Effects of Grading Rings and Spacers on Potential Distribution of ZnO Arrester

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Abstract: - The electric field distribution in high voltage plant and insulation systems is governed by the shape and location of the metallic electrode as well as the type of insulation media. Surge arresters are common examples of configurations giving rise to non-uniform electric field distribution. In this paper effect of grading rings and spacers on potential distribution of ZnO arresters are presented.

Key-words: -Grading ring, Spacer, ZnO Arrester, Potential

1 Introduction

The voltage distribution on a ZnO surge arrester under normal operating conditions has been observed to be non-uniform. The discs at the top are subjected to a higher voltage and hence thermal stresses, leading to a faster thermal ageing of these highly stressed discs [1,2,3,4].

In this paper with the aid of PC-Opera-8.7 software [5] two surge arresters (230 kV and 400kV) are simulated and effects of grading rings and spacers are investigated.

2 Simulation

In the present paper two surge arresters (220 kV & 400 kV) are simulated [6]. 220 kV surge arrester is composed of two units and 400 kV surge arrester is composed of three units. These units are connected together. The housing of arresters is made of porcelain.

Fig. 1 shows the simulated 220 kV surge arrester.

Fig. 2 shows simulated 400 kV surge arrester.

3 Effects of Grading Rings

3.1 Effect of Grading Position

The grading ring is used to make the voltage distribution uniform. Its efficiency is clearly dependent on its relative position. Therefore position of grading rings on 200 kV and 400 kV surge arresters are changed. Potential distribution on arresters is shown in figs. 3 and 4.

The maximum of voltage gradient for different height of grading ring is shown in table 1.

Fig. 1. Simulated 220 kV surge arrester

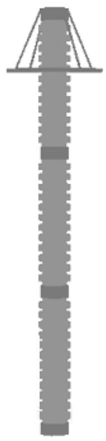

Fig. 2. Simulated 400 kV surge arrester

Table 1. Maximum of Voltage Gradient For Different Position of Grading Ring

$(H_{ring}/H_{arrester})$ %	$(E_{max}/E_{average})$ % 220 kV Arrester	$(E_{max}/E_{Averasge})$ % 400 kV Arrester
Without Ring	328.7	436.2
100	213.2	309.1
90	194.8	238.7
85	182.8	223.5
80	176.2	202.8
75	173.2	184.5
70	190.1	203.7

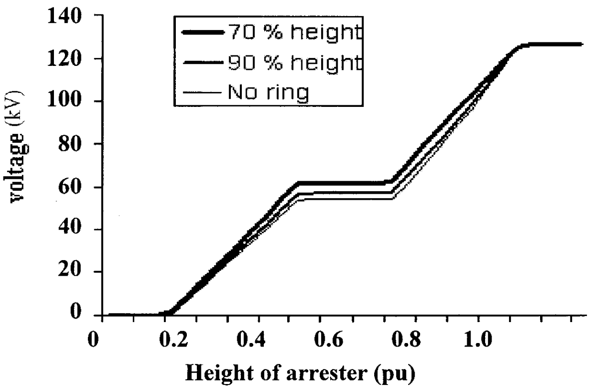

Fig. 3. Potential distribution on 220 kV surge arrester for different height of grading ring

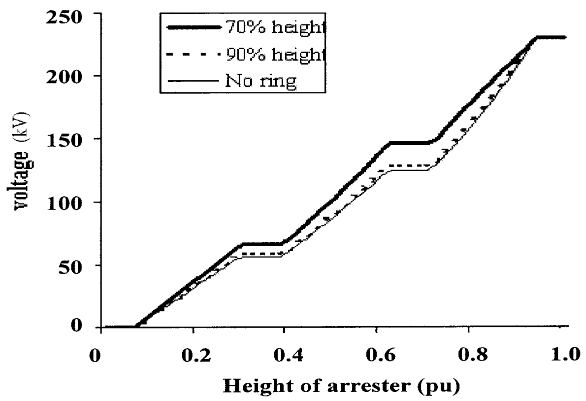

Fig. 4. Potential distribution on 400 kV surge arrester for different height of grading ring

Fig. 5 shows the voltage countor across the arrester axis without grading ring.
Fig. 6 shows the voltage countor across the arrester axis with grading ring.

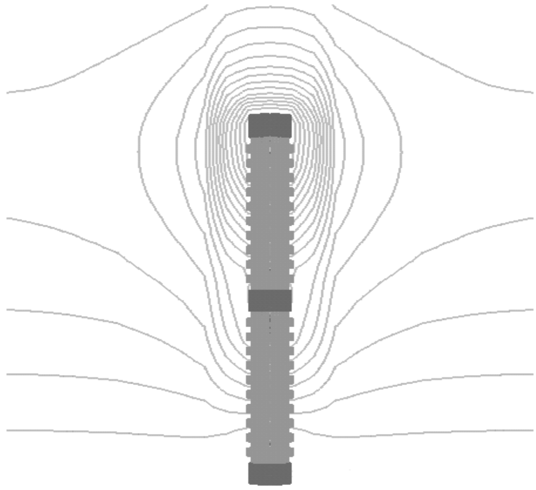

Fig. 5. Countor across the arrester without grading ring

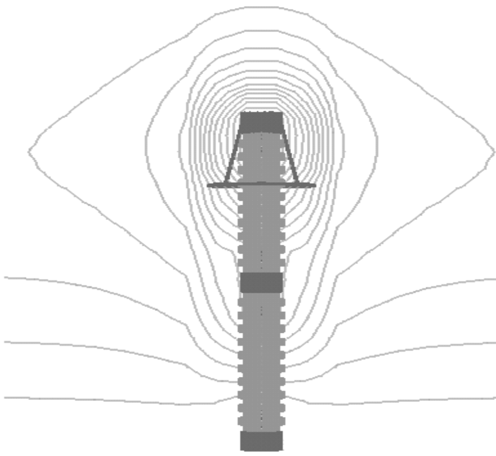

Fig. 6. Countor across the arrester with grading ring

3.2 Effect of Grading Ring Diameter

In this section we assumed the position of grading ring at 85% of height of arrester and the effect of diameter of grading ring on maximum of voltage gradient is investigated and results a are shown in table 2.

Table 2. Voltage Gradient For Different Diameter of Grading Ring

Diameter of ring (cm)	$(E_{max}/E_{average})$ % 220 kV Arrester	$(E_{max}/E_{average})$ % 400 kV Arrester
600	182.8	223.5
700	166.38	204.5
800	137.93	170.7

3.3 Effect of Spacers

The height of the porcelain housing is dependent on the voltage rating of the arrester and the environmental pollution conditions [1]. Thus for given voltage rating, the total height of the discs will be less than the height of housing and hence metallic spacers are employed to make up the extra height. To ascertain the effect of these spacers, three cases were considered and effect of positions of spacers on the maximum of voltage gradient are shown in table 3.

Table 3. Maximum of Gradient of Voltage For Different Positions of Spacers

Spacers Positions	$(E_{max}/E_{average})$ % 220 kV Arrester	$(E_{max}/E_{average})$ % 400 kV Arrester
Bottom	124.8	161.3
Equal (Top and Bottom)	135.3	164.8
Top	143.1	188.8

4 Conclusion

From results of this paper we can conclude:

1-For both arresters the best position of grading ring is at the 75% to 80% of height of arrester.

2-By increasing the grading ring diameter, the maximum value of voltage gradient will decrease.

3-Best position for spacers is bottom.

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