

Presented by :
Manash Jyoti Baishya
Chief Manager, POWERGRID
NERTS RHQ AM

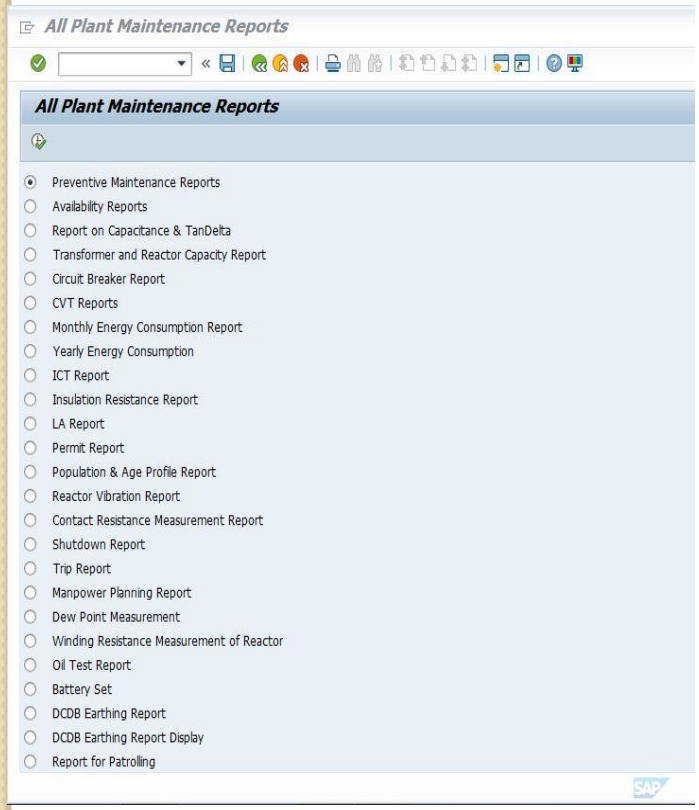
Aim of condition monitoring

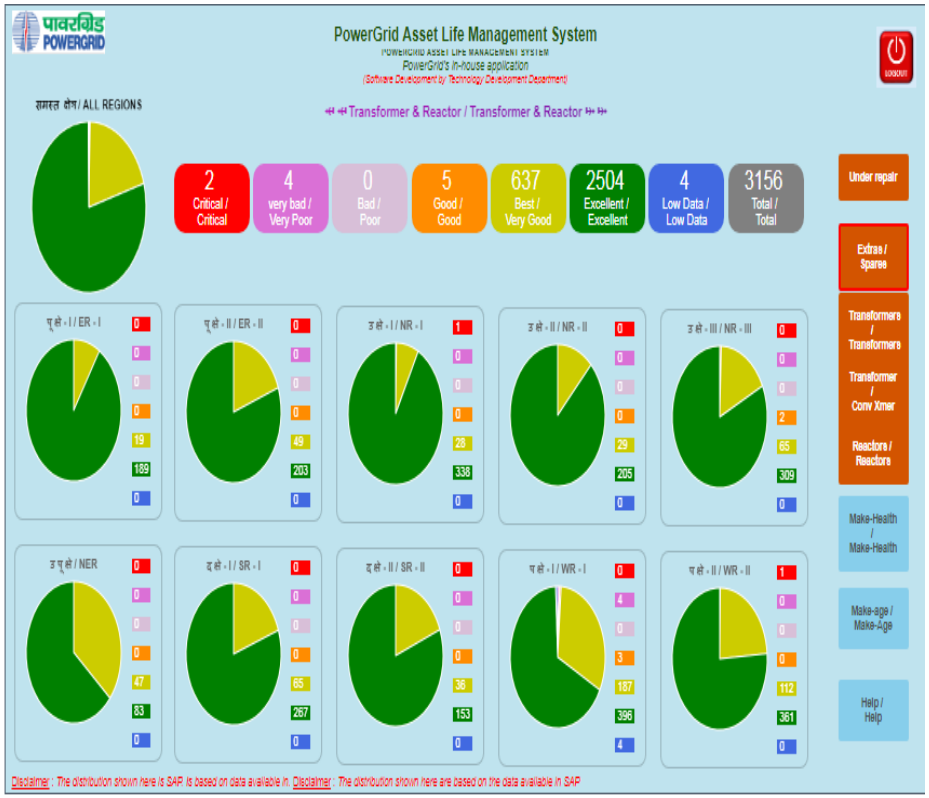
- *"Prevention is better than cure"*
- Just like the human body, if any defect in electrical equipment can be detected in the initial stages, the treatment of that defect can be easier. It will prevent major damage to the equipment just like the human body.
- All assets are to be monitored as per approved schedule to ascertain their healthiness (similar to annual health checkup of human body).
- For major oil filled equipments, oil DGA is to be carried out just like blood test for human body at regular intervals.

Basics of condition monitoring

- For any electrical equipment, all electrical pre-commissioning and condition monitoring tests revolve around 02 basic tests :
  - Insulation test
  - Electrical conductivity test
- The procedure to carry out the above tests & interpretation may vary equipment wise but the basic is common for all equipments.

Tools for effective condition monitoring assessment in POWERGRID





ERP – PM Module

PALMS – inhouse developed platform

Safety First

- Prior to commencing of any activity in our substations, the following actions are mandatory :
  - ✓Applying & approval of PTW (permit to work) in ERP.
  - ✓Safety Pep Talk to maintenance team.
  - ✓Isolation & closing of earth switches in presence of substation in charge.
- Using of latest safety gear & PPEs.

Safety Pep Talk

Use of Arc Flash suit at HVDC BNC

Major EHV equipments in a substation

- Transformers
- Reactors
- Circuit Breakers
- Current Transformers
- CVTs
- Disconnectors & Earth switches
- Surge Arresters

Transformers & Reactors

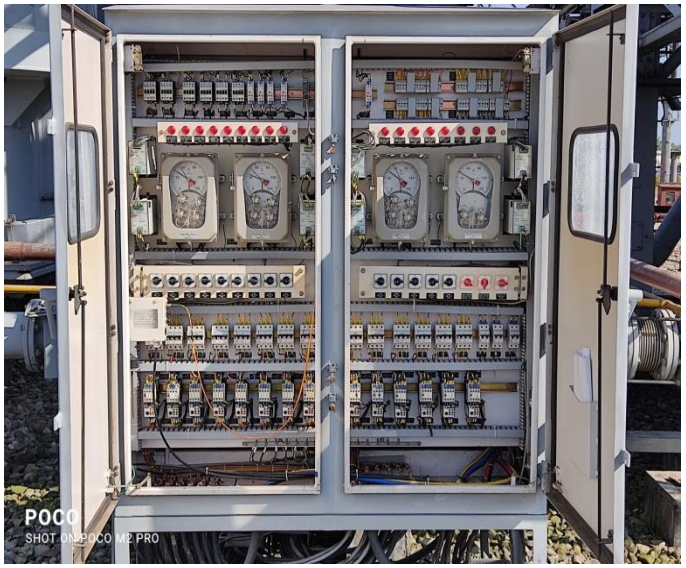
Transformers & Reactors – Monthly maintenance activity (without shutdown)

- Oil level checks – bushing, conservator, OLTC conservator, Breather oil cup
- Manual starting of oil pumps & fans
- Condition of Silica Gel
- Checking of oil leak
- Online DGA healthiness
- Online Dry Out system healthiness

Transformers & Reactors – Yearly maintenance activity

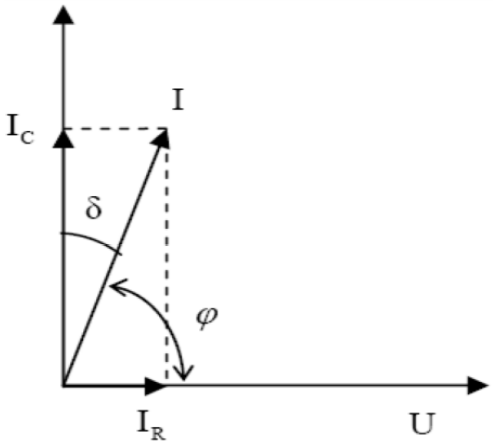
- Auto starting of fans & pumps
- Measurement of BDV of OLTC oil (minimum 40 kV during O&M)
- External cleaning of : Radiators, Bushings, Buchholz & Gas Collecting Device etc
- Maintenance of OLTC & Driving Mechanism :
  - Visual inspection of equipment
  - Manual Operation on all taps & handle interlock switch
  - Local & Remote operation (Electrical) & L/R Switch
  - Matching of Tap Changer Position & Tap Position Indicator
  - Matching of local & Remote Tap Position
  - Matching of Operation of OLTC from Minimum Tap Position to Maximum Tap Position

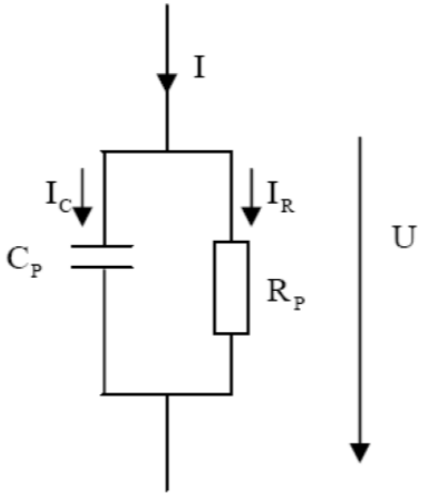
- Matching of Local & Remote indications of WTI
- Rust, Damages & Repainting, if required
- Marshalling Box Maintenance :
  - Tightening of terminations
  - Cleaning
  - Checking of space heaters & illumination
  - Condition of gaskets & sealing
- Application of insulating coating on Buccholz & PRD TBs to prevent mal operation due to moisture.
- Core Insulation Test (where terminals are brought out):
  - Shorting link between CC, CL & G are to be removed & IR value is to be taken between CC-G, CL-G & CC-CL by applying 2 kV DC (Transformer)/ 3.5 kV DC (Reactors) for1 min
- Oil DGA checks



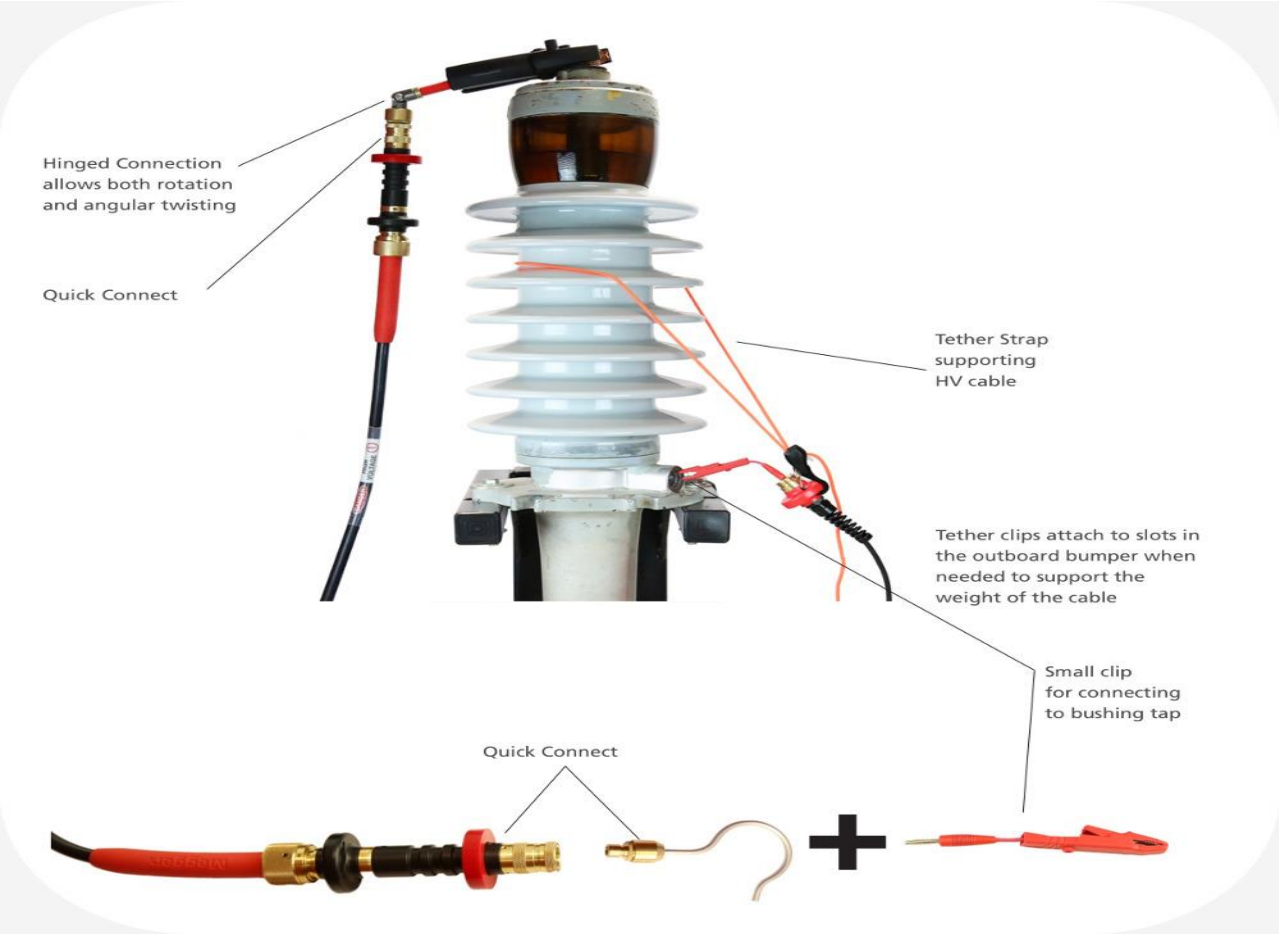
- **Tan Delta & capacitance measurement for bushings :**
  - A pure insulator when is connected across line and earth, it behaves as a capacitor.
  - In an ideal insulator, as the insulating material which acts as dielectric too, is 100 % pure, the electric current passing through the insulator, only have capacitive component. There is no resistive component of the current, flowing from line to earth through the insulator as in ideal insulating material, there is zero percent impurity.
  - In practice, the insulator cannot be made 100% pure. Also due to the aging of insulators, the impurities like dirt and moisture enter into it & add a resistive component.
  - In another way, the healthiness of an electrical insulator can be determined by the ratio of the resistive component to the capacitive component.
  - For good insulator, this ratio would be quite low. This ratio is commonly known as tanδ or tan delta. Sometimes it is also referred to as dissipation factor.

