1. What are the differences between IBC 2006 and previous versions?

The IBC-2000 and 2003 primarily addressed critical equipment being certified to be able to withstand certain seismic design loads of a given project. Critical equipment needs to be certified through independent analysis or testing to prove the equipment will remain operational after a seismic event. The 2006 version of the code does not limit the online functionality of critical equipment to only seismic events. It implies equipment should remain operational after other natural events such as wind.

The U.S. Geological Survey (USGS) also changed some of the values of the mapped short period response spectra (Ss) throughout the country. In some areas some values went up in others they went down.

The biggest changes to the code occurred in the 2006 version where factors such as the Response Modification Factor (Rp) and Amplification Factor (ap) changed. This has caused the calculation for the seismic design force to increase dramatically for engine generator sets.

2. What is an approved agency?

An approved agency is a company recognized as having the capabilities of performing certain types of testing and/or analysis or inspection services. The definition of an approved agency is outlined in chapter 17 of the code. An approved agency must be independent, must have adequate equipment to perform testing and must employ competent personnel educated in conducting, supervising and evaluating the testing.

3. What is the role of an approved agency in IBC certification?

In the IBC 2000 and 2003 versions of the code, approved agencies need to be employed to do the actual testing and analysis. The agencies guarantee through independent review and analysis that equipment will meet the specified design standards. The manufacturer of certified equipment must supply equipment labels indicating the agency that has certified their product. The 2006 version of the code implies that manufacturers can "self-certify." However, when labeling of equipment is required, it still needs to carry the designation of an approved agency.

4. Is using seismic isolators for equipment installation enough for IBC compliance?

The use of seismic isolators does not mean the equipment is IBC compliant. The confusion with seismic vibration isolators is that people often refer to them as "seismic isolators." This term infers that their intended function is to isolate or reduce the effects of a seismic event. A seismic vibration isolator ***is not*** designed to reduce these harmful effects. At best, properly designed seismic vibration isolators ***will not amplify*** the effects of the earthquake into the system; however, they will transfer the seismic forces from the building structure into the equipment. This is the very reason that equipment manufacturers are analyzing and testing their equipment to meet certain seismic design forces. If seismic vibration isolators actually *reduced* the g-levels into equipment, the building codes would require everything to be "seismically isolated" rather than be designed to survive the effects of an earthquake.

Seismic vibration isolators do have a function when it comes to a properly designed seismic system. When vibration isolation is required on a project to minimize the harmful noise and vibration created by a

generator set from entering the building structure, then seismic vibration isolators are required in seismic areas of the country. A properly designed seismic vibration isolator will reduce the noise and vibration emanating from the equipment during normal operation and will also keep the equipment properly attached to the building structure in the event of an earthquake. This style of vibration isolator must be captive in design and constructed to handle the overturning moments of the generator set when a seismic design force is applied to the center of gravity of the equipment. The design should incorporate no more than a ¼" gap in the horizontal directions and a snubbing device to minimize the amplification of the earthquake forces into the equipment.

If vibration isolation into the structure is not a concern of the design engineer, then the requirements for the project should only be proper attachment to the building structure. This includes analyzing the resulting overturning forces of the generator set based on the seismic site conditions of the project and then properly selecting an anchorage that can handle these forces.

5. What are the seismic design requirements on equipments for different seismic zones?

It is important to note that all former "zones" defined in UBC code have gone away. Design professionals must now reference Ss value mapped by the U.S. Geological Survey to define seismic requirements for a certain project. In order to determine what is required for a project, site specific factors such as soil profile, occupancy category, and equipment importance factors (Ip) must also be considered.

There are ONLY TWO importance factors given to a piece of equipment and they are a 1.0 or 1.5. An importance factor of 1.5 means equipment is required to function after a seismic event and the manufacturer must verify that it has been analyzed or tested in accordance with the ASCE 7 (American Society of Civil Engineers, Standard 7). This verification comes through supplying a certificate of compliance during the submittal stage and proper labeling of the equipment. If the structural engineer has designated the project as a Seismic Design Category C, D or F and the specifying engineer has given the equipment an Importance Factor of 1.5, then the manufacturer must supply a Certificate of Compliance and must also supply product labeling.

6. What types of equipment are required to meet IBC design standards?

The International Building Code says that any equipment required for the continued operation of buildings in Seismic Design Categories C, D or F need to comply with the certification requirements of the code. The certification requirements being that the equipment has been tested or analyzed and will continue to function after the specified design forces for the project. This is not just limited to a generator set. All the ancillary equipment that is part of the system is also affected if its failure could impair the performance of the generator set. For example; remote radiators, silencing equipment, remote battery chargers, sub-base fuel tanks, and day tanks would also be required to meet the online and functional performance standards of the IBC.

7. What level of Richter scale does IBC require on equipments attached to a building?

There is only a vague correlation between the Richter scale and the design criteria for equipment set forth in the IBC. The Richter scale is a measurement of seismic energy that is used to compare the size of earthquakes. Specifying engineers and structural engineers should not be referencing the Richter scale in equipment specifications. Instead, they should reference the Mapped Spectral Accelerations for Short

Periods (designated as Ss in the code book) as the ground acceleration criteria to be used for calculating the seismic design force on a building and its equipments. The Ss value can be determined by using maps provided by the US Geological Survey (USGS) or using software downloaded from USGS website. Additionally, the seismic design force applied to buildings and equipments is also dependent on the soil factor as well as the height within the building where the equipment is being installed.

8. Does the design requirement vary for below grade, grade level, and rooftop application?

Yes. The seismic design forces applied to a piece of equipment vary depending on the location in a building. The seismic design force for a piece of equipment installed on the roof is 3 times greater than the same piece of equipment installed at grade. For equipment installed within a building, the seismic design force is a ratio of the installed height in the building to the overall height of the building. It is important to note that a piece of equipment may be certified to use on a project where the installation is at grade but that same equipment would not be suitable for the same application on the rooftop.

9. Who is responsible for IBC compliance?

The code clearly states that it is the responsibility of the engineering community, design team managers, equipment suppliers and manufacturers, code enforcement officials and installing contractors to ensure that a project complies with the requirements of the IBC Code.