Contribution ID: **121** Type: **Oral Presentation**

Vibration and Audible Noise Analysis of Power Capacitors with Constrained Damping Structure

Thursday 7 July 2016 11:00 (15 minutes)

In a HVDC converter station, filter capacitors, specifically the can-type capacitors, are the main noise sources after transformers and reactors. It is necessary to investigate the filter capacitor vibration and noise reduction measure. Capacitor current contains fundamental and high frequency harmonics, which cause high-frequency alternating forces on the internal capacitor element, lead to vibrations of the steel enclosure of the capacitor can and thus generate acoustic noise radiated as airborne sound. A new way to restrict noise is to consume the vibration energy and decrease the oscillating amplitude of capacitor enclosures. In this paper, a composite damping structure, composed of a base steel plate, a polymer damping material layer and a constraining plate in order, was set up to damp the vibration of the steel enclosures. The damping structures were equipped on the bottom surface of a can-type capacitor in the experiments, since most of audible noise came from the bottom. In experiments, fundamental voltage and several harmonics with harmonic number 9th , 11th, and 13th were applied on the tested capacitors to simulate the actual operating conditions. The vibration velocity of the composite damping structural capacitor was measured utilizing laser Doppler vibrometry technology. Tested capacitors were set in a semi-anechoic room, and sound level around the capacitors was measure by 24 microphones. Vibration and acoustic noise characteristics of composite damping structural capacitors were studied, comparing with regular ones. It was proved that the composite structure with constrained damping layer would efficiently reduce the vibration of filter capacitors and it had a better damping effect on high-frequency oscillation. And thickness of the constraining plate used in experiments had no evident effect on damping vibration, because the two plate acted as the same constraining component in the structure.

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Session Classification: Oral 6

Track Classification: Power Electronics and High Voltage