Opponent's review of the dissertation thesis of Jana Matoušková
"Neutron Imaging at Very Low Power Research Reactors"

Ing. Jana Matoušková, author of the dissertation thesis, in the frame of her Ph.D. study was devoted to the current issues of neutron imaging, radiography and tomography at a low-power reactor under the supervision of doc. L. Sklenka (FNSPE CTU) and Dr. B. Schillinger (Technical University of Munich).

The thesis has a form of an annotated collection of publications, which together with the author's conference contributions are presented in separate chapters (p. 79 and 81). The thesis is divided into 7 chapters (including the introduction and conclusion) and a total of 5 appendices. It contains two thematically different parts. The first part is general giving the basic facts about the issue of neutron imaging and a description of the VR-1 reactor. Chapter 2 presents the objectives of the dissertation thesis. The author's own work and the obtained results are concentrated in the extensive chapter 5 and in the appendices A.2., A.3., A.4. and A.5. In the conclusion, the author summarizes the results achieved and her contribution to obtaining them.

The objectives of the dissertation were set as follows:
- Development of the equipment for neutron imaging,
- Implementation of the equipment for neutron imaging at the VR-1 reactor,
- A proposal for the use of this equipment in education at the FNSPE CTU, Department of Nuclear Reactors as well as in practical specialized courses.

The author was first devoted to the technical design of the NIFFLER "Neutron Imaging Facility for learning and Research" device. The device has four main parts – neutron beamline, tomographic equipment, detection system and shielding (e.g. lead bricks, boron-added rubber, and polyethylene). The author had to deal with adjusting the neutron radial beamline, during which it was necessary to measure the flow of thermal neutrons (1-5 x 10^9 neutrons/cm^2.s) using Ag foils in several positions, including the position of the sample, and then verify the experimental data by Monte Carlo simulations. Based on the proposal from the Technical University of Munich, the author implemented a detection system using a CMOS camera with scintillation screens (for fast neutrons or for thermal neutrons with ^{6}Li content). The detection part was tested on reactors LVR-15 (Research Centre Řež), TRIGA Mark-II (Vienna) and also on neutron generators D-D and D-T. An important part of the work was the safety aspect. Dose equivalents were determined for gamma radiation at the level of 0.5 μSv/h and for neutrons at the level of 10 μSv/h in the beam axis behind the shielding. For the needs of neutron tomography, the device was supplemented with a movable part (linear and rotary displacement). The thesis also includes annotations for students' teaching needs in connection with the developed device. An interesting chapter is the device tests in connection with the cultural heritage of Asia (sculptures from China and Tibet). The author spent several months at the RA-6 reactor (Argentina), during which she participated in the modification (for neutron tomography) of their measuring equipment.

During the defense, I would like to hear the author's opinion:
1) How is the presence of Li in the measured sample reflected in the detected signal from the measuring sensor for neutrons and gammas? What about the presence of water?
2) What is the smallest spatial resolution of the developed device?

The advantage of the presented dissertation thesis lies in its topicality (neutron radiography, neutron tomography) and novelty (use of a low-power reactor, 100 W). Furthermore, it is very important that the author managed to complete the assigned tasks under the guidance of the supervisors – design of the device, its construction, testing of individual components and putting it into full operation. I highly appreciate the nature of the dissertation thesis, which combines practical experimental activities, Monte Carlo calculations (including safety evaluation), processing of measured data from the analysis of the internal structure of statues from Central Asia, the introduction of methodology into educational process in FNSPE CTU or the application of obtained knowledge at the RA-6 reactor laboratory in Argentina. The author is listed as the first author of 4 publications, which sufficiently demonstrates her contribution to the results.

The dissertation thesis proves that the author is thoroughly familiar with the issue and that she acquired detailed knowledge of the research subject during her studies. The dissertation was carried out in direct international cooperation between the FNSPE CTU in Prague and the Technical University in Munich.

In conclusion, I state that, based on the submitted dissertation, I propose to award Ing. Jana Matoušková scientific degree Ph.D.

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