Analysis of the FMI protocol as an alternative for the model-base certification of installations based on converters according to TG 4

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- Functional Mock-UP interface protocol (FMI protocol)
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What makes FGW e.V. special

- Demands guidelines as a regulator for decentralized energies for 40 years.
- Development association as a neutral mediator in the industry.
- Creation of technical guidelines as instructions/recommendations in practice.
- 150 members represent the entire value chain.
- Well-structured network of experts for professional contacts and trusting cooperation.

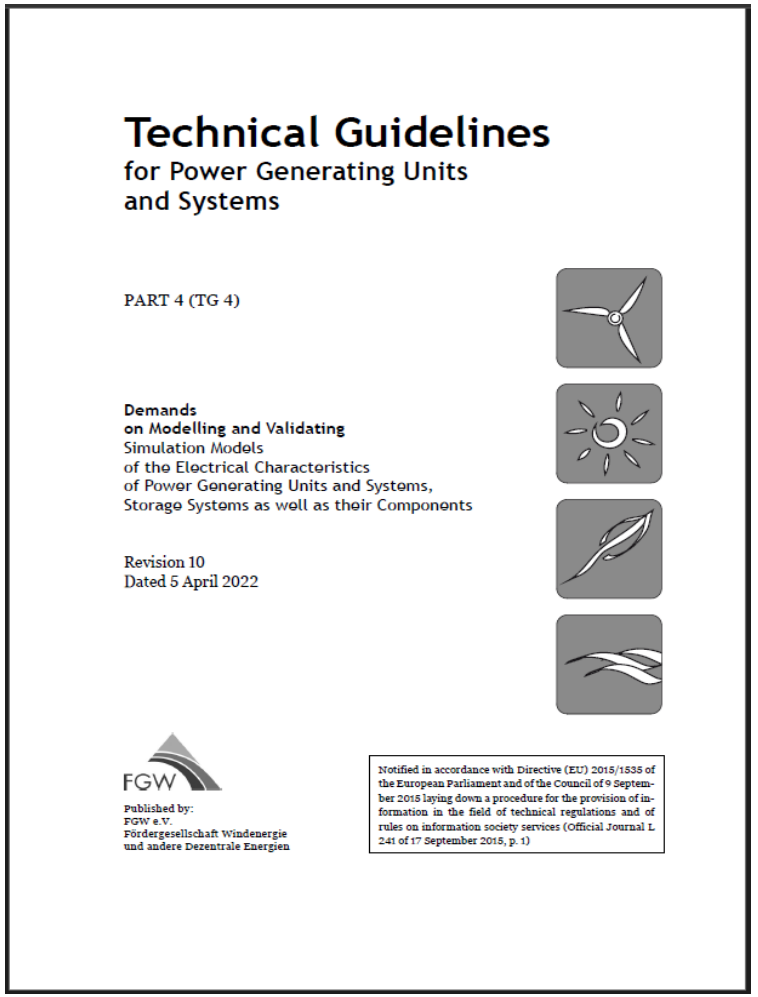
FGW webpage

What FGW e.V. does for the industry

- Guideline expertise in the field of decentralized energies.
- Reliable and targeted provision of information.
- Recommendations for national and international regulations and drafting of legal requirements.
- Active co-determination of the state of the art.
- Efficient and modern committee work.
- Needs-based, flexible and tried-and-tested working methods.

Technical Guideline 4 (TG 4)

- Demands on Modelling and Validating Simulation Models of the Electrical Characteristics of Power Generating Units and Systems, Storage Systems as well as their Components.
- AG Einheitliche Schnittstelle.

