**Day 1—September 26, 2023**

1:00 to 5:00 p.m.

## Welcome, Call to Order

Song Wang, Modeling and Validation Subcommittee (MVS) Chair, called the meeting to order at 1:05 p.m. MT on September 26, 2023. A quorum was present to conduct business. A list of attendees is attached as Exhibit A.

## Review WECC Antitrust Policy

Doug Tucker, Senior Engineer Reliability Assessments, read aloud the WECC Antitrust Policy statement. The meeting agenda included a link to the posted policy.

## Approve Agenda

Mr. Wang introduced the proposed meeting agenda.

**By consensus, the MVS approved the agenda.**

## Review and Approve Previous Meeting Minutes

Mr. Wang introduced the minutes from the meeting on May 24-25, 2023.

As amended, the “load modeling” by Nick Hatton for oscillations line 16 was added to the minutes.

**By consensus, the MVS approved the meeting minutes from May 24-25, 2023.**

## Review Previous Action Items

Mr. Tucker, reviewed action items carried over from the MVS meeting on May 24-25, 2023. Action items that are not closed and will be carried forward can be found [here](https://www.wecc.org/Administrative/MVS%20Action%20Items.pdf).

## Review Approved Dynamic Model List

Mr. Tucker presented on the Approved Dynamic Model list. He posted a list of unapproved models for 2023. Please submit your Phase One Models list to Mr. Tucker.

The presentation is posted on the WECC [website.](https://www.wecc.org/Administrative/24HS3%20Unapproved%20Models.xlsx)

## ESS Sizing and Siting

## Meng Yue, Brookhaven National Laboratory, (BNL) presented on the Energy Storage Systems (ESS) Sizing and Siting. The overall objective is to develop a framework for sizing, siting, and operation of energy storage systems to ensure efficiency, security, and reliability of the power grid.

The presentation is posted on the WECC [website](https://www.wecc.org/Administrative/Yue,%20M.,-%20MVS%20-%20ESS%20sizing%20and%20siting_September%202023.pdf).

**Items for Discussion**

Mr. Wang is creating a team of volunteers to assist and guide the future work of the MVS including power systems modeling and validation, white paper guidance, and other topics. Once established this team will meet monthly. If interested, contact Mr. Wang at: [song.wang@png.com](mailto:song.wang@png.com) and introduce yourself to the committee.

Mr. Wang reviewed the WECC Model Approval Process and requested that members also review a posted copy of the process. In the last 20 years, there has always been a Model Benchmark for this document. He would like to obtain feedback from the MVS members regarding this document.

The MVS suggested adding the criteria for retiring the model.

Mr. Wang discussed the Phasor and Electromagnetic Transients (EMT) modeling. The renewables penetration has been increasing over time. Mr. Wang wants to form a task force to support the EMT model. He is asking for feedback on ideas and the future of this model.

Jayapalan Senthil, Siemens Energy, Inc. discussed writing a white paper on the EMT Model. rom the May 2023 meeting. He stated that NERC has an EMT Task Force.

Nick Hatton, Staff Engineer, Reliability Modeling, discussed creating a response or memo that would outline transmission line effects. Once available the document can be found on the MVS web page.

## Review MVS Member List and Update—Doug Tucker, WECC

Mr. Tucker requested that members contact support@wecc.org to update their MVS member status.

**Day 2—September 27, 2023**

9:00 a.m. to 12:00p.m.

## Grid-Forming Study—Doug Tucker, WECC

Mr. Tucker presented on the Grid-Forming Inverters Study Assessment. This study assessment follows up on the Changes in System Inertia study, performed as part of the previous study cycle. The new study focuses on spring and low inertia conditions to see how recent changes in technology affect the Western Interconnection.

