सत्यमेव जयते

भारत सरकार/ Government of India

विद्युत मंत्रालय/ Ministry of Power

केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority

विद्युत प्रणाली अभियांत्रिकी एवं प्रौद्योगिकी विकास प्रभाग

Power System Engineering & Technology Development Division

Date: 01 .10.2025

विषय: Minutes of the meeting of the Standing Committee of the Experts to discuss the failure of 220 kV and above voltage level Transformers during period of January, 2025 to June, 2025-reg.

महोदया/महोदय,

You are kindly aware that a Standing Committee comprising experts in the field of design and operation of EHV Substations from CEA, various power utilities and research/academic institutes was reconstituted by Central Electricity Authority vide letter No. CEA-PS-14-97/3/2018-PSETD Division-Part(5) dated 03.02.2025 to investigate the failure of Transformer and Reactor at 220 kV and above sub-station/switchyard and recommend measures to avert recurrence of such failures in future.

2. In this connection, a meeting of the Standing Committee of the Experts was held on 01.09.2025 through video conferencing mode to discuss the cause of failures of the transformer reported by various utilities to CEA which had failed during the period from January 2025 to June 2025.

3. Based on the data provided by utilities and deliberation held during the meeting, The minutes of the meeting have been prepared and are enclosed herewith for kind information and necessary action please.

Encl.: As above

भवदीय,

Signed by Pankaj Kumar Verma
Date: 01-10-2025 16:39:59

(पंकज कुमार वर्मा / Pankaj Kumar Verma)

उप-निदेशक/Dy. Director

प्रतिलिपी:

1. SA to Chairperson, CEA
2. SA to Member (PS)
3. PA to Chief Engineer (PSE&TD Division), CEA

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Index

Power System Engineering & Technology Development Division
Central Electricity Authority

1 Background

Under Section 73, Clause (l) of the Electricity Act, 2003, CEA vide Office Order No: CEA/SETD/220-O/2012/1-80 dated 01.01.2013 constituted a Standing Committee of Experts in the field of design and operation of EHV Substations from CEA, various power utilities and research/academic institutes to investigate the failure of 220 kV and above voltage class substation/ switchyard equipment. The Committee was reconstituted vide CEA office order no: CEA-PS-14-97/3/2018-PSETD Division-Part(5) dated 03.02.2025 (**Annexure-V**) to investigate the failure of 220 kV and above voltage class Transformers & Reactors and recommend measures to avert recurrence of such failures in future. As part of this activity, CEA has been receiving reports of failures from power utilities.

All the utilities are required to report any event of failure of Transformer and Reactor at the earliest in the specified format for reporting the incident (available on CEA website and attached as **Annexure-IV**) along with all the additional information [like Disturbance Recorder (DR)/ Event Logger (EL) report], SLD, Test reports, O&M history, photographs etc.) to be submitted by the utilities while reporting the incident.

The objective of the Standing Committee is to investigate the causes of failures, deliberate the failures of Transformers and Reactors, suggest remedial measures to prevent recurrence of such events in future and prepare a report which would serve as a repository of case studies of failures and suggested remedial measures for future.

In this connection, a meeting of the Standing Committee of Experts to investigate the failure of 220 kV and above voltage Class Transformer for the period of January 2025 to June 2025 was held on 01.09.2025 through video conferencing mode. List of participants is given at **Annexure-I.**

2 Introduction

Sh. N.R.L.K. Prasad, Chief Engineer (PSE&TD), CEA and Chairperson of the Standing Committee, extended warm welcome to all the Members & Participants, and gave a brief background about the formation and mandates of the committee. He mentioned that the Standing Committee comprising experts in the field of design and operation of EHV Substations from CEA, various power utilities and research/academic institutes was reconstituted by Central Electricity Authority vide letter dated 03.02.2025 to investigate the failure of Transformer and Reactor at 220 kV and above sub-station/switchyard and recommend measures to avert recurrence of such failures in future. To enable Standing Committee carry out its work, it is important that the Utilities report the instances of failures in their network/ system well within time as per regulatory provisions, and ensure proper analysis of their respective events by the Committee by undertaking site visits, if required, in time.

It was informed that as per Regulation 48 (8) of CEA (Measures relating to Safety and Electric Supply) Regulations, failures of any 220 kV and above voltage level Transformer & Reactor shall be reported by the owner utility within 48 hours of occurrence of the failure, to the Authority, and the reasons for failure and measures to be taken to avoid recurrence of failure shall be sent to the Authority within one month of the occurrence as per stipulated formats, along with all the additional information (like Disturbance Recorder (DR)/ Event Logger (EL) report], SLD, Test Reports, O&M history, Photographs etc.). He requested all utilities to adhere to these timelines strictly.

It was informed that for the period of January 2025 to June 2025, a total of 17 incidents of failure of Transformer were reported to CEA by 8 Utilities (DTL, DVC, GETCO, MSETCL, NLCIL, NTPC, PSTCL and UPPTCL). It was noted that out of the 8 Utilities who have reported failures, representatives from 7 Utilities attended the Standing Committee meeting. **However, no representative from MSETCL has attended the Standing Committee meeting.**

He requested all the utilities to furnish a brief on the action taken by various utilities w.r.t. recommendations given by the standing committee in their past meetings such as centralized asset monitoring system, condition based monitoring, etc. He also emphasized on the need to for undertaking regular O&M of substation equipment, and requested utilities to share a brief on O&M practices being followed by them for various substation equipment such as Transformer, Reactors, Circuit Breaker, CT, PT/CVT, Isolator/Disconnector, Surge Arrester/LA etc. covering various aspects like the tests conducted on the equipment, periodicity of testing and permissible limits/acceptable range of test results. He highlighted that in the meeting of the Standing Committee held on 24.03.2025 and 25.03.2025, it was requested to all Utilities to furnish the action taken report on the recommendation suggested by the Standing Committee and O&M practices being followed for various substation equipment. However, none of the Utility has furnished the above information. He requested each Utility to furnish the action taken report on the recommendation suggested by the Standing Committee and O&M practices being followed for various substation equipment at the earliest.

He also requested all the utilities to report the failure events to the OEMs also, even after the warranty period. So that OEMs can improvise the design part of the equipment based on the feedback provided by the utilities. This will help in reducing the failure of such equipment in the future.

Thereafter presentations by Utilities for their respective failure incidents were held. The failure incidents and their subsequent findings were deliberated upon by the members of the committee.

3 Deliberations held during Standing Committee Meeting

3.1. General:

A total of 17 failure incidence of Transformer of 220 kV and above voltage rating between 1st January 2025 and 30th June 2025 were reported by 8 Utilities (DTL, DVC, GETCO, MSETCL, NLCIL, NTPC, PSTCL & UPPTCL). Complete details of all the reported Transformer failures are given at **Annexure-II.** The details of the deliberations of the standing committee meeting are presented in the ensuing paras. List of participants is attached as **Annexure-I.**

3.2. Failure Report of MSETCL Transformers

There were total nine (09) Transformer failures of MSETCL**. However, Representative from MSETCL did not attend the meeting. Therefore, failure events reported by MSETCL could not be discussed.**

3.3. Failure report of 100 MVA, 220/66 kV Power Transformer at Kasor S/s, GETCO

Representative of GETCO presented the case of failure of 100 MVA, 220/66 kV Power Transformer at Kasor Substation. The Kasor S/s has Double Main & Transfer bus scheme at 220 kV side and Double Main bus Scheme at 66 kV side. The LV side of transformer is connected to 66 kV side bus scheme with power cable. Representative of GETCO mentioned that before the tripping of the transformer, 66 kV LV R-ph UG cable flashed-fault occurred at 66 kV Kasor S/s end which led to operation of LV side REF protection and LV side circuit breaker opened. The transformer could not withstand the external fault and fault developed inside the transformer during the cable fault. Thereafter, HV side circuit breaker got opened on differential protection. NIFPES also operated as per the design logic. Voltage Ratio Test, Magnetizing Current Test, Magnetic Balance Test, LV winding resistance measurement, Turns Ratio Test, SFRA were carried out after the failure of transformer and results were abnormal. Internal Inspection of the Transformer was carried out at site after draining main tank oil completely and opening inspection windows. During internal inspection, burnt insulation paper pieces and copper particles observed near LV R Phase coil. He further mentioned that fault current magnitude was 1.7 kA on HV side and 5.4 kA on LV side. The fault was cleared within 400 ms.

CE (PSE&TD Division), CEA enquired whether the protection is provided for 66 kV power cable. Representative of GETCO replied that cable is of short length (around 200 m) and bus side CT is not installed. They are checking the feasibility of installing CT at bus side and of providing pilot wire protection for cable. CE (PSE&TD Division), CEA stated that since the length of the cable is short, it can be covered in the transformer differential protection also. CE (PSE&TD Division) highlighted that no part of the transmission line/cables/substation should be left out without providing protection. He directed GETCO to take necessary steps to provide the required protection for power cables as per the CEA regulation.

3.4. Failure report of 100 MVA, 400/132 kV Power Auto Transformer at Singrauli, NTPC

Representative from NTPC presented the case of failure of 100 MVA, 400/132 kV ICT-2 at Singrauli. ICT-2 was manufactured in the year 1981 and commissioned in 1982. ICT-2 caught fire and tripped on electrical/mechanical protection. There was no abnormality in the system at the time of failure. Previous test results of the ICT were also normal. All bushings of the ICT are completely damaged. All oil of the ICT was drained. As per the DR data, fault current of around 31 kA was observed in Y-ph. As per the preliminary report submitted by OEM, Y-Phase bushing on the HV side showed catastrophic insulation failure, external burning, sign of pitting on corona shield and delamination. R & B-phases also showed damage. R and B Phase Bushing also failed. 132 kV partially overheating marks observed. Structural deformation at bottom and Top of tank, burn marks, and pressure signs were noted on the tank, likely due to extreme high pressure due to heavy arc-generated gases inside tank. Internal inspection revealed disintegrated insulation, scattered debris, arcing signs, and thermally damaged conductors. Multiple laminations and spacers were fractured. Several internal arcing spots were visible on the transformer structure (core clamp surfaces), indicating concentrated high-energy discharge.

CE (PSE&TD Division), CEA enquired the present condition of the transformer. In response, representative from NTPC informed that the said transformer is beyond repairable. Further, CE (PSE&TD Division), CEA highlighted that transformer has served for more than 35 years (around 43 years).

3.5. Failure report of 200 MVA, 400/132 kV ICT-I at Kasara, Mau S/s, UPPTCL

Representative from UPPTCL, Mau presented the case of failure of 200 MVA, 400/132 kV ICT-1 at Kasara, Mau S/s of UPPTCL. The Y-phase CT of 132 kV Mau New-1st line got damaged, distance protection operated in Zone-1 having fault current of 12.5 kA of 132 kV Mau New-1 line. At the same time, ICT-1 and ICT-2 (running in parallel) got tripped. On switchyard inspection, it was found that HV bushing of ICT-1 was damaged and oil leaked. Further, he mentioned that the transformer got tripped on Differential Protection, Over Current, Earth fault, Buchholz and PRV indications. The transformer tank was completely damaged and is beyond repair. Post tripping, furan test was carried out and test results were normal.

CE (PSE&TD Division), CEA stated that due to through fault, some internal fault may have got developed and transformer got failed. The transformer was commissioned in the year 1993 and completed around 32 years of service. Further, CE (PSE&TD Division), CEA asked the UPPTCL, Mau to submit the through fault details of the said ICT.

3.6. Failure report of 315 MVA, 400/220/33 kV ICT at Jaunpur S/s, UPPTCL

Representative from UPPTCL, Jaunpur presented the case of failure of 315 MVA, 400/220/33 kV ICT-III at 400 kV Jaunpur S/s. Prior to the incident, ICT-I and ICT-III were operating in parallel and load on ICTs were 75 MW and 77 MW, respectively. At 15:16 Hrs, ICT-III tripped on Differential, Buchholz, and PRV with a blasting sound. No other tripping observed at the substation. DR showed 13.6 kA fault current in Y-phase, IV side. The Y-phase and B-phase bushings on IV side were damaged which caused oil leakage. Oil leakage and heavy fault current caused a minor fire near neutral earthing. The emulsifier system operated, and fire was quickly extinguished using a CO_2 cylinder. The transformer body was intact. He further informed that the said transformer was operational from 2011 to 2023 at 400 kV substation Unnao. After increasing capacity at 400 kV Unnao, this transformer was transported from 400 kV Unnao to 400 kV Jaunpur and was commissioned on 15.05.2024. All the testing including SFRA were carried out for the transformer before its charging and were found in order. DGA and tan delta test of transformer was carried out in October, 2024 and test results were normal. The post tripping magnetic test showed abnormality. Internal inspection of the transformer was carried out after draining of oil and it was observed that insulation of the Y-phase winding was damaged with the possibility of damage to the winding. Internal inspection team was of the view that the transformer may got damaged because of insulation failure as no abnormality in the structure was observed in the transformer.

CE (PSE&TD Division), CEA enquired about the final report submitted by OEM. In response, representative from UPPTCL, Jaunpur replied that OEM has submitted the final report, however no clear reason of failure was specified. CE (PSE&TD Division), CEA asked to check the historical data and any through faults the transformer was subjected to during the period it was installed at Unnao S/s. It might help in finding the actual cause of failure of transformer.

3.7. Failure report of 300 MVA, 16.5/400 kV, GT-1 TPS II Expansion, NLCIL

Representative of NLCIL presented the case of failure of 300 MVA, 16.5/400 kV GT-I at TPS-II Expansion, NLCIL. He stated that GT-I got tripped on differential protection and caught fire. Bulging of the transformer tank was observed which led to oil leakage. The spilled oil caused the fire. In the Protection REF, Buchholz & PRV operated. Damage of R & Y ph bushings were observed. GT LV bus duct support insulators also got damaged. Transformer emulsifier system operated. There was no Buchholz, OTI, WTI alarm prior to the failure. He further mentioned that there were no external faults in the system when the transformer failed. From relay DR it is suspected that it is a sudden inter-turn winding short circuit fault and then converted as a ground fault. From commissioning until the incident, there were no operational issues or abnormal observations reported for this transformer. All periodic inspections and routine maintenance checks confirmed that the transformer was in sound working condition. OEM was of the view that transformer may got failed due to transient over voltage. These transient may be of small duration therefore could not be able to captured in the records. However, these transient may have led to the dielectric insulation failure. It was informed that DSC test was not carried out on the Subject Transformer.

CE (PSE&TD Division), CEA highlighted that transformer has served for around 4 years. The transformer is designed to withstand such small transient. In this case, the quality of the transformer appeared to be substandard, which likely contributed to its inability to withstand the transients, ultimately leading to its failure. M/s NLCIL was advised to take the issue with OEM to further check the root cause of the failure. Further, NLCIL was advised to ensure the compliance of all the regulatory requirement.

3.8. Failure report of 100 MVA, 220/132 kV Auto Transformer at Moga (Singhawala) S/s, PSTCL

Representative from PSTCL presented the case of failure of 100 MVA, 220/132 kV Auto transformer at Moga (Singhwala) S/s of PSTCL. He mentioned that Power Transformer tripped with operation of Differential, REF, Main Buchholz Trip, OLTC Buchholz Trip & Master Trip. This incident occurred during a thunderstorm with heavy rain and lightning. During inspection by sub-station staff in switchyard, it was found that HV Y-Phase Lightening Arrestor (LA), HV Y-Phase & HV B-Phase bushings of this power transformer was damaged. NIFPES operated due to operation of Differential, Buchholz & Master Trip relay & oil of power transformer drained into sump tank. Main tank was bulged, top cover bolts sheared off and welding of main body opened. Due to this the nitrogen gas injected in the main body came out and oil drained out from the body which led to fire in the cable trench. HV Y-ph & B-ph bushing got damaged and LA of HV Y-ph & B-ph got damaged. The surge from the lightning strike likely caused an internal insulation breakdown and the same was also confirmed by the damaged surge counter.

CE (PSE&TD Division), CEA stated that this transformer was commissioned in 1990 and served for around 35 years. Further, he stated that as per the report submitted, the Power Transformer has tripped 28 times from 2011 to 2025. It indicates that particular lines do not have requisite protection setting leading to tripping of Transformer in through fault. In case of through faults, transformer should not trip. He asked PSTCL to review the protection settings of the lines.

3.9. Failure report of 315 MVA, 400/220/33 kV Auto Transformer at Bamnauli S/s, DTL

Representative of DTL presented the case of failure of 315 MVA, 400/220/33 kV Auto Transformer at 400 kV Bamnauli S/s. He stated that a fault occurred on B-phase of 220 kV PPk-2 circuit-2. The circuit tripped on Z-1 and isolated within 57 msec. Simultaneously, 315 MVA ICT-4 failed and tripped on differential protection, PRV, Buchholz relay, OTI, HV WTI and OLTC Buchholz. ICT isolated within 65 msec. During the feeding of fault current of 220 kV PPK-2 circuit-2, the internal fault developed in the ICT resulting in short circuit of HV and LV windings and fed 24 kA to PPK-2 circuit-2. The transformer got tripped on Differential, REF Buchholz, PRV, OTI, WTI, OLTC Buchholz. No fault on this transformer was noticed prior to this failure. All the test results conducted during previous maintenance were in order. Post fault test could not be performed as the transformer failed with fire in ICT and main tank was damaged along with bushings.

