

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

NERC Inverter-Based Resource (IBR) Webinar Series:

Session 5: Modeling Part 1 – Modeling Requirements, Model Creation, Model Usability

June 20, 2023

RELIABILITY | RESILIENCE | SECURITY





***Modeling Part 1 -
Modeling
Requirements,
Model Creation,
Model Usability***

1. SOFTWARE
2. GRID EXPERIENCE
3. MODEL VALIDATION
4. ADAPTABILITY
5. CHALLENGES

1. SOFTWARE

P0-E Offers Modeling support for the following programs

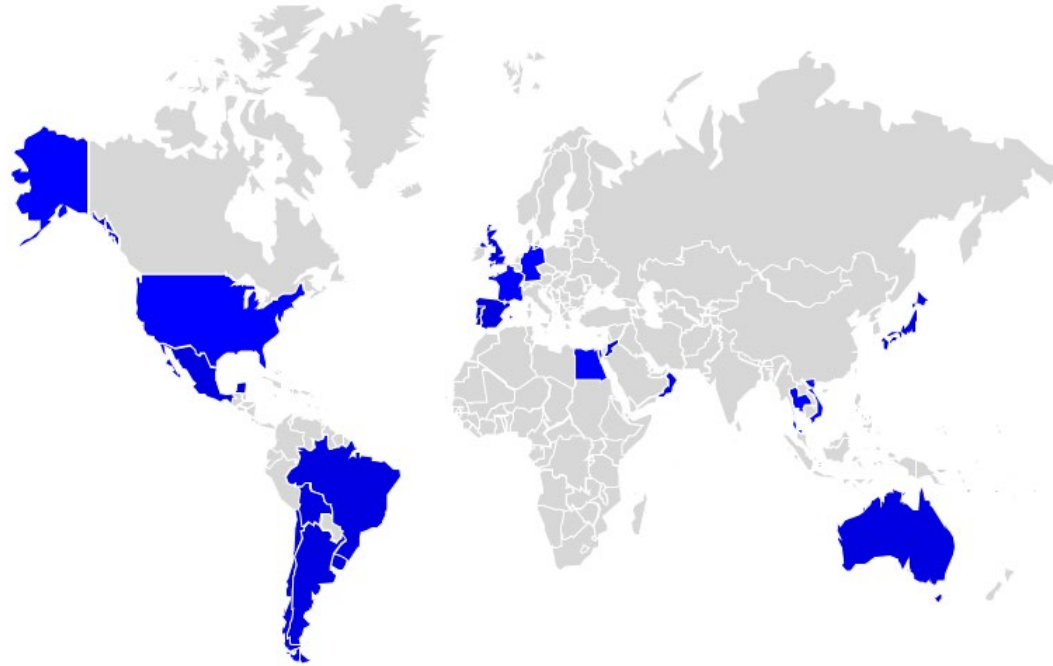
Software



- DlgSILENT Power Factory
- PSCAD
- PSS/E (WECC and User Defined)
- PSLF
- EMTP-RV
- TSAT-SSAT
- EMTP-ATP
- ANATEM

2. GRID CODE EXPERIENCE

- USA
- Australia
- España
- Portugal
- Alemania
- Francia
- UK
- Japón
- Omán
- Jordania
- México
- Brasil
- Uruguay
- Bolivia
- Argentina
- Chile
- Egipto
- Tailandia
- Vietnam



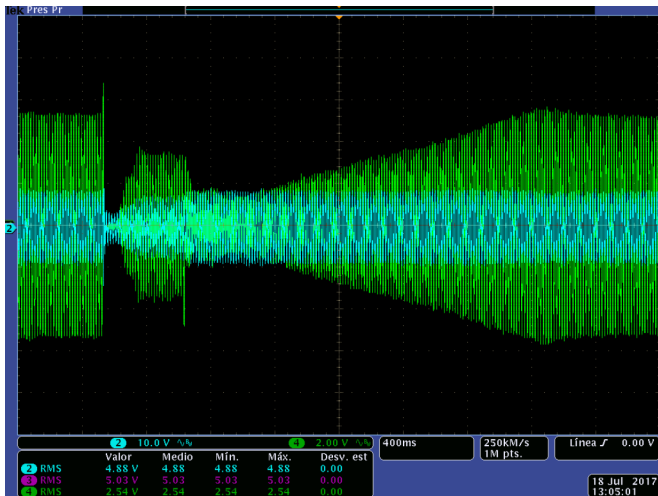
**P-E tries to proactively maintain model compliance but
It is challenging to track proposed updates in the US and
worldwide**

