



# Dynamic Characteristics of the Unit A in HPP Vrutok

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**Abstract:** In this paper an overview of the experiments performed on one unit in HPP Vrutok are presented. According to the joint project DYSIMAC (Dynamic Simulation of the Macedonian Power Plants in a New Technological and Market Environment), the authors investigate dynamic characteristics of the hydro units in power system. Since the power plants shall operate in a new technological and market environment, additional technical requirements have to be met by rehabilitated equipment and the unit itself. The results and graphical presentation for typical experiments of unit dynamics are presented in original form.

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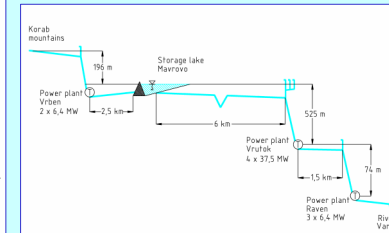
**Keywords:** data acquisition, dynamic characteristics, hydro power plant, measurement, parameter identification



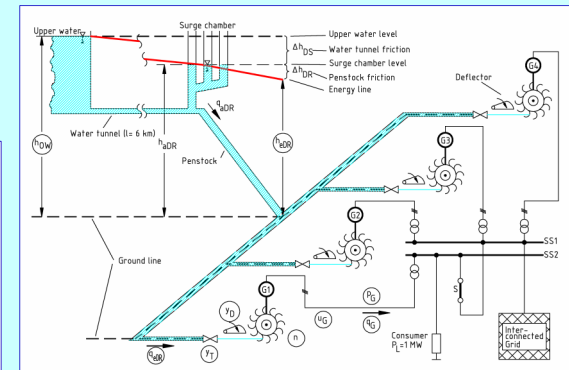
Electric power system of Macedonia

## Main data of HPP Vrutok:

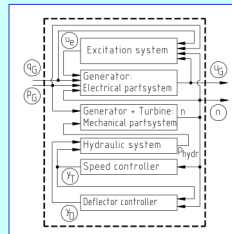
Number of units..... 4  
Rated flow..... 4 x 8 m<sup>3</sup>/s  
Rated power..... 4 x 42 MVA  
Rated voltage..... 12 kV  
Rated current..... 2020 A  
Rated speed..... 500 rpm



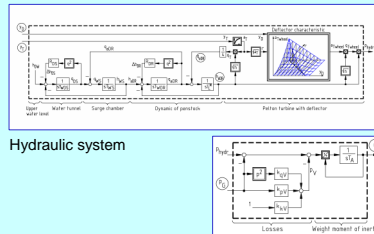
Profile of the cascade system „Vrben – Vrutok – Raven“



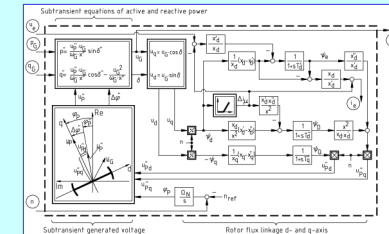
Scheme of the hydro power plant Vrutok



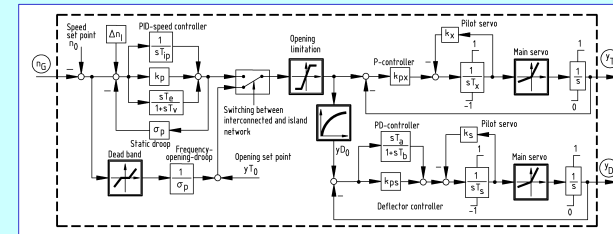
General block diagram for the hydro power plant Vrutok



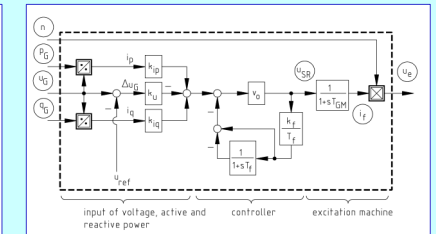
Hydraulic system



Electrical part of the power plant (generator)

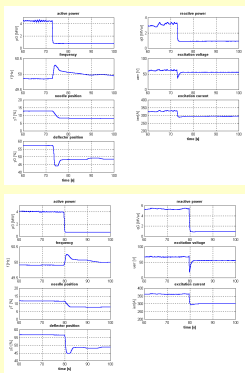


Speed controller with deflector controller

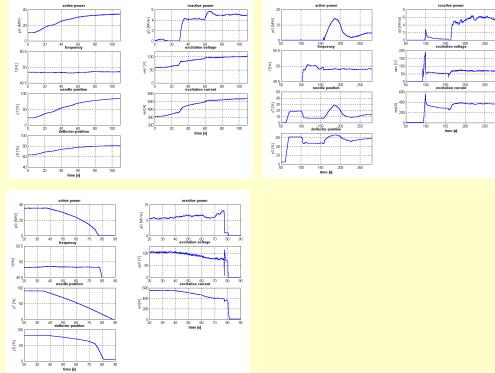


Excitation system

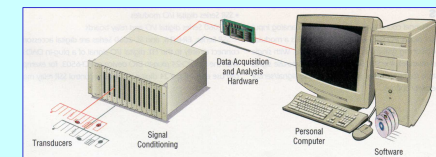
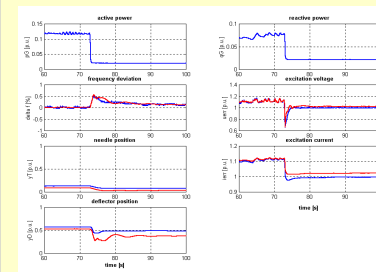
## Experiments with islanded operations



## Experiments with interconnection to the grid



## Comparison of measured (blue) and simulated (red) signals after a +4 MW exchange-power-step



Computer based system for data acquisition

**Conclusion:** Functioning of the hydro power plants in a new technological and market environment is very important issue, especially now when rehabilitation of the main equipment in Macedonian hydro power plants is underway. The most important characteristics of the unit are obtained for a few typical experiments that could be used in further analysis and development of unit dynamics. The experimental results could be used for evaluation of the already developed simulation model of the HPP Vrutok and identification of the control system parameters.