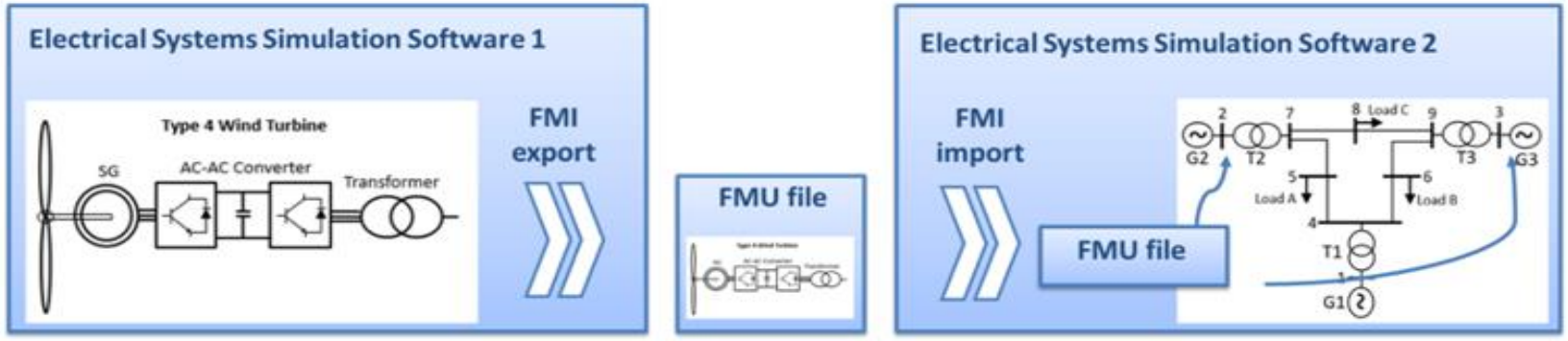


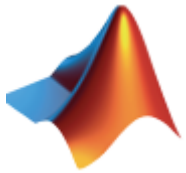
Functional Mock-Up Interface (FMI) protocol

- FMI: Characteristics
  - Free standard.
  - Improve interoperability between different simulation tools, enabling the **exchange of dynamic models** and the integration of various simulation environments.
  - Modelica Association Project (MAP) FMI. Since 2008.
  - Implemented in more than 170 programs.
  - https://fmi-standard.org/.

Objective

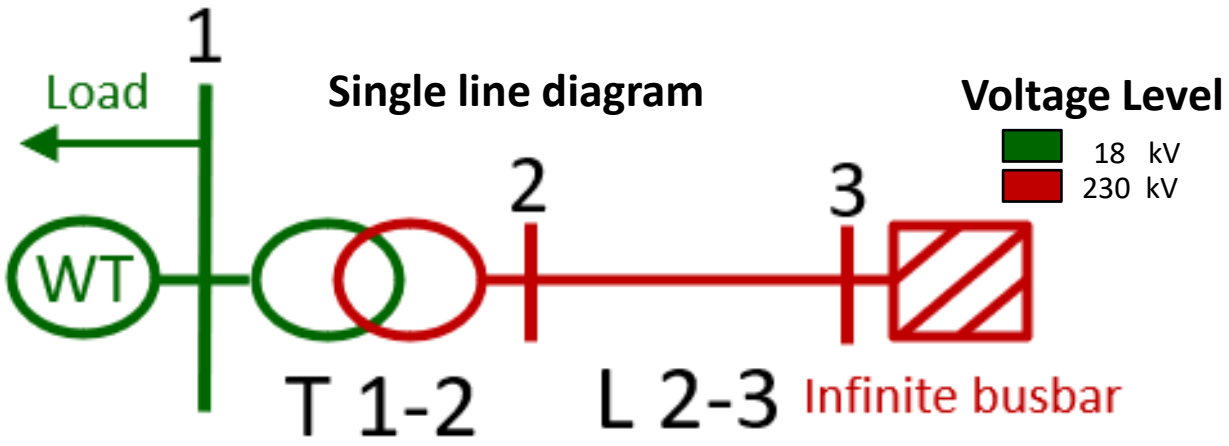
- General objective
  - Propose improvements in the technical guide TG 4.
    - Power-electronic based generators.
    - Is it possible to use/include the FMI protocol in the TG 4?.