4. MODEL VALIDATION

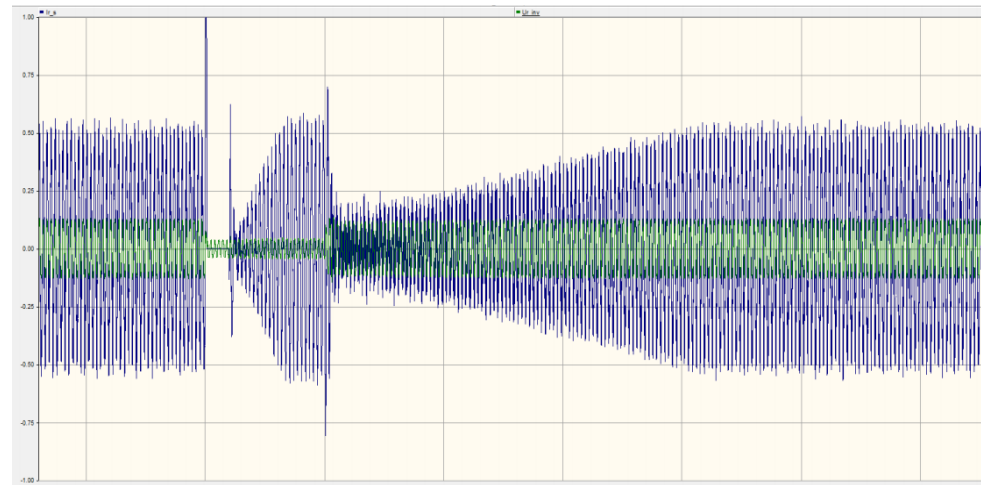
SW	UWM	GENERIC	Application
DIgSILENT Power Factory			Static studies
			Dynamic studies (RMS)
PSS/E			WECC: Dynamic studies (RMS)
			Dynamic studies (RMS)
PSCAD			Dynamic studies (EMT)
EMTP-RV			Dynamic studies (EMT)
PSLF			WECC: Dynamic studies (RMS)

- P-E provides general purpose models that must be parametrized for site specific conditions.
- The Power-Electronics Grid Team is based in Valencia, Spain and can assist with modeling issues and project specific requirements
- Power-Electronics uses it's world-wide experience in places like Chile and Australia to advance the US modeling work
- P-E inverter models are benchmarked against our Hardware-in-the-Loop

HIL



PSCAD



¡THANKS!



A map of North America, including the United States, Canada, and Mexico, is shown in a light blue color. A darker blue gradient overlay covers the central and eastern parts of the map, where the title text is located.