The presentation is posted to the WECC [website.](https://www.wecc.org/Administrative/Tucker,%20D%20.%20MVS-%20GFM%20report%20to%20MVS_September%202023.pdf)

## Renewable Energy Modeling

Wei Du, Pacific Northwest National Laboratory (PNNL) presented on the Droop Based Grid-Forming Inverter Model (REGFM\_A1). Mr. Du discussed the occurrences between May 2023 to September 2023. He clarified which variables interfaced with the controller. During two MVS meetings the model specifications had updates. Mr. Du presented benchmarking results at the May 2023 meeting, but there were some reservations on this model and approval of this document was postponed.

**By consensus, as amended, with model specifications and imitations, the MVS, approved the Generic Grid-Forming Inverter Model (REGFM\_A1).**

The presentation is posted on the WECC [website.](https://www.wecc.org/Administrative/Du,%20W.,%20-MVS%20-%20Droop-based%20Grid-Forming%20Inverter%20Model-REGFM_A1_September%202023.pdf)

Mr. Du presented on the Virtual Synchronous Machine Grid-Forming Inverter Model and Power Systems Computer Aided Design (PSCAD) / Power System Simulator for Engineering (PSSE) comparison results. He worked on this presentation with Deepak Ramasubramanian, Electric Power Research Institute (EPRI). There was a comparison of the initial results between the VSM-GPM and virtual synchronous machine inertia models. These models are a vendor specific design. The VSM-GFM model has specification that includes the steady state active and reactive current limiting controls.

Mr. Du discussed the PSCAD and PSS/E simulation results of REGFM\_B1 with the group. All the parameters for these models were set the same. Several tests have taken place on grid inverter-based systems. The first test to occur was islanding, as recommended by NERC and performed for a two grid inverter-based system (GFM). These tests took place on a single GFM- infinite-bus system. There were eighteen variables compared to obtain enough data to review the level of alignment.

Mr. Du discussed the 5% drop test voltage a form of testing. It is a single inverter-based system for more testing. When the grid voltage drops, the VSM-GFM increases the reactive power. Again, all eighteen variables achieved good alignment.

Mr. Du discussed the frequency drop testing where it dropped to 59.5 Hz. The frequency drops because of the overload. These eighteen variables achieved a good alignment.

Mr. Du discussed the form of testing, the 0.1 second fault test the current transient current limiting clips at 1.5 per unit. This system is still stable but different from grid forming works. Eighteen variables were compared and tested achieved good alignment.

Mr. Wang postponed further discussion of this specification for approval, until the next MVS meeting in the new year.

Mr. Wang will schedule a meeting offline with vendors and report back to the MVS at its January 2024 meeting.

The presentation is posted on the WECC [website](https://www.wecc.org/Administrative/Du,%20W.,%20and%20Ramasubramanian,%20D.,%20-%20MVS%20-%20Virtual%20Syncrhonous%20Machine%20Grid-Forming%20Inverter%20Model_REGFM_B1.pdf).

Houshang Salimian, The University of Texas Austin, presented on the Coupled Energy Storage System. Specifically on grid and renewable generation. There was more than 50% on the grid that was solar energy. There were three different solutions developed for photovoltaic (PV) GFM and presented to the MVS. They are PV inverter without storage, AC coupled GFM and energy storage, and direct current coupled GFM and energy storage.

The presentation is posted on the WECC [website](https://www.wecc.org/Administrative/Rizi,%20H.%20-%20MVS%20-%20Photovoltaic%20Synchronous%20Generator%20(PVSG)_September%202023.pdf).

Dimitry Kosterov, Bonneville Power Administration, (BPA) presented on the next steps in Dynamic Load Modeling. The model structure needs to match with the same data sets in use. The Chemical Methods and Library Development Modular Structure had initial tests on the Power Sequence Load Flow simulation, and it should have matched these same data sets.

Nick Hatton commented that he will obtain guidance to ensure the right simulations are ran.

Mr. Salimian stated WECC was using load composition data sets in 2011. This data is changing because of energy efficiency measures, electrification, and heat pumps.