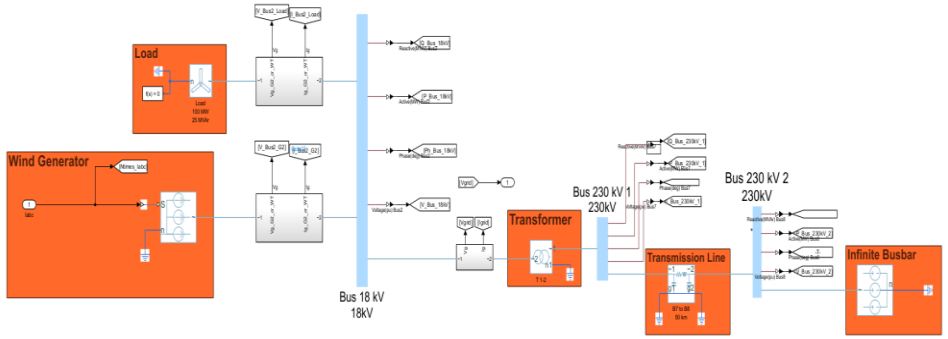




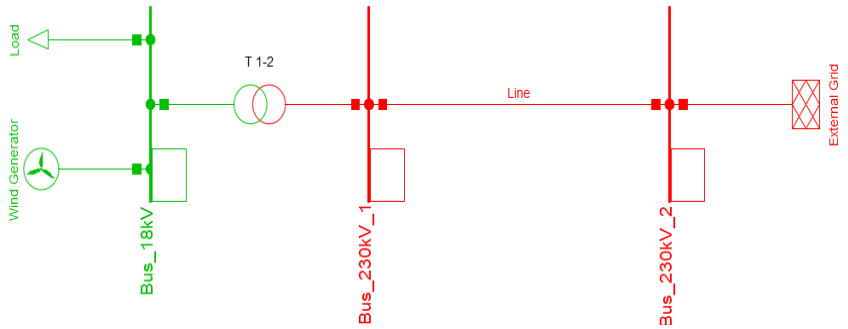
Modeling

- Grid





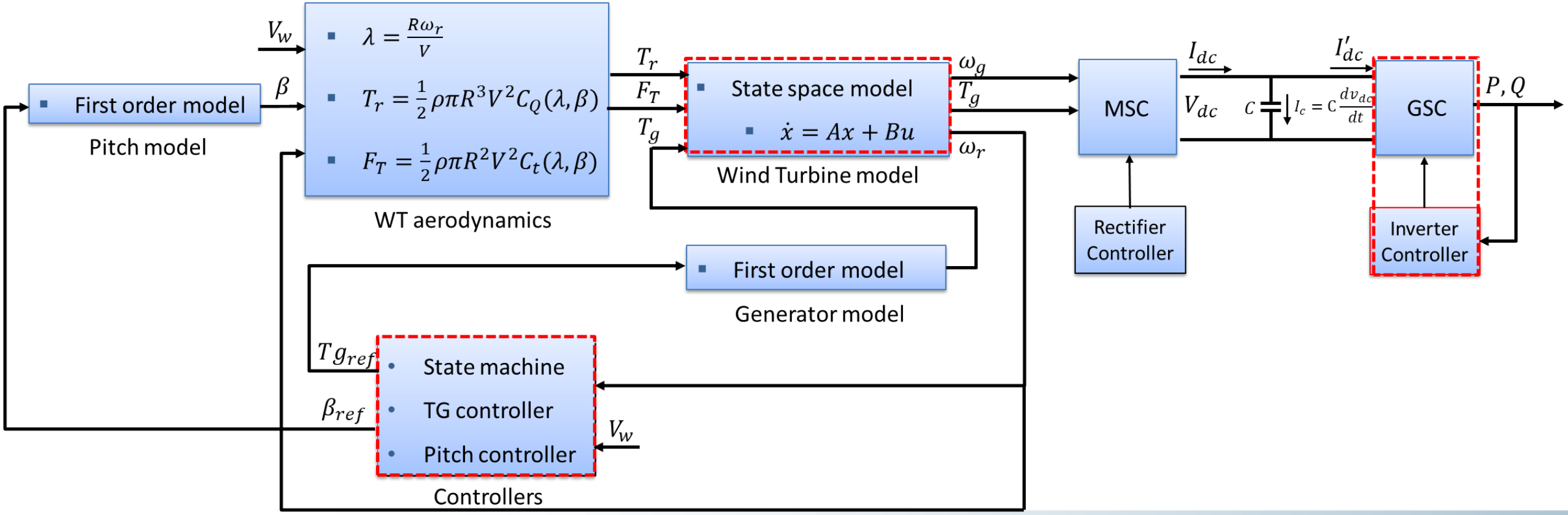
