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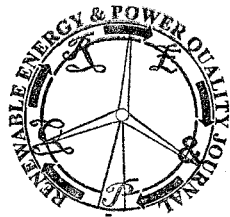
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## Magnetic Field Density Analysis in Switchgears

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**Abstract.** For many years the evaluation of the electromagnetic field (EMF) generated by transformer substations (TS) and switchgear assemblies has been an extremely cumbersome and expensive process. Manufacturers and users of TS and switchgear lacked a broadly-accepted assessment procedure specified in an international reference standard. The publication of the new Technical Report IEC/TR 62271-208 solves this situation since it describes a technique for the evaluation of the EMF generated by switchgear assemblies and TS and opens the possibility of employing simulation tools for this purpose.

In this paper, preliminary stage of process for validation of simulation tests in order to substitute laboratory tests according to IEC/TR 62271-208, is described. With this purpose, magnetic field emission analysis is carried out using finite elements (FE) method, for a set of 5 identical switchgears (manufactured by Ormazabal), in series connection. Results obtained through simulation are compared to those measured in laboratory tests. Evaluation results are also compared with applicable limits (100  $\mu$ T and 500  $\mu$ T at 50 Hz, according to most human exposure regulations: ICNIRP Guidelines, EU Council Recommendation, Spanish Royal Decree 1066/2001, etc).

### Key words

Finite elements method, human exposure, magnetic field, medium voltage, switchgear.

### 1. Introduction

In recent years, the electric and magnetic fields emitted by power lines, electrical equipment and installations have received a lot of interest from the general public, and as such no less attention has been paid by regulators, scientists, manufacturers and electrical companies. National and international regulations have set the limits of human exposure to these type of fields based on current scientific evidence and a precautionary principle. Nowadays most widespread international analysis on this issue, is published by International Commission on Non-Ionizing Radiation Protection (ICNIRP) [1].

European Union (EU), following advice from Scientific Steering Committee, elaborated the EU Council Recommendation on exposure of the public to electromagnetic fields of 0 Hz to 300 GHz frequency [2], which bases on ICNIRP Guidelines and aims to prevent acute effects (short term) caused by induction of electric currents in human body. In the case of power frequencies, EU Council sets a theoretic reference level for magnetic field (MF) at power frequency (50 Hz) in 100  $\mu$ T and 500  $\mu$ T for general public and occupational (workers) exposure, respectively.

In Spain is of the highest importance the technical report [3] issued by a committee of experts summoned by the Ministerio de Sanidad y Consumo. This report concludes