Compliance Bulletin – MOD-032 and ISO New England's

Model Data Requirements and Reporting Procedures

ISO New England Inc.
Reliability and Operations Compliance
March 15, 2019

In case of a discrepancy between this Compliance Bulletin and a NERC Reliability Standard or an ISO New England Operating Document, the NERC Reliability Standard or the ISO New England Operating Document shall govern.

ISO New England Compliance Bulletin-MOD-032

ISO New England Model Data

Requirements and Reporting Procedures

EFFECTIVE DATE: July 1, 2015

REFERENCES:

NERC Standard MOD-025-2 — Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability

NERC Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

NERC Standard MOD-027-1 —Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

NERC Standard MOD-032-1 — Data for Power System Modeling and Analysis

NERC Standard PRC-001-1.1(ii) – System Protection Coordination

NERC Standard TPL-007-1 Transmission System Planned Performance for Geomagnetic Disturbance Events

ISO New England Transmission, Markets and Services Tariff, Market Rule 1, Section III.1.5.1: Claimed Capability Audits

OATT II.16.2 Application Procedures (*for Regional Network Service)*

ISO New England Transmission, Markets and Services Tariff, Section II, Attachment K, Supply of Information and Data Required for Regional System Planning

Schedule 22 to the ISO New England Open Access Transmission Tariff – Large Generator Interconnection Procedures

Schedule 23 to the ISO New England Open Access Transmission Tariff – Small Generator Interconnection Procedures

Schedule 25 to the ISO New England Open Access Transmission Tariff, Elective Transmission Upgrade Interconnection Procedures

(Continued)

REFERENCES (Continued)

ISO New England Transmission, Markets and Services Tariff Section I.3.9

ISO New England Operating Procedure No. 5 Generator, Dispatchable Asset Related Demand and Alternative Technology Regulation Resource Maintenance and Outage Scheduling (OP 5)

ISO New England Operating Procedure No. 12 Voltage and Reactive Control (OP 12)

ISO New England Operating Procedure No. 14 - Technical Requirements for Generators, Demand Resources, Asset Related Demands and Alternative Technology Regulation Resources (OP 14)

ISO New England Operating Procedure No. 16, Transmission System Data (OP 16)

ISO New England Operating Procedure No. 23, Generator Resource Auditing (OP 23)

ISO New England Planning Procedure 5-1, Procedure for Review of Governance Participant’s Proposed Plans (Section I.3.9 Applications: Requirements, Procedures and Forms)

ISO New England Planning Procedure 5-6 Interconnection Planning Procedure for Generation and Elective Transmission Upgrades

ISO New England Planning Procedure PP-7, Procedures for Determining and Implementing Transmission Facility Ratings in New England

ISO New England Planning Procedure PP-11, Planning Procedure to Support Geomagnetic Disturbance Analysis (Pending Approval).

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1.0 Introduction

The ISO New England Transmission, Markets and Services Tariff and NERC Standard MOD-032 require ISO New England, as a Planning Coordinator and Transmission Planner, to work with other entities registered in New England as Transmission Planners to develop data requirements for steady state, dynamic and short circuit transmission system studies. In accordance with NERC Standard MOD-032 and certain provisions of the ISO New England Transmission, Markets and Services Tariff, this Compliance Bulletin, along with associated procedures and applications, sets forth the means for entities to provide accurate modeling information.

For many years, ISO New England has had a number of documents and processes in place that provide much of the data required under NERC Standard MOD-032. This Compliance Bulletin describes how entities shall reference and use those documents and processes to meet the requirements of NERC Standard MOD-032. In some cases, however, ISO New England and the New England Transmission Planners need additional requirements to comply with NERC Standard MOD-032. This Compliance Bulletin sets forth those additional requirements.

For existing equipment model recertification, ISO New England will provide the models and backup documentation that it currently maintains. For new and proposed equipment, ISO Tariff language dictates format as summarized within this document.

Models that are "on-file" with ISO or updated for NERC standards must not be listed on the Obsolete Model Listing in Section 7.0

2.0 Steady State Information

Generator Owners and Transmission Owners provide much of the required steady state data to ISO New England using the NX-9 forms for existing equipment. Appendix B shows some typical steady state information and indicates the level of detail to be provided. Generator Owners and Transmission Owners shall provide site-specific information in accordance with referenced procedures for New England transmission system studies.

Unless otherwise noted below, for existing equipment with no planned modifications, Generator Owners and Transmission Owners (Owners) shall provide annual recertification of data. ISO New England shall initiate annual recertification. Owners shall provide the information to ISO New England for existing facilities that Owners are modifying, prior to making the changes in accordance with relevant provisions of, but not limited to, Section I.3.9 and Schedules 22, 23 and 25 to the ISO New England Open Access Transmission Tariff. Transmission studies in the planning horizon include new or modified facilities once approved by ISO New England as the Resource Planner.