Simulink



Power Factory

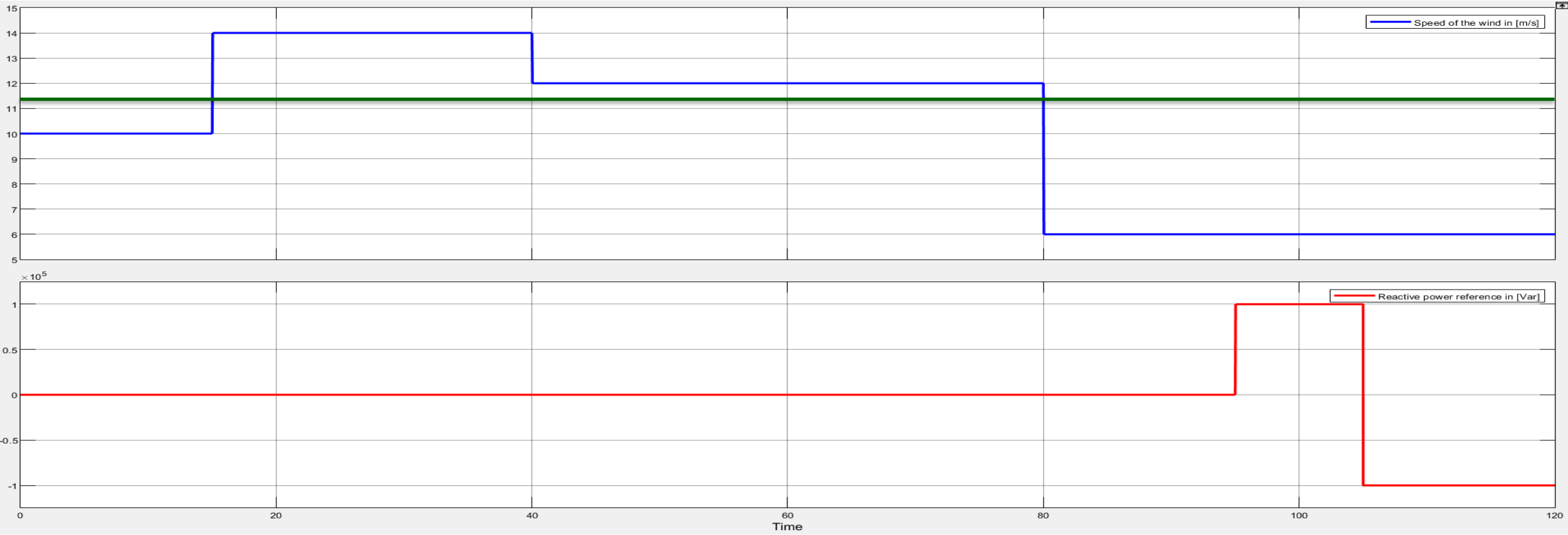
Modeling

- Type 4 Wind Turbine NREL 5.5 MW. Diagram.