Mr. Hatton will take this information to the Reliability Action Scheme Subcommittee for further review.

Andreas Schmitt, BPA, is working on a project for getting composition fractions from data.

Mr. Saliman commented that he will again review control models. The validation and systems impact studies recognize the behavior of loads on single phase faults. There should be better coordination with NERC and supporting these studies.

Bo Gong, Salt River Project, is stepping down from load modeling due to other commitments.

Angel, BPA, will take over for Mr. Gong as the lead for load modeling.

The presentation is posted on the WECC [website.](https://www.wecc.org/Administrative/Kosterev,%20D.,%20Next%20Steps%20In%20Dynamic%20Load%20Modeling.pdf)

## Survey for MVS

The MVS members viewed the Joint Guidance Committee Metrics Survey. MVS members will complete the survey.

The presentation is posted on the WECC [website.](https://www.wecc.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Administrative/MVS-JGC%20Engagement%20Survey%20Slides.pdf&action=default&DefaultItemOpen=1)

## Renewable Energy Modeling

Tony Faris, BPA, presented on the WECC load model composition. The Lower Cost Market (LCM) Climate Zones 48 proposed representative cities versus 12 LCM climate zones. The hotter or colder dates are not similar. There was a representative city analysis on peak loads. There were different results for the different climates in cities. There will be future discussions to distinguish “com” and “not com” loads.

Mr. Hatton asked for clarification on origin of this data.

Mr. Faris will research this and report back to the MVS group.

The presentation is posted on the WECC [website.](https://www.wecc.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Administrative/Faris,%20A.,%20-%20MVS%20-%20Load%20composition%20Update_September%202023.pdf&action=default&DefaultItemOpen=1)

## Load Modeling

Meng Yue, Brookhaven National Laboratory (BNL), presented on the Hierarchical Machine Learning based optimal parameterization scheme for BNL. There are disparate load devices spread along with feeder of different structures. Current load modeling practices rely on field knowledge and experience on based on a limited number of scenarios. There is a proposed solution for the WECC composite load model (CLM). The technical approach was to verify and validate the performance of CLM parameterized through a real-life approach. The final steps consisted of minimizing deviation responses of CLM.

The presentation is posted on the WECC [website](https://www.wecc.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Administrative/Yue,%20M.,%20-%20MVS%20-%20Load%20Modeling_September%202023.pdf&action=default&DefaultItemOpen=1).

Yunzhi Cheng, Electric Reliability Council of Texas, (ERCOT) presented on the preliminary assessment of grid forming inverter-based energy storage resources in ERCOT. There were increasing load modeling events from Odessa 1 in 2021 and Odessa 2 in 2022 showing a need to strengthen the system and resilience needed to mitigate the reliability risk. ERCOT focused on improving the resources such as adoption of NERC Reliability Risk Guidelines and improvement of the translation system. ERCOT evaluated three different scenarios for discussion.

The presentation is posted on the WECC [website](https://www.wecc.org/_layouts/15/WopiFrame.aspx?sourcedoc=/Administrative/Cheng,%20Y.,%20-%20MVS%20-%20GFM-%20IBR-ESR_September%202023.pdf&action=default&DefaultItemOpen=1).

# Day 3—September 28, 2023

9:00 a.m. to 12:00 p.m.

## How a Large-Scale Deployment of Grid-Forming Inverters May Impact Area Oscillation Modes: An investigation in the U.S. Western Interconnection—Xiaoyuan Fan and Shuchismita, Biswas, PNNL

Xiaoyuan Fan, PNNL, presented on the large-scale deployment of grid-forming inverters and their impact on area oscillation modes. Mr. Fan discussed four tasks regarding oscillation trends. PNNL has a project industry advisory board with five IAB (Industry Advisory Board) members joining them for three meetings.

Shuchismita Biswas, PNNL, discussed task deliverables and results. There were three project tasks that were reviewed for the oscillation cases with high penetration IBRs.

