INTERCONNECTION INNOVATION e-XCHANGE
U.S. DEPARTMENT OF ENERGY

EMT Bootcamp for BES IBR Studies Preparation Session | 7/27/23

An initiative spearheaded by the Solar Energy Technologies Office and the Wind Energy Technologies Office

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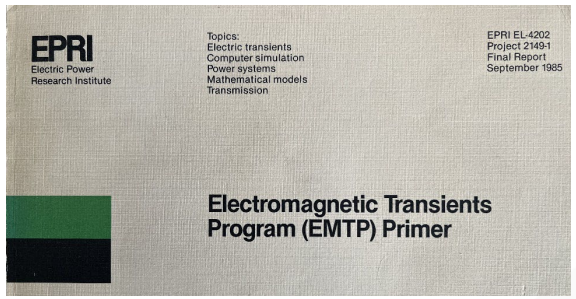
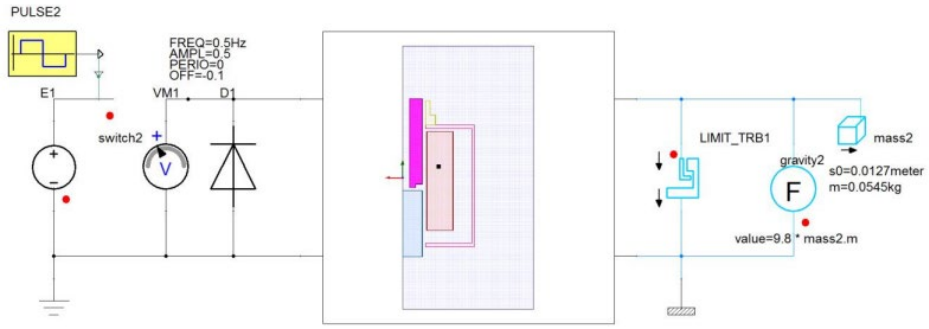
Introducing your lead co-instructors.

- Thomas.McDermott@pnnl.gov
- Theory Modules
- EMTP® Examples

- Aung.Thant@nerc.net
- NERC EMT Task Force
- PSCAD Examples



https://www.osti.gov/biblio/6473065



https://peer.asee.org/24682

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Electromagnetic Transient Modeling Task Force (EMTTF)

Scope Document
December 2022

Purpose

The purpose of the NERC Electromagnetic Transient Modeling Task Force ("EMTTF") is to support and accelerate industry adoption of electromagnetic transient (EMT) modeling and simulation in their interconnection and planning studies of bulk power system (BPS)-connected inverter-based resources.[1] The EMTTF will provide guidance and reference materials to Transmission Planners (TPs) and Planning Coordinators (PCs) embarking on EMT modeling and simulations to more adequately assess BPS impacts and reliability risks of interconnecting inverter-based resources. The EMTTF will also focus on developing technical documents to support BPS planning under increasing penetrations of BPS-connected inverter-based resources.

https://www.nerc.com/comm/RSTC/Pages/EMTTF.aspx

Interconnection Innovation e-Xchange (i2X)

Mission: To enable a **simpler**, **faster**, and **fairer** interconnection of clean energy resources while enhancing the **reliability**, **resiliency**, and **security** of our **distribution and bulk-power electric grids**

Stakeholder Engagement

Nation-wide engagement platform and collaborative working groups

Data & Analytics

Collect and analyze interconnection data to inform solutions development

Strategic Roadmap

Create roadmap to inform interconnection process improvements

Technical Assistance

Leverage DOE laboratory expertise to support stakeholder roadmap implementation

An i2X Solution e-Xchange, August 2, 2023, 2-4 p.m. Eastern Time: "***Defining Distribution, Sub-transmission, Transmission, and the Bulk System for Interconnection***", register at energy.gov/i2x