Questions and Answers After All Presentations

Facility Model Creation and Usability Roadblocks

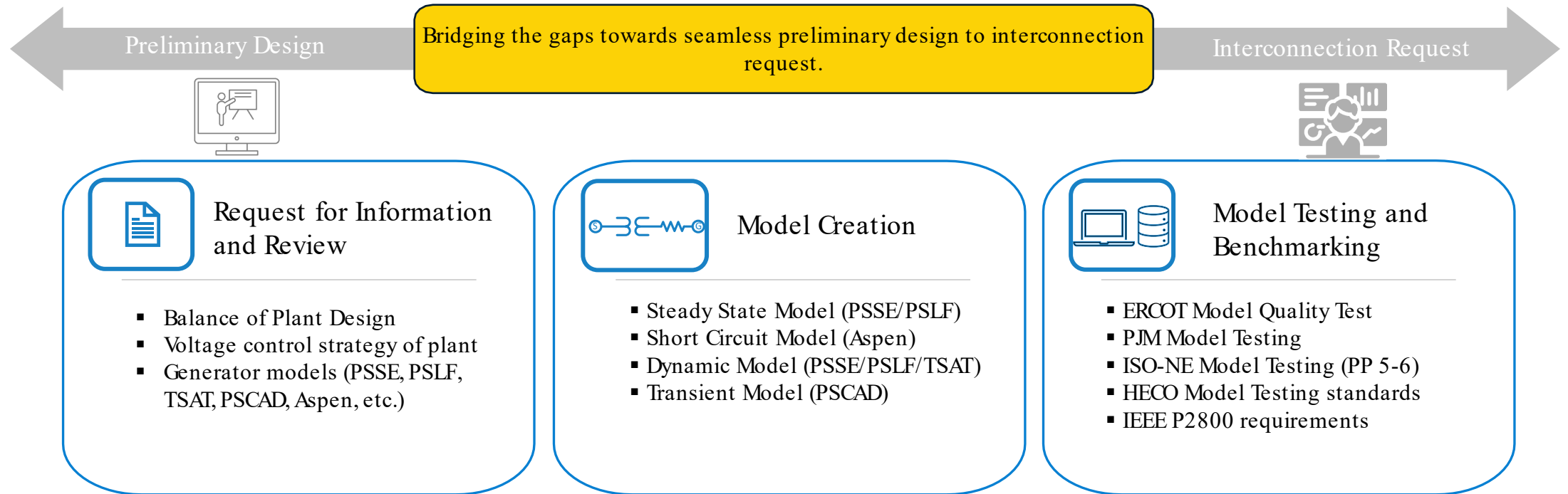
Billy F. Yancey III
VP Technical Services and Compliance

June 20, 2023
NERC IBR Webinar Series



Facility Model Creation Process

The facility model creation process is an iterative process with interaction between multiple parties, i.e., Developers, OEMs, EORs, Consultants, etc.



Facility Model Creation Process

The request for information and review can be a time-consuming process. This is where critical assumptions are sometimes made that can have significant impacts on projects and could lead to need to restudy during the interconnection process or even further down the road during commissioning.



Request for Information and Review

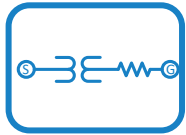
- Balance of Plant Design
- Voltage control strategy of plant
- Generator Models (PSSE, PSLF, TSAT, PSCAD, Aspen, etc.)

RFI Challenges

- BOP Design
 - Typically, very preliminary and subject to change leading to assumptions
 - Inverter selection is still being negotiated and finalized
 - Power Plant Controller (PPC) is most of the time not even in the discussion at this point
- Generator Models
 - Depending on requirements within a region, dynamic and transient models may take extended time to provide due to availability of necessary controls

Facility Model Creation Process

Model creation is typically an iterative process. The assumptions made during the request for information gathering are pre-tested to ensure they meet the necessary requirements and additional equipment/controls are not needed before moving to full model testing and benchmarking.



Model Creation

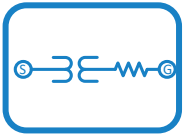
- Steady State Model (PSSE/PSLF)
- Short Circuit Model (Aspen)
- Dynamic Model (PSSE/PSLF)
- Transient Model (PSCAD)

Model Creation Challenges

- Steady State Model (PSSE/PSLF)
 - MPT sizing and OLTC control
 - Need for additional reactive devices
 - Quantity of IBRs and OEM selection
- Short Circuit Model (Aspen)
 - Utilities requested IBRs to be modeled as current limited generators
 - Moved to Voltage control current source (VCCS)
 - Recently requested of converter interface resources (CIR)

Facility Model Creation Process

Model creation is typically an iterative process. The assumptions made during the request for information gathering are pre-tested to ensure they meet the necessary requirements and additional equipment/controls are not needed before moving to full model testing and benchmarking.



Model Creation

- Steady State Model (PSSE/PSLF)
- Short Circuit Model (Aspen)
- Dynamic Model (PSSE/PSLF/TSAT)
- Transient Model (PSCAD)

Model Creation Challenges

- Dynamic Model (PSSE/PSLF/TSAT)
 - Control parameters set as default without any guidance on tuning to meet requirements
 - Minimal to no documentation related to tests to demonstrated compliance with latest requirements
 - Still concerns surrounding VRT response requirement (ERCOT)
 - Protection settings set to default without ranges provided
 - Hybrid PPCs
 - OEMs provide PPC with model even though it is not available or typically installed.
 - No clarity on integrating external PPC
 - UDM vs GM
- Transient Model (PSCAD)
 - Similar concerns to dynamic model
 - Some OEM documentation not clear on P and Q initialization
 - Some parameters are hidden as compared to dynamic model and adjustments for benchmarking can be challenging

Thank You

A map of North America, including the United States, Canada, and Mexico, is shown in a light blue color. A darker blue gradient overlay covers the central and southern parts of the map, where the title text is located.

