

**Project title: Improvement of hydrogenerators operation by developing excitation systems with a view to increasing their energy efficiency and competitiveness**

***Stage I: Analysis of the solutions for modernizing the electric hydrogenerator excitation***

For achieving the stage I, the following activities have been performed:

**Activity I.1. Study of the excitation systems aimed at automation and monitoring**

In achieving the activities from this stage, the following ones have participated:

**Project leader (CO) – ICMET Craiova** has developed a synthesis study referring to the static excitation systems on the basis of the experience gained in designing and achieving them by its own specialists, in correlation with the latest technological achievements in the field.

**Partner I – “Politehnica University” - Timisoara** has drawn up a synthesis study on the present situation and trends in the applications of classical excitation systems.

**Partner II – Romanian Academy – Timisoara branch** has performed a bibliographic study in recent literature related to the excitation systems.

**Partner III - University of Craiova** has performed studies on mathematical modeling of the system for automatic control of voltage, on hydrogenerator modeling with a view to improving its dynamic stability.

**Stage I:** Analysis of the solutions for modernizing the electric hydrogenerator excitation

### **1. Objectives of the execution phase**

The main objective of this phase is preparing the document “Study on the excitation system with a view to automating and monitoring”, which is the basis for substantiating the next activities for reaching the specific objectives of the project.

The study is aimed at carrying out the following analyses:

- Analysis of the structure of present voltage control and excitation systems, emphasizing their limits and disadvantages;
- Analysis of present trends at European level in the field of static excitation for hydrogenerators;
- Comparative analysis between the technical-scientific stage reached by the well known companies in the field of static excitations and the technical level of the similar equipment manufactured in the country and, in particular, by ICMET Craiova;

For defining properly the problems and for understanding the novelty elements applied in achieving the modern excitation systems, a bibliographical study on recent literature was also carried out.

### **2. Phase summary**

The document named “Study on the excitation system with a view to automating and monitoring”, drawn up as a result of executing the activities corresponding to the first phase of the project, contains five chapters:

#### **Chapter 1 – Excitation systems for high power synchronous machines**

Within this chapter, the schematic diagram of the excitation systems for synchronous machine in general, and for hydrogenerators in particular, are presented. The typical functions of the excitation systems are emphasized and the constructive variants of the excitation sources (DC generators, ionic excitations, synchronous generators, static excitation systems) are presented.

The static excitation systems are exhaustively presented, from the point of view of their structure and functions, both classical variants and modern solutions for static excitations.

#### **Chapter 2 – Control of synchronous generator excitation**

The analog and digital control solutions for the excitation systems of synchronous generators are analyzed. The performances of digital systems are highlighted, from the point of view of their reliability and versatility.

#### **Chapter 3 – Performances of digital excitation systems**

It presents in detail the digital structures for controlling and regulating the synchronous generator excitation, also the advantages of these structures

#### **Chapter 4 – Monitoring of the hydrogenerator excitation systems**

The objectives of SCADA monitoring – the system most used in assisting the control of complex power systems - and dedicated systems for data acquisition are analyzed at large.

## **Chapter 5 – Excitation systems for reversible synchronous generators.**

### **Hydrogenerator operation as motor.**

Within this chapter, the excitation system for synchronous motors SRAEx–MS-MSCK 2.0, developed by ICMET Craiova in cooperation with Technosoft Company – Bucharest, as technical solution integrable in the excitation systems for hydrogenerators with a view to their operating as synchronous motor for water pumping, is presented.

### **3. Conclusions**

Within this study, technical-scientific conclusions are presented at the end of the chapters; these conclusions represent guidelines for the future development of the project, which will be concretized in:

- Digital excitation system in laboratory model variant;
- Technical specification for the prototype of the excitation system;
- Stand for testing and certifying the modern excitation systems