

## Article

# Experimental Study and Modeling of the Effect of ESDD/NSDD on AC Flashover of SiR Outdoor Insulators

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**Abstract:** Pollution flashover occurs when soluble and nonsoluble materials cover the surface of an insulator, and this may ultimately cause a reduction in its performance. In this paper, the common type of sodium chloride (NaCl) was used as a soluble pollutant (ESDD) and kaolin as a nonsoluble pollutant (NSDD). Samples of silicone rubber (SiR) insulators were selected for this study and fabricated at the Advanced High Voltage Engineering Research Centre (AHIVEC) at Cardiff University. The samples were preconditioned and polluted according to standard specifications. Additionally, the AC voltage ramp technique was used to achieve flashover (FOV) voltage with different pollution levels. The aim of this work was to investigate the effect of nonsoluble materials on flashover characteristics to understand their interaction with dry-band arcs by using FOV electrical equations and experimental data. The test results show that the FOV voltage of the silicone rubber insulator substantially decreased with the increase in both ESDD and NSDD values. It was also identified from these results that the dry-band arcs were considerably influenced by both ESDD and NSDD levels. This impact can be quantified by determining the variation of discharge parameters ( $N$ ,  $n$ ). Based on the FOV equations and experimental data, a mathematical model was suggested, taking into account the effect of both ESDD and NSDD.

**Keywords:** pollution insulators; nonsoluble deposit density; flashover characteristics; arc parameters



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## 1. Introduction

One of the major problems facing HV electrical grid engineers is the disturbance generated by insulator arcing due to pollution flashover (FOV), especially in harsh environments [1,2]. Pollution FOV of insulators is a complex phenomenon and has become a significant aspect in the design of HV overhead lines and substations [2,3]. This phenomenon can be affected by many parameters such as insulator material, insulator profile, pollution level, and atmospheric conditions (air pressure, temperature, humidity, fog, rain, snow, ice, etc.) [1,3–6].

The chemical constitution of the pollution layer is one of the key factors affecting the FOV characteristics and performance of insulators [7,8]. Sodium chloride (NaCl) is commonly utilized as the key reference indicator for conductive pollution materials [9,10]. The pollution degree is defined by the equivalent salt deposit density (ESDD) and represents the concentration of NaCl that, when dissolved in demineralized water, gives the same volumetric conductivity as that of the natural deposit removed from a given surface of the insulator divided by the area of the surface, generally expressed in  $\text{mg}/\text{cm}^2$ . However, in the real field, the pollution constitution depends on the local environment where NaCl is not the predominant salt, as established by many researchers [7,8,11–15]. On the other hand, the pollution layer contains insoluble materials consisting mainly of ferrite, silica, and alumina [4,9,13,15–18]. The pollution index for insoluble or nonsoluble materials is

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**Lingsheng Yao**



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b pressure test procedures when you pressure test the bop system you must conduct a low pressure test and a high pressure test for each bop component excluding test rams and non sealing shear rams you must begin each test by conducting the low pressure test then transition to the high pressure test

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there are two elements to the pre job well site pressure test 1 wireline valve wlv pressure function test the tests should be performed on the test stump prior to rigging up and involves testing the pressure integrity of the wlv and the individual

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the purpose of bop stack function and pressure testing is to verify the hydraulic integrity of all the components of the bop stack at their rated working pressure in this article we will discuss the function test and pressure test procedure using cup tester

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all elmar wireline pressure control equipment is certified to be manufactured following api6a specifications to inhibitors for the pressure test the pressure test procedure for each assembly is stated on each assembly drawing equipment is stripped down rebuilt with new elastomers including bop ram outer seals and quick

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7 31 body pressure test procedure 1 locate the test plug and test cap on to their appropriate ends 2 bleed off all air within the assembly 3 ensure all external surfaces are dry 4 pressure test to test pressure for 3 minutes 5 reduce pressure to zero and repeat test for 15 minutes minimum no leakage acceptable 7 32 bop manifold test

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feb 14 2011 1 prior to supping the well or the first time that bop is installed on the well 2 after repairing or disconnecting of any pressure sealing elements of bop 3 as per mms you can use bop for 21 days 3 weeks before you need to test it

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this unit is a pressure test system intended for pressure testing 5 000 10 000 and 15 000 psi rated pressure control

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