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Mitigation of induced voltages and AC corrosion effects on buried gas pipeline near to OHTL under normal and fault conditions

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ABSTRACT

In this paper the induced voltages along the length of the buried gas pipeline, due to the inductive coupling and conductive coupling between this pipeline and the overhead transmission line (OHTL), are calculated under normal and fault conditions of the OHTL. Also, this paper deals with the mitigation of these induced voltages.

Fault conditions of the OHTL include symmetric and un-symmetric faults. Where, ATP software is used to simulate the OHTL under all fault conditions. The obtained results from the ATP program are used to calculate the pipeline induced voltages under both normal and fault conditions.

Mitigation system to minimize the impact of the OHTL on pipelines at normal and fault conditions is designed. Under normal condition, the pipeline induced voltages, after earthing system (mitigation system) was erected, are measured and compared with the calculated values.

Also, pipeline coating discharging current and pipeline AC current density due to inductive coupling under normal operation and due to inductive and conductive coupling under single phase to ground fault condition of the OHTL, before and after erecting the mitigation system, are calculated and analyzed.

1. Introduction

Overhead transmission lines (OHTLs) are the major source of the electromagnetic field interference (EMFI) with metallic structures such as pipelines, railways and underground cables laying in the same corridor. The EMFI produces induced voltages due to the time-varying magnetic fields that produced by the conductors' currents. The induced electro-motive force causes an induced voltage on the pipeline with respect to the surrounding earth, and causes a current circulation in the pipeline [1–4]. This induced voltage may pose danger to the working personnel or may accelerate the corrosion of the pipeline's metal, so a mitigation system is required to be designed. The primary focus of most AC mitigation is to reduce the AC induced voltages at normal condition and during fault conditi-

introduced in [8,9]. Inductive interference calculations were based firstly on field theory, which was used to compute self and mutual impedances of the pipeline. In [8], the pipeline was assumed to be parallel to OHTL, which is a simple in analysis. Also, in [8], for calculating the induced voltage, it neglected the propagation effects and the screening factor. Finally, it didn't deal with the fault currents simulation and its effect on the induced voltage. For the mitigation of the induced voltage, three mitigation wires buried in the soil that were not bonded to the pipeline were used in [8].

An analytical method of calculating induced voltages and currents (inductive coupling only) in a complex induced circuit (pipeline), such as single, two or three cascaded parallel section of a pipeline with a few inducing circuit (power lines), based on a