Ensuring Future Reliability using Manufacturers' Standards to Assess Cable System Performance after Installation

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ABSTRACT

After decades of installing cables, Wiener Netze GmbH, the public utility in Vienna, Austria, is developing an efficiency strategy to move from legacy PILC cable to the newer solid dielectric type cable systems while outsourcing its installation operations in order to reduce costs. The procedural and material shift presents an opportunity to the utility to maintain higher reliability standards at lower costs while operating a system that is easy to work with and better for the environment, but as with any change there will be a learning curve to overcome. With this, the utility is partnering with a global leader in cable reliability assessment that has the largest database pertaining to the performance of new and aged solid dielectric cable systems in the world. The database, including over 30 million meters of cable systems, supports a long held theory that the root cause of cable system failures leading to service outage often originate during initial installation workmanship, shipping or are the result of manufacturing anomalies. Using a partial discharge assessment that is directly comparable to the manufacturer's quality control procedures, Wiener Netze has the ability to determine that all of their installed cable and component infrastructure perform to manufacturers' standards with the additional benefit of a meter-by-meter performance database to help objectively manage asset return and ensure the power system performs optimally.

KEYWORDS

Partial Discharge Diagnostic testing at 50/60 Hz, Improving grid reliability, Asset management, Extruded dielectric cable, Manufacturer's Quality Control, Failure modes of newly installed cables, Very Low Frequency (VLF), Best practices, PILC, Mass impregnated (MI) cable, Tangent Delta

INTRODUCTION

Vienna is the capital and largest city of Austria. It has a population of about 1.8 million, and is a cultural, economic, and political centre. In a 2005 study of 127 world cities, the Economist Intelligence Unit ranked Vienna first (in a tie with Vancouver, Canada) for the world's most livable cities. The city was ranked first globally for its culture of innovation in 2007 and 2008 and fifth globally (out of 256 cities) in the 2011 Innovation Cities Index, which analyzed 162 indicators in covering three areas: culture, infrastructure, and markets. Vienna regularly hosts urban planning conferences and is often used as a case study by urban planners. Between 2005 and 2010, Vienna was the world's number one destination for international congresses and conventions. It attracts over 12 million tourists a year. However, with all of its cultural diversity and individualism, Vienna, shares a common trait akin to many of Europe's large capital cities in that its infrastructure is showing signs of aging.

BACKGROUND

In 1996, the energy markets in the European Union were liberalized to promote competition and to ensure transparent pricing. In 2001, a regulatory organization was formed in Austria to monitor and observe the process of continuous cost reduction and investments into the energy sector. In 2013 the energy transmission networks owned by the Town of Vienna were unbundled and operations for the electricity, gas and heating networks were merged into a new infrastructure company called Wiener Netze GmbH (WN). Wiener Netze serves 1.2 million customers in Vienna and parts of Niederösterreich and Burgenland.

The medium voltage underground electrical network in Vienna was an immediate focus for reliability improvement; the system consists mainly of cables made up of paper insulated lead covered (PILC) including mass impregnated (MI) cable construction. These cable types have been very dependable throughout their lifetime, which in some cases exceeds 50 years, but the failure rate has been increasing annually causing many power outages. Globally, there has been a changing trend in underground network restructuring where legacy PILC cables are being replaced with a newer polymeric type construction where the most commonly used insulating material is cross-linked polyethylene (XLPE). The migration from one cable platform to another has not come without challenges but the benefit of an observable, predictable and assessable network is paramount to Wiener Netze. Thus the result has been to drive changes in supply chain, quality, standards engineering and education.

Underground Network Changes

Vienna's medium voltage network consists of 7,247 kilometers of 10kV and 20kV underground cables with approximately 40,000 joints (of which 20,000 are solid dielectric). 50% of these cables were installed more than 30 years ago. The medium voltage networks are the source of 80% of the power failures in the city and as such were the main focus for reliability improvement for Wiener Netze.

During the 1970's the company began replacing its underground oil-filled cable network with the more advanced PILC cable standardized with 240mm^2 aluminum conductors. By 1985 the company transitioned from traditional paper-taped joints to heat shrink joints as a cost effective strategy. PILC cables are traditionally