Type testing of 150kV / 161kV cable system combining AEIC, ICEA and IEC test requirements

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In today's global HV and EHV power cable system segment, there are number of different standards and specifications for qualifying cables and cable accessories, and they usually come with different sets of testing requirements and relatively low level of harmonization between them.

In order to feasibly qualify the products by minimizing testing costs and time, manufacturers are increasingly trying to consolidate different testing protocols and optimize testing procedures. This process is often complicated and can result in much iteration as stakeholders such as independent testing laboratories and utility and industrial customers may have different interpretations of the requirements and its intended goals in regard to the performance of the individual components and cable system as a whole.

This paper explores one approach of consolidating testing requirements per US standard AEIC CS9 for cable systems, ICEA requirements for cables and international standard IEC 60840 in single test program, in order to qualify cable, accessories and cable system at 150kV / 161kV level and 105 deg. C emergency operating temperature.

Goal was to optimize testing protocol to capture all required tests and in the same time to customize test sequences in order to minimize lab time and eliminate unnecessary stressing of the cable system.

The selection of the cable conductor size and electric stress levels at conductor and insulation screen was such that would maximize range of type approval and demonstrate robust performance margins, as this is often additional requirement by many customers and end users.

Test program was performed in cable manufacturer's factory laboratories and was witnessed, inspected and certified by independent HV testing laboratory.

Testing loop consisted of 150kV XLPE cable with 2000 mm^2 segmental copper conductor, two outdoor terminations (one with porcelain and one with composite insulator), two dry type GIS terminations in horizontal arrangement in SF6 housing and one single-piece premolded rubber joint.

Big challenge was the fact that tests had to be performed at three different locations within the factory. The complete loop had to be moved 6 times between different laboratories with AC, PD, BIL and load cycling testing equipment and capabilities.

In particular, this paper will present:

- Overview of relevant standards with respect to their level of harmonization and discussion on different requirements for components (cables and accessories) and system as a whole.
- Customized test program that combine all three required specifications: AEIC CS9-06, ICEA S-108-720-2012 and IEC 60840:2011.
- Design considerations for cable and accessories in regard to desired goals of the program.
- Testing approach "test as you build", where set of initial tests are performed in each stage when new accessories are added to the loop, in order to mitigate the risk of installation errors.
- Design of special stands for cable accessories and SF6 housing to accommodate for movement of the whole loop between different testing locations.
- Design, planning and implementation of loop relocations.
- Results of the tests.
- Discussion on benefits of component approach - cable and cable accessories are designed and manufactured by different companies, each specializing in its area of expertise.