and only three regions were in crisis state then in 1997 the regions with normal state with power security has not become and 5 from 11 regions was entered into different stages of crisis state. These changes have taken place in period from 1990 to 1995. Period from 1995 to 1997 was characterized by relative stabilization of situation in all regions but noticeable improvement of a situation in the regions is not observed.

Comparing a state of power security in regions of Russia and in their subjects it is possible to mark that regions of Russia are characterized by more favourable situation (both in 1990 and in 1997). This phenomenon is explained by the fact that regions possess large total riches of fuel power resources, variety of power sources, possibilities of integration effects etc. and are more stable against effect of the threats of power security. This does not mean that among subjects of Russian Federation there are no or few subjects with favourable power security state. The matter is differentiation of a state at a level of the subjects of Russia is more essential than at level of regions of Russia.

Power security is new but important problem of electrical and power system's investigation. That is why it is included into special disciplines of electrical power system's educational process.

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VISUALIZATION OF ELECTRICAL MACHINES

В докладе "Визуализация процессов в электрических машинах" рассмотрены вопросы визуализации электромагнитных процессов в электрических машинах с помощью компьютерной анимации на основе пакета 3D STUDIO MAX. Работа выполнена Уральским государственным техническим университетом (Россия) совместно с Гентским университетом (Бельгия) в рамках проекта URAL-ELECTRO.

The subject under discussion is "Electrical machines". It is well known that electrical machines are the main producers and the main suppliers of the electrical energy. So the students of all the electrical specialties have to study this subject.

As any other subject this one contains some pitfalls. The practice shows that it is often difficult for the students to understand the link between the real machine and

its mathematical representation. The students also come across with some difficulties during studying the mechanical structure of electrical machines.

Therefore in the frame of the joint project "URALElectro" of the Urals State Technical University (Russian Federation, Ekaterinburg) and the University of Gent (Gent, Belgium) the first step was made to solve this problem.

The 3D Studio MAX package was chosen as the main tool to create animations. Such a choice was made because of the possibilities of this powerful package. It provides the creation and further animation of sophisticated objects. Finally it allows to create qualitative static animations in the "*.avi" format of almost any size and resolution. It also should be noted that 3D Studio MAX has a very successful interface.

By the present moment the visualization of the mechanical structure of the different types of transformers has been accomplished. Visualized structures were diversified with respect to the number of phases, the type of material, the way of lamination and the type of winding. The table below shows it in detail:

Animation number	The number of phases	Material	The type of magnetic core	The type of winding (Primary/Secondary)
1	1	Ferrite	EE	Cylindrical/ Cylindrical
2	1	Ferrite	Pot	Foil/Cylindrical
3	1	Ferrite	Ring	Cylindrical/ Cylindrical
4	1	Steel (non-oriented)	EI	Cylindrical/ Cylindrical
5	1	Steel (non-oriented)	EI	Disk/Disk
6	1	Steel (non-oriented)	EI	Spiral/Spiral
7	1	Steel (non-oriented)	UI	Cylindrical/ Cylindrical
8	1	Steel (non-oriented)	UI	Disk/Disk
9	1	Steel (non-oriented)	UI	Spiral/Spiral
10	1	Steel (oriented)	EI	Cylindrical/ Cylindrical
11	1	Steel (oriented)	EI	Disk/Disk
12	1	Steel (oriented)	EI	Spiral/Spiral
13	1	Steel (oriented)	UI	Cylindrical/ Cylindrical
14	1	Steel (oriented)	UI	Disk/Disk
15	1	Steel (oriented)	UI	Spiral/Spiral
16	3	Steel (non-oriented)	EI	Cylindrical/ Cylindrical
17	3	Steel (non-oriented)	EI	Disk/Disk
18	3	Steel (non-oriented)	EI	Spiral/Spiral
19	3	Steel (oriented)	3 leg core	Cylindrical/ Cylindrical
20	3	Steel (oriented)	3 leg core	Disk/Disk

21	3	Steel (oriented)	3 leg core	Spiral/Spiral
22	3	Steel (oriented)	5 leg core	Cylindrical/ Cylindrical
23	3	Steel (oriented)	5 leg core	Disk/Disk
24	3	Steel (oriented)	5 leg core	Spiral/Spiral.

The main attention in these movies was paid to the relative position of the windings and magnetic system and to the way of winding.

Two large animations have been made in order to show the correspondence of an equivalent circuit to the real transformer. The first one is devoted to the no load regime and the second one is devoted to the short circuit. Some results of electromagnetic field calculations in the transformers were included into the separate animations.

Visualization of the mechanical structure of an induction motor has been done. The prototype of this machine is situated in the Laboratory of Electrical Machines and Power Electronics of the University of Gent (ELMAPE). The visualized motor corresponds to the real one with respect to the dimensions and colors in order to reach a higher level of reality. Rotor and stator structures are shown in the separate movies.

A DC motor was visualized in a similar way.

An executable Windows application was created to provide a comfortable access to the movies. The Borland Delphi programming language was used to do it.