INTERCONNECTION INNOVATION e-XCHANGE
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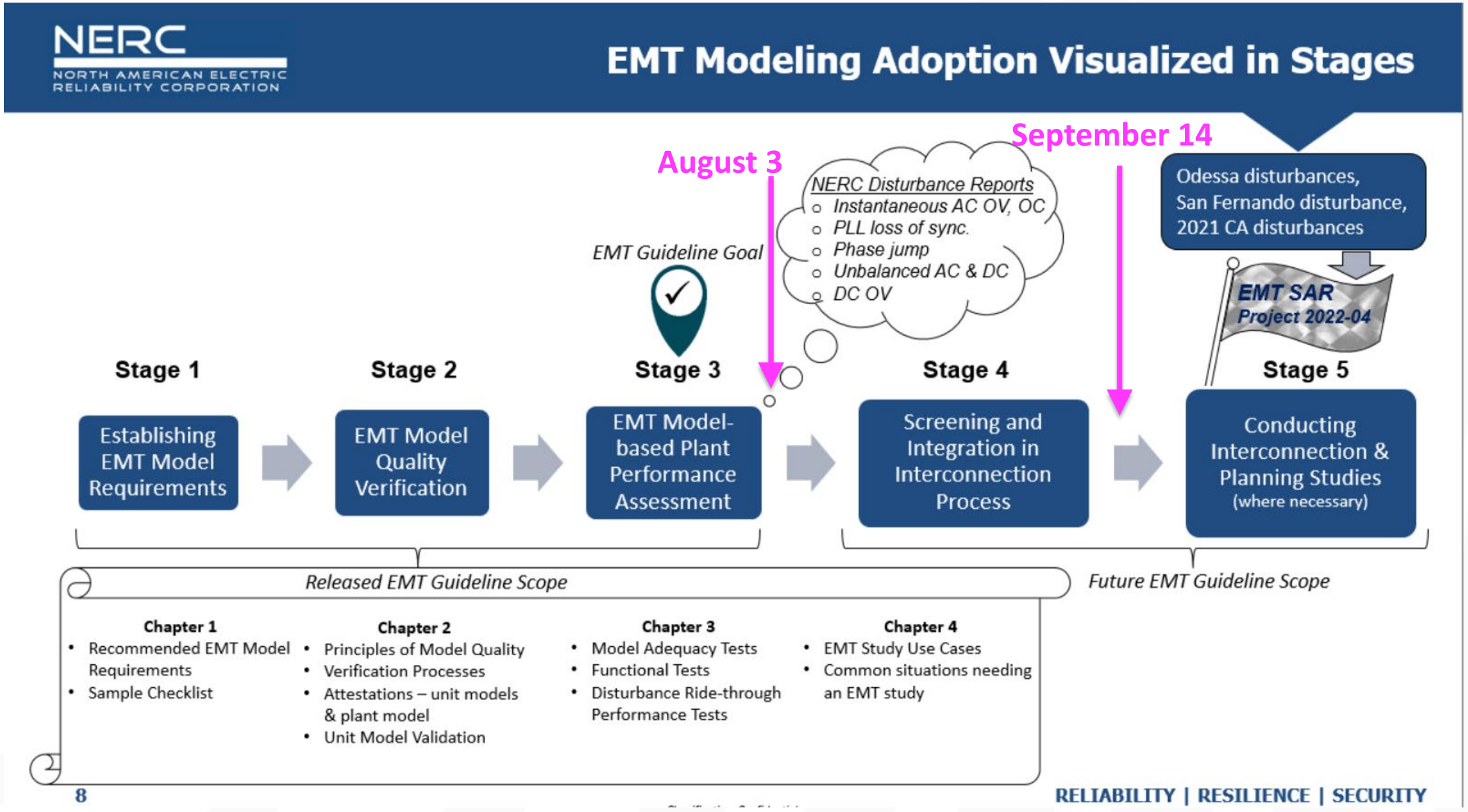
These boot camps are designed to support NERC's 5-stage framework to adopt EMT modeling.



