Testing submarine cables for combined axial compression and bending loads

Andreas **TYRBERG** (1), Erik **ERIKSSON** (1), Jørgen **GRØNSUND** (2), Frank **KLÆBO** (2)

1 ABB AB, High Voltage Cables, Karlskrona, Sweden, andreas.tyrberg @se.abb.com, erik.x.eriksson@se.abb.com
2 MARINTEK, Department of Structural Engineering, Trondheim, Norway, jorgen.gronsund@marintek.sintef.no, frank.klaebo@marintek.sintef.no

Dynamic analyses are performed to verify that the structural integrity of a submarine power cable is maintained during an installation campaign. The analysis can be performed for different weather conditions with the purpose to establish the weather restriction of an installation operation. For dynamic cables, a dynamic global analysis is performed to establish the extreme and fatigue loads that will be applied to the cable during its service life. Since the dynamic cable is a permanent installation it is important to verify that the integrity of the cable is maintained even during the worst storm conditions. In the analysis, the curvature, torsion and tension of the cable is evaluated and the results are compared to the cable integrity criteria.

In the case of large vertical movements of the vessel or host platform, the cable can be subjected to axial compression, i.e. negative tension. There are currently no standards or recommendations which give guidance with regards to acceptable levels of axial compression in power cables, nor how to verify that the cable can sustain axial compression. Due to lacking knowledge, common industry practice is therefore to not allow axial compression.

For cable laying “zero compression” will often be the limiting criteria, thereby restricting the weather window of the installation operation. For a dynamic installation a zero compression integrity criteria can have a large impact on the feasibility of the configuration.

Excessive axial compression can result in birdcaging or buckling of the helical elements in the cable. The combination of compression and bending is assumed to reduce the compressive capacity of the cable. Testing on flexible pipes, with helical tensile wires, has shown that compression and cyclic bending, can trigger lateral buckling of the armour wires.

To verify that a power cable can sustain combined compression and cyclic bending loads, a test program has been performed in a new built full-scale rig specially designed for testing combined compression and bending loads. The loads used in the test program where established based on the extreme loads from the dynamic analysis.

This paper describes the new rig and the test program performed. The paper also gives background to the loads used in the test program and discusses the potential failure modes associated with axial compression.