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Impulse Voltage for Testing a Low Voltage Bust duct Performances

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Abstract: This study was set to test 6.6 kV Bustduct with 20 kV for power frequency withstand voltage test and with 6 kV ,1.2/50 μs lightning impulse withstand voltage test according to IEC 60439 standard. This impulse generator is used to test conductor bar material in 3 Phase 4 Wire 400V,1600 A and 2500 A. The conductor bars that are designed to withstand a voltage test at a frequency of resistance impulse. Increasing the temperature according to the criteria and the resistance of the insulation can be used as a standard.

Keywords: Impulse voltage/ withstand voltage / Power System Stability

1. Introduction

Over voltage high level in power system, when it occurs, causes a great deal of trouble. Besides damage to electric appliances, over voltage causes great danger to electricity users. Now, there are various production of Distribution Board such as Switchboard, Switchgear and Consumer Unit to satisfy the expanded industry. These distribution boards must be tested of insulator tolerance as IEC 60439 standard and low voltage electrical equipment have to be tested by using 6 kV and 1.2/50 μs impulse voltage waveform.

2. Experimental System

Impulse voltage circuit as fig. 1 direct current voltage source (Ug) charges to impulse capacitor (Cs) until the voltage is equal Uo in which RL eliminate current charge to Cs. When spark at S occurs, voltage resulting from Uo charging would drop at Rd and Cb enabling Capacitor Cs discharge to testing material, which is capacitor of the load (Cb).

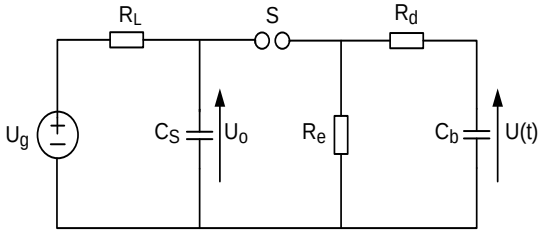

Figure 1 Impulse generator circuit 1.2/50 μs.

Where U_g is Dc voltage source, U_o is Dc voltage charger of capacitor, $C_s$is Impulse capacitor, C_b is Capacitor of load, R_L is Resistor Current limit charger, R_d is Front resistor, R_e is Tail resistor, S is

Switching spark gap. Whereas the lightning impulse front time T1according to IEC 60439-1[1-2] is essentially determined by resistance of front resistor Rd and capacitor of load Cb see fig. 1, the time to half-valve T2 is determined by the impulse capaci-tance of the impulse capacitor Cs and the resistance of the tail resistor, T2 is varied according to Re and time constant of discharge capacitor equal Cs Re being part of impulse voltage testing generator. According to IEC 60439-1, there are the following time parameters and tolerances for the standard lightning impulse 1.2/50 μs as shown in Fig.2.

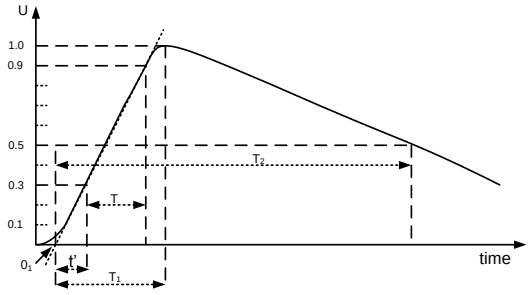

Figure 2 Lightning impulse voltage waveform 1.2/50 μs.

Design of circuit generating impulse voltage through analysis on impulse voltage generating fundamental circuit by Kirchhoff's Law and Laplace Transform [2] and define the equation in term of time, then acquired the following:

$$U(t) = \frac{U_o}{k} * \frac{1}{(\alpha_2-\alpha_1)}(e^{-\alpha_1 t}-e^{-\alpha_2 t})$$

Where U(t) is impulse voltage varied as time, U_o is charging voltage on C_s, K is voltage waveform constant α_1, α_2 is time constant and t is time variable

3. Experimental

3.1 Power frequency withstand voltage test at 2.5 kV

Test Phase	Criteria	result
All phase to earth	To be withstood	Withstood
1 st-phase to earth	To be withstood	Withstood
2 nd- phase to earth	To be withstood	Withstood
3 rd-phase to earth	To be withstood	Withstood
Neutral-phase to earth	To be withstood	Withstood

3.2 Lightning impulse withstand voltage test at 6 kV

Test Phase	Criteria	result
All phase to earth	To be withstood	Withstood
1 st-phase to earth	To be withstood	Withstood
2 nd- phase to earth	To be withstood	Withstood
3 rd-phase to earth	To be withstood	Withstood
Neutral-phase to earth	To be withstood	Withstood

3.3 Waveform of Impluse withstand test
(3Φ4W 400V 1600A,6 kV)

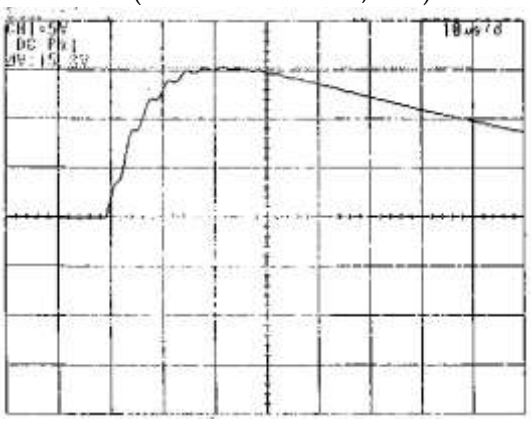

Figure 3 Positive Polarity (All phase to earth)

