DEVELOPMENT OF EXTRUDED SINGLE CORE CABLES FOR DEEP WATERS

Mikael BERGKVIST, ABB Power Systems, (Sweden), mikael .bergkvist@se.abb.com
Ola HANSSON, ABB Power Systems, (Sweden), ola.hansson@se.abb.com
Marc JEROENSE, ABB Power Systems, (Sweden), marc.jeroense@se.abb.com
Claes SONESSON, ABB Power Systems, (Sweden), claes.sonesson@se.abb.com

ABSTRACT

*The installed amount of polymeric insulated HVDC cable has become impressive. Presently 1566 km cable has been installed since the start in 1999[1] with more than 5000 km*years.*
The first installations were land cables, but the latest projects, the Cross Sound, the Troll A[2] and the Estlink are submarine with 340 m as the record laying depth for extruded DC cables.
This paper will describe the development, including mechanical and electrical testing, of extruded cable systems for deep sea laying to support the commercial evolution of extruded high voltage cable technology. Special emphasis is put on the limit with conventional designs.

KEYWORDS

HVDC, polymer, cable, system, deep water installation

INTRODUCTION

The electricity networks of today increasingly need control and stability at high levels of loading. Due to restrictions in right-of-way or limits to acceptable short circuit currents, simply increasing the stability through adding more lines is not always an option. For these cases, HVDC transmission solutions using undergrounding through extruded cables systems offer unique advantages.

Other reasons for introducing HVDC Light® cable systems in the network are the bulk transport of power both at land and sea, the interconnection of different parts of network for stability or control reasons and the connection of remote loads as for example off shore oil-platforms.

Both underground and submarine projects have been realized using the HVDC Light® converter and the HVDC Light® polymer cable technique. The installed systems, so far, work on voltages of 80 and 150 kV. The installed powers have increased from the first project (Gotland) at 50 MW to the latest installed (Estlink) at 350 MW. At the moment of writing a total of 1566 km of HVDC Light® cable has been installed.

A gradual increase in both power and voltage is foreseen. For the larger powers, i. e. more than 3-400 MW, it is more suitable to use a higher transmission voltage. The next DC voltage that complies with AC system levels is 320 kV. This new voltage level opens a window of power transmission between roughly 400 and 1000 MW. In parallell to this we also see a need for larger installation depths.

DEVELOPMENT OF DEEP WATER CABLE SYSTEM

The development of the deep water cable system follows the same cautious philosophy as the development for higher voltages, starting at lower voltages and establishing limits of existing technology to build experience and ensuring a solid basis for further development. In this first stage reported here, we use an 80 kV cable system. As the same design concept is used for the higher voltage levels, we are able to extrapolate results from this testing to these.

Cable system

An extruded HVDC Light® sea cable links requires, apart from the cable itself, terminations, flexible factory joints as well as prefabricated land and repair joints.

Prefabricated Joint.
The electrical design of the prefabricated joint used for the land part is shown in Figure 1 below.

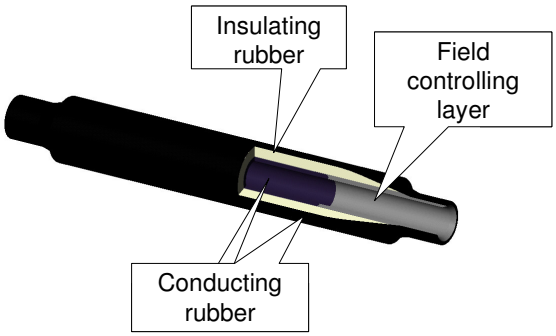

Figure 1. Electrical design of prefabricated joint.

The prefabricated joint consists of an EPDM insulated body, where a non-linear dielectric layer controls the electric field under stable DC as well as transient conditions. Over this layer, the insulating EPDM takes over the electric field from the cables. The final layer is a conducting layer of EPDM rubber that confines the field to the inside of the joint. A deflector of conducting rubber at high potential shields the field from the sharp edges of the conductor connection, not visible in the