Recommendation of Pre-Qualification Test for the DC 500kV MI-PPLP cable

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ABSTRACT

Characteristics and insulating paper of MI PPLP cable are quite different from those of MI cables. Especially, because the 500kV MI PPLP cable is a new type of cable, KEPCO decided to carried out PQ test for MI PPLP cable. Load cycle tests, polarity reversal tests, and superimposed impulse tests are included in the test, and bending test and sidewall pressure test are added as mechanical preconditioning tests because MI PPLP cable basically is weak in flexural characteristics. Total test period is 180 days for the electrical test except for the superimposed impulse test.

KEYWORDS

MI-PPLP cable; PPL (Polypropylene laminated); PQ (Pre-Qualification); HVDC cable; Bukdangjin - Godeok

INTRODUCTION

Bukdangjin - Godeok HVDC Project

The aim of Bukdangjin-Godeok HVDC Project is tranmit electric power generated from power plants in South Korea's west area including Dangjin thermal plant to area in the capital, which lack power plants. It consists of two converter stations, Bukdangjin Station in Dangjin and Godeok station in Pyeongtaek, and ±500 kV HVDC transmission line between two converter stations. It is LCC (line commutated converter) bi-pole HVDC system and will transmit up to 3 GW of power.

Fig. 1: Bukdangjin – Godeok HVDC Project

The construction of the power transmission line will be carried out in two stages. First, the mono-pole system, including the neutral and the power lines, will be built by May 2020 in the first stage, and the power lines will be added in the second phase and the transmission lines will finally be completed with bi-pole system by December 2021.

The Bukdangjin-Godeok transmission line is the world's first transmission line installed underground in all sections with MI-PPLP (polypropylene laminated paper) cable, which consists of 24.7 kilometers inside the conduit, 4.3 kilometers inside the cable tunnel and 5.2 kilometers inside the underwater tunnel.

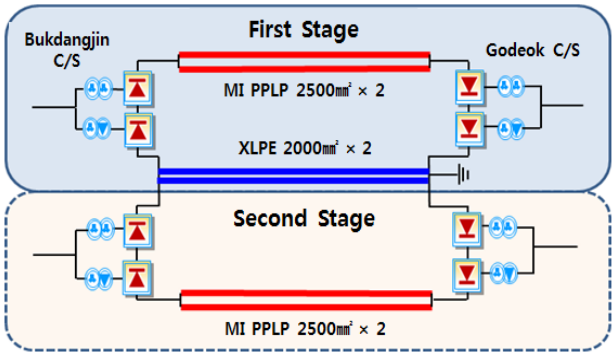

Fig. 2: Bukdangjin-Godeok HVDC System

Necessity of PQ test for the MI-PPLP cable

MI PPLP cables are structurally identical to conventional MI cables, but by using kraft paper with polypropylene film, unlike MI cables, the DC Breakdown strength is stronger than MI cables and the allowable temperature is higher, allowing more power to be transmitted.

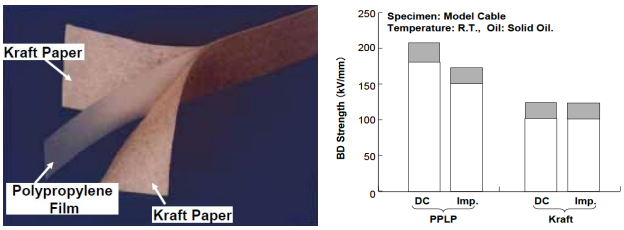

Fig. 3: Construction of PPLP(Left) and DC Breakdown Strength of Kraft and Film(Right)

The PQ test is a test that proves that a manufacturer can manufacture and deliver certain levels of EHV cable, and if the PQ test is successful, the cable is recognized for its ability to maintain long-term performance through over-voltage or thermal load cycle tests, and the manufacturer of the cable is recognized as a cable provider for the project.

Unlike type testing, there is no international standard for PQ testing for MI cables. However, the long-term operational performance of the 500kV MI cable can be considered to be highly validated because the 500kV MI cable has already been installed and operated in several HVDC projects since 1992.

However, since unlike MI cables, MI PPLP cables have never been installed and operated on a real grid worldwide, and insulation is different from MI cable's kraft, the type test alone cannot guarantee the long-term operation performance of the cables. Moreover, the Bukdangjin-Godeok HVDC project requires verification of long-term operation performance considering cable characteristics and installation environment, since MI PPLP cables will be installed and operated underground, including vertical cable tunnels, for the first time in the world.