

Experimental and Mathematical Modeling of the Effect of Pollution Constitution on DC Flashover of High Voltage Insulator

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Abstract: This paper is aimed at the study of the influence of salts and salts mixtures on dc flashover discharge of high voltage polluted insulators. It's shown that the type of salt and salts mixtures don't have a significant influence on the critical voltages at both polarities. The critical voltages computed using the dynamic equations of dc flashover discharge characteristic constants (n and N) of polluted insulators we established elsewhere are found in a good accordance with the experimental ones. It also appears from this study that the most important components of the discharge column are water vapour and air and the transfer of metal ions has not a significant influence on flashover voltage.

Index Terms — Pollution, Insulators, Flashover, Modeling, Discharge characteristic constants, Constitution of pollution layer, Salts, Salts Mixtures.

1 INTRODUCTION

THE Flashover of polluted high-voltage insulators is a common problem in power electrical networks. The accumulation of pollution layer on the insulator surface is the first stage of flashover process. The constitution of this pollution differs from one site to another. However, the main elements that are found are minerals and insoluble materials [1-7]. Numerous studies have been conducted to determine the influence of pollution constitution on ac and dc flashover characteristics [8-12]. Ghosh and Chatterjee [12] showed that the constituents of pollution deposits represent a crucial parameter that can affect the ac flashover characteristics. They conclude that the discharge electrical gradient is affected by the nature of electrolyte. This influence is reflected by the variation of values of the discharge characteristic constant N and n with the type of salt within the pollution deposit (Table 1). The critical current versus the linear resistance of pollution with NaCl is greater than that with other salts [12]. As concerns the variation of critical voltage versus the linear resistance of pollution, these authors don't give any indication. By measuring the quantities of metallic ions before and after flashover, they found that these quantities increase; and they conclude that there is a transport phenomenon of metallic ions during flashover process. Matsumoto *et al.* [13], show that in the first step of discharge propagation, the discharge column contains traces of Na_2 and Na . They conclude

that the presence of metallic atom has an influence on the temperature of the discharge comparing to a free air discharge. In electrochemistry field, many authors investigated the interaction of an electrical discharge with a water surface or volume [14 - 17]. It was shown that the most components of chemical species in discharge column are water vapour and air and there is a transfer of a few part of metallic ions from the liquid. The presence of metallic ions is explained with the sputtering phenomena from the liquid to plasma. The amounts of metallic ions depends on their concentration within the liquid.

The aim of this paper is to study the experimental effect of different salts and salts mixtures on dc critical flashover voltage V_{co} . The experimental values of V_{co} are compared to those deduced from the relationships we established elsewhere [2].

Table 1: Values of flashover characteristic constants n and N according to Ghosh [12]

| Electrolyte | N | n |
|-----------------|-----|------|
| NaCl | 360 | 0.59 |
| CaCl_2 | 461 | 0.42 |
| FeCl_3 | 270 | 0.66 |
| CuSO_4 | 450 | 0.49 |

2 EXPERIMENTAL SETUP

The experimental device we used is the same as that presented in a previous work [11, 18]. It consists of a

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Atmospheric Icing of Power Networks Masoud Farzaneh,2008-06-26 Atmospheric ice takes a wide range of fascinating forms all beautiful in their own ways but many posing severe risk to the security of overhead networks for electric power communications and other systems This comprehensive book documents the fundamentals of atmospheric icing and surveys the state of the art in eight chapters each written by a team of experienced and internationally renowned experts The treatment is detailed and richly illustrated The presentation follows a logical sequence starting with the icing climate and meteorological conditions proceeding through development of observations and models of accretion and release of ice and heavy snow then considering static and dynamic mechanical loads the effects of ice and snow on electrical insulation de icing ice prevention and mitigation methods The statistical analysis of icing data and the mathematical and numerical modelling support appropriate mechanical and electrical design processes for icing conditions on overhead lines Technical specialists researchers and students in engineering and environmental science will all find value throughout the text Energy Research Abstracts ,1988 Emerging Trends in Power Systems, Vol. 1 , Proceedings of the Annual Eastern Snow Conference ,2004 **NBS Special Publication** ,1968 **NIST Building & Fire Research Laboratory Publications**

,1994 *Publications of the National Institute of Standards and Technology ... Catalog* National Institute of Standards and Technology (U.S.),1986 *Fire Science and Technology 2015* Kazunori Harada,Ken Matsuyama,Keisuke Himoto,Yuji Nakamura,Kaoru Wakatsuki,2016-10-04 This book focuses on topics in the entire spectrum of fire safety science targeting research in fires explosions combustion science heat transfer fluid dynamics risk analysis structural engineering and other subjects The book contributes to a gain in advanced scientific knowledge and presents or advances new ideas in all topics in fire safety science Two decades ago the 1st Asia Oceania Symposium on Fire Science and Technology was held in Hefei China Since then the Asia Oceania Symposia have grown in size and quality This book reflecting that growth helps readers to understand fire safety technology design and methodology in diverse areas including historical buildings photovoltaic panels batteries and electric vehicles *Publications* United States. National Bureau of Standards,1980 **Publications of the National Bureau of Standards ... Catalog** United States. National Bureau of Standards,1979 *Fire Technology Abstracts* ,1978 **Building and Fire Research Laboratory Publications** Building and Fire Research Laboratory (U.S.),1995 [Publications of the National Bureau of Standards](#) United States. National Bureau of Standards,1985 **Fire Standards and Safety** Alexander Francis Robertson,1977-06 **NIST Technical Note** ,1992 **UHV Transmission Technology** China Electric Power Research Institute,2017-10-18 UHV Transmission Technology enables power system employees and the vast majority of those caring for UHV transmission technology to understand and master key technologies of UHV transmission This book can be used as a technical reference and guide for future UHV projects UHV transmission has many advantages for new power networks due to its capacity long distance potential high efficiency and low loss Development of UHV transmission technology is led by infrastructure development and renewal as well as smart grid developments which can use UHV power networks as the transmission backbone for hydropower coal nuclear power and large renewable energy bases UHV is a key enabling technology for optimal allocation of resources across large geographic areas and has a key role to play in reducing pressure on energy and land resources Provides a complete reference on the latest ultra high voltage transmission technologies Covers practical applications made possible by theoretical material extensive proofs applied systems examples and real world implementations including coverage of problem solving and design and manufacturing guidance Includes case studies of AC and DC demonstration projects Features input from a world leading UHV team **Evaluating Small Board and Care Homes; Sprinklered vs. Nonsprinklered Fire Protection** ,1993

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