- Total leakage electric current I makes an angle δ (say) with y-axis.
- From the diagram above, it is clear the ratio, I_R to I_C is nothing but tan delta.
  - **Tan delta = I_R / I_C**
- A causal relation between losses and the resistive part can be assumed, as the higher the losses are, the higher the resistive current will be.
- If the dissipation factor (tanδ) is very small – typically less than 10 %, which can be presumed as given when measuring healthy electrical machine insulation, the dissipation factor and the power factor differ in a negligible amount and can be assumed to have the same value





Bushing Tan Delta set up

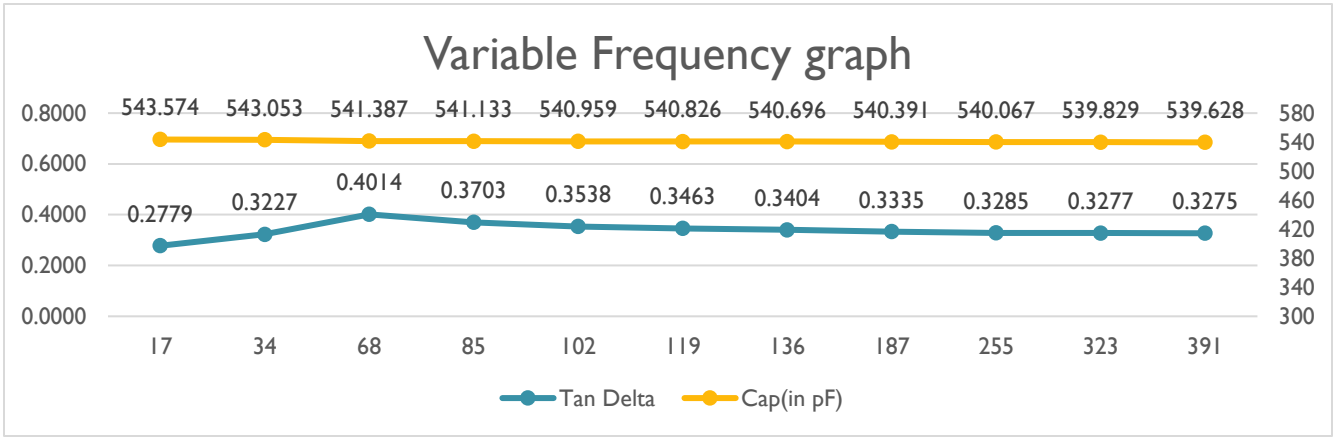


- **Bushing tan delta permissible limits :**

Tests at 2 kV & 10 kV in UST mode	At the time of first charging	During O&M
Capacitance for bushings - Main capacitance (C1)	Within ±5% of previous test result	Within ±5% of previous test result
Tan delta for bushing	Less than 0.005	Maximum Variation of 0.001 from previous value allowed

- For measurement of C & Tan Delta of bushings, shorting of HV-IV-N terminals of all bushings to be made & LV windings are to be shorted.
- If absolute value of tan delta is more than 0.007 or rate of rise of tan delta is more than 0.001, the equipment is to be replaced immediately.

- **Variable frequency tan delta for bushings :**



- Test to carried out for following frequencies : 17, 25, 34, 43, 51, 68, 85, 102 , 119, 136, 187, 255, 323, 391 Hz

Freq.	Tan Delta in %	Capacitance in pF
	For aged bushing	**For aged bushing**
17 Hz	**0.1 increase from 51 Hz**	**± 3 pF from 51 Hz results**
51 Hz	**0.6 Max**	
391 Hz	**0.1 increase from 51 Hz**	

Transformers & Reactors – 2 yearly activity

- **WTI & OTI settings verification** :
  - WTI - Alarm : 100 deg C, Trip : 110 deg C
  - OTI – Alarm : 90 deg C, Trip : 100 deg C
- **Alarm & Trip test :**
  - OTI
  - WTI
  - PRD
  - Buchholz
  - MOG low oil level
  - Diff Trip
  - O/C Trip

- **Neutral Earth Pit resistance measurement** – to be carried out after disconnecting link with grid (Below 10 Ohm max. value)

Transformer & Reactors – 10 yearly activity

- **Tan Delta & capacitance measurement of windings :**
  - Jumpers to be disconnected from all the bushings before start of the tests & all bushings of individual windings (HV-IV-N) are shorted. Neutral to be disconnected from ground.
  - Test Modes :
    - HV-IV/LV in UST Mode
    - HV-IV/LV+G in GST Mode
    - HV-IV/LV with gaurd GSTg mode
    - LV/HV-IV in UST Mode
    - LV/HV-IV+G in GST Mode
    - LV/HV-IV with guard GSTg Mode
  - Maximum limit of Tan Delta is 0.007 (During O&M)
- **Calibration of OTI & WTI**
- **Checking & cleaning of Diverter Switch contacts**

Transformers & Reactors – SOS Activity

- **Winding Resistance Measurement :**
  - To check for any abnormalities due to loose connections, broken strands and high contact resistance in tap changers.
  - The winding resistance should preferably be carried out last after completion of all other LV tests, as after this test core gets saturated and tests like magnetizing current, magnetic balance etc. carried out after winding test may be affected and indicate a misleading results, if the core is not de-magnetized before carrying out these tests.
  - Measurement of HV side winding resistance at all taps
  - Measurement between windings & for all phases
  - Calculate the resistance at 75°C as per the following formula
    - **R = R (235+75)/(235+t),**Where R = Resistance measured at winding temperature t
  - Permissible limit : ±5% variation between phases or from factory results.

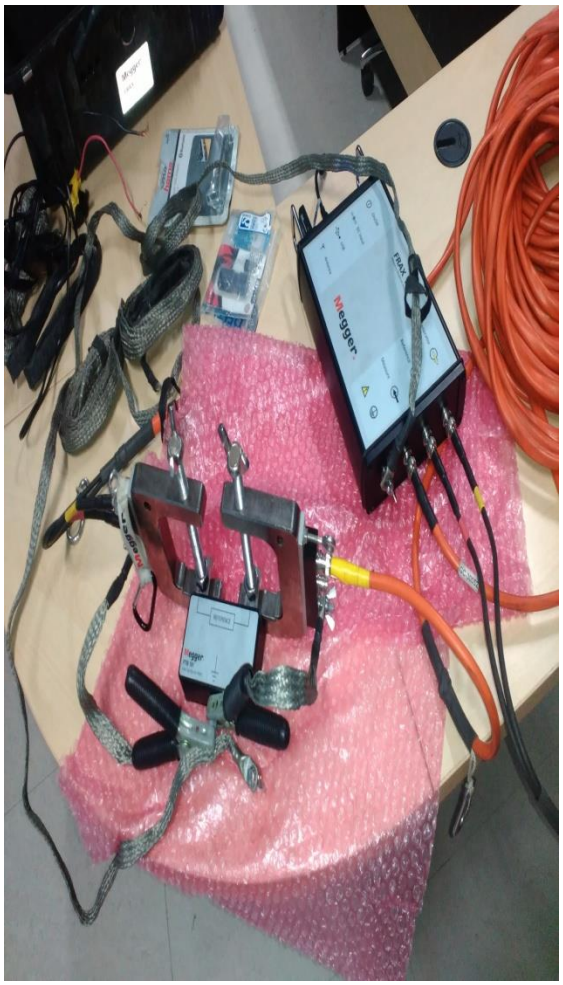
Insulation Resistance Test :

- Test reveals the condition of insulation (i.e. degree of dryness of paper insulation), presence of any foreign contaminants in oil and also any gross defect inside the transformer
- Following are the combinations :
  - HV + IV to Tank
  - LV to Tank
  - HV to LV
- The ratio of 60 second insulation resistance to 15 second insulation resistance value is called **dielectric absorption coefficient or Index (DAI).** Minimum limit is 1.3.
- The **polarization index is the ratio of the 10 min to the 1** min mega ohm readings.

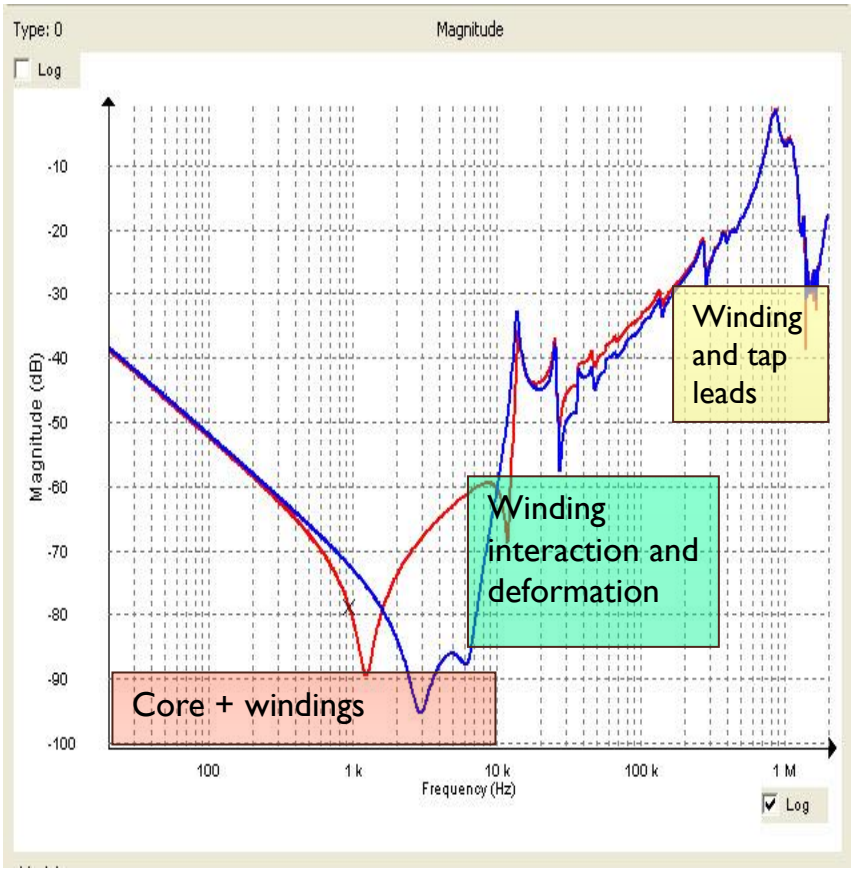
Polarization Index	Insulation Condition
Less than 1	Dangerous
1.0-1.1	Poor
1.1-1.25	Questionable
1.25-2.0	Fair
2.0 – 4.0	Good
Above 4.0	Excellent

- **Voltage ratio of Transformer (all taps) :**
  - **V2/V1 = N2/N1**
  - Ratio measurements must be made on all taps to confirm the proper alignment and operation of the tap changers.
  - **The turns-ratio tolerance should be within ± 0.5 % of the nameplate specifications**.

- **Sweep Frequency Response Analysis :**
  - Frequency Response Analysis (FRA) is conducted to assess the mechanical integrity of the transformer which may get disturbed due to transportation shocks.
  - FRA signatures will be taken after assembly and oil filling and compared with factory testing to ensure the healthiness of core /coil assembly during transportation.
  - Frequency response
    - The amplitude ratio and phase difference between voltages measured at two terminals of the test object over a range of frequencies when one of the terminals is excited by a voltage source.
    - As V_{out}/V_{in} varies over a wide range, it is expressed in decibels (dB). The relative voltage response in dB is calculated as $20 \times \log_{10}(V_{out}/V_{in})$



- Transformer issues can be detected in different frequency ranges
  - "Low" frequencies
    - Core problems
    - Shorted/open windings
    - Bad connections/increased resistance
    - Short-circuit impedance changes
  - "Medium" frequencies
    - Winding deformations
    - Winding displacement
  - "High" frequencies
    - Movement of winding and tap leads



Some best practices in Transformers & Reactors in POWERGRID

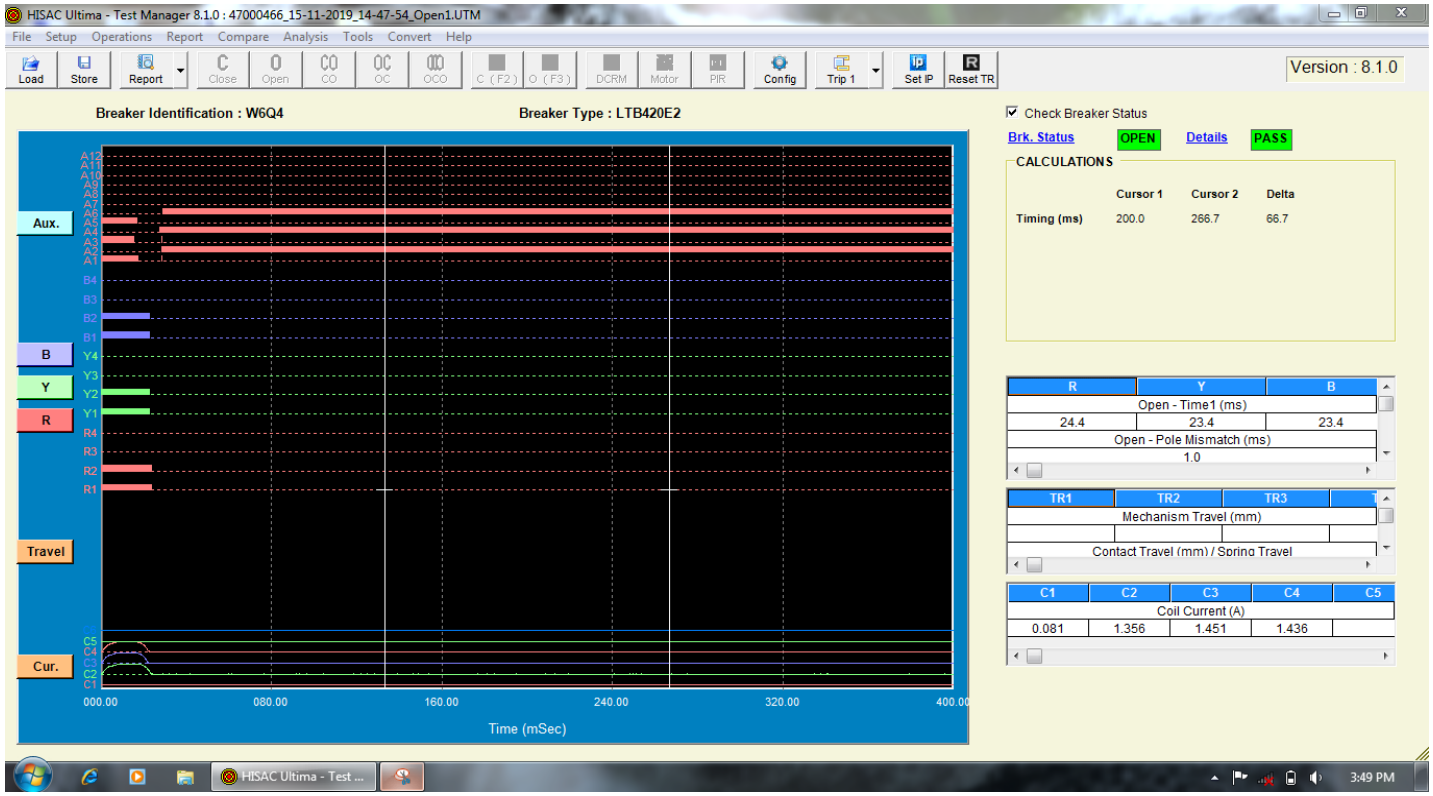
- **Canopy in Buchholz & PRD** : to prevent spurious tripping due to moisture ingress in contacts

- **Insulation sleeve in ICT tertiary conductors**

Circuit Breakers

Condition Monitoring of Circuit Breakers

- **Circuit Breaker Yearly activity**
  - **CB Operating timings check :** To measure closing/ tripping/ CO timings. These timings should be within permissible limits and shall be comparable with factory values.



- **CB operating timing limits :** (Sampling Freq. - 5 kHz)

	765 kV	400 kV	220 kV	132 kV
Closing Time (Max)	150 msec	150 msec	150 msec	150 msec
Trip Time (Max)	25 msec	25 msec	35 msec	40 msec

- **CO time (min)** – Recommended value – 35 msec
- **Checking of Pole Discrepancy Relay :**
  - 2.5 sec for CBs with A/R & 0.5 sec with CBs without A/R
  - WHEN CB IN OPEN POSITION : Closing Command is extended to close one pole, say R-Pole, of CB. After closing R-Pole of CB, this Pole should automatically open after 2.5 seconds/ 0.5 seconds.
  - WHEN CB IN CLOSED POSITION : Tripping Command is extended to trip one pole, say R-Pole, of CB. Remaining Y and B - Poles of CB should automatically open after 2.5 seconds/0.5 seconds.

