Interconnection Process: Symptom or Solution – OEM Perspective

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The Interconnection Process is Broken

When Considering Grid Reliability

- The goal of the Interconnection Process is to connect as many resources as possible
- ISOs/TSPs have motivations to meet political renewable energy goals
- Developers have motivations to build and operate or sell as many resources as possible
- Consultants have motivations to get as many studies done efficiently as possible
- OEM have motivations to sell IBR

Process and Implementation is the Root Cause

Not Necessarily the Players

- ISO/TSP need to trust the data they receive
- OEMs may not always be asked to provide the right model for the right task
- Developers may not have the technical expertise to request the correct study inputs or to review study results
- Consultants need to utilize only the inputs described in their scopes and carry out only the defined scope

Where are the Gaps?

Overall Lack of Knowledgeable Resources

Inaccurate Models = No connection = No sales

Models are required through the entire project life cycle, and they become more demanding as markets mature.

- There is a large deficiency in modelling experts
  - Frequent pushback against new studies and processes because of the lack of resources to perform the work and costs associated with developing these resources
- There are very few tangible consequences for submitting poor data (as long as the data responds well)
- Business and political goals most often have higher priority than grid reliability
- Scope blindness

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How Can We Fill These Gaps?

More Knowledge in the Industry and Better Data

Inaccurate Models = No connection = No sales

Models are required through the entire project life cycle, and they become more demanding as markets mature.

- All participants in the Interconnection Process should have a thorough understanding of what is being studied, why it is being studied, and how the inputs effect the results
- The interconnection Process needs better inputs
  - Additional verifications and validations early in the study process to show plant model accuracy
  - Better due diligence from Developers and consultants with regards to using the best data at each step
  - Knowledge, resources, and regulatory tools at the Governmental and ISO/TSP level to ensure there is a motivation to submit accurate data at every single step

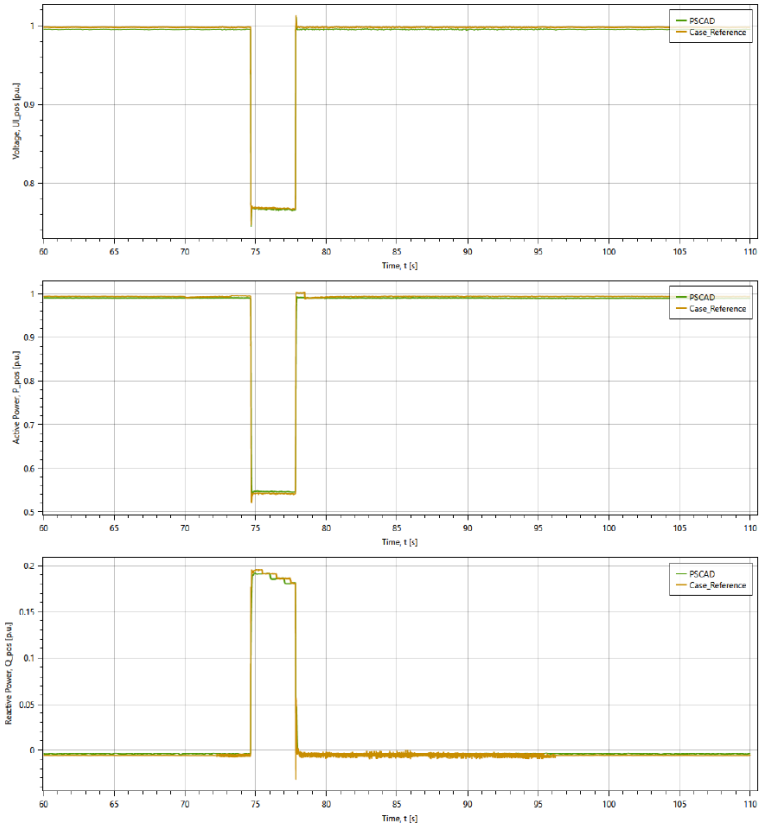
What is Vestas Doing?

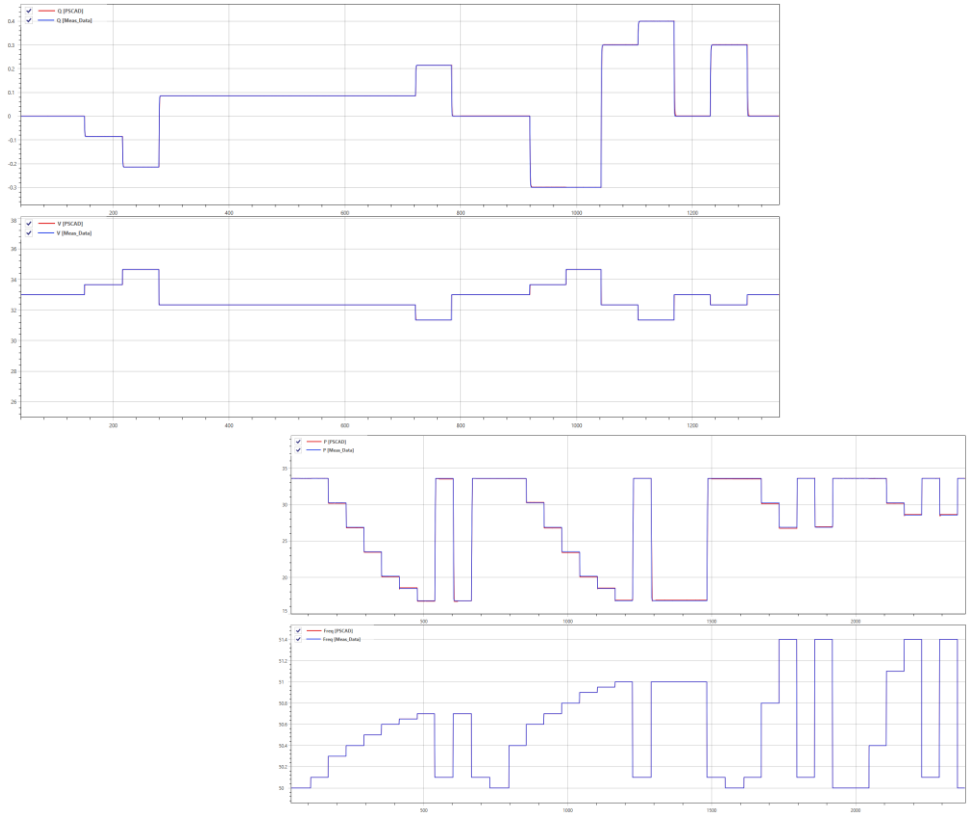
Increasing Industry Knowledge and Pushing for Better Practices

