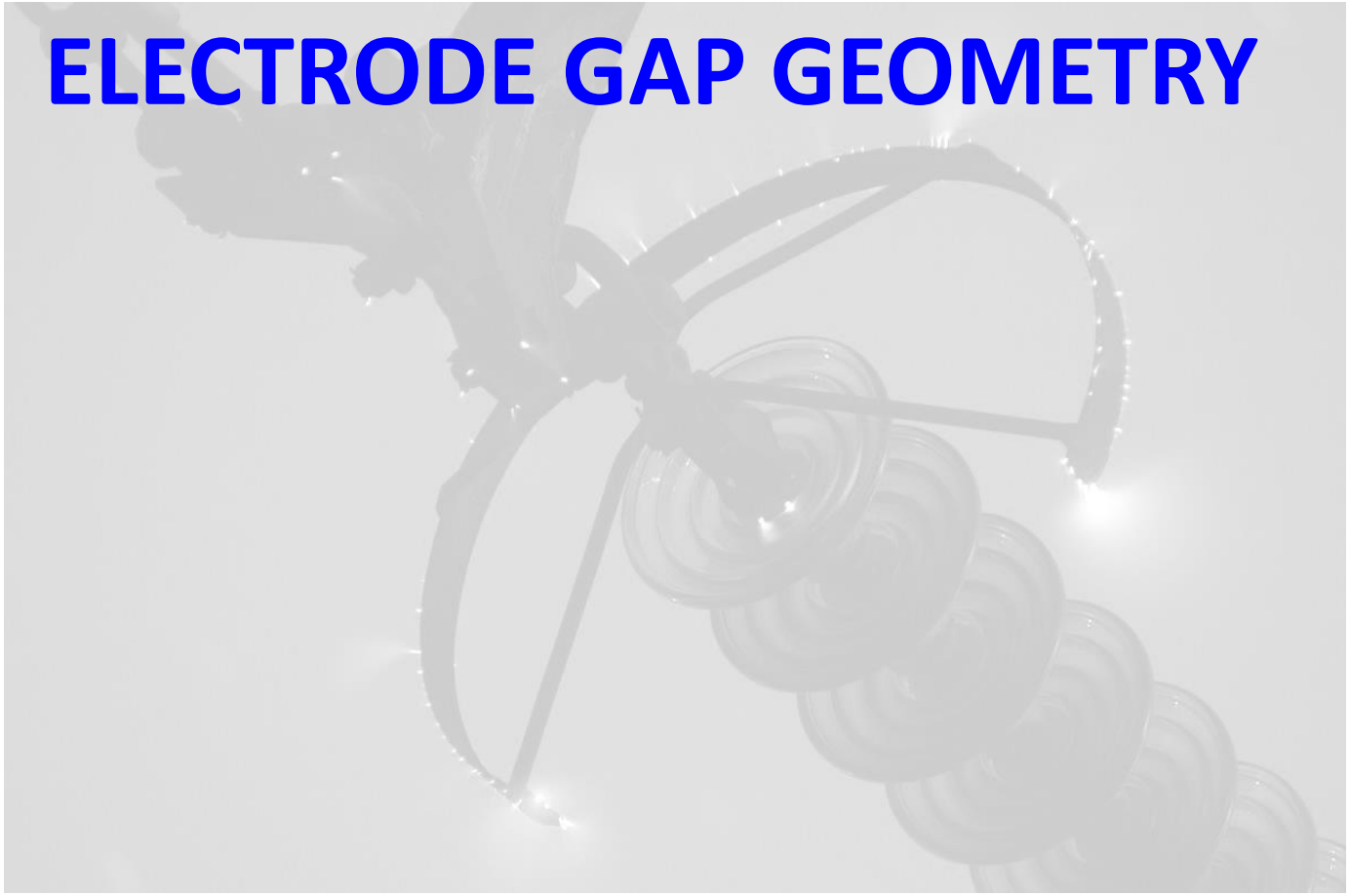
STUDY OF CORONA DISCHARGE AND AC BREAKDOWN VOLTAGE FOR DIFFERENT ELECTRODE GAP GEOMETRY