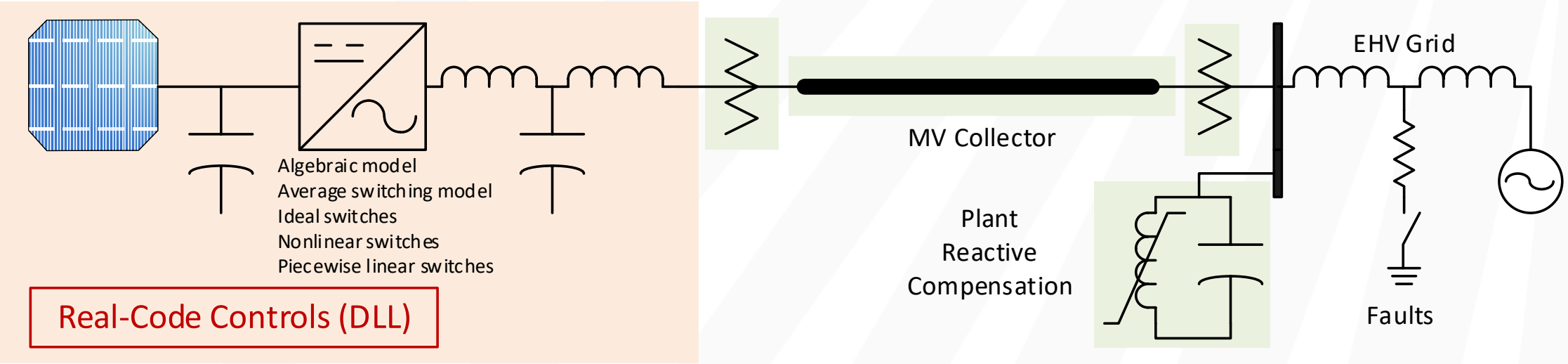
Expectations and level-setting, i.e., how can we possibly address this topic adequately in two half-day sessions?

- Our goal is to get everyone into the water.
- Anyone capable of running dynamics can also run EMT.
- We want you to imagine yourself running EMT, and to understand the next steps:
  - New Software Licenses
  - New Models
  - New Engineering Processes
  - How to get more experience
  - What questions to ask vendors, consultants, utilities, etc.

Image by prostooleh on Freepik

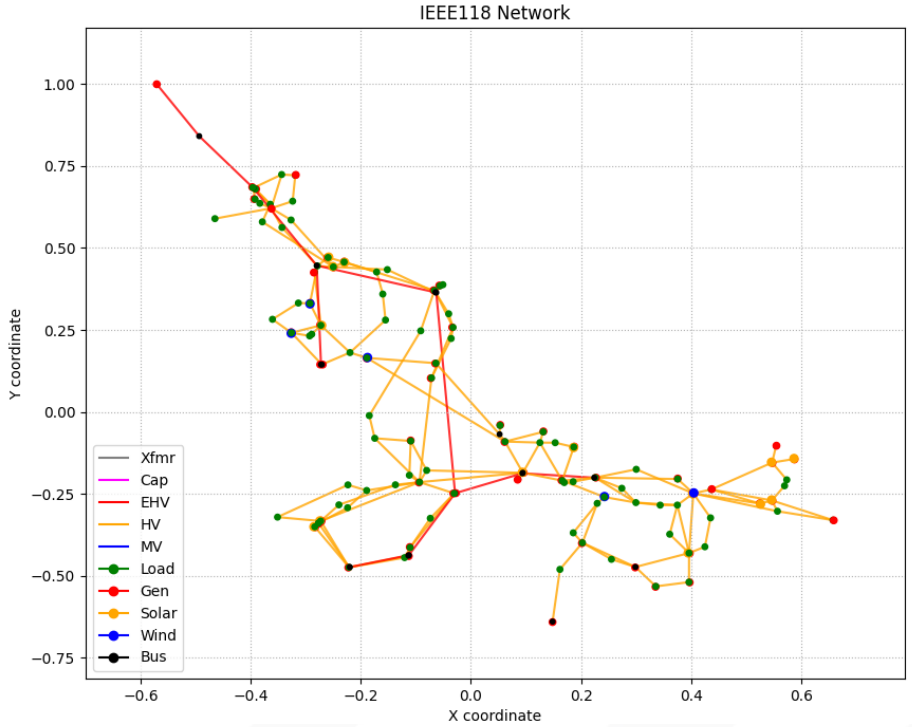
Preview of the August 3 Plant-Level Session