Phase to phase (max) – close operation	5.0 msec
Phase to phase (max) – open operation	3.33 msec
Break to Break (Max) of same pole	2.5 msec

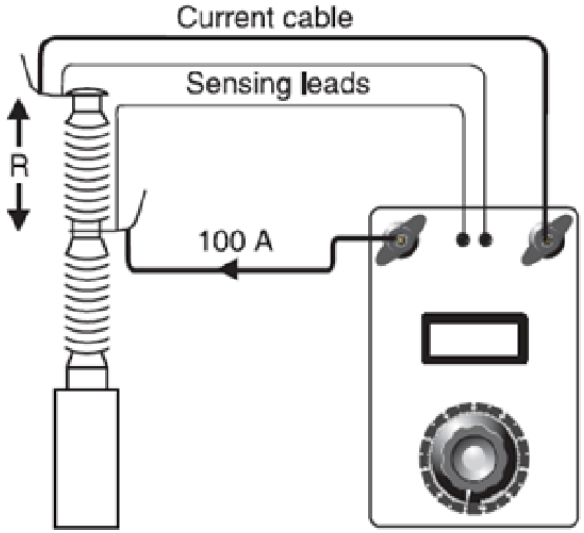
- **Checking of Anti Pumping relay** : When the breaker is in open position and closing and opening commands are given simultaneously the breaker first closes and then opens, but does not reclose even though the closing command is maintained.

- **Checking of alarm/lockout contacts to be checked through simulation -** SF6 Gas Pressure Low & Lockout, AC fail, DC fail, Trip coil faulty, Spring Charging etc

- **Check of interlocks :**
  - Line Isolator with CB
  - Earth Switch Interlocks with CB
  - Isolator Interlocks with CB

- **Maintenance of Control Cabinets**

- **Measurement Of Static Contact Resistance -** The Static contact resistance of main circuit of each pole of a circuit breaker is of the order of a few tens of micro ohms. 100 A DC is injected and millivolt drop is measured across each CB contact to compute contact resistance. The values should be within specified limits.



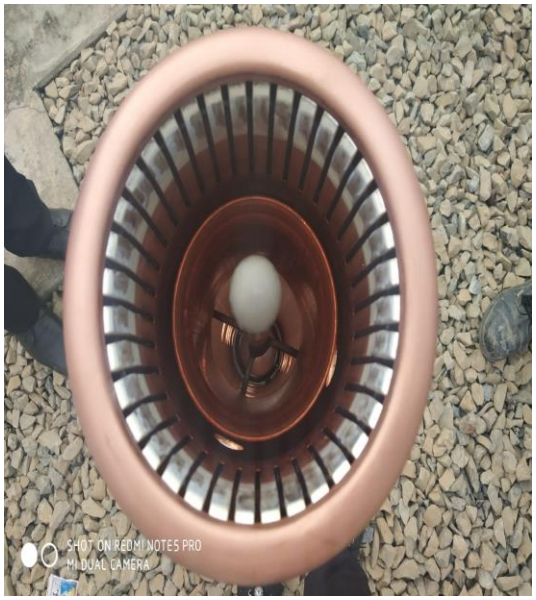
	765 kV	400 kV	220 kV	132 kV
Contact Resistance of CB per break	75 μΩ	75 μΩ	75 μΩ	100 μΩ
Contact Resistance of CB terminal connector	100 μΩ per connector			

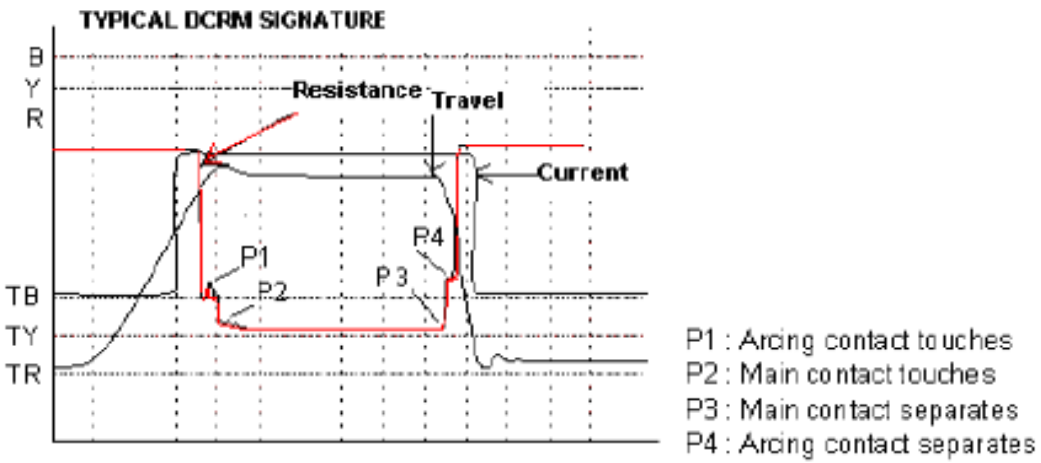
Circuit Breaker – 2 yearly activity

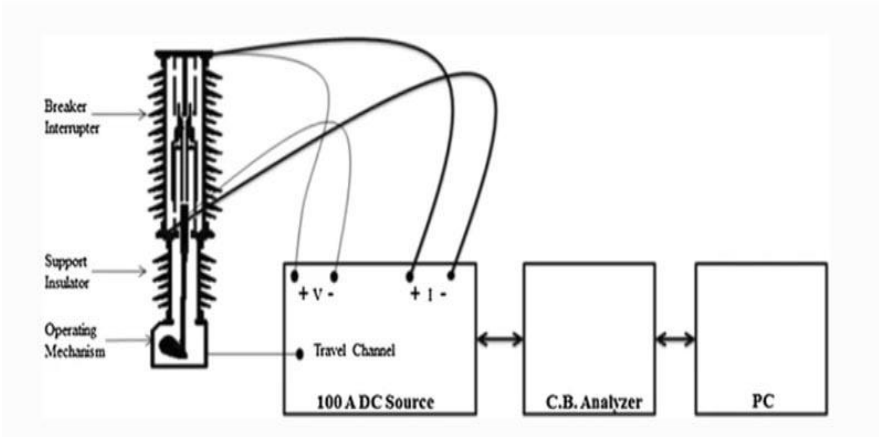
- **Dew Point Measurement** Dew Point is the temperature at which moisture content in SF6 gas starts condensing.
- **Permissible limits of dew point :**
  - -36 deg C at atmospheric pressure (commissioning)
  - -30 deg C at atmospheric pressure (O&M)
  - -28 deg C at atmospheric pressure (Critical)

DCRM (Dynamic Contact Resistance Measurement)

- By application of **Dynamic Contact Resistance Measurement**, condition of arcing contact, main contact, operating levers, driving mechanism can be predicted.
- DCRM is the technique for measuring Contact Resistance during operation (Close/ Trip) of a circuit breaker with a delay Tco of 300ms. A DC current of at least 100 Amp is injected through the circuit breaker. Sampling frequency is 10 kHz.
- The current and voltage drop are measured and resistance is calculated.
- The resistance and travel versus time data provides useful information on the condition of the circuit breaker contacts and is used as a diagnostic tool.
- Transducers are attached to the operating rod or interrupting chamber in order to record the contact travel. When CB closes, contact travel is recorded. Contact bounces or any other abnormality is also clearly indicated by the Contact Travel Measurement.

