Skoltech
Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Alvaro Gonzalez

PhD Program: Engineering Systems

Title of Thesis: Flexibility characterization in power systems

Supervisor: Assistant Professor Aldo Bischi, Skoltech

Co-supervisor: Assistant Professor David Pozo, Skoltech

Name of the Reviewer: Full Professor Vladimir Terzija, Skoltech

I confirm the absence of any conflict of interest 	**Date: 08-10-2021**

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 relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

This is a high-quality Thesis, presented according to high international standards. It is well-structured, adequately defining the problem, its importance and existing solutions, after that proposing original new solutions, criticized and compared with the existing solutions.

Flexibility of electrical power systems and multi-energy systems in general is an important research topic, relevant for successful operation of sustainable low-carbon energy systems. Impact of energy storage system components is equally a relevant and not yet well-explored research topic.

Methods used in the Thesis are classical and stochastic optimization. Models used are linear models, ensuring low computational efforts and technically acceptable accuracy.

Results obtained are at the highest international standards. Their relevance has been recognized through a good number of journal papers (e.g. IEEE Transactions, or Elsevier journals). Few papers are submitted.

I believe that results obtained could be used in modern Energy Management Systems, contributing to flexible power system operation. The same holds for Distribution Management Systems.

The candidate has published quite a high number of publications (conference and journal papers). I have put my focus on the paper published in IEEE Trans on Power Systems (paper cited 16 times – Google Scholar). The paper published in International Journal of Electrical Power & Energy Systems has already been known to me (I am the EiC of this journal). I was indeed very pleased that this paper has been cited 15 times.

Thesis Changes Log

1. To provide more details about different definitions of power/energy system flexibility.

2. Results presented in Fig 2.11 are based on a “day ahead” forecasting approach. Would it be applicable and why to undertake additional “hourly modifications” in reaching optimal solutions?

3. In page 11 few details are given about gas-systems. I would appreciate more comments about potential approaches for using gas system and busting system flexibility.

4. In page 41 a linear storage model is presented. The optimization problem has been solved, but I’d appreciate if a block diagram, in which input and output variables used in the optimization procedure, could be presented. If possible, do the same for the OPF optimization in which

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*