- Numerous discussions with customers, ISO/TSP, and Industry Groups to promote proper model use and practice
- Providing validation reports for most all models
- Updating all in-service and proposed plants with site-specific models
- Providing dynamic and tuned solutions to mitigate unnecessary transmission expansion
- Working in an Officer's Role on IEEE P2800.2

Vestas UDM Results Versus Reference Data

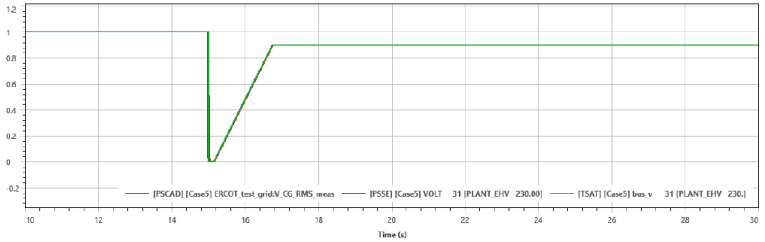
WTG Fault Ride Through and PPC Frequency and Voltage Reference Changes

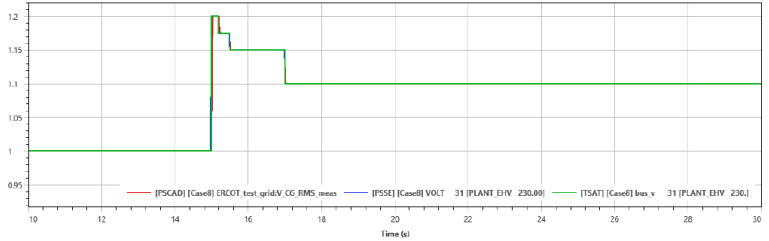


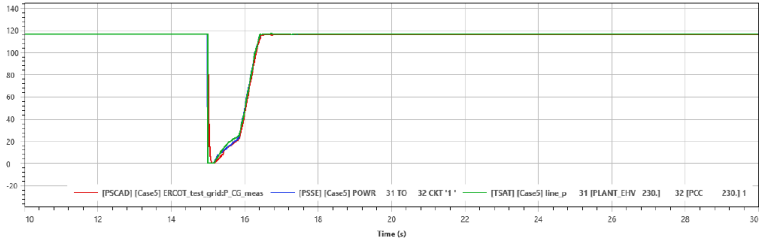


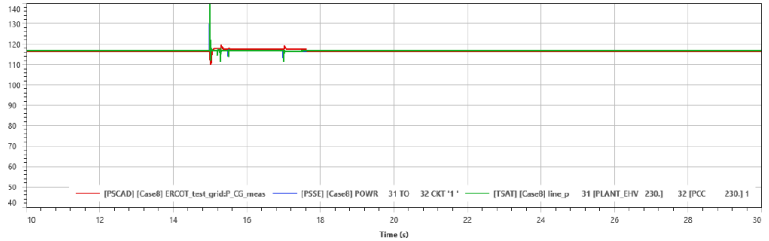
Vestas UDM Results Across Different Software

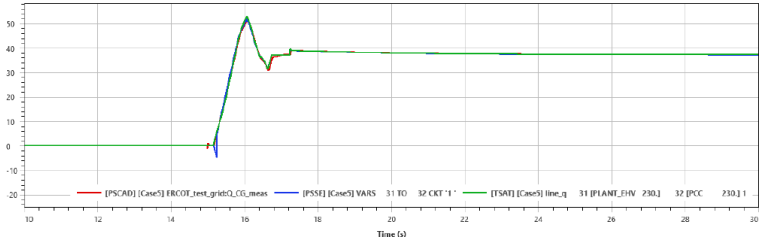
High Voltage Ride Through and Low Voltage Ride Through

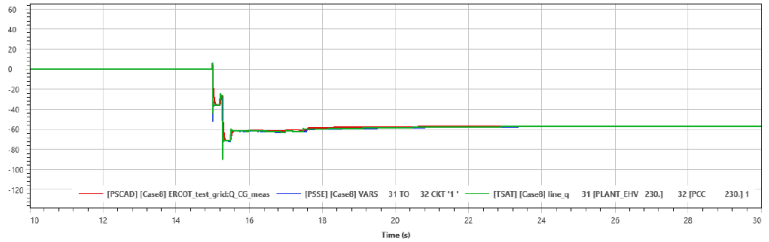












Vestas UDM Results Versus Site Measured Response

Direct Parameter Download from Site Software Produces Results Within 1% of MOD-026 and MOD-027 Tests