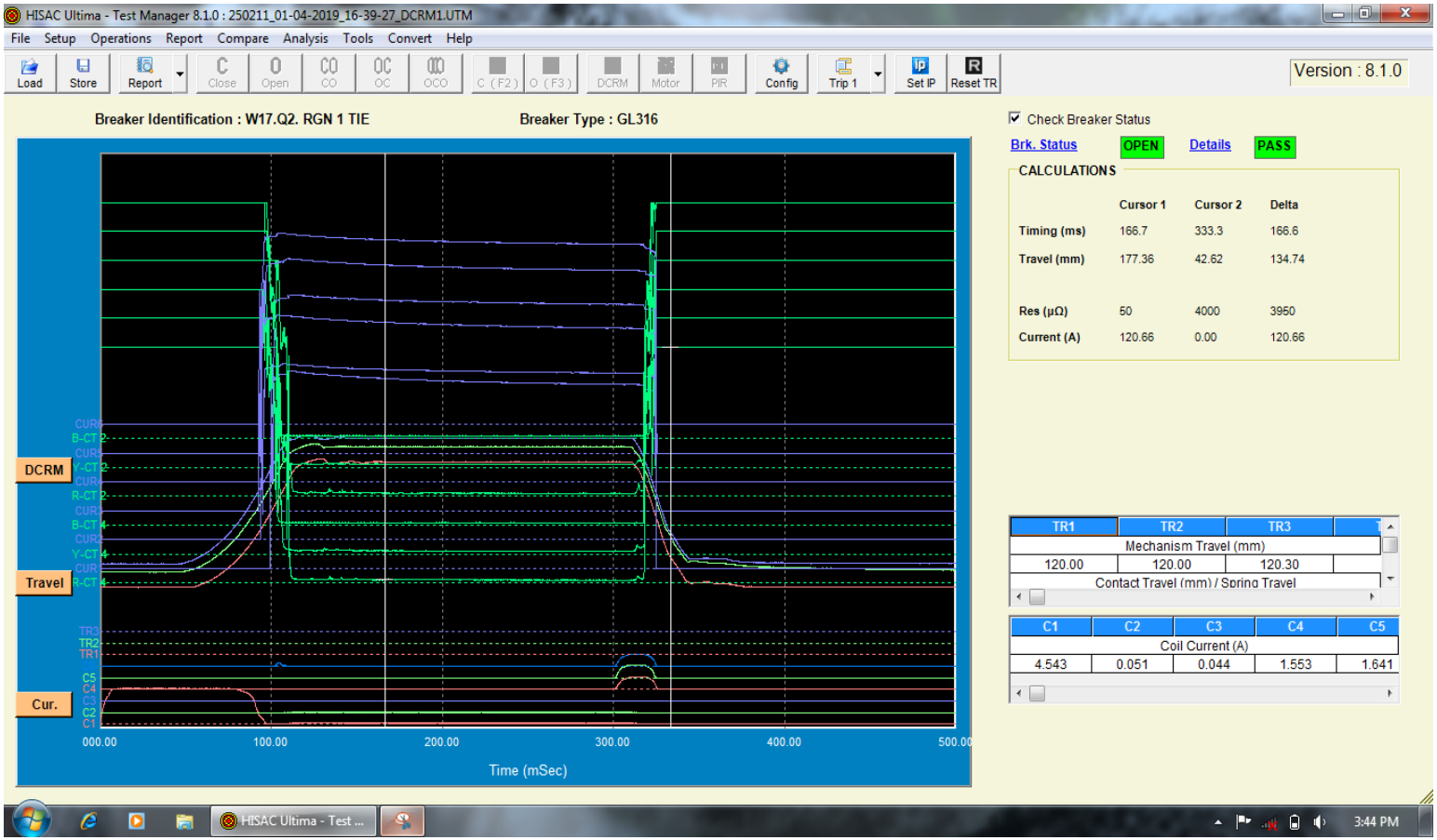




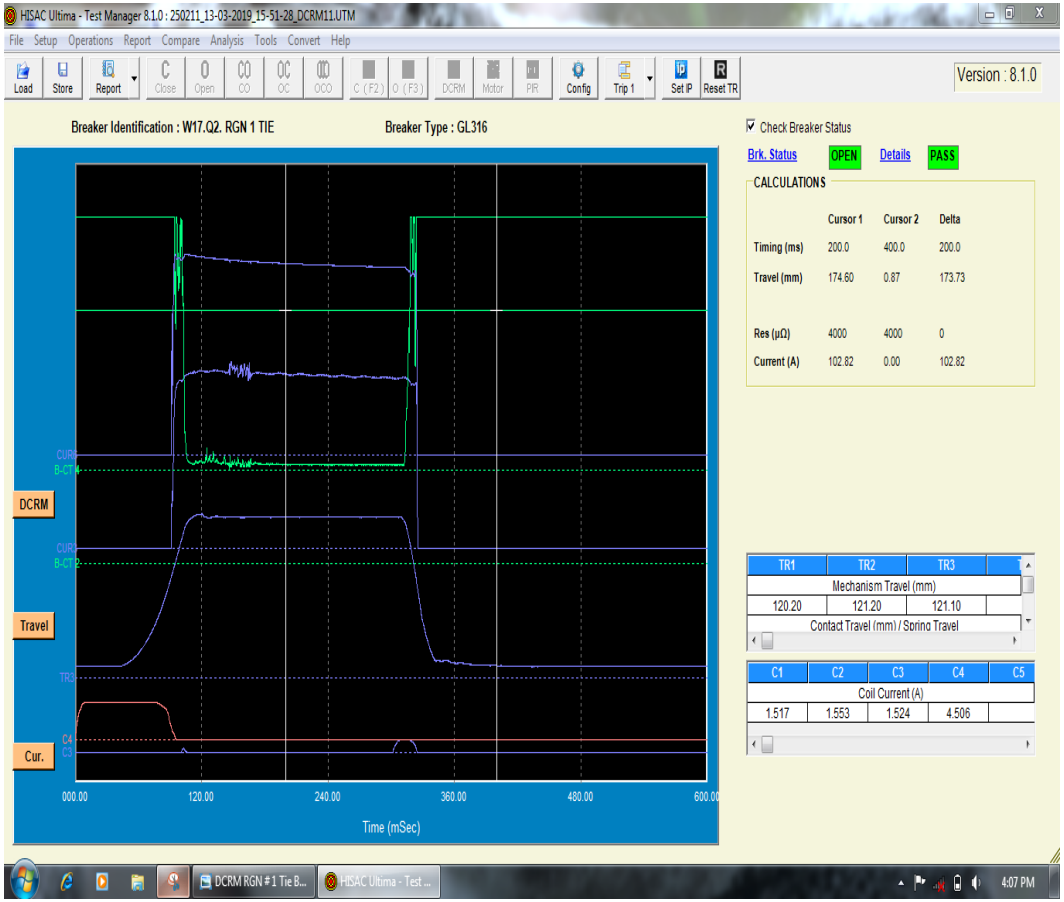


Schematic diagram of DCRM

DCRM signature

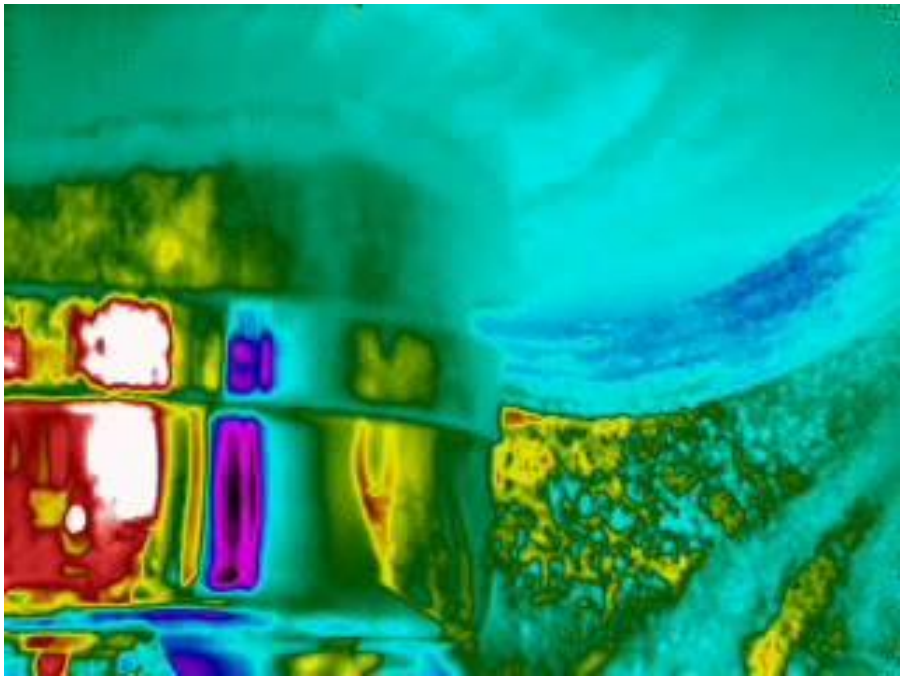


DCRM signature for Faulty CB – one side of the DAC was completely open



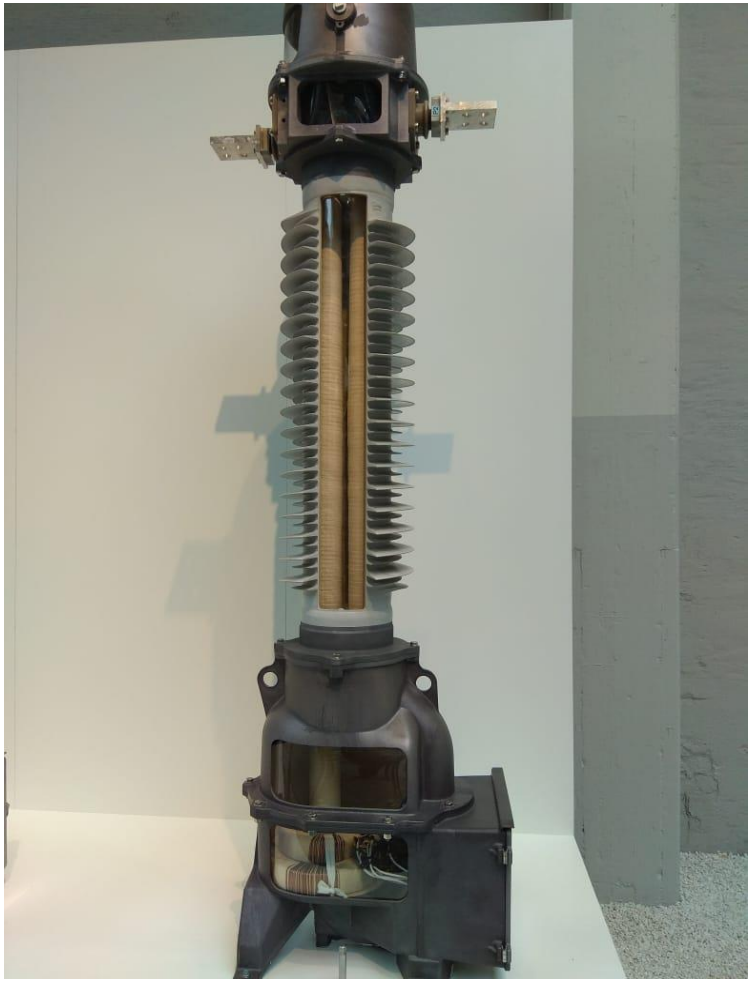
Circuit Breaker SF6 gas leakage detection

- Use of SF6 gas leakage detection camera in POWERGRID NERTS for detection of even the smallest leakage to arrest the greenhouse gas (SF6) leakage.



Current Transformer

Installed 400 kV CT



Internal view – for demo CT

Condition monitoring of CT

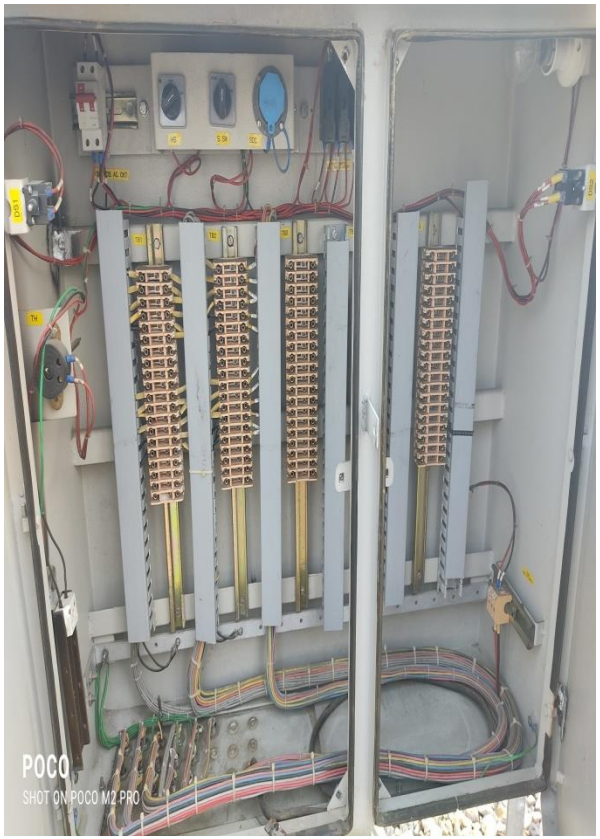
- **Monthly Activity**
  - Visual Inspection of CT for oil leakage and crack in insulators.

CT oil leakage pics detected by visual inspection

- **Yearly activity for CT**

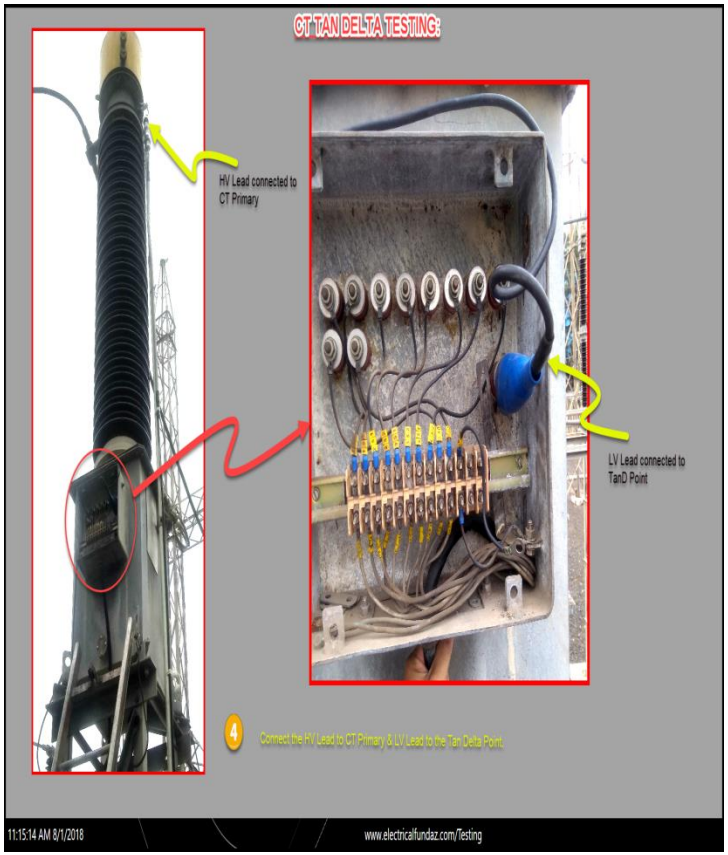
I. Marshalling Box

- Cleaning of MB
- Checking the tightness of all electrical connections including earthing of MB.
- Cleaning & tightness of CT secondary terminals.
- Checking of space heater & illumination.
- Checking of oil leakage from secondary terminal box in case of oil filled CTs.



II. Capacitance & Tan Delta Measurement of oil filled CT

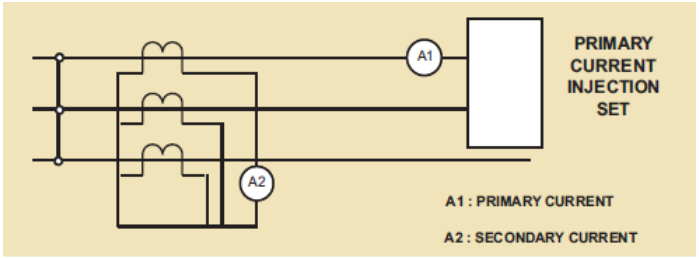
- Tan Delta (Maximum) – 0.007
- Rate of rise of tan delta – 0.001 per year (Max)
- value to be compared with previous years' results



Current Transformer – SOS Activity

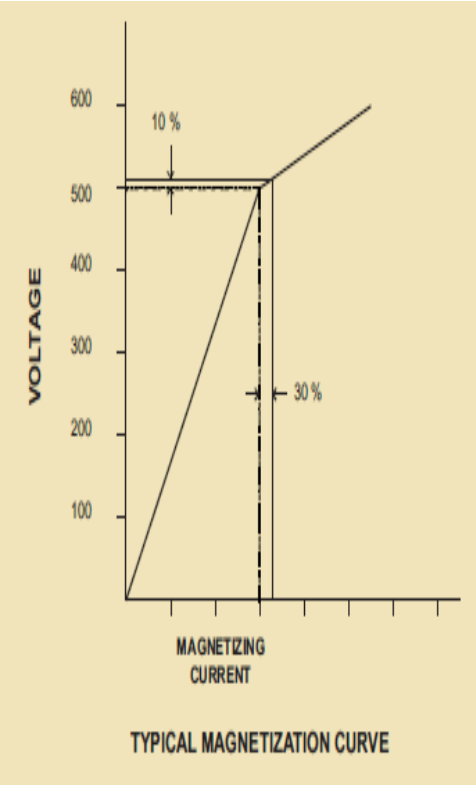
- **Dissolved Gas Analysis**
  - For new CTs, 1st sampling to be carried out within one month of commissioning
  - 2nd sampling to be carried out within 06 months to 12 months of commissioning.

- **Measurement of CT ratio -** The ratio errors of the primary to the secondary currents should within specified ratio errors.
  - *Permissible ratio error* :
    - Protection core : ± 3%
    - Metering core : ± 1%



- **Polarity Test -** To ascertain whether the polarity markings are correct or not as per drawing.

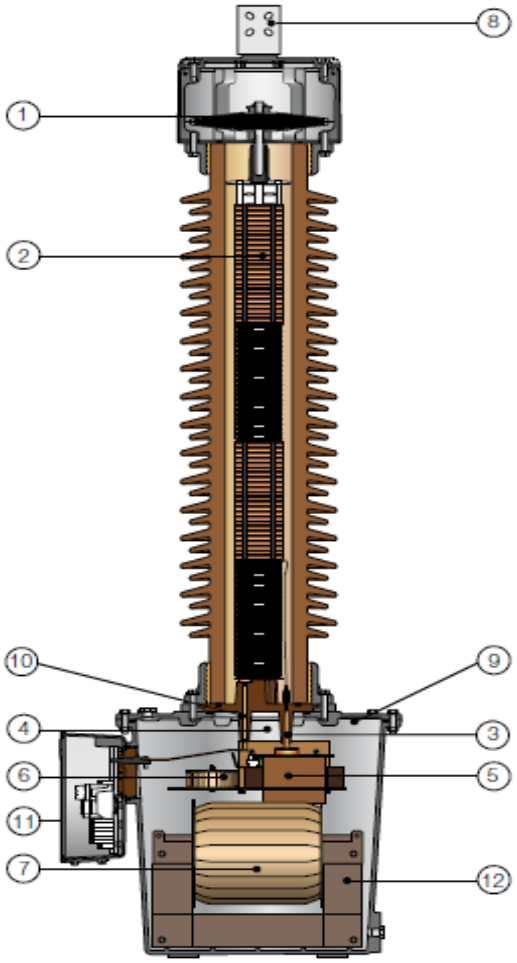
- **Measurement of secondary resistance –** to ascertain if there is any open circuit condition in the secondary circuit.
- **Magnetization characteristics of CT –**
- Knee Point Voltage is normally defined as the voltage at which 10% increase in the applied voltage causes 30 to 50% increase in secondary current.
- The magnetization current at rated Knee Point Voltage should not be more than the specified/designed value.
- A curve can be drawn between applied voltage and magnetizing current. Typically, the curve drawn should be like the one given Fig.
- Up to rated KPV (Knee Point Voltage), the VI curve should be almost a straight line.
- However, if this line is not linear, this indicates that the magnetizing characteristics are not desirable.



TYPICAL MAGNETIZATION CURVE

- **IR measurement of CT (Primary & Secondary windings)**
  - Changes in the normal IR value of CT indicate abnormal conditions such as presence of moisture, dirt, dust, crack in insulator of CT and degradation of insulation.
  - Permissible Limits :
    - Primary – Earth = 1000 Mohm (Min) by 5 kV Megger
    - Secondary – Earth = 50 Mohm (Min) by 500V Megger

Capacitive Voltage Transformer



Capacitor Voltage Divider

1	Expansion system
2	Capacitor elements
3	Intermediate voltage bushing
8	Primary terminal, flat 4-hole Al-pad
10	Low voltage terminal (for carrier frequency use)

Electromagnetic unit

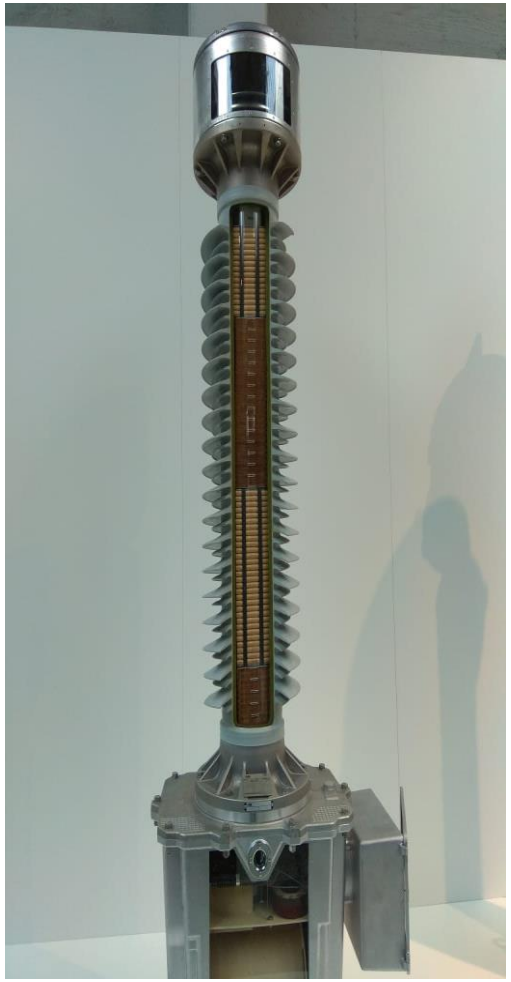
4	Oil level glass
5	Compensating reactor
6	Ferro-resonance damping circuit
7	Primary and secondary windings
9	Gas cushion
11	Terminal box
12	Core

Condition monitoring of CVT

- **6 monthly activity**
  - **Voltage drift measurement**
  - Measurement to be carried out simultaneously for same phase of Bus CVTs and line CVTs with 0.2 class multimeter.
  - Limits :
    - Upto ± 0.5 Volts – Healthy – 06 monthly
    - + 0.5 to +0.8 Volts – To be monitored – 03 monthly
    - +0.8 to +1.2 Volts – Close monitoring – monthly
    - +1.2 to +1.5 Volts – Close monitoring – 15 days
    - Above + 1.5 Volts – Alarming – Replacement
    - -0.8 to -4.0 Volts – Close monitoring – 15 days
    - Less than -4.0 Volts – Alarming – Replacement.

