Development of Y-branch Type Joint for 275kV XLPE and Fluid-filled Cable

Introduction
In case new substations are planned to be introduced in the urban area, π branched lines are generally employed to connect to the nearest existing transmission lines. In order to minimize the cost of the switching equipment and cables, 275 kV Y-branch joint (hereafter called “YJ”) was developed, which was so designed as to connect to not only the existing 275 kV XLPE cable but also the existing 275 kV fluid-filled cable. This newly developed YJ has been used in two actual commercial lines since 2002 and other three lines are under construction in Japan.

275kV YJ Construction
The construction of YJ is as shown in Fig.1. It consists of an epoxy unit, a pre-molded rubber-cone with a spring unit for the XLPE cable and oil-impregnated papers with an epoxy bell-mouth for the fluid filled cable. The cable conductors can be connected through multi-contacts, which are attached on each of conductor ferrules, to the electrode embedded in the epoxy unit.

The YJ has the following special features:
1) Large and Y-shaped cast epoxy,
2) With an embedded shielding electrode made of aluminum to minimize the weight.
3) Epoxy unit that can be used for not only fluid-filled cables but also XLPE cables.
4) Multi-contact conductor connection.
When only two cables are connected by YJ for temporary operation of the line, YJ can be put into service with the remaining mouth closed by an insulating plug.

Verification (Qualification & Type) Tests
Verification tests were carried out to confirm the performance of the YJ. The YJ’s initial and long-term electrical test results confirmed the long-life of over 30 years operation.
1) Epoxy Unit Specimen Test
   The heat-shock withstand test and the partial discharge test were carried out. All the test results were satisfactory and the large Y-shaped epoxy unit was proved to be manufactured without any defects.
2) Initial Performance Test
   To verify the initial performance of the assembled YJ, partial discharge test, AC and Impulse withstand voltage tests, and AC and Impulse voltage breakdown tests, etc. were successfully carried out.
3) Long-term Loading Cycle Tests
   A long-term loading cycle test for 6 months was successfully carried out with two circuits to verify the long-term performance of the YJ.

Conclusion
Through the initial electrical performance tests and a long-term loading cycle test, the developed YJ was verified to have sufficient electrical and mechanical characteristics for the 275kV transmission system.

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