SEISMIC
Qualification Certificate

Delivered on: **Monday, February 12nd 2018**

References:

- **VIRLAB** test procedure number **141128E3**, issue 1, dated 02/12/2014: *STANDARD TEST PROCEDURE FOR THE SEISMIC QUALIFICATION OF "TWO DISTRIBUTION SWITCHBOARDS SYSTEM PRO AND POWER" ACCORDING TO IEEE Standard 693-2005 and EUROPEAN STANDARDS EN60068-3-3:1993 AND EN60068-2-57:2000***"**
- North American standard **IEEE-693/2005**: "*IEEE Recommended Practice for Seismic Design of Substations*".
- European standard **EN 60068-3-3/1993**: *Environmental testing – Part 3: Guidance. Seismic tests methods for equipments.*
- European standard **EN 60068-2-6/2008***: Environmental testing – Part 2: Tests – Fc: Vibration (sinusoidal).*
- European standard **EN 60068-2-47/2005**: "*Environmental testing - Part 2-47: Tests. Mounting of specimens for vibration, impact and similar dynamic tests*".
- European standard **EN60068-2-57/2000**: "*Environmental testing - Part 2-57: Test Ff: Vibration - Time-history method*".
- TURKISH SEISMIC CODE, edition 2007.
- REQUIRED RESPONSE SPECTRA applicable to "YATAY" and "DIKEY" sites (*TURKEY*).

Laboratory Name: **VIRLAB, S.A. (**accredited by ENAC, Spanish National Accreditation Entity**).**
ENAC certificate number 54/LE131.

Laboratory Address: Polígono Industrial de Asteasu, Zona B - 44
Apartado 247
20159 ASTEAU (SPAIN)

Equipment tested: A **DISTRIBUTION SWITCHBOARD,** manufactured by **ABB SACE ADB (Italy)**, according to drawing number 862553, revision 0, dated 06/11/2013, with the characteristics described here below**:**

- ***Name of the Switchboard:*** Conf.4 3200 A
- ***Family:*** system pro E_Power
- ***Protection degree IP:*** 65
- ***Icw máx (KA):*** 100

- ***Segregation form:*** 4B
- ***Ue (V):*** 436
- ***Overall size HxLxP (mm):*** 2214x2008x816

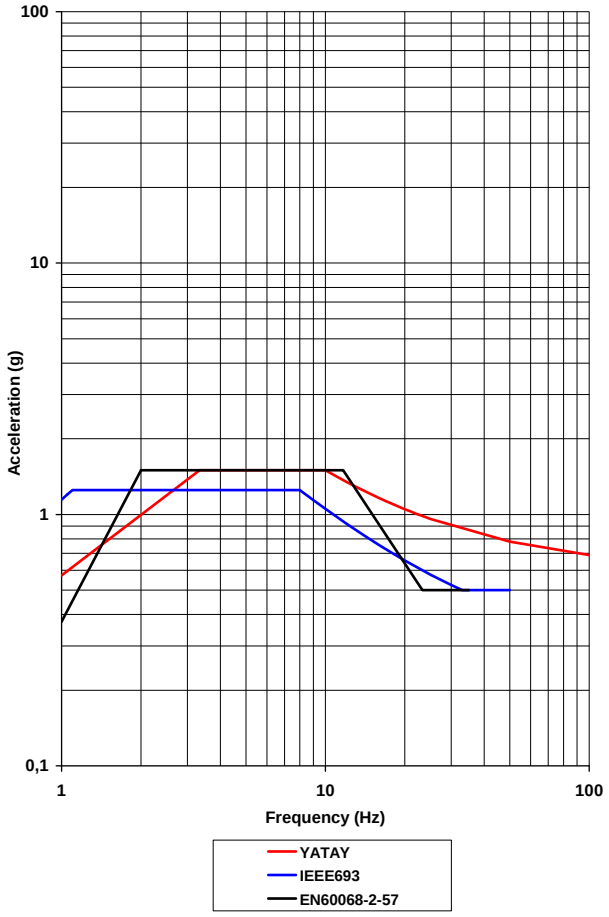
Picture included here below shows the **Switchboard** on the test platform EDB250x250 (*2500x2500 mm*), before starting the tests.

VIRLAB, S.A. certifies that the referred ***Switchboard*** has been seismically tested in January, between the 20'th and the 21'th 2014, according to test procedure number **141128E3,** Issue 1, of VIRLAB, elaborated in agreement with **IEEE Standard 693-2005** and ***European Standards* EN 60068-2-57:2000, EN 60068-3-3:1993**, **EN 60068-2-6:2008** and **EN 60068-2-47:2005.**

