

**ESIG Webinar: Modeling Inverter-Based Resources: Findings, Observations, and Challenges Ahead**

Question	Answer
Any progress on 'platform/tool-independent' representation of plant model data? PSCAD may move onto something else or the right tool for the right phenomena.	There is a CIGRE/IEEE joint effort focused on real-code models that could be more platform-independent. In terms of modeling the entire facility in a plant-form independent way, I am not familiar. This would be a very interesting activity for IEEE, CIGRE, or the software vendor community to initiate.
You mentioned that the NERC guideline for EMT modeling will go out for industry comment - is this limited to specific groups? Do you have an expected date?	The NERC guidelines are publicly posted on the NERC website for industry comment. We expect the guideline to be posted for comment early Q1 2023 and ideally published in March 2023, if the team can respond to all comments received.
Are you concerned about the performance implications of running a large number of EMT models? (edited)	NERC reports have highlighted the computational and staffing concerns associated with EMT modeling/studies; however, there are notable reliability risks if those studies are not conducted to ensure BPS reliability.
Do you know the grid code(s) used (e.g., IEEE 2800)? Were the plants tested for grid code compliance?	As IEEE 2800 was approved in mid-2022 and the plants involved in the 2022 Odessa event were older than this, I would assume that these plants were not tested for any conformance with the IEEE standard. Furthermore, the IEEE 2800.2 activities are still underway, so there are no unified ways to test conformance with the standard.
Do you think data-driven parameterization of existing generic IBR models would be useful?	No. Models should be based on actual equipment, settings, controls, and protections installed in the field. With sufficient documentation to justify the model.
Do you think modelling wide area network model to include all protections and dynamic models is practical in EMT tool and run studies?	Modeling certain protections in dynamic models could go a very long way in early detection of protection settings that would cause performance issues, etc., as we have seen with past IBR-related events. Modeling all protections is not practical.
What did you find for the small stuff? Has the IEEE1547.1 roll out been effective there?	No DERs were involved in the 2021 or 2022 Odessa disturbances. I believe IEEE 1547-2018 and associated .1 activities have helped improve ride-through performance for DERs; however, international colleagues have stressed that conformance with IEEE 1547-2018 does not necessarily equate to ride-through.
To what extent should we just mandate certain model quality expectations across the board regardless of grid strength where plant is connecting?	Recent NERC SARs and standards projects are moving in that direction. I believe model quality checks/requirements should be established industry-wide consistently to ensure accurate models for all newly interconnecting projects.
Which's the best way to check model quality and a good representation? Because doing that for hundred of plants could be very onerous for ISOs	Put the onus back on the developers and GOs to provide proof of model quality, rather than putting all the onus on the TP/PC to do all that work themselves. It should be a part of the interconnection requirements and process.

What are feasible options in the planning timeframe. Are generic EMT models any use? Can assumptions in planning studies be 'built in' to interconnection reqs? (edited)	I strongly discourage generic models across the board. Models representing actual plants connected to the BPS should be represented with accurate and validated/verified models from the plant owner and attested by the OEMs. In some cases, legacy plants or far-out exploratory studies may use "generic" models to the extent needed based on circumstances.
Can +ive sequence models be derived in a rules-based manner, from the detailed EMT specification? Also important to know when the +ive sequence models fail.	I am not sure what rules-based manner means. But NERC recommends model benchmarking across platforms to ensure uniformity to extent possible.
Is there scope to use high-performance surrogate models (at least one order of magnitude faster) in lieu of the actual EMT model?	I am not sure what surrogate models means. EMT modeling/study practices are improving everyday, with faster studies being conducted. While we have a long way to go, computational capability is improving rapidly.
The focus appeared to be on trips. How about operational issues such as out of bound voltages, due to reverse flow, specifically on the distribution system?	DER impacts are outside the scope of this presentation.
During the fault, the voltage waveform distorts and there is a zero crossing , how to avoid such Inverter trippings	Inverter manufacturers have ways in which they can avoid tripping for distorted waveforms - it is an essential reliability service.
How much of the SI that triped used IEEE-1547 2018 settings?	I am not aware of any that used IEEE 1547-2018 settings, as those should NOT be used on the bulk power system. IEEE 1547 is applicable to distribution-connected resources only.
Is NERC developing an explicit pro forma list of modeling requirements for IBRs?	NERC is developing guidance material in this area, and providing references to entities that have modeling requirements established.
Are there any standards-based approaches we can consider in the model in-take stage during connection, and potentially a larger role for OEMs?	Yes, standards could be used to ensure sufficient model quality checks and studies were conducted. NERC FAC-002 covers this and industry is considering revisions to it to address these issues. OEMs can and do play a big role in the interconnection process and should be active in ensuring model accuracy through the process.
I am interested in joining a working team to resolve these issues. I was on past NERC working teams. What is the process now?	Feel free to reach out to me. My email is ryan.quint@nerc.net
After Commisioning is it necessary to validate the models with the real response, coordination and performance of DER's when connected in Parallel with others?	DERs are outside the scope of this discussion. But yes, NERC standards are being updated now to address model verification and validation activities more comprehensively for BES resources.
Why does NERC's DER Strategy not mention IEEE 1547-2018, but NERC's IBR Strategy does mention IEEE 2800-2022?	NERC is working with state regulatory entities on adoption of IEEE 1547-2018. Generally speaking, the state regulators are the authorities governing interconnection requirements for DERs. This is covered in the strategy.