A Standing Committee of Experts comprising members from CEA, NRPC, PGCIL and CPRI carried out the site visit on 05.06.2025. The committee observed following:

a) At 16:34 hrs on 01.06.2025, a transient fault of 24 kA occurred on Y phase on 220 kV Bus-A at 400 kV Bamnauli S/s. 220 kV Busbar differential protection of Bus-A operated. The ICT-2 and ICT-3 were out because of differential protection operated at Bus-A.
b) In case of fault on Y phase on Bus-A, only ICT-3 and DIAL circuit-1 & 2 should have tripped in addition to Bus Section-1 and 220 kV Bus Coupler-1. However, ICT-2 has also tripped in addition to these. DTL informed that the Status of the Isolator of ICT-2 was not updated and therefore Bus Bar Protection considering the ICT- 2 connected to Bus-A, also tripped the ICT-2 in differential protection.
c) Subsequently, Line fault B-N occurred in 220 kV PPK-2 circuit-2 at 16:39 Hrs. During the fault, line tripped along with tripping of ICT-4. ICT-4 tripped on Differential, PRV, Buchholz, OLTC Buchholz, WTI protection.
d) From the relay waveform, it was observed that PPK-2 line circuit-2 B earth fault current was fed from the ICT-4 which was initially 6 kA. As per the outage report submitted by O&M Division of DTL, the fault location has been shown 607 meters approximately.
e) Therefore, it appears that Transformer has almost terminal short circuit current. Since huge fault current equivalent to terminal fault current developed, therefore heavy short circuit forces got developed inside the Transformer.
f) DTL has also informed that the Dynamic short circuit (DSC) test had not been conducted on the Transformer.
g) During the Incident- 1 at 16:34 Hrs i.e. Operation of 220 kV Busbar-A protection on Y phase fault, the fault current fed by ICT-4 was 7.8 kA. In absence of the tested capability of the Transformer to deliver the short circuit current and two high fault current fed by the Transformer in short span of time, it appears that the Transformer could not sustain the mechanical forces developed due to huge fault current during the Incidence-2 which was around equal to the terminal fault current.
h) As High Velocity Water Spray (HVWS) could not operate immediately due to failure of both the auxiliary supply of the substation, huge fire got generated before the HVWS could be operated after switching the DG set. This fire could not be extinguished by HVWS and ICT burnt completely. Finally, fire was extinguished by the fire tenders.

CE (PSE&TD Division), CEA recommended that proper bus protection setting should be done to avoid unwanted equipment tripping. It was also advised that the auxiliary Supply from Source-1(BSES) to Source-2(Tertiary of ICT-4) should be in auto changeover mode and DG set should be in auto changeover Scheme. Further, representative from DTL informed that

DTL is under the process of shifting one transformer from Powergrid, Bawana. It was also advised that new Transformer to be procured shall be Dynamic short Circuit (DSC) tested as per the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022.

3.10. Failure report of 315 MVA, 400/220/33 kV ICT at Koderma S/s, DVC

Representative of DVC presented the case of failure of 315 MVA, 400/220/33 kV ICT#2 at 400 kV Switchyard KTPS, DVC, Koderma. The ICT got tripped on Differential Protection, PRV, Buchholz relay, OTI, WTI, and OLTC on 02.06.2025 at 03:06 Hrs. The transformer caught fire immediately during the event, leading to the explosion of the High Voltage (HV), Intermediate Voltage (IV), and Low Voltage (LV) bushings. The emulsifier-based fire protection system activated automatically; however, it was insufficient to fully extinguish the fire. Consequently, the CISF fire wing was engaged in controlling and extinguishing the fire. Internal inspection of the transformer was carried out in presence of representative of BHEL and BHEL recommended that the ICT is beyond repair looking to the extensive damage in all major components. He mentioned that internal inspection team of DVC was of the view that the ICT might got failed due to bushing failure. In response, the CE (PSE&TD Division), CEA enquired whether any abnormalities had been observed in the tan delta and capacitance test results of the bushing during maintenance. To this, the DVC representative clarified that no irregularities were noted in the bushing test results. He further mentioned that maintenance/testing of the ICT was done from 20/08/2024 to 24/08/2024 & 20/01/2025 to 24/01/2025. The testing includes the Tan Delta test of all the bushings and windings, Turns ratio at existing tap (Tap 10), winding resistances (Tap 10), Magnetising current measurement, Core insulation check, IR & PI. No abnormality was observed in the test results. Root cause analysis by BHEL is under process.

During the inspection of the ICT by the Standing Committee comprising of CEA, ERPC, PGCIL and CPRI, it was observed that buchholz alarm was noticed 01 minute 35 seconds prior to the initiation of differential trip protection. Fault in R-ph occurred first and immediately after that Y-ph fault appeared as per DR. Based on DR observation and physical condition of the transformer after failure (damage of bell tank joint, bulging of main tank, tilting of Core coil assembly etc), it is suspected that ICT-2 was failed due to fault inside the main tank, which might have been initiated from R-Phase winding assembly. Further, as per the DGA test results provided by the DVC, it was observed that CO2/CO ratio is less than 3 or approaching to 3 for the test conducted on 23.06.2018, 19.09.2019, 24.12.2024. Also, with lower CO2/CO ratio, H2 gases generation have been observed on higher side in DGA test results. As per recommendations of IEC 60599:2022, if CO2/CO ratio is less than 3 along with formation of H2 gases, it is generally considered as an indication of probable paper insulation involvement in fault, with possible carbonization, in the presence of other fault gases. Filtration of Oil has been carried out on 25.01.2025 and 12.10.2021 (although BDV and water content were in order).

CE (PSE&TD Division), CEA enquired about the present status of new ICT to be installed. Representative from DVC informed that one ICT from PGCIL, Muzaffarpur has been transferred to KTPS, DVC and is currently under the erection stage. he requested DVC to share the RCA report upon receipt from the OEM.

3.11. Conclusion

The Chief Engineer (PSE&TD), CEA concluded the deliberations with the following remarks:

a. Each Utility is required to intimate each incidence of failure of equipment to Chairperson of the Standing Committee within 48 hours of occurrence of the failure. Further, each Utility shall submit the detailed report of equipment failure within one month of occurrence of failure as per the format available on CEA website along with all the relevant information such as test reports, photographs, OEM recommendation etc. This will help not only in analysing the failure events, but also enable the Committee members to undertake site visit in time, if required.

b. All Utilities should furnish the action taken report on the recommendation suggested by the Standing Committee and O&M practices being followed for various substation equipment.

c. Transformer should be subjected to Dynamic effect of short circuit withstand test (DSC) as per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines), 2022 Regulations, to verify its capability to withstand dynamic effect of short circuit.

4 Statistics & Analysis of the failure of Substation equipment

4.1 Statistics of Reporting of Equipment Failure to CEA

SN	Category	Number of Equipment Failure	Number of Utilities	Remarks
1	**Failures of Equipment reported within 48 hrs on their own by the Utilities**	2	2	NLCIL, DTL
2	**Failures of Equipment intimated by Utilities after 48 hours on their own**	1	1	DVC
3	**Failures of Equipment for which Detailed Report was submitted by Utilities within one month by their own**	3	3	NLCIL, DTL, DVC
4	**Failures of Equipment for which Detailed Report was submitted by Utilities after One Month on their own**	0	0	
5	**Failures of Equipment for which Detailed Report was submitted by Utilities only after CEA letter**	14	5	GETCO, MSETCL, NPTC, PSTCL, UPPTCL

4.2 General Statistics of Reported Equipment Failures

The Committee investigates failures of 220 kV and above voltage class Transformers. A total of 17 failure incidences of Transformers of 220 kV and above voltage rating were reported between 1st January 2025 and 30th June 2025 to CEA. The voltage wise quantity of each equipment has been indicated in the Table-1 below:

Table-1: Voltage wise segregation of Equipment

Equipment	Voltage Class			Quantity (Nos.)
	220 kV	400 kV	765 kV	
	Quantity (Nos.)			
Transformers	**6**	**11**	**-**	**17**
Reactors	**-**	**-**	**-**	**-**
			Total	**17**

Quantity of failed Transformers and years of service put in by these Transformers before failures is given in Table-2.

Table-2: Year of Service of failed Transformer

Years of Service	No. of Transformers Failed
0-5	6
5-10	3
10-15	3
15-20	2
>20	3
	17

Note: In some cases, years of service have been considered taking the difference between re Commissioning (after repairing of the equipment) and failure date.

Complete details of all the above-mentioned Transformers failures are provided in **Annexure-II.** The probable cause of failure is based on information, data, and reports furnished by the utility. The type of equipment wise analysis of failures is presented in ensuing paras.

4.3 Failure of Transformers

1. Transformer, the costliest equipment in a switchyard/substation, is expected to serve the entire life of a substation which is considered to be 35 years. However, it has been observed that many transformers installed in Indian utilities have failed within first few years of service which is a matter of concern.

2. Summary of Inter Connecting Transformers/Generator Transformers (GTs) reported to CEA that have failed between 1st January 2025 and 30th June 2025 is detailed below (Table 3):

Table 3: Summary of failure of Transformers

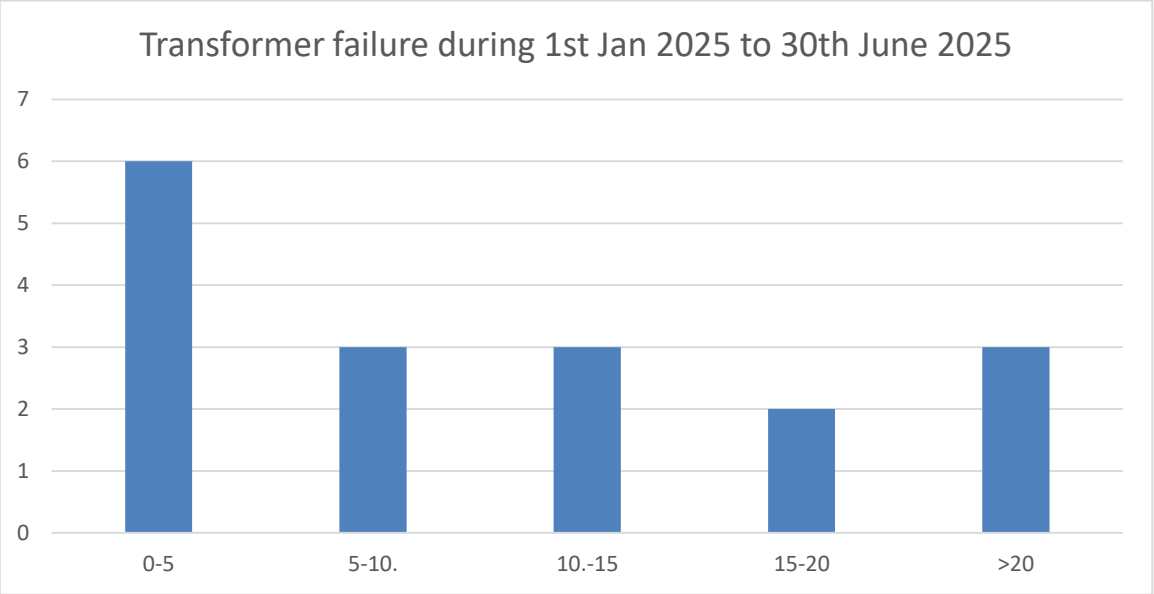
S.N.	Utility	Substation Name	Make	Rating	Year of Commissioning	Date of Failure	Probable cause of failure
(i)	MSETCL	220 kV Chandrapur S/s	CGL	50 MVA, 220/132 kV	03.01.2025	14.01.2025	--
(ii)	MSETCL	220 kV Bhaveghar S/s	GEC Alstom	50 MVA, 220/33-22 kV	09.05.2023	17.04.2025	--
(iii)	MSETCL	220 kV Bhosari-2 S/s	CGL	50 MVA, 220/22 kV	05.02.2013	26.04.2025	Radial movement of LV R Ph & Intert-urn short circuit due to neareby fault (22 kV PMAY feeder.)
(iv)	MSETCL	220 kV Hinganghat S/s	BHEL	100 MVA, 220/33-33 kV	18.08.2018	05.05.2025	Heavy fault on 33 kV feeder causing mechanical jerk leading to possible thermal fault inside Main tank
(v)	MSETCL	220 kV Taloja S/s	ALSTOM	50 MVA, 220/100/22 kV	01.04.2005	26.05.2025	Due to lightning strike.

(vi)	MSETCL	220 kV Miraj S/s	ABB	50 MVA, 220/33 kV	25.06.2024	01.06.2025	---
(vii)	MSETCL	220 kV Warora S/s	BBL	50 MVA, 220/33 kV	05.12.2011	10.06.2025	Y-ph LV Winding insulation failure
(viii)	MSETCL	220 kV Anandnagar S/s	AREVA	50 MVA, 220/22 kV	16.01.2007	24.06.2025	Internal Fault
(ix)	MSETCL	220 kV Malegaon (Zodga) S/s	Vijai	100 MVA, 220/132 kV	10.08.2017	26.06.2025	R-Phase HV winding inter-turn short circuit
(x)	GETCO	400 kV Kasor S/s	BHEL	100 MVA, 220/66 kV	21.07.2016	26.02.2025	Internal Fault due to 66 kV side cable fault
(xi)	NTPC	Singrauli	BHEL.	100 MVA, 400/132 kV	1982	01.03.2025	Internal Fault
(xii)	UPPTCL	400 kV Kasara Mau S/s	BHEL	200 MVA, 400/132 kV	31.12.1993	25.03.2025	Internal Fault
(xiii)	UPPTCL	400 kV Jaunpur S/s	AREVA	315 MVA, 400/220/33 kV	14.05.2024	28.03.2025	Internal Fault
(xiv)	NLCIL	400 kV TPS II Expansion, NLCIL Switchyard	EMCO	50 MVA, 220/33 kV, 3-Phase	Oct-2021	11.05.2025	Sudden inter-turn winding short circuit
(xv)	PSTCL	220 kV Moga (Singhwala) S/s	GEC	100 MVA, 220/132 kV	31.05.1990	24.05.2025	Internal Fault due to lightning.
(xvi)	DTL	400 kV Bamnauli S/s	TELK	315 MVA, 400/220/33 kV	27.03.2007	01.06.2025	Internal Fault due to 220 kV feeder fault
(xvii)	DVC	400 kV Switchyard, KTPS	BHEL	315 MVA, 400/220/33 kV	26.06.2012	02.06.2025	Internal Fault

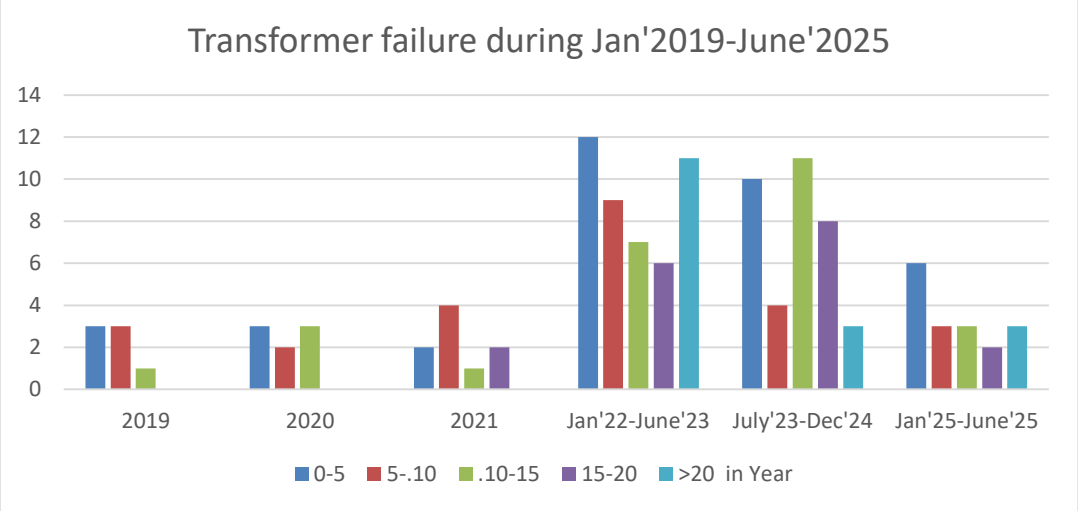
Note: The probable cause of failure is based on information, data, and reports furnished by the utility.

3. As can be seen from Table 3 above, seventeen (17) transformer failure cases from January 2025 to June 2025 have been reported by eight (8) Utilities to CEA. It is highlighted that a large number of transformer failure cases remain unreported as many of power utilities [State Transmission Utilities, Private Utilities/Licensees, Central Transmission Utilities, Public Sector Power Utilities] in the Country have not reported the failures.

4. Out of total 17 failures of the Transformers occurred, 6 were of 220 kV class, 11 of 400 kV class and none of 765 class. 6 Nos. of Transformers failed within five years, 3 Nos. of Transformers failed in 5-10 years of period. 5 Nos. of Transformers failed during 10-20 years of their operation. 3 Nos. of Transformers failed who had operation of more than 20 years. The transformers failures that occurred between 1st January 2025 and 30th June 2025 from the commissioning of the equipment is as per the below graph below:



1. Failures of transformers during Jan'2019-June'2025: The number of different transformer failures as reported in the last 6.5 years to CEA has been shown in the graph below:



5 Observations & Recommendations

1) Recommended measures suggested by the Committee for the Utilities to improve the performance of the substation equipment are listed below. These have been given with the objective that the utilities take necessary action to improve performance of equipment and use modern diagnostic tools for condition assessment so as to keep substation equipment healthy for long trouble-free and reliable operation.

2) It is observed that reported failures are primarily due to the following reasons:
   a) Normal Ageing
   b) Failure of Insulation system & Bushing for Transformers
   c) Lack of prudent maintenance practices
   d) Frequent System Faults and transient over voltages generated by the system.

3) Condition Based Maintenance (CBM) Practices using modern diagnostic tools is yet to be adopted in large scale by many utilities, and in general, periodic Time Based Maintenance (TBM) is still being practiced. Adequate modern Diagnostic tools are also not available with most of the State Utilities.

4) As the utilities have been intimating failure events to CEA with extended delay times, the required site visits could not be undertaken by the Committee for most of the failure.

5) In most cases of the failures, utilities do not furnish factory test reports, pre-commissioning test reports, history of O&M & repairs, relay settings, environmental & system conditions at the time of failure etc. which makes it very difficult to analyze the cause of failure.

6) In case of failure of transformers, report of detailed internal inspection carried out by the Original Equipment Manufacturer (OEM) at site or at its works are not provided.

7) All the utilities should furnish preliminary information of failure of substation equipment of 220 kV and above voltage class within 48 hours of the occurrence of the failure and detailed report within a Month in the prescribed format available at **Annexure-IV** and also on CEA website. The report should accompany tests carried out after failure, test reports and details of previous maintenance, pre-commissioning test reports, and photographs of the failed equipment.

8) The utilities should report to the Original Equipment Manufacturer (OEM) about the failure of equipment, even if the warranty has expired, which may help the manufacturers to take corrective action for improving the product design.

9) The practice of Condition Based Monitoring using online modern diagnostic tools should be followed instead of conventional Periodic / Time-Based Maintenance. A list of diagnostic tools is given in CEA Grid Standard regulation which can be used for one substation or a pool of substations depending upon requirement.

