Development of software for magnetic field calculation and mitigation using passive loops

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SUMMARY

This paper studies the implementation of passive loops as a tool for Magnetic Field (MF) mitigation, at Extremely Low Frequency (ELF). Mainly, the study focuses on the development of a tool to estimate variables involved in the implementation of passive loops. To achieve this objective, a mathematical formulation that allows to know the behaviour of passive loops and facilities was developed, in which mitigation strategies are to be implemented, considering its own characteristics.

Using this formulation, a software that allows the calculation of the involved variables was implemented. This software was divided in two modules. The first one makes it possible to know the behaviour of the induced currents (magnitude and phase) of conductors in passive loops. The other module makes it possible to calculate the magnetic field in the areas of interest, with or without the implementation of passive loops.

The obtained results are the modules of the magnetic field produced by the facilities in RMS, the values of the spatial components of the field in RMS, and its temporal variation, in order to determinate the polarization.

It also allows to compare the indications delivered between a three axis magnetic field meter and a one axis meter. Since in some circumstances, important differences between them could arouse.

The results obtained from these simulations allows to know the behaviour of the total field, considering the incorporation of different geometry and / or location of passive loops models, in the area where mitigation is required. This way, the most suitable option can be applied to each case.

The magnetic field calculations are performed following the guidelines indicated by standards such as IEC 61876:1998 and IEEE Std 644-1994 (R2008). This allows to make comparisons between values obtained by calculation and measurements that validate the results obtained by the developed tool.

As an example, magnetic field measurements with and without the implementation of passive loops are performed in the laboratory, and in facilities of the Argentinean network. These cases were simulated using the developed tool, obtaining a very good concordance, which allowed the validation of the implemented models.

One of the advantages of using the developed tool is that it allows to know the values and main characteristics of the magnetic field generated by different systems and under different load conditions. It also allows to compare between different constructions alternatives in the design stage, evaluate the effect of passive loops implemented with different conductor types, sizes and locations, make comparisons of the obtained results, and evaluate the best option for each case, optimizing resources.

KEYWORDS

Magnetic Field (MF), calculation, mitigation, passive loops.

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