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CZECH TECHNICAL UNIVERSITY IN PRAGUE
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Reviewer Report of PhD Thesis „Neutron Imaging at Very Low Power Research Reactors" presented by Jana Matoušková

General impression

- **Scientific impact:** The thesis represents a feasibility study of implementation of neutron imaging facility at the low power Training reactor VR-1 with a thermal power of 100 W followed up by installation, optimization, and commissioning of operational instrument. This way the facility became a platform for education, research, and industrial applications with a high scientific impact at the Czech Technical University in Prag and even abroad where the knowledge and experience gained at the VR-1 reactor were applied for upgrade of the detection system for neutron imaging at the RA-6 reactor in Argentina.
- **Originality:** The outstanding achievement of the thesis is the design and construction of the first neutron tomography facility in the world operated at such a low-power research reactor. The used procedure for the optimization of the moderator design and the beam extraction system of the instrument is remarkable leading to excellent results in terms of improved beam thermalization and collimation allowing for better image quality in practical exposure times.
- **Manuscript quality:** The manuscript is well structured with rich conclusions supported by various experimental data organized in clear plots and charts, as well as high quality figures and images. The thesis is written in good Englis.

Focused review

- **Chapter 1 *(Status of neutron imaging)*:** Detailed historical review of the development of the neutron imaging method emphasizing the role of the improvement of the neutron sources and the related instrumentation, especially the increased efficiency and spatial resolution of the detector systems. The neutron imaging at low power neutron sources is emphasized, describing the specifics of this technique, its spread worldwide and presenting examples of applications.
- **Chapter 2 *(Dissertation Thesis Objectives)*:** Clear and well structured definition of the thesis objectives starting with the instrumental design, construction and optimisation, going

through a commissioning process and ending with the rutine operation of the facility for educational and scientifical purposes.

- **Chapter 3** ***(Neutron Imaging)***: Very detailed and comprehensive introduction of essential definitions of the neutron imaging technique which allow for better understanding of the specific methods and routines used later for the characterization of the commissioned neutron facility. This makes possible to compare the performance of the facility installed at low power neutron source to the state-of-the art neutron imaging instruments. The different instrumentation components like collimators and detectors are described in detail and their performance is discussed. The theory of the data processing and analysis in neutron imaging experiments is provided and various prominent examples in science, technology and education are presented.
- **Chapter 4** ***(Training reactor VR-1)***: The parameters of the reactor are presented briefly followed by examples of utilization.
- **Chapter 5** ***(Neutron imaging at training reactor VR-1)***: The design parameters and the instrumentation components of the neutron imaging facility at the VR-1 low power reactor are fully described. The optimization procedure for improving of the moderator and collimation performance of the beam extraction system is described in detail using well prepared graphs and tables. Aspects of instrument controlling system, detector development adapted to the specifics of low power reactor, shielding modifications and comparison to neutron imaging instruments at different neutron sources, including D-D and D-T generators, are presented. The tomography option is emphasized, and examples of instrument utilization and knowledge transfer to other facilities worldwide are highlighted.

Suggestions for improvement (a base for discussion at the thesis defense)

- The description of the coherent neutron scattering interaction is incomplete and not accurate.
- The definition of L/D ratio and beam collimation should be given more precise.
- The neutron transport by super mirror guide should be described properly.

Conclusion

Based on the detailed review of the thesis of Jana Matouskova determining her exceptional personal contribution and the obtained excellent results, I am evaluating the work as outstanding and ensure that the thesis has enough quality to receive PhD degree.

Sincerely yours.

Dr. Nikolay Kardjilov

(Senior scientist, X-ray and neutron imaging)