

THE MODELLING AND THE SIMULATION OF THE INFLUENCE OF THE ELECTROMAGNETIC FIELD PRODUCED BY THE ENSEMBLE: SWITCH-SEPARATOR ON THE HUMAN BODY

PUIU GABRIEL PETRU, POPA SORIN EUGEN

University of Bacau

Abstract: The present work shows the modelling and the simulation results of a situation in which one human being is subdued to the influence of an electromagnetic field generated by a working ensemble switch-separator.

For making possible the construction of the ensemble switch-separator and of the human model, too, it is necessary to make a simplified model in Solid Works.

The simulation of the electromagnetic field is possible only with the analyze in AC Magnetic in COSMOS EMS, by following the materials' features and technical specifications of the equipment in debate. It obtains the diagrams and the graphics of the current density and of the induced current.

Keywords: electromagnetic field, modelling, simulation.

1. INTRODUCTION

Going on with the attempt of modelling and simulating the electromagnetic field effects on the human body, the authors try to determine the values of the current density and of the induced current that establish into the body at the influence of the electromagnetic field produced by the ensemble switch- separator.

It is already known that the sensibility level of the human body is about 1mA and that a current of about 100 mA can cause death.

The size of the current intensity passing through the human body depends on the body resistance at the current passing and on the all serial strenghts in the leakage with earth circuit.

The human being presence in the intense electric fields pointed out some changes in the biological activity.

As it is, if the value of the currents produced by the electric field is lower than the biological currents' value or it has the same size, the perturbations that are produced because of the influence of the electromagnetic field can be cancelled after they are getting out the field. The result of the simulation shows exactly the current value that can be established in the body and the risk level a person under the field influence can be subdued at.

The study has been made on the basis of some simplifying hypothesis:

- the field has been estimated to be constant up to 3 mts, so, the human body being in the influence area will be subdued to the action of a homogeneous field;
- the resulting human model is considered to be an isotrop one.

2. THE MODELLING AND THE SIMULATION

2.1. The modeling

The modelling of the switch-separator system has been made in Solid Works.

The threedimensional model that has been subdued to the simulation is presented in figure 1.

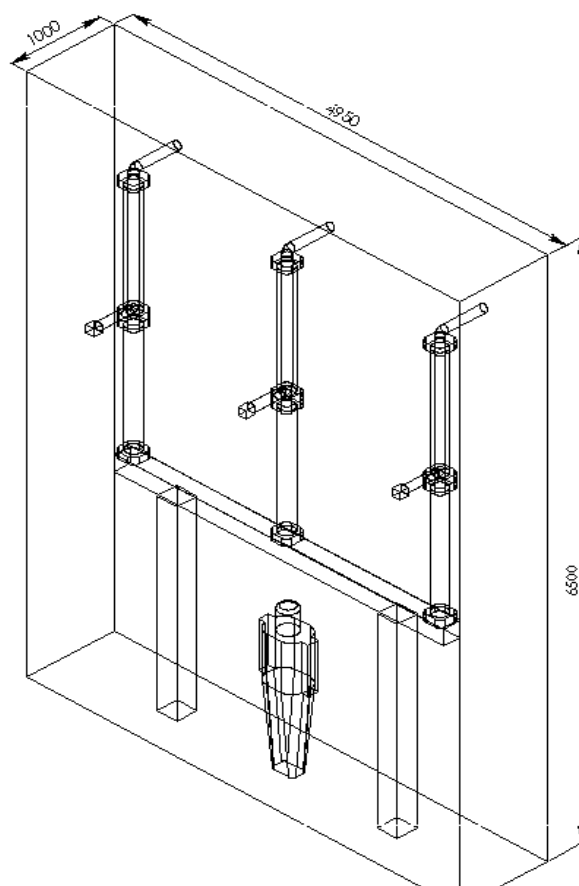


Figure 1 The constructive scheme of the module switch-separator under which a man is standing

Entering sizes:

- the conductive ways are made of Aluminium, with the relative permeability 1 and the electric conductivity of 38.200.000 S/m;
- the metallic support is made of steel, with the relative permeability 5,000 and the electric conductivity 10.300.000 S/m;
- the support and the passing insulators are made of ceramics, with the relative permeability 1 and the electric conductivity 0S/m;
- for the human being it has been taken into consideration the relative permeability 1 and the electric conductivity 0,0054 S/m;
- there has been applied to the system a threephases simetrical current of 2000 A with the following dephases: 0,120, -120.

