Acoustical Problems with Electrical Equipment

When designing or procuring electrical equipment for a project, although your choice may be theoretically ideal, you also have to consider whether it will be too noisy or cause excessive vibration, rendering it inappropriate for the intended installation. Here are some common acoustical problems associated with transformers, motors and generator sets, along with effective mitigation measures.

Transformers

We have all heard electrical equipment "hum". Transformers are famous for producing this irritating noise. How is it caused? Within the transformer core, magnetostrictive forces produce a phenomenon known as *harmonics that* cause the core to vibrate at twice the electrical line frequency. The low frequency hum you hear is the sound of the tones produced by the harmonics. The transformer coil also contributes a small component of the overall noise. However, the most significant noise is produced by the transformer's cooling fans.

Motors

Motors have three main noise components: *mechanical*, *aerodynamic* and *magnetic* noise. Mechanical noise is caused by one or more of the moving parts of the motor. Aerodynamic noise is caused by the airflow through the motor. A "siren" effect can be caused by sudden interruption of the flow. And magnetic noise can cause the component parts of the motor to produce noise and structure-borne vibration.

Generator Sets

With generator sets, the most significant noise contributor is the engine, which produces low frequency tones and vibration. And just like transformers and motors, generator sets also produce magnetic and aerodynamic noise and vibration. The vibration is largely caused by mechanical imbalance. Large generators, 15,000+ kVA, are quieter because they are hydrogen-cooled and sealed units. Medium-sized generators, 10,000-15,000 kVA, are louder because they are air cooled, have thinner casings, and are not airtight.

Typical Mitigation Measures

There are several effective ways to approach noise mitigation for electrical equipment. Prior to purchase and installation, the simplest mitigation method is to request the quietest equipment available in the procurement specifications. After installation, there are other alternatives, including:

- Barriers with a minimum surface density of 4 lbs./sq.ft., no more than 10’ from the source, extending past the end of the equipment or flanking around it, and high enough to block the line of sight to the receiver. These typically provide about 8-10 dB of noise reduction.
- Partial enclosures, typically sound-absorptive barriers on four sides, minimum surface density of 4 lbs./sq.ft., no more than 10’ from the source, high enough to block the line of sight to the receiver, and with well-sealed access doors, provide about 10-12 dB of noise reduction.
- Full enclosures, with absorptive walls and roof, minimum surface density of 4 lbs./sq.ft., at least 6’ from the source, with well sealed access doors and all openings acoustically treated, provide at least 20 dB of noise reduction.
- Vibration isolation is achieved using resilient mounts of neoprene or compressed fiberglass, steel spring floor mounts, or restrained spring isolators.