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: Petr Vorobev

I confirm the absence of any conflict of interest 	**Date: 25-09-2021**

Reviewer's Report

The presented thesis is dedicated to an important problem of quantification of power systems flexibility and considers three different areas of application: energy storage use, combined heat and power markets, and power market operation under stochastic environment. I would like to note that the thesis applies advanced mathematical methods to practically important problems. It is especially true for the case of energy storage, where the thesis provides a new modelling approach that allows an accurate assessment of the storage capacity needed for power applications by applying more realistic storage models. It is to be noted, that the area of storage application in power sector is a rapidly developing field in terms of industrial applications all over the world, and the method developed in the thesis has a very good potential to advance into practical applications.

The scientific level of the thesis results corresponds to the world-level state-of-the-art in the field, which is confirmed by the fact that the thesis already resulted in publications in two best journals in electric engineering and a number of conference papers. In additional to its academic merit, I believe that the thesis results can and should be used to initiate some industrial projects. My suggestions below should be considered rather as an extension of the thesis work, since the thesis itself is written on a very high level and is ready to be defended in its present state.

1. For the energy storage application, I suggest to use a number of real-life test cases to illustrate the method advantages. The topic of storage application on a distribution grid level is now widely discussed in Russia with a number of pilot projects being launched, and in my opinion thesis results can be put into practical application rather quickly.
2. Regarding the combined heat and power markets, a certain practical case can be developed, explicitly comparing the proposed methods to solutions now used in practice. It is especially actual for Russia with its high demand for heating and extensive use of combined heat and power plants. Optimization of the heating sector is considered to be one of the most promising ways to reduce the carbon footprint and the thesis results can be used to offer new ways for heating systems modernizations.

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*