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Design of an adjustable-span test bench for studying fatigue of high-voltage clamp-conductor assemblies

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ABSTRACT

Aluminum Conductor Steel Reinforced (ACSR) are used to transport high-voltage electric power across long distances. In use, those cables suffer from fretting fatigue caused by wind-induced vibrations. Resonance test benches often serve in laboratories to simulate field conditions and study wire failure. Electromagnetic shakers generate vibration loads on standardized conductor length of 7 m. For some laboratories, testing shorter conductor lengths would be more practical. However, it seems that the current literature offers no specification to realize valuable fatigue tests on shorter conductor lengths. Therefore, the objective of this study is to evaluate the validity of fatigue tests realized with shorter conductor lengths, and to design a new fatigue test bench allowing adjustable test lengths and conductors of various diameters. The study aims to demonstrate that tests made on shorter lengths can generate internal load conditions and damages at conductor critical positions equivalent to those produced under the standard framework imposed by the IEC62568:2015 standard. The official standard defines the test conditions and parameters such as the excitation frequency range and the displacement measurement positions along the Y longitudinal axis. For example, one of the positions is at 89 mm from the Last Point of Contact (LPC) between the clamp and the conductor. To achieve its goal, the proposed research should first establish the internal load conditions at the critical positions of a conductor tested under the standard framework. The main hypothesis is that equivalent displacement at the standard 89 mm position from LPC should result in equal stress distributions and damage at the strand critical positions. The adopted procedure evaluates these stress distributions via Finite Element Analysis (FEA). This first step validates the model through comparisons with experimental results found in the literature. The second step establishes the force and power required for an electromagnetic shaker to generate a chosen displacement at the standard 89 mm position on reduced cable lengths. This part also determines the stress distributions. The third step completes the design of the Adjustable Span Test Bench (ASTB). Finally, after fabrication of the ASTB, tests should be conducted on well-documented cable configurations, and the obtained experimental results compared with those available in the literature to validate the reduced length strategy put forward.