Expanding the performance potential of the universal cable system by the use of Dow ENDURANCE™HFDC-4202 EC water tree retardant crosslinked polyethylene insulation.

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Traditionally, electrical power distribution is divided between underground cables and overhead lines, where underground cables dominate in urban areas and overhead lines more common in rural areas. The design of the underground power cable or overhead line is very different. However the use of nkt's Universal Cable System is beginning to blur this difference as the Universal cable system has been shown to work equally well whether installed overhead on poles, or buried underground or even in a submarine environment. Clearly the advantage of using the same type of cable in multiple environments, lowers investment and maintenance costs while delivering a new and cost effective method for 12-36kV power distribution.

Identified problems for grid owners with overhead lines are e.g. falling trees, snow loaded trees and ice loads. Falling trees due to storms may cause permanent failure that must be addressed with high priority. Besides great expense, these incidents cause poor and hazardous working environment. Snow loads can make trees and branches come into contact with wires. These occasions generates heavy and time consuming workload, with long downtime as a result. Heavy ice and snow loads on electrical wires cause outage due to broken wires and joints. The Universal cable system is designed to withstand these natural phenomenons. Experience shows excellent performance compared to other existing solutions.

Recently nkt cables AB has produced Universal cable cores using Dow ENDURANCE™ HFDC-4202 EC (C-4202), the new enhanced performance water tree retardant crosslinked polyethylene (TR-XLPE) insulation from Dow Electrical & Telecommunications. The Universal cable cores have been subjected to the Cenelec 500 Hz wet ageing protocol at SINTEF, Norway. As shown in Figure 1 the 500 Hz test results demonstrated excellent retained breakdown performance of the cable cores with breakdown values well in excess of Cenelec requirements (6 cables > 18kV/mm or 6 > 14kV/mm, 4 > 18kV/mm and 2 > 22kV/mm).

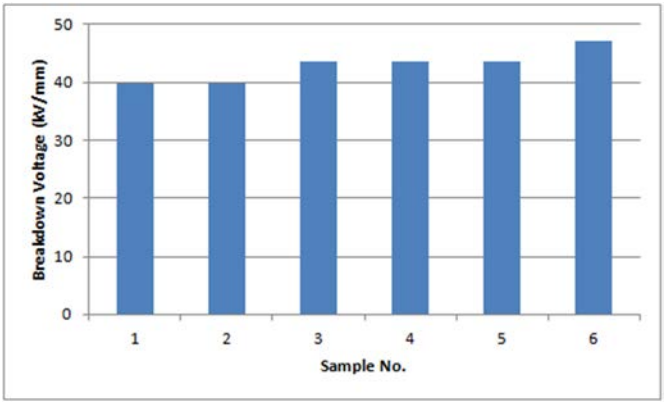

Figure 1: Retained breakdown voltage of nkt cable cores based upon Dow ENDURANCE HFDC-4202 EC following Cenelec 500 Hz accelerated wet aging test.

Cable lifetime data generated by Dow Electrical & Telecommunications confirms the excellent performance of medium voltage (MV) cables made with C-4202. Figure 2 shows time to failure data for full size 15kV MV cable subjected to the Accelerated Cable Life Test (ACLT) protocol. As Figure 2 illustrates, cables made with C-4202 show significantly increased time to failure and characteristic lifetime as compared to current commercial TR-XLPE insulation systems. The characteristic time-to-failure for MV cable with C-4202 is more than five times the existing commercial grade (HFDB-4202 EC); approximately 2,500 days versus 350 days. To date the new enhanced TR-XLPE insulation has experienced only one failure at more than 1,000 days.

Figure 2: 4,4 ACLT of 15kV medium voltage cable made with C-4202 (4.4mm insulation).

An additional benefit of using this high performance tree retardant insulation is that both bonded and strippable insulation shields can be employed with C-4202, offering cable manufacturers a broader design choice with a TR-XLPE system. In fact, easy strip semi-conductive insulation shields work exceptionally well with C-4202 insulated cables and nkt cables AB is able to employ this combination in Universal system cable cores.

This paper highlights the most recent developments in the design of Universal cable systems from nkt cables AB, Sweden. Furthermore, the high retained breakdown strength in the Cenelec 500 Hz test and the increased characteristic time to failure in the ACLT protocol, raises the possibility that cable cores made with C-4202 insulation can be considered in the design of higher voltage power cables or in reduced wall thickness insulation MV cable designs.

Key words: Universal cable, XLPE insulation, medium voltage cable, water tree retardant