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A STUDY ON TRANSIENT PROTECTION USING MO-SURGE ARRESTERS FOR DC RAILWAY SYSTEMS

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Abstract: Transient protection of DC railway systems is studied in this paper, by considering the different insulation of the rails and the earthing concepts. The ratings of gapless Metal oxide(MO) surge arresters are based on the relevant EN standards and national guidelines. A recently evolved crossover voltage limiter, which joins overvoltage security and the insurance against risky touch voltages, is presented in the writing is introduced in this article.

Keywords: DC railway systems, High voltage limiter, Low voltage limiter, Transient protection, Surge Arresters

1. Introduction

Transients in electrical networks are due to effects of lightning strokes and switching actions which is unavoidable. Lightning strokes hits the tall objects hence in railways there is a possibility of direct or nearby lightning. Due to indirect lightning there is a induced voltages, and unacceptable voltages due to failures in the system. Contingent upon the protection of the rails against earth, various viewpoints must be considered for an overall security idea. A DC traction protection system against a lightning strike is given in [1]. In [2] and the use of different protection apparatus is discussed.

2. Voltages in DC railway systems

The voltages in the railway system is broadly classified as (i) system voltages and (ii) overvoltage

2.1. System voltages

The supply voltages for railways are given in the two *standards*: BS EN 50163 and IEC 60850. For railway applications traction system supply voltages is used. To study about arresters and the protection concept in general the following some definitions are necessary, that are given for the reference.

Nominal voltage Vn: the designated value for a system.

Maximum permanent voltage Vmax1: the maximum value of the voltage likely to be present indefinitely.

Maximum non-permanent voltage Vmax2: the maximum value of the voltage likely to be present for maximum of 5 min .

The values for Vmax2 can become 800V in the 600V system, and 1000V in the 750V system in case of regenerative breaking.

To design a insulation coordination and transient protection, the highest value of voltage will be taken for consideration.

2.2. Overvoltage's

The height of tower, insulators used in overhead DC power transmission system and other dimensions used in railways are more or less same as that of medium voltage (MV) distribution networks. Hence the consideration used in MV system can be taken as the reference input for designing insulation coordination and transient protection. Based on the lightning day of that location, the expected number of indirect lightning which depends on the exposure of the line, nearby objects such as trees, buildings, towers, etc protection system will be designed.

Overvoltage's due to direct and indirect lightning strikes are identified by different wave shapes. From the literature it is clear that overvoltage's due to a direct strike have an overall wave shape similar to that of the incident lightning current, the fast impulse rising portion consists of superimposed with several spikes created due to insulation breakdown. Induced overvoltage's are characterized by pulse width significantly shorter than the channel-base current of the lightning and

Their wave shape is strongly affected by the ground electrical conductivity [3].

A direct lightning striking a phase conductor infuses current waves in the two ways. The relating voltage rises to half of the current increased by the line trademark impedance, which is about 400Ω. Since over 90% of the strokes have a peak current of 10 kA, the overvoltage will surpass 2MV for 90% of the strokes. These voltages developed by direct lightning are far higher than the lightning withstand voltage of the line. Thus flashovers among stage and earth will happen.