

Development of Factory-Expanded Cold-Shrinkable Joint for 500kV XLPE Cable

Cold shrinkable joint (CSJ) has enabled easy assembly and simplified quality control on site compared to traditional ones. The main insulation rubber unit of CSJ, which is pre-expanded on special carrier pipe at factory, has advantage of shortening construction time. Therefore, CSJ has been becoming a mainstream over the world recently.

Particularly, the silicone rubber, the insulation material of CSJ, shows excellent electrical and elastic properties for long term operation. We have already supplied many joints up to 400kV class underground transmission lines. This paper describes development activities on challenging test conditions and 1 year prequalification test for 500kV CSJ.

The prequalification tests in accordance with IEC62067 with 500kV CSJ for 2500mm² Cu conductor XLPE cable was basically implemented under co-development with Tokyo Electric Power Company as shown in Table-1. However these tests included special conditions to meet with an extended consideration of requirement in JEC-3408. Hence, 105°C of conductor temperature, surge voltage and residual AC performance tests were carried out after loading cycle test. No defect was observed in the appearance test of disassembled CSJ.

Table-1 Results of the prequalification tests with special condition

Prequalification test IEC62067 for 500kV class		
Items	Conditions	Results
Loading cycle test	367 cycles Load condition * T _c = 90-95°C / 331 cycles * T _c = 105-110°C / 36 cycles Voltage condition 508 kV / 367 days	good
Lightning impulse voltage	±1550 kV / 10 shots ±1705 kV / 3 shots * T _c = 90-95°C	good
AC voltage	505 kV / 10 min at * T _a	good
Examination	Appearance check	good

* T_c = Conductor temperature

* T_a = Ambient temperature

To ensure the low-temperature environment performance of cable system, a special test with challenging condition was carried out for more than 30

Table-2 Results of the initial electrical test and the special condition test

Items	Conditions	Results
AC voltage	580 kV / 30 min	good
Lightning impulse voltage	±1550 kV / 10 shots	good
Loading cycle test	Loading cycle 10 times Cooling room temp. -30°C Cable conductor temp. 95°C Voltage condition 580 kV / more than 30 days	good

days with cyclic condition between -30°C (Cooling room temperature) and 95°C (dummy cable conductor temperature outside cooling room). Applied voltage was 580kV, which is in accordance with IEC-62067 type test condition. Table-2 shows the results of the loading cycle test with the initial electrical performance tests.

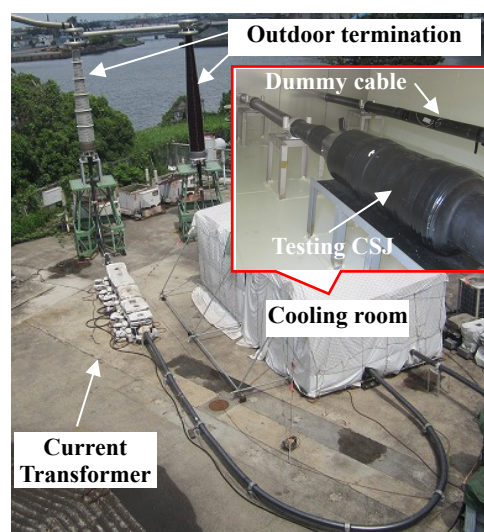


Fig.1 Loading cycle test loop for 500kV CSJ

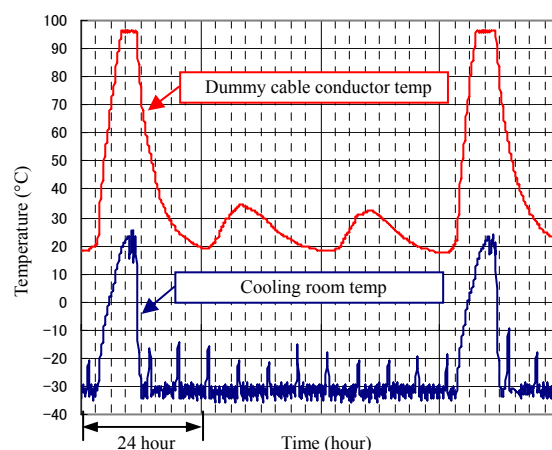


Fig.2 Example of loading cycle chart

The test results satisfied the requirements including special testing condition described above. CSJ has shown excellent performance to be applied in 500kV class transmission lines. CSJ is expected to be ready for 500kV class application in the near future.

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