EVALUATION OF FIELD AGED PILC CABLES 66 AND 68 YEARS

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ABSTRACT

The Electric Power Research Institute worked with Cable Technology Laboratories to evaluate the health and performance of samples of PILC cables removed from service. The cables were operated in Uo = 4 kV network systems This report describes the physical and electrical tests and findings of the evaluation of two field aged PILC cables of 66 and 68 years. One cable contained a field failure attributed to moisture ingress due to localized lead sheath corrosion. The remainder of the two cables were in very good condition for their age and could have provided further reliable service.

KEYWORDS

Paper-insulated lead-covered, PILC, aging, failure analysis

INTRODUCTION

Condition assessment and performance evaluation of aged paper-insulated lead-covered (PILC) cables is an important factor in managing aging underground distribution systems. Two cables were evaluated after many years of service in the northeastern part of the United States. The cables placed in service in 1937 and 1940 and operated for 68 and 66 years respectively. The 1940 cable experienced a field-failure in 2007 and was removed from service and replaced. The 1937 cable was replaced during system upgrades in 2005.

Performance tests and detailed evaluation of PILC cables of this age provides insight into the degree of aging and degradation from decades of service. The cables discussed here are part of a larger project to evaluate aged PILC cables [1].

CABLE DESCRIPTIONS

The cables used for this evaluation were manufactured by two different cable companies.

The 1937 cable was a 4 conductor, 7 kV belted design operating in a 4 kV phase-to-phase system.. Copper conductors were 33.6 mm^2. Phases had 2.41 mm oil impregnated paper tapes (19 x 0.13 mm thick tapes) with a 1.65 mm thick overall belt (13 x 0.13 mm thick tapes). The lead sheath was 2.5 mm thick with no overall jacket. There were paper fillers in the center and outer interstices of the cable core to make the cable round. The cable cross section is shown in Figure 1. Seventy meters of cable was supplied for testing. This cable will be referred to as “Cable A”.

The 1940 cable was a 3 conductor, 7 kV belted design operating in a 4 kV phase-to-phase system. Copper conductors were 253 mm^2. Phases had 2.54 mm oil impregnated paper tapes (18 x 0.14 mm thick tapes) with a 1.65 mm thick overall belt (12 x 0.14 mm thick tapes). The lead sheath was 3.0 mm thick with no overall jacket. There were paper fillers in the center and outer interstices of the cable core to make the cable round. The cable cross section is shown in Figure 2. Sixty meters of cable was supplied for testing. The field failure was located close to one end of the 60 m section. This cable will be referred to as “Cable B”.

Three samples of approximately 15 meters were cut from each cable. One from each end, with the third sample from the approximate middle of the total length supplied.

Figure 1 – Cable A: 1937 PILC cable, 68 years service

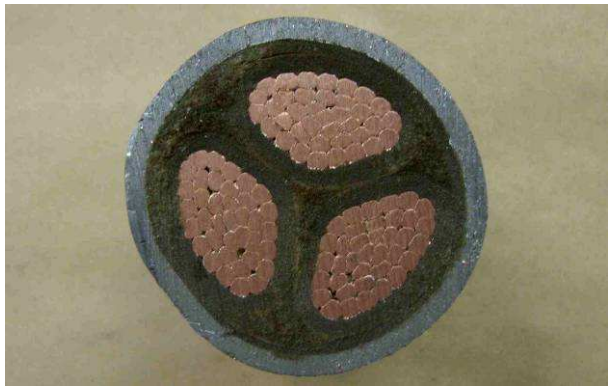

Figure 2 – Cable B: 1940 PILC cable, 66 years service

TEST PROGRAM

The test program was based on previous experience with PILC cable evaluations [2-8]. It was agreed upon with all parties to use the AEIC CS1-68 standard [9] as the reference document for test procedures and performance criteria. The following tests were performed:

1. Visual inspection
2. PD at ambient temperature
3. Power factor versus voltage (ionization factor at ambient temperature)