Mr. Fan discussed how there will be changes on the generator side over the next few years. He asked for input from the group regarding any changes to the generator side.

The presentation is posted on the WECC [website.](https://www.wecc.org/Administrative/Fan,%20X.,,%20Biswas,%20S.%20-%20MVS-%20%20Wide-Area-Oscillation_September%202023.pdf)

## The Survey Data Center Data Collection—Parag Mitra, EPRI

Parag Mitra, EPRI, presented on the survey data center data collection to the group. EPRI examined traditional loads versus the data centers. These loads are large and have small motors running different processes. The data center loads are mostly electronic. These loads may or may not remain connected to the grid during normal cleared disturbances. A data center questionnaire will be available later this year.

## Power Plant Modeling

Quincy Wang, British Columbia Hydro, reviewed the GENTPJ model retirement timeline. WECC announced the GENTPJ retirement plan 1-27-2022. On GENTPJ there was an improvement on the steady state of this model. The group developed an updated model. GENTPJ model may remain in WECCs Master Dynamics File for 10 years after the retirement of this model. The GENTPJ is scheduled to be retired on December 31, 2023.

Mr. Wang commented the MVS will focus on GENQEC.

Mr. Tucker will schedule another meeting to address if MVS will need to postpone the retirement date of the GENTPJ model to a future date. The meeting will take place before the end of 2023.

The presentation is posted on the WECC [website.](https://www.wecc.org/Administrative/Wang,%20Q.,%20MVS-%20GENTPJ%20Retirement%20Timeline_September%202023.pdf)

Mr. Wang presented on behalf of Jin Tan, National Renewable Energy Laboratory (NREL) an update on the progress of adjustable pump (A-PSHI) model specification development. The project’s objective is to develop a generic model specification for advanced pumped storage hydro technologies, including adjustable pump, ternary pump (T-PSH), and quaternary pumped storage (Q-PSH) for WECC. NREL is trying to get the testing data to benchmark and validate. There is project team assembled. If interested in joining contact Jin Tan at [jin.tan@nrel.gov](mailto:jin.tan@nrel.gov).

Mr. Wang will talk to Ms. Tan about adding Mr. Gong to the Project Team.

The presentation is posted on the WECC [website](https://www.wecc.org/Administrative/Tan,%20J.%20MVS%20-%20PSH%20Dynamic%20Modeling.pdf).

MVS will prioritize the next set of models as follows.

* Grid-forming inverter model
* REEC\_E model
* REPC\_D (hybrid plant controller)
* Multi-terminal HVDC VSC model
* SVSMO4 model
* SCMOV (series capacitor MOV model)

## Active Transmission System Modeling Update

Pouyan Pourbeik, Power and Energy, Analysis, Consulting and Education, PLLC (PEACE) presented on the latest Renewable Energy Standard (RES) Models This model may replace REPC\_D. Mr. Pourbeik will email the group, so that it may review and approve this topic at the next MVS meeting.

Mr. Pourbeik then discussed the VH-PDC1 can create a better model VH-PDC2. REGFM\_A3 Models.

Mr. Pourbeik will provide a copy of this document to the group.

## MOD-33 Update

Jin Licheng, California Independent System Operator, (CAISO) presented RC West update to the group. RC West will implement the MOD-33 event analysis. There were two events posted online. The first event was in San Diego, California. There was MOD -33 event analysis performed on the first event.

The second event is the Palo Verde Unit 1. This was a generation trip. The system frequency exceeded frequency trigger limits slow limit to a low of 59.858 hertz due to loss of the Palo Verde Unit.

There will be further updates at the next MVS meeting.

Mr. Tucker commented that Southwest Power Pool is continuing to work with RC West in getting a one for one model.

## Program Updates

Mr. Senthil presented on the PSSE on recent and future updates. One version the Independent User Defined Modeling (UDM) has the following features: It highlights a v36 that will be a version independent dynamic link library for user defined models. There are steady state enhancements such as a bypassing option added to the branch records. There was a unique name created for every load type.

