Session 4: Importance of Modeling	
Question	**Answer**
Pouyan - Why will Australia then move away from PSSE and go full into EMT (Hypersim)	This is really a question for AEMO, I cannot presue to answer for them. The though is simply offered that it would not make sense to fully move to EMT. For example, power flow contingency analysis will always remain a critical part of planning, and is most effectively done in positive-sequence power flow programs.
Deepak, how do you propose to do model validation in the planning phase, i.e. before I can measure plant level behavior?	The aim is not carry out model validation in the planning phase. Model validation and parameterization can only be carried out later on in the interconnection resources. But, in the planning phase, if generic/default parameters were used for a study, it should be ensured that these parameter values are updated.
Hi Deepak. Can you share those papers where a correction to the RMS model is adequate and did not lead to the need for an EMT model	1: Deepak Ramasubramanian, Xiaoyu Wang, Sachin Goyal, Manjula Dewadasa, Yin Li, Robert J. O'Keefe, and Peter F. Mayer, "Parameterization of Generic Positive Sequence Models to Represent Behavior of Inverter Based Resources in Low Short Circuit Scenarios," Electric Power Systems Research, Volume 213, 2022, 108616 2: Deepak Ramasubramanian, Wenzong Wang, Pouyan Pourbeik, Evangelos Farantatos, Anish Gaikwad, Sachin Soni, and Vladimir Chadliev, "Positive Sequence Voltage Source Converter Mathematical Model for Use in Low Short Circuit Systems," IET Generation, Transmission & Distribution, vol. 14, no. 1, pp. 87-97, Jan 2020 Please note that these new positive sequence models do not imply that EMT simulations or models are not required. This depends on the study that is being carried out. These new models provide an improved confidence in the positive sequence/RMS simulation results

Pouyan - For PRC-024 detailed collector grid is needed for evaluation at plant level and dynamic model required with correct parameters	Not necessarily. This is always a difficult question. We need to move away from deterministic analysis (i.e. prove that not a single IBR unit will trip in a plant for a give fault) to more of a risk based approach (e.g. prove that at least 90% of the IBR units will remain on-line for a given fault with a reasonable confidence level). No level of modeling detail will prove something 100%.
Is EMT used much in Operations or Operations Support?	At ISO-NE our opertional planning group is starting to run PSCAD. They are planning on moving to a process where PSCAD analysis is used to inform operational decisions.
How many simulation seconds does it take to stabilize a load flow for the ISO model in Pscad? And how many machines do you include?	We try to get everything initialized within the first 5 seconds or so. Some older OEM models however required up to 10 seconds to initialize, so it will vary. We include as many machines as we feel we need to. ISO-NE runs EMT analysis for clusters of DERs as well and so we've had studies that included 40-50 separate inverter models. These kinds of studies require very powerful hardware and take a long time to run.
How do we resolve the conflict with requiring models at the time of interconnection request with the fact developers are unlikely to have chosen a OEM?	If the developer has not chosen an OEM, then they should not be requesting interconnection. A valid interconnection request should include specific turbines/inverters and their models.
Could you share any experience on how to maintain UDM/BlackBox models along with the software upgrade?	If this is with respect to EMT, it's not as much of an issue because it uses an external compiler. We require use of intel visual fortran compiler version 12 or higher. As long as we have those compilers installed, then it doesn't matter what version of PSCAD is used. However, you cannot run two models that require different compilers within the same PSCAD instance and so you need to parrallelize them and run each on its own core.
We often see plots of waveforms (RMS or point on wave) comparing model to hardware, how do we actually measure/quantify goodness of fit in each of these cases?	Engineering judgement must remain our approach to determining goodness of fit. Any criteria developed will always give a false positive in some cases. The experienced engineer must always be afforded the opportunity to explain legititate differences between measured and simulated response, and collective consultation lead to agreement of the goodness of fit.
How does grid forming inverter affect model representation?	Not sure what this question means. Grid forming inverters can be modeled and models are being developed as we speak in all software platforms. Some vendors already sell GFM, but it remains and area of significant R&D.
How will you get parameters from Standard Lib models into the equipment?	Consult with the original equipment manufacturer.

Why can't the appropriate models be submitted instead of talking Generic vs. UDM? Some ISO's block certain models.	Indeed, fully agree. We must move away from saying "I only want this type or that type of model". For some OEM equipment the standard models can be parameterized to effectively represent the equipment to a very high-level of accuracy. While in other cases UDMs are needed, becasue the standard library models ("generic models") lack some of the functionality in the equipment. We must move more towards using the most suitable, and simplest, model on a case by case basis.
Hi Bradley, what do you think about the EMT simulation in Power Factory compared to PSCAD?	I am not familiar with EMT in Power Factory so I cannot speak to it.
Should the utility be building the full plant model from the inverter model and xfrmr / collection sys data or should the developer be providing the full model?	Typically, this is the job of the developer (and its consultant) since they have easy access to the details of the collector system.
The presenter mentioned that EMT studies are required for all ISO-NE inverter-based generator facility requests. Does this also include Type 4 wind turbines?	Yes, type 3 and type 4 turbines are considered inverter based resources.
Brad: Does conversion to EMT from RMS model result in a readable / graphical PSCAD model that you can tweak?	Yes, the ETRAN converts the PSS/e model directly into a PSCAD case. / There is now also a software called PRSIM that converts PSS/e to PSCAD
How HIL help validating the code? An old version of the software could be embedded in the HIL the same way an outdated version of the DLL may be provided.	Indeed, comparing models to models is always fraught with the danager that one model is not the latest model and what is actually in the field. Clear and effective consultation among all parties is of paramount importance always, to ensure everyone is on the same page and the latest models are being used.
Does the assertion that the POI looks that same as the detailed model hold under very low SCRs?	Please refer to the Hydor Quebec paper listed in one of the presentation.
Brad - how soon (In the interconnection process) are the transient stability and EMT models required by ISO-NE? Later inverter revisions.How is this dealt with?	EMT (PSCAD for ISO-NE) models are required to be submitted as part of the interconnection request, so really it's required right at the first step. There are opportunities in our process to update the inverters, however signfiicant deviations from the originally planned inverters/turbines can trigger a material modification determination so we always advocate not to change inverters or turbines.