10) Regular O&M of Substation equipment shall be carried out. In this regard, Model O&M Guidelines given at **Annexure-III** should be followed by Utilities.

11) A centralized Asset Monitoring System shall be installed that can monitor all Medium voltage and high voltage electrical assets like GIS, AIS, Breakers, Power Cables including Transformers for condition based maintenance. All FAT, SAT and Periodic testing data for all electrical equipment shall be stored in this system for performing health assessment. The system shall have advanced health index models that utilizes analytics and threshold limits as prescribed by latest IEEE, IEC, and CIGRE standards / recommendations. This system shall also be capable of integrating online monitoring of sensors installed at electrical assets, and inspection records/reports from the visual inspection of assets. It shall have the capabilities to monitor DGA, Partial discharge – Electrical & UHF, bushing, fan control, fiber optic monitoring and other monitoring parameters. This system shall support cloud and on-premise installation and provide access to electrical asset health dashboards at engineer's PC, Mobile, Laptops or tablets.

12) Condition monitoring as mentioned in Standard specifications and technical parameters for transformers and reactors (66 kV & above voltage class) CEA standard shall be adopted.

13) The frequency/ periodicity of measurement should be changed depending on the condition/ healthiness of the equipment in operation. The trend of test results should be monitored rather than the absolute values of test results.

14) Utilities should follow the best practices for maintenance of each equipment. All the equipment which have reached/ approaching end of service life need to be monitored closely and utility should plan and take action in advance for replacement of such equipment in a phased manner.

15) The utilities should make it a practice to carry out various tests on major electrical equipment at sites one or two months prior to expiry of warranty period of respective equipment so that any abnormality observed in test results can be discussed with OEM for taking up further necessary action within warranty period.

16) The utilities must be careful during installation of transformers at site and long hanging connecting leads which might touch with other parts of the transformer, should be avoided.

17) The utilities must be careful while storing the equipment as spare or keeping transformer uncharged in the yard for long time before putting in to service. The OEM's recommendation for storage should be followed strictly. Spare equipment should be periodically tested as per OEM's recommendation.

18) Utilities should take appropriate actions for repair/ replacement of concerned equipment as soon as some abnormality is observed through visual inspection or diagnostic tests.

19) Frequent failures of equipment of any particular make should be thoroughly investigated in consultation with OEM and necessary action including design modification, if required, should be carried out by OEM.

20) Most of the utilities are facing problem due to shortage of supporting staff for operation & maintenance of sub-station equipment. The manpower should be strengthened for efficient operation & maintenance.

21) The regular cleaning of dust deposited on the housings of major equipment and bushings of transformer in Thermal Power Plant are essential to avoid flash over across the insulators, as such frequent flashover across the bushing / housing of equipment (due to operation in such dusty environment) may lead to failure of equipment. Wherever feasible, the porcelain housings of major equipment (CB/LA/CT/CVT) and bushings of transformer may be protected by providing Room Temperature Vulcanisation (RTV) coating. RTV coating over porcelain housing of equipment (CB/LA/CT/CVT) / bushings of transformer & reactors may also be considered by utilities for substation equipment installed in pollution prone areas.

22) Utilities should create and maintain complete database of equipment/transformers including previous test reports (reports of factory tests/pre-commissioning tests/tests during O&M etc.), operation & maintenance history of equipment with make, model & year of commissioning etc. for proper evaluation, interpretation of test results and for taking Run-Refurbish-Replacement decision.

23) However, merely maintaining the history of O&M is not sufficient. Test results are not useful if correct method of testing is not followed. All tests and maintenance should be carried out as per best practices. The method of testing as well as the conditions while conducting the tests should be consistent / identical to previous testing condition as far as possible. For example, test voltage, tap position at which test is conducted, etc., should be maintained while measuring IR or Turns Ratio, or conducting SFRA and other similar tests. Details of test kits, should be maintained so that the test results can be compared with subsequent test results. For variation in temperature, required correction factors could be incorporated. Calibration of the testing instruments should be ensured for reliability of the assessment.

24) Utilities should explore the possibility of installation of CCTV cameras in the substation, covering transformer area so that transformers could be monitored from the control room and any mishap with the transformer could be recorded for further analysis. It would also help to determine the point of initiation and actual cause in case of fire in transformer.

25) If any damaged equipment is sent to the manufacturer's works for repair, detailed investigation report including probable causes of failure should be submitted to the Standing Committee for benefit of the other utilities.

26) Proper handling, loading, transportation, unloading, and storage at site before assembling play important role in satisfactory operation of equipment.

27) The erection of major equipment including transformers/reactors should always be carried out by experienced technical team under the close supervision of manufacturer.

28) Inordinate delay in commissioning of equipment after reaching at site should be avoided.

29) When there is a wide gap between the year of manufacturing and year of commissioning of the transformers/ reactors, proper care must be taken to ensure satisfactory operation of transformer/ reactor. Storage and periodic testing of transformer/ reactor should be done as per manufacturer's recommendations.

30) Transformer/ reactors should not be kept for more than three (3) months with dry air/inert gas (Nitrogen) filling and all throughout the period, required pressure needs to be maintained in order to avoid the exposure of active part to atmosphere. After three (3) months, transformer/ reactor should be filled with oil under vacuum and it should be provided with oil conservator including oil level indicator and breather. The oil parameters need to be monitored regularly.

31) As far as possible the transformer/ reactor should be transported filled with dry air. Use of nitrogen for this purpose should be avoided.

32) The height of the fire wall between two transformers/reactors should be at least 600 mm above the highest point of the transformer and fire wall should be rated for four-hour fire rating so that fire in one transformer/reactor does not affect adjacent transformers/ reactor.

33) Whenever there is movement of transformer either from manufacturing works or from one station to other, Sweep frequency response analysis (SFRA) should be carried out before movement and after shifting to new location and in case of any discrepancy, OEM may be contacted. SFRA signature would provide valuable information about deformation in winding /core during transportation.

34) On Load Tap Changer (OLTC) is one of the contributors to the failure of transformer. Possibility of eliminating OLTC from 400 kV & 765 kV class transformer should be considered (based on system studies) in consultation with Regional Power Committee (RPC) and Regional Load Despatch Centre (RLDC)/Grid-India and CEA. The reduction in in number of taps/steps can also be considered in case of OLTC of 220 kV and below voltage class transformers. The removal of OLTC will simplify the design and manufacturing of transformers.

35) Tertiary winding should be avoided, wherever feasible, as it increases the probability of failure of the transformer. Tertiary terminals of transformer prone to short circuiting by external element such as bird or animal may be suitably insulated.

36) Transformer should be subjected to short circuit withstand test as per CEA (Technical Standards for Construction of Electrical Plants and Electric Lines), 2022 Regulations, to verify its capability to withstand dynamic effect of short circuit. The design review of the transformers should be carried out properly before

commencement of manufacturing. Stage inspection should also be carried out to check manufacturing process as well as quality of material used in subsequent transformers.

37) An internal inspection of the failed transformer on-site is warranted at times to locate fault inside the transformer and to assess the extent of damage. As far as possible, internal inspection should be carried out in association with OEM / in presence of representative of OEM. All safety precautions must be observed at all times. Internal inspection must be performed by experienced staff with proper training. The internal inspection should not cause any further damage to the transformer and precaution should be taken to prevent ingress of moisture and any foreign material into the transformer and hence internal inspection should be meticulously planned.

38) As far as possible, LV test and SFRA should be conducted after through fault to check the integrity of the transformer.

39) The capacitance and tan delta measurement of transformer bushing at variable frequency and Dissolved gas analysis (DGA) of bushing oil should be carried out for health assessment of bushings as this has been proved to be very effective in assessing the condition of in-service bushings.

40) Residual Life Assessment (RLA) should be conducted for old and aged transformers (approaching end of service life) for proper planning to replace them in stages.

41) At substations where fault level has increased beyond the design level, suitable corrective measures such as splitting of bus or employment of fault limiting devices should be adopted.

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Annexure-I

List of Participants

CEA

1. Sh. N.R.L.K. Prasad, Chief Engineer (PSE&TD Division)
2. Sh. Bhanwar Singh Meena, Director (PSE&TD Division)
3. Sh. Pankaj Kumar Verma, Deputy Director (PSE&TD Division)
4. Sh. Bhavesh Mahawar, Assistant Director-I (PSE&TD Division)

BBMB

1. Sh. Kushal Chandel, Sr. Xen
2. Sh. Satish Pahal, Sr. Xen, O&M
3. Sh. Vikas Banger, DD
4. Sh. Sanjeev Kumar, DD

GETCO

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2. Sh. J V Patel, EE

NTPC

1. Sh. Gautam Upadhyay, DGM

UPPTCL

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3. Sh. M K Gupta, SE
4. Sh. Shivam Rai

NLCIL

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2. Sh. Alok Verma, Sr Xen

DTL

1. Sh. Satish, DGM (O&M)

DVC

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2. Sh. Vivek Rastogi
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Torrent Power

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WBSETCL

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2. Sh. Soumava Sarkar, Add CE

JUSNL

1. Sh. C S Pandey, Sr. Manager

HPPTCL

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2. Sh. Virendra Sharma, DGM

HPGCL

1. Sh. Subhash Garg, Xen

NHPC

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RVUNL

1. Sh. Ashok Kumar Sharma, Xen

Apraava

1. Sh. Ajay Barnwal, Asst Manager

Indi-Grid

1. Sh. Vivek Karthikeyanr

CPRI

1. Sh. Manohaer Singh, Addl Director

Other Online Participants

1. Sh. Sujeet Kumar
2. Sh. M Devakumar
3. Sh. Vivek Mahajan
4. Sh. Ramjee Kumar
5. Sh. Karma D Bhutia
6. Sh. Aman Katoch
7. Sh. Vivek Pratap Singh
8. Sh. Rakesh Tewatia
9. Sh. Heamit Singh Chauhan
10. Sh. Sanajaoba Singh
11. Sh. Anuj Kukreti
12. Sh. Sukhjeet Singh
13. Sh. Maranani Sreekanth
14. Sh. Prosenjit Mukhopadhyay
15. Sh. Prashant Kumar Sammeta
16. Sh. Guru Prakash
17. Ms. Sagarika Mohanty
18. Sh. Jasvir Dhiman

Annexure-II
Detailed Information of All Failed Equipment Reported to CEA between January 2025 and June 2025

Annexure-II: Detailed Information of Failed Equipment Reported to CEA between January 2025 and June 2025

Detailed information in respect of following failures is given in subsequent pages of this annexure:

S. N.	Failure report	Utility	Serial No.	Date of Failure
1.	Failure report of 50 MVA, 220/33 kV Power Transformer at Chandrapur S/s	MSETCL	23307	14.01.2025
2.	Failure report of 50 MVA, 220/33-22 kV Power Transformer at Bhaveghar S/s	MSETCL	B-28540	17.04.2025
3.	Failure report of 50 MVA, 220/22 kV Power Transformer at Bhosari-2 S/s	MSETCL	T8518/2	26.04.2025
4.	Failure report of 100 MVA, 220/33 kV Power Transformer at Hinganghat S/s	MSETCL	2004698	05.05.2025
5.	Failure report of 50 MVA, 220/100/22 kV Power Transformer at Taloja S/s	MSETCL	B29851	26.05.2025
6.	Failure report of 50 MVA, 220/33 kV Power Transformer at Miraj S/s	MSETCL	B-12012/ 001	01.06.2025
7.	Failure report of 50 MVA, 220/33 kV Power Transformer at Warora S/s	MSETCL	5196/1	10.06.2025
8.	Failure report of 50 MVA, 220/22 kV Power Transformer at Anandnagar S/s	MSETCL	B-30029	24.06.2025
9.	Failure Report of 100 MVA, 220/132 kV Power Transformer at Malegaon (Zodga) S/s	MSETCL	90075B01	26.06.2025
10.	Failure report of 100 MVA, 220/66 kV Power Transformer at Kasor S/s	GETCO	2040835	26.02.2025
11.	Failure report of 100 MVA, 400/132 kV Power Auto Transformer at Singrauli	NTPC	6004312	01.03.2025
12.	Failure report of 200 MVA, 400/132 kV ICT-I at Kasara, Mau S/s	UPPTCL	6005254	25.03.2025
13.	Failure report of 315 MVA, 400/220/33 kV ICT at Jaunpur S/s	UPPTCL	B30633	28.03.2025

14.	Failure report of 300 MVA, 16.5/400 kV, GT-1 TPS II Expansion, NLCIL	NLCIL	6007837	11.05.2025
15.	Failure report of 100 MVA, 220/132 kV Auto Transformer at Moga (Singhawala) S/s	PSTCL	B-27143	24.05.2025
16.	Failure report of 315 MVA, 400/220/33 kV Auto Transformer at Bamnauli S/s	DTL	140123-2	01.06.2025
17.	Failure report of 315 MVA, 400/220/33 kV ICT at Koderma S/s	DVC	6006673	02.06.2025

1. Failure report of 50 MVA, 220/33 kV Power Transformer at Chandrapur S/s, MSETCL

i.	Name of Substations	:	220 kV MIDC Chandrapur SS
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	Power Transformer
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/3-phase)	:	50 MVA, 220/132 kV Transformer
v.	Make (Original equipment manufacturer)	:	CGL
vi.	Serial No.	:	23307
vii.	Date and time of occurrence of fault	:	14.01.2025 at 7:54 hrs
viii.	Fault discovered during (Operation or periodic testing/maintenance)	:	T/F was tripped on differential, Buchholz & PRV
ix.	Year of Manufacturing	:	1975
x.	Date of Commissioning	:	03.01.2025 (Date of charging after repair)
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	Transformer tripped on Differential Buchholz and PRV
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure? If no tests were conducted, reasons for the same may be stated.)	:	1) Magnetic balance test 2) No load test 3) Ratio Test
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment/ materials etc.)	:	Y-ph bushing lead broken near bushing thimble and thrown along with jumper
xiv.	Probable cause of failure	:	Detail analysis will be carried out at VPES work shop
xv.	IF OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	M/s. Vishvas Power Engineering Services Pvt. Ltd (Repairer agency) has done internal inspection & it was observed that • Y-ph bushing lead broken near bushing thimble and thrown along with jumper. • Bottom portion of the Y-ph bushing is crack & also Y-ph winding conductor has come out from winding coil.
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Yes, Repairable
xvii.	(a) Details of previous maintenance (Activities carried out in previous	:	Above said repair Transformer by M/s. Vishvas Power Engineering Services Pvt. Ltd was

	maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?		Charged on dated 03.01.2025 with all necessary test & testing activity.
xviii.	Details of any previous failure on the same unit	:	NA
xix.	Is tertiary winding provided (Yes/No)	:	NA
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	NA
xxi.	Whether tertiary terminals are bare/insulated	:	NA
xxii.	Whether relay time is synchronized with UTC	:	NA
xxiii.	Bushing details (OIP/RIP/RIS, Porcelain/Polymer housing)	:	Porcelain
xxiv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load
xxv.	Tap positing of OLTC at the time of failure	:	9
xxvi.	Past record of Operation of OLTC	:	NA
xxvii.	Tap Range	:	1 to 17
xxviii.	Details of Protection provided for ICT/GT/Reactor	:	Differential Protection, REF Protection, Buchholz Protection, PRV Protection, Overcurrent Earth fault Protection.
xxix.	Details of Protection operated	:	Transformer was operated on differential, Buchholz & PRV
xxx.	Whether equipment is properly earthed	:	Yes
xxxi.	Earth Resistance of Substation and date of its measurement	:	Dated 02.01.2025, Earth Resistance -0.4 ohm (TF-Earth pit Resistance)
xxxii.	Surge Arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	SA Provided on HV, LV side for all Three phases
xxxiii.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	NA
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	NA

xxxv.	Type of Fire protection provided (Emulsifier system/N2 Injection based fire protection system/foam based protection etc.)	:	foam based protection
xxxvi.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Clear sky
xxxvii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/oil filled	:	Oil Filled
xxxviii.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Yes, Short circuit test carried out
xxxix.	Number of through faults the equipment was subjected to before failure	:	NIL

2. Failure report of 50 MVA, 220/33-22 kV Power Transformer at Bhaveghar S/s, MSETCL

i.	Name of Substation	:	220 kV Bhaveghar SS
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	220/33-22 kV Transformer No:-1
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/3-phase)	:	50 MVA, 220/33-22 kV, 3 Phase
v.	Make (Original equipment manufacturer)	:	GEC Alstom (Repaired by M/s SET On SITE in Year 2021)
vi.	Serial No.	:	B-28540
vii.	Date and time of occurrence of fault	:	17.04.2025 at 8:35 Hrs.
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	Repaired by M/s SET On SITE in Year 2021
x.	Date of Commissioning	:	09.05.2023
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	17.04.2025 at 8:35:00 Hrs. Tripping on Buchholz Alarm protection (30LM) with Tripping Relay 86 A alongwith 22 kV Palsai feeder Tripping.
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	Top & Bottom oil's sample are tested for DGA of transformer oil. Flame Test of Bucholz Relay Open Circuit tests Short Circuit tests Magnetic Balance Tests Winding Resistance Tests Capacitance & Tan delta of bushing & Winding IR & PI Tests SFRA & DFR Tests
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment/material etc.)	:	Internal Inspection of Transformer carried Out by repairer Agency following abnormalities are observed I. The Y Phase bottom side permalli wooden blocks usually situated in between winding & core assembly channel found dislocated from the original position due to heavy jerk and some wooden blocks are fallen at the bottom of the tank. II. The burnt smell sensed from the transformer tank after opening of inspection window. III. The Y phase winding wrapping

			paper/sheet found loose.
xiv.	Probable cause of failure	:	Insulating Permalli wooden spacers & blocks are found Dislocated
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached	:	Internal Inspection of Transformer carried Out by repairer Agency.
xvi.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	Annual Maintenance carried out on date 06.12.2024. Capacitance & Tan Delta Tests of Tranformer Winding & Bushing. IR & PI Test.
xvii.	Details of any previous failure on the same unit	:	NA
xviii.	Is tertiary winding provided (Yes/No)	:	No
xix.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	No
xx.	Whether tertiary terminals are bare/ insulated	:	NA
xxi.	Details of protection for Tertiary	:	NA
xxii.	Whether relay time is synchronized with UTC	:	NA
xxiii.	Bushing details (OIP/RIP/RIS, Porcelain/polymer housing)	:	OIP/Porcelain
xxiv.	On Load Tap Changer or Off Circuit Tap Changer	:	OLTC
xxv.	Tap position of OLTC at the time of failure	:	15
xxvi.	Past record of Operation of OLTC	:	Working in order
xxvii.	Tap Range	:	1-17
xxviii.	Details of Protection provided for ICT / GT / Reactor	:	NA
xxix.	Details of Protection operated	:	17.04.2025 at 8:35:00 Hrs. Buchholz Alarm protection (30LM) with Tripping Relay 86 A
xxx.	Whether equipment is properly earthed	:	Yes

xxxi.	Earth Resistance of Substation and date of its measurement	:	Earth Resistance of 50MVA 220/33-22 kV T/F-1 measured on 10.03.2025 - Earth Pit No. 25: HV Neutral - 0.13Ω Earth Pit No. 26: HV Neutral - 0.75Ω Earth Pit No. 30: 33kV Neutral - 0.11Ω Earth Pit No. 31: 33kV Neutral - 0.8Ω Earth Pit No. 32: 22kV Neutral - 0.2Ω Earth Pit No. 34: 22kV Neutral - 0.19Ω Earth Pit No. 33: Body Earthing - 0.1Ω
xxxii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Surge Arrestor provided (b) Healthy Condition (c) No Change in LA Counter Reading during failure
xxxiii.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	950 kV
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	950 kV
xxxv.	Type of Fire protection provided (Emulsifier system/N2Injectionbasedfire protection system/ foam based protection etc.)	:	NA
xxxvi.	Weather conditions at the time of failure (clear sky/ rainy/ thunderstorm etc.)	:	Clear
xxxvii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/oil filled	:	Nitrogen filled
xxxviii.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit with stand Capability was verified on the basis of calculation?	:	NA
xxxix.	Number of through faults the equipment was subjected to before failure	:	22 kV feeder faults-428

