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IEEE Guide on the Selection of Transmission and Distribution Insulators with Respect to Cold Weather Conditions

IEEE Dielectrics and Electrical Insulation Society

and

IEEE Power and Energy Society

Developed by the
Outdoor Insulation Committee
and the
Transmission and Distribution Committee

IEEE Std 1820™-2020

IEEE

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Abstract: Procedures for selecting external insulation that is likely to be subjected to an outdoor environment that includes combinations of contamination, ice, snow, or cold fog are specified by this guide. The selection methods are applicable to insulators, surge arresters, bushings, live line tools and other high voltage ac and dc apparatus with a rated voltage above 1 kV.

Keywords: contamination, flashover, fog, freezing, high voltage, ice, IEEE 1820™, insulator, snow

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Introduction

This introduction is not part of IEEE Std 1820-2020, IEEE Guide for on the Selection of Transmission and Distribution Insulators with Respect to Cold Weather Conditions.

Service experience has revealed a weakness in outdoor insulation that is exposed to moderate levels of contamination with coincident icing leading to flashover under normal service voltage stress at the melting point. The problem is particularly severe for EHV insulators at or above 345 kV that have been selected on the basis of adequate switching surge control, leading to higher electric stress (voltage per meter of dry arc distance) compared to HV insulators.

A joint DEIS/PES Task Force on Icing Tests for Insulators consolidated test methods into and distilled them into a series of standard ice, snow, and cold fog tests (IEEE P1783). To the extent possible, the standard icing tests are coordinated with existing practice in heavy rain and contamination testing in IEEE Std 4[1] These electrical tests supplement the usual extreme-cold testing down to −45°C that affect material performance of insulators.

Standard icing tests can only evaluate the electrical performance of insulators in a representative environment. Guidelines for selecting insulators, based on test results, are needed for selecting insulators in new installations, for insulator replacement programs, and for mitigation options where existing insulators must be upgraded. Parameters for insulator selection include insulator dry arcing and leakage distances, type, profile, and configuration.

Adequate climate data and environmental exposure parameters are needed to establish the risk factors at a point, such as a substation, or along a path, such as a transmission line. Suitable statistical models are introduced for the time and space variation of winter pollution.

Standard icing test results can provide electrical withstand levels for fixed severity, characterized mainly by ice thickness and freezing water conductivity. A process is given to adapt these test results for insulator selection, based on the variable severity corresponding to local climate and environment.

Selection of insulators suitable for an icing and melting environment may affect insulation coordination with other equipment. For example, a simple increase in dry arc distance solves many line and station insulator icing problems but the increase in external electrical strength needs to be matched by improvements to internal apparatus ratings, or by selection of surge protective devices that will carry out their limiting functions correctly in the icing environment.

[1]Information on references can be found in Clause 2.

Contents

IEEE Guide on the Selection of Transmission and Distribution Insulators with Respect to Cold Weather Conditions

1. Overview

1.1 Scope

The guide specifies procedures for selecting external insulation that is likely to be subjected to an outdoor environment that includes combinations of contamination, ice, snow, or cold fog. The selection methods are applicable to insulators, surge arresters, bushings, live line tools, and other high-voltage ac and dc apparatus with a rated voltage above 1 kV.

1.2 Purpose

The purpose of this guide is to provide methods to characterize the pollution and icing environment of a location or region and then to select outdoor high-voltage insulator types and dimensions to achieve a desired reliability level.

1.3 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).[2]

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals i*s recommended that*).

The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals *is permitted to*).[3]

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can* equals *is able to*).

[2]The use of the word *must* is deprecated and cannot be used when stating mandatory requirements, *must* is used only to describe unavoidable situations.
[3]The use of *will* is deprecated and cannot be used when stating mandatory requirements, *will* is only used in statements of fact.