FORCED VIBRATION ANALYSIS OF 230KV AIR BLAST CIRCUIT BREAKERS: ENERGY DISSIPATION PARAMETERS CALCULATED FOR DIFFERENT EXCITATION LEVELS

by

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To better understand the mechanism of energy dissipation or damping in structures dynamic measurements and the corresponding analyses were performed on two structural systems each composed of 230KV air blast circuit breakers supported by a welded steel frame. The breaker systems are part of electrical switchyard equipment located at the A. D. Edmonston Pumping Plant on the California Aqueduct. The moderate size of the breaker systems permitted forced vibration excitation by an electro-magnetic shaker unit up to the 0.1g level. Both sinusoidal and bandwidth limited white noise forcing functions were used to excite the breaker systems. Accelerometers were used to monitor the vibrations and a mini-computer system aided in the on-site determination of Fourier spectra. The two breaker systems analyzed were identical with exception that one was modified by the addition of a mechanical damper at the base of each of the four columns of the support frame.

Results of the analyses include plots of damping values (i.e., expressed as the % of critical damping) with respect to the rms level of excitation (e.g., displacement, velocity and acceleration) for each first and second mode of vibration. For all modes of both breaker systems damping increases dramatically with an increase in the rms level of excitation. For a given excitation level the damping values associated with the modified breaker system are, on the average, over twice as large as those of the unmodified breaker system. For both breaker systems the plots of damping vs. excitation level vary greatly for different modes. However, similarities exist between the two breaker systems in the nature of the plots of damping vs. excitation level when compared for the same mode (e.g., second mode, torsion). Attempts were unsuccessful to identify the domain (e.g., displacement, velocity or acceleration) in which the plots of damping vs. excitation level for different modes would look most similar. The values of the damping terms for the modified structure appear related to the stress level of the dampers (i.e., more stress, higher damping).

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