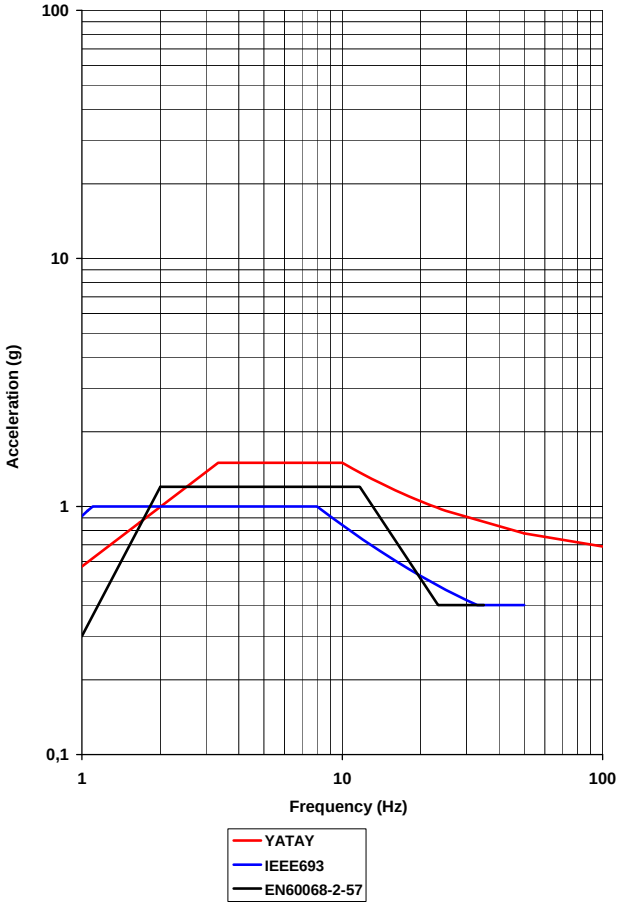
This equipment has been initially submitted to seismic tests with the envelope of the "***High Required Response Spectrum, 0.5 g***" of the American Standard **IEEE-693:2005**, the **EN60068-2-57: 2000 (*Category 1, ZPA=0.5 g*)** and the **YATAY** required spectra**,** that considers a Zero Period Acceleration, ZPA, of **0.5 g** in horizontal direction and **0.4 g** in vertical direction for the **IEEE-693:2005** and the **EN60068-2-57: 2000** standards; and of **0.69 g** in horizontal and vertical direction for the **YATAY** site.

So, the envelope of the three referred spectra presents a ZPA (*Zero Period acceleration*) of **0.69 g** in both horizontal and vertical direction, corresponding to the **YATAY** site.

Here below are included the referred levels, defined as spectra of level S2 according to standard **UNE EN 60068-3-3,** drawn for the 5% of damping.



S2 HORIZONTAL (5% Damping)



S2 VERTICAL (5% Damping)

The horizontal ZPA (*Zero Period acceleration*), **0.69 g**, is higher than the corresponding to the AG5 "*Ground Acceleration Reference*" defined in Table 3 of point 8.2.4 of European standard ***EN 60068-3-3,*** value calculated, as it is described in point 8.2.7 of the referred standard, as follows:

- $a_f = a_g \times K \times D = 0.5 \times 1 \times 1 = 0.5$ g, being

a_f (floor acceleration);
a_g (ground acceleration) = 0.5 g (*Table 3 of EN 60068-3-3: 1993*);
K (*amplification factor*) = 1 (*Table 4 of EN 60068-3-3: 1993*);
D (*direction factor*) = 1 (*Table 5 of EN 60068-3-3: 1993*).

The vertical ZPA, **0.69 g**, is also higher than the corresponding to the AG5, **0.25 g,** value calculated as follows:

- $a_f = a_g \times K \times D = 0.5 \times 1 \times 0.5 = 0.25$ g, being

a_f (floor acceleration);
a_g (ground acceleration) = 0.5 g (*Table 3 of EN 60068-3-3: 1993*);
K (*amplification factor*) = 1 (*Table 4 of EN 60068-3-3: 1993*);
D (*direction factor*) = 0.5 (*Table 5 of EN 60068-3-3: 1993*).

The ***Switchboard*** has been submitted to the tests described here below:

- Resonance search tests between 1 and 35 Hz, before and after performing the seismic tests. These tests have been carried out in horizontal direction, *front-to-back* and *side-to-side* and in vertical direction to the ***Switchboard***.
- Seismic tests, longer than 20 seconds, performing five (5) S1 (*50% S2*) level tests followed by one (1) S2) level test. These tests have been carried out in the two main horizontal directions, *front-to-back* and *side-to-side* with regard to the ***Switchboard***, simultaneously with the vertical direction.

The tested ***Equipment*** complies with the CRITERIA 0, according to point 4.3 of European standard **EN 60068-3-3: 1993**, which states that "*equipment tested has experienced no malfunction either during or after the test*".