Results

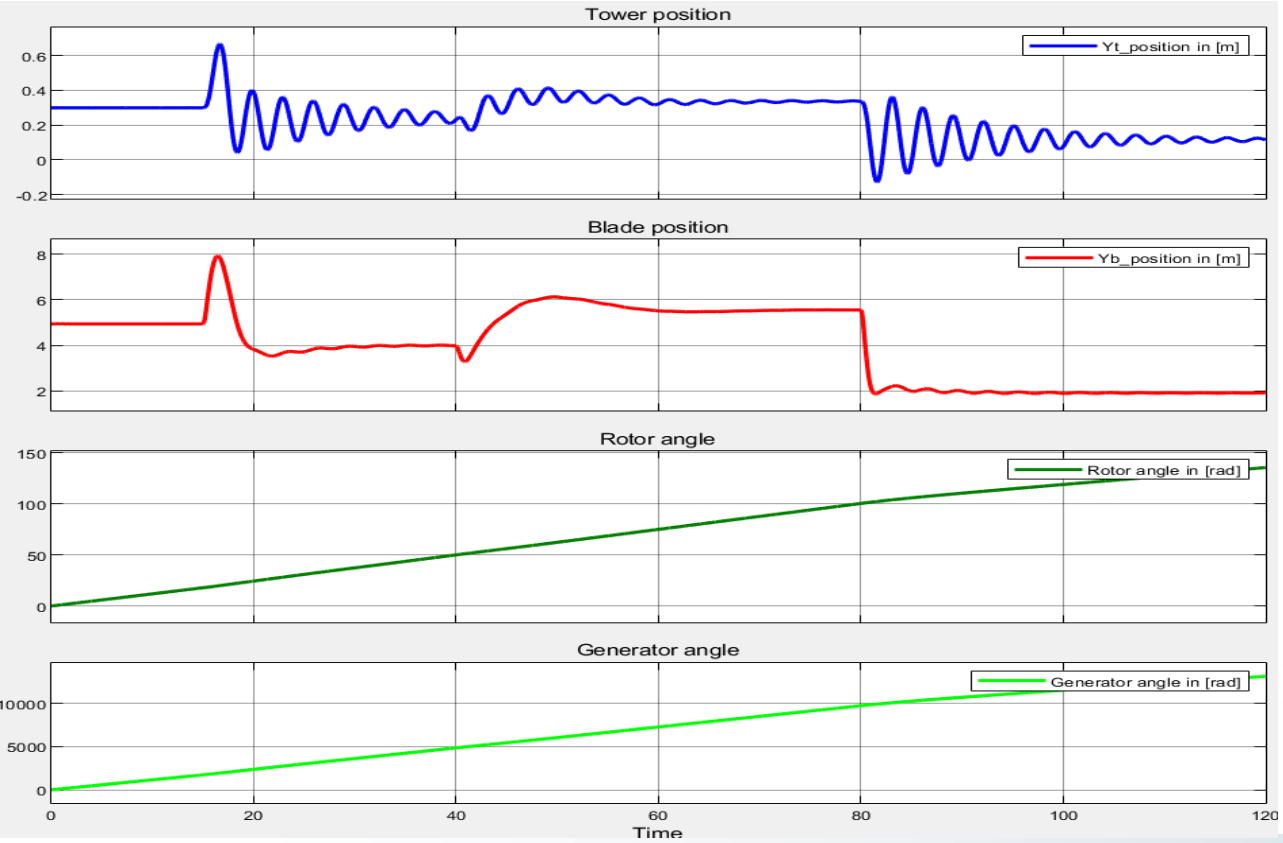
- Events: Wind speed variation and reactive power reference variation.