The presentation is posted on the WECC [website](https://www.wecc.org/Administrative/Senthil,%20Jayapalan-MVS-PSSE%20Update_September%202023.pdf).

Jamie Weber, Power World, is actively working on RAPCD model that needs testing. The RADCE is complete. If there are any questions, please contact Mr. Weber.

## Public Comment

Mr. Wang stated the next MVS virtual meeting is in January 2024

## Review New Action Items

* Draft a Summary or Statement on EMT Modeling position.
  + Assigned To: Nick Hatton/WECC Pouyan Pourbeik/PEACE
  + Due Date: January 2023
* Work with WECC staff on modular load benchmarking comparisons.
  + Assigned To: WECC Staff.
  + Due Date: January 2024
* Schedule another meeting on GENQEC before the January 2024 meeting
  + Assigned To: Doug Tucker
  + Due Date: Before January 2024 meeting

## Upcoming Meetings

January 2024 (TBD) Salt Lake City

May 2024 (TBD) Salt Lake City

September 2024 (TBD) Salt Lake City

## Adjourn

Mr. Wang adjourned the meeting without objection at 12:15 p.m.

Exhibit A: Attendance List

### Members in Attendance

Hassan Baklou San Diego Gas and Electric

Wei Du Pacific Northwest National Laboratory

Gordon Kawaley Bonneville Power Administration—Transmission

Doug Tucker WECC

Song Wang Portland General Electric Company

Angel Aquino PowerWorld Corporation

Zachary Beus Puget Sound Energy, Inc.

Kevin Brooks Southern California Edison Company

Emerson Butler Puget Sound Energy, Inc.

Ken Che Public Utility District No. 1 of Snohomish County

Christopher Corral El Paso Electric Company

Roberto Favela El Paso Electric Company

Carlos FloresLopez US Army Corps of Engineers

Chris Gilden Tri-State Generation and Transmission—Reliability

Bo Gong Salt River Project

Robert Jackson Burns & McDonnell (1898 and Co.)

Robert Jones Seattle City Light

Lesley Kayser-Sprouse Hetch Hetchy Water and Power

Slaven Kincic Pacific Northwest National Laboratory

Dmitry Kosterev Bonneville Power Administration—Transmission

Parag Mitra Electric Power Research Institute

Saurav Mohapatra PowerWorld Corporation

Pouyan Pourbeik Power and Energy, Analysis, Consulting and Education, PLLC

Sergey Pustovit Bonneville Power Administration

Amro Quedan Electric Reliability Council of Texas

Juan Sanchez-Gasca GE Energy Consulting Group

Jayapalan (Jay) Senthil Siemens Energy, Inc.

Spencer Tacke Auriga Corporation

John Undrill Independent Subject Matter Expert

Jianhui Wang Southern Methodist University

Maggie Watkins US Army Corps of Engineers

James Weber PowerWorld Corporation

Steve Yang Bonneville Power Administration—Transmission

### Members not in Attendance

Joel Ankeny PacifiCorp

Ian Beil Portland General Electric Company

Jeff Bloemink Powertech Labs, Inc.

Jess Boatwright NorthWestern Energy

Daniel Cervantes Los Angeles Department of Water and Power

Lakmal Chandrasekara Turlock Irrigation District

Mengxi Chen GE Energy Consulting Group

Tuan Dang Public Utility District No. 1 of Snohomish County

Fangfang Du PacifiCorp

Chris Effiong Western Area Power Administration

Xiaoyuan Fan Pacific Northwest National Laboratory

Jonathon Flores Los Angeles Department of Water and Power

Christopher Fuchs California Independent System Operator

Joseph Gillette Utility System Efficiencies, Inc.

