# FIRST 220 KV CITY CABLE FOR RETROFITTING OF STEEL PIPE CABLES

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## *ABSTRACT*

*In the end of the last decade the City Cable concept was developed in order to provide an easy replacement of old paper insulated pipe type cables by modern XLPE insulated cables. This concept gave the opportunity to use the existing "hole in the ground" for the reinstatement, herewith minimizing the amount of civil work and "social disturbance" caused by intensive construction works. In planning of high and extra high voltage cable system projects, civil work costs and the huge impact of civil works on the public life play an increasingly important role especially in strongly urbanized areas. In this publication the first commercial City Cable project in the voltage level of 220 kV will be presented.*

## *KEYWORDS*

City Cable; retrofitting; civil works, installation techniques, EMC requirements, RTTR

## INTRODUCTION

The City Cable system was developed to have the possibility of an easy replacement of old paper insulated pipe type cables by modern XLPE insulated cables.

The concept was to use the existing steel tubes and ducts for the new XLPE cable system and achieve a minimization of the civil works and therefore a minimization in costs, time and the disturbance of the social life especially in highly urbanized areas. This procedure is established as retrofitting.

Further improvements and development of XLPE materials allowed in the last decades the use of the City Cable systems for increasing voltage levels, so that in this publication the first three core retrofitted City Cable project for the Voltage level of 127/220 kV will be presented.

## HISTORY OF CITY CABLE SYSTEMS

The first City Cable system was developed for the 110 kV network [1]. The electrical stresses of the XLPE-insulation where aligned with those of a 220 kV single core cable and depending on the cross section of the cable chosen at approx. 10 mm.

The three core design (see fig. 1) was a well known technique as at that time paper insulated three core cable designs were a common technique, e.g. external gas pressure cables.

On the first City Cable system additional to the long term test a field test was performed to ensure the long term reliability of the City Cable system. This field test included a period of three years with a test voltage of $2U_0$. The test was conducted not only on the cable itself but also on a full set of accessories [2].

The three year load cycles were performed in a sequence, the first 360 cycles during the first year according to IEC, the second 360 heating cycles with a utility load factor of 0.7. During the third year the cable circuit was subjected to full load.

Subsequent to the three year test, the joint and the GIS termination had to withstand tests. The electrical field strength of the accessories after the three years test was not reduced to the initial electrical field strength and no signs of deterioration of these accessories were found.

As all these tests were passed successfully and lead to a commercial use of the City Cable technique. In total up to now approx. 100 km of City Cables have been installed.

In the later use of the technique the City Cable system was extended to higher voltage levels, as 87/150 kV, and in the system presented in this publication: 127/220 kV.

**Fig. 1: City Cable Construction (example)**