PFT - Non-Intrusive Oil Filled Cable Leak Location

Use of Perfluorocarbon Tracers (PFT) in Self Contained Fluid Filled Cable Oil Leak Location.

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ABSTRACT

Oil leak location from buried cables is a critical step in addressing oil loss to the environment. A number of technologies have been applied to the problem with, to date, limited success. Recently developments have centred upon the use of tracers injected into the cable oil medium which when released into the soil will release a specific tracer gas that can be readily detected from above ground and does not require circuit outages. Outages are only required do effect repairs thereby reducing the overall outage time to locate and repair by approximately two thirds, thus improving system reliability and efficiency.

KEYWORDS

PFT, Freezing, Bar Holing, Tracer, PerFluorocarbon

INTRODUCTION

Self contained fluid filled cable technology is a mature, robust and reliable HV cable system that has been deployed in most major cities and towns around the world for many years. In recent times the deployment and installation of oil filled cable has declined, with the majority of new installations now using XLPE solid insulated cables. However due to the high capital replacement cost, and with limited access to roads and streets in our major towns, it is anticipated that fluid filled technology will continue to be in service for many years to come.

Problems do occur on buried cables from ground movement, deterioration, and third party strikes which result in the leakage and loss of the insulating fluid. This leakage is often difficult to locate and repair when circuits need to be removed from service. In addition, the associated difficulties and inconveniences that accompany major road works and excavations in busy roads and cities result in long outage periods. Leaks can range from a few litres per day to many litres an hour, having an effect on the local environment, causing breaches to national and local environmental legislation and exposing utilities to financial penalties and possible loss of reputation.

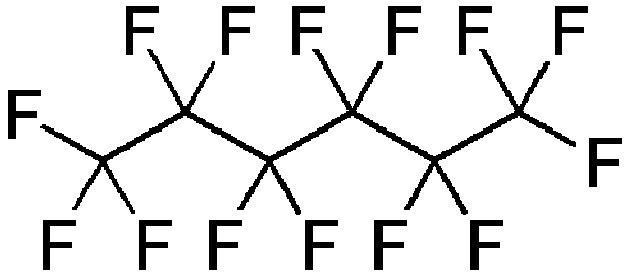
PFT Leak location technology offers a benign and environmentally acceptable method of pinpointing leaks, even very small leaks that cannot be detected using traditional 'freezing' techniques. The leak location is carried out by tagging the cable fluid with a liquid tracer, personnel can then detect leaks using above ground test equipment with the cable still in service, thus reducing outage time, cost of excavation and speeding up the repair process. Leaks can be detected to within 1m depending on ground conditions and the local environment.

HISTORY

PFT stands for PerFluoroCarbon Tracer. It is a Non-CFC Freon liquid that is used for a multitude of applications in the medical and environmental fields. It is also referred to as PFC in some industries. A technique was developed by the Energy Products Research Institute (EPRI) to apply PFT for use as a liquid tracer in High Pressure Fluid Filled cable systems[(1)]. The original project was carried out in partnership with Consolidated Edison[(2)] of New York (Coned) and Brookhaven National Lab (BNL)[(3)] in the mid 1990's. The focus being leak location on High Pressure Fluid Filled cable systems, as the fluid in the cables can circulate at up to 300 gallons per minute, thus any leaks result in large volumes of oil being lost.

Various tests where carried out to determine the level of PFT required to be injected in to the cable that could be accurately detected above ground. The results demonstrated that a presence of PFT's within the cable fluid at less that 10ppm could be detected at ground level when a leak occurred. This very low level was safe to the cable, joints and seals of the cable system and has no foreseen long term potential problems. This differs from other tracers experiments tried in the past using SF6, helium or Hydrogen where tracer concentration must be near 100% and injected in gaseous form. At these extremely low levels there is no effect on the characteristics of the dielectric fluid. There is also no environmental or emission issues using PFC's in this application. As a result of having such a low level of tracer, instrumentation must have an extremely low detection level. Instrumentation must be able to see individual PFC's at the part per quadrillion range (ppq) or equivalent to 1 second in 37 million years.

The outcome of the project was so successful that Coned has pre-tagged all 1000km of their cable system, over 27 million litres. In addition they invested in a number of vehicle-mounted test instruments to provide a 24-hour response when leaks on the system developed, and has been their primary method of leak location since 1997.



Chemical Structure of a PerFluorocarbon