2.1 Steady State - Bus Data Nominal Voltage, Area, Zone, Owner (MOD-032 A1-1a,b, TO)

For existing equipment, Transmission Owners provide bus numbers and bus nominal voltagewith information for area, zone and owner on the NX-9 form and provide updates using the NX application per OP-16. Note that for system changes, ISO New England provides a range of bus numbers with zones and owners to New England Transmission Planners. These Transmission Planners provide information back to ISO New England through the ISO/Transmission Planner Base Case Working Group (BCWG). This working group manages bus number assignments and other information for this requirement, such as area, zone, and owner. Outside of the regularly scheduled working group meetings, upon request of ISO New England, Transmission Planners shall also provide information by e-mail to ISO New England.

2.2 Steady State - Aggregate Demand (MOD-032 A1-2a, b, LSE)

ISO New England does not request aggregate demand data from LSE's for MOD-032. ISO-NE develops a regional load forecast and has aggregate demand data based on revenue quality hourly meter readings. ISO-NE posts meter requirements in Operating Procedure 18 - Metering and Telemetering Criteria (OP-18). Note that New England Transmission Planners provide load distribution by bus including real and reactive load to ISO New England. ISO New England Load Forecasting develops a New England total load forecast and individual state forecasts that sum to New England. ISO New England uses load distribution to allocate its state load forecasts. New England Transmission Planners must ensure that reactive capability is consistent with Sections 6 and 7 of the ISO New England Planning Technical Guide, which is available at http://www.iso-ne.com/static-assets/documents/2014/12/planning_technical_guide_2014-12-2_clean.pdf, and the Load Modeling Guide for ISO New England Network Model, which is available at http://www.iso-ne.com/static-assets/documents/rules_proceds/isone_plan/othr_docs/load_modeling_guide.pdf. Any dedicated loads such as large mill facilities are reviewed annually by the BCWG.

2.3 Steady State - Generator Unit Min/Max Real Power Capability (MOD-032 A1-3aGO, RP)

When performing Seasonal Claimed Capability Audits used to determine Qualified Capacity, Generator Owners shall provide necessary real power information for existing units. This testing shall be conducted in accordance with Section III of the ISO New England Transmission, Markets and Services Tariff (Market Rule 1) using the CCAT Application, ISO New England Operating Procedure OP-23 Generator Resource Auditing and the NX-12 form. Specific sections of Market Rule 1 that apply are Section III.1.5 and Section III.1.7. Note that Planning Studies, in addition to Qualified Capacity, may also consider maximum power from Generator Interconnection Agreements and Pmin from Day-Ahead Market submissions.

Prospective Generator Owners and existing Generator Owners shall provide real power capability information for proposed units as called for in accordance with ISO Planning Procedure PP 5-1 Attachment 1 and Attachment 2 as required and through their Generator Interconnection Agreements.

2.4 Steady State - Generator Unit Min/Max Reactive Power Capability (MOD-032 A1-3b)

With reactive capability audits, Generator Owners provide Reactive Power Capability to ISO New England in accordance with ISO New England Operating Procedure No. 12 – Voltage and Reactive Control and OP-12 Appendix B, ISO Operating Procedure OP-23 Generator Resource Auditing and OP-14 Appendix B (NX-12D form using the NX-Application and MOD-025 data sheet for synchronous condensors). Capability testing results shall be in accordance with the Generator Interconnection Agreements. If a change to reactive capability occurs prior to an audit then Generator Owners shall report the change to ISO.

Prospective Generator Owners and existing Generator Owners shall provide reactive power capability information for proposed units in accordance with ISO Planning Procedure PP 5-1 Attachment 1 and Attachment 2 as required and through their Generator Interconnection Agreements.

2.5 Steady State - Generator Unit station service auxiliary load (MOD-032 A1-3c)

Generator Owners shall provide station service auxiliary load information for existing units via the OP-14 Technical Requirements for Generators, Demand Resources and Asset Related Demands Appendix B (NX-12D).

Prospective Generator Owners and existing Generator Owners shall provide information corresponding to unit station service auxiliary load for proposed units by completing ISO Planning Procedure PP 5-1 Attachment 1 and the Attachment 2 form as required.

2.6 Steady State - Generator Unit regulated bus and setpoint voltage (MOD-032 A1-3d)

Generator Owners shall provide Steady State Generator Unit regulated bus voltage in accordance with ISO New England Operating Procedure No. 12 – Voltage and Reactive Control and its Appendix B and D. The NX-12D form includes an entry for Generator Owners to include the Voltage Schedule.

New unit regulated bus and set-point voltage are determined and documented via System Impact Studies.

2.7 Steady State - Generator Unit machine MVA base (MOD-032 A1-3e)

Generator Owners shall provide Generator Unit MVA base for existing units using the Dynamics Database Application (DDMS). This shall be consistent with the existing NX-12D form and Generator Interconnection Agreements. Appendix A to this Compliance Bulletin contains information on how to use the DDMS to enter and confirm generator information.

Prospective Generator Owners and existing Generator Owners shall provide MVA rating for proposed units by completing ISO Planning Procedure PP 5-1 Attachment 1 and the Attachment 2 form as required, and through their Generator Interconnection Agreements.

