ANALYSIS OF THE SOLUTIONS FOR INCREASING THE ELECTRIC HYDROGENERATOR PERFORMANCES

1. Phase objectives

-study on the magnetic components determining electro-thermal losses in generator winding;

-analysis of the possibilities of measuring some electromagnetic quantities

2. Phase summary

When an alternating current is set through a rectangular bar located in a ferromagnetic slot, then the electric current is non-uniformly distributed on the bar section, its density being lower towards the slot bottom and increasing progressively towards the slot opening.

The more deformed the distribution curve of the electric current density along the radial axis of the slot is, the higher the losses by electro-thermal effect are.

The cause of the deformation of current distribution curve on the bar section is the magnetic field from the slot, which makes the magnetic flux density vector, $\vec{B}$, to be not the same in all the bar points; consequently, the strength of the electric field $\vec{E}$ induced by this magnetic field and according to Ohm law, also the density of electric current intensity, $\vec{j} = \sigma\vec{E}$, is no more constant.

For remedying the consequences of this disturbing effect, Roebel proposed the use of a bar composed of many insulated conductors, called elementary conductors, instead of a solid bar. These conductors should be executed so as the overall inner magnetic flux from the bar should have, as far as possible, the same value for all the elementary conductors. For this purpose, he proposed the transposition of these elementary conductors in the side located in the slot, so as they passed through all the positions from the section of the slot.

This measure proposed by Roebel and used today almost entirely for high and very high power machines, is focused mainly on the processes inside the slot. But the bar has, besides the part from the slot, the two end parts which are within a non-magnetic environment, whose role is to connect together the bars belonging to the same phases, in order to achieve a winding way. For most of the machines, the winding is two layers, short pitch one and its type is wave winding, when the two ends are taken to opposite directions.

Consequently, the following magnetic fields, from which the losses in bar are depending on, can be identified:

-own magnetic field from the slot area, whose field lines are perpendicular to the slot walls;

-own inner magnetic field of the bar in the area of bar ends, which can be considered equivalent to the field of two magnetically equivalent slots, one for each half of the bar;