Yearly maintenance activity of CVT

- Visual checking of earthing of HF point (in case it is not used for PLCC)
- Checking of any breakage or cracks in HF bushing.
- Checking for any breakage or cracks in cementing joint.
- Cleaning of CVT capacitor stacks & tightness of terminal connections.
- Checking of Neutral earthing in CVT MB & tightness of all connections.
- Cleaning of MB & JB
- Checking of space heater & illumination.
- EMU checks : a) Checking of oil level
  b) Checking of oil leakage



SOS activity for CVT

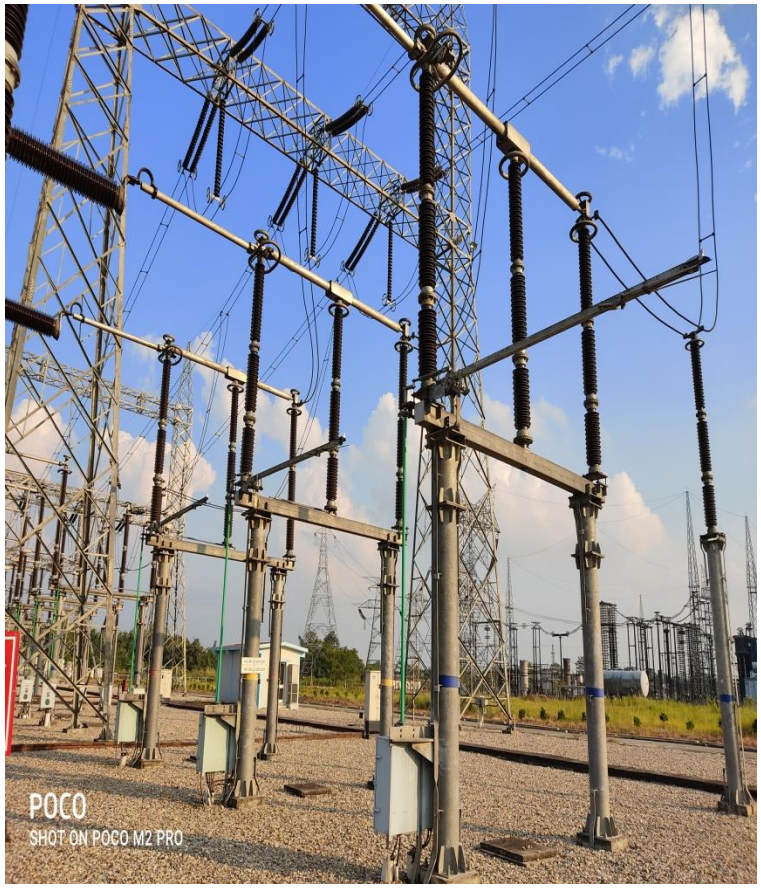
- **Capacitance & Tan Delta measurement of CVT**
  - Measurements to be carried out stackwise.
  - Due to presence of EMU connected to the bottom stack, tan delta values may come negative in some cases which can be ignored.
  - While measuring bottom & middle stack, short middle/top stack respectively.
  - Limits :
    - Tan delta (Max) - 0.007
    - Change in capacitance from Pre. Comm. value : ±5%

Other limits pertaining to CVTs.

- **IR value** :
  - Pri – E : 01 Gohm (Min) by 5 kV Megger
  - Sec – E : 50 Mohm (Min by 0.5 kV Megger
- **CVT voltage ratio errors** :
  - Protection cores : ± 5%
  - Metering cores : ± 0.5%
- **Contact Resistance of terminal connector**
  - 10 Micro – Ohm per connector

Damaged internal PT of CVT

Disconnectors & Earth Switches



Condition Monitoring of Disconnectors & Earth Switches

Yearly activity :

1. **Operating Mechanism**
   - Maintenance of linkages including transmission gears
   - Checking of stopper bolts
   - Cleaning of Aux. switch contacts & greasing with silicon grease.
   - Lubrication of operating mechanism hinges, lock joints on levers & bearings
   - Checking & tightening of all mounting bolts

2. Isolator

- Cleaning & greasing of main contacts
- Alignment of contacts /operating levers
- Tightening of Bolts, Nuts & Pins etc
- Cleaning of support insulators & check for cracks in insulators, if any
- Checking of interlocks (Mechanical & Electrical)
- Checking of corona rings for pitting & alignment

3. Earth Switch

- Checking & alignment of earth blades
- Checking of contacts
- Operation of earth switch
- Checking of continuity of Aluminium/ copper flexible conductor
- Checking of earth connections of structure & MOM box.

4. Marshalling boxes of Isolators & Earth Switches

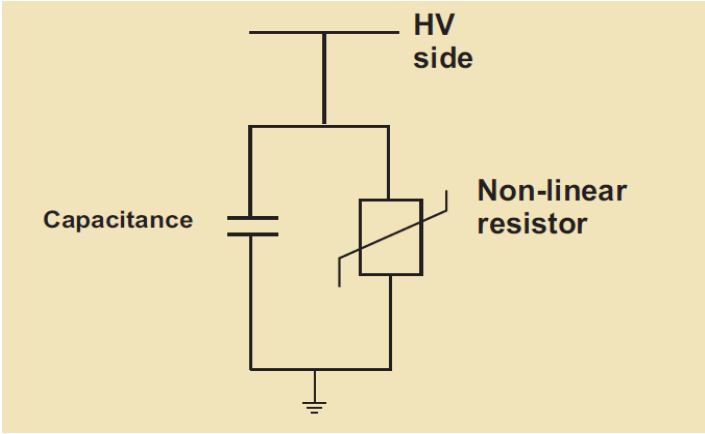
- Checking of space heater & illumination
- Checking of healthiness of rubber gaskets
- Visual check of auxillary contacts
- Cleaning & tightness of all terminations

- **Four yearly activity**
  - **Isolator** :
    CRM measurement – 300 µOhms (Max.)
  - **Earth Switch** :
    CRM measurement – 300 µOhms (Max.) :

Surge Arresters

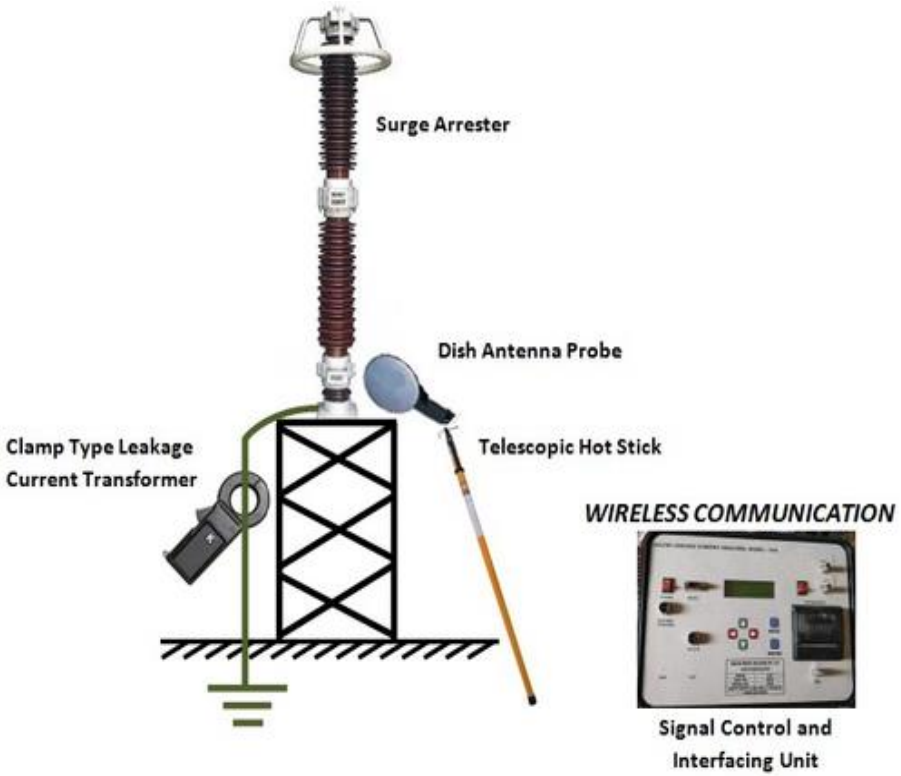
LA THRC test basics

- ZnO Surge Arrester continuously conducts a small leakage current. The resistive component of this leakage current may increase with time due to different stresses causing ageing and finally cause arrester failure.
- The total leakage current component is the sum of all harmonic components. But out of all the harmonic components, THRC is the most important as it is directly responsible for the degradation of LAs/SAs.



Arrester Equivalent Circuit

THRC test kit & set up



Condition Monitoring of Surge Arresters

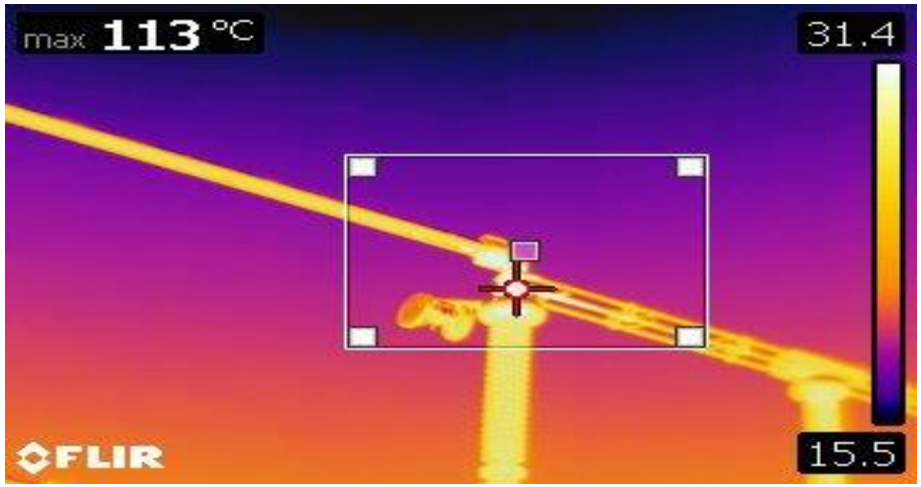
- **Half Yearly activity** :
  - Checking of Third Harmonic Resistive Current (THRC) in pre monsoon period & post monsoon period
  - Violation limits of THRC :
    - For new LAs (immediately after commissioning)
      - 120 kV - upto 30 µAmps
      - 216 kV - upto 30 µAmps
      - 336 kV - upto 60 µAmps
      - 390 kV - upto 30 µAmps
      - 624 kV - upto 100 µAmps
    - For LA in service
      - upto 150 µAmps - Normal
      - 150 to 350 µAmps - IR to be checked & removed on low IR value
      - Beyond 350 µAmps - to be removed

- **Yearly activity** :
  - Testing of Surge Monitor Counter & Meter
  - Cleaning of LA insulators

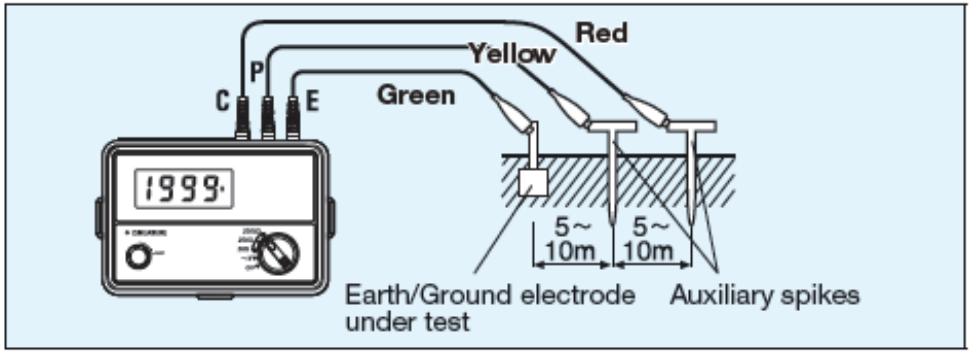
- **SOS activity** :
  - Capacitance & Tan Delta measurement – to be compared with pre commissioning values.
  - Insulation Resistance Measurement – 1000 Mega Ohm (Min.) per stack.

Miscellaneous

- **Thermovision Scanning :**
  Carried out quarterly
  - *Temperature Limits* **:**
    - upto 15 deg C above ambient – Normal
    - Above 15 to 50 deg C from ambient – Alert
    - Above 50 deg C from abient – Attend immediately



- **Earth pit resistance measurement**
  - Carried out annually
  - Station Earth Resistance : 1.0 Ohm (Max)
  - ICT/Reactor earth pit without grid : 10 Ohm (Max)
  - If earth resistance is more, proper treatment is to be given.



- **DC Earth fault & DC mixing checking done baywise during AMP**

- **Transformer Oil DGA**

Oil Parameters	Reference Standard: IS-1866:2017(In-Service)				Dissolved Gas Analysis	Test Method: IEC60567 Reference Standard: IEEE-C57.104		
PARAMETER	Unit Of Measurement	Measured Value	Violation/ Recommended Action Limit	Test Method	PARAMETER	UoM	Measured Value	Violation Limits, max
BreakDownVoltage	kV	57.6	FAIR	IS-6792	Total Gas Content	%	1.21	---
Water Content	ppm	9	GOOD	IS-13567	Nitrogen (N2)	%	0.90	---
Resistivity @ 90°C	E12 ohm-cm	63.0	GOOD	IS-6103	Oxygen (O2)	%	0.23	---
Resistivity @ 27°C	E12 ohm-cm	NT		IS-6103	Hydrogen (H2)	ppm	15	100
Tan Delta @ 90°C	--	0.0004	GOOD	IS-6262	Methane (CH4)	ppm	3	120
InterFacialTension@27°C	mN/m	41.9	GOOD	IS-6104	Ethylene (C2H4)	ppm	1	50
Total Acidity *	mgKOH/g	NT	NT	IS-1448 P-1	Ethane (C2H6)	ppm	0	65
Flash Point	°C	138.5	---	IS-1448 P-21	Acetylene (C2H2)	ppm	1.11	1
Sludge & Sediments *	%	NT	0.02 Max.	IS-1866	Carbon Monoxide (CO)	ppm	233	350
Appearance *		Colorless			Carbon Dioxide (CO2)	ppm	948	2500

THANK YOU

Annexure B.3

North East Regional Power Committee

PROTECTION PROTOCOL OF NORTH EAST REGION

Prepared in Compliance to

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

By

NERPC Secretariat

October 2023

(Effective from 01.10.2023)

Contents

PROTECTION PROTOCOL OF NORTH EAST REGION

1. Background

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

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 analyse 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**: In order 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. The protection system for 400kV and higher voltage transmission line and the line compensating equipment shall have one hundred percent back up communication channels i.e. two channels for tele- protection in addition to one channel for speech plus data for each direction. Provided that, for 220 kV, 132 kV, 110 kV and 66 kV lines, the channel for speech plus data can also be used for tele-protection

4.9. 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.

4.10. 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.

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. Hydro Generating Units

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 specializedprotection 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.

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. Transmission circuit construction can be considered in three main categories viz.: Overhead construction, Underground cable construction and Composite (overhead plus underground) construction.

5.6.2. Transmission circuit Main protection is required to provide primary protection for the line and clear all type of faults on it within shortest possible time with reliability, selectivity and sensitivity. Transmission circuit back-up protection shall cater for failure of any main protection system to clear any fault that it is expected to clear. A protection function that offers back-up for most faults may also provide main protection for some fault conditions. Combinations of main and back-up protection systems should be used to address the main and application specific requirements for transmission circuits.