2.8 Steady State - Generator Unit step-up transformer (MOD-032 A1-3f)

Generator Owners shall provide Generator Unit step-up transformer characteristics for existing units using the ISO New England NX application and ISO Operating Procedure No. 16, Transmission System Data.

Prospective Generator Owners and existing Generator Owners shall provide step-up transformer characteristics for new units by completing ISO New England Planning Procedure 5-1, Attachment 3.

2.9 Steady State - Generator Unit generator type - hydro, wind, fossil, solar,etc. (MOD-032 A1-3g)

Generator Owners shall provide Generator Unit generator type using the NX-12 form (ISO New England Operating Procedure No. 14 - Technical Requirements for Generators, Demand Resources, Asset Related Demands and Alternative Technology Regulation Resources, along with associated Appendices, contain information on filling out the NX-12 form).

Prospective Generator Owners and existing Generator Owners shall provide Generator Unit type for proposed units by completing ISO Planning Procedure PP 5-1 Attachment 1 and 2 as required and the information required by the Generator Interconnection Agreement.

2.10 Steady State - Generator Unit in-service status (MOD-032 A1-3h)

Regarding outages, Generator Owners shall provide outage data in accordance with ISO New England Operating Procedure No. 5 Generator, Dispatchable Asset Related Demand and Alternative Technology Regulation Resource Maintenance and Outage Scheduling and Control Room Operating Window (CROW) outage scheduling.

With respect to retirement, Generator Owners shall submit retirement plans for retirement according to Planning Procedure PP5-1 Section 3.

Proposed units are included as appropriate in study cases once approved by ISO New England.

2.11 Steady State - AC Transmission Lines or Circuits (MOD-032 A1-4a-h)

Transmission Owners shall provide Transmission Line or Circuit characteristics using the ISO New England NX application. ISO New England Operating Procedure No. 16, Transmission System Data explains how to enter information in the NX application. Information provided shall be consistent with ISO New England Planning Procedure PP-7, Procedures for Determining and Implementing Transmission Facility Ratings in New England. Outages for transmission lines or circuits shall be reported by Transmission Owners directly to ISO or through the LCC using the ISO New England Control Room Operations Window (CROW) application and in accordance with ISO New England Operating Procedure No. 3 Transmission Outage Scheduling.

Prospective Transmission Owners and existing Transmission Owners shall provide information for proposed transmission lines or circuits by completing ISO Planning Procedure PP 5-1 Attachment 3 and also including the line MVA ratings, line impedance (positive sequence) and charging (susceptance) or if appropriate a Schedule 25 Appendix 1 Interconnection Request.

2.12 Steady State - DC Transmission Systems (MOD-032 A1-5)

Transmission Owners shall provide DC Transmission (HVDC) information for existing facilities using the Dynamics Database Application. Appendix A to this Compliance Bulletin contains information on how to use the DDMS to enter and confirm HVDC device information. Transmission Owners shall report outages using the ISO New England Control Room Operations Window (CROW) application and per ISO New England Operating Procedure No. 3, Transmission Outage Scheduling.

Prospective Transmission Owners and existing Transmission Owners shall provide information for proposed HVDC Transmission facilities using a Schedule 25 Appendix 1 Interconnection Request.

2.13 Steady State - Transformers (MOD-032 A1-6a-h)

Transmission Owners shall provide transformer characteristics using the ISO New England NX application. Refer to ISO New England Operating Procedure No. 16, Transmission System Data for entering information in the NX application. Entries shall be consistent with ISO New England Planning Procedure PP-7, Procedures for Determining and Implementing Transmission Facility Ratings in New England. Transmission Owners shall report outages using the ISO New England Control Room Operations Window (CROW) application and in accordance with Operating Procedure No. 3 Transmission Outage Scheduling.

Prospective Transmission Owners and existing Transmission Owners shall provide information for a proposed transformer facility by completing ISO Planning Procedure PP 5-1 Attachment 3 along with transformer impedances, tap ratios, minimum and maximum tap position, number of tap positions and emergency ratings or if appropriate, a Schedule 25 Appendix 1 Interconnection Request. Regulated bus voltage is determined during the interconnection study.

2.14 Steady State - Reactive Compensation Devices

Transmission Owners shall provide information concerning existing Reactive Compensation Devices using the NX application and ISO New England Operating Procedure No. 16 Transmission System Data. Transmission Owners shall report outages using the ISO New England Control Room Operations Window (CROW) application. Transmission Owners who own reactive compensation devices shall also review information directly from PSS/E.

Prospective Transmission Owners and existing Transmission Owners shall provide information for proposed reactive devices by completing ISO Planning Procedure PP 5-1 Attachment 3 along with the facility MVA rating, mode of operation, regulated bus and variable reactor tap range or provide a Schedule 25 Appendix 1 Interconnection Request as appropriate.

2.15 Steady State - Static VAR Systems

Transmission Owners shall provide steady state information for existing Static VAR Systems using the NX Application. Transmission Owners shall report outages using the ISO New England Control Room Operations Window (CROW) application. Transmission Owners who own Static VAR devices shall also review information directly from PSS/E.