Questions and Answers After All Presentations

Establishing Modeling Requirements

ATC's Experience in MISO

PRESENTED BY:

Tom Dagenais

Director, System Planning - ATC

June 20, 2023

- ATC Proprietary -

atcllc.com

Introducing ATC

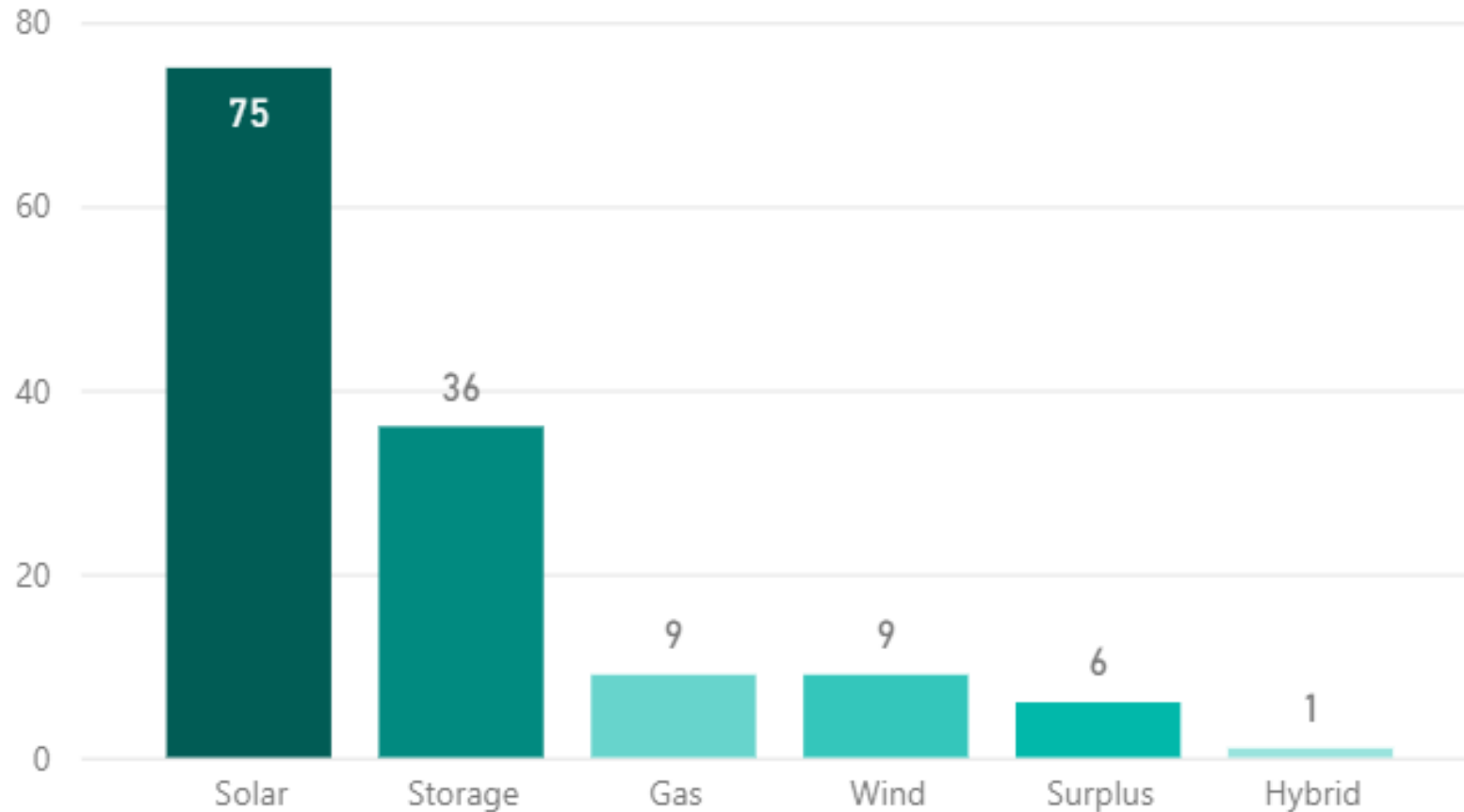
- Wisconsin-based company
- Over 5 million electric consumers in service area
- Over 500 employees making sure you have the energy you need, when you need it