5.6.3. Protection system of Transmission line shall have following features:

i) The systems applied must be capable of detecting all types of faults, including maximum expected arc resistance that may occur at any location on the protected line.

ii) The protection should be set not to trip under system transient conditions, which are not short circuits. Conversely where the short circuit current is low due to local grid conditions (weak network) or due to high resistance of the arc, this must be taken into consideration to trip the relay by using the most appropriate criterion, without jeopardizing the unwanted tripping during heavy load conditions.

iii) The design and settings of the transmission line protection systems must be such that, with high probability, operation will not occur for faults

external to the line or under non-fault conditions.

iv) Distance relay shall be capable to protect the series compensated lines from voltage inversion, current inversion phenomenon. Special measures must be taken to guard against these phenomenon

v) On 220kV and above transmission lines, 2 Main Protections (Main I and Main II), Inverse Definite Minimum Time (IDMT) directional back up Earth Fault protections alone to be provided. No back up over current protection to be applied.

vi) The Main-I and Main-II protection shall be numerical relays of different makes or employ different fault detection algorithm. They should be provided carrier aided tripping and powered by two separate DC sources

vii) Both Main-Main-II and I shall send initiation signal to Breaker Failure Relay (BFR) /LBB protection system.

viii) Internal DEF (Directional earth fault) function shall be set to trip the line in case of high resistive earth fault.

ix) The internal overvoltage function shall be used to protect the line against over voltages. Two stage over voltage protection for the transmission lines (Stage-I as Voltage and Time graded & Stage-II @ 140% of Nominal Voltage with time delay 100 ms) shall be implemented for the transmission lines of voltage levels 400kV and above only. The lines emanating from same substation shall be provided with pick-up as well as time grading to avoid concurrent trippings. The overvoltage relay shall have better than 98% drop-off to pick-up ratio (the ratio of the limiting values of the characteristic quantity at which the relay resets and operates). For over voltage detection, though Ph-to-N voltage is preferable to Ph-to-Ph voltage, to achieve required discrimination for OVR grading because of limitation imposed by voltage resolution of the relay, Ph-to-Ph voltage to be used for Over Voltage detection.

x) On 132kV and lower voltage transmission lines, only one Main protection and Back up protection by Inverse definite Minimum time (IDMT) directional O/C and E/F to be applied. Main protection should be suitable for single or three phase tripping. Additionally, auto-reclose relay suitable for 1 ph or 3 ph (with dead line charging and synchro-check facility) reclosure shall be provided.

xi) For very short lines less than (10) ten kilometers (any voltage level 132kV and above), cables, and combination of cable and overhead line, Differential protection (segregated phase type) has to be provided as Primary protection with distance protection as back up protection (built-in Main relay or standalone). Zone-I protection feature shall get automatically enabled in case of communication failure observed by the differential relay for built in Main and in case of LDP relay

failure/communication failure for stand alone The current differential protection should a reliable type (preferably digital). The protection should be of the segregate phase type, i.e. it should be able to detect the phase in fault and therefore for the case of single line-ground (SLG) faults to trip only the phase in fault (also to establish single phase A/R). The synchronization of the measured values is done via a communication system. The communication system for differential line protection should be based on fibre optic and any equipment should comply with the IEC 60834.

5.6.4 33kV OUTGOING FEEDER SETTING PHILOSOPHY

Note: Trend analysis (observation of events over a period) should also be incorporated during calculation of time gradient settings with Distribution Substations at Grid Substation end.

1. The protection functions to be activated are:

   a. Non-directional Overcurrent Protection (IDMT Normal Inverse Curve)

   b. Non-directional Earth fault Protection (IDMT Normal Inverse Curve)

   c. Non-directional Definite Time Overcurrent and Earthfault Protection

   d. Local Breaker Backup Protection

   e. Under/Over-frequency, df/dt, Under/Over voltage should only be enabled if there is any case special case of system requirement

2. The TMS for overcurrent and earthfault may be kept at 0.1 (fixed). The downstream DISCOM Substations should maintain a time gradient with respect to observed average fault current and TMS kept at Grid Sub-station end.

3. If long network of LILO DSS (Distribution SS) are present, extreme inverse, very inverse curve may be followed at DSS end.

4. The Highset for OC and EF at Grid SS (GSS) side should be kept at 50ms. The Distribution SS (DSS) should keep their Highset at instantaneous. This would allow a time gradient of 50ms in case of Highset pickups at both GSS and DSS ends. The Highset delay at GSS may be increased only in case when Highset overlapping is observed in the feeders. (This may arise when the CB opening time and arc extinguishing time at DSS end is increased due to wear and tear)

5. The Highset may be kept between 3A to 5A (As per trend analysis).

6. Harmonic Restraint feature is to be enabled.

7. The pickup of overcurrent should be kept at least 1.1 times the CT ratio. Basically, 400/1A ratio is adopted at 33kV Level outgoing feeders. (The maximum demand being 20MW). The OC pickup should be kept at 440A

8. The pickup for earth fault protection is normally kept at 80A. However, the special case may be taken into account:

   If a 33kV Feeder is kept at less load most of the times (say, 2MW). The maximum

load current in the line will be 40A (Approx.) In case of open circuit fault (no earth path), the feeder will not trip, as the zero-sequence current read by the relay will be 40A and the pickup of earth fault is kept at 80A. Such cases may be hazardous in case the line travels through city area. In that case, the earthfault pickup should be kept at a lower value (say 35 to 40A). Open circuit fault in such cases, will lead the relay to issue a trip on earth fault IDMT.

The Time gradient between 33kV Feeder at GSS end and Transformer LV side should also be maintained at 300ms.

5.6.4. Philosophy for protection settings:

Sl. No.	Protection setting		Reach and time
1.	Distance protection	Zone 1(Forward)	80% of the protected line, instantaneous
		Zone 2(Forward)	120% of the protected line (150% in case of D/C line). Time delay: 350msec (generally) and 500msec in case 20% of the protected line is greater than 60% of the shortest line at remote end
		Zone 3(Forward)	120% of the protected line + 100% of the longest line emanating from the far end bus bar. Time delay: 800msec
		Zone 4 (Reverse)	• For lines < 100 km 10% of the protected line or 50% of adjacent shortest line, whichever is lower • For lines > 100 km 20% of the protected line or 50% of adjacent shortest line, whichever is lower Time delay: 500mesc
2.	Line differential protection		Primary protection for lines less than 10KM. Time delay: instantaneous
3.	LBB protection and Bus Bar Protection (for 220kV and above as well as all Generating stations)		Two stage: Stage-I: (Re-Trip) time delay of 100 msec to trip own CB Stage-II: LBB time delay: 200msec to trip all CBs connected to the respective bus, LBB Current sensor I >20% In Bus bar protection time delay: instantaneous
4.	O/C back up protection (for 132kVand below)	IDMT	For I>1 Ib = 150% of current rating of the line. Time delay: to be coordinated with Z2 for three phase fault at remote bus (500msec). Forward directional For I> 2 (and above) Generally disabled unless decided otherwise by NERPC for special scenario
5.	E/F backup protection(for 132kV and above lines)	IDMT	For In>1 Ib= 20 % of current rating of the line. Time delay: to be coordinated with Z3 for single phase to ground fault at remote bus (900msec). Forward directional For In>2 (and above) Generally disabled unless decided otherwise by NERPC for special scenario
6.	Broken conductor protection (alarm only)		Negative Sequence current to Positive Sequence current ratio more than 0.2(I2/I1 ≥ 0.2) Only for alarm: Time delay = 3-5 sec

6.	**Allowable Load impedance encroachment**	**Imax = 150% of current rating of line** **Vmin = 0.85pu (85%)** **30 degrees for load blinder**
7.	**Power swing Blocking function**	**Block all zones except Zone-1 or** **Block all zones and trip with OOS function**
8	**Carrier Aided Protection**	**To be provided on 132kV and above lines (PLCC or DTPC)**

9.	**Single/Three phase auto reclosure**		**To be provided on 132kV and above lines on Zone 1 or differential relay operation Dead time = 1.0s for Main CB, 1.5 to 2 sec for Tie CB. Reclaim time = 25.0s**
10.	**Over voltage protection (two stage, for 400kV and above only)**	**Stg I***	**V>110%. Time delay: 5 seconds**
		Stg II	**V>140%. Time delay: 100msec**
11.	**Carrier Aided Protection**		**Mandatory for Distance protection**
12.	**Antitheft Charging of line**		**Distance setting: Time delay for Z-1/2/3 should be made instantaneous which will help to trip immediately during fault and would not disturbed the remote end setting of other lines connected from the substation. Dir EF: Pickup to be 20 % of rated current and TMS as minimum as possible. O/V setting: Stage-1 pickup should be minimum of that of all lines connected from the charging substation with minimum time delay and grading as possible.**

*** The OVR grading, Voltage and Time graded, for the Stage-I over voltage protection shall be as recommended by NERPC/NERLDC**

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 shall coordinate its Protection System schemes with concerned transmission system, sub-transmission system and generators.

ii) Each Generating Company shall coordinate its Protection System schemes with concerned transmission system and station auxiliaries.

iii) Utilities may seek assistance of NERPC and NERLDC also for ensuring coordination

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 one week of receipt of such a request from the entity.

vi) Each user, for voltage levels 132kV and above, 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 NERPC/NERLDC for every new/modified element to be commissioned. The mentioned information shall be submitted to the NERPC/NERLDC **fifteen** days in advance for all the elements proposed to be commissioned. The user has to obtain relay setting approval by NERPC before FTC can be provided.

vii) FTC will only be issued after complete relay setting coordination is ensured by the applicant. It is the responsibility of the utility, which is applying for the FTC of any element, to coordinate with concerned utilities to ensure that they complete the relay coordination before applying for FTC

viii) The PCCM of NERPC shall review the settings to ensure that they are properly coordinated with adjacent system and comply with the existing guidelines. The forum may issue proper directions to utilities in this regard.

ix) All users connected to the grid shall obtain approval of the NERPC for any revision in settings, and implementation of new protection system

x) All users connected to the grid shall ensure correct and appropriate settings of protection as specified by the NERPC and intimate to the NERPC about the changes implemented in protection system or protection settings within a fortnight of such changes

xi) In case of failure of a protective relay or equipment failure, the Generating Company and Transmission Licensee shall inform appropriate LDC/NERLDC/NERPC. The

Generating Company and Transmission Licensee shall take corrective action as soon as possible.

xii) NERPC in consultation with the NERLDC & 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 NERPC & NERLDC. The modifications/changes, if any, in protection settings shall be advised to the respective users and STUs.

xiii) NERPC 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 132 kV and above. NERLDC also shall maintain such database.

xiv) Respective entities are responsible for ensuring to make available the implemented protection settings in the centralized database before obtaining FTC.

xv) If System Protection Schemes (SPS) is recommended to be implemented by the appropriate forum/Sub-Committee of NERPC 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 behaviour 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.

ii) Each line shall be provided with facility for distance to fault locator.

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 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.)
- V sync(for Three phase Auto reclose scheme)Three phase currents and neutral currents.
- Mutual compensation current (in case of double circuit line)
- 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 shall be specified by the PCC of NERPC.

vi) 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 as per 59th PCCM**). 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.

vii) 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.

viii) The time synchronization of the disturbance recorders shall be corroborated with the PMU data or SCADA event loggers by NERLDC. NERLDC shall list out for

Disturbance recorders which are non- compliant for discussion in PCC meetings of NERPC.

ix) Each Transmission Licensee and Generating Company shall submit the data files to the NERLDC 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**.

x) 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.

xi) 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 NERLDC and NERPC. 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 NERLDC through voice message.

ii) Written flash report shall be submitted to NERLDC 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 NERLDC.

iv) NERLDC shall classify the grid incidents and grid disturbances according to CEA (Grid Standards) Regulations, amended to date. NERLDC shall report the event (grid disturbance or grid incidence) to CEA, NERPC 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 NERLDC and NERPC.

vi) NERLDC 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 NERPC 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 NERLDC	Discussion in PCC and final report submission deadline by NERPC
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 NERLDC shall be discussed in the Protection Coordination Sub-Committee (PCC) meetings of the NERPC. 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 repot 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 NERPC.

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 NERPC, NERLDC and concerned SLDC shall be furnished by the Users including NERLDC 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 NERPCs, NLDC, NERLDCs 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 NERLDC and NERPC 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 NERLDC 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 NERLDC or concerned SLDC within 24hours 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 NERPC including those in the State grids that are critical for regional grid operation to NERPC and NERLDC 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

8.1 All Users/Entities connected at 132 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 NERPC. The audit report along with action plan for rectification of deficiencies detected, if any, shall be shared with NERPC.

8.2 All users shall also conduct third party protection audit of each sub-station at 132 kV and above once in five years or earlier as advised by the respective RPC.

8.3 After analysis of any event, PCC of NERPC 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.

8.4 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 NERPC and NERLDC 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 NERPC.

8.5 Annual audit plan for the next financial year shall be submitted by the users to NERPC by 31st October every year. The users shall adhere to the annual audit plan and report compliance of the same to NERPC.

9. Performance Monitoring of the Protection Systems

9.1. Users/Entities shall submit the following protection performance indices of previous month to NERPC and NERLDC on monthly basis for 132 kV and above by 10th of the subsequent month and the same shall be reviewed in the ensuing PCC meeting of NERPC.

a) The Dependability Index defined as: D=(NC+NF)

Where, NC is the number of correct operations at internal power system faults and

NF is the number of failures to operate at internal power system faults.

b) The Security Index defined as: S=(NC+NU)

Where, NC is the number of correct operations at internal power system faults and

NU is the number of unwanted operations.

c) The Reliability Index defined as: R=(NC+NI)

Where, NC is the number of correct operations at internal power system faults and

NI is the number of incorrect operations and is the sum of NF and NU

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

10. Compliance Monitoring

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

10.2. Violation of the Protection Protocol of the North Eastern Region shall be brought to the notice of NERPC by the NERLDC 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 NERPC within the specified timelines, the NERPC would approach the Commission with all relevant details for suitable directions.

***

SCHEDULE- I

[See sub-regulation (10) of regulation 10]

List of Electrical Protection Functions for Thermal Generating Units

1. Generator

Sl. No.	Protection Function	Remarks
(a)	Generator differential protection (87G)	
(b)	100% stator earth fault protection (64G)	For units of 100 MW and above.
(c)	95% stator earth fault protection (64G1)	For units less than 100 MW.
(d)	Standby stator earth fault protection (64G2)	
(e)	Inter-turn fault protection (87TG)	Applicable where split winding in Stator is provided and if six terminals are available.
(f)	Loss of field protection (40G)	To be duplicated for units of 500 MW and above.
(g)	Negative phase sequence current protection (46G)	
(h)	Low-forward power and Reverse power interlock for steam turbine generator (37/ 32G)	Preferably 3-phase power relays shall be provided. Both the relays shall be duplicated for units of 500 MW and above.
(i)	Rotor earth fault protection - two stages (64F1/F2)	
(j)	Definite time over-voltage protection (59G)	
(k)	Generator under frequency protection (81G)	
(l)	Over-fluxing protection for generator (99G)	To be provided for units of 500 MW and above in duplicate.
(m)	Overload protection for generator (51G)	
(n)	Back- up impedance protection, 3 pole (21G)	
(o)	Overheating (winding and/ or bearing) (49G)	Alarm only.
(p)	Instantaneous and time delayed over current protection on high voltage side of excitation transformer (51)	
(q)	Generator pole slipping protection (98G)	
(r)	Accidental back energisation protection (50GDM)	
(s)	Generator circuit breaker failure protection (50ZGCB)	To be provided for GCB scheme only.

Note: In case digital multifunctional generator protection system is provided, the protection systems for generator shall be duplicated for units of one hundred mega watt and above. Each MGPS shall preferably be provided with individual inputs from CTs and VTs and connected to the independent set of hand-reset trip relays, such that one set is always available in case of testing and mal-operation of the other set. If the MGPS does not include any protection mentioned in the table above, separate discrete protection shall be provided for the same. The MGPS shall preferably have continuous self-monitoring and testing facilities.

2. Generator Transformer

Sl. No.	Protection Function	Remarks
(a)	Overall differential protection (87OA)	
(b)	Generator transformer differential protection (87GT) for single phase bank	
(c)	Restricted earth fault protection for generator transformer (87NGT)	
(d)	Over head line connection differential protection (87L)	For 3 single phase banks, if 87L

		includes HV winding, separate 87NGT is not mandatory.
(e)	Back- up earth fault protection on generator transformer HV neutral (51NGT)	
(f)	Over-fluxing protection for generator transformer (99GT)	To be duplicated for units of 500 MW and above.
(g)	Back- up non-directional over-current protection in all phases on HV side of generator transformer (51GT)	
(h)	Generator transformer oil temperature indicator (OTI) trip (49Q) and winding temperature indicator (WTI) trip (49T)	
(i)	Generator transformer Buchholz (63), Pressure relief valve (PRV)/ other mechanical protections	
(j)	Pole discrepancy protection of generator transformer breaker (162)	To be provided, if single pole breakers are used.
(k)	Breaker failure protection of generator transformer breaker (50Z)	
(l)	Start-up earth fault protection for LV and HV winding of generator transformer and UATs (64T)	To be provided for GCB scheme only.

