



SURGE PROPAGATION AND PROTECTION OF UNDERGROUND DISTRIBUTION CABLES



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ABSTRACT

The lightning surge and switching surge could be injected to the underground distribution line through the riser pole in the mixed distribution line of overhead and underground. These surges travel along the cable and are reflected at the end of cable. It can be doubled and affecting underground distribution facilities.

We made a underground distribution model representing KEPCO's distribution system. We measured propagation characteristics by applying lightning surges to this underground distribution model. Meanwhile, we simulated this system with ATP-EMTP and compared these results.

There were differences between real test measurements and EMTP simulated results. Those differences come from cable parameters and surge wave shapes. To minimize those differences, relative permittivity of the cable insulation material must be measured from the real cable and surge source type should be used.

To protect underground distribution system from surge, arrester should be installed at the open terminal in which doubled voltage are reflected.

installing arresters, while underground distribution lines have the only riser pole arrester. In the underground distribution line, during lightning surge discharge through arrester residual voltage is applied to the cable and travel along the cable line. This traveling surge is reflected at the terminal with doubled voltage and travels again. This traveling surge could make a fault at the weakened insulation point.

To analyze traveling surge mechanism and solve the problem, we constructed a field test model of underground distribution line and applied impulses and measured voltages. We also simulated our test model with ATP-EMTP(Electro-Magnetic Transient Program) and compared the results of field test and EMTP simulation. To accord EMTP results with field test results, we tuned parameters of EMTP. Until now it has been rare to verify EMTP simulation results by field test results. Therefore the result of EMTP not accepted easily.

If EMTP parameters fixed precisely we can simulate various cases which are difficult to test in the real underground distribution system. Through this process we can make a solution for the surge protection of underground distribution system.

KEYWORDS

URD, Surge, Protection, EMTP, Cable

INTRODUCTION

Underground distribution of Korean distribution system became 12% in 2006, and in Seoul 50%. The more economy grows, the more underground distribution system increases.

Overhead distribution lines are protected from lightning by

CONSTRUCTION OF UNDERGROUND DISTRIBUTION LINE FOR TEST

We constructed a underground distribution line for test with cables, pad-mounted switchgears and pad-mounted transformers used in Korea. Four switchgears, three transformers, two type of cables and joints are installed onto the 4 circuits of 250 m long. This test line connected to the impulse generator through about 100 m long cable. Line length and branching can be varied by switchgear operation.

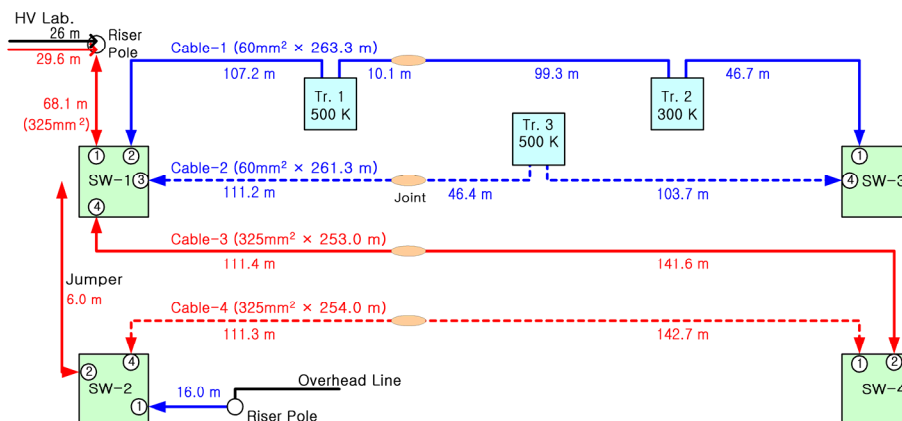


Figure 1: Field test model of underground distribution system