2.2.The simulation

The simulation are possible with Cosmos EMS program, based on the finite elements method.

Figure 2 presents the important model in the program and figure 3 presents a part of the mesh in the human being area.

The simulation has been possible in two particular cases, for three different dephases of the currents, such as:

- in the first situation, the human being is standing at equal distances between the two pillars, and in the second, the human being is standing in close proximity of one of the pillars.

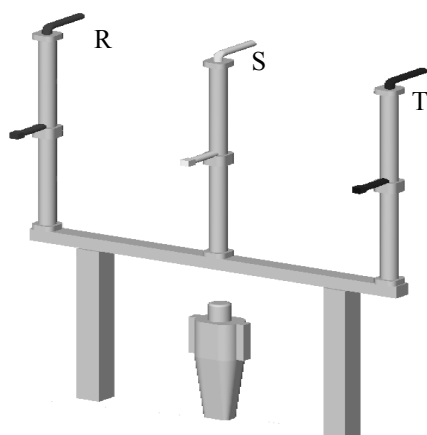


Fig.2. The model in Cosmos/EMS program

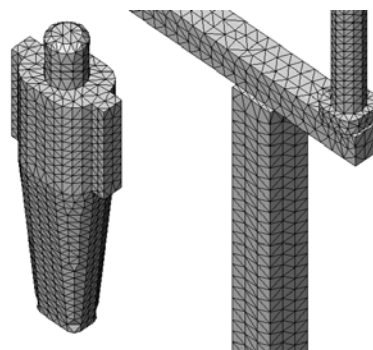


Fig.3. The Mesh.

For the same absolute value of the currents, of 2000A , there were taken into consideration the exposed dephases in table 1, for the three phases:

Table no. 1

Dephases for the three phases			
	f 1	f 2	f 3
Faza R	0	-120	-120
Faza S	-120	0	+120
Faza T	+120	120	0

The figure. 4 presents the isometric surfaces of the induced current with the value $1 \cdot 10^{-7} [A / m^2]$ for the two studied cases, for the dephase 1 of the currents.

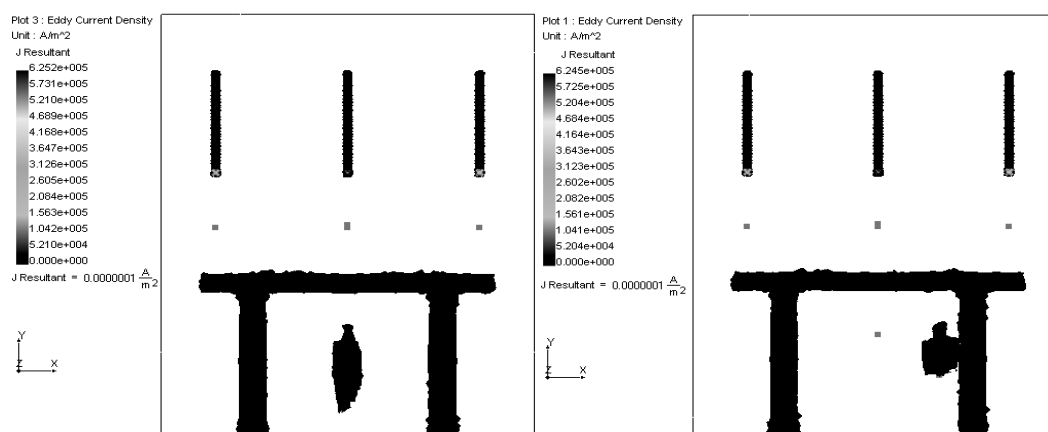
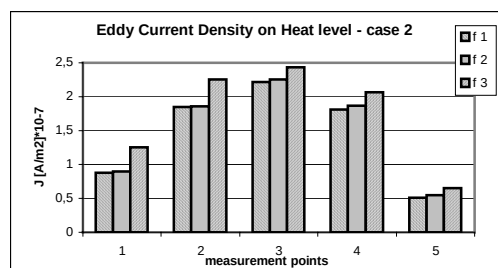
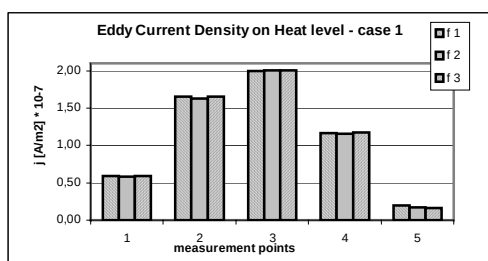


