AUTHORS
Luke Dykstra
Staff Engineer

Seismic Isolation and IBC Certification

INTRODUCTION

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 1600 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 skid and the ground or lift base. These systems tend to be greater than 1600 kW.

INTRODUCTION (CONTD)

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.

Figure 1: This Seismically Certified Coil Spring Isolator is Typically Mounted Between the Generator Skid and Ground.

INTERNATIONAL BUILDING CODE (IBC)

Seismic certification is based on building standards represented in the International Building Code (IBC), 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 standardsfor power systems to survive a seismic event.

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 or lift base. 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 1600 kW and below. 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 isolator. There is no need to invest extra expense on additional seismic isolators for mounting.

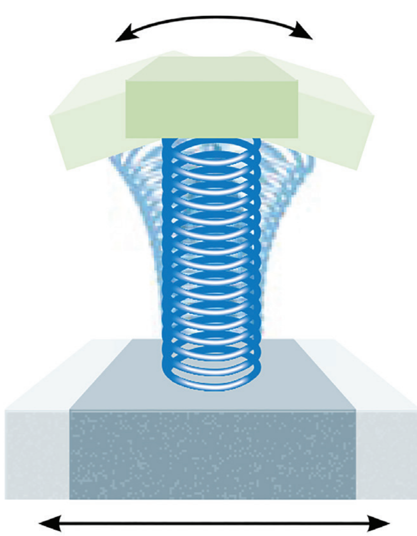

Figure 2: A Model of a Simple Resonant System.

For units that do not include integral vibration isolation mounts, 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 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.

VMC GROUP
THE POWER OF TOGETHER
rehlko

CERTIFICATE OF COMPLIANCE
SEISMIC DESIGN OF NONSTRUCTURAL COMPONENTS AND SYSTEMS

IBC CERTIFIED VMC GROUP

Certification No.
VMA-51700-01C (Revision 4)

Expiration Date: 12/31/2027

Certification Parameters:
The nonstructural products (mechanical and/or electrical components) listed on this certificate are CERTIFIED[1] FOR SEISMIC APPLICATIONS in accordance with the following building code[2] releases.

IBC 2018, 2015, 2012, 2009

The following model designations, options, and accessories are included in this certification. Reference report number VMA-51700-01 as issued by VMC Group for a complete list of certified models, included accessories/options, and certified installation methods.

Kohler; Gaseous Engine Generator Set
KG40-KG200; 40kW-200kW

The above referenced equipment is **APPROVED** for seismic application when properly installed[3], used as intended, and contains a Seismic Certification Label referencing this Certificate of Compliance[4]. As limited by the tabulated values, below grade, grade, and roof-level installations, installations in essential facilities, for life safety applications, and/or of equipment containing hazardous contents are permitted and included in this certification with an Equipment Importance Factor assigned as I_p=1.5. The equipment is qualified by successful seismic shake table testing at the nationally recognized Dynamic Certification Laboratories under the witness of the ISO Accredited Product Certification Agency, the VMC Group.

Certified Seismic Design Levels			
Certified **IBC**	**Importance $I_p \le 1.5$** Soil Classes A-E Risk Categories I-IV Design Categories A-F	z/h ≤ 1.0	z/h = 0.0
		$S_{DS} \le 2.000$ g	$S_{DS} \le 2.000$ g

Certified Seismic Installation Methods
Rigid Mounting From Unit Base To Rigid Structure

HEADQUARTERS
113 Main Street
Bloomingdale, NJ 07403
Phone: 973.838.1780
Toll Free: 800.569.8423
Fax: 973.492.8430

CALIFORNIA
180 Promenade Circle
Suite 300
Sacramento, CA 95834
Phone: 916.634.7771

TEXAS
11930 Brittmoore Park Drive
Houston, TX 77041
Phone: 713.466.0003
Fax: 713.466.1355

thevmcgroup.com

ADVANCED ANTIVIBRATION COMPONENTS
DCL DYNAMIC CERTIFICATION LABORATORIES

102S-103387 Rev18

Page 1 of 3

Figure 3: Seismic Certificate of Compliance.

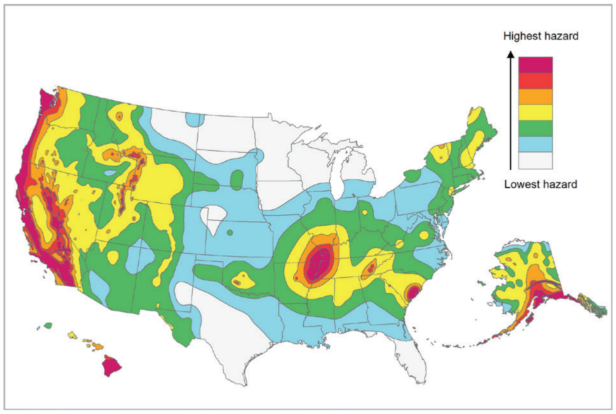

Figure 4: Map of Earthquake Hazards, Reflecting Various Intensities.

CONCLUSION

Specifying engineers demand power systems that have undergone IBC seismic certification. Standby power systems with integral seismic isolation 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.

ABOUT THE AUTHOR

Luke Dykstra is a staff engineer and holds a bachelor of science degree in mechanical engineering from University of Wisconsin-Platteville. Luke joined Rehklo in 2013 as a manufacturing engineer, then managed the custom generator solutions team, and is currently on the structural Finite Element Analysis (FEA) team. His primary focus in on finite element modeling, non-linear, seismic, and fatigue simulations. He also specializes in IBC and ICC matters. Prior to Rehlko he did non-linear simulation on lattice crawler cranes.

ABOUT POWER SYSTEMS

Power Systems, Rehlko's largest division, delivers worldwide energy solutions designed to ensure resilience for mission-critical applications of all sizes. Building on more than a century of expertise and dedication, the company offers complete power systems, including industrial backup generators (HVO, diesel, gaseous), enclosures, hydrogen fuel cells systems, automatic transfer switches, switchgear, monitoring controls, genuine parts and end-to-end services. As a global company with service partners in every country, Power Systems provides reliable, cutting-edge technology to keep industries and businesses running.
www.powersystems.rehlko.com

ABOUT REHLKO

A global leader in energy resilience, Rehlko delivers innovative energy solutions critical to sustain and improve life across home energy, industrial energy systems, and powertrain technologies, by delivering control, resilience and innovation. Leveraging the strength of its portfolio of businesses – Power Systems, Home Energy, Uninterruptible Power, Clarke Energy, Heila Technologies, Curtis Instruments, and Engines, and more than a century of industry leadership, Rehlko builds resilience where and when the grid cannot, and goes beyond functional, individual recovery to create better lives and communities, and a more durable and reliable energy future.

rehlko