

HIGH VOLTAGE ENGINEERING

UNIT-V HIGH VOLTAGE TESTING AND INSULATION COORDINATION

High voltage testing of electrical power apparatus – Power frequency, impulse voltage and DC testing – International and Indian standards – Insulation coordination.

PART-A

1. Name the different types of standard tests conducted on high voltage apparatus.

- Type Test - To check the design features
- Routine Test - To check the quality of the individual test piece.
- High Voltage Tests Include
 - Power frequency tests
 - Impulse tests

2. What is the test conducted on bushings?

- * Power Factor-Voltage Test
- * Internal or Partial discharge Test
- * Momentary Withstand Test at Power frequency
- * One Minute withstand Test at Power Frequency
- * Visible Discharge Test at Power Frequency
- * Impulse voltage tests- a. Full wave Withstand Test , b. Chopper Wave withstand Test

3. Define withstand voltage.

The voltage which has to be applied to a test object under specified conditions in a withstand test is called the withstand voltage [as per IS: 731 and IS: 2099-1963].

4. Define impulse voltage.

- * Impulse voltages are characterized by,
 - Polarity,
 - Peak value,
 - Time to front (t_f), and
 - Time to half the peak value after the peak (t_t).
- * According to IS: 2071 (1973), standard impulse is defined as one with $t_f = 1.2\mu\text{Sec}$, $t_t = 50\mu\text{Sec}$ (called 1/50 μSec wave).
- * The tolerances allowed are $\pm 3\%$ on the peak value, $\pm 30\%$ in the front time, and $\pm 20\%$ in the tail time.

5. Differentiate type test and routine test. (or) What do you mean by type tests and routine test?

Type Tests:

- ↗ These tests are intended to prove or check the design features and quality
- ↗ Type tests are done on samples when new designs or design changes are introduced.

Routine Tests:

- ↗ Routine tests are intended to check the quality of the individual test piece.
- ↗ Routine tests are done to ensure the reliability of the individual test objects and quality and consistency of the materials used in their manufacture.

6. Define the term 'ac test voltage' referred to HV testing.
7. Give the values of reference atmospheric conditions as per Indian standard specification.
8. Define disruptive discharge voltage.

9. What are the demerits of synthetic testing of circuit breakers?

10. Define creeping distance.

It is the shortest distance on the contour of the external surface of the insulator unit or between two metals fitting on the insulator

11. What is insulation co-ordination?

The process of bringing the insulation strengths of electrical equipment and buses into the proper relationship with expected overvoltages and with the characteristics of the insulating media and surge protective devices to obtain an acceptable risk of failure

12. Define 50% and 100% flashes over voltage.

50% Flashover Voltage:

This is the voltage which has a probability of 50% flashover, when applied to a test object. This is normally applied in impulse tests in which the loss of insulation strength is temporary.

100% Flashover Voltage:

The voltage that causes a flashover at each of its applications under specified conditions when applied to test objects is specified as hundred per cent flashover voltage.

13. Differentiate flashover and puncture.

Flashover: It is a discharge over the surface of the insulation systems.

Puncture or Spark over: It is a discharge through the insulation systems. If the insulation is solid, it could not able to regain its insulation strength after puncture.

14. What are the different tests done on insulators?

- Type Test - To check the design features
- Routine Test - To check the quality of the individual test piece.
- High Voltage Tests Include
 - Power frequency tests
 - Impulse tests

15. What are impulse tests?

16. What is the significance of impulse tests?

17. What is an isolator?

- * It is an off-load or minimum current breaking mechanical switch.
- * Explained according to “IS:9921 Part-1, 1981”.
- * Interrupting small currents(0.5A): Capacitive currents of bushings, busbars etc.,

18. What are the test conducted on isolators and circuit breakers?

The main tests conducted on the circuit breakers and isolator switches are

- i. Dielectric tests or overvoltage tests,
- ii. Temperature rise tests,
- iii. Mechanical tests, and
- iv. Short circuit tests

19. What is the test conducted on transformer?

- * Induced Overvoltage Test
- * Partial Discharge Tests
- * Impulse Test

20. What are partial discharges?

These are the discharges due to presence of void or any other inclusions inside of the dielectrics. The partial discharges may not be suddenly bridge the electrode; but is increasing with the duration of the operation.

21. What is the test conducted on surge arresters?

- * Power frequency spark over test
- * Impulse sparkover test
- * Residual voltage test
- * Impulse current withstand test

22. What is the test conducted on cables?

Different tests on cables are

- i. Mechanical tests like bending test, dripping and drainage test, and fire resistance and corrosion tests
- ii. Thermal duty tests
- iii. Dielectric power factor tests
- iv. Power frequency withstand voltage tests
- v. Impulse withstand voltage tests
- vi. Partial discharge test
- vii. Life expectancy tests

23. Why is insulation coordination needed?

- * To ensure the reliability & continuity of service
- * To minimize the number of failures due to over voltages
- * To minimize the cost of design, installation and operation

24. State the principle that is followed in the insulation design of EHV and UHV substations.

In EHV and UHV substations, the insulation design is mainly based on the consideration of switching surges whereas in high voltage substations consider lightning surges.

25. Explain the reasons for conducting wet tests on high voltage apparatus and give the specifications for the water used for wet tests.

The wet test is carried to satisfy the service condition of the HV apparatus. The test object is subjected to spray of water with the following specifications:

- * Precipitation Rate : $3 \pm 10\%$ (mm/min)
- * Direction of Spray : 45° to the vertical
- * Conductivity : 100 micro-siemens $\pm 10\%$
- * Water Temperature : Ambient $\pm 15\%$

26. What are the equipment and devices needed for conducting impulse test on HV equipments?

- i. Impulse Generator
- ii. Sphere Gap
- iii. Potential Dividers
- iv. Protection Gap
- v. Probes
- vi. CRO