

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Stanislav Bogdanov

PhD Program: Engineering Systems

Title of Thesis: Modeling and operation optimization of vanadium redox flow batteries

Supervisor: Dr. Mikhail Pugach, Skoltech

Co-supervisors: Associate Professor Federico Martin Ibanez, Skoltech
Dr. Sergei Parsegov, Skoltech

Name of the Reviewer: Dr. Henni Ouerdane, Associate Professor

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	Date: 11-10-2024
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The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.

The thesis contains 6 chapters, including the Introduction and the Conclusion chapters. A comprehensive nomenclature and a solid bibliography section are also provided. The thesis title is informative and accurate. The text is well written and balanced throughout the thesis. The thesis goal is clear and the scientific novelty highlighted. Overall, this is a good quality PhD thesis.

- The relevance of the topic of dissertation work to its actual content

The thesis reports a research work dedicated to the modeling and the operation optimization of vanadium redox flow batteries, which is a fairly recent technology for energy storage, which is the object of active

studies notably for their integration in the power grid. The actual goal is to manage a real-time simulation model of the vanadium redox flow batteries under various operating conditions.

- The relevance of the methods used in the dissertation

The theoretical approach is based on the lumped parameters modeling to study the transport of vanadium ions across the membrane. A parameter identification algorithm has been developed to adapt the model to real time dynamics, thus managing the simulation of the instant state of the main redox flow battery components. This gives scope for the development of model predictive control approaches to manage the operation of industrial-scale energy storage systems. A very strong aspect of the work is the validation by comparison against experimental data.

- The scientific significance of the results obtained and their compliance with the international level and current state of the art

The scientific significance and their compliance with the current state of the art and international level standards is shown by the 3 publications in leading international journals and the attention they have attracted so far, as well as 3 conference proceedings papers.

- The relevance of the obtained results to applications (if applicable)

The validation of the model required performing experiment to simulate industrial-scale systems. This shows that the obtained results can be useful for real-life applications.

- The quality of publications

The doctoral work presented in the thesis manuscript has resulted in 6 Scopus-indexed publications: 3 journal articles in Q1 leading international journals and 3 international conference proceedings papers. Two journal articles are already well cited, thus showing recognition by the energy storage community.

- The summary of issues to be addressed before/during the thesis defense
 - Avoid writing paragraphs as a single sentence. See, e.g., bottom of page 18.
 - State clearly the basic scientific hypotheses made to conduct the research.
 - Avoid self-praise like in the following sentence found in the Conclusion: “Thus, the results obtained during the thesis research make a great contribution contribution for the development [...]”. Also note that the word contribution is written twice.
 - The statements concerning the further research should be substantiated by some arguments showing not only the interest in the suggested works but also their feasibility. At present, this looks as a wish list.
 - Figure captions should systematically end with a full stop.
 - The title of Chapter 4 could simply read: Comprehensive model for real-time VRFB simulations.

Provisional Recommendation

I recommend that the candidate should defend the thesis by means of a formal thesis defense

I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report

The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense