# DEVELOPMENT OF TECHNOLOGY AND EQUIPMENT OF PREQUALIFICATION TEST FOR 500 kV XLPE CABLE SYSTEMS

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## *ABSTRACT*

*This paper presents the development of technology and equipment for prequalification test of XLPE cable systems for rated voltage of 500 kV. The series resonant test system with natural cooling can provide the continuous test voltage to test assembly. The current transformers with special slope hatch have been developed, and can be used in parallel connection to induce heating current in the test assembly. A specially designed needle sensor is stretchy fixed on the conductor with a certain pressure to measure the conductor temperature directly. A dummy loop and a test assembly are all used in heating period, and the system with hardware and software has been developed to monitor and control the conductor temperature. A specially designed impulse voltage generator has been developed to carry out impulse voltage test on the whole test assembly, and it is close to the actual operation condition. All developed systems have been successfully applied for more than 6 cable systems for rated voltage of 500 kV, these can ensure the quality of prequalification test, and meet the requirements of IEC standards.*

## *KEYWORDS*

Prequalification test, XLPE cables, series resonant test system, current transformer, impulse voltage

## INTRODUCTION

According to the requirements of IEC 62067: 2006[1] and GB/T 22078—2008[2] [3] [4], the prequalification test of power cables with cross-linked polyethylene insulation and their accessories for rated voltage of 500 kV ($U_m$=550 kV) shall be carried out in the following sequence: heating cycle voltage test, lightning impulse voltage test on cable samples or cable system and the examination of the cable system after the completion of the tests above.

For the prequalification test, there are a lot of difficulties. The first one is how to guarantee the long-term reliable voltage on test cable system. Secondly, it is difficult to install the sensor on the conductor because of the high voltage on it, so the problem is how to get conductor temperature. Thirdly, normally the hatch of current transformer is designed on the top or side, it is not convenient to install current transformer to test assembly, an easier way of transformer installation is needed. The fourth one is how to install temperature sensor on cable conductor of dummy loop. And finally, the cable of prequalification test is very long, and its capacitance is huge, so normally the impulse voltage generator can not meet the requirement of the test, the problem is which kind of impulse voltage generator can be used to carry out the impulse voltage test on the whole test assembly.

This paper presents the development of technology and equipment for prequalification test of XLPE cable systems for rated voltage of 500 kV. The technology and equipment in the lab is worked well, and these can guarantee the test quality.

## GENERATION OF TEST VOLTAGE

Because of the huge capacitance of test assembly, a series resonant test system is used to produce the needed test voltage. A picture of the 800 kV/30 A series resonant test system is shown in Figure 1.

**Figure 1 The 800 kV/30 A corona free series resonant test system at power frequency**

From the view of application, there are four advantages in using a series resonant test system:

(1) The waveform of the test voltage is optimized. Since the test voltage shall come into the resonant status and be magnified for *Q* times only at the frequency of 50 Hz, the voltage at other frequencies can not come into resonance or be magnified. Thus, the harmonic wave shall be minimized and the better waveform of the test voltage is achieved;
(2) The overvoltage of the test system is avoided. With several test assemblies connected in parallel, once one assembly broken down, the whole test system will be detuned promptly and no overvoltage would be applied on the other assemblies to cause breakdown;
(3) The breakdown path can be minimized. Once a breakdown occurred, the test system will short-circuit to the ground directly and the impedance of the adjustable inductance would be maximized. The short-circuit current and damage of breakdown path