**IMPULSE GENERATOR**

**Objectives:**

Study of Impulse Generator and determination of Critical Flashover Voltage of a sphere-gap

**Procedure:**

1. Study the manual (attached) of the Impulse Voltage Generator (IVG) carefully
2. Adjust the gap distance of the sphere (500 mm diameter) at 70 mm
3. Chose the Impulse Generator level (say) 17 kV/ Stage. Set the Gap distance and voltage control on the controller at this level.
4. Close the circuit breaker and slowly rise the voltage
5. Form a table for recording the events. (As shown in the table I)
6. Trigger the generator and note if it causes a flashover across the main sphere gap. If it causes the Flashover then note it is a Flashover or ‘F’. Otherwise note it as a withstand or ‘W’

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7. Repeat step 5 till ten impulses are applied with an interval of 5 min. Each time note the outcome. If there are ‘n’ Flashover out of 10 pulses then the probability of Flashover associated with the voltage is n/10

8. Increase the voltage level by 0.2 kV/stage and repeat steps 4, 5, & 6
9. Repeat step 7 for at least 5 voltage levels

10. Reduce the voltage fully and open the circuit breaker 11.
Ground the Generator
12. Plot the voltage vs probability of Flashover curve. From this estimate the 50 % Probability point, which is the critical Flashover voltages
13. Correct the value obtained for Air density effects with the help of instructions given below.
14. Observe one full impulse wave and one chopped impulse on the oscilloscope and read waveform parameters.

Instructions for correction:

1. Use Table 1.3 to decide on corrections to be applied for any gap.
2. Obtain k_d and k_h from page 23 attached.
3. Since gap distance is less than 1m, so from fig 1.4, m, n and w are unity.
4. Humidity Correction can be obtained from fig 1.3.

<table>
<thead>
<tr>
<th>Voltage Level/ Stage kV</th>
<th>Pulse No.</th>
<th>Probability of Flashover</th>
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<tr>
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<td>1 2 3 4 5 6 7 8 9 10</td>
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# F - Flashover  W- Withstand

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Find Out:

1. Why the Impulse testing?
2. How is the wave shape controlled?
3. Why is the Impulse breakdown of a sphere Gap statistical?
4. Why Capacitive storage not Inductive storage for Impulse Generator?

Further Reading:

1. Kuffel & Zaengel: High voltage engineering, Pergamom press
2. M. Khalifa : High Voltage Engineering, Marcel Dekker
Supplementary Copy for Exp. No. 7 in PES Lab

Exp. No. 7. Impulse Voltage Generator: Study the Impulse voltage generator. Observe the Impulse waveform. Determine critical flashover voltage of the given sphere gap

1. Standard 1.2/50 μs Lightning Impulse Voltage Waveform

2. 4-Stage Impulse Voltage Generator Circuit in HV Lab

\[ R_{V1} = R_{V2} = R_{V3} = 8.5k \Omega, \quad R_{B1} = R_{B2} = R_{B3} = R_{B4} = 15 \Omega, \quad R_{B81} = R_{B82} = R_{B83} = R_{B84} = 115 \Omega, \quad R_6 = 160 \Omega \]

\[ C_C = \text{Capacitor} = 1.2 \mu F, 50 KV \]

Transformer: 220 V/ 100 KV, 7.5 KVA, 50 Hz, 1 Ω
Rectifier: 100 KV, 20 mA continuous current, 1 Ω Half wave
Impulse voltage generator: 600 KV, 18 KJ, 6 stage
Test object (sphere gap): Diameter of sphere = 500 mm
Gap between two sphere = 70 mm
3. Measurement of Impulse Voltage

The impulse voltage is of very short duration and the time during which it remains at the peak value is of the order of 0.01µs for a standard lighting impulse voltage of 1.2/50µs. In this short period of time breakdown may or may not be established depending upon the availability of initiating electron. Hence, breakdown of sphere gap under impulse voltage is probabilistic in nature.

From the S-curve, it can be seen that for \( V < V_{20} \), breakdown will never occur, while for \( V > V_{100} \), breakdown will always occur. The voltage for which the breakdown probability is 50% corresponds to the peak value of the impulse voltage. In other words, out of 10 impulse voltage application, if breakdown occurs between 4 to 6 times, then that value of impulse voltage can be taken as the peak value. If the probability is more than 50%, then breakdown occurs at the front of the wave, while breakdown occurs at the tail of the wave when the probability is less than 50%.