3. Unit Auxiliary Transformer(s)

Sl. No.	Protection Function
(a)	Differential protection (87UAT)
(b)	LV back-up earth fault protection (51NUAT)
(c)	LV restricted earth fault (87NUAT)
(d)	Back-up over-current protection (51UAT)
(e)	OTI(49Q) and WTI (49T) trip
(f)	Buchholz (63), PRV/ other mechanical protections

4. Station- Transformer(s)

Sl. No.	Protection Function
(a)	Differential current protection (87)
(b)	Restricted earth fault protection for LV winding (87NLV)
(c)	Restricted earth fault protection for HV winding (87NHV)
(d)	Back-up over-current protection on HV side (51)
(e)	Back-up earth-fault protection (51N)
(f)	Over-fluxing protection (99)
(g)	Buchholz protection (63)
(h)	Winding temperature high (49T)
(i)	Oil temperature high (49Q)
(j)	Pressure relief valve trip (PRV)
(k)	Breaker failure protection (50Z)

SCHEDULE-II

[See sub-regulation (3) of regulation 12]

Design Requirements for Ash Handling System

A. Design Requirements for Ash Handling System of Pulverised Fuel Steam Generators

1. The capacity of ash handling systems, as a percentage of maximum ash generated corresponding to firing of worst coal or lignite at boiler maximum continuous rating, shall not be less than the following:

		-	100% standby blowers for intermediate and storage silos;
		-	50% standby for air compressors to be used for transporting ash.
(c)	Ash slurry disposal	-	One pump stream as operating standby and one pump stream as maintenance standby for wet slurry system;
		-	One standby stream for high concentration slurry system.

SCHEDULE-III

[See sub-regulation (7) of regulation 36]

The minimum Load for Continuous Operation for Various Types of Hydraulic Turbines

Sl. No.	Type of turbine	Minimum load for continuous operation (percent)
(a)	Pelton or Kaplan or Bulb	30
(b)	Deriaz	40
(c)	Francis	50
(d)	Propeller	85

SCHEDULE-IV

[See clause(f) of sub-regulation (12) of regulation 40]

Minimum Protections to be provided for Hydro- electric Generating Units

1. Generator

Sl. No.	Protection functions	Size of generating unit		
		Small (<10 MVA)	Medium (10-100 MVA)	arge (> 100 MVA)
(a)	Differential (87G)	Y	Y	Y
(b)	95 % stator earth fault (64G1)	Y	Y	Y
(c)	100 % stator earth fault (64G2)	N	Y	Y
(d)	Backup impedance (21G)	N	Y	Y
(e)	Voltage controlled over current (51)	Y	N	N
(f)	Negative phase sequence (46G)	Y	Y	Y
(g)	Loss of excitation (40G)	Y	Y	Y
(h)	Reverse power (37/32G)	Y	Y	Y
(i)	Pole slipping (98G)	N	N	Y
(j)	Stator overload (49S)	Y	Y	Y
(k)	Over voltage (59G)	Y	Y	Y
(l)	Under frequency (81G)	Y	Y	Y
(m)	Dead machine (27/50G)	N	N	Y
(n)	Rotor earth fault (64R)	Y	Y	Y
Note: Y- Required; N- Not required.				

2. Excitation Transformer

Sl. No.	Protection functions	Size of generating unit		
		Small (< 10 MVA)	Medium (10-100 MVA)	Large (> 100 MVA)
(a)	Restricted earth fault (64)	Y	Y	Y
(b)	Instantaneous and IDMT over current (50/ 51)	Y	Y	Y
(c)	Winding temperature (49)	Y	Y	Y
Note: Y- Required.				

3. Generator Transformer

(a) Generator transformer differential protection (87T)
(b) Restricted earth fault protection (64GT)
(c) IDMT over current protection (51)
(d) Neutral grounding back-up earth fault protection (51NGT)
(e) Over head line connection differential protection (87L)
(f) Overfluxing protection (99GT)
(g) Monitoring of Insulation of low voltage bushing (59T)
(h) Buchholtz relay (63)
(i) Winding temperature protection (49T)
(j) Oil temperature protection (49)
(k) Pressure relief valve (PRV)

4. Generator and Generator Transformer

(a) Overall differential protection (87OA)
(b) Breaker Failure Protection (50Z)

5. Unit Auxiliary Transformer

(a) Restricted earth fault protection (64)
(b) Instantaneous and IDMT over current protection on high voltage winding (50/51)
(c) Neutral grounding back-up E/F protection (51NGT)
(d) Winding temperature protection (49T)

6. Station Auxiliary Transformer

(a) Restricted earth fault protection (64)
(b) Instantaneous and IDMT over current protection on high voltage winding (50/51)
(c) Neutral grounding back-up earth fault protection (51NGT)
(d) Winding temperature protection (49T)

SCHEDULE-V

[See sub-regulation (3) of regulation 48]

Protection Details of Transmission Lines, Transformers, Reactors and Bus Bars

1. Transmission Line Protection

No.	Protection	765 kV	400 kV	220 kV/230 kV	132 kV/110 kV/ 66 kV
(a)	Main l- Distance protection*	Y	Y	Y	Y (for 132 kV/110 kV) Y/N (for 66 kV)
(b)	Main Il- Distance protection* or directional comparison protection or phase segregated line	Y	Y	Y/N 'N' if Directional IDMT over	N

	differential protection			current and earth fault back up protection is provided otherwise 'Y'	
(c)	Directional inverse definite minimum time (IDMT) type earth fault relay	Y	Y	'Y' if both Main-I & Main-Il are distance protections otherwise 'N'	N
(d)	Directional IDMT over current and earth fault back up protection	N	N	'Y' if Main-II is not provided otherwise 'N'	Y
(e)	Two stage over voltage protection	Y	Y	Y/N	Y/N
(f)	Auto reclosing#	Y (Single phase and three phase)	Y (Single phase and three phase)	Y (Single phase and three phase)	Y/N (three phase)

***For short line (less than 10 km) or cable or combination of overhead line and cable, line differential protection shall be used with built-in backup distance protection.**

 # For cable or combination of overhead line and cable, autoreclosing shall not be provided.

Note: (1) Y- Required; N- Not required; Y/N- Optional.

(2) Transmission lines with distance protection shall, in general, have carrier aided or fibre optic based inter-tripping or blocking feature.

(3) Separate cores of current transformer and voltage transformer shall be used for Main-I and Main-ll.

2. Transformer Protection

Sl. No.	**Protection**	**765 kV**	**400 kV**	**230 kV/220kV/ 132 kV/110 kV**	**66 kV**
(a)	Differential protection	Y	Y	Y	Y
(b)	Over fluxing protection	Y	Y	Y	N
(c)	Restricted earth fault (REF) protection	Y	Y	Y	Y
(d)	Backup directional over current and earth fault protection (HV and LV side) or impedance protection	Y	Y	Y	Y
(e)	Buchholz, WTI and OTI (for 1 MVA and above), MOG with low oil level alarm, OSR for OLTC, PRD, SA on both primary and secondary sides of transformers located outdoors and connected to over head lines	Y	Y	Y	Y
(f)	Tertiary winding protection	Y	Y	Y	N

Note: (1) Y- Required; N- Not required.

(2) WTI- winding temperature indicator; OTI- oil temperature indicator; OLTC- on load tap changer; PRD- pressure relieve device; OSR- oil surge relay; MOG- magnetic oil gauge; SA- surge arrester.

3. Reactor Protection

Sl. No.	Protection	765 kV	220kV /400 kV
(a)	Differential protection	Y	Y
(b)	REF protection	Y	Y
(c)	Reactor backup protection (impedance type or definite time over current (O/C) and earth fault (E/F) protection)	Y	Y
(d)	Buchholz, WTI, OTI, MOG with low oil level alarm, SA (if required)	Y	Y

Note: (1) Y- Required.

(2) WTI- winding temperature indicator; OTI- oil temperature indicator; MOG- magnetic oil gauge; SA- surge arrester.

4. Bus Bar Protection and Local Breaker Backup Protection (breaker failure protection)

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. Duplication of bus bar protection shall be done for all main buses of 400kV and above voltage class. The bus bar protection scheme shall be centralized or distributed type and have provision for planned future expansion.

SCHEDULE-VI

(See regulation 49)

PART-A

Technical Details of Classical HVDC Terminals/ Stations

1. **General:** The conventional Thyristor (Gate Turn On device) based HVDC converter technology or Line Commuted Converter technology or Current Source Converter technology shall be used for back to back and long distance bulk power HVDC transmission system. Gate Turn Off devices / other better devices capable of handling similar or higher quantum of power may also be considered.
2. **Design Consideration:** (a) The converter configuration and rating for HVDC installation shall be based on following considerations:
   (i) The amount of power to be transmitted
   (ii) The transmission distance
   (iii) Staging consideration of the project
   (iv) Location of converter station
   (v) The amount of power to be transmitted at the different stages of the project
   (vi) Reliability and availability requirements
   (vii) Loss evaluation
   (viii) Size and weight of the Converter transformers for transport
   (ix) Electrical characteristics of sending and receiving end power system to which HVDC transmission system is connected

Note: The DC power rating shall include nominal, reverse, forward and overload power levels, specific loading cycle and weightage factor to calculate load losses.

(b) Electric design of HVDC transmission lines shall take into account the following considerations:

(i) Corona performance (Corona loss, Radio Interference, Audible Noise, Electric field and ion current in the vicinity of the line)

(ii) Air Characteristic

(iii) Insulator performance

(c) The minimum conductor height above Ground level shall be selected mainly on the basis of ensuring human safety, Ground level electric field and ion current density level. The corona loss with I^2R losses

harmonic injection and self-excitation. Sub Synchronous Damping (SSD) Controller shall be provided for converter Stations near Generating stations.

(A) Load frequency controller (LFC)

(B) Current margin controller

(C) Excessive reactive power consumption controller

(D) AC system stability function, such as power swing damping function.

(E) Run back / Run up controller with provision to be linked to SPS of System Operator

(iv) The pole control, converter control, and valve control modules shall also be provided.

(v) The control shall be designed to give fast stable and proper response to normal control actions as well as during disturbances such as AC & DC faults.

(b) Protection System

(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 busbars. 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 shall have two redundant systems with following protections.

(A) Converter differential protection;

(B) DC over current protection;

(C) DC differential protection;

(D) AC conductor ground fault protection;

(E) Commutation failure protection;

(F) DC filter protection#;

(G) DC smoothing reactor protection;

(H) DC line ground fault protection with restarts#;

(I) DC line differential protection#;

(J) DC under voltage/ over voltage protection;

(K) Ground Return mode / Dedicated Metallic Return (DMR) protection#

(L) AC filter protections

(M) Electrode line monitoring and protection#

(N) Thyristor Failure Monitoring

not applicable for back to back schemes

(iv) DC online fault locators shall be provided to monitor the entire DC line length and give location of the fault with good accuracy in the range of $\pm$ 1000 meters

(c) 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. Operation of the HVDC bipole system shall be possible in the following modes:

(i) Balanced/ unbalanced bipolar operation;

(ii) Monopolar operation with pole metallic return:

(iii) Monopolar operation with ground return / with Dedicated Metallic Return (DMR) mode;

(iv) Reduced voltage operation;

(v) Power reversal mode.

(d) The 'Sequence of events' recorder, transient fault recorder, on-line DC Line fault locator, GPS system, visual display system, operator control protection and monitoring system shall be a part of the HVDC system.

14. Telecommunication- For smooth operation of the HVDC system, communication network with high reliability and availability shall be provided for transmission of control and protection signals between the two or more (in case of multi-terminal DC) HVDC terminals. There shall be main and back up communication link. The main communication link shall be through OPGW and back up communication link shall be either through OPGW or PLCC.

15. Valve Hall: The valve hall shall mainly contain thyristor valves, its associated structure, & cooling and arresters. No oil filled equipment shall be present inside the valve hall. In case the turret of converter transformers (having oil) is protruding inside the valve hall, suitable fire barrier matching with adjacent valve hall wall fire rating shall be provided. The valve halls shall be provided with interference screening. In addition, the control cable and cable termination rooms shall be suitably screened to minimize radio interference. Two nos. scissor lift for erection and maintenance of valve modules shall be provided per station. Proper cable sealing shall be provided for cable entry into valve hall and control room to avoid entry of water and moisture. Necessary measures shall be taken to take care of high frequency noise emission from valves.

16. Valve Hall Ventilation: Suitable ventilation systems and filters with adequate redundancy shall be provided in the valve hall. The valve hall shall be kept at a positive pressure under all conditions.

17. Grounding & Safety

(a) The design of the grounding system shall be based on relevant IS/ IEEE.

(b) In order to prevent adverse effect (overheating due to induced circulating current) of magnetic field of air core reactors, special care shall be taken such that no closed loops are formed by the earthing conductors and in reinforcement bars of the foundation. Air core reactor manufacturer's guidelines shall be followed.

(c) The electrical safety clearances for the dc side shall not be less than the clearances applicable for an ac switchyard at the equivalent BIL level.

(d) The total electric field excluding space charge at ground level shall be as prescribed in relevant standards.

(e) Fencing and electrical & mechanical key interlocking arrangements shall be provided for valve halls, smoothing reactor area, AC and DC filter areas, DC LFL Capacitor Area and for equipment mounted directly on ground without suitable height of steel structure.

18. Dedicated Metallic Return (DMR) / Earth Electrode

The current return path of a bipolar configuration shall be either via a Dedicated Metallic Return (DMR) conductor or via earth return using earth electrodes at both converter terminals. DMR mode shall be preferred if it is difficult to identify a suitable site for earth electrode station.

If earth electrodes are to be used the following requirements shall also be considered:

(a) The earth electrode station shall be connected to the terminal by means of an overhead transmission line. The earth electrode shall be located at a minimum distance of approximately 25 km (radial distance) away from the converter station. It shall be designed to operate continuously at nominal load and overload as per the requirement. The electrodes shall be designed for both types of operation, anodic and cathodic.

(b) The thorough soil investigation shall be carried out for shallow and deep resistivity, thermal conductivity and moisture content etc. at the proposed location.

(c) The earth electrode station shall have sub-electrodes. The maximum current density at the sub-electrode surface, i.e. the boundary between backfill (coke) and soil shall not exceed 0.5 A/m2 in clay soils. The number of sub-electrodes shall be determined considering that 30% of the sub-electrodes are not available. The amp hour rating for earth electrode shall be selected based on the study for duration of earth electrode current and the service life of the earth electrode station.

(d) The earth electrode station shall not affect the nearby electrical installation, buried metallic pipelines, oil & gas pipelines, and railway lines etc.

(ii): The above values of creepage distance are applicable for an altitude upto 1000m above sea level. For altitude above 1000m above sea level, necessary altitude correction factor as per relevant IS/IEC shall be considered.

(c) **DC wall bushing -**DC wall bushings, used for electrical connection between the equipment inside the valve hall and the outdoor DC yard shall be of polymer housing as per relevant standards.

(d) **DC Reactors -** The DC reactors (if used) shall be of air core type. The reactors shall generally comply with relevant standards and shall also have beensubjected to DCtests as pertheir application.

(e) **DC Voltage and Current Measuring Devices-** The DC voltage measuring equipment shall be installed at each pole. The DC measuring equipment at pole and neutral bus shall be suitably located based on the control philosophy and different protection zones such that complete pole and neutral equipment are protected.

