

Development of 320kV subsea/underground HVDC extruded cable system

Naoto **SHIGEMORI** (1), Yasuhiro **SAKAI** (2), Hiroki **Mori** (1), Yukihiro **Yagi** (1)

- 1 VISCAS corporation, Ichihara, Japan
n-shigemori@viscas.com, h-mori@viscas.com, yu-yagi@viscas.com
- 2 VISCAS corporation, Hiratsuka, Japan
y-sakai@viscas.com

In recent years, high voltage direct current (HVDC) technologies have been focused in fields of grid interconnection, large capacity and long distance transmission, for example to islands and from offshore wind farms. HVDC transmissions can make their total costs lower than HVAC in longer distance use. A lot of applications of HVDC system have been reported all over the world, for example in use of long distance submarine transmission. However, oil filled or mass impregnated paper insulated cables have ever been conventionally used in such applications. Nowadays, extruded cables are preferred due to their advantage in load capacity, impact to environment and maintenance.

VISCAS has developed the original insulation material including the special conductive inorganic filler to XLPE. The material was named as "SXL-A". "SXL-A" has good electrical performances in not only space charge and volume resistivity but also breakdown strength. VISCAS has also developed pre-molded accessories made of ethylene-propylene rubber (EPR) as insulation material for HVDC system and has confirmed their excellent performance for DC electric field.

As for land cable system development, DC320kV prequalification test in accordance with CIGRE TB-496(VSC-compliant) was carried out. Tested cable had large size conductor (2500 mm²), "SXL-A" insulation layer. The test circuit, in length 190 m, consisted of 4 pre-molded joints, 2 outdoor terminations and 2 GIS terminations. In order to simulate an actual installation condition on site, pipe section, direct buried simulated section and tunnel simulated section were included in the circuit. Every load cycle tests and all of withstand tests after load cycle were successfully completed without any problem. In addition, DC320kV type test in accordance with CIGRE TB-496 (VSC-compliant) also was conducted. The test circuit, in length 60m, consisted of 2 pre-molded joints, 2 outdoor terminations. Every test sequences were successfully completed without any problem.

For sub-marine cable system, technologies of factory joint, land joint and repair joint and outer armoured cable are needed. In order to evaluate the performance of them, another 320kV type test was demonstrated. It was in accordance with CIGRE TB-496 (LCC compliant) and ELECTRA 189. The test circuit consisted of 1 factory joint, 1 land joint, 1 pre-molded joint as repair one, 2 outdoor terminations, 2 GIS terminations and cables. Cables including factory joints were applied to coiling test and tensile bending test before the construction of load cycle test loop. Every load cycle tests and all of withstand tests after load cycle regulated in CIGRE TB-496 were successfully completed without any problem. On the other hand, prequalification test using another test loop similar to the type test's

As an achievement of those development activities, VISCAS was awarded his first HVDC XLPE cable project in Sweden. Supply and installation of DC+/-300kV cable and the accessories are implemented in 2013-2014. Cable system with DC+/-300kV is higher level of rated voltage in the field of HVDC XLPE application.