3rd Year UG Power System Lab

OBJECTIVE

1. Breakdown studies of uniform field and non-uniform field gaps under AC excitation
   - Point-plane (non-uniform field gap) and
   - Sphere-Sphere (nearly uniform field gap)
2. Observation of Corona Inception and Corona Extinction Voltage

Experimental Setup…

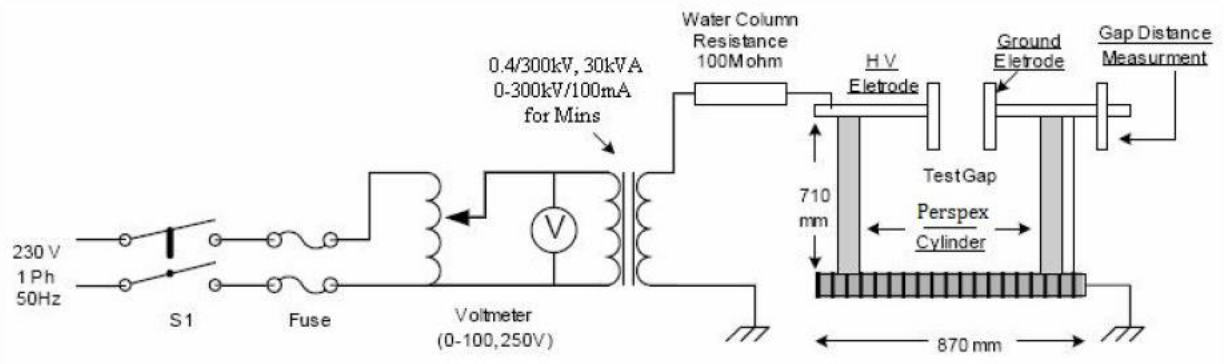


Fig. 1: Schematic for experimental setup

Experimental Setup…

Fig. 2: Different electrode gap geometry (a) point-plane (b) sphere-sphere

Experimental Setup…

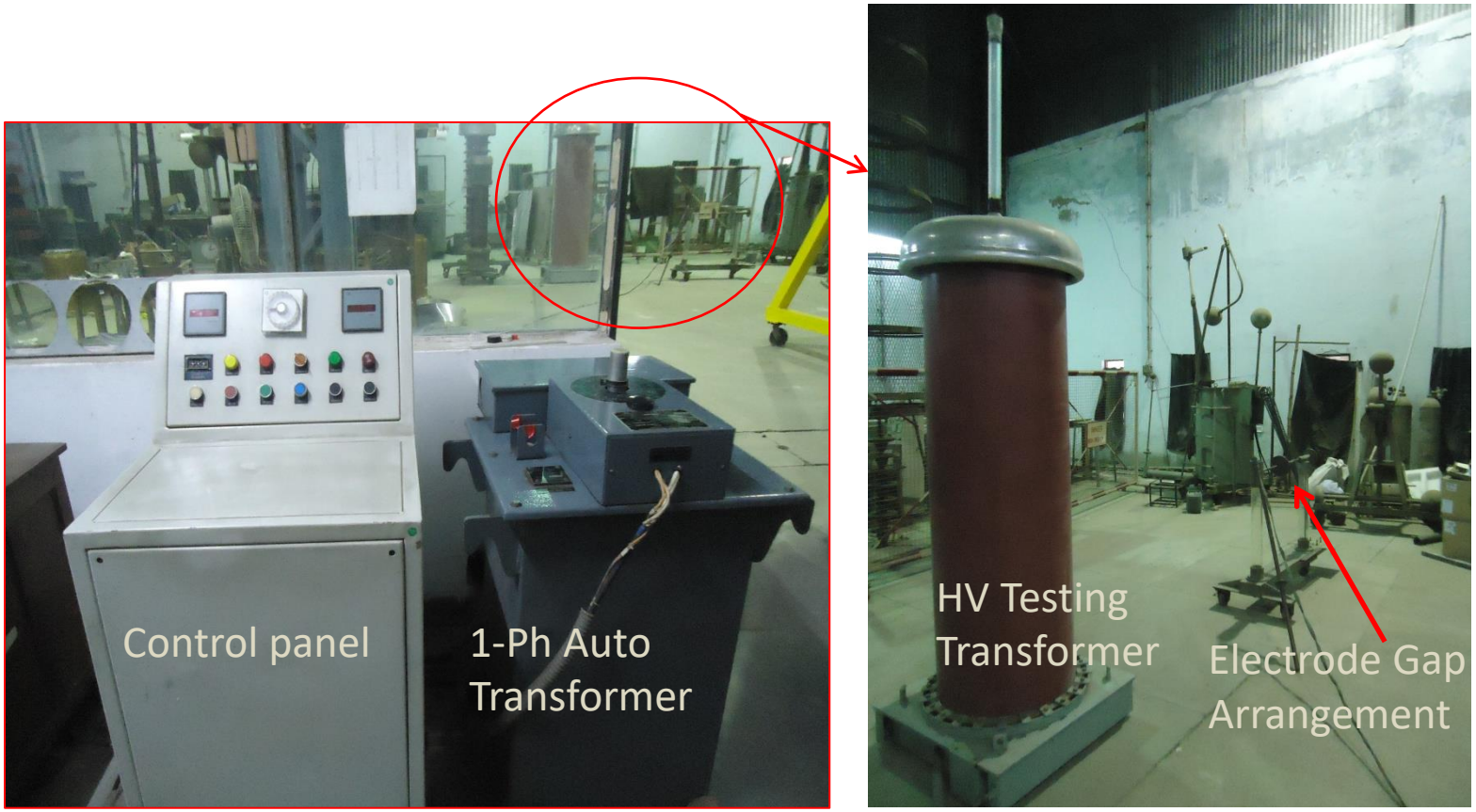


Fig. 3: Experimental setup with high voltage testing transformer

Electrode-Gap Setting Arrangement

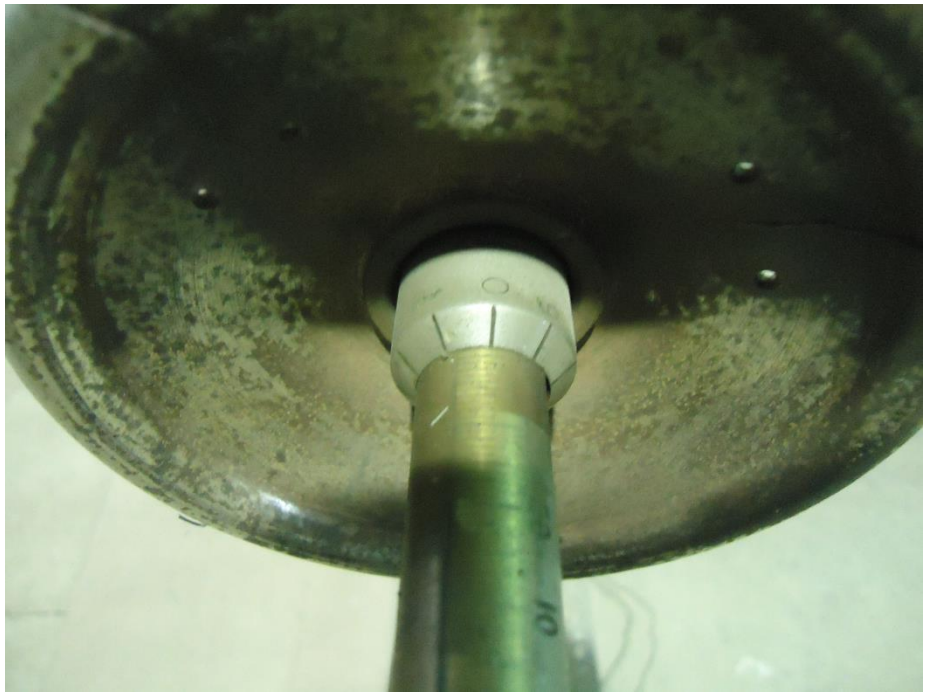


Fig. 4: Electrode gap-setting arrangement

Phenomena of Corona Discharge

- A corona discharge is an electrical discharge caused by the ionization of a gas such as air surrounding a conductor of a high voltage.
- It's a local discharge where the air (or other fluid) undergoes electrical breakdown and become conductive, allowing charges to continuously leak off the conductor into the air.
- Corona occurs at locations where the strength of the electric field (potential gradient) around a conductor exceeds the dielectric strength of the air.
- It is often seen as a bluish glow in the air adjacent to a sharp edge of high voltages. Corona discharge is also audible with a hissing sound