Aaron Hancock Tucson Electric Power

Allison Hidalgo U.S. Bureau of Reclamation

Hamody Hindi Bonneville Power Administration—Transmission

Siraji (Sam) Hirsi Bonneville Power Administration

Licheng Jin California Independent System Operator

Milad Kahrobaee AES Corporation

James Keller Western Area Power Administration - Rocky Mountain Region

Seongtae Kim PacifiCorp

May Le Public Utility District No. 2 of Grant County

Jonathan Lesage MathWorks

Hongtao Ma North American Electric Reliability Corporation

Ron Markham Pacific Gas and Electric Company

Mitchell Miller NorthWestern Energy

Amir Mohammednur Southern California Edison Company

Avinash Narava Tucson Electric Power

Shawn Patterson U.S. Bureau of Reclamation

Mark Pigman Tacoma Power

Nathan Powell Deseret Generation & Transmission Cooperative

Ryan Quint North American Electric Reliability Corporation

Ramu Ramanathan Maxisys, Inc.

Deepak Ramasubramanian Electric Power Research Institute

Daniel Ramirez Energy Strategies

Alistair Rennie Salt River Project

Benjamin Rodriguez El Paso Electric Company

Tracy Rolstad Public Utility District No. 2 of Grant County

David Roop Mitsubishi Electric Power Products, Inc.

Micah Runner Black Hills Corporation

Amanuel Selassie Los Angeles Department of Water and Power

Hari Singh Public Service Company of Colorado (Xcel Energy)

Alejandro Solis El Paso Electric Company

Jonathan Stahlhut TransCo Energy, LLC

Khanh Thai Tacoma Power

Jade Thiemsuwan Sempra Renewables Services, Inc.

Chifong Thomas Thomas Grid Advisor

Chad Thomson Utility System Efficiencies, Inc.

Patrick Truong Sacramento Municipal Utility District

Andres Valdepena Delgado Idaho Power Company

Dhayanesh Velusamy Burns & McDonnell (1898 and Co.)

Jeffery Watkins NV Energy

Trevor Werho Arizona Public Service Company

Scott Wilson Avista Corporation

Xiaokang Xu S&C Electric Company

Xiaofei (Sophie) Xu Pacific Gas and Electric Company

Janice Zewe Sacramento Municipal Utility District

Jimmy Zhang Alberta Electric System Operator

George Zhou S&C Electric Company

Songzhe Zhu GridBright, Inc.

### Others in Attendance [Only for technical committees]

Nick Hatton WECC

Yuri Komlev U.S. Bureau of Reclamation

Marie Smith WECC

Quincey Wang Briticih Columbia Hydro Electric

Meng Yue BNL

Stephanie Benjes Bonneville Power Administration

Gregory Brooks USACE army

Jon Cichosz AES Corporation

Kyler Cordeiro Briticih Columbia Hydro Electric

Jackson Daly Idaho Power Company

Donna Enriquez El Paso Electric Company

Bryan Frierson Briticih Columbia Hydro Electric

Vic Howell WECC

Chaudhary Malati Public Service Company of New Mexico

Stony Martin SERC Reliability Corporation

Soumyadeep Nag soumyadeep.nag@inl.gov

Mohamed Osman North American Electric Reliability Corporation

Kirha Quick WECC

Anthony Rendon Salt River Project

Ricardo Rodriguez El Paso Electric Company

Houshang Saliman University of Texas

Andreas Schmitt Bonneville Power Administration

Abhyankar Shounak ISO New England

Ahmed Soliman Siemens Energy, Inc.

Xavier Sosa Southern California Edison Company

Ailin Sun Southern California Edison Company

Sushrut Thakar Electric Power Research Institute

Vishal Verma Electric Power Research Institute

Shiyuan Wang Quanta Technology, LLC

Li Yu Hawaiian Electric

Chelsea Zhu Chuanjiang

Wenchun Zhu Siemens Energy, Inc.

Scott Zuloaga Electric Reliability Council of Texas