

## EXAMINER'S RECORD OF THE DOCTORAL THESIS

**PhD Candidate:** Ing. Le Thi Minh Trang

**Title:** Dynamic model of two synchronous connected via long transmission line

**Opponent:** Prof. Ing. Josef Tlustý, CSc.  
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a) Aktuálnost zvoleného tématu / Topicality of the Ph.D. Thesis theme

The thesis for assessment was submitted by MEng. Le Thi Minh Trang. This work deals with current problems in the operation of energy sources in the power grid. In the field of this topic there are generally known problems with the low frequency oscillation in the electricity grid, which has led to increased instability of the system operation, deterioration in the quality of the supplied electricity and, consequently, to the enormous increase of the risk of collapse and the formation of blackout. Therefore, I consider the work in this area, especially the proposal of instruments for analyzing of negative effects on the stability of electroenergetic system, to be very up-to-date, which also applies to the dissertation submitted. The research is supported by a rather extensive study of the current state of the problem.

b) Splnění sledovaných cílů v disertační práci / Fulfilment of the Ph.D. Thesis objectives

The objectives of the dissertation were specified in detail in the introductory first part of the dissertation thesis, with the emphasis on the development of a complex modeling tool for modeling the dynamic response of simple transmission systems with two generators. The main goal of the thesis is to create a complex model of a simplified electroenergetic system in a steady state, eventually in a fault state for the study of stability. This developed model serves to analyze the influence of individual parameters on the occurrence of characteristic states indicating instability or blackout.

The core of the dissertation is the development of a complex simulation tool for modeling the dynamic responses of generators and a case study of the transmission network focusing on the dynamic response and identification of instability of the operation.

c) Zvolené metody zpracování / Research methods and procedures

It is evident that author is very familiar with the simulations tools (MATLAB/Simulink in this case) and has deep knowledge of electricity distribution system and its simulation. The thesis demonstrates the depth of the author's theoretical knowledge as well as his ability to use modern simulation tools. It is comprehensible and the mathematical expressions seem to be correct.

Furthermore, all diagrams and figures have been made with the due care and diligence expected from a doctoral student.

I consider the chosen research methods and procedures as satisfactory and promising for any future researches.

d) Vyjádření k výsledkům disertace s uvedením jaké nové poznatky přinesla / Results of the Ph.D. Thesis dissertant's concrete achievements

I can state that the goals of the dissertation, as defined in the introduction of the dissertation, have been fulfilled. The presented work appropriately combines the theoretical knowledge with practical applications and, in my opinion, has significant possibilities for application in technical practice.

e) Teoretický přínos práce/ Theoretical benefits of the thesis

The complex model of a simplified steady-state electrical energy system, eventually in a fault condition for the study of stability, is based on a detailed theoretical basis. The theoretical approach reflects current knowledge in the field. I also miss some other advanced approaches, especially from the field of nonlinear dynamics, which is suitable for studying system stability. Also, synchrophasic approach is not emphasized.

f) Význam pro praxi nebo pro další rozvoj vědy / Importance for practice and for development within a branch of science

I can state that in order to elaborate the dissertation thesis

- The topic of the dissertation corresponds to the field of Power Electrical Engineering and Electricity, it is very current because it brings new knowledges, which can positively contribute to the optimization of the operation of transmission systems.
- I consider that his significant contribution is the design and implementation of complex simulation tools for modeling dynamic response of generators and their verification on a case study.
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- The thesis was supplemented by the list of 7 published papers of the author (1 in Impact Factor Journal (submitted 2018). I can claim that the core of the thesis was sufficiently published. I'm interested in the state of the impacted publication.

g) Notes and comments

p. 48 - It is a conclusive comparison of a very small machine of about 2 MW with a large machine of 350 MW. Explain their similar behavior.

p.56 – why is the frequency-independent load considered in the model? Is it possible to extend your model to a more machine problem?

p. 59 and following – Can the simulation results be compared with the results of the measurements in the real network?

The above comments are mostly of a formal nature and do not reduce the evaluation of the dissertation level.

#### Final assessment of the Ph.D. Thesis

The submitted thesis supports the evidence that Ing. Le Thi Minh Trang demonstrated theoretical knowledge, that he is able to actively use scientific methods of work as far as concrete solution of topical technical relevant questions is concerned.

I claim that the thesis by Ing. Le Thi Minh Trang fulfils the requirements of doctorate thesis and that is why

#### **I recommend**

it to be submitted for a viva and after a successful defense of the Ph.D. Thesis to grant MSc. Ing. Le Thi Minh Trang the Ph.D. degree

Praha, 28. 1. 2019

Prof. Ing. Josef Tlustý, CSc.