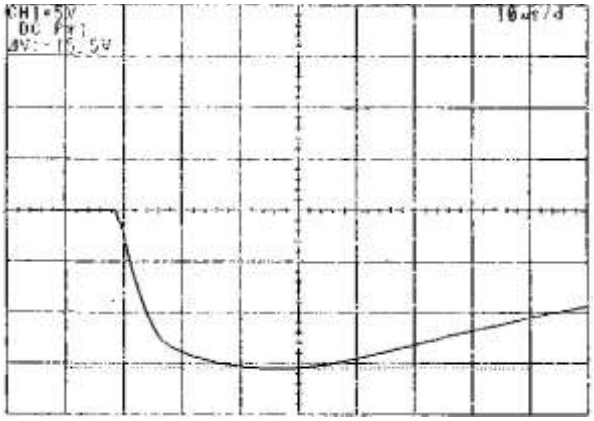

Figure 4 Negative Polarity (All phase to earth)

3.4 Waveform of Impluse withstand test
(3Φ4W 400V 2500A,6 kV)

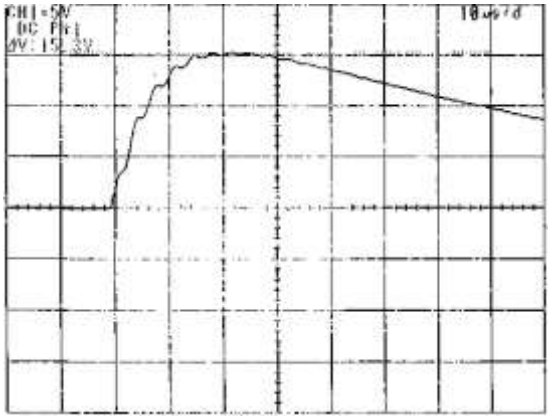

Figure 5 Positive Polarity (All phase to earth)

3.4 Waveform of Impluse withstand test

3Φ4W 400V 2500A

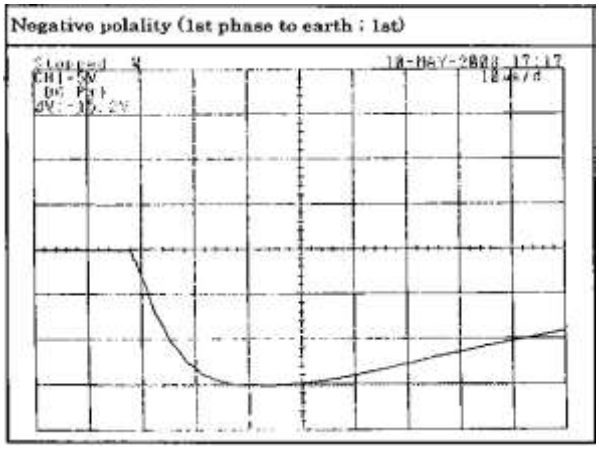

Figure 6 Negative Polarity (All phase to earth; 1st)

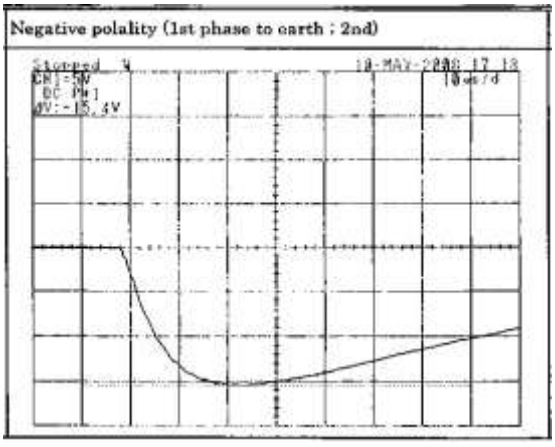

Figure 7 Negative Polarity (All phase to earth ; 2nd)

3.5 Insulation resistance test at 1600 A

Test Phase	Criteria	result
All phase to earth	Above 0.4 MΩ	Satisfactory
1 st-phase to earth	Above 0.4 MΩ	Satisfactory
2 nd- phase to earth	Above 0.4 MΩ	Satisfactory
3 rd-phase to earth	Above 0.4 MΩ	Satisfactory
Neutral-phase to earth	Above 0.4 MΩ	Satisfactory

4. Conclusion

This study has presented the design and invention of lightning impulse voltage generator with 6 kV open circuit and 1.2/50 μs waveform for testing low voltage electrical equipment according to IEC 60439-1. Testing low voltage Busduct using IEC 60439 Standard. The conductor bar system design and test a 3 Phase 4 Wire 400V. By test Withstand Voltage Test and Insulation Resistance Test, The coordinates of the test results 1600A and 2500A. The conductor bars that are designed to withstand a pressure test at a frequency of resistance Impulse. Increasing the temperature according to the criteria and the resistance of the insulation can be used as a standard. As the results, the magnitude of voltage and waveform conform with IEC 60439-1 standard, consequently this impulse voltage generator can be used to test insulator tolerance of low voltage equipment as well as this designed and invented generator is cheaper than the imported one[3].

References

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2. IEC 60439-2. 2005. Low-voltage Switchgear and Controlgear Assemblies Part 2 : Particular requirements for busbar trunking systems (busways) International standard
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