

# Design of Electrical Components for Earthquake and Airplane Impact Induced High-Frequency Vibrations Based on Enveloping the In-Cabinet Response Spectra (ICRS)

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## Abstract

Continued functionality of digital control systems and associated electrical equipment during and after an earthquake gained significant attention in recent years. Developments in the field of autonomous control systems have increased the importance of continued functionality for such electrical systems. Historically, seismic design and performance assessment of such devices has been based on earthquake ground motions recorded in the Western United States which typically contain frequencies below 10 Hz. However, it has been observed over the past decade that the ground motions recorded at nuclear power plant sites in the Central and Eastern United States (CEUS) have exceeded the design spectrum at frequencies above 10 Hz. The 1986 Northeastern Ohio Earthquake, the 2011 Mineral, Virginia earthquake, and most recently the 2016 Gyeongju earthquake in South Korea represent events in which nuclear power plants were subjected to high-frequency ground motions and various electrical systems tripped even though they were seismically qualified to continue operation during and after the earthquake. In the context of airplane crash (APC) impact loads, the significance of understanding the behavior under high-frequency vibrations is even greater because aircraft impacts typically excite high-frequency modes of building. These vibrations propagate from the impact location through the structure into electrical cabinets and can affect the functionality of safety-related electrical and I&C equipment (e.g., relays). In this research, we study the correctness and accuracy of the various aspects in generating in-cabinet response spectra (ICRS) for high-frequency floor motions induced by APC loads and seismic ground motions.