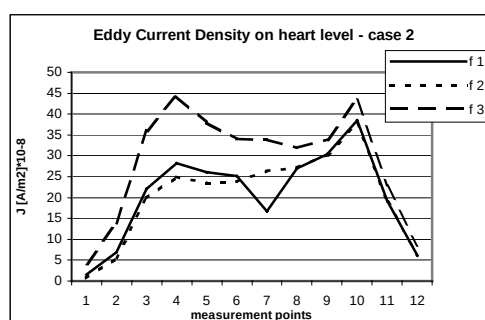
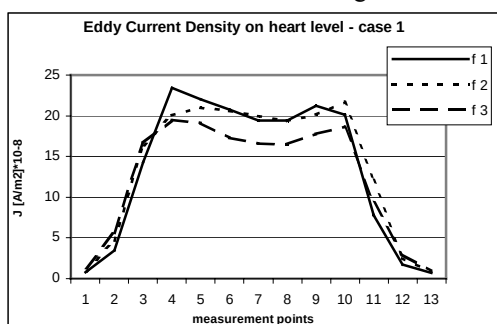
Fig. 4: Eddy Current Density distribution – isometric surface.

To point out better the differences between the two cases,(that of the human being standing in close proximity of the pillars and that of the human being standing in the middle of the distance between the two pillars), the graphics with the current density values have been traced through the head area(axis1) and through the chest area (axis2) and for the three dephases.

There were obtained the following results in the head area:



There were obtained the following results in the chest area:



3. CONCLUSIONS

- as nearer the human being is standing by the metallic pillar of the plant, as higher the induced current density is;(both in the head and in the heart area);
- if the human being is placed in the middle of the plant, the influence of the three current dephases through the switch is unimportant;
- if the human being is placed in close proximity of one of the steel pillars, the currents dephase has influence on the value of the induced current in the human body, touching the highest value when dephases ,,,,,
- in both cases, the current density in the human body is higher in the heart area than in the head area..

REFERENCES

1. T. Leordinimbros, *Effects of electric field an human beings and animals*
2. MOCM-8 – Dan Rotar, Ștefan Ababei, Sorin Popa, "Communication system for DSP and PC compatible computer", Bacău, 2002,
3. MOCM-9 – Popa Sorin Eugen, Rotar Dan, "New techniques for electromagnetic field modeling", Bacău, 2003, vol II, - ISSN 1224-7480;
4. MOCM-9 – Rotar Dan, Popa Sorin Eugen, "Electromagntic compatibility study by numerical analysis ", Bacău, 2003, vol II, - ISSN 1224-7480;
5. Ioan Gheorghiu, Sorin Eugen Popa, Mihai Puiu-Berizintu *Echipamente electrice pentru centrale, stații și posturi de transformare* - Ch. "Tehnica-Info", 2003, ISBN: 9975-63-204-1;
6. A. Maio, I. S. Stievano, F. G. Canavero, *Signal Integrity and Behavioral Models of Digital Devices*, Proceedings of the 1999 Zurich Symp. on EMC, February 1999;
7. O. Rethmeier, *Modeling of Integrated Circuits to Support SI-Analysis*, Proceedings of the 1998 Zurich Symp. on EMC, February 1998;
8. F. Haslinger, U. Neibig, B. Unger, *EMV Charakterisierung von elektronischen Steuergeräten im Kfz*, Proceedings EMV2000, Düsseldorf Germany, VDE Verlag, Berlin, 2000;