Prospective Transmission Owners and existing Transmission Owners shall provide information for proposed reactive devices by completing ISO Planning Procedure PP 5-1 Attachment 3 along with the facility MVA rating or when appropriate, a Schedule 25 Appendix 1 Interconnection Request.

2.16 Steady State - Sensitivity Cases

ISO New England provides sensitivity cases for the Eastern Interconnection Planning Collaborative (EIPC) MWG and studies based on different case types/scenarios for planning base-cases including:

Summer Peak	Shoulder Peak	Fall Peak
Winter Peak	Spring Light Load	Spring Peak

ISO New England builds cases for these scenarios for (1-10) year out configurations depending on the study and case requested.

3.0 Dynamics Information

The Dynamics Database Application shall be used by Generator Owners and Transmission Owners to provide dynamic characteristic information for equipment listed below. The listings also include the ISO Operating Procedure (OP) and NERC functional registration associated with the characteristic. The level of detail for dynamics data is illustrated in Appendix C.

Models must be compatable with the latest PSSe version that ISO is using for operations and planning studies. Siemens PSSe library models are preferred and acceptable but cannot be obsolete models as listed in Section 7. User written models that were accepted by ISO prior to January 1, 2017 are allowed (See Planning Procedure 5-6). When new library model characteristics are provided, they must be provided with dyr and raw files for PSSe along with PDF backup materials for the model.

a. Generators (OP-14, GO)
b. Excitation Systems (OP-14, GO)
c. Governor Modeling (OP-14, GO)
d. Power System Stabilizers (OP-14, NX-12D includes entry for PSS commissioning, GO)
e. Demand (OP-16, Dynamic Load Modeling, LSE – removed from NERC Functional Registration)
f. Wind Turbines (OP-14, GO)
g. Photovoltaic systems (OP-14, GO)
h. Static VAR systems (OP-16, GO, TO, LSE – see above)
i. FACTS Devices (OP-16, GO, TO, LSE)
j. DC System (HVDC) (per OP-16, TO)
k. Protective Relaying and Control Characteristics (Note: Future part of the application)

For existing facilities, annual recertification of dynamics data is in accordance with the Operating Procedure referenced. In addition to annual recertification, for the dynamic characteristic information listed above, Generator Owners or Transmission Owners shall provide information to ISO New England prior to existing systems being modified. Appendix A contains information on how to use the Dynamics Database Application to enter and confirm information for equipment listed above. For existing equipment, ISO New England provides the modeling documentation that is on file for Owner recertification. For new equipment, applicable entities make data submissions in accordance with Tariff documents. Generator Owners and Transmission Owners shall include test reports and equipment manufacturers modeling information as back up for dynamics models. For new or modified equipment, developers or equipment owners shall shall enter dynamics data into DDMS once the System Impact Study (SIS) is complete.

In 2014, Lawrence Livermore National Laboratory provided New England State Dynamic Load Characteristics. The Dynamic Load Characteristic development was coordinated for New England Transmission Planners with ISO New England and the NPCC SS-38 Working Group on Inter-Area Dynamics. Load Serving Entities shall review the 2014 Dynamic Load Modeling information in accordance with OP-16.

PSCAD models may be required for generators using power electronic equipment per ISO New England Operating Procedure No. 14 - Technical Requirements for Generators, Demand Resources, Asset Related Demands and Alternative Technology Regulation Resources. PSCAD modeling is dependent on generator location as proximity of power electronic devices may cause interference affecting performance of power electronic equipment.

4.0 Short Circuit Data Collection Process

ISO Operating Procedure OP-16 governs the provision of short circuit information. Transmission Owners and Generator Owners shall provide short circuit data in accordance with OP-16 Appendix K. Appendix D of this Complinace Bulletin shows the level of detail associated with short circuit information. ISO also provides forms for short circuit data updates.

5.0 Generators 20 MW or less

In accordance with Schedule 23 to the ISO New England Open Access Transmission Tariff, generators above 5 MW shall submit models to ISO New England during construction. PSCAD models may be required for generators using power electronic equipment per ISO New England Operating Procedure No. 14 - Technical Requirements for Generators, Demand Resources, Asset Related Demands and Alternative Technology Regulation Resources. PSCAD modeling is dependent on generator location as proximity of power electronic devices may cause interference affecting performance of power electronic equipment.

6.0 Inverter Based Resources (IBRs)

In 2018, NERC issued a number of recommendations regarding modeling of IBRs. These recommendations were summarized in NERC's ERO Enterprise CMEP Practice Guide: Information to be Considered by CMEP Staff Regarding Inverter-Based Resources, January 24, 2019. A best practice is to review that document and other NERC recommendations to ensure that existing and new IBR are adequately modeled for planning and operations studies. ISO Planning Procedure PP5-6 - Interconnection Planning Procedure for Generation and Elective Transmission Upgrades also includes specific ISO requirements for IBR.