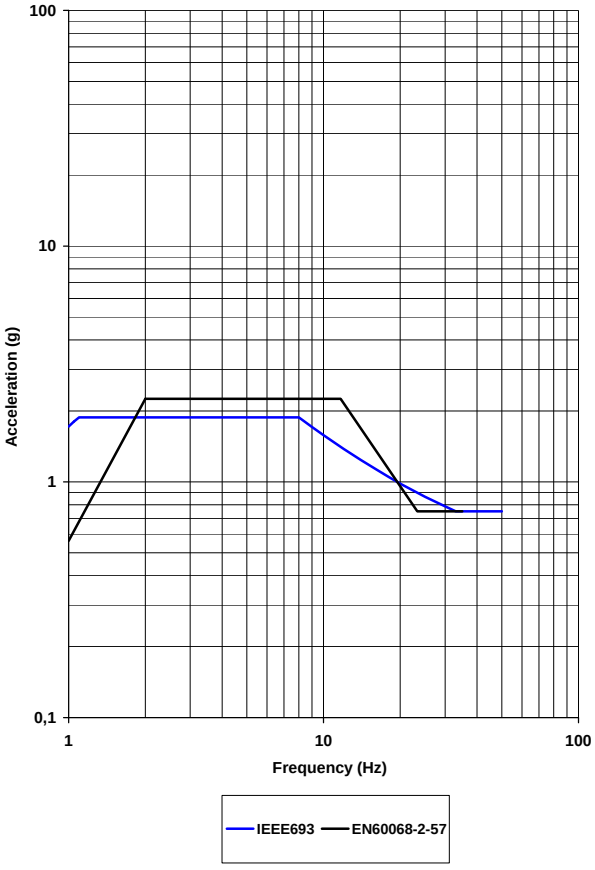
No deviations in the resonances longer than the 20%, allowed by standard **IEEE693/2005,** have been detected.

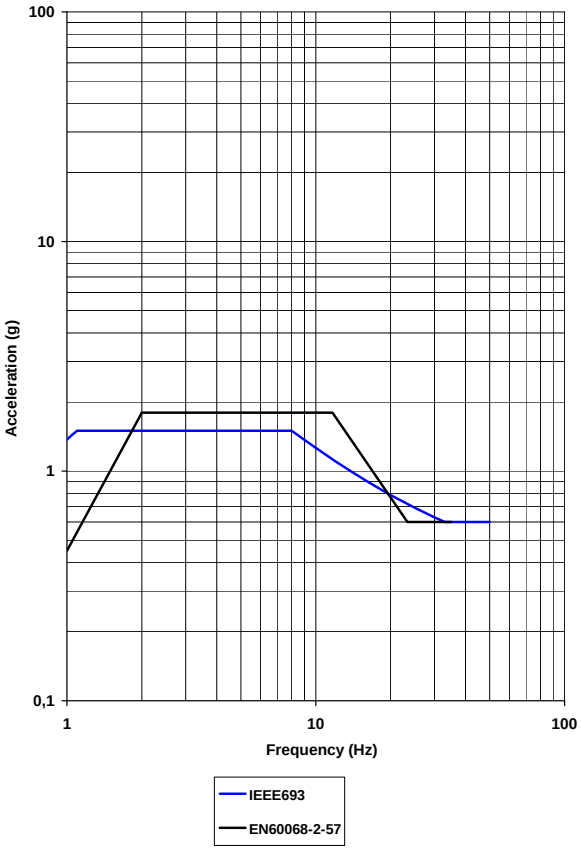
After having performed the seismic tests with the envelope of the "***High Required Response Spectrum, 0.5 g***" of the American Standard **IEEE-693:2005**, the **EN60068-2-57: 2000 (*Category 1, ZPA=0.5 g*)** and the **YATAY** required spectra**,** one more S2 level test has been performed in OY/OZ and OX/OZ Direction with the envelope of the levels described here below:

- The level according to the "*High Required Response Spectrum, 0.5 g***"** of the **IEEE-693 of 2005, incremented in a 50%,** so, considering a Zero Period Acceleration of **0.75 g** in horizontal direction and 0.6 g in vertical direction (*80% of the horizontal component*), reaching maximum spectral accelerations of 1.875 g in horizontal direction, for 5% damping.

- The level according to **EN60068-2-57: 2000 (***Category 1, ZPA=0.5 g***), incremented in a 50%,** so, considering a Zero Period Acceleration of also **0.75 g** in horizontal direction and 0.6 g in vertical direction (*80% of the horizontal component*), reaching maximum spectral accelerations of 2.25 g in horizontal direction, for 5% damping.

The envelope of referred **S2** level Required Response Spectra, for both the horizontal and the vertical direction, drawn for the 5% damping are included here below.





S2 HORIZONTAL (0.75 g ZPA; 5% Damping) **S2 VERTICAL (0.6 g ZPA; 5% Damping)**

On the other hand, during tests performed with the level of acceleration of **0.75 g**, the following incidences have been detected in the ***Switchboard***:

- Several screws of the front panels of the ***Switchboard*** fall.
- Several small locking pieces of the ***Switchboard*** internal doors are broken.
- A lateral panel of the ***Switchboard*** is released.

In test report number **152146 of VIRLAB, S.A.**, will be included all the information obtained, with tables, photographs and so on.

VIRLAB representative

LABORATORIO DE ENSAYOS DE VIBRACIÓN VIRLAB

Mr. ALBERTO CORRAL
Engineer of Laboratory