Research on Transient Enclosure Voltage in GIS under VFTO

Rao Xuni
School of Electrical Engineering
Xi'an Jiaotong University
Xi'an, Shaanxi, China

Guo Jie
School of Electrical Engineering
Xi'an Jiaotong University
Xi'an, Shaanxi, China

Abstract—In Gas-Insulated Switchgear (GIS) substation, the Transient Enclosure Voltage (TEV) would threaten the reliability of secondary devices. Studying the propagation law of TEV can provide reference for the electromagnetic compatibility assessment of the secondary equipment. This paper studies the TEV generated by operation of disconnecting switch in 330kV GIS substation. In order to obtain the characteristic parameters of the TEV, the TEV was measured in different position of enclosure. The results show that the TEV waveforms produced by different disconnecting switch operation are quite different. As a whole, the TEV has the characteristics of sharp steepness, high amplitude, and multiple frequency components, and its maximum values always appear on the enclosure of out-line bushing. Therefore, when testing the Electro Magnetic Compatibility (EMC) of secondary equipment, it is necessary to consider the influence of the secondary equipment locations.

Keywords- GIS; TEV; disconnecting switch; waveform analysis; characteristic parameters

I. INTRODUCTION

When the Very Fast Transient Overvoltage (VFTO) coupling to the enclosure of GIS, it would form TEV which can cause fault to secondary equipment. Although the secondary equipment has passed the national standards. the current testing standards for secondary equipment are not enough to meet the working conditions. Therefore, it is necessary to study the characteristics of the TEV, which can provide the basis for EMC testing of the secondary equipment.

II. TEST METHODS AND ANALYSIS

A. Test Methods

The TEV produced by switching operation of no-load bus were measured. The electrical wiring diagram under this operation and arrangement of the probe is shown as Figure 1. In the testing process, an earth point at 30 meters away from the measuring point was chosen as zero potential reference point.

B. Waveform Definition

To describe the features of TEV better, this paper defines the macro pulse and the micro pulse as the characteristic parameter of the TEV. The macro pulse stands for pulse group during the whole process of operation, and the micro pulse is the pulse whose amplitude reaches 20% of the maximum amplitude.

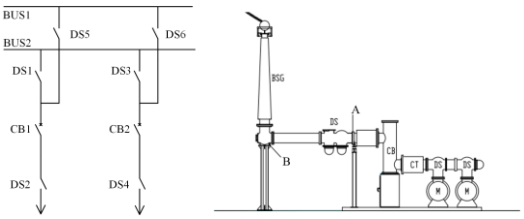

Figure 1. Main electrical scheme and measuring point distribution of 330 kV substations

III. CONCLUSION

By the measure and analysis of the TEV, we can conclude that: (1) the macro pulse duration and micro pulse number can be used to describe the severity of the TEV. The greater the value is, the more serious the TEV process is. (2) TEV in different situations has significant difference, and the most serious TEV is generated by the operation of disconnecting switch near the outgoing line (3) the maximum value of TEV always appears on the enclosure of out-line bushing. The maximum amplitude can reach 5.2kV, the main frequency can reach 67MHZ, and the maximum frequency can reach over 200MHz.

TABLE I. CHARACTERISTIC PARAMETERS OF TEV UNDER DIFFERENT CONDITIONS

Type of measurement	Measuring point	Maximum peak/kV	Macro pulse duration /ms	Micro pulse number/μs	Supreme steepness /kV · us^{-1}	Main frequency /MHz
DS1 closing operation	A	0.8	128.3	19	64.2	23
	B	0.5	117.0	16	17.1	11
DS1 opening operation	A	1.0	157.0	18	80.4	24
	B	0.5	152.8	14	17.3	13
DS3 opening operation	A	1.8	104.2	32	114.5	15
	B	1.2	96.5	26	49.5	11
DS4 closing operation	A	5.2	160	75	726.7	57
DS4 opening operation	A	4.9	160	99	697.7	67

REFERENCES

[1] Okabe S, Takami J, Nojima K, "Phenomena of leaking electromagnetic waves and high frequency surges from isolated joint of gas insulated switchgear," IEEE Transaction on Dielectrics and Electrical Insulation. 2008, 15(4): 1006-1014.