7.0 Data Collection Schedule

In all cases for existing equipment, ISO New England will initiate data collection. When ISO schedules existing equipment recertification, it will provide the equipment owner with the information that is on file. ISO New England will collect data according to specific Operating Procedures. Table 1 summarizes the data collection schedule. For new equipment installations or modifications to existing equipment characteristics, Owners shall provide equipment characteristics to ISO as soon as possible and under appropriate ISO Tariff provisions. For new equipment, ISO New England as the Resource Planner for New England enters information into the base case when it approves new installations. Appendix E includes process flow diagrams illustrating the provision and review of data associated with MOD-032 and ISO procedures.

Table 1 – Data Recertification Schedule for Existing Equipment

Equipment Type	Per Document/Process	Annual Recertification *
Steady State (S.S.) – Bus Data	OP-16/NX Application	by ISO request at least once every 13 calendar months
S.S. – Aggregate Demand	LSE function eliminated	
S.S. – Generator Min/Max Real Power	Market Rule 1/CCAT	Seasonal **
S.S. – Generator Min/Max Reactive	ISO OP-14/NX Application	Generator updates when change occurs
Steady State Generator Aux Load	ISO OP-14/NX Application	Januaryby ISO request at least once every 13 calendar months
S.S. Generator Unit Regulated Bus	ISO OP-14/NX Application	by ISO request at least once every 13 calendar months

Steady State Generator MVA base	This document/DDMS	by ISO request at least once every 13 calendar months
S.S. Generator Unit Type	ISO OP-14/CAMS	November ***
S.S. Generator Unit In-Service Status	OP-5/CROW	Outage Specific
S.S. AC Lines	OP-16/NX Application	by ISO request at least once every 13 calendar months
S.S. DC Transmission System	This document/DDMS	With Dynamics
S.S. Transformer	OP-16/NX	by ISO request at least once every 13 calendar months
S.S. Reactive Compensation	OP-16/NX	by ISO request at least once every 13 calendar months
S.S. Static VAR Systems	OP-16/NX	by ISO request at least once every 13 calendar months
Dynamics - Generator	OP-14/DDMS	by ISO request at least once every 13 calendar months
Dynamics - Excitation System	OP-14/DDMS	by ISO request at least once every 13 calendar months
Dynamics – Governor Modeling	OP-14/DDMS	by ISO request at least once every 13 calendar months
Dynamics – Power System Stabilizer	OP-14/DDMS	by ISO request at least once every 13 calendar months

Dynamics – Demand	LSE function eliminated	by ISO request at least once every 13 calendar months
Dynamics – Wind Turbine	OP-14/DDMS	by ISO request at least once every 13 calendar months
Dynamics – Photovoltaic Systems	OP-14/DDMS	by ISO request at least once every 13 calendar months
Dynamics – Static VAR Systems	OP-16/DDMS	by ISO request at least once every 13 calendar months
Dynamics – FACTS Devices	OP-16/DDMS	by ISO request at least once every 13 calendar months
Dynamics - DC System (HVDC)	OP-16/DDMS	by ISO request at least once every 13 calendar months
Short Circuit Data Collection Process	OP-16/e-mail/SCWG	by ISO request at least once every 13 calendar months
Geomagnetic Characteristics	PP-11/Notification	by ISO request

* - Month that ISO initiates annual recertification. If equipment performance becomes degraded or changes, Owners shall notify ISO New England immediately using the NX application or DDMS unless otherwise noted.

** - Generator Owners schedule individual Seasonal Claimed Capability Testing with ISO-NE

*** - CAMS implementation of NX-12

If a registered entity believes an ISO data request is overdue then please contact ISO Customer Service and describe the item pertaining to NERC Standard MOD-032.

8.0 Acceptable Models

ISO New England accepts models that are available in latest version of PSS/E simulation software that ISO uses to represent the dynamic behavior of equipement and can provide information to obtain those models from Siemens. These models can be used as long as they are not obsolete. Over time, significant improvements to models may occur and models may become obsolete though the models are still available for PSS/E. When that occurs, models must be replaced with more current models even though the model may still be available in PSS/E. Table 2 includes a listing of models that are obsolete and required replacement dates. In addition, models must not be obsolete as listed by NERC in the NERC List of Acceptable Models for Interconnection-Wide Modeling (also below).

Table 2 – ISO New England List of Obsolete Models

Model to be replaced	Required replacement date	Basis for Replacement
GENSAL	For new and modified generators per I.3.9, along with NERC MOD-026 and MOD-027 submissions the GENSAL model shall not be used. The GENTPJ or another acceptable model shall be selected that represents the generator as currently configured and analyzed*.	NERC Modeling Notification Use of GENTPJ Generator Model Distribution Date: November 18, 2016 and Subsequent Webinar Industry Webinar: Modeling Notifications EX2000 and GENTPJ December 2016
GENSAL	For all generators effective March 1, 2022 the GENSAL model shall be replaced with an analyzed* GENTPJ or another acceptable model that represents the generator as currently configured.	NERC Modeling Notification Use of GENTPJ Generator Model Distribution Date: November 18, 2016 and Subsequent Webinar Industry Webinar: Modeling Notifications EX2000 and GENTPJ December 2016
GENROU	For new and modified generators per I.3.9, along with NERC MOD-026 and MOD-027 submissions the GENROU model shall only be used if rotor generator data has been analyzed* and verified where a suitable match of simulations to the available measured data is achieved. The GENTPJ or another acceptable model that represents the generator as currently configured* is	NERC Modeling Notification Use of GENTPJ Generator Model Distribution Date: November 18, 2016 and Subsequent Webinar Industry Webinar: Modeling Notifications EX2000 and GENTPJ December 2016

