MINUTES OF MEETING OF THE STANDING COMMITTEE OF EXPERTS TO INVESTIGATE THE FAILURE OF 220 KV AND ABOVE VOLTAGE CLASS SUBSTATION EQUIPMENT HELD ON 04.11.15 IN CEA, NEW DELHI, IN CONNECTION WITH REPORTED FAILURES FROM OCTOBER 2014 TO AUGUST 2015 AT VARIOUS SUBSTATIONS IN THE COUNTRY

The list of participants is enclosed as **Annexure-1.**

Chief Engineer (PSETD) & Chairman of the subject Standing Committee (Substation) welcomed the participants. He stated that discussing the failures and sharing of experiences and maintenance practices of utilities will help in adopting best practices of maintenance and thereby reducing the failures. The Chairman informed that during above period 52 nos. equipment failures (4 nos. of Interconnecting Transformers, 2 nos. of Generator Transformers, 3 nos. of cable, 8 nos. of SAs, 19 nos. of CTs, 9 nos. CVTs, 6 nos. of CBs, one no of PT) were reported by fourteen (14) utilities. He also highlighted that number of utilities do not report the failure of equipment and prime objective of formation of above committee gets defeated due to non-participation of utilities and non-reporting of failures. The representatives from PGCIL, PPCL (Pragati Power Corporation Limited), GETCO and NPCIL did not attend the meeting.

A draft report, prepared based on information provided by utilities between October 2014 and August 2015, was uploaded on the CEA's website prior to the meeting. The failure of various substation equipments and their important maintenance practices were discussed in detail in the meeting. Summary of discussion is as follows:

1. During deliberation on transformer failure in KPTCL installation, KPTCL informed that it is their practice to provide tertiary winding with 100 MVA transformers and bringing out all three terminals of tertiary outside the tanks to carry out various tests. The Committee suggested that tertiary winding may be avoided for 3 phase power transformers rated less than 160 MVA as it increases the probability of failure of the transformer. However, tertiary winding may be provided for single phase power transformers. Tertiary terminals of transformer prone to short circuiting by external element such as bird or animal may be insulated by insulating sleeves. The Committee also suggested SFRA test should be carried at factory as well as at site before commissioning of transformers and test results should be reference signature for future use. The capacitance and tan delta measurement of transformer bushing at variable frequency and 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.

2. There were two straight through joint failures and one termination failure in 400 kV XLPE cable system at Bamnauli substation of DTL. Director (Substation) and Member Secretary stated that for the first time EHV cable failures have been included in the report so that other utilities are also benefited from the discussion. He informed that CEA team had visited the site of failure to assess the cause of failure and it was observed that DTS was not properly installed for monitoring hot spot temperature along the route of cable. It was concluded that partial discharge at joint location could be one of the reasons of failure of the cable. The GM, DTL discussed about failure of XLPE cable and also informed that laying of cable is being modified as recommended by M/s LS Cables, the supplier of cable system. The snaking of cable is being done to reduce the mechanical stress at joints during faults in the system.

3. Regarding CT failures, the Committee recommended that in addition to tan delta and Insulation Resistance tests, DGA of tank oil of CT should also be monitored wherever feasible. The committee also suggested ensuring the health of gaskets and bellows periodically for CTs. Thermo vision scanning of CTs, CVTs and PTs should also be carried out regularly as a good maintenance practice. Following tables can be referred while measuring tan δ and capacitance of CVTs:

Change in Tanδ	**Monitoring Frequency**
Upto +0.002	Three yearly
+0.002 to +0.003	Yearly
Above +0.003	Alarming

Change in Capacitance	**Monitoring Frequency**
upto ±2%	Three yearly
±2% to ±3%	Yearly
Above ±6%	Alarming

The change in secondary voltage of CVTs is a very good indicator of the condition/health of CVTs. Following table may be referred for monitoring of secondary voltage:

Drift in secondary Voltage (to be measured by 0.2 / 0.5 class multimeter)	**Condition**	**Monitoring Frequency**
Upto ± 0.5 volts	Healthy	Six monthly
± 0.5 to ±0.8 volts	To be monitored	03monthly
±0.8 to ±1.2 volts	Close monitoring	Monthly
±1.2 to ±2.0 volts	Close monitoring	15 days
above +2.0 volts	Alarming	replacement
-0.8 to -4.0 volts	Close monitoring	15 days
less than -4.0 volts	Alarming	replacement