3. Failure report of 50 MVA, 220/22 kV Power Transformer at Bhosari-2 S/s, MSETCL

i.	Name of substation	:	220 kV Bhosari-2 S/s
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Auto Transformer/ GT/ Reactor	:	220/22 kV 50 MVA TF No 1, CGL MAKE, Repaird by AVAL in year 2012.
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase / 3-phase)	:	50 MVA/220-22 kV 3-Phase
v.	Make (Original equipment manufacturer)	:	CGL MAKE Repaird by AVAL in year 2012.
vi.	Serial No.	:	T 8518/2
vii.	Date & time of occurrence/discovery of fault	:	26.04.2025 at 06.00 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Transformer No. 1 tripped on 26.04.2025 at 06.00 Hrs on Buchholz alarm, Differential R ph at 6:00 AM along with 22 kV PMAY 1 feeder fault. Transformer No 1 HV, LV CB, 22 KV PMAY 1 feeder tripped.
ix.	Year of Manufacturing	:	1997 (Repaired by M/s AVAL in year 2012)
x.	Date of Commissioning	:	05.02.2013
xi.	Sequence of events/ Description of fault (SOE with time stamp, protection operated during fault)	:	Transformer tripped on Differential protection along with Simultaneous tripping of 22 kV PMAY-1 Feeder Window indication: 86 A operated, 86B operated, Buchholz Alarm Relay indication On Diff relay, R ph Trip Iref: 5.082, Iref:5.083, Iref:6.082 HV Back up: Ia:302.4 A, Ib:668.5 A, IC:63.70 A, IN: 557.1 A LV backup: IA: 3.015 kA, IB: 7.068KA, IC:701.3A, IN: 6.432 A 22 kV PMAY 1 feeder Ia: 84.9 A, Ib: 5333.6A, Ic:114A
xii.	Details of test done after failure (What test were conducted after discovery of failure. If no tests were conducted, reason for the same may be stated)	:	1) Flame test carried carried out, T/F IR PI carried out. LV Cable IR taken 2) T/F Oil DGA carried out. 3) SFRA of Transformer conducted 4) Bushing Winding Tan Delta 5) Excitation HV & LV.6) O/C and S/C Test 6) Magnetic Balance.8) Vector Group 7) WRM.DR taken by PAC Division 2 .

xiii.	Observation (Visual observation e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment/ material etc.)	:	Observations as under- 1) Acetylene C2H2 of 117 ppm is found in DGA test. 2) Abnormal values LV and HV excitation of R Phase. Deviation in SFRA for HV R & B phase & LV R & B Phase. 3) Transformer internal inspection done and flash observed near core on top side of the R Ph LV Winding. Insulation found damaged. The copper granules are observed on the top side of R Ph winding in large quantity. The permalie wooden ring found of R PH found damaged.
xiv.	Probable cause of failure	:	Radial movement of LV R Ph & Inter-turn short circuit due to nearby fault (22 kV PMAY feeder.)
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	Transformer was commissioned in 2013. TF is not under warranty period. Not inspected by OEM.
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Repairable
xvii.	a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) b) Whether any abnormality observed in these tests. If yes attach the test reports c) What steps were taken to address the abnormality?	: : :	a) HYM Carried out on dt. 09.05.2024 1) T/F IR PI valus taken. 2) WTI OTI oil pockets checked and refilled. 3) PRV, OSR and Buccholz connections checked. HYM carried out on dt. 10.10.2024 1) Bushing and winding Tan Delta Carried out 2) HV LV Earthing pit values checked DGA carried out on 21.08.2024 and 18.11.2024 T/F OLTC overhauling done on dt. 13.02.2025 b) Test results are normal. c) NA
xviii.	Details of any previous failure on the same unit	:	Initially said Power Transformer was commissioned at 220 kV Telco S/s on 27.03.1998. Further, said TF failed on 27.04.2012 & repaired by M/s. AVAL.

			After repairing, said TF commissioned at 220 kV Bhosari-II S/s on 05.02.2013.
xix.	Is tertiary winding provided (Yes/ No)	:	No
xx.	Tertiary loaded (Yes/ No) if yes, specify load on tertiary	:	No
xxi.	Whether tertiary terminals are bare / insulated	:	NA
xxii.	Details of protection for tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	No
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ Polymer housing):-	:	Porcelain
xxv.	On load tap changer or off circuit Tap changer	:	On load tap changer
xxvi.	Tap position of OLTC at the time of failure	:	9
xxvii.	Past record of Operation of OLTC	:	Healthy
xxviii.	Tap Range	:	Tap 1 to Tap 17
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	Body Protection, Differential bus bar, NDR, REF
xxx.	Details of protection operated	:	Differential, OC Backup, REF, Buchholz, temperature trip, PRV, OSR
xxxi.	Whether equipment is properly earthed	:	Differential protection & Buchholz alarm
xxxii.	Earth Resistance of Substation and date of its measurement	:	Date of Measurement: 19.04.2025 Earth Pit No. Resistance value 20 T/F - I neutral (LV) 0.29 21 T/F -I LA R ph 0.61 22 T/F -I LA Y ph 0.46 23 T/F -I LA B ph 0.27 24 T/F - I nutral (HV) 0.34 25 T/F - I Body 0.61 26 T/F - I Body 0.20
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	a) Yes b) Yes-LCM tested. Dated :04.11.2024 (R phs = 35 µA, Y phs=13 µA, B phs= 15 µA) c) No
xxxiv.	Lighting Impulse and Switching Impulse Withstand Voltage of the bushing of all voltage level	:	NA

xxxv.	Lighting Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	NA
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 injection based fire protection system/ foam based protection etc.)-	:	Fire Protection not provided for said TF.
xxxvii.	Weather condition at the time of failure (clear sky/ rainy/ thunderstorm etc.)	:	Clear sky
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled /Nitrogen filled / oil filled	: 	 a) NIL b) NA c) NA
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Yes
xl.	Number of through faults the equipment was subjected to before failure	:	Not Applicable

4. Failure report of 100 MVA, 220/33 kV Power Transformer at Hinganghat S/s, MSETCL

i.	Name of substation	:	220 kV Hinganghat S/s
ii.	Utility/owner of substation		MSETCL
iii.	Faulty Equipment (ICT, Auto-transformer/GT/ Reactor etc.	:	220/33-33 kV PTR 4
iv.	Rating	:	100 MVA
v.	Make	:	BHEL
vi.	Serial No-	:	2004698
vii.	Date and time of occurrence of fault	:	05.05.2025/ 01:05 hrs
viii.	Fault discovered during (Operation or Periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	NA repaired in year 2014
x.	Date of Commissioning	:	18.08.2018
xi.	Sequence of Events leading to failure/ Description of fault	:	On date 05.05.2025 at 00:47 hrs 33 kV Wani kutki feeder tripped on Earth fault protection. Rph 1.136 A,Y ph 23.07A, B ph 1.2 A, N 24.019 A. CTR connected 200/1 00:49 33 kV Wani kutki feeder charged and stood OK On date 05.05.2025 at 00:50 hrs 33 kV Sonegaon feeder tripped on Earth fault protection Rph 0.005 A, Yph 13.15 A, Bph 0.005 A, N 14.83 A. CTR connected 400/1 On date 05.05.2025 at 1:05 hrs 33 kV Wani kutki feeder tripped on Earth fault protection. Rph 15.47 A, Yph 7.663A, Bph 0.005 A, N 8.268 A. CTR connected 200/1 Also, at 01:05, 100 MVA 220/33-33 kV PTR 4 tripped on Differential Protection and Buchholz alarm. 86MTR Operated. (IA HV- 188.3 A, IB HV- 20.63 A, IC HV- 30.26 A, IA LV1- 50.82 A, IB LV1- 106.9 A, IC LV1- 110.6 A, IA LV2- 6.201 A, IB LV2- 0 A, IC LV2- 3.173 A)
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	No load test, Short circuit test, Magnetic Balance test, Voltage ratio test, Vector group test, SFRA, Winding resistance test taken.
xiii.	Observation (Visual observations during site visit e.g. bulging of tank, fire, any leakage of oil,	:	Open circuit test, magnetic balance test and SFRA test not confirmed with factory test results

	damage to various components of transformer and nearby equipment / material etc.)		
xiv.	Probable cause of failure	:	Heavy fault on 33 kV feeder causing mechanical jerk leading to possible thermal fault inside Main tank
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remark, MOM to be attached.	:	No.
xvi.	Details of previous maintenance activity carried out on equipment.	:	The transformer has been subjected routine testing and maintenance as per the approved PMS of the company.
xvii.	Present condition of equipment (whether repairable or beyond repair)	:	Repairable
xviii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	(a) Maintenance carried out on 23.01.2025 (Tan delta, CB CRM, Timing, IR values taken) (b) No (c) NA
xix.	Details of any previous failure on the same unit	:	Repaired by M/s Aditya Vidyut in year 2014 (Conversion into 100 MVA 220/33-33 kV PTR)
xx.	Is tertiary winding provided (Yes/No)	:	Yes
xxi.	Tertiary loaded (Yes/No). If yes, specify load on tertiary.	:	NA
xxii.	Whether tertiary terminals are bare/ Insulated	:	NA
xxiii.	Details of Protection for tertiary.	:	NA
xxiv.	Whether relay time is synchronized with UTC	:	No
xxv.	The type of bushing and housing: OIP/RIP, Porcelain / polymer housing	:	OIP Porcelain
xxvi.	On load tap changer or Off circuit tap changer	:	On load
xxvii.	Tap position OLTC at the time of failure	:	8
xxviii.	Past record of Operation of OLTC	:	On date 25.02.2025
xxix.	Tap Range	:	17

xxx.	Details of Protection provided for ICT/GT/Reactor	:	Differential, OC & EF relay, REF relay, Buchholz, PRV provided
xxxi.	Protection operated during fault	:	At 01:05 100 MVA 220/33-33 kV PTR 4 tripped on Differential Protection and Buchholz alarm. 86MTR OPERATED. (IA HV- 188.3 A, IB HV- 20.63 A, IC HV- 30.26 A, IA LV1- 50.82 A, IB LV1- 106.9 A, IC LV1- 110.6 A, IA LV2- 6.201 A, IB LV2- 0 A, IC LV2- 3.173 A)
xxxii.	Whether equipment is properly earthed.	:	Yes
xxxiii.	Surge Arrestor a) Is SA provided for protection b) Whether healthiness of SA is monitored c) Whether reading of SA Counter changed during failure	:	a) Yes b) Yes c) No
xxxiv.	Lighting Impulse and switching Impulse withstand voltage of bushings of all the voltage level.	:	220 kV BIL 505 kV/1050 kVp 132 kV BIL 305 kV/650 kVp
xxxv.	Lighting Impulse and switching Impulse withstand voltage of windings of all the voltage level.	:	HV/HVN/LV- LI 950 AC 395/LI 95 AC 38/LI 170AC 70
xxxvi.	Type of Fire protection provided (Emulsifier system Injection based fire Protection system/ for based protection etc.)	:	N2 based
xxxvii.	Weather conditions at the time of failure (clear sky/ rainy/ thunderstorm etc.)	:	Thunderstorm
xxxviii.	Storage condition of equipment at site before commissioning a) Period of storage b) Idle charged or uncharged c) Dry air filled/ Nitrogen filled/ Oil filled	:	Was not in storage but charged
xxxix.	Whether short circuits test carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation	:	No
xl.	Number of through fault equipment is subjected to before failure	:	4

5. Failure report of 50 MVA, 220/100/22 kV Power Transformer at Taloja S/s, MSETCL

i.	Name of Substation	:	220/100/22 kV Taloja SS
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	Power Transformer
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3-phase)	:	50 MVA
v.	Make (Original equipment manufacturer)	:	ALSTOM
vi.	Serial No.	:	B29851
vii.	Date and time of occurrence of fault	:	26.05.2025 at 05:28 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Probably due to lightning strike
ix.	Year of Manufacturing	:	2005
x.	Date of Commissioning	:	01.04.2005
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	TF tripped on Differential Protection, PRV trip & Main Buchholz trip at 05:28Hrs.
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	1) Main tank Oil sample & DGA test 2) Flame Test 3) SFRA 4) HV, LV excitation 5) Ratio test, HV, LV side Open Circuit, Short Circuit, Magnetic balance by application of LV Voltage 6) Winding, Bushing Tan Delta, Capacitance measurement on 10 kV 7) HV, LV Winding Resistance measurement by injection of DC current 8) IR, PI results of TF all three modes viz HV-E, LV-E & HV-LV by 5kV DC Megger make digital Insulation Tester
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	Nothing observed abnormal externally. No damage to other nearby equipment/material.
xiv.	Probable cause of failure	:	Due to lightning strike.

xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	NIL
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Internal inspection is required.
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	1) Capacitance Tan Delta of Bushing carried out on dated 13.12.2024 and test results within limit. 2) Capacitance Tan delta of Winding carried out on dated 02.02.2024, test results normal within limit. 3) DGA -02.01.2025 dissolved gases in oil are within limits. No abnormality Observed.
xviii.	Details of any previous failure on the same unit	:	Nil
xix.	Is tertiary winding provided (Yes/ No)	:	No
xx.	Tertiary loaded (Yes/ No) If yes, specify load on tertiary	:	NA
xxi.	Whether tertiary terminals are bare/ insulated		NA
xxii.	Details of protection for Tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	No
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	9B
xxvii.	Past record of Operation of OLTC	:	10 on dated 14.03.2023
xxviii.	Tap Range	:	1 to 17
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	NA

xxx.	Details of Protection operated	:	TF tripped on Differential Protection, PRV trip & Main Buchholz trip.
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	21/05/2025 avg 0.37
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	Yes
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	NA
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	NA
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	Fire Extinguishers provided
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Heavy Rains and Lightening
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	NA
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Yes
xl.	Number of through faults the equipment was subjected to before failure	:	Nil

6. Failure report of 50 MVA 220/33 kV Power Transformer at Miraj S/s, MSETCL

i.	Name of Substation	:	220 kV Miraj Substation
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	Transformer
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3- phase)	:	50 MVA, 220/33 kV, 3- phase
v.	Make (Original equipment manufacturer)	:	ABB
vi.	Serial No.	:	B-12012/001
vii.	Date and time of occurrence of fault	:	01.06.2025
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	During Operation
ix.	Year of Manufacturing	:	2002
x.	Date of Commissioning	:	25.06.2024
xi.	Sequence of events/Description of fault (SOE with time stamp, protection operated during fault)	:	On dated 31.05.2025, Buchholz Alarm on Annunciator (Window Facia) of ABB TF, Testing work carried out. During internal inspection on dated: 01.06.2025, LV Y phase permali wooden ring found dislocated.
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure? If no tests were conducted, reasons for the same may be stated.)	:	All Low voltage test, OC/SC, Magnetic Balance, Winding Tan delta measurement, Winding Resistance, Oil DGA Test, SFRA, DFRA, IR Values
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	LV Y phase permali wooden ring found dislocated.
xiv.	Probable cause of failure	:	LV Y phase permali wooden ring found dislocated
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc.	:	T/F was repaired by M/s. Jain Electircals, Repairer agency visited the site after failure.
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Repairable (To be repaired)

xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	Previous maintenance carried out on dated 15.04.2025 & 13.05.2025. On 04.03.2025 Testing of Transformer carried out for low voltage test and test results found normal.
xviii.	Details of any previous failure on the same unit	:	On 16.09.2021 at 13:35 Hrs, Y ph LV winding found damaged at 220 kV Vita S/s
xix.	Is tertiary winding provided (Yes/No)	:	No
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	NA
xxi.	Whether tertiary terminals are bare/ insulated		NA
xxii.	Details of protection for Tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	No
xxiv.	Bushing details (OIP/RIP/RIS, Porcelain /polymer housing)	:	OIP
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	ON LOAD TAP CHANGER
xxvi.	Tap position of OLTC at the time of failure	:	16
xxvii.	Past record of Operation of OLTC	:	Normal
xxviii.	Tap Range	:	1 to 17
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	Differential Protection, REF, Backup, WTI, OTI, PRV, Buccholz etc
xxx.	Details of Protection operated	:	Buchholz Alarm on Annunciator
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	Below 1 ohm dated 24.04.2025

xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Yes (b) Healthy (c) No
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	505 kV
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	HV-950 kV LV-170 kV
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	Foam based protection
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Clear
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	(a) 78 days (b) Uncharged (c) Nitrogen filled
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand Capability was verified on the basis of calculation?	:	NO
xl.	Number of through faults the equipment was subjected to before failure	:	184 (33kV feeder trappings) connected to the said T/F at 220kV Miraj S/s.

