VIRLAB, S.A.
División de URBAR INGENIEROS, S.A.
Laboratorio de Ensayos de Vibración

VIBRATION
Qualification Certificate

Delivered on: Monday, 30 January 2017

References:

- VIRLAB Document number 151223E1, issue 0, dated 15/15/2015: "*VIBRATION TEST PROCEDURE OF DRY TRANSFORMERS TO BE INSTALLED IN THE 2.1MW WIND TURBINES FABRICATED BY GAMESA, ACCORDING TO EUROPEAN STANDARD EN 60068-2-6:2008*"
- GAMESA EÓLICA, Test Specification number GD220231-en, Rev. 0, dated 8/04/14: ***"****2.1MW WIND TURBINE TRANSFORMER SPECIFICATION****"***.
- 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*".
- International Standard **IEC 61373: 1999**: "*Railway applications – Rolling stock equipment – Shock and vibration tests"*.

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

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

Equipment tested: A ***2350 kVA Dry Type Transformer - CRT***, 2200 mm high x 2200 mm wide x 180 mm deep and an approximate weight of 5700 kg, serial number ADA2716015, fabricated by RAYCHEM RPG (P) LIMITED for GAMESA Wind Turbines.

Pictures included here below show the ***Transformer*** on the test platform EDB 250x250 mm in tests carried out in the three main axes of it, *vertical*, *side-to-side* and *front-to-back*.

Longitudinal "X" & Vertical "Z"

Transversal "Y"

We hereby, certify that the ***Transformer*** described here above has been tested in our laboratory of ASTEASU between the 23rd and the 24th January 2017, according to **VIRLAB** document number **151223E1**, Rev. 00.

This ***Transformer*** has been submitted, in the three main directions of it, on the biaxial test platform EDB250x250, 2500x2500 mm usable surface, to the tests described here below:

- Initial & final Resonance search test, in the range of frequencies of 1 to 100 Hz.
- Endurance test with sinusoidal sweep vibration type, in the range of frequencies of 1 to 100 Hz, during 4.5 hours per each axis.

No significant deviations in the resonance frequencies of the ***Transformer*** have been detected during the endurance tests carried out; with the exception of the *front-to-back* main resonance of the ***Transformer*** which has underwent a reduction from 6.56 to 5.81 Hz.

The ***Transformer*** has satisfactorily passed the tests performed in the three main directions of it, no anomaly nor structural deterioration being detected.

In test report number **172535 of VIRLAB, S.A.**, is included all the information obtained, with tables, photographs and so on.

VIRLAB representative

LABORATORIO DE ENSAYOS DE VIBRACIONES VIRLAB

Mr. Denis AGOTE
Engineer of Laboratory

NOTE: *According to Section 5.10.2 of Standard ISO-IEC 17025:2005, it is stated that the results of the present certificate apply only and exclusively to the samples subjected to test.*