

TRANSNATIONAL ACCESS USER PROJECT FACT SHEET

USER PROJECT	
Acronym	VALERIA
Title	Validation of low-voltage energy and renewables integration analysis
ERIGrid Reference	06.007-2019
TA Call No.	6

HOST RESEARCH INFRASTRUCTURE			
Name	TECNALIA Research and Innovation, Smart Grid Technologies Laboratory (SGTL)		
Country	Spain		
Start date	19/01/2020	N° of Access days	10
End date	01/02/2020	N° of Stay days	14

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1. USER PROJECT SUMMARY (objectives, set-up, methodology, approach, motivation)

Dynamic stability analysis has been identified as one of the fundamental issues with increasing renewable energy penetration. To tackle this issue, elena international GmbH and the Potsdam-Institute of Climate Impact Research developed the open source library *PowerDynamics.jl*. It was presented during the Openmod Conference 2018 as well as the Wind Integration Workshop 2018. During our access to the TECNALIA testbed, we aimed at validating this open-source library.

In order to achieve this, we conducted fault scenarios with six different testcase setups, that is six different grid topologies. For each testcase, a couple of fault scenarios was performed, like frequency deviations, line faults or a power setpoint dispatch. The most promising fault scenarios were chosen and the corresponding models were implemented and simulated with *PowerDynamics.jl*.

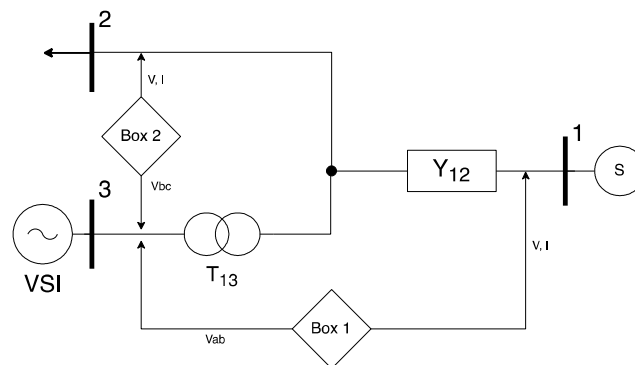


Figure 1. Exemplary setup of a testcase.

2. MAIN ACHIEVEMENTS (results, conclusions, lessons learned)

The main achievements were to find concrete steps for improvement of *PowerDynamics.jl*. First, the software library contains a node macro which makes it very convenient for users to implement the dynamic equations of an inverter without having to deal with the details and challenges of operation point search and numerical integration of a large dynamical system. On this specific manner, we are quite satisfied with the current state of our software. Once the equations and exact parametrization were clarified, it took only a few lines of code to implement the control schemes of TECNALIA's custom built current source and voltage source inverter. In some detail, there is still room for improvement of the node macro, e.g. regarding the implementation of fictitious impedance in the voltage source inverter.

Another challenge was the question of (frequency) reference frames, especially in case of islanded scenarios which will lead to some design changes in the open source library. For more accurate results, we further found that the load and line models of the library should be improved. In conclusion, VALERIA access helped us to evaluate which parts of the simulation and software should

be improved to come even closer to the values measured. We hope to address most of the aforementioned issues in the next major release of *PowerDynamics.jl*, in order to make the software even more useful and convenient, not only in the context of theoretical research but also for practical applications as the dynamical stability analysis of inverter-based microgrids.

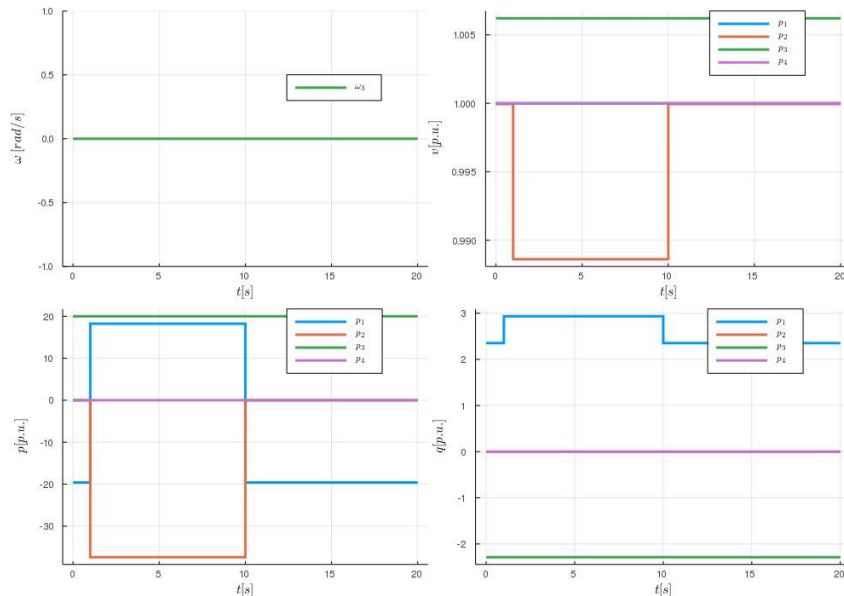


Figure 2. Simulation in *PowerDynamics* with a current source inverter (green), load (red), slack (blue) and a connector node (purple). The fault is a large increase of the resistive load.

3. PLANNED DISSEMINATION OF RESULTS (journals, conferences, others)

We submitted an abstract to SoftwareX, Elsevier, Special Issue on Energy System Models, and are waiting for a reply. Further, we plan to write a paper or give a talk at the CIRED 2021 conference.

4. PLANNED DISSEMINATION OF RESULTS THROUGH ERIGRID CHANNELS

Contact erigrd-ta@list.ait.ac.at to organise promotion of your results

After a new version of *PowerDynamics.jl* with improvements based on the ERIGrid access, it would be great if results could be disseminated via ERIGrid channels.