Table 2 – ISO New England List of Obsolete Models		
Model to be replaced	**Required replacement date**	**Basis for Replacement**
	recommended as a replacement if GENROU cannot match simulations.	
GENROU	For all generators effective July 1, 2024 the GENROU model shall only be used if round rotor generator data has been analyzed * and verified where a suitable match of simulations to the available measured data is achieved. The GENTPJ or another acceptable model that represents the generator as currently configured* is recommended as a replacement if GENROU cannot match simulations.	NERC Modeling Notification Use of GENTPJ Generator Model Distribution Date: November 18, 2016 and Subsequent Webinar Industry Webinar: Modeling Notifications EX2000 and GENTPJ December 2016
EX-2000	Commence immediate replacement – complete by January 1, 2019	Modeling Notification, EX2000 Dynamics Component Model for Excitation Systems, Initial Distribution: March 21, 2016 indicates the field current limiter portion of this model is suspect. And the NERC List of Acceptable Models for Interconnection-Wide Modeling lists this model as obsolete
GAST, GAST2A, GASTWD, GFT8WD, and WESGOV	Generators required to perform MOD-027 reviews or generators making I.3.9 modifications - models listed at left are not to be used for representing new generators and applicable existing generators when control systems have been replaced with digital controls. Transition to GGOV1 (or GGOV1DU if deadband is used) with MOD-027 reviews or I.3.9 modifications. Complete phase out by July 1, 2024 with MOD-027 testing.	Modeling Notification Gas Turbine Governor Modeling Initial Distribution: August 2017

Table 2 – ISO New England List of Obsolete Models		
Model to be replaced	**Required replacement date**	**Basis for Replacement**
GAST, GAST2A, GASTWD, GFT8WD, and WESGOV	Generators not required to perform MOD-027 reviews or making I.3.9 modifications shall verify the model by July 1, 2024 and replace with analyzed* GGOV1 or GGOV1DU (or GGOV1DU if deadband is used)	Modeling Notification Gas Turbine Governor Modeling Initial Distribution: August 2017
*- The model that is submitted shall be analyzed to ensure that parameters match the actual characteristics of the generator and analysis shall be provided illustrating that a suitable match of simulations to the available measured data is achieved.		

In addition, models shall be as listed in the latest version of the NERC List of Acceptable Models for Interconnection-Wide Modeling. The current version at the time of publication of this guide follows. It is also available on-line at http://www.nerc.com/comm/PC/Pages/System-Analysis-and-Modeling-Subcommittee-(SAMS)-2013.aspx as listed under "NERC Acceptable Model List".

NERC LIST OF ACCEPTABLE MODELS FOR INTERCONNECTION-WIDE MODELING

Purpose

The purpose of this list of acceptable models is to develop and maintain a repository of models deemed acceptable by the ERO and industry stakeholders for use in developing interconnection-wide models developed by the MOD-032 Designee. The NERC System Analysis and Modeling Subcommittee (SAMS) maintains and coordinates activities to address any modeling issues and will reflect any updates in this list of acceptable models on a periodic basis, or as needed.
This list seeks to bring together multiple sources of data to ensure uniformity in the use of models across interconnections. While models may be deemed 'obsolete' or 'deprecated' due to known issues, those models are not removed from the software vendor libraries for various reasons. However, those models should not be used for developing interconnection-wide models.

Table Legend

Yellow: Use of this model is not recommended. Other models may be more appropriate for use. While existing models in the cases may still use these models, their future use is discouraged. Resubmission of models as per MOD-026-1 and MOD-027-1 for existing resources should convert the existimg model to a more representative model.

Orange: Use of this model for new resources or resources re-certifying their models as per MOD-026-1 and MOD-027-1 is prohibited. Replace in accordance with requirements.

Blue: These models are industry-accepted (e.g., IEEE standard models) that have not yet been implemented by the software vendors. Therefore they are listed on the list of acceptable models for tracking purposes using this color and will be updated accordingly once implemented by the software vendors. This is intended to provide direction to software vendors on which models industry recommends being implemented with higher priority.

Disclaimers and Notes

> Some of the models in this list may not be acceptable for use by all Modeling Designees. Modeling requirements as specified for each interconnection by the Modeling Designees supercede this list and those Designees should be consulted directly.

> This list of models may not be comprehensive of all models available in the various commercial software platforms. Additional models may exist in the software platforms and are not addressed in this list of acceptable models.

> 'Black box' models (e.g., no block diagrams, documentation, proprietary models, etc.) are prohibited for use in interconnection-wide models.