ATC Service Territory Resource Interconnection Projects: Queues 2019-2022

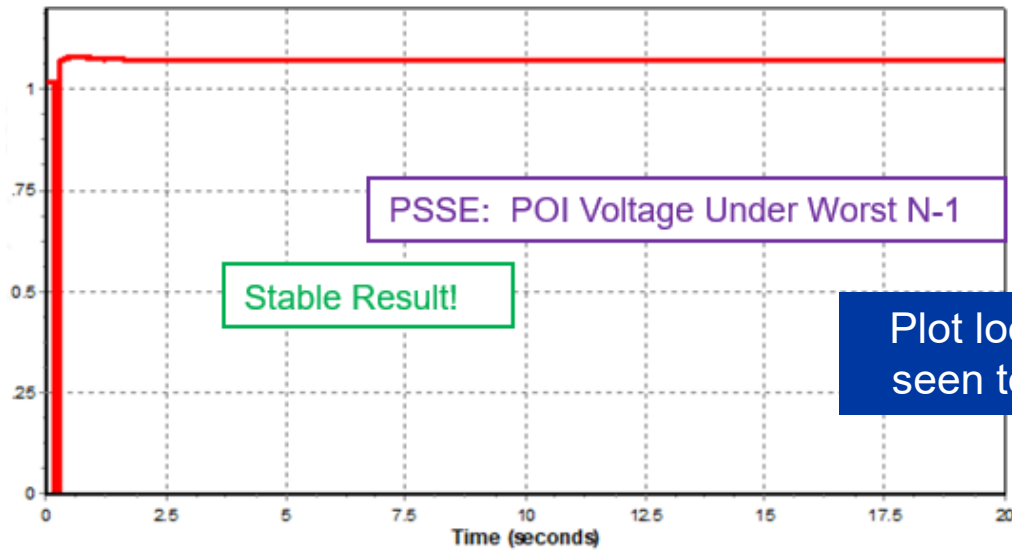
Active MISO GT Projects
136
Developers
43
Types of Fuel
6
Total MWs in Queue
18.41K