7. Failure report of 50 MVA 220/33 kV Power Transformer at Warora S/s, MSETCL

i.	Name of Substation	:	220 kV Warora
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	Power Transformer
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3- phase)	:	50 MVA, 220/33kV 3-Ph
v.	Make (Original equipment manufacturer)	:	BBL (Bharat Bijlee Ltd.)
vi.	Serial No.	:	5196/1
vii.	Date and time of occurrence of fault	:	10.06.2025 at 21:22 Hrs (without any simultaneous feeder fault)
viii.	Fault discovered during (Operation periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	2010
x.	Date of Commissioning	:	05.12.2011
xi.	Sequence of events/ Description of fault (SOE with time stamp, Protection operated during fault)	:	Transformer tripped on differential protection and Buchholz trip without any simultaneous outgoing feeder fault Differential relay indication: - LED- Idiff R, Idiff Y, Idiff B Fault data- Started phase ABC, Tripped phase ABC, IA(HV) -8.26A, IB(HV) -121.4A, IC(HV) -12.45A, IA(LV)-70.19A, IB(LV) -63.61A, IC(LV)-72.68 A, IA(Diff)-0.294PU, IB(Diff) -0.594PU, IC(Diff)-0.299PU, IA(Bias) -0.227PU, IB(Bias) -0.343PU, IC(Bias) -0.163PU, Buchholz Relay operated , Trip relay- 86 trip relay
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure? If no tests were conducted, reasons for the same may be stated.)	:	Post occurrence transformer was tested for all necessary tests wherein abnormality found in magnetic balance test, Open circuit test, LV winding test. Moreover, during excitation test (10KV) for Yphase winding Tan Delta kit tripped on 1 kV Voltage. Further IR Values for LV-Earth found low (67 MΩ) with sudden drop in voltage. SFRA results for Y phase LV Winding found distorted. Suspected inter turn short in

			winding portion with possible arcing. DGA of transformer was immediately carried out and Acetylene gas (C2H2) upto 421 µl/l detected with other gases beyond permissible limit. Transformer kept out of service for internal inspection.
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment/ material etc.)	:	NIL
xiv.	Probable cause of failure	:	Suspected Y-ph LV Winding insulation failed & earth
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.		Yes. Transformer repairer M/s Vishwas power engineering services representatives visited site on dated 13.06.2025. During internal inspection, copper granules, particles and black color sludge found at top ring of HV Y-phase. It is suggested by Transformer repairer M/s Vishwas power engineering services to open down the transformer at factory level for further detail inspection.
xvi.	Present condition of equipment (Whether repairable or beyond repair)		Yes, Repairable
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	Diagnostic Testing of said Transformer carried out on Dt. 29.05.2025 and all the are found in order.
xviii.	Details of any previous failure on the same unit	:	NA
xix.	Is tertiary winding provided (Yes/No)	:	NA
xx.	Tertiary loaded (Yes/ No) If yes, specify load on tertiary	:	NA

xxi.	Whether tertiary terminals are bare/ insulated		NA
xxii.	Details of protection for Tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	No
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	ON LOAD TAP CHANGER
xxvi.	Tap position of OLTC at the time of failure	:	9(b) (normal tap:9b)
xxvii.	Past record of Operation of OLTC	:	As and when required
xxviii.	Tap Range	:	1-17
xxix.	Details of Protect provided for ICT/ GT/ Reactor	:	Differential protection, REF Protection, HV & Backup protection, Buchholz Protection, PRV, WTT
xxx.	Details of Protection operated	:	Differential and Buchholz protection
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Yes (b) Yes (c) IR value of LA taken and found in order
xxxiii.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	NA
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	NA
xxxv.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	NA
xxxvi.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Heavy Lightning, Stormy & Rainy
xxxvii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	In Service

xxxviii.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Yes
xxxix.	Number of through faults the equipment was subjected to before failure	:	Around 500 Nos of 33 kV feeder faults occurred on said transformer prior to 1 Year of Transformer Failure with max fault current of about 6 kA.

8. Failure report of 50 MVA, 220/22 kV Power Transformer at Anandnagar S/s, MSETCL

i.	Name of Substation	:	220 kV Anandnagar SS
ii.	Utility	:	MSETCL
iii.	Faulty Equipment (ICT/ Autotransformer/ GT/ Reactor etc.)	:	Power Transformer
iv.	Rating (MVA/MVAr, Voltage ratio, 1-phase/3-phase)	:	50 MVA, 220/22 kV, 3-phase
v.	Make (Original equipment manufacturer)	:	AREVA
vi.	Serial No.	:	B-30029
vii.	Date and time of occurrence of fault	:	24.06.2025 / 01:53 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	2006
x.	Date of Commissioning	:	16.01.2007
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	50 MVA 220/22 kV Transformer No.2 reported tripped on Transformer Differential protection, Main Buchholz on date 24.06.2025 at 01:53 Hrs on L-L-L-G fault on 22 kV Feeder-10(MIDC-1).
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure? If no tests were conducted, reasons for the same may be stated.)	:	(a) Flame test (b) Oil Sample & oil DGA tests (c) Excitation test on HV & LV (d) SFRA test (e) Ratio, HV Open circuit, LV Short circuit test (f) Magnetic balance test (g) Winding & Bushing Tan Delta (h) Winding Resistance measurement test
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformers and nearby equipment / material etc.)	:	Cracks on the HV B phase bottom, IV B phase, deformation in the main tank, bushing damage in HV – R, Y and B Phase, IV – R, Y and B phase and oil spilled in heavy quantity in the surroundings of ICT.
xiv.	Probable cause of failure	:	Based on these results, combined with the protection trip data, points towards Transformer internal damages due to high fault current due to L-L-L-G fault on Cable-Overhead composite feeder. The Transformer sustained inter turn shorting, deformed & displaced windings, reduced clearance between windings & main tank.

xv.	If OEM representatives had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	High fault current due to L-L-L-G fault on Cable-Overhead composite feeder, TF sustained inter turn shorting, deformed & displaced windings, reduced clearance between windings & main tank
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	No
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	17.01.2025 (a) Transformer Diagnostic Testing Work (b) No
xviii.	Details of any previous failure on the same unit	:	01.10.2022 LV neutral bushing link open/ damaged
xix.	Is tertiary winding provided (Yes/ No)	:	No
xx.	Tertiary loaded (Yes/ No) If yes, specify load on tertiary	:	NA
xxi.	Whether tertiary terminals are bare/ insulated		NA
xxii.	Details of protection for Tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	Condenser Bushing
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	13
xxvii.	Past record of Operation of OLTC	:	OLTC overhauling carried out on dt. 17.01.2025
xxviii.	Tap Range	:	1 to 17
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	1) Differential protection 2) Over current Earth fault protection 3) Buchholz protection
xxx.	Details of Protection operated	:	1) Differential protection operated 2) Main Buchholz Alarm
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	Date: 31.05.2025 / 0.8 ohms

xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	: :	 (a) Yes (b) Yes (c) No
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	BIL : 505kV / 1050kVp of HV Bushing
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	950 kV / 395kV of HV winding 125 kV / 50kV of LV winding
xxxvi.	Type of Fire protection provided (Emulsifier system/ N_2 Injection based fire protection system/foam-based protection etc.)	:	NA
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Rainy
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	Information not available
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer, or short circuit withstand capability was verified on the basis of calculation?	:	Information not available
xl.	Number of through faults the equipment was subjected to before failure	:	Information not available

9. Failure Report of 100 MVA, 220/132 kV Power Transformer at Malegaon (Zodga) S/s, MSETCL

i.	Name of Substation	:	220 kV Malegaon (Zodga) Substation
ii.	Utility	:	MSETCL
iii.	Faulty Equipment	:	220/132 kV, 100 MVA ICT-I (Vijai Make, Sr. No. 90075B01)
iv.	Rating (MVA/MVAr, Voltage ratio, 1-phase/ 3-phase)	:	220/132 kV, 100 MVA
v.	Make (Original equipment manufacturer)	:	Vijai
vi.	Serial No.	:	90075B01
vii.	Date and time of occurrence of fault	:	26.06.2025 at 05:51 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	220/132 kV 100 MVA ICT-1 tripped on Main Buchholz relay.
ix.	Year of Manufacturing	:	Mfg. 2010. Said ICT was kept idle from 2010 to 2017 at 220 kV Malegaon (Zodga) S/s as substation bay work not carried out by M/s. ECI. After completion of substation work in risk and cost said ICT commissioned on 10.08.2017
x.	Date of Commissioning	:	10.08.2017
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	1. The ICT-1 tripped on following indication: W.I.:- 1) Main Buchholz trip 2) Main Buchholz alarm RI:- 3) On HV Backup relay(67/67N) a) HV Backup R-ph pickup. Fault current R-ph=392A, Y-ph= 84 A, B-ph= 92.4 A, N= 355.2 A b) Transformer internal Fault. 4) 86A, 86B operated. 5) Auxiliary relay 30J Buchholz alarm. 6) Auxiliary relay 30A Buchholz Trip. 7) Master Trip 86A & 86B operated
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	The 220/132 kV 100MVA ICT-1 tripped on Main Buchholz relay and tested by Testing wing on Dt. 26.06.2025 and following test had been conducted. 1) Flame Test of trapped gas in main Buchholz. 2) SFRA Test 3) Winding resistance test (HV & LV) 4) Magnetic Balance test. 5) Winding tan delta test.

			6) Excitation Current test 7) Ratio test 8) OLTC Continuity Test 9) Open Circuit Test 10) Short Circuit Test 11) IR values. Observation:- • The trapped gas in Main Buchholz relay found flammable (Burnt with blue flame). • In SFRA test, deviation found in R-phase winding graph. • In low voltage tests, short circuit test and winding resistance test results found abnormal in R phase winding of ICT. Hence call given to M/S Set on Site for internal inspection of ICT. On dated 28/06/2025, team of M/s Set on Site visited and carried out internal inspection of ICT 1 after draining out of oil and following are the observations. a) Position of LV R-phase winding found disturbed from its original position. b) Flashover found at bottom side lead of HV R-phase and also bulging of HV R-phase winding observed. c) Carbon particles found at R-phase winding top and bottom of permille ring. d) Top yoke found rusted in R-phase. 5. Water contents observed at bottom side of R-phase. e) Water contents observed at R-phase main lead.7. Smell of oil found burning. f) From the above observations it seems that R-Phase HV winding inter-turn short circuited and causes damage to insulation and thus flashover occurred. g) The repairing of said ICT at site is not possible, hence needs to be sent to the factory for repair and further rectifications.

xiii.	Observations	:	The trapped gas in Main Buchholz relay found flammable (Burnt with blue flame). In SFRA test, deviation found in R-phase winding graph. In low voltage tests, short circuit test and winding resistance test results found abnormal in R phase winding of ICT. Hence call given to M/s Set on Site for internal inspection of ICT. On dated 28/06/2025, team of M/s Set on Site visited and carried out internal inspection of ICT 1 after draining out of oil and following are the observations. 1) Position of LV R-phase winding found disturbed from its original position. 2) Flashover found at bottom side lead of HV R-phase and also bulging of HV R-phase winding observed. 3) Carbon particles found at R-phase winding top and bottom of permille ring. 4) Top yoke found rusted in R-phase. 5) Water contents observed at bottom side of R-phase. 6) Water contents observed at R-phase main lead. 7) Smell of oil found burn, From the above observations it seems that R-Phase HV winding inter-turn short circuited and causes damage to insulation and thus flashover occurred. The repairing of said ICT at site is not possible, hence needs to be sent to the factory for repair and further rectifications
xiv.	Probable cause of failure	:	From the above observations it seems that R-Phase HV winding inter-turn short circuited and causes damage to insulation and thus flashover occurred. The repairing of said ICT at site is not possible, hence needs to be sent to the factory for repair and further rectifications.
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	No OEM representative. M/s Set On Site, representative visited. (M/s Set on site authorized repairer agency of MSETCL)

xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Repairable as per M/s Set On Site representative but cannot repair at site
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	(a) Oil filtration was carried out from date 04.05.2025 to 07.05.2025 also pre-monsoon maintenance carried out. Oil leakage attended on dt 20.06.2025 by power seal method. (b) Before oil filtration PPM is fair and DFR values is 2.3 (moderately in wet condition) (c) Oil filtration was carried out from date 04.05.2025 to 07.05.2025NA
xviii.	Details of any previous failure on the same unit	:	No
xix.	Is tertiary winding provided (Yes/No)	:	No
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	NA
xxi.	Whether tertiary terminals are bare/ insulated		NA
xxii.	Details of protection for Tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/RIP/RIS, Porcelain/polymer housing)	:	Porcelain
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	Tap: 14
xxvii.	Past record of Operation of OLTC	:	On dated 07.05.2025 OLTC trails taken
xxviii.	Tap Range	:	Tap 1 to Tap 17
xxix.	Details of Protection provided for ICT / GT / Reactor	:	Differential Protection, HV and LV Back up Protection, Auxiliary protections, REF
xxx.	Details of Protection operated	:	W.I.:- 1) Main Buchholz trip 2) Main Buchholz alarm, RI:- 1) On HV Backup relay(67/67N) a) HV Backup R-ph pickup

			b) Transformer internal Fault. 2) 86A, 86B operated 3) Auxiliary relay 30J Buchholz alarm. 4) Auxiliary relay 30A Buchholz Trip 5) Master Trip 86A & 86B operated.
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	All values within limit and measurement on dated 12.05.2025
xxxiii.	Surge arrestor : a) Is SA provided for protection b) Whether healthiness of SA is monitored c) Whether reading of SA counter changed during failure	:	a) SA is provided at 220 KV and 132 KV Side b) All 06 nos.(HV and LV) of SA is healthy c) No change
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	Not Available on Name plate
xxxv.	Lightning Impulse and Switching Impulse With stand Voltage of the winding of all voltage level	:	Not Available on Name plate
xxxvi.	Type of Fire protection provided (Emulsifier system/N2Injectionbasedfire protection system/ foam based protection etc.)	:	Nitrogen Injection based fire protection system (NIFPS)
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Rainy
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/Oil filled	:	Said ICT was kept idle from 2010 to 2017 at 220 kV Malegaon (Zodga) S/s as substation bay work not carried out by M/s ECI. After completion of substation work in risk and cost said ICT commissioned on dt. 10.08.2017
xxxix.	Whether short circuit test was carried out on this transformer or same design Transformer or short circuit with stand Capability was verified on the basis of calculation?	:	Dt.07.05.2025 (Before Fail) and Dt 26.06.2025 (After Fail)
xl.	Number of through faults the equipment was subjected to before failure	:	21

10. Failure report of 100 MVA, 220/66 kV Power Transformer at Kasor S/s, GETCO

i.	Name of substation	:	400 kV Kasor SS
ii.	Utility	:	GETCO
iii.	Faulty Equipment (ICT/ Auto Transformer / GT / Reactor	:	Power Transformer
iv.	Rating (MVA /MVAr, Voltage ratio, 1-phase / 3-phase)	:	100 MVA, 220/66 kV, 3-PHASE
v.	Make	:	BHEL
vi.	Serial No.	:	2040835
vii.	Date & time of occurrence/discovery of fault	:	26/02/2025, 04:09 Hrs
viii.	Fault discovered during	:	Operation
ix.	Year of Manufacturing	:	2015
x.	Date of Commissioning	:	21.07.2016
xi.	Sequence of events/ Description of fault (SOE with time stamp, protection operated during fault) :-	:	TRF tripped in Differential & Buchholz along with 66 kV LV R-ph U/G cable flashed-fault at 66 kV Kasor S/s end.
xii.	Details of test done after failure (What test were conducted after discovery of failure. If no tests were conducted, reason for the same may be stated)	:	
(i) Voltage ratio results: Less volts are recorded in LV R-N. (ii) HV Magnetic Current test: Current values are higher. HV R Phase Mag. Current value is quite higher compared to that of other phases. (iii) LV Magnetic. Current test: Higher currents (in terms of Amp.) recorded for all phases. LV R phase current is almost double compared to that of other phases. (iv) Magnetic Balance test: Very less volts are induced in Y Phase. (v) LV Winding resistance measurement: LV R-N resistance values are higher, higher than double as compared to that of other phases. (vi) Turns ratio test: Results for LV R Phase are abnormal. (vii) SFRA Graphs found abnormal (Compared to previous results)			
xiii.	Observation (Visual observation e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment/ material etc.)	:	On Date 11-03-2025, Internal Inspection of the Transformer carried out at site - after draining main tank oil completely and opening inspection windows. Abnormalities noticed as under:- • Burnt insulation paper pieces found near LV R Phase coil • Black spot observed on the paper insulation of LV R Phase tapping winding lead number 7, 13 & 14 • Copper particles observed near LV R Phase coil

xiv.	Probable cause of failure	:	Due to 66 kV LV R-ph U/G cable flashed-fault at 66 kV Kasor S/S end.
xv.	If OEM representative had inspected the equipment or visited the site after failure their remarks, MoM etc. may be attached	:	OEM/Internal inspection not done
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Not repairable at site after carried out internal inspection at site.
xvii.	a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activates) b) Whether any abnormality observed in these tests. If yes attach the test reports c) What steps were taken to address the abnormality?	:	Last maintenance was carried out on dated 11.03.2024 Routine maintenance along with OLTC O/H
xviii.	Details of any previous failure on the same unit	:	On dated 22.01.2017, this Transformer was tripped and during inspection in presence of OEM on 30.01.2017, it was found that LV R-Ph winding is faulty and due to that mentioned transformer lifted by OEM and repaired under G.P. at factory and again charged on 17.03.2020 at 16:09 hrs at 400 kV Kasor S/s.
xix.	Is tertiary winding provided (Yes/No)	:	No
xx.	Tertiary loaded (Yes/No) if yes, specify load on tertiary	:	NA
xxi.	Whether tertiary terminals are bare / insulated	:	NA
xxii.	Details of protection for tertiary	:	NA
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/RIP/RIS, Porcelain/Polymer housing):-	:	OIP, Porcelain
xxv.	On load tap changer or off circuit Tap changer	:	On load tap changer
xxvi.	Tap position of OLTC at the time of failure	:	13
xxvii.	Past record of Operation of OLTC	:	-
xxviii.	Tap Range	:	Tap 1 to Tap 17
xxix.	Details of Protection provided for ICT/GT/Reactor	:	NA
xxx.	Details of protection operated	:	HV Side: Y & B ph. Trip, Buchholz Trip LV Side:

			R,Y,B & E/F Tripped, NIFPS: Differential trip, Buchholz trip
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	0.69 ohm dated 03.04.2024
xxxiii.	Surge Arrestor: a) Is SA provided for protection b) Whether healthiness of SA is monitored c) Whether reading of SA counter changed during failure	:	(a) Yes (b) Yes (c) No
xxxiv.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam-based protection etc.)	:	N2 Injection based fire protection system
xxxv.	Weather condition at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Clear
xxxvi.	Storage condition of equipment at site before commissioning: a) Period of storage b) Idle charged or uncharged c) Dry air filled /Nitrogen filled / oil filled	:	NA
xxxvii.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Short Circuit Test carried out
xxxviii.	Number of through faults the equipment was subjected to before failure	:	None

Burnt Insulation Paper Pieces

Visible Black Marks

Copper Particles

11. Failure report of 100 MVA, 400/132 kV Power Auto Transformer at Singrauli, NTPC

i.	Name of Substation	:	NTPC Singrauli
ii.	Utility	:	NTPC
iii.	Faulty Equipment	:	ICT Auto Transformer
iv.	Rating (MVA/MVAr, Voltage ratio, 1-phase/ 3- phase)	:	100 MVA, 400 /132 kV
v.	Make (Original equipment manufacturer)	:	BHEL
vi.	Serial No.	:	6004312
vii.	Date and time of occurrence of fault	:	01-03-2025
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	NIL
ix.	Year of Manufacturing	:	1981
x.	Date of Commissioning	:	1982
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	ICT#2 caught fire and tripped on electrical/mechanical protection. Following that VSTPP line#2 tripped on 21 protections. CB Tripped, Transformer trouble, Transformer Buchholz operated, Group Protection operated. **On ICT#2 panel:** • 87 Differential Protection 64REF • 30A-Buchholz trip, 3:3-OLTC surge Protection, 30F-PRV trip • Trip relay operated - 86A, 868, 86C, 86D **On VSTPP 2 panel:** • 21 operated in main 1 & 2 relay • Trip relay 86A, 86B, 86LO
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	DGA of oil sample collected is done.

xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	Tank body is bulged, and tank body also raptured at two three places, Heavy oil leakage. All oil drained from tank, All Bushings were completely damaged
xiv.	Probable cause of failure	:	As per DR of ICT#2 and operation of trip relay it seems that initially internal fault occurred phase in ICT#2 HV side. Due to which bushing of Y phase caught fire and subsequently R and B phase bushing caught fire. Due to that differential and REF protection operated. Due to fire in oil gas formation happened which led to operation of Buchholz relay. Also, Transformer oil got pressurized due to fire which lead to operation of OLTC surge & PRV.
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	PO is awarded; OEM has done primary investigation.
RCA by OEM: (BHEL Primary Report) (a) HV Bushings Damage: Y-Phase bushing on the HV side showed catastrophic insulation failure, external burning, sign of pitting on corona shield and delamination. R & B-phases also showed damage. R and B Phase Bushing also failed. 132 kV partially overheating marks observed. (b) Winding and Core Damage: Internal inspection revealed disintegrated insulation, scattered debris, arcing signs, and thermally damaged conductors. Multiple laminations and spacers were fractured. (c) Tank Distortion: Structural deformation at bottom and Top of tank, burn marks, and pressure signs were noted on the tank, likely due to extreme high pressure due to heavy arc-generated gases inside tank. (d) Oil Degradation: Signs of high-temperature combustion and oil discharge. Emulsifier system was triggered. Oil leaked and mixed with emulsifier fire water during failure of transformer. Removed Oil kept in drums were observed at the site filled with water contaminated oil during transformer dismantling. (e) Flash Marks: Several internal arcing spots were visible on the transformer structure (core clamp surfaces), indicating concentrated high-energy discharge. (f) External Enclosure Damage: Transformer body exhibited burn, dark spots, mechanical damage, and peeling paint-indicative of tank pressurization and bulging.			
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Not repairable.

xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	Maintenance and testing were done on 12.10.2024. Tests: (i) Winding. -Insulation resistance of Winding (ii) Winding resistance. (iii) Tan delta of transformer winding HV/LV. HV bushing tan delta. (iv) Oil DGA analysis monthly and three monthly. (v) Moisture and BDV of Oil. BDV Oil-65.8, NETRA Moisture-8ppm No abnormalities found.
xviii.	Details of any previous failure on the same unit	:	NIL
xix.	Is tertiary winding provided (Yes/No)	:	Yes, but not taken out as bushing.
xx.	Whether tertiary terminals are bare/ insulated	:	__
xxi.	Details of protection for Tertiary		NIL
xxii.	Whether relay time is synchronized with UTC	:	NIL
xxiii.	Bushing details (OIP/RIP/RIS, Porcelain/ polymer housing)	:	OIP
xxiv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load Tap Changer
xxv.	Tap position of OLTC at the time of failure	:	12
xxvi.	Past record of Operation of OLTC	:	NIL
xxvii.	Tap Range	:	1 to 17
xxviii.	Details of Protection provided for ICT/GT/Reactor	:	Directional O/C-R, Y, B ph, 87 Differential, OTI, WTI, Buchholz, PRV, Overfluxing, 64R REF, 50N Directional E/F, OLTC Surge
xxix.	Details of Protection operated	:	87 Differential Protection, 64REF, 30A-Buchholz trip, 30B-OLTC surge protection, 30F-PRV trip Trip relay operated-86A. 86B. 86C. 86D
xxx.	Whether equipment is properly earthed	:	Yes

xxxi.	Earth Resistance of Substation and date of its measurement	:	MAX-0.16 ohm , date of measurement: 15.01.2025
xxxii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Yes (b) Yes (c) No Change
xxxiii.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	Insulation level Lighting impulse HV/LV/SV-1425 KVp/550 KVp, 170 KVp Power freq:- HV/ LV/ Neu /SV-630 kV/ 230/38 / 70 KVrms
xxxv.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	Emulsifier System-water based, automatic
xxxvi.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Normal
xxxvii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	Charged
xxxviii.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	-
xxxix.	Number of through faults the equipment was subjected to before failure	:	NIL


Damage and
Oil spilling point


HV Bushing Y-Phase


HV Bushing Y-Phase


Internal tank body Near Y phase


Lead damage, scattered debris inside tank

12. Failure report of 200 MVA, 400/132 kV ICT-I at Kasara, Mau S/s, UPPTCL

i.	Name of Substation	:	400 kV S/s Kasara, Mau
ii.	Utility	:	UPPTCL
iii.	Faulty Equipment (ICT/Auto-transformer/GT/Reactor etc.)	:	ICT-I
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/3- phase)	:	200 MVA, 400/132 kV, 03 Phase
v.	Make (Original equipment manufacturer)	:	BHEL
vi.	Serial No.	:	6005254
vii.	Date and time of occurrence of fault	:	25.03.2025, 07:18 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	1992
x.	Date of Commissioning	:	31.12.1993
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	On dated 25.03.2025 at 07:18 Hrs 400/132 kV, 200 MVA ICT-I trip on following protection differential trip Y Phase, over current trip, earth fault trip, second harmonic block, over current High set, Earth Fault High Set, Buchholz relay PRV operated
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	Furan Test
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	No
xiv.	Probable cause of failure	:	Internal Fault
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	No

xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Beyond Repair
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	SFRA Test, Tan Delta of Bushing, Oil Test-PPM, BDV, IFT & DGA, WRM Test, Magnetic Balance, Short Circuit, Open circuit test, Magnetizing current test
xviii.	Details of any previous failure on the same unit	:	No
xix.	Is tertiary winding provided (Yes/No)	:	Yes
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	No
xxi.	Whether tertiary terminals are bare/ insulated		Insulated
xxii.	Details of protection for Tertiary	:	-
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP Porcelain
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	11 No.
xxvii.	Past record of Operation of OLTC	:	04.10.2024
xxviii.	Tap Range	:	1 to 17
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	
xxx.	Details of Protection operated	:	Differential Protection, Over Current, Earth fault, Buchholz and PRV
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	0.2-0.3 ohm

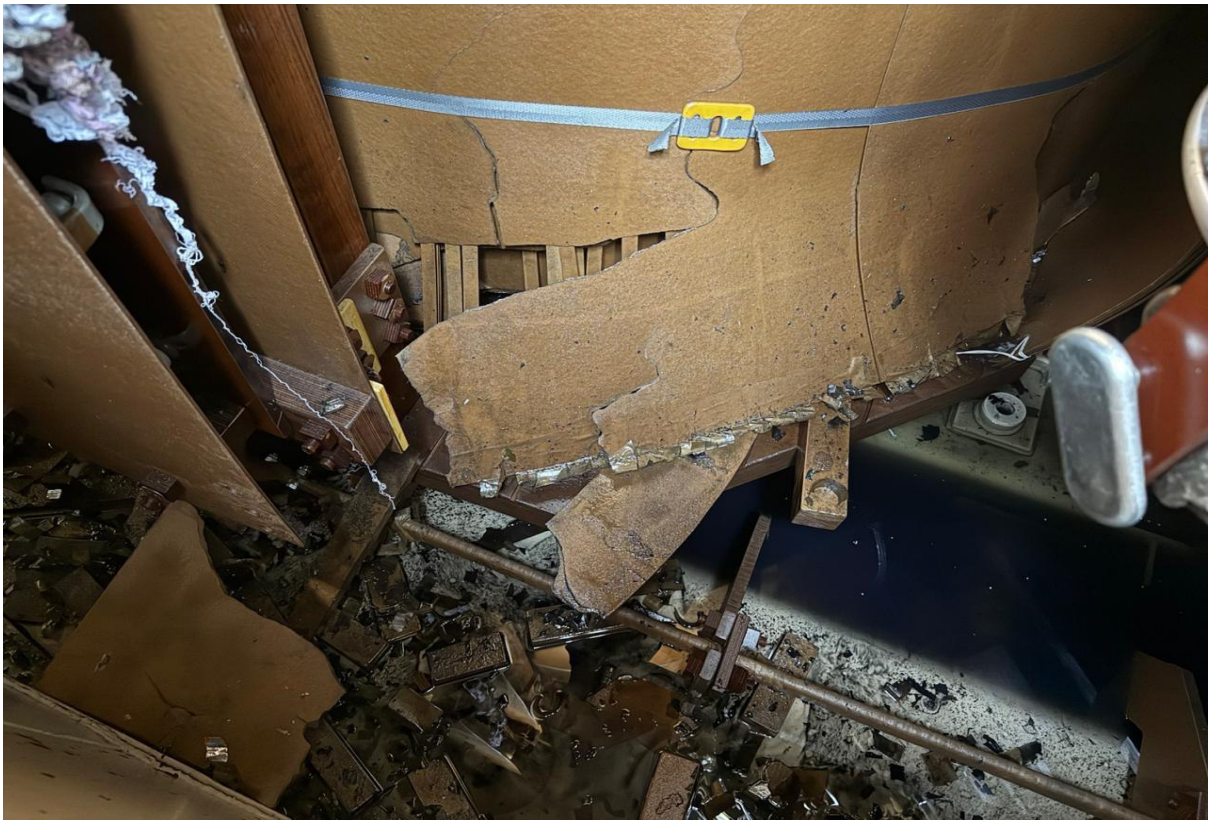
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	Yes
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	Lighting Impulse (420 kV, 1425 kVp) (145 kV, 650 kVp)
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	Switching Impulse (420 kV, 1425 kVp) (145 kV-N/A)
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	Emulsifier System
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Clear Sky
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	(a) 06 months (b) uncharged (c) Nitrogen filled
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Yes
xl.	Number of through faults the equipment was subjected to before failure	:	NIL

13. Failure report of 315 MVA, 400/220/33 kV ICT at Jaunpur S/s, UPPTCL

i.	Name of Substation	:	400 kV Substation Jaunpur
ii.	Utility	:	UPPTCL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	ICT-III
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3-phase)	:	315 MVA, 400/220/33 kV, 3-Phase
v.	Make (Original equipment manufacturer)	:	Areva
vi.	Serial No.	:	B30633
vii.	Date and time of occurrence of fault	:	28.03.2025, 15:16 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	2011
x.	Date of Commissioning	:	14.05.2024
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	On dated 28.03.2025 at 15:16 Hrs 400/220/33 kV 315 MVA ICT-III trip on following protection- differential trip RYB-Phase, REF Trip, Buchholz Trip, PRV operated
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	1) Oil samples were collected from the Y-phase OLTC chamber and Main Tank, and DGA testing was carried out. 2) Acetylene content was found to be greater than 1381.7 ppm in OLTC chamber oil sample and greater than 113.6 ppm in Main Tank oil sample. 3) All low-voltage tests of the transformer were performed. 4) Results of all tests were normal and matched pre-commissioning test results, except for the magnetic balance test, which showed abnormality.

xiii.	Observations: (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	220 kV Bushing (Y & B-Phase) damaged, Oil Leakage form bushing
xiv.	Probable cause of failure	:	Internal Fault
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	Not Visited. Internal inspection of the transformer was conducted on 1st April 2025 after draining oil into the storage tank. Inspection revealed that the insulation of the Y-phase winding was damaged with the possibility of damage to the winding.
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Repairable
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	• All the testing were carried out for the transformer before its charging and were found in order. • The DGA and Tan Delta testing of the transformer oil were carried out after its charging in the month of October 2024 and the results were satisfactory as per the standard.
xviii.	Details of any previous failure on the same unit	:	No
xix.	Is tertiary winding provided (Yes/No)	:	Yes
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	No
xxi.	Whether tertiary terminals are bare/ insulated	:	Insulated
xxii.	Details of protection for Tertiary	:	-
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP Porcelain
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	9 No.

xxvii.	Past record of Operation of OLTC	:	14.05.2025
xxviii.	Tap Range	:	(1-17No)
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	
xxx.	Details of Protection operated	:	Differential, PRV, Buchholz, and PRV flags. DR showed 13.6 kA fault current in Y-phase.
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	(0.3 Ohm) 09.06.2025
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	Yes
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	Lighting Impulse (420 kV 1425 kVp) (145 kV 650kvp)
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	Switching Impulse (420 kV 1425 kVp) (145 kV-N/A
xxxvi.	Type of Fire protection provided (Emulsifier system/ N_2 Injection based fire protection system/ foam based protection etc.)	:	Emulsifier System
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Clear Sky
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	(a) 03 Months (b) Before this the transformer was in charged state at 400 kV S/s Unnao (c) Dry Air Filled
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	Yes
xl.	Number of through faults the equipment was subjected to before failure	:	Nil



14. Failure report of 300 MVA, 16.5/400 kV, GT-1 TPS II Expansion, NLCIL

i.	Name of Substation	:	TPS II Expansion, NLCIL, 400 kV Switchyard (2X 250 MW)
ii.	Utility	:	TPS II Expansion, NLCIL
iii.	Faulty Equipment (ICT/ Auto transformer/ GT/ Reactor etc.)	:	GT-1
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3- phase)	:	300 MVA, 16.5/400 kV, 3-Phase
v.	Make (Original equipment manufacturer)	:	BHEL
vi.	Serial No.	:	6007837
vii.	Date and time of occurrence of fault	:	Around 03:30 Hrs on 11-05-2025
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	2019
x.	Date of Commissioning	:	Oct-2021
xi.	Sequence of events/ Description of fault (SOE with time stamp, Protection operated during fault)	:	On 11.05.2025 Unit- 1 got tripped at 3.31 Hrs subsequent to fire in Generator Transformer-1.
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	No tests carried out due to heavy damage
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	• Transformer Bulging observed leading to Oil leak leading to Fire. Entire Oil got drained into Oil Soak Pit. • GT Top PRV Flange got opened. • GT LV winding lead terminal insulator damaged. • GT HV Bushing got damaged. • OCTC was completely damaged. • Lighting Arrestors were also damaged.
xiv.	Probable cause of failure	:	• From Relay DR it is suspected that it is a sudden inter-turn winding short circuit fault and then converted as a ground fault. • There were no external faults in the system when the transformer failed.

xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	Yes, Root Cause Analysis by OEM • From Commissioning until the incident, there is no history of operational issues or abnormal observations in this transformer. • Results from all periodic inspections and routine maintenance checks confirmed that the transformer was under sound working condition. • The average service life of Generator transformer is 25 years. As the Transformer is commissioned in 2021, ageing, corrosion or equipment degradation is ruled out. • Sudden dielectric failures are most consistent with electrical disturbances such as high frequency transient over voltages which is beyond operator control.
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	Beyond Repair declared by OEM.
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	The DGA tests for GT-1 were carried out in CARD and CPRI on 27-01-2025, 30-08-2024 respectively. Despite this, the BDV and Moisture values were tested at TPS-II on 21-03-2025. The resulting value at TPS-II and test reports for the DGA is found within the recommended values.
xviii.	Details of any previous failure on the same unit	:	Nil
xix.	Is tertiary winding provided (Yes/No)	:	No
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary		NA
xxi.	Whether tertiary terminals are bare/ insulated		NA
xxii.	Details of protection for Tertiary		NA
xxiii.	Whether relay time is synchronized with UTC	:	No
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP Porcelain

xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	Off Circuit Tap Changer (OCTC)
xxvi.	Tap position of OLTC at the time of failure	:	5 (Nominal tap)
xxvii.	Past record of Operation of OLTC	:	OCTC was operated during testing in Nov-2024, but in running condition GTs are operated at nominal Tap only as per SRPC.
xxviii.	Tap Range	:	1 to 9
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	• GT1 Differential Protection (87) • Overall Differential Protection (870A) • GT1 Restricted Earth Fault (REF) • GT1 HVOC (51) • GT1 Stand-By EF(51N) • Buchholz Relay • Pressure Relief Valve (PRV) • Surge Protection relay (SPR) • WTI and OTI
xxx.	Details of Protection operated	:	GT1 Differential protection (87), Overall differential (87OA), GT1 Restricted Earth Fault (REF), Buchholz relay, Pressure Relief Valve (PRV) & Surge Protection Rise relay (SPRR), WTI and OTI. Fire Fighting System (Emulsifier) came into service on Auto
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	--
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Yes (b) Yes (c) Due to fire, surge arrestors with counters were damaged
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	H.V- SI 1050 kVp, LI 1425 kVp
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	H.V- SI 1050 kVp, LI 1425 kVp L.V – LI 125 kVp
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	Emulsifier System

xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Clear Night Sky
xxxviii.	Storage condition of equipment at site before commissioning:(a) Period of storage(b) Idle charged or uncharged(c) Dry air filled/Nitrogen filled/ Oil filled	:	7 months with N2 and 22 months in Oil Uncharged
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand Capability was verified on the basis of calculation?	:	Not carried out (Type Test)
xl.	Number of through faults the equipment was subjected to before failure	:	No through faults or recently before failure