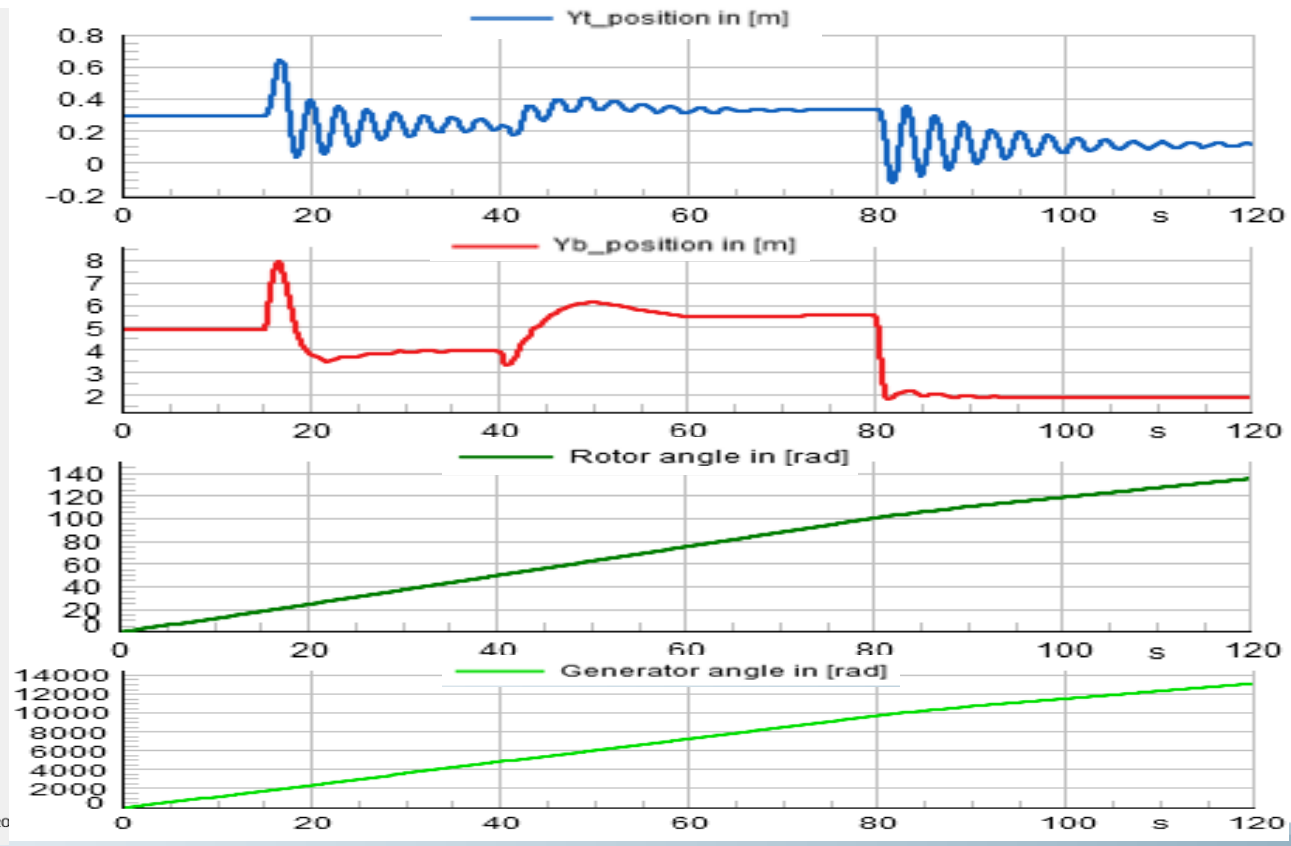
Results

- State space model: State space variables.