Number of Projects by Fuel Types



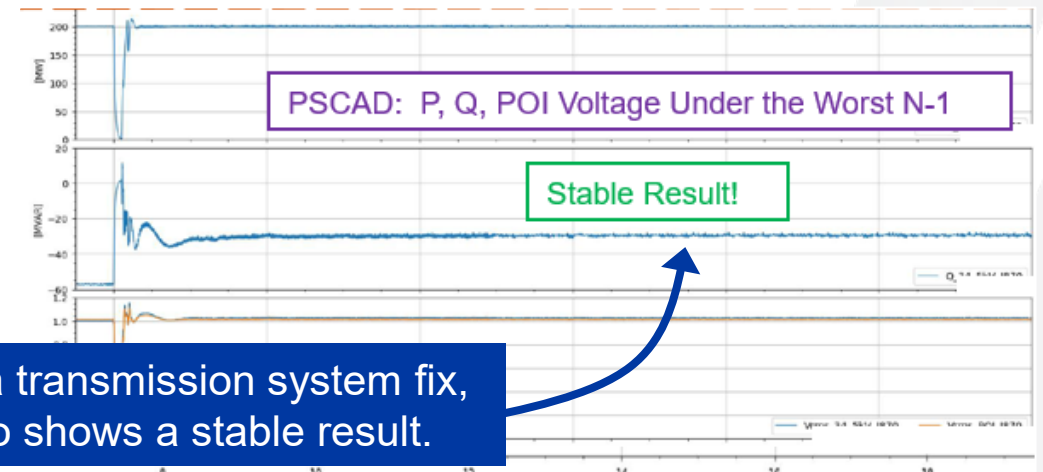
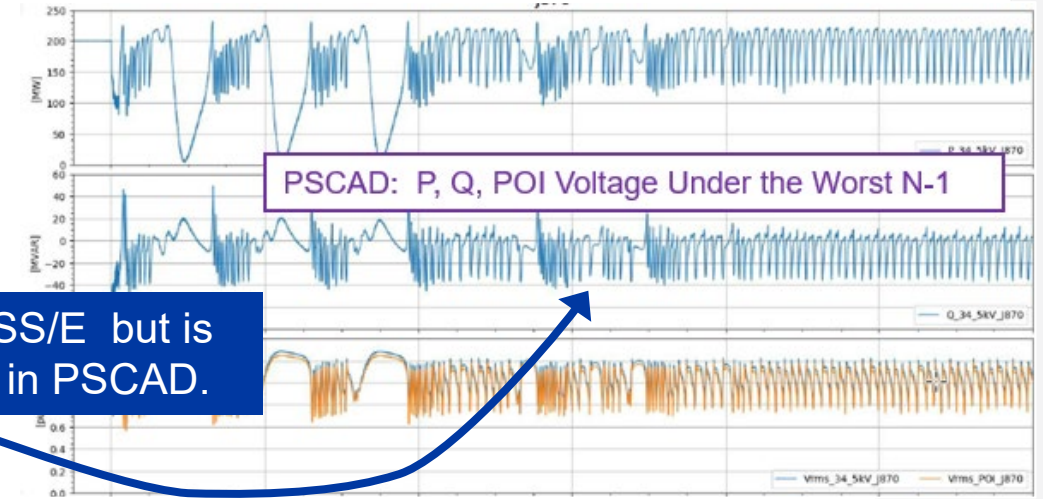
PSS/E vs. PSCAD Analysis

PSS/E Simulation



Plot looks stable in PSS/E but is seen to be oscillating in PSCAD.

PSCAD Simulation



After adding a transmission system fix, PSCAD also shows a stable result.

- PSCAD provides a much more detailed look at what is happening on the system

Streamlining the Process: SCR

We can't study everything... so we prioritize based on SCR and WSCR

- Short Circuit Ratio (SCR)

$$SCR_{POI} = \frac{SCMVA_{POI}}{MW_{VER}}$$

- Weighted Short Circuit Ratio (WSCR)

$$WSCR = \frac{\sum_l^N SCMVA_l * P_{RMW_l}}{(\sum_l^N P_{RMW_l})^2}$$



Maintaining Reliability

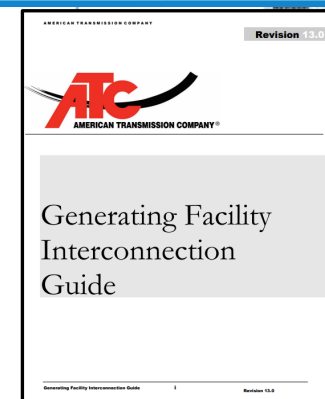
- Reliability issues are real and are here today – and will become more challenging in the future
- ATC among the first to include IBR requirements in our local planning criteria
- ATC has developed a PSCAD model verification process to screen out modeling issues before studies begin
 - Includes a checklist, process guide, and PSCAD test component
 - Publicly available through ATCLLC.COM
- When more widely adopted, this will be seen as a typical part of doing business

Generator Interconnections

MISO administers all interconnections of new generation directly to the ATC transmission system. The ATC Generating Facility Interconnection Guide (updated on October 17, 2022) supplements MISO's requirements and describes ATC's minimum requirements for the connection of such generation.

Inverter-Based Resource PSCAD Model Verification

ATC requires that all PSCAD plant models submitted to ATC use the [ATC test controller component](#) as the system equivalent. The interconnection customer submitting the PSCAD plant model must use the ATC test controller to complete the [ATC PSCAD Model Verification Checklist](#). The checklist must show that the PSCAD plant model meets all ATC PSCAD modeling requirements for ATC to accept the PSCAD plant model. The ATC PSCAD Plant Model Verification Procedure is provided in [here](#).







Questions and Answers

*Feel free to reach out to us if
interested in participating in the NERC
IRPS or EMTTF!*