GT LV winding lead terminal insulator damaged

GT HV bushing got damaged

15. Failure report of 100 MVA, 220/132 kV Auto Transformer at Moga (Singhawala) S/s, PSTCL

i.	Name of Substation	:	220 KV S/S Moga (Singhawala)
ii.	Utility	:	PSTCL
iii.	Faulty Equipment (ICT/ Auto-Transformer/ GT/ Reactor etc.)	:	Auto Transformer
iv.	Rating (MVA/MVAr, Voltage ratio, 1-phase/ 3- phase)	:	100 MVA, 220/132 KV, 3 Phase
v.	Make (Original equipment manufacturer)	:	GEC
vi.	Serial No.	:	B-27143
vii.	Date and time of occurrence of fault	:	24-05-2025, 19:21 Hrs.
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	NIL
ix.	Year of Manufacturing	:	1989
x.	Date of Commissioning	:	31-05-1990
xi.	Sequence of events/ Description of fault	:	On dated 24.05.2025 time 19:21 Hrs. Power TF tripped with operation of Differential, REF, Main Buchholz Trip, OLTC Buchholz Trip & Master Trip. During inspection by sub-station staff in switchyard, it is found that HV Y-Phase LA, HV Y-Phase & HV B-Phase Bushings of this power transformer was damaged. NIFPES operated due to operation of Differential, Buchholz & Master Trip relay & oil of power transformer drained into sump tank. Also, the bolts of the top cover broke due to which its cover was lifted up & welding of its main body opened from one place. Due to this the Nitrogen gas injected in the main body came out & oil drained out from the body. As a result of this oil drainage low oil level alarm operated & this drained oil caught fire in the surrounding of the transformer & controlled with the help of fire brigade. The weather was very bad during the occurrence of this incident, there was very strong wind/storm, lightening & heavy rain.
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	1) TTR Test 2) Magnetic Balance Test 3) Charging Current 4) Short Circuit Test Current (LV Winding Shorted)

			5) DC Winding Resistance Test 6) IR Values 7) Oil Sample Test
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	1) Bulging of Main tank of T/F. 2) Fire due to Oil leakage from Transformer Main Tank & NIFPES Bottom Tank. 3) HV Y-Phase LA got damaged. 4) HV B & Y Phase Bush got damaged.
xiv.	Probable cause of failure	:	Keeping in view, observations of protection team, joint inspection committee and the ODTL results, The Power Transformer core is found distorted & dislocated, oil having combustible gases i.e acetylene and the IR Value of power transformer is very low. The weather was very bad during the occurrence of this incident, there was very strong wind/storm, lightening & heavy rain. So, lightening during bad weather on power transformer leads to damage power transformer.
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	OEM was not contacted, because equipment was out of warranty.
xvi.	Present condition of equipment (Whether repairable or beyond repair)		Beyond Repairable (damaged)
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	(a) Previous Post Paddy Maintenance- (Half Yearly) PTW-07, Dated: 18-10-2024, Time:10:30 To 16:40 Hrs. 1) All nut bolts were tightened and heated nut bolt replaced. 2) 2) HV and LV side bush cleaned with cloth. 3) 3) Checking of oil level in Main and OLTC C-Tank. 4) Oil leakage from T/F main body, inspection window, bottom and top of radiator, OLTC valve, OLTC conservator, OLTC drainage valve, bottom of thermosyphon tank and from bottom of Y-phase HV bush attended. 5) Buchholz relay covered with polythene. 6) CTR Cubical, Main cabinet cleaned.

			7) Silica gel replaced for Main Tank & OLTC Tank. 8) Checked NCT connection found ok. 9) OLTC mechanism was lubricated. 10) Put fresh oil in WTI and OTI pockets. Last complete protection testing was done on dated:20-07-2024 To 25-07-2024 1) HV/LV Bushing Tan Delta, 2) Tan delta of winding, 3) Continuity of HV-LV 4) T/F Turns Ratio test 5) Magnetic Balance Test, 6) Short Circuit Current 7) Charging current test at tap no.5, 8) DC Winding resistance test, 9) IR Value 10) Protection checks (b) No (c) NIL
xviii.	Details of any previous failure on the same unit	:	No previous failure occurred
xix.	Is tertiary winding provided (Yes/No)	:	Yes
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary	:	No
xxi.	Whether tertiary terminals are bare/ insulated	:	Bare
xxii.	Details of protection for Tertiary	:	None
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	5
xxvii.	Past record of Operation of OLTC	:	Tap increased from 3 To 5 on Dated:15-05-2025, Time:10:37 Hrs.
xxviii.	Tap Range	:	1-17
xxix.	Details of Protection provided for ICT/GT/Reactor	:	Not applicable (Auto Transformer)

xxx.	Details of Protection operated	:	1) Differential, 2) REF, 3) Main Buchholz Trip 4) OLTC Buchholz Trip, 5) Master Trip
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	0.75 Ohm on Dated:03-05-2024
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	: 	 (a) Yes (b) Yes (c) Counter got damaged during this event
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	Lightning Impulse Withstand voltage 220 KV Bushing- 1050 kVp 132 KV Bushing- 650 kVp
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	Lightning Impulse withstand voltage 220 KV Bushing- 1050 kVp 132 KV Bushing- 650 kVp Switching Impulse withstand voltage 220 KV Bushing- 630 kVp 132 KV Bushing- 275 kVp
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	N2 Injection based fire protection system
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Thunderstorm
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/ Nitrogen filled/ Oil filled	:	NA
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand	:	Short circuit test was conducted on this transformer during protection testing from dated: 20-07-2024 To 25-07-2024 & found result ok.
xl.	Number of through faults the equipment was subjected to before failure		Power Transformer tripped 28 times from Dated:30-04-2011 To 25-05-2025. Tripping Data before 30-04-2011 is not available.

16. Failure report of 315 MVA, 400/220/33 kV Auto Transformer at Bamnauli S/s, DTL

i.	Name of Substation	:	400 kV Bamnauli S/s
ii.	Utility	:	DTL
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	Auto Transformer ICT-4
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3- phase)	:	315 MVA, 400/220/33 kV, Three Phases
v.	Make (Original equipment manufacturer)	:	TELK
vi.	Serial No.	:	140123-2
vii.	Date and time of occurrence of fault	:	01.06.2025 and 16:39 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	Operation
ix.	Year of Manufacturing	:	2005
x.	Date of Commissioning	:	27.03.2007
xi.	Sequence of events/Description of fault (SOE with time stamp, Protection operated during fault)	:	At 16:39 hrs, Pappankalan-2 circuit-2 tripped on Zone-1 and Differential B-Phase Trip. Simultaneously ICT-04 tripped on Differential, REF, Buchholz, PRV, OTI, WTI, OSR, 86A, 86B.
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	No testing conducted as of now due to damage to main tank
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	Fire was observed in ICT. Main tank was bulged and damaged. All Bushings damaged. Oil drained. One 220 kV side LA (R-phase) was also damaged.

xiv.	Probable cause of failure	:	315 MVA ICT-04 fed the thorough fault of 220 kV feeder (Pappankalan-2 circuit-2). Therefore, Internal fault developed in ICT -4 while feeding the fault.
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	No
xvi.	Present condition of equipment (Whether repairable or beyond repair)		Completely Damaged
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the Abnormality?	:	(a) PMS done on regular basis (b) No abnormality observed, test results are found in order. (c) NIL
xviii.	Details of any previous failure on the same unit	:	NIL, this transformer was in operation since 27.03.2007
xix.	Is tertiary winding provided (Yes/No)	:	Yes
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary		Yes
xxi.	Whether tertiary terminals are bare/ insulated		Insulated
xxii.	Details of protection for Tertiary		Over current and earth fault
xxiii.	Whether relay time is synchronized with UTC	:	No
xxiv.	Bushing details (OIP/RIP/RIS, Porcelain / polymer housing)	:	OIP condenser type at HV side, IV side & LV side
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	11
xxvii.	Past record of Operation of OLTC	:	In working condition. Operation of OLTC was carried out during shutdown on 03.05.2024 to carry out routine test.
xxviii.	Tap Range	:	1-9b-17

xxix.	Details of Protection provided for ICT/GT/Reactor	:	Differential, Over current & Earth Fault Relay, REF, Buchholz, PRV, OSR, Over-flux, Winding & Oil Temp.
xxx.	Details of Protection operated	:	Transformer tripped on Differential, REF, Buchholz, PRV, OTI, WTI, OSR, 86A, 86B, HVW spray system operated
xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	0.24 ohm and 08.03.2024
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Yes (b) Yes (c) Yes (counter reading of SA installed for Tertiary is increased by one).
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	Lightning Impulse is 1425 kV peak. Switching Impulse is 1050 kV peak.
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	LI of HV winding is 1300 kV peak. Sl of HV winding is 1650 kV peak LI of IV winding is 950 kV peak. LI of LV winding is 250 kV peak.
xxxvi.	Type of Fire protection provided (Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc.)	:	High Velocity Water (HVW spray system)
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Thunderstorm and Heavy rainfall. Overcast weather.
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	This transformer having mfg. year 2005 and date of charging was 27.03.2007.
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand Capability was verified on the basis of calculation?	:	No

IV side winding (completely burnt)

HV side winding (completely burnt)

17. Failure report of 315 MVA, 400/220/33 kV ICT at Koderma S/s, DVC

i.	Name of Substation	:	400 kV switchyard of KTPS, DVC, Koderma
ii.	Utility	:	Damodar Velley Corporation
iii.	Faulty Equipment (ICT/ Auto-Transformer/ GT/ Reactor etc.)	:	315 MVA ICT#2
iv.	Rating (MVA/ MVAr, Voltage ratio, 1-phase/ 3- phase)	:	315 MVA, 400 KV/220 KV/33 KV, 3-Phase
v.	Make (Original equipment manufacturer)	:	BHEL
vi.	Serial No.	:	6006673
vii.	Date and time of occurrence of fault	:	02/06/2025 at 03:06 Hrs
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	No
ix.	Year of Manufacturing	:	2009
x.	Date of Commissioning	:	26.06.2012
xi.	Sequence of events/ Description of fault (SOE with time stamp, Protection operated during fault)	:	**Event** — **Time stamp** Buchholz alarm — 03:04:37.276 3Φ Differential trip — 03:06:12.512 Group A Relay Operated — 03:06:12.529 Group B Relay Operated — 03:06:12.531 PRV 1_2 Trip — 03:06:12:553 OLTC Trip — 03:06:12.703 REF Trip — 03:06:12.718 Buchholz Trip — 03:06:12.933 WTI Alarm — 03:06:46.144 WTI Trip — 03:06:46.692 OTI Alarm — 03:07:40.238 OTI Trip — 03:07:42.270 MOG Alarm — 03:08:30.359
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure? If no tests were conducted, reasons for the same may be stated.)	:	Transformer in fully damaged condition, no test can be performed.
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	1. Burnt/damage of all 3 HV bushings, 3 IV bushings, 3 tertiary bushings and neutral bushing. 2. Y-phase turret dislodged from main tank and thrown away around 1 meter.

			3. Oil found spilled out from cracks and tank rim joint. 4. Main tank found bulged and burnt. Rim joint got damaged. 5. All 3 phase windings found burnt and damaged. All the insulation, copper are carbonized and lying all over the area inside the tank. 6. Core found burnt and damaged. 7. All instrumentation/devices, turret CTs are found burnt and damaged. 8. Marshalling box found burnt and damaged. 9. Conservator and radiators in general have no burning marks however burnt oil could be present in radiators/piping.
xiv.	Probable cause of failure	:	Based on DR observation and physical condition of the transformer after failure (damage of bell tank joint, bulging of main tank, tilting of Core coil assembly etc), it is suspected that ICT-2 was failed due to fault inside the main tank.
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	BHEL representative visited DVC Koderma, TPS for inspection/ fire incidence of ICT#2. BHEL recommended that the ICT is beyond repair looking to the extensive damages in all major components.
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	After inspection at site, BHEL has recommended that subject ICT is beyond repair, looking to the extensive damages in all major components.
xvii.	(a) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (b) Whether any abnormality observed in these tests. If yes, attach the test reports. (c) What steps were taken to address the abnormality?	:	(a) Maintenance/Testing has been done from 20 /08/24 to 24/08/24 & 20/01/2025 to 24/01/2025.Tests include Tan Delta test of all the bushings and windings, Turns ratio at existing tap (Tap 10), winding resistances (Tap 10), Magnetising current measurement, Core insulation check, IR &PI. (b) No (c) NA

Pre-failure DGA (all the values are in PPM)

Sample Date	H2	CH4	C2H4	C2H6	C2H2	CO	CO2
08.05.2025	BDL	7.2	17.7	4.3	BDL	76.9	1275.5
07.04.2025	BDL	7.5	17.0	6.4	BDL	81.7	1274.1
23.12.2024	116.0	50.4	85.2	18.4	BDL	407.6	1911.3

05.10.2024	134.1	45.6	86.0	17.1	BDL	370.4	2303.2
23.09.2023	32.7	30.5	66.7	7.6	BDL	197.2	1267.6
07.06.2022	9.8	13.8	26.3	34.1	BDL	97.2	977.2
06.11.2021	0.00	2.66	9.15	2.34	0.00	44	483
12.09.2019	195.3	43.9	80.9	12.8	0.00	546	1680
21.06.2018	25.6	38.1	65.6	11.6	0.00	568	1978

BDL-Below Detection Limit

- Filtration of Oil has been carried out on 25.01.2025 and 12.10.2021
- CO2/CO ratio is less than 3 or approaching to 3 as indicated DGA test results dated 21.06.2018, 12.09.2019, 23.12.2024.
- Increasing trend of H2 gas.

xviii.	Details of any previous failure on the same unit	:	No
xix.	Is tertiary winding provided (Yes/No)	:	Yes
xx.	Tertiary loaded (Yes/No) If yes, specify load on tertiary		No load on tertiary winding
xxi.	Whether tertiary terminals are bare/ insulated		Bare
xxii.	Details of protection for Tertiary		No
xxiii.	Whether relay time is synchronized with UTC	:	Yes
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing)	:	OIP Bushing, Porcelain
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	On Load Tap Changer
xxvi.	Tap position of OLTC at the time of failure	:	10^{th} Position
xxvii.	Past record of Operation of OLTC	:	No
xxviii.	Tap Range	:	1 to 17
xxix.	Details of Protection provided for ICT/GT/Reactor	:	O/C, E/F, Diff protection, REF, Buchholz, PRV, WTI, OTI, OSR (For Auto Transformer)
xxx.	Details of Protection operated	:	

During the tripping event following protections of ICT#2 were operated:-

MAIN-1 TRANSF. DIFF. PROTECTION (87.1T)	MAIN-2 TRANSF. DIFF. PROTECTION (87.2T)	NUMERICAL REF RELAY (64.2T)
DIFF. TRIP	DIFF. TRIP	REF TRIP
R-PH DIFF. TRIP	R-PH DIFF. TRIP	BUCH. ALARM
Y-PH DIFF. TRIP	Y-PH DIFF. TRIP	WDG & OTI ALARM
B-PH DIFF. TRIP	B-PH DIFF. TRIP	MOG ALARM
PRV TRIP		BUCH. TRIP
WTI-HV TRIP		WDG & OTI TRIP
		OLTC & PRV TRIP

Electromagnetic Aux Relays operated as reported by DVC:

a) 86, 1 (both flags)
b) 86, 1X (both flags)
c) 30AB (A, B)
d) 30CD (D)
e) 86, 2 (both flags)
f) 86, 2X (both flags)
g) 30EF (E, F)

xxxi.	Whether equipment is properly earthed	:	Yes
xxxii.	Earth Resistance of Substation and date of its measurement	:	0.011 Ohm and measured on 19-02-2025
xxxiii.	Surge arrestor: (a) Is SA provided for protection (b) Whether healthiness of SA is monitored (c) Whether reading of SA counter changed during failure	:	(a) Yes Surge arrester provided (b) Yes-Healthiness monitored (c) No, SA counter not changed
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	For 400 kV : BIL-1550 kVp, SIL- 1180 kVp For 220 kV-: BIL-1050 kVp., SIL- 950 kVp For 33 kV BIL-250 kVp SIL- 170 kVp
xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	HV: SI:1180 kVp, LI:1425kVp, AC:630 -AC38 kVrms IV : LI: 950 kVp, AC:38kVrms LV : LI: 250 kVp, AC:95 kVrms

xxxvi.	Type of Fire protection provided(Emulsifier system/ N2 Injection based fire protection system/ foam based protection etc	:	Emulsifier System based fire protection system provided.
xxxvii.	Weather conditions at the time of failure (clear sky/rainy/thunderstorm etc.)	:	Weather condition was clear.
xxxviii.	Storage condition of equipment at site before commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	 (a) Less than one year (b) Uncharged (c) Nitrogen filled
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit withstand capability was verified on the basis of calculation?	:	No
xl.	Number of through faults the equipment was subjected to before failure	:	Nil

Burnt ICT

Damaged Winding

Damaged Bell Tank Joint

Annexure – III
General Guidelines for Substation/ Switchyard Operation & Maintenance Activities by Transmission Utilities

Substation/ Switchyard Operation & Maintenance Activities

(Issued vide CEA letter no: CEA-PS-14-12/18/2022-PSETD Division dated 22.06.2023)

