Understanding Seismic Isolation and IBC Certification

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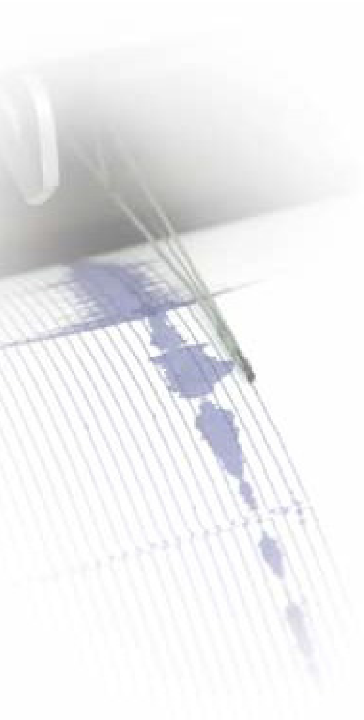

It is important for standby power systems to function after natural events including hurricanes and seismic events specifically earthquakes. Standby power systems located in regions where earthquakes are possible should be certified to function properly after a seismic event. Standby power systems are designed in various ways to achieve seismic certification. A critical element in designing for seismic loading is the mounting system.

There are two basic approaches in mounting – isolated or rigid mount. The first mounting method requires mounts, also called integral vibration isolators, to be placed between the engine/alternator and the skid. The skid is then rigidly attached to the ground. This integral vibration is built into the generator design, and certification is attained without additional isolation. Integral vibration isolators are made from rubber or neoprene. Systems designed with integral vibration isolators tend to be less than 1000 kW. In the other mounting method, rigid mount, the engine and alternator are rigidly mounted to the skid and mechanical coil springs (which are seismically rated) are required to be installed between the frame and the ground. These systems tend to be greater than 1000 kW. Specifying engineers and facility owners need to understand the seismic certification process and know the difference between systems tested with integral vibration isolators and others tested with the addition of coil springs. Understanding the design elements in place during seismic testing ensures proper specification and installation of standby power systems. Adding additional seismic isolation to standby power systems that were certified and designed with integral vibration isolators is unnecessary and can amplify the seismic vibration energy.

INTERNATIONAL BUILDING CODE (IBC)

Seismic certification is based on building standards represented in the International Building Code (IBC 2000, 2003, 2006, 2009 and 2012), which sets requirements for structures and ancillary systems, including standby power systems. All state and many local authorities have adopted a version of the IBC which is updated and released every three years. Most states have adopted the code at the state level, while other states have adopted versions of the code at the county level. While the IBC is not a federal government mandate, its adoption has been encouraged – and in some cases required – to ensure funding coverage by the Federal Emergency Management Administration (FEMA).

Generally speaking, the requirements for emergency power systems are the same regardless of which version of the code a state has adopted. In all versions of the code, critical equipment – including emergency power systems – must be certified with the same seismic standards as the building in which it is located. The IBC establishes design standards for power systems to survive a seismic event.

Figure 1. This seismically certified coil spring isolator is typically mounted between the generator skid and ground.

IBC CERTIFICATION

Many power system manufacturers use a combination of shake-table testing in accordance with ICC-ES Standards and mathematical modeling using computer programs to qualify their products for IBC certification. Tests are performed at a nationally recognized test facility while analysis is certified by an independent approval agency. These tests can verify the integrity of a power system design, and the results of both successful and noncompliant tests can be used to improve design. It is not always necessary to test every individual component. For example, several standby generators of similar construction can be grouped together, with only the worst-case configuration (mass, size, center of gravity) undergoing shake testing. Systems that are certified with integral vibration isolators do not require additional coil spring seismically rated isolators between the system skid and ground. In fact, addition of these items will void the certification.

INTEGRAL VIBRATION DESIGN INSTALLATION AND MOUNTING CONSIDERATION

A typical emergency power system consists of a skid, engine, alternator, fuel tank, transfer switch, enclosure, controls and associated engine cooling. Of equal importance to the design of the power system are installation and mounting to ensure that the components remain connected to the structure and to their foundations throughout a seismic event.