Following table can be referred while measuring tan δ of CTs:

Value of Tanδ	**Monitoring Frequency**
Upto 0.007 (annual rise@0.001)	Yearly
0.007 to 0.011	Half Yearly
Above 0.011	Replace the CT

4. Monitoring of Leakage Current and IR value are essential for accessing the healthiness of Surge Arrestors (SAs). Measurement of the 3rd harmonic resistive component of leakage current is a very good method for assessing healthiness of SA which can be done on-line. If 3rd harmonic component of resistive current is more than 150 µA then Insulation Resistance (IR) value test should also be conducted and if current exceeds 350 µA then LA should be removed from service and replaced. The measurement of leakage current before and after the monsoon should be carried out so as to ascertain the effect of moisture. The specification of SA should include Sealing Test of SA which can be carried out at manufacturer's works to ensure proper sealing against ingress of moisture.

5. The Committee suggested that while formulating the specification for procurement of CB for new substation, provision should be made for procurement of Operational Analyzer along with Dynamic Contact Resistance Measurement (DCRM) test kit, which are useful tools to assess healthiness of CB. These diagnostic tools can also serve/cater to the requirement of nearby substations.

6. The Chairman stated that OLTC is one of the causes of failure of transformer. Utility should carry out system studies and the possibility of removal of OLTC from power transformers of voltage rating 400 kV and above may be explored in consultation with respective Regional Power Committee (RPC). The removal of OLTC will simplify the design and manufacturing of transformers.

7. It was recommended that oil sampling for transformer oil testing should be done as per relevant IS/IEC. The oil sample should be tested in NABL accredited laboratory on calibrated equipment. Apart from monitoring absolute values of key parameters, trend of change in key values should also be closely monitored. In case of suspicious test results, second sample should also be got tested for eliminating element of doubt.

8. The Committee recommended that utilities should make it a practice to carry out various tests on major electrical equipment at sites one or two months before the expiry of warranty period of respective equipment.

9. The Chairman stated that shortage of operation and maintenance personnel and lack of proper training are matter of concern. Utilities should look into such issues with seriousness.

It was decided that in the next meeting a representative from PGCIL/NTPC/equipment manufacturer/supplier of diagnostic tools will be invited to share their experience and highlight about the use of various modern diagnostic tools in monitoring the healthiness of various substation equipments.

The meeting ended with vote of thanks to the Chair.

Annexure - I

LIST OF PARTICIPANTS

Central Electricity Authority, New Delhi

1. Shri S.K.Ray Mohapatra, Chief Engineer, PSETD .....in the Chair
2. Shri Y.K.Swarnkar, Director, PSETD
3. Shri Faraz, Assistant Director, PSETD
4. Ms. Noopur Chaudhary, Assistant Director, PSETD
5. Ms. Bhaavya Pandey, Assistant Director, PSETD

Central Power Research Institute

1. B.M. Mehra, Joint Director

Bhakra Beas Management Board

1. Shri Arun Kumar, Director
2. Shri Rakesh Singla, Addl. SE

TANTRANSCO

1. Shri S.Rajendiran, S.E.

Karnataka Power Corporation Ltd. (KPCL)

1. Shri H.R. Ramesh, S.E. (Electrical)

Kerala State Electricity Board

1. Shri Jayarajan C.N., Executive Engineer

Madhya Pradesh Power Transmission Corporation Ltd.

1. Shri Sanjay Nigdikar, E.E. (Testing)

Transmission Corporation of Andhra Pradesh Ltd.

1. Shri C. Venkateswarlu, D.E. (O&M), Nellore
2. Shri G. Sree Rama Kumar, D.E. (O&M), Kurnool
3. Shri S. Sira Rama Krishna, D.E.

Karnataka Power Transmission Corporation Ltd.

1. Shri S.S. Mithare, E.E.
2. Shri B.V. Girish, E.E.

Himachal Pradesh State Electricity Board Ltd.

1. Shri Suresh Kumar, C.E.

Delhi Transmission Corporation Ltd.

1. Shri Harjiwan Vyas, E.D. (T)
2. Shri R.S. Meena, Dy. GM (T)

Knowledge Cluster

1. Shri Jagdish Sandhanshir, Director