

## DEVELOPMENT OF PRE-MOLDED ACCESSORIES FOR HVDC EXTRUDED CABLE SYSTEM

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### ABSTRACT

The high voltage direct current (HVDC) system has been applied for long-distance power transmission to reduce power transmission loss. Various accessories for HVDC extruded cable have developed and some have already been in actual service line. But for shortening construction time and easy assembling without sophisticated jointing skill, the pre-molded accessories which mainly consist of rubber insulation have been developed.

This paper introduces the newest technology based on the development of the pre-molded accessories, which have sufficient reliability to the HVDC system.

Furthermore, the prequalification test of the 320 kV HVDC system is now being conducted in accordance with CIGRE TB-219.

### KEYWORDS

HVDC, DC XLPE, cable, Pre-molded accessories, Pre-molded joint, GIS termination

### INTRODUCTION

With the recent increase in the electric power supply on a worldwide scale, the HVDC system has been more and more applied to long-distance power transmission for the improvement of power transmission efficiency. In recent years, XLPE cables have been developed not only for submarine power lines but also for land power lines because of the consideration for maintenance-free and environmentally friendly aspect.

Though cables up to 500 kV class have been already developed through long-term loading tests in Japan, the molded joints made of the same material as such cables are used for factory joint of submarine cables [1], and  $U_0=250\text{kV}$  pre-qualification test with some accessories, which is in accordance with CIGRE TB-219, is almost completed soonest. And as another example, a land joint has been introduced that requires special treatment such as electric-field control layers to secure stable insulation at the interface between the cable and the rubber [2].

Since rubber insulations are generally used for HVAC cables, we have conducted a series of various investigations and assessment tests of the pre-molded accessories. Making use of the superior insulation resistance properties and space charge properties of the above-mentioned DC XLPE material which is called SXL-A for short as own developed material [3], author et al. have conducted the basic study to investigate the excellent compatibility and combination with SXL-A and the materials used in pre-molded accessories, and examined the feasibility of the application to the HVDC system.

The space charge properties as well as the temperature and electric-field dependence of the DC insulation resistance are conducted as the basic study and also for the selection of DC insulating materials.

Next, the investigations on the maximum performance of the interface between the selected pre-molded component and the SXL-A insulation are implemented experimentally because such interface is considered to be the weak point in the insulation performance. Then, for assessing electrical performance of HVDC accessories, load cycle and polarity reversal tests of DC 200 kV class and DC 320 kV class are carried out respectively. These test results are described below.

### STRUCTURE AND FEATURE OF PRE-MOLDED ACCESSORIES

There are various types of accessories having different insulations. Here, Figure 1 shows the outline of a pre-molded joint (PMJ) as a typical example. The rubber unit is quality-controlled in the factory and can be easily assembled on a construction site. The edge of deflector is the region, where minimum electric field in cable insulation appears (hereinafter referred to as "Emin.-region"), that is likely to be a weak point as discussed below.

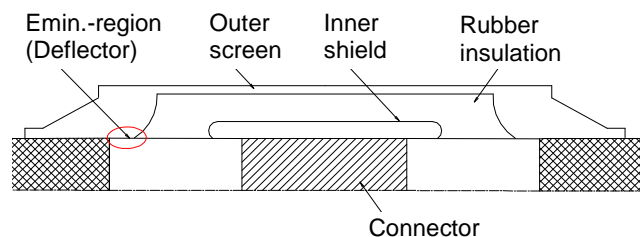


Figure 1: Pre-molded joint