Corona Discharge…

Fig. 4: Corona discharge on a line insulator guard ring

Corona Inception Voltage and Corona Extinction Voltage

- The voltage at which corona discharge starts is known as corona inception voltage. In short, corona onset voltage is known as corona inception voltage. Corona onset could be recognized by a faint hissing audible sound
- Voltage at which the corona is visible with a faint glow is known as visible corona inception voltage
- If the voltage is slowly reduced from high value to low value, corona disappears at a level. This voltage is known as corona extinction voltage. At this voltage hissing sound subsides or corona becomes extinct

see the lab videos for experiment….

Procedures…

1. Connect the test gap (A) to the transformer as shown in the circuit diagram.
2. Adjust the gap distance to an initial value of 10 mm.
3. Close the circuit breaker S1.
4. Slowly raise the till faint hissing audible sound is heard. Note the reading on the Controller and actual value from the calibration chart provided. This is the beginning of corona. Hence the *Corona Inception Voltage*.
5. Raise the Voltage further till such time there is a faint visible glow at the high voltage electrode. This is the *Visible Corona Inception* level. Note the value.
6. Then slowly reduce voltage further till such time the hissing sound subsides i.e., dies down or becomes extinct. Note this value as *Corona Extinction Voltage*.
7. Once again rise the voltage till such time there is a Break Down. Note this value as break down Voltage.
8. Reduce the voltage completely and open the circuit breaker.
9. Increase the gap distance by 5 mm and repeat steps 3 to 8.
10. Repeat step 9 for 6 (six) different gap distances.
11. Repeat the experiment for test Gap (B).
12. Correct the observed values for standard atmospheric conditions and plot the gap distance Vs Breakdown voltage for each gap with the help of the instructions given below.

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Experimental Results

- **Refer 'procedure' in instruction manual and perform the experiment**

Point-Plane Electrode

Sr. No.	G6ap Distance (mm)	Corona Inception Voltage (kV)	Visible Corona Inception Voltage (kV)	Corona Extinction Voltage (kV)	BDV (kV)
1	10	-	-	-	4
2	20	8	11	5	13
3	30	10	14	6	19
4	40	11	17	9	21
5	50	12	18	10	24

Experimental Results

Sphere-Sphere Electrode

Sr. No.	G6ap Distance (mm)	Corona Inception Voltage (kV)	Visible Corona Inception Voltage (kV)	Corona Extinction Voltage (kV)	BDV (kV)
1	10	-	-	-	5
2	20	20	-	-	17
3	30	34	-	27	36
4	40	35	-	30	50
5	50	40	-	32	63

Temperature and Humidity Measurement

- Dry Bulb Temp: 33°C
- Wet Bulb Temp: 30°C
- Atmospheric Pressure: 755 mm Hg

Atmospheric correction factor

- **Air density correction factor:** $K_1 = P/P_0 * (273+t_0)/(273 + t)$
- $V_{BD} = V_0 * K_1 * K_2$
- **Humidity correction factor (K_2):** **No humidity correction factor for sphere-gap arrangement**
- ***Refer annexure for more details…***

Lab Report Preparation

- **Name of the experiment**
- **Objective**
- **Schematic diagram of experimental setup**
- **Complete observation tables for experimental results and plot the curve for BDV Vs Gap distance for both electrode gaps.**
- **Repeat the table with corrected values at NTP (correction for air density and humidity)**

ANSWER THE FOLLOWING QUESTIONS

- **Why no humidity correction factor for sphere gap**
- **What is unique about high voltage testing transformer**
- **Is corona useful at all?**
- **Why corona inception voltage is not observed for small gap distance for both electrode gaps?**
- **Why corona extinction voltage is less than the corona inception voltage?**
- **Why BDV is more for sphere-sphere gap compared to point-plane gap?**
- **How the BDV will vary for a 30 mm gap if point-point electrodes are used instead of point-plane gap?**