I. Transformer/Reactor/Neutral Grounding Reactor (NGR):

Sl. No.	Test Name/Maintenance Check	Frequency
1.	Capacitance/Tan Delta for a) Bushing & b) winding	Yearly (for Bushing) 10 Yearly/SOS (for Winding)
2.	Magnetizing current Test (Excitation Current Test)	SOS
3.	Magnetic Balance Test (Three Phase) on transformer	SOS
4.	Winding resistance (Resistance converted to 75 ºC)	SOS
5.	Voltage Ratio (All Taps) on transformer	SOS
6.	IR Value of Winding	SOS
7.	Polarization Index (Ratio of IR values at 10 min to 1 min)	SOS
8.	Core Insulation Test (Between core to clamp; clamp to tank; & core to tank)	SOS
9.	Neutral Earth pit Resistance Value	Yearly
10.	Turret/ Neutral CT Ratio Errors	SOS
11.	Vibration Level for reactors	SOS
12.	Sweep Frequency Response Analysis Tests (20 Hz to 5 MHz)	SOS
13.	Insulation Condition Dry (at commissioning) Normal in operation Wet Extremely Wet	SOS
14.	Short Circuit Impedance of transformer	SOS
15.	Dissolved Gas Analysis (DGA) of tank oil & Onload Tap Changer (OLTC) oil	Half Yearly
16.	Oil parameters of tank oil	Yearly
17.	Thermo-vision Scanning	Half Yearly
18.	Other maintenance checks:	
	(a) Checking of bushing oil level	Monthly
	(b) Checking of oil level in conservator	Monthly
	(c) Checking of oil level in OLTC conservator	Monthly

	(d) Checking of oil leaks	Monthly
	(e) Checking condition of silica gel in breather	Monthly
	(f) Checking of oil level in oil seal of breather	Monthly
	(g) Manual actuation of cooler fans and oil pumps	Monthly
	(h) External cleaning of all bushings	Yearly
	(i) External cleaning of radiators	Yearly
	(j) Checking of marshalling box/control cubicles: cleaning, tightening of terminations, checking of contactors, space heater, lamps etc	Yearly
	(k) Maintenance of OLTC driving mechanism	Yearly
	(l) Checking/testing of buchholz relay by oil draining	Yearly
	(m) Electrical checking/testing of Pressure Relief Device (PRD), buchholz relay, rapid pressure rise relay, OLTC surge relay, checking of alarm/trip	Yearly
	(n) Checking of gaskets	Yearly
	(o) Checking of Oil Temperature Indicator (OTI)/Winding Temperature Indicator (WTI) and tap position indicator and top up of oil in pockets, if required	Yearly

II. Current Transformer:

Sl. No.	Test Name/Maintenance Check	Frequency
1.	Measurement of Tan Delta & Capacitance	Yearly
2.	Measurement of Insulation Resistance (IR) value	SOS
3.	Measurement of Current Transformer (CT) secondary resistance	2 Yearly
4.	Magnetization characteristics	SOS
5.	CT ratio test	SOS
6.	DGA and testing of other parameter of oil	SOS
7.	Thermo-vision scanning of CT and top dome	Quarterly
8.	Checking of bellow expansion	Monthly
9.	Visual inspection of CT for oil leakage and crack	Monthly

10.	Checking of healthiness of marshalling box gaskets	Yearly
11.	Checking of space heater and illumination	Yearly
12.	Checking the tightness of all connections including earthing	Yearly
13.	Cleaning of marshalling box and junction box	Monthly

III. SF6 circuit breakers:

Sl. No.	Test Name/Maintenance Check	Frequency
1.	Checking of SF6 gas pressure (wherever pressure gauges are provided)	Daily
2.	Checking of oil leaks form grading capacitor	Monthly
3.	Status of healthiness of CSD relay	Monthly
4.	Tan delta and capacitance of grading capacitor	2 Yearly
5.	SF6 gas leakage test	SOS
6.	Dew point measurement of SF6 gas	2 Yearly
7.	Operating timing of Circuit Breaker (CB)/Pre-insertion Resistance (PIR)]	Yearly
8.	Static contact resistance	Yearly
9.	Checking of pole discrepancy relay	Yearly
10.	Checking of all operation lockouts	Yearly
11.	Checking of all interlocks	Yearly
12.	Cleaning of breaker interrupter, support insulators, PIRs and grading capacitors	Yearly
13.	Checking of healthiness of operation counter	Yearly
14.	Checking of tightness of all cable's termination in Marshalling Box (MB)	Yearly
15.	Checking of door sealing gaskets and replacement, ift necessary	Yearly
16.	Repainting of metallic surfaces (if required)	2 Yearly

17.	Checking of space heater	Yearly
18.	Dynamic Contact Resistance Measurement (DCRM) test	2 Yearly

IV.Capacitor Voltage Transformer:

1.	Visual checking of earthing HF (high-frequency) point [(in case it is not being used for Power Line Career Communication (PLCC) system]	Yearly
2.	Checking for any breakage of cracks	Yearly
3.	Checking of oil leaks	Monthly
4.	Cleaning of Capacitive Voltage Transformer (CVT) capacitor stacks and tightness of terminal connections	Yearly
5.	Capacitance and tan-delta measurement	SOS
6.	Measurement of voltage ratio error	SOS
7.	Measurement of voltage at metering points in control room	Monthly
8.	Testing of EMU tank oil for Break Down voltage (BDV)	SOS
9.	Thermo vision scanning of capacitor stacks	Quarterly
10.	Checking of space heater and illumination	Yearly
11.	Checking and tightness of all connections including earth connections	Yearly
12.	Cleaning of marshalling box and junction box	Yearly
13.	Checking of healthiness of gaskets	Yearly

V. Isolators:

1.	Maintenance of linkages and transmission gears	Yearly
2.	Cleaning of auxiliary switch contacts with rustolene spray	Yearly
3.	Lubrication of operating mechanism, hinges, locks, joints on leavers, bearings	Yearly

4.	Checking of all bolts for tightness	Yearly
5.	Cleaning and lubrication of main contacts	Yearly
6.	Alignment	Yearly
7.	Main contact resistance measurement	Yearly
8.	Tightness of bolts, nuts and pins etc	Yearly
9.	Cleaning of support insulators and checking of insulator cracks, if any	Yearly
10.	Thermo vision scanning of insulator hinges and contacts	Quarterly

VI.Earth Switch:

1.	Checking & alignment of earthing blades	Yearly
2.	Cleaning of contacts	Yearly
3.	Contact resistance	Yearly
4.	Operation of earthing switch	Yearly
5.	Checking of aluminum/copper flexible conductor	Yearly
6.	Checking of earth connections of structure and Manual Operating Mechanism (MOM) box	Yearly
7.	Visual check of auxiliary contacts	Yearly
8.	Cleaning and terminal tightness in MOM box	Yearly
9.	Checking of space heater and illumination	Yearly
10.	Checking of healthiness of marshalling box gaskets Surge Arresters	Yearly

VII. Surge arrester:

1.	Checking of leakage current	Monthly
2.	Reading of surge counter	Daily
3.	Testing of counters	Yearly

4.	Cleaning of Lightning Arrester (LA) insulator	Yearly
5.	Measurement of capacitance and tan-delta	SOS
6.	Measurement of IR value	SOS
7.	Stack meggering	SOS
8.	3rd harmonic resistive current measurement	4 Monthly

VIII. Wave Traps:

1.	Tightness and cleanliness	Yearly
2.	General inspection	Yearly

IX. Protection System:

1.	Testing of Disturbance Recorder and Event Logger	Monthly
2.	Calibration of panel meters (indicating / recording instruments along with the transducers)	Yearly
3.	Calibration of tariff/non-tariff energy meters	SOS
4.	Secondary injection test of individual protection schemes	5 Yearly
5.	Checking of voltage (in services) for relays	Half Yearly
6.	Checking of Direct Current (DC) logic circuits for trip and ammonization including timers and simulation	Yearly

X. Line Protection Distance Protection:

1.	Reach check for all four (4) zones	Yearly
2.	Time measurement	Yearly

XI. PLCC System:

1.	Power supply measurements	Yearly
2.	Checking of alarms	Yearly

XII. Miscellaneous:

1.	Measurement of station earth resistance	Yearly

2.	Cleaning of insulator for cracks	Yearly
3.	De-weeding of switchyard	Monthly
4.	Repainting, rust removal of all structures, equipment's etc	SOS
5.	Checking of switchyard lighting	Daily

XIII. Thermal Imaging & Corona Scanning:

1.	Thermo vision scanning of all conductor joints, terminal connector/clamps	Quarterly
2.	Removal of hot spots	SOS
3.	Corona Scanning of Bay equipment	Yearly

XIV. Other Operational activities:

1.	Visual checking of the bay	Daily
2.	Isolation & restoration of bays as per LDC instruction	As required
3.	Mega Watt (MW)/Mega Volt Ampere Reactive (MVAR) meter reading (line flows)	Hourly
4.	Energy Meter readings	Daily
5.	PLCC counter readings	Daily
6.	Battery charger voltage and current	Daily
7.	Measurement of cell voltage	Monthly
8.	Healthiness of FF system	Daily
9.	Healthiness of SAS system/DR PC/Event Logger	Daily
10.	Providing trip related information/ documents to LDC/New TSP	As required
11.	Healthiness of AC plant system/KIOSK AC	Daily
12.	Defect Records	As required
13.	Healthiness of Emergency DC Lighting system	Monthly

SOS: as and when needed.

Annexure – IV
Format for report of failure of the Transformer/Reactors

Proforma for reporting of failure of Transformer/ Reactor

i.	Name of Substation	:	
ii.	Utility	:	
iii.	Faulty Equipment (ICT/ Auto-transformer/ GT/ Reactor etc.)	:	
iv.	Rating (MVA/MVAR, Voltage ratio, 1-Phase/ 3- Phase)	:	
v.	Make (Original equipment manufacturer)	:	
vi.	Serial No.	:	
vii.	Date and time of occurrence of fault	:	
viii.	Fault discovered during (Operation or periodic testing/ maintenance)	:	
ix.	Year of Manufacturing	:	
x.	Date of Commissioning	:	
xi.	Sequence of events/ Description of fault (SOE with time stamp, Protection operated during fault)	:	
xii.	Details of Tests done after failure (What tests were conducted after the discovery of failure. If no tests were conducted, reasons for the same may be stated.)	:	
xiii.	Observations (Visual observations e.g. bulging of tank, fire, any leakage of oil, damage to various components of transformer and nearby equipment / material etc.)	:	
xiv.	Probable cause of failure	:	
xv.	If OEM representative had inspected the equipment or visited the site after failure, their remarks, MoM etc. may be attached.	:	
xvi.	Present condition of equipment (Whether repairable or beyond repair)	:	

xvii.	(d) Details of previous maintenance (Activities carried out in previous maintenance including the tests conducted, periodicity of the maintenance activities) (e) Whether any abnormality observed in these tests. If yes, attach the test reports. (f) What steps were taken to address the abnormality?	:	
xviii.	Details of any previous failure on the same unit	:	
xix.	Is tertiary winding provided (Yes/ No)	:	
xx.	Tertiary loaded (Yes/ No) If yes, specify load on tertiary	:	
xxi.	Whether tertiary insulated terminals are bare/ insulated	:	
xxii.	Details of protection for Tertiary	:	
xxiii.	Whether relay time is synchronized with UTC	:	
xxiv.	Bushing details (OIP/ RIP/ RIS, Porcelain/ polymer housing	:	
xxv.	On Load Tap Changer or Off Circuit Tap Changer	:	
xxvi.	Tap position of OLTC at the time of failure	:	
xxvii.	Past record of Operation of OLTC	:	
xxviii.	Tap Range	:	
xxix.	Details of Protection provided for ICT/ GT/ Reactor	:	
xxx.	Details of Protection operated	:	
xxxi.	Whether equipment is properly earthed	:	
xxxii.	Earth Resistance of Substation and date of its measurement	:	
xxxiii.	Surge arrestor: (d) Is SA provided for protection (e) Whether healthiness of SA is monitored (f) Whether reading of SA counter changed during failure	:	
xxxiv.	Lightning Impulse and Switching Impulse Withstand Voltage of the bushings of all voltage level	:	

xxxv.	Lightning Impulse and Switching Impulse Withstand Voltage of the winding of all voltage level	:	
xxxvi.	Type of Fire protection provided (Emulsifier system Injection based fire Protection system/ for based protection etc.)	:	
xxxvii.	Weather conditions at the time of failure (clear sky/ rainy/ thunderstorm etc.)	:	
xxxviii.	Storage condition of equipment at site before Commissioning: (a) Period of storage (b) Idle charged or uncharged (c) Dry air filled/Nitrogen filled/ Oil filled	:	
xxxix.	Whether short circuit test was carried out on this transformer or same design transformer or short circuit with stand, capability was verified on the basis of calculation?	:	
xl.	Number of through faults the equipment was subjected to before failure	:	
xli.	Attach the following: (a) Single Line Diagram of the substation (b) Photographs of the failed equipment (c) Disturbance Recorder/Even Logger Data (d) Reports of tests conducted after failure (e) Factory test results (f) Pre-Commissioning test results (g) Protection schematic diagram	:	

Annexure- V
Office Order for constitution and reconstitution of the Standing Committee

Government of India
Central Electricity Authority
Office of Secretary
Sewa Bhawan, R.K. Puram
New Delhi- 110 066
Fax No. 011-26108476
Tel.No. 011-26105619

(ISO :9001-2008)

No. CEA/SETD/220-O/2012/ /-80

01.01.2013

Subject:- Constitution of a Standing Committee of Experts to investigate the failure of equipment at 220 kV & above sub-stations.

In order to investigate the failure of equipment at 220 kV & above sub-stations, it has been decided to constitute a Standing Committee comprising experts in the field of design and operation of EHV substation from Central Electricity Authority(CEA), various power utilities and research/academic institutes under section 73, clause(1) of the Electricity Act, 2003.

2. The Committee shall consist of the following members:

(i)	Chief Engineer (SETD), CEA	-Chairperson
(ii)	A representative from CPRI, Bangalore	-Member
(iii)	A representative from IIT, Hauz Khas, New Delhi	-Member
(iv)	A representatives from concerned State Utility/Generating Companies/Transmission Companies where Substation Equipment failure has taken place	-Member
(v)	Member Secretary of concerned RPC	-Member
(vi)	Director (SETD), CEA	-Member Secretary

3. The terms of reference of the Committee shall be as follows:

(a) To investigate the causes of failure of substation equipment in service
(b) To recommend remedial measures to avert recurrences of such failures in future.

4. Every incident of substation equipment failure needs to be immediately reported to Chairperson of the Standing Committee by a designated officer of the concerned organization.

5. The Power Utility where failure of substation equipment has taken place will provide all assistance required by the Committee in carrying out the investigations.

6. The TA/DA and other expenses shall be borne by the respective organizations of the members of the Committee.

The Chairperson of the Committee will prepare compendium of the analysis of the failures and recommendations every six months and submit the same to the Authority and MoP.

(M.S. Puri)
Secretary, CEA

To:

1. Director General, Central Power Research Institute, Professor Sir C.V. Raman Road, P.O. Box- 8066, Bangalore- 560080.
2. Director, Indian Institute of Technology, Hauz Khas, New Delhi- 110016.
3. Chairman/CMDs of State Utility/ Generating Companies and Transmission Companies.

With a request to nominate their representative as member of the Committee along with an alternative member.

4. Member Secretaries, Regional Power Committees:
   a) NRPC, New Delhi
   b) WRPC, Mumbai
   c) SRPC, Bangalore
   d) ERPC, Kolkata
   e) NERPC, Shillong
5. Chief Engineer (SETD), CEA
6. Director (SETD), CEA.

भारत सरकार/ Government of India

विद्युत मंत्रालय/ Ministry of Power

केन्द्रीय विद्युत प्राधिकरण/ Central Electricity Authority

सचिव का कार्यालय/ Office of Secretary

No.-CEA-PS-14-37/3/2013-PSETD Division-Part(5) 03-02-2025

Subject: - Constitution of a Standing Committee of Experts to investigate the failure of equipment at 220 kV & above substations/switchyard.

In suppression of the Letter No CEA/SETD/220-O/2012/1-80 dated 01.01.2013, following Standing committee comprising experts in the field of design and operation of EHV substation/switchyard from Central Electricity Authority (CEA), various power utilities and research/academic institutes is constituted to investigate the failure of Transformers and Reactors at 220 kV and above sub-stations/switchyard under section 73, clause (1) of the Electricity Act, 2003.

1.	Chief Engineer (PSETD), CEA	Chairperson
2.	Representative of CPRI	Member
3.	Representative of an Academic Institution	Member
4.	Representative from concerned State Utility/Generating Companies/Transmission Companies where Transformers/Reactors failure has taken place	Member
5.	Member Secretary of concerned RPC or its representative	Member
6.	Director(PSETD), CEA	Member Convener

2. The terms of reference of the Committee shall be as follows:
   (a) To investigate the causes of failure of Transformer/Reactor in service
   (b) To recommend remedial measures to avert recurrences of such failures in future
3. Each organisation shall report every incident of failure of 220 kV and above Transformer/Reactor within 48 hours of the occurrence of the failure to Chairperson of the Standing Committee. For this purpose, each organization shall nominate the designated officer.
4. The Power Utility where failure of substation/switchyard equipment has taken place will provide all assistance required by the Committee in carrying out the investigations.
5. The TA/DA and other expenses shall be borne by the respective organizations of the members of the Committee.
6. The committee may invite other experts as needed.
7. The committee shall publish the report every six months.

03/02/2025

(Rakesh Kumar)
Secretary, CEA

To:

1) Director General, Central Power Research Institute, Professor Sir C.V Raman Road, P.O Box, Bangalore-560080
2) Director Indian Institute of Technology, Hauz Khas, New Delhi-110016
3) Chairman/CMDS of state Utilities/ Generating Companies and Transmission Companies.

4) Member Secretaries, Regional Power Committees
   a) NRPC, New Delhi
   b) WRPC , Mumbai
   c) SRPC, Bangalore
   d) ERPC, Kolkata
   e) NERPC, Shillong
5) Chief Engineer (PSETD), CEA
6) Director (PSETD), CEA