> User-defined models are acceptable; however, where a generic model can accurately represent the resource (e.g., wind power plants), the generic model should be used. Some exceptions to this exist such as HVDC circuits.

Questions

Please direct any questions to NERC System Analysis (SystemAnalysis@nerc.net).

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
genrou	X	X	X	X	X	X	Treatment of saturation. Use GENTPJ. See Modeling Notification.	Modeling Notification - Use of GENTPJ
gensal	X	X	X	X	X	X	Treatment of saturation. Use GENTPJ. See Modeling Notification.	Modeling Notification - Use of GENTPJ
--	X	--	X	--	X	--	Treatment of saturation. Use GENTPJ. See Modeling Notification.	Modeling Notification - Use of GENTPJ
--	X	--	X	--	X	--	Treatment of saturation. Use GENTPJ. See Modeling Notification.	Modeling Notification - Use of GENTPJ
gensdo	X	--	--	--	--	--		
gencc	--	X	--	X	--	X		
gentpf	--	X	--	X	--	X		
gentpj	--	X	X	X	--	X		
gencls	X	X	X	X	X	X	Does not allow for representation of excitation system and turbine/speed governor models.	SME input.
--	--	--	X	--	--	--	Specialized model (Ontario-Hydro model (and IEEE Std. 1110)) that goes to sub-sub-transient effects (up to 3 windings in the d- or q-axis) for special cases.	
--	X	--	X	--	--	--	Simplified model without subtransient effects; prone to numerical problems.	PSS/E PAG V2, Section 14.4.5.4

