Feedback on cable system testing from recent offshore projects

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ABSTRACT

1. Implementing tests throughout a project is crucial for quality control, especially for critical assets like submarine cable systems which are subject to significant stresses and loads during their lifetime. Compliance testing is an important stage to ensure the technological maturity of the materials and raise possible issues before starting mass production. Similarly, the manufacturing of such a system is a critical step of any HV cable project, especially for submarine cable production where handmade activities present quality assurance challenges. Repeating the tests across projects highlighted some of them as being particularly critical compared to the others, as they are more likely to fail.

The paper will focus on these different tests through the experience of a TSO during its various projects. The aim is to draw lessons and possibly good practices for the writing of technical specifications and standards, in the execution and control of critical tests.

KEYWORDS

Test; Testing methods; Compliance Test; Factory Test; Offshore; Quality

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INTRODUCTION

With the need to perform an energy transition, offshore windfarm projects became increasingly important to produce low-carbon power. From a grid point of view, these farms are remote production sites which need to be linked to the onshore electricity transmission network. To ensure the security of electricity supply, the linking material shall demonstrate sufficient operational quality; this can be partly done through the manufacturing and testing of the cable system. As windfarms go bigger and further away from the coast, this issue becomes more and more important with links being longer and longer and carrying greater amounts of energy. The installation of interconnections follows the same trend, with the same quality concerns.

As the French TSO, RTE (Réseau de Transport d'Electricité) will connect many offshore windfarms in years to come, with an objective of 50 offshore windfarms by 2050, as well as to connect by offshore links with neighbouring TSOs such as REE (Spain) or EirGrid (Ireland). With already three offshore windfarm links and two submarine connections with National Grid (England) installed, RTE proposes to share its experience and lessons to be drawn for future projects.

The experience put forward comes from AC applications. The study is a statistical one: all tests already done were listed with a distinction according to the test object. Three results were distinguished as well:

- Success: the test object perform successfully the test
- Remark: the test was finally accepted but one or several parameters were not deemed sufficient
- Fail: the test object did not perform successfully the test

The study focuses on the tests showing high rates of "Fail" or "Remark" results. Statistical results are not given.

The approach will go through the different tests done in a project lifetime, dividing them in three categories: the compliance tests, the factory tests, and the on-site tests. A final part will focus on the offshore specific issues.

I. COMPLIANCE TESTS

1. Range of approval

To ensure its capability to perform efficiently, a cable system shall pass compliance tests which represent the different constraints it will undergo during its lifetime: electrical and mechanical stresses, short-circuits, water-tightness, etc. These constraints link the cable system design to the project features, or to a variety of projects if the product is designed to be installed in a range of applications. Indeed, a cable system performing successfully tests representing a high level of constraints will as well be compliant for applications with lower levels of constraints. In the same way, a homothety can be done to qualify cable system whose design ensure lower constraints than the one tested.

In line with this approach can be defined the notion of range of approval, discussed in IEC 60840 and IEC 62067 §12.2. The range of approval designates all the cable system designs or applications validated through the completion of compliance tests on a single reference cable system design.

To give an accurate definition of what is considered less constraining, many parameters need to be defined, in line with the constraints mentioned above. Some parameters can easily be applicable from a design to another. A good example could be the water tightness: the water tightness (if needed) of a cable is ensured through one specific layer, in many cases the metallic sheath. Once a cable design has been tested successfully to ensure water tightness, it can be considered that all cable designs using the same metallic sheath design are also watertight in less or equally demanding applications.

An expensive part of compliance tests is the supply of the test loop. It is a part that cannot be, or in a very difficult way, reduced. Knowing that, it becomes clear that a prior thinking stage is necessary to set the parameters to perform compliance tests covering the largest panel of