(f) **DC Filters-** If required DC harmonic filters shall be provided in DC yard to limit harmonic voltages present on the DC lines (pole lines and electrode lines).

8. Control and Protection

(a) Control

(i) DC converter terminals shall be either manned by operator or controlled by remote Operation of SCADA system. The control system hierarchy shall be as follows:

(A) Station/ Bipole* Control (*only for bipolar arrangements, functionality offered as part of station control also acceptable);

(B) Converter /Pole Control;

(C) MMC control;

(ii) The HVDC converter shall have control features including but not limitedto the following:

(D) Active power control

(E) Reactive power control;

(F) AC Voltage control

(G) DC Voltage control

(H) Frequency controller (if applicable);

(I) Power modulation control (if applicable);

(J) Runback and run-up functions (if applicable);

(K) Power Oscillation Damping (POD)

(L) Sub synchronous torsional interaction dampingcontrol (if applicable);

(b) Protection

(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) HVDC system protection shall consist of following protection zones:

(A) AC System Protection zone

(B) Converter or Interface Transformer Protection Zone

(C) Secondary Busbar Protection Zone

(D) Converter Protection Zone

(E) DC Busbar Protection Zone

(F) DC line & cable Protection Zone

(iii) Protection system shall have two redundant systems including the following protections.

(A) AC over- and under-voltage protection

(B)Over- and under-frequency protection

(C)AC busbar differential protection;

(D) Insertion resistor overload protection

(E)AC overcurrent protection

(F) Converter overcurrent protection

(G) Converter overload protection

(H) Converter module differential protection

(I) Converter current differential protection

(J) DC voltage imbalance protection

(K) DC busbar differential protection

(L) DC link differential protection

(M) DC over- and under-voltage protection

(N) Electrode line monitoring and protection (if applicable)

(O) DC filter protection (if applicable)

(P) AC filter protection (if applicable)

(Q) AC connection Harmonic protection

(R)Phase current unbalance

(S) Protection.Block Failure or Repetitive Blocking failure protection

(T)Converter arm harmonic protection

(U) DC Line + cable Overcurrent Protection

(V) DC Line + cable harmonic protection

(c) 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.

(d) For bipolar schemes the following operation modes shall be possible:

(i) Balanced/ unbalanced bipolar operation;

(ii) Monopolaroperation with metallic return;

(iii) Monopolar operation with ground return / DMR

(e) The 'Sequence of events' recorder, transient fault recorder, on-line DC Line fault locator, GPS system, visual display system, operator control protection and monitoring system shall be a part of the HVDC system.

9. Telecommunication- For smooth operation of the HVDC system, communication network with high reliability and availability shall be provided for transmission of control and protection signals between the two or more (in case of multi-terminal DC) HVDC terminals. There shall be main and back up communication link. The main communication link shall be through OPGW and back up communication link shall be either through OPGW or PLCC.

10. Grounding & Safety

(a) The design of the grounding system shall be based on relevant IS/ IEEE.

(b) In order to prevent adverse effect (overheating due to induced circulating current) of magnetic field of air core reactors, special care shall be taken such that no closed loops are formed by the earthing conductors and in reinforcement bars of the foundation. Air core reactor manufacturer's guidelines shall be followed.

(c) The electrical safety clearances for the dc side shall not be less than the clearances applicable for an ac switchyard at the equivalent BIL level.

(d) The total electric field excluding space charge at ground level shall be as prescribed in relevant standards.

(e) Fencing and electrical & mechanical key interlocking arrangements shall be provided for valve halls, smoothing reactor area, AC and DC filter areas, DC LFL Capacitor Area and for equipment mounted directly on ground without suitable height of steel structure.

11. Dedicated Metallic Return (DMR) or Earth Electrode –The current return path of a bipolar configuration shall be either via a Dedicated Metallic Return (DMR) conductor or via earth return using earth electrodes at both converter terminals. DMR mode shall be preferred if it is difficult to identify a suitable site for earth electrode station. If earth electrodes are to be used the following requirements shall also be considered:

(a) The earth electrode station shall be connected to the terminal by means of an overhead transmission tine or underground cable. The earth electrode shall be located at a minimum distance of approximately 25 km (radial distance) away from the converter station. It shall be designed to operate continuously at full load as per the requirement. The electrodes shall be designed for both types of operation, anodic and

GD/GI/NEAR MISS EVENTS IN OCTOBER'23

1. GD at Tenga, Khuppi and Diskshi HEP are of Arunachal Pradesh

   Time: 0300hrs of 3.10.2023
   Elements tripped: 132kV Balipara-Tenga line
   Load/Generation affected: Blackout of Tenga, Khuppi and Dikshi HEP
   Preliminary analysis:
   As per DR Analysis: 3 phase fault of Solid nature appears in the line and cleared from both the end in 90 msecs (Z-1 operation from both ends). Fault current of around 3 KA observed in the submitted DR of Balipara end. Voltage dip of around 25 kV observed in all 3 phases
   Suspected lightening fault

   Deliberation of the sub-group:

   Remedial measures suggested:

2. GD at Sarupathar and Golaghat areas of Assam

   Time: 13:58 of 14-10-2023
   Elements tripped: 132kV Sarupathar-Bokajan line
   Load/Generation affected: Blackout of Sarupathar and Golaghat areas of Assam
   Preliminary analysis:
   As per DR Analysis: For Dimapur end, fault current of 7 kA appears at 13:58:52.968 hrs in the peak of the R phase voltage waveform. R phase voltage dip to 6 kV due to metallic nature of the fault. Fault cleared in 60 msecs from Dimapur end and the 3 phase AR successfully operated at the Dimapur end after dead time of 1.5 seconds. Additionally, Backup EF (In>1) initiated at Dimapur end during after CB reclosed at Dimapur end as fault current 430A appears in the neutral and disappears after 550 msecs.

For Sarupathar end, ZIII, forward fault initiated at 13:58:52.991 hrs and disappears from the system in 30 msecs. Fault current of 300 A reappears in the DR signal of Sarupathar end after successful AR operation at Dimapur end at 13:58:54.656 hrs. All 3 phase CB opened at 13:58:55.196 Hrs.

Deliberation of the sub-group:

Remedial measures suggested:

3. GD at Zuanguti and radially connected areas of Mizoram

Time: 19:57 Hrs on 04-10-2023
Elements tripped: 132 kV Melriat (PG) – Zuangtui Line
Load/Generation affected: Zuangtui, Serchip, Saitul, Lunglei and Vankal Solar power

Preliminary analysis:

As per DR signature of Melriat(PG) end, B-E fault initiated at 19:57:26.395 Hrs and CB opened after 350 msecs. Fault current of 580 A and 440 A appears in B & N. Voltage dip of 8-9 kV observed in B phase. In starts appears at Melriat (PG) End.
It is suspected that fault is in downstream of Zuangtui SS.
NERPC vide email dated 21.09.2023 suggested for modifications in B/U EF and OC setting at Melriat and Zuangtui SS. NERTS has changed the settings while Mizoram has not yet confirmed.

Deliberation of the sub-group:

Remedial measures suggested:

4. GD at Marghaerita, Rupai, Chapakhowa SS of Assam and Roing and Pashighat SS of Arunachal Pradesh

   Time: 09:38 Hrs on 15-10-2023
   Elements tripped: 132 kV Tinsukia-Margherita (Ledo) line (132kV Tinsukia-Rupai line and Along-Pashighat line were under PSD
   Load/Generation affected: Marghaerita, Rupai, Chapakhowa SS of Assam and Roing and Pashighat SS of Arunachal Pradesh
   Preliminary analysis:
   132 kV Tinsukia- Margherita tripped at 09:38 hrs at Tinsukia end only with Ib:1.6 kA, Vbe:59 kV on Z-II and fault was cleared from system within 400 msec. Fault was due to B-phase jumper snapped at location no. 174 of the said line.
   Deliberation of the sub-group:

   Remedial measures suggested:

5. GD at LTPS SS in Assam

   Time: 19:31 Hrs on 17-10-2023
   Elements tripped: 132kV LTPS-Moran Line, 132kV LTPS-Mariani (AS) Line, 132kV LTPS-Nazira D/C Line, 132kV NTPS-LTPS Line and 132kV LTPS-Sonari line
   Load/Generation affected: LTPS generating station
   Preliminary analysis:

Sl. No.	नाम	Trip time (hh:mm:ss)	Restoration time	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत
1	132kV LTPS – Moran	19:31Hrs	21:00Hrs	Zone 4 operated	Zone 2 Pickup
2	132kV LTPS – Namrup	19:31Hrs		Zone 4 operated	Zone 2 Pickup
3	132kV LTPS – Nazira I&II	19:31Hrs		Zone 4 Pickup	Zone 2 Operated
4	132kV LTPS – Sonari	19:31Hrs		Zone 4 Pickup	Zone 2 Operated
5	132kV LTPS - Mariani	19:31Hrs		Zone 4 Pickup	Zone 2 Operated

The main bus Y-phase jumper snapped and a flashover occurred with R-phase conductor of 48MVA (GT bay of WHRP). As a result, all 132kV lines connected to the bus tripped on Zone-2 and Zone-4 respectively.

Deliberation of the sub-group:

Remedial measures suggested:

6. GD at Dharmanagar SS in Tripura

Time: 01:47 Hrs on 19-10-2023

Elements tripped: 132 kV Dharmanagar-PK Bari Line and 132 kV Dharmanagar-Durlavchera Line

Load/Generation affected: Dharmanagar area

Preliminary analysis:

	नाम	Trip time (hh:mm:ss)	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत	Restoration time
1	132 kV PK Bari-Dharmanagar Line	01:47 Hrs	DP, Z-1,YB, FD: 8.424 km	DP,Z-1, RY, FD:27.14 Kms	02:28 Hrs
2	132 kV Dharmanagar-Dullavchhera Line	01:47 Hrs	No Tripping	B/U OC, R-Y ph	02:25 Hrs

Phase to Phase fault was in 132 kV PK Bari-Dharmanagar Line with Iy=Ib:6.6 kA, Vye=Vbe:43 kV and fault was cleared from PK Bari within 60 msec. Protection system at Dharmanagar fails to isolate the fault even after issuance of Z-1 Trip, due to which fault was feeding continuously from adjacent healthy Line 132 kV Durlavchera-Dharmanagar Line and finally cleared within 631 msec on B/U O/C protection.

Deliberation of the sub-group:

Remedial measures suggested:

7. GD in Pailapool area of Assam

Time: 12:47 Hrs on 30-10-2023
Elements tripped: 132 kV Jiribam(PG)-Pailapool lines (132 kV Srikona-Pailapool line was under planned shutdown).
Load/Generation affected: Pailapool area of Assam
Preliminary analysis:

Sl. No.	नाम	Trip time (hh:mm:ss)	Restoration time	उप केंद्र 1 रिले संकेत	उप केंद्र 2 रिले संकेत
1	132kV Jiribam(PG)-Pailapool Line	12:47 Hrs	18:53 Hrs	DP, Z-1, R-Y-E, FD: 6.41 Km, A/R successful	DP, Z-1, R-Y-E, FD: 0.3 Km
2	Solar IPP- Azure Pailapool Generation	12:47 Hrs	12:53 Hrs	Loss of evacuation path	

Phase-to-Phase fault occurred at 12:47:25.207 Hrs with Ia=Ib=4.3 kA, Vae=Vbe: 43 kV and fault was cleared from system within 59 msec. Autorecloser was successful from Jiribam(PG) and CB tripped from Pailapool (AEGCL). Again, at 12:49:40.3 Hrs, the line tripped from Jiribam (PG) on similar fault where A/R was lockout. There is no involvement of ground path for the fault and angle separation between the faulty phases: 180 degree out of phase. Fault seems to be due to phase clearance issue.

Deliberation of the sub-group:

Remedial measures suggested:

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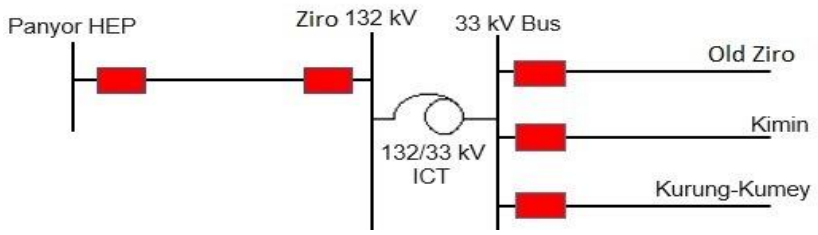
SPS LOGIC TO BE IMPLEMENTED AT 132 kV Ziro Substation

Single line diagram of the inter connected grid for the implementation of system protection scheme.



A. SPS OPERATION LOGIC DETAILS

On the event of outage of 132 kV, Panyor HEP-Ziro Line - the following elements are to be tripped to prevent under-voltage scenario in Ziro/Daporizo area of Arunachal Pradesh Power System:

a. 33 kV Ziro-Old Ziro Line
b. 33 kV Ziro-Kimin Line and
c. 33 kV Ziro-Kurung-Kumey

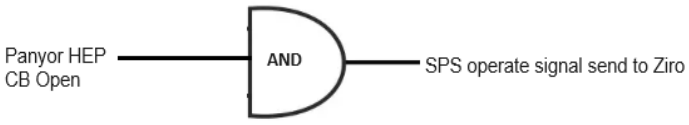
The loss of 132 kV Panyor HEP- Ziro Line should initiate the "Operation of SPS". Two major potential events were taken into consideration while designing the SPS.

CASE A: CB tripped at Ziro end

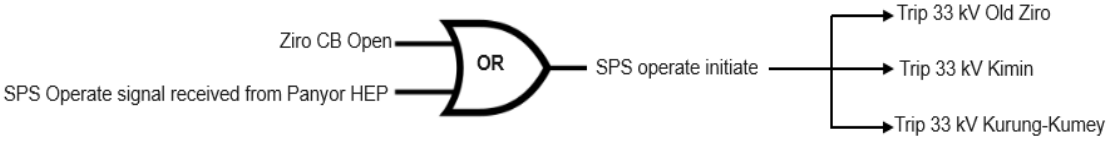
CASE B: AR successful at Ziro end, but CB tripped at Panyor end

As per CASE A and CASE B, it is observed that the "SPS OPERATE LOGIC" is to be configured both at Ziro end and at Panyor HEP end.

B. LOGIC DIAGRAM OF SPS



Logic-1: To be configured at Panyor HEP



Logic-2:To be configured at Ziro SS

Annexure C.1

Name of the line	Status as updated in 56/57th PCC meeting	Latest Status
132 kV Agia - Mendipathar	PLCC works completed. AR operation configuration to commence from March'22. Latest Status to be intimated.	
132 kV EPIP II - Byrnihat D/C		
132 kV EPIP II - Umtru D/C		
132 kV Kahilipara - Umtru D/C		
132 kV Khliehriat – Mustem		
132 kV Mustem - NEHU line		
132 kV Khliehriat (MePTCL) - Khliehriat (PG) Ckt#II		
132 kV Khliehriat- NEIGRIHMS		
132 kV NEHU – Mawlai		
132 kV Mawlai - Umiam Stage I		
132 kV Mawphlang - Nongstoin		
132 kV Mawphlang - Umiam Stg I D/C		
132 kV Mawphlang- Mawlai		
132 kV Mendipathar – Nangalbibra		
132 kV Myntdu Leshka - Khleihriat D/C		
132 kV Nangalbibra – Nongstoin		
132 kV NEHU – NEIGRIHMS		
132 kV NEHU – Umiam		
132 kV Sarusajai - Umtru D/C		
132 kV Umiam - Umiam St I	By March'22	
132 kV Umiam St I - Umiam St II		
132 kV Umiam St I - Umiam St III D/C		
132 kV Umiam St III -Umiam St IV D/C		
132 kV Umiam St III - Umtru D/C		
132 kV Umtru - Umiam St IV D/C		