Simulink



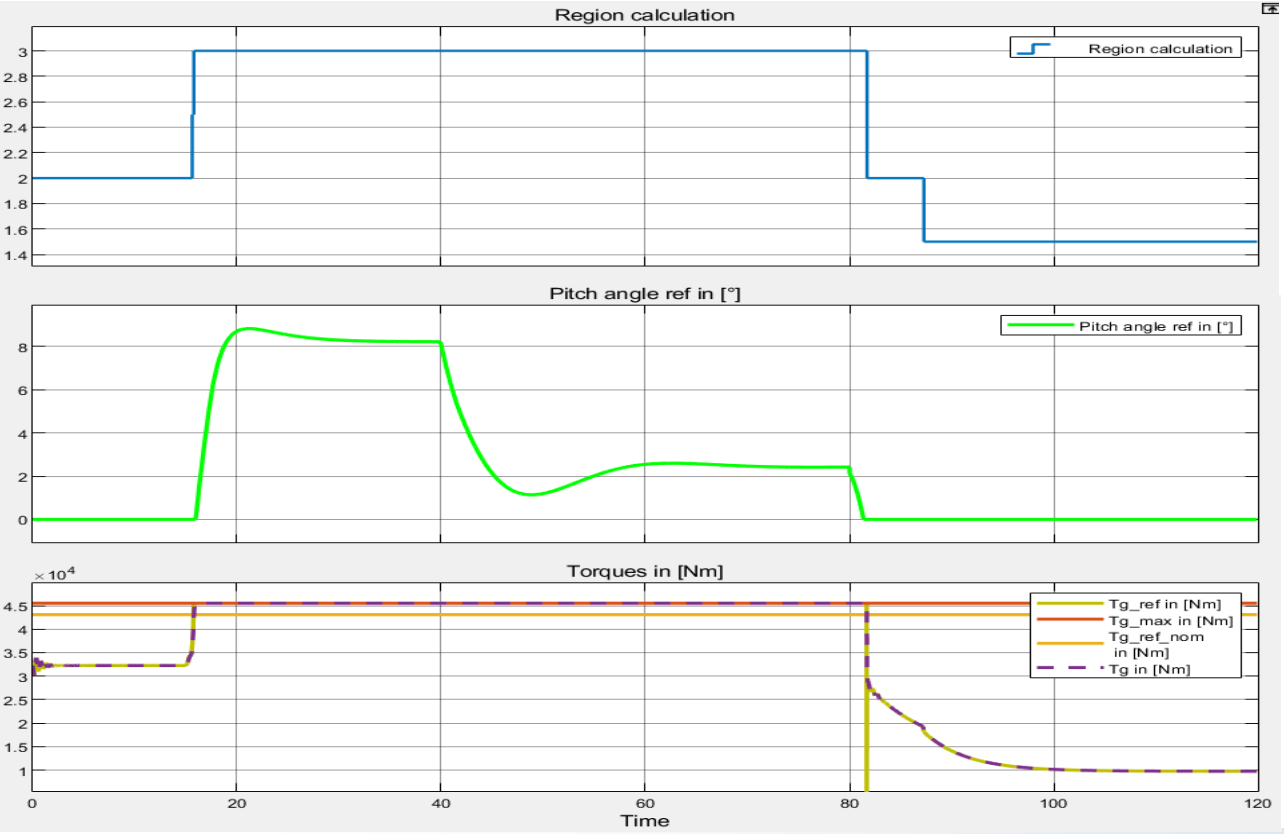
Power Factory



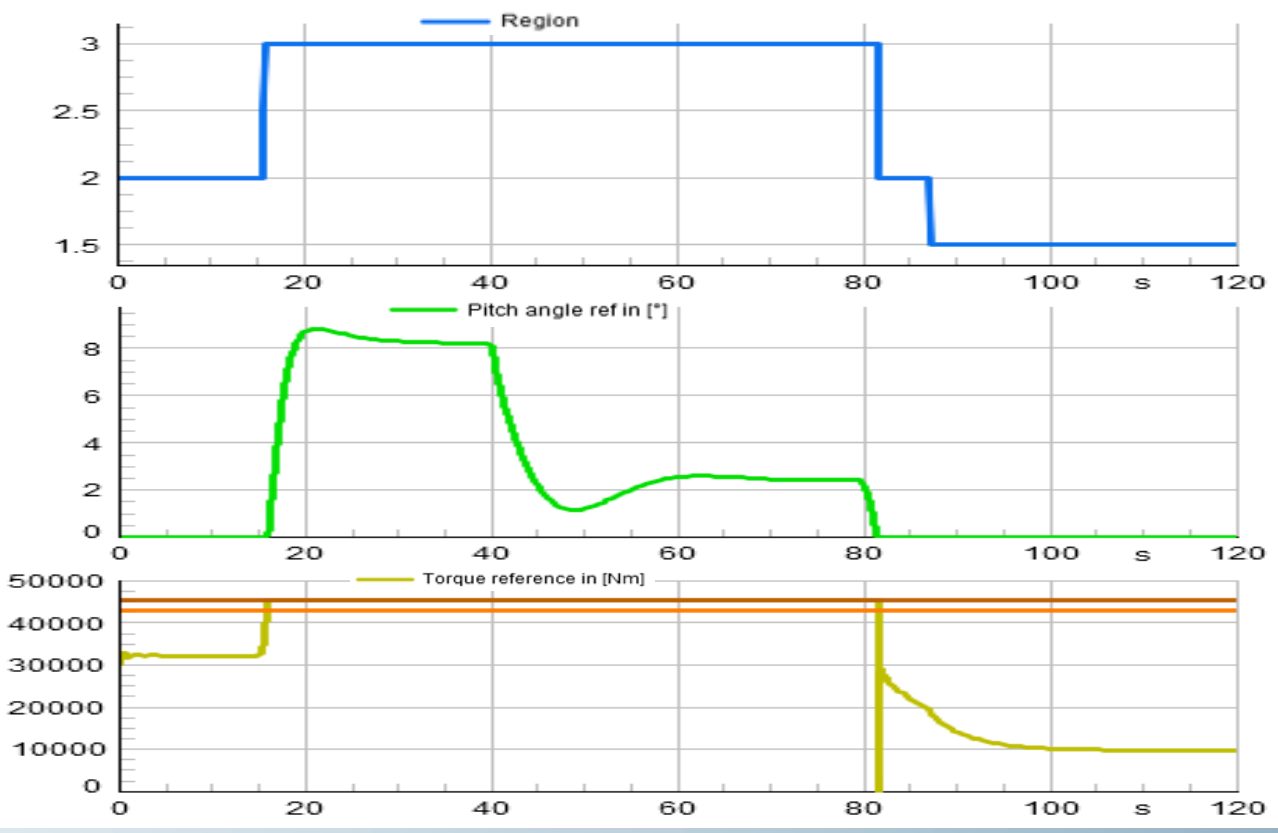
Results

- Pitch and torque-generator controllers.

Simulink

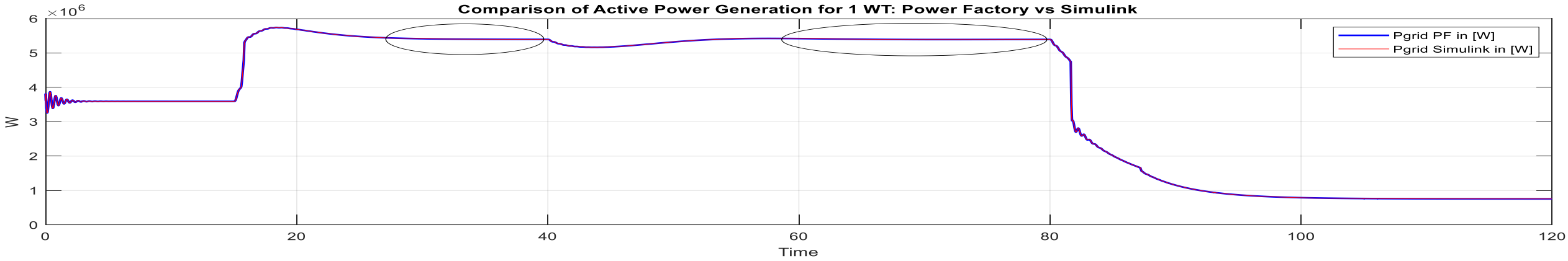


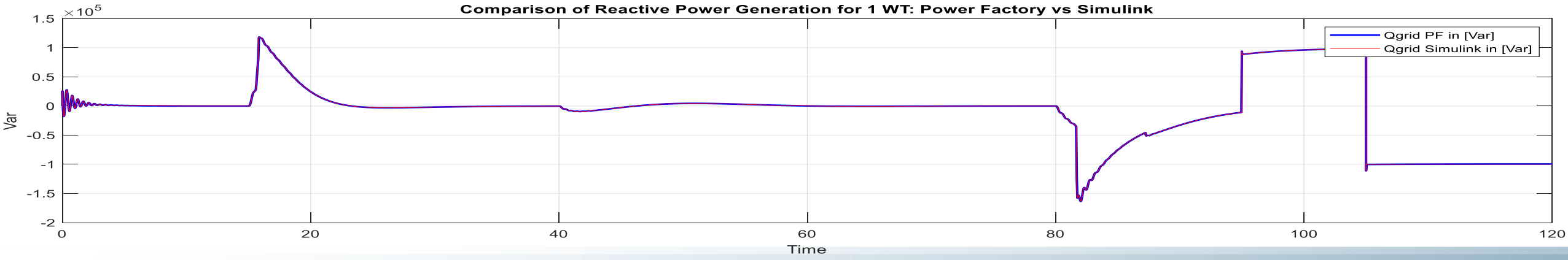
Power Factory



Results

- Grid Side Converter: Simulink and Power Factory, active and reactive power.





Conclusions

- Proposals for the TG 4
  - It is possible to propose the use of the FMI protocol as an alternative for the model-base certification of converter-based projects.
    - No differences were found in the observed variables.
    - Definition of the parameters, and input and output variables.

- Main limitations
  - More test considering other:
    - Programs,
    - Technologies,
    - Controllers,
    - Events.

Thank you for your attention
Questions?

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