

NEW 400KV UNDERGROUND XLPE INSULATED CABLE SYSTEM IN UAE

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ABSTRACT

400kV 2500mm² XLPE insulated cables and pre-molded one piece joints have been applied to two circuits of 400kV transmission line between existing ADST Grid Station in Abu Dhabi Island and newly developed Al Reem Island Grid Station on Al Reem Island in UAE. For the 400kV cable system, temperature sensing and monitoring system based on Distributed Temperature Sensing technology has been provided. It is equipped with Dynamic Cable Rating software to evaluate the real-time conductor temperature and the allowable maximum load current of 400kV XLPE insulated cables. The 400kV power cable system was commissioned in December of 2009.

KEYWORDS

400kV XLPE insulated cable, Pre-molded one piece joint, Partial discharge measurement sensor, Distributed temperature monitoring system, Dynamic cable rating

1) INTRODUCTION

UHV (Ultra high voltage) power transmission infrastructures have been rapidly introduced and constructed in Persian Gulf countries, especially in United Arab Emirates (UAE), State of Qatar and State of Kuwait, in order to meet the steady increase of electric power demand. Abu Dhabi Transmission & Despatch Company (TRANSCO), a power utility company in Abu Dhabi, UAE, planned to site a 400kV Grid Station on newly developed Al Reem Island located near Abu Dhabi Island, and to install two circuits of 400kV XLPE insulated cable line for power transmission between Al Reem Island Grid Station and existing ADST Grid Station.

J-Power Systems Corporation has supplied 400kV 2500mm² XLPE insulated cables and their accessories, intermediate joints, SF₆ switchgear sealing ends, etc. and completed construction of the underground transmission line. For the 400kV power cable system, partial discharge (PD) measurement sensors were provided to each joint for PD measurement for commissioning test and future maintenance purpose. Furthermore Distributed Temperature Sensing (DTS) system composed of DTS cables, DTS unit, Control unit, etc. has been applied, which is equipped with Dynamic Cable Rating (DCR) software. Main feature of DCR software is provision of useful and practical information for maintenance of transmission line, e.g. calculation of conductor temperatures of 400kV XLPE insulated cables along whole cable route and evaluation of allowable maximum load current in a cable conductor under both normal load and emergency overload conditions. The 400kV XLPE insulated cable line was commissioned in December, 2009.

This paper reports the summary on construction of 400kV XLPE insulated cable system and describes the DTS system and DCR software provided to the cable line.

2) DESCRIPTION OF CABLE ROUTE

The 400kV XLPE insulated cable line is approx. 3km underground transmission line connecting ADST Grid Station and Al Reem Island Grid Station located in new development area, to which 400kV 2500mm² single-core XLPE insulated, lead alloy sheathed and HDPE outer sheathed cables have been applied. The transmission line consists of two circuits. Each circuit is composed of two major cross-bonded sections. For one major section (approx. 1.5km) of ADST Grid Station side, the Horizontal Directional Drillings (HDD) method was applied for water channel crossings and land crossing. Three HDPE pipes were installed in trefoil formation in HDD bore and a 400kV cables was pulled into each HDPE pipe. For another major section (approx. 1.5km) of Al Reem Island Grid Station side, the 400kV cables were basically installed in flat formation in concrete troughs which were filled with stabilized backfill material.

Main accessories for power cable line were twelve (12) sets of SF₆ switchgear sealing end and thirty (30) sets of pre-molded one piece joint.

For communication purpose, a 32-core fibre optic cable was installed to each 400kV cable circuit.

DTS system equipped with DCR software was installed in Al Reem Island Grid Station. Along the entire cable route, a DTS fibre optic cable was provided for cable temperature sensing and monitoring.

The 400kV cable system is summarized in Table 1 and 400kV cable route is outlined in Fig. 1.

Table 1: 400kV XLPE cable system

Nominal operating voltage	400kV
Highest voltage	420kV
Lightning impulse withstand voltage	1,425kV
Transmission capacity	1,000MVA per circuit
Route length (Cable length)	Approx. 3km (Approx. 18km)
Number of circuits	Two
Bonding system	Cross bonding
Laying configuration	-Trough sections: flat formation -HDD sections: trefoil formation
Number of joints	30 (15 per circuit)
Type of joints	Pre-molded one piece joint
Number of sealing ends	12 (6 per circuit)
Type of SF ₆ switchgear sealing end	Prefabricated sealing end, dry type