A High Voltage Dry Type Outdoor Cable Termination

Sedat **ADILI**, Guoyan **SUN**, Andrea G. **NASSI**, Oldrich **SEKULA;** Brugg Cables (Switzerland), sedat.adili@brugg.com, guoyan.sun@brugg.com, andrea.nassi@brugg.com, oldrich.sekula@brugg.com.

ABSTRACT

This work presents a new concept of a HV dry type termination which is based on: a) existing technologies and materials with proven track record, b) combining electric field control methods from different HV products and designs which are established in the HV technology. The new concept brings benefits like, minimizing the product assembly time at site by maximizing the value addition in the factory and a fully routine pre-tested termination. In this paper we will show the principal idea, the main advantages, challenges and the key approach methods in the development of a HV dry type outdoor cable termination for any voltage level.

KEYWORDS

HV Cable Sealing End, Dry Type, HV Outdoor Cable Termination, Innovative High Voltage Design

INTRODUCTION

High Voltage (HV) outdoor terminations for polymer cables are important accessories for the interconnection between overhead and underground power transmission networks.

A common oil insulated outdoor cable end termination consist mainly of the following parts: an outdoor insulator (made of porcelain or a composite insulator with a GRP tube), a stress cone and the insulating fluid filling the void between the stress cone and the outdoor insulator inner walls (Figure 1). The use of an insulating fluid is suitable for low and as well as high voltages. Insulating fluids are generally good dielectric insulators. The dissipation of the thermal losses due to the cable current and then the dielectric losses, which are proportional to the voltage on the cable conductor, are mainly done by convection and conduction. This design is easy to produce at relatively low price and is suitable for all voltage levels.

Dry type cable accessories have many advantages, as compared to oil filled types, mainly for environmental and safety reasons. Besides the elimination of fluid insulation media and the necessary fluid expansion mechanisms, dry type solutions present undisputable additional advantages such as faster and easier installation, thus considerably reducing the outage time of power networks.

Cable accessories manufacturers have developed several concepts of a dry type high voltage (HV) outdoor cable termination, however, they have encountered physical limits at highest voltage levels [3 - 6, 10]. It has proved difficult to test a universal design which is scalable and can be built at a competitive price.

Generally, the development and market introduction of new HV Equipment based on new technologies and new concepts is rather slow. Customers are keen to trust more the proven technologies, which have a track record of functionality and reliability of 30 or 40 years.

New designs of a dry outdoor cable termination try to replace the insulating fluid with a dry or gel insulating medium. This works well, especially for voltages up to U_{max} of 170 kV. From U_{max} of 245 kV and higher (depending on the overall design, field control techniques, used materials, volume etc.) the physical limits of direct replacement of the insulating fluid are reached, mainly because of thermal runaway. Standard cable end terminations, Figure 1, with a stress cone use geometrical field grading. This makes them bulkier with relatively wide body diameters.

One way of reducing the thermal problems is reducing the overall diameter of the insulators. This requires new design and electric field control methods in order to reduce the thermal bulk volume and so cope with the dielectric losses of higher voltages up to U_{max} of 550 kV system voltage.

When developing a new HV apparatus there are commercial and technical aspects to be considered:

- The product requirements and market needs;
- Electrical and mechanical aspects: dielectric materials, type/prequalification tests, ampacity, seismic characteristics;
- New materials: unknown long-term behavior;
- Costs;
- Existing designs by competitors, patented designs (issued and granted);
- Customer acceptance.

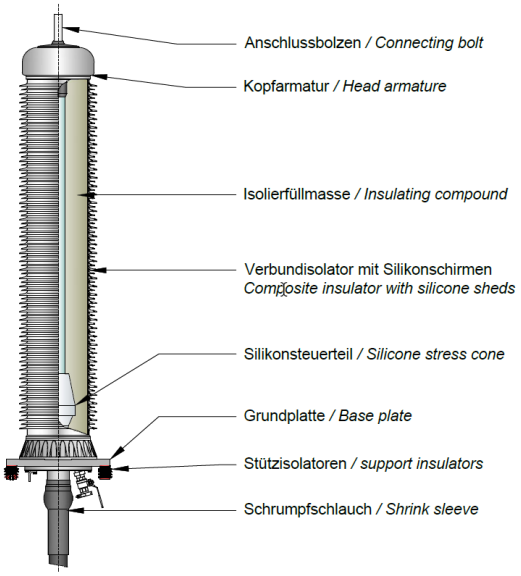

Figure 1. A typical oil filled cable termination up to U_{max} 550kV

Further market requirements on cable terminations, as well as generally for high voltage apparatus, can be summarized as follows:

- Easy on-site assembly;
- Protection & Security of personnel;