As stated earlier, mounting can be either isolated or rigid mount. In isolated mounting, the product built with isolators between the alternator/engine and the skid is fastened directly to a concrete pad. Often standby power system manufacturers design these integral vibration isolators into their smaller models sized from 25 to 1000 kW. All sets with integral vibration isolators should be rigidly attached to the ground. Be aware that the use of so-called “seismic isolators” between the tank or skid and concrete on systems that are built with integral vibration isolation will not protect the product during a seismic event. In fact, the use of additional isolators allows the product to move more and is actually counterproductive during a seismic event. Seismic certification for units with integral vibration isolation was completed without an additional coil spring

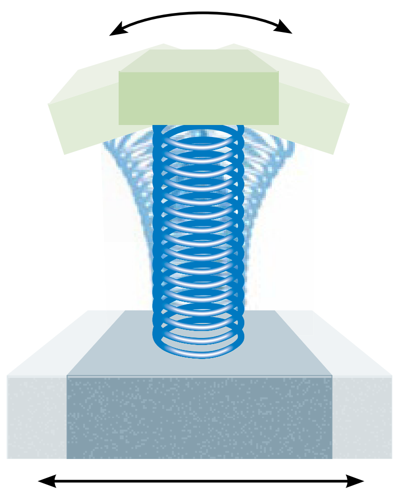

Figure 2. A model of a simple resonant system.


SEISMIC DESIGN OF NON-STRUCTURAL COMPONENTS AND SYSTEMS

KOHLER POWER SYSTEMS

CERTIFICATE OF COMPLIANCE

SAMPLE

Figure 3. Seismic Certificate of Compliance

isolator. There is no need to invest extra expense on additional seismic isolators for mounting.

For units that do not include integral vibration isolation mounts (often greater than 1000 kW), the product is mounted on seismically designed isolators, but the purpose of the "seismic isolators" is to reduce transmitted vibration from the generator set to the foundation during normal operation. They are only called "seismic isolators" because they carry ratings for seismic applications and are designed to survive a seismic event. With this said, adding seismic isolators to a non-certified unit will not make the unit seismic certified. The unit will still need to be seismic tested to be certified. These standby power systems greater than 1000 kW are often designed and seismic tested with certified coil springs.

Power system manufacturers supply installers with critical information about concrete pads, anchor requirements and mounting considerations for seismic installations. The installing contractor is responsible for proper installation for all anchors and mounting hardware. Understanding whether the standby power system is built with or without integral vibration isolators can ensure the application is installed per IBC certification assumptions.

CONCLUSION

Specifying engineers demand power systems that have undergone IBC seismic certification. Standby power systems with integral seismic isolation (often smaller than 1000 kW) pass IBC seismic testing without additional isolation. In fact, inserting additional isolation can result in the device moving more during a seismic event. Larger standby power systems designed without integral vibration isolation will require coil spring isolators that are certified. All power systems must be mounted in accordance to specifications from the manufacturer which match what was used in the certification process.

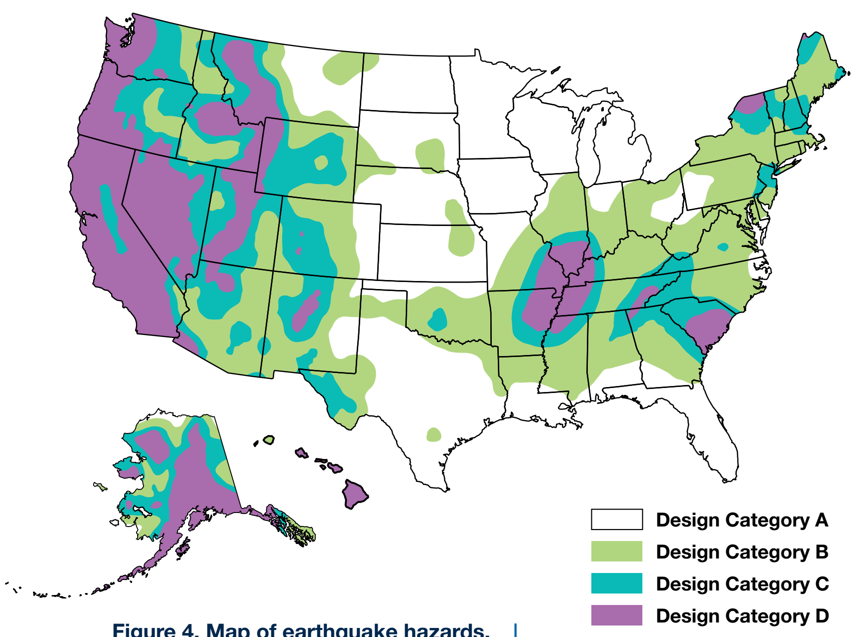

Figure 4. Map of earthquake hazards, reflecting various intensities

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ABOUT THE AUTHORS

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