Quality Control of HVDC Cables – The next industry challenge

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ABSTRACT

HVDC cable systems will see a large increase in manufactured quantity, voltage and power levels and grid criticality. With decreasing design margins due to higher stresses and temperatures there is a need for increased and additional Quality Assurance and Quality Control. This article describes in a logical manner the increasingly challenging industrial environment that leads to this conclusion. By comparing some historical HVAC facts, compelling suggestions are made for directions and areas of additional Quality Assurance and Quality Control methods.

KEYWORDS

HVDC, Quality Assurance, Quality Control

INTRODUCTION

The cable industry experiences a never witnessed level of grid investments, of which EHV cable systems are becoming a more and more significant part. Especially HVDC cable systems are increasingly requested in huge infra-structural projects. Climate change has been one of the major drivers of the increased pace of HVDC cable systems realization. And the prospects do not show a decrease, rather on the contrary.

This article will shed some light on the facts related to the increase in demand of HVDC cable systems and the unavoidable consequences in case the speed of driving the industrial vehicle is not sufficiently controlled by skilled chauffeurs.

The cable industry and all its stake holders have no choice and even a socio-economic responsibility (but) to answer on the increased demand. It will be argued in this article that an increased and inventive focus on Quality Assurance (QA) and Quality Control (QC) are one of the necessary actions in safeguarding the proper implementation of the huge amounts of high-tech cable systems with significant infrastructural value.

The proper QA and QC methods that are needed are best developed by cable manufacturers, because they have the deepest knowledge of the peculiarities of their newest products. Nevertheless, some important directions and idea's will be discussed in this article.

The article will focus most on extruded cable technology, but the general thoughts are not limited to that technology.

INCREASE

Several parameters in the HVDC cable industry are changing at an increasing pace. Four of them will be elaborated more in detail. These are yearly manufactured cable length, voltage and power, operating temperature and technology type.

Yearly manufactured length

The MI HVDC technology was commercially introduced for about 7 decennia ago, whereas the extruded HVDC technology saw the light of day in a commercial fashion for about 2 decennia ago. Ever since then the demand of the latter has been increasing. However, since about 2009 a trend-discontinuity is observed. The yearly amount of requested, contracted, manufactured and installed cable core has become significantly larger than before that date as shown in Figure 1. Within 2 decennia more than 10,000 km of extruded HVDC cable core has been awarded, a huge part of which that has been installed and is in operation.

Between 1997 and 2009 we can deduce an average cable core length per year of roughly 160 km per year. Whereas the number is about 1000 km per year for the years after 2009. A significant increase.

January 2018 ENTSO-E and Europacable have published a common document [1], summarizing the expected amount of cable for the next decade based on the Ten-Year Network Development Plan (TYNDP) 2016 including regional plans. The expected HVDC cable demand between 2017 and 2026, is reported more than 40,000 km, roughly 4000 km per year. This would mean another discontinuity in the yearly amount of cable to be contracted and manufactured: an even steeper increase. This number excludes the America's and Asia. For sure, we are facing an astonishing amount of future HVDC cable production and installation. The document mentions also the global HVDC cable production capacity and concludes that the manufacturing industry is capable of meeting the reported demand.

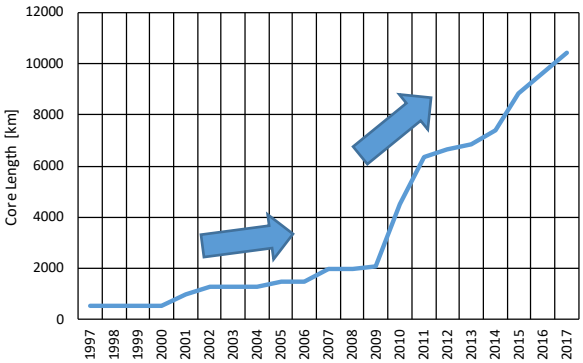

Figure 1. Global cumulative amount of contracted extruded HVDC cable core as a function of award year.

Voltage and Power

We have also faced a steep curve in the development of the extruded HVDC technology in terms of voltage and power. Figure 2 shows the voltages that have been established through full qualification according to CIGRE Recommendations and/or proven by commercial implementation. Starting from 80 kV (disregarding the 10 kV Hellsjön pilot project), the industry has now arrived at a voltage level of 525 kV that is now seen as a standard level. Even 640 kV has been type tested and PQ-tested [2]. Other