Are the EMT models detailed or equivalent. If detailed why detailed ... please may explain	Generally the EMT models are an equivalent aggregation of the plant due to computational limitations of the detailed representation in larger studies.
How can we join EMT Task Force?	An announcement will be sent out to industry for participation. Feel free to join NERC IRPS and/or EMT Task Force by reaching out to me at ryan.quint@nerc.net.
Seems like a lot of fixing as you go - will grid codes and plant obligations once in service also be updated?	Interconnection requirements need to be enforced, and NERC standards are being updated to ensure performance obligations are met.
Is it realistic to model the large numbers of the SI? Are you lumping them into different design configurations/settings? Do you have all of the SI designs?	Yes aggregated models are used to represent IBR facilities.
Who can take part in the NERC standardization effort mentioned with the December 22 reliability guide?	Anyone can nominate themselves to participate on NERC Standard Drafting Teams. Feel free to go to the NERC website and search for standards for more details.
Modeling accuracy is vital in the semiconductor space too. If model is bad company goes bankrupt. How do GO's have "skin in the game" to give a good model?	Interconnection requirements need to be enforced to bring that "skin in the game" to the forefront.
Why doesn't NERC require only UDMs be provided to pass TP requirements? Since every plant design is different, UDMs make the most sense for model accuracy	NERC has provided guidance on this, and is enhancing that guidance now. However, per MOD-032 standard the TP/PC establish their own modeling requirements.
Do you beleive that in the future, we will do more recordings during power plant commissioning to validate models?	I would hope so. But those will only be small disturbance and therefore we need more than that to validate the large disturbance behavior.
Is there is a limit on time of simulation for Harmionics study using EMT models? and what are other parameters you consider while performing these studies?	I am not an expert on harmonics studies, and therefore will not attempt to answer this question.
Has the proliferation of real-time asset monitoring, online equipment diagnostics, remote sensors, etc. had positive impact on quality of equipment models?	In situations where that monitoring is REQUIRED by interconnection requirements, then it is useful. However, without those requirements, developers tend to have poor monitoring at the site which greatly hinders event analysis, model validation, etc.
Are generator underexcitation and overexcitation with other electrical protections, eg AVR limiters acts before protections	Coordination of limiters and protection is required per PRC-019. However, we occassionally see plants tripping which makes one wonder why the limiter did not catch it.
Do you need maximum values for 1. Rate of change of frequency. 2. AC Grid phase jumps. 3. Rise time of item 2. This is worst case for validating a controller	This type of information can be provided by the TP/PC during interconnection studies. I believe they should be established in interconnection requirements to the largest expected reasonable change/jump/rise/etc. ROCOF protection should be disabled for BPS-connected facilities. AC phase jumps of 40+ degrees are normal, so those limits should be significantly higher.

What about economics compensation to or by DER's when events or deviation occurs	DERs are outside the scope of this discussion.
Are we ready to see any of these issues in Distribution networks yet?	DERs are outside the scope of this discussion.
Are all of these tripping causes verified as incorrect trips?	Yes, they are unexpected and considered incorrect since none of these resources tripped consequentially due to the faulted element and voltages and frequencies were well within the "no trip zone".
Are EMT studies fast enough with the current computational capabilities, to update the planning decisions on the fly?	Planning decisions are not made "on the fly". This type of challenge is more applicable to operations studies.
what is the meeting ryan is referring to? How do we attend it? Any link to it please?	NERC DER Workshop. Materials will be posted publicly to the NERC SPIDERWG webpage.
Slide 23-The WTG power becoming zero after fault-IS it due to a stability issue? Since EMT and actual equipment matched, Is it that Pos Seq model be corrected?	No it is due to OEM choice/design. This is very common and not widely known by grid planners because the positive sequence models don't show it. This is a risk.