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The comparison characteristics of investigation breakdown voltage of long flash over arrestor (LFA) with different gaps space by using positive and negative impulse voltage

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Abstract

This paper presents the investigation and compares the ring components characteristics of long flashover arrestor (LFA) multi-gap and single gap. There are two cases in this work: (i) the gap ring for the multi-gap with various spacing of 0.5, 0.75, 1.0, 1.25, 1.5, 1.75 and 2.0 cm with diameter of 2.20 cm, and (ii) the gap ring for the single gap with various gap spaces to maximum length of break down. The standard positive and negative impulse voltage was applied from 9 – 150 kV. The results show that LFA with the same breakdown voltage and different gap spaces had the different flashover lengths. The flash length of LFA multi-gap with gap space of 0.75, 1.0, 1.25, 1.5, 1.75 and 2.0 cm under positive and negative impulse is almost the same value and lower than the LFA single gap. The flash length of LFA gap of 0.5 cm under the positive impulse voltage is longer than under the condition of the negative impulse voltage average about 1.5 cm. The flash length of single gap is equally with the voltage level 9-72 kV. At the positive voltage over 72 kV that the flash of LFA gab 0.5 cm is longer than LFA single gap.

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1. Introduction

The maintenance and reliability of the power system in high voltage distribution line is very important for the

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developing country. The required protection of the power system should be the high stability system and highly reliable protection equipment. The main problem of overhead distribution line system protection is lightning voltage (Lightning Surge or Switching Surge). The surge arrester consists of the nonlinear resistance. The resistance decreases with increasing the voltage or current. Nowadays, for the protection overhead line in distribution system, there are many types of arrestor instance metal-oxide arresters, gap-silicon carbide, etc. [1, 2] On the other hand, the problem of protection overhead transmission by using top metal-oxide arresters that can be destroyed by a lightning stroke and maintenance lightning protection equipment can be replaced and continuously worked [3]. There is the utilization of alternative equipment for protection of the overhead transmission line that called long flashover arrestor (LFA). It is a type of arrestor that constituted a simple structure. The principle is based on an extension of the lightning flashover cross over arrestor surface using discharge effect. The advantages of LFA are simple structure, low price, highly reliable and maintenance free [4]. There are two types of LFA: (i) LFA-L (Loop type) like insulator loop, one part is connected to a power line and the other part connects to ground. It consists of up to line conductor ring gap space 2.0-4.0 cm that utilized for the purpose of flashover by passing to ground. (ii) LFA-M (Modular) includes two cables like pieces, has a semi conductive core of resistance in each cable piece. The cable pieces are connected with three flashover modules [5].

This paper presents the characteristics of breakdown voltage of a new LFA multi-gap design that consists of insulator tube and aluminum conductor ring marshaled in different gap spaces: 0.5, 0.75, 1.0, 1.25, 1.5, 1.75 and 2.0 cm including single gap by using the positive and the negative impulse voltage level of 9-150 kV.

1. Experimental setup

• Samples: In the experiments, the breakdown voltage's characteristics of LFA gap spacing of the samples were designed by using insulator tube Polyvinyl Chloride (PVC diameter of 2.2 cm, thickness of 0.18 cm), variable gaps space of 0.5, 0.75, 1.0, 1.25, 1.5, 1.75 and 2.0 cm including LFA single gap under positive and negative impulse voltages level of 9.0-150 kV.

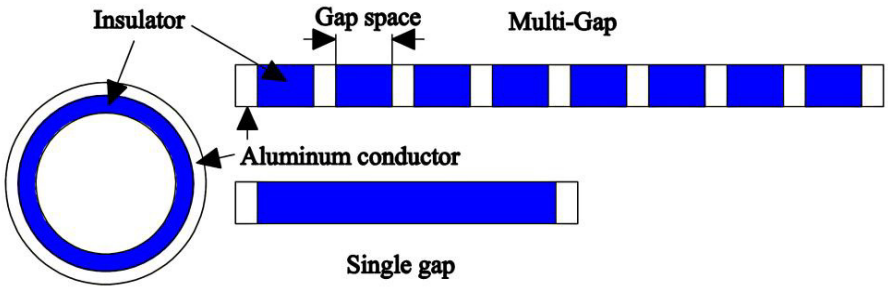

Fig. 1. Long flashover arrester model.

• Circuit diagram: The essential equipment in the demonstration is AC slide voltage regulation transformer 0 – 220 V was used for to control and measure input voltage. It was connected to step up transformer 220 V/15 kV. The voltage was increased and applied to Cockcroft-Walton circuit DC generator 0-100 kV with Positive and Negative. This generator voltage was supplied to the impulse generator 0-375 kV and impulse voltages was measured by impulse voltage divider (Foster) ratio 1: 1000 and captured the voltage's result on an oscilloscope screen. The flash length was recorded and measured by using a high speed camera as showed in Fig. 2.

• The process of experiment: Firstly, the impulse was at the voltage level of 9 kV and gradually increasing voltage level step by step until the voltage level up to 150 kV. Each sample was tested under positive and negative standard impulse voltage level of 9, 18, 27, 35, 42, 52, 60, 71, 81, 90, 99, 105, 112, 120, 130, 135, 145 and 150 kV.