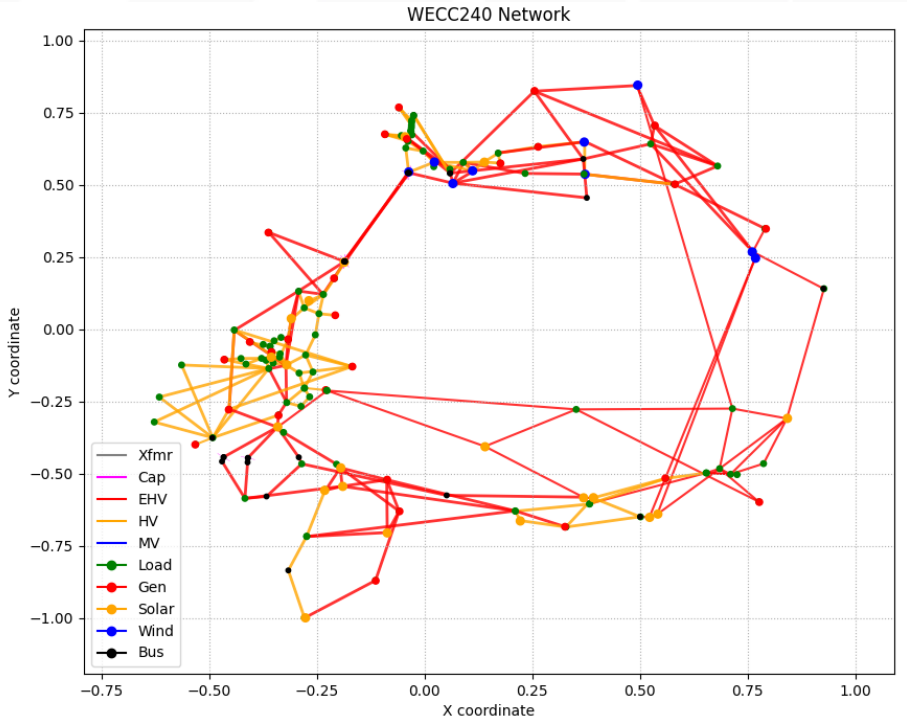
1. Theoretical background, focused on the difference between EMT and positive-sequence models of machines, transmission lines, transformers, and faults
2. Hands-on: type tests and fault responses for inverter-based resources compared to rotating machines
3. Hands-on: comparing textbook and vendor models, comparing average and switching models of IBR
4. Hands-on: methods to visually and quantitatively evaluate EMT simulation results



Preview of the September 14 System-Level Session

1. NERC guidelines for the use of EMT models
2. Building and validating large-scale bulk system EMT models
3. Hands-on: connecting a plant model to a medium scale bulk system, running interconnection study cases
4. Hands-on: automation of model-building, simulation, validation, and reporting





Suggested References for EMT Newcomers to Start With

1. Power System Relaying Committee Tutorial on EMT: https://resourcecenter.ieee-pes.org/publications/tutorial-papers/PESTP150.html
2. Teodorescu, Liserre, and Rodriguez "Grid Converters for Photovoltaic and Wind Power Systems", Wiley-IEEE, 2011. ISBN 978-0470057513. (2nd edition due soon)
3. NERC Reliability Guideline, "Electromagnetic Transient Modeling for BPS-Connected Inverter-Based Resources— Recommended Model Requirements and Verification Practices", March 2023, https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Reliability_Guideline-EMT_Modeling_and_Simulations.pdf
4. Your EMT simulation tool vendor's web site for tutorials and application notes
5. NERC EMTTF Work Item 3 is developing a more comprehensive list

Discussion

1. Questions and Answers as time permits
2. This meeting will “end for all” at 1:30 p.m. Eastern time.
3. From 1:30 – 3:00 p.m. Eastern time, please join the separate tool-specific meeting that you registered for.
4. Slides and examples will be available on https://github.com/pnnl/i2x/tree/develop/emt-bootcamp