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# PERFORMANCE OF LIGHTNING ARRESTERS UNDER POLLUTED CONDITIONS

A Thesis Submitted

BY

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# S U M M A R Y

Sugre arresters being main devices used to protect high voltage networks against undesirable overvoltages, investigation tests were carried out in the present work on the two different types of arresters commonly used, the conventional gapped and gapless ones. These devices are mostly installed outdoor and subjected to weather conditions, therefore, their performance under polluted conditions is of prime importance.

As many investigators have performed studies to approach this problem, the present work is devoted to study the effects of heavy pollution on these two types. The results are compared for the two types in order to select the most suitable arrester type in a specific polluted area.

The tests were performed using power frequency a.c 50 c/s voltage and solid layer surface conductivity. The prencentage decrease of sparkover or discharge voltage under different solid layer-surface conductivities were determined.

The present work includes quantitative figures for the sparkover, discharge or flashover voltages for both

types of arresters. Also the answers for the various questions about the effects of polluted arresters are presented.

Hence, the thesis comprises five chapters. The first chapter is an introduction to the problem of the performance of lightning arresters under polluted conditions and the reflections of this problem on the performance of electrical networks.

Meanwhile, Chapter two presents a general review of literature and previous work done by others.

Futher, Chapter three presents a description of the experimental arrangements and test techniques, including investigated testing and measuring circuits.

Chapter four presents the obtained results, analyses of results, including performance curves for the various lightning arrester types of various voltages under various intensities of pollution layers up to very heavy pollution, as detailed in the text.

Finally, Chapter five presents the main conclusions and recommendations for improving the performance of lightning arresters.

# CHAPTER (1)

# INTRODUCTION

## 1.1 General

Surges and overvoltages are considered a main problem in electrical networks particulary for extra high voltage. For more efficient and economical operation and design of a network, the origin and properties of overvoltages which can occur in the network must be studied.

Protection of the network aginst overvoltages by using some means to reduce and limit the overvoltages is due. The surge (lightning) arresters are the most common devices used in this respect.

Contamination considerably influences the performance of surge arresters. The arrester may be even damaged due to pollution, causing many troubles in the electrical network.

## 1.2 Surges and Overvoltages in Networks

Surges and overvoltages in networks are caused by: lightning (extenal), switching (internal) and temporary overvoltages.

- Lightning overvoltages which are caused by lightning strokes directly or indirectly by the high induced charges from the nearly clouds (back flashover)[1].
- Switching overvoltages, caused by switching operations.
- Temporary overvoltages can happen in the networks and power systems in case of load rejection or single-phase earth fault[1,2,3].

Surges and overvoltages determine and thus define the costs of insulation for equipment and installations in electrical systems. Therefore overvoltages must be reduced to avoid over-insulation. Measures are thus, used such as earth wire and tower footing resistance against lightning surges and closing resistors for switching overvoltages.

Finally, the use of surge arresters is considered the counter measure against all kinds of overvoltages to reduce the insulation levels in networks[1,4,5].

### 1.3 Surge Arresters as a Protection Against Overvoltages

Surge arresters have been used to protect the networks and power systems from surges and overvoltages. It can be used from low voltages systems to high altitude application. They are used against lightning,