MODUTEC
Simplifying Panel Building

SEISMIC TEST ON SWITCHGEAR PANELS

Electrical panels are widely used in power control systems. Electrical panel is a housing for many protections, measuring and control equipments like relays, meters, circuit breakers, logic device, etc.

Seismic load should be one of criteria for selection of electrical enclosures. Seismically qualified Electrical panel ensures proper functioning and safety of equipment installed in it during and after seismic event. Electrical enclosures should not amplify seismic waves and should withstand seismic load without undergoing any physical failure.
In our country, the best would be to test the panel for Indian Seismic Zone V (as per IS:1893 – Part 1)

However, Zoning varies from country to country. In most countries in Europe (including Germany), the zones range from 0 to 3 but up to five zones might be categorized. This is further complicated by the lack of uniformity between the national standards that define the zones (See Table 3).

Thus, it is not possible to draw a simple comparison between national standards. However, classifying earthquake zones is important when it comes to delivering earthquake resistant systems, as the appropriate measures – incurring additional costs – need only be taken in high-risk areas.

Country	AUSTRIA	GERMANY	SWITZERLAND	FRANCE	ITALY * for Italy, the zones are ordered in the opposite sequence.	GREECE	USA
Standard	ÖN 1998-1	DIN EN 1998-1	SIA 261	NF EN 1998-1	OPCM 28	GNA 1998-1	1997 UBC
Zone 0	a < 0.035 g	0.0 g					0.0 g
Zone 1	0.035 g < a < 0.05 g	0.04 g	0.06 g	a < 0.07 g	a < 0.05 g	a < 0.16 g	0.075 g
Zone 2	0.05 g < a < 0.075 g	0.06 g	0.1 g	0.07 g < a < 0.11 g	0.05 g < a < 0.15 g	0.16 g < a < 0.24 g	0.15 g
Zone 3	0.075 g < a < 0.1 g	0.08 g	0.13 g	0.11 g < a < 0.16 g	0.15 g < a < 0.25 g	0.24 g < a < 0.36 g	0.3 g
Zone 4	0.1 g < a		0.16 g	0.16 g < a < 0.3 g	0.25 g < a < 0.3 g		0.4 g

Table 3: Ground acceleration in Europe and the USA

OVER VIEW OF CURRENT APPLICABLE STANDARDS

Three specific sets of standards are particularly relevant to switchgear systems and other electrical engineering and information technology infrastructures – DIN EN/IEC 60068-3-3, IEEE 693 and Telcordia GR-63-CORE. Other standards, for example from the construction industry, are generally not relevant to switchgear production. It can be assumed that structural engineers will ensure compliance with these standards. Only the interface between construction and electrical engineering – where the building and enclosure meet – plays a certain role. This means that references to the respective building standards also appear in various standards.

DIN EN/IEC 60068-3-3

IEC 60068-3-3, identical to DIN EN 60068-3-3 [Beu93] in Germany and Europe, is primarily a guideline for checking electrical devices for seismic resistance. The standard distinguishes between a general and a specific seismic class. The specific seismic class should be used where knowledge of the seismic movement exists based on the local geographical situation or the building in which the device is to be installed.

IEEE 693

The 693 [IEE05] standard issued by the Institute of Electrical and Electronics Engineers (IEEE) specifies the parameters for earthquake-resistant switchgear. It defines the test methods for complete switchgear systems and for individual components such as power circuit-breakers. Besides test methods, the standard also contains guidelines for designing earthquake proof switchgear. These guidelines relate, for example, to buildings, foundations and how enclosures are anchored to the floor. Thus, reference is also made to building standards in this document.

Telcordia GR-63-CORE

Although the GR-63-CORE [Tel02] generic requirements originally developed by Bell core – now Telcordia – for telecommunications are not a formal standard as such, they form a very commonly stipulated requirement in contracts, especially in the United States. The basic premise is that systems – such as data centers – need to offer a high level of structural resilience under exposure to various influences such as moisture, fire, pollutants and earthquakes. The document refers to the designated zones in the United States (zones 0 to 4), where zone 0 represents a very low risk and zone 4 a high risk of earthquakes (see tab. 3). In order to ensure high system availability, the requirements in zone 4 are correspondingly higher than in zone 0. These requirements are very high and can therefore also be found in other standards (e.g. IEC 60068-3-3, DIN EN 61587-5 (RRS for uniaxial acceleration), ETSI EN 3

Scope and limitations of the analysis

Analysis is one of the methods recommended by Standards for Seismic qualification of electrical panels. However, it is very complex to simulate the mass of equipment,

connections & joints adopted in the fabrication of cabinet in the mathematical modelling and finite element analysis.
By analysis it is not possible to check the loosening of fasteners. Unless preliminary tests are conducted the damping values of the cabinet cannot be evaluated.
Damping value is one of the important design parameters required for analysis. It is preferable to qualify the panel for earthquake loading prior to mounting sensitive equipment like protection relays, measuring instruments etc., to prevent premature failure during seismic testing of panels with all the equipment mounted