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
--	--	--	--	--	--	--		
genind	X	X	--	--	--	--		
--	X	--	X	X	--	--		
--	X	--	X	X	--	--		
plefd	X	--	X	X	--	--		
plnow	--	--	X	X	--	--		
plref	X	--	X	X	--	--		
pltp	X	--	X	X	--	--		
gthev	--	--	X	X	--	--		
wt1g	X	X	X	X	X	X		
wt2g	X	X	X	X	X	X		
--	X	--	X	--	X	--	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
wt3g	X	X	X	X	X	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
--	X	--	X	--	X	--	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
wt4g	--	X	--	X	X	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
wt2e	X	X	X	X	X	X		
wt3e	X	X	X	X	X	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
--	X	--	X	--	X	--	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
wt4e	--	X	--	X	X	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	
wt1t	X	X	X	X	X	X		
wt2t	X	X	X	X	X	X		
wt3t	X	X	X	X	X	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
wtgt_a	X	X	X	X	X	X		
wt3p	X	X	X	X	X	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
wtgp_a	X	X	X	X	X	X		
wt1p	X	X	X	X	X	X	Does not accurately represent Type 1 WTG pitch controls.	SME input.
wt1p_b	--	X	--	--	--	--		
wtga_a	X	X	X	X	X	X		
wtgq_a	X	X	X	X	X	X		
wt4t	--	X	--	X	--	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
wt4p	--	--	--	X	--	X	2nd Generation Renewable Models replace these; numerical issues in base cases.	WECC Wind Modeling Guideline
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
regc_a	X	X	X	X	--	--		
reec_a	X	X	X	X	X	X		
repc_a	X	X	X	X	X	X		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
reec_b	X	X	X	X	X	X	If resource uses momentary cessation during ride-through operation, use REEC_A to represent this.	Modeling Notification
reec_c	--	X	--	X	--	--		
--	--	--	--	--	--	--		
genwri	--	X	--	X	--	X	2nd Generation Renewable Models should replace these; potential numerical issues in base cases.	
exwtg1	--	X	--	X	--	X	2nd Generation Renewable Models should replace these; potential numerical issues in base cases.	
wndtge	--	X	--	X	--	X	2nd Generation Renewable Models should replace these; potential numerical issues in base cases.	
gewtg	--	X	--	X	--	X	2nd Generation Renewable Models should replace these; potential numerical issues in base cases.	
exwtge	--	X	--	X	--	X	2nd Generation Renewable Models should replace these; potential numerical issues in base cases.	
wndvar	--	--	--	--	--	--	2nd Generation Renewable Models should replace these; potential numerical issues in base cases.	
pv1g	--	X	--	X	--	--		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
pv1e	--	X	--	X	--	--		
pvd1	--	X	--	--	--	--		
esac1a	X	X	X	X	X	X		
--	--	--	X	--	X	--		
esac2a	X	X	X	X	X	X		
esac3a	X	X	X	X	X	X		
esac4a	X	X	X	X	X	X		
esac5a	X	X	X	X	X	X		
esac6a	X	X	X	X	X	X		
exac6a	--	X	--	--	--	--		
esac7b	X	X	X	X	X	X		
ex21br	--	--	--	--	--	--		
esac8b	X	X	X	X	X	X		
exac8b	X	X	X	X	X	X		
esdc1a	X	X	X	X	X	X		
esdc2a	X	X	X	X	X	X		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
esdc3a	X	X	X	X	X	X		
esdc4b	X	X	X	X	X	X		
esst1a	X	X	X	X	X	X		
esst2a	X	X	X	X	X	X		
esst3a	X	X	X	X	X	X		
esst4b	X	X	X	X	X	X		
exst4b	--	X	--	X	--	X		
esst5b	X	X	X	X	X	X		
--	X	--	X	--	X	--		
esst6b	X	X	X	X	X	X		
esst7b	X	X	X	X	X	X		
ieeet1	X	X	X	X	X	X		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
exdc4	X	X	X	X	X	--		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
exac1	X	X	X	X	X	X		
exac1a	X	X	X	X	X	X		
exac1m	--	--	--	--	--	--		
exac2	X	X	X	X	X	X		
exac3	X	X	X	X	X	--		
exac3a	--	X	--	X	--	X		
exac4	X	X	X	X	X	X		
exdc1	X	X	X	X	X	X		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
exdc2a	X	X	X	X	X	X		
exdc2	--	X	--	X	--	X		
exdc4	X	X	X	X	X	X		
exst1	X	X	X	X	X	X		
exst2	X	X	X	X	X	X		
exst2a	X	X	X	X	X	X		
--	X	--	X	--	X	--		
exst3	X	X	X	X	X	X		
exst3a	--	X	--	X	--	X		
rexs	X	X	X	X	X	X		
--	X	--	X	--	X	--		
expic1	X	X	X	X	X	X		
mexs	--	X	--	--	--	X		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
texs	--	X	--	X	--	X	Simplified, early generation model considered obsolete; other models more suitable.	SME input, IEEE Std. 421.5
scrx	X	X	X	X	X	X		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
sexs	X	X	X	X	X	X	Simplified, early generation model considered obsolete; other models more suitable.	SME input, IEEE Std. 421.5
exivo	X	X	X	--	X	X		
--	--	--	X	--	X	--		
--	X	--	X	--	X	--		
exbbc	X	X	X	X	X	X		
exeli	X	X	X	X	X	X		
exeli2	--	--	X	--	X	--		
--	X	--	X	--	X	--	Field current limiter latch issue. Replace with AC7B in PSSE and ex21br in PSLF.	NERC EX2000 Modeling Notification
--	X	--	X	--	X	--		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
--	X	--	X	--	X	--		
ieeest	X	X	X	X	X	X		
--	X	--	--	--	--	--		
--	--	--	X	--	--	--		
--	--	--	X	--	--	--		
pss1a	X	X	--	X	--	X		
pss2a	X	X	X	X	X	X		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
pss2b	X	X	X	X	X	X		
pss3b	--	X	--	X	X	X		
--	--	--	--	--	--	--		
--	--	--	X	--	X	--		
--	--	--	X	--	X	--		
--	X	--	X	--	X	--		
--	X	--	X	X	X	--		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
wsccst	X	X	X	X	X	X		
psssb	--	X	--	X	--	X		
--	X	--	X	--	X	--		
--	--	--	--	--	--	--		
psssvc	--	--	--	--	--	--		
ccomp4	--	X	--	--	--	--		
**	X	--	X	--	X	--		
ccomp	X	X	--	--	X	--		
†	X	†	X	†	X	†		
**	X	--	X	--	X	--		
ccbt1	--	X	--	--	--	X	Similar but different than TGOV5.	
ccst3	--	--	--	--	--	X		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
gegt1	--	--	--	--	--	--	Detailed model. Encouraged to use generic model - GGOV1 - for interconnection-wide modeling.	
ggov1	X	X	X	X	X	X		
ggov2	--	X	--	--	--	X		
ggov3	--	X	--	X	--	X		
lm2500	--	--	--	--	--	--	No supporting documentation (block diagrams), proprietary model. Use GGOV1.	
lm6000	--	--	--	--	--	--	No supporting documentation (block diagrams), proprietary model. Use GGOV1.	
stag1	--	--	--	--	--	--		
w2301	--	X	--	X	--	X		
--	--	--	--	--	X	--		
crcmgv	X	X	X	X	X	X		
--	X	--	--	--	X	--		
degov1	X	--	X	--	X	--		
gast	X	X	X	X	X	X	Simplistic representation of steam turbine-governor system. Insufficient model capability of modern digital controls.	
--	X	--	X	--	X	--	simple representations of a turbine-governor control system. Insufficient model capability and flexibility for most modern digital gas turbine-governor control systems.	Modeling Notification - Gas Turbine Governor Modeling

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
--	X	--	X	--	X	--	simple representations of a turbine-governor control system. Insufficient model capability and flexibility for most modern digital gas turbine-governor control systems.	Modeling Notification - Gas Turbine Governor Modeling
--	X	--	X	--	X	--	simple representations of a turbine-governor control system. Insufficient model capability and flexibility for most modern digital gas turbine-governor control systems.	Modeling Notification - Gas Turbine Governor Modeling
hygov	X	X	X	X	X	X		
--	X	--	X	--	X	--	Superceded by hygov4 or any other updated hydro model.	
--	--	--	--	--	--	--		
hygovr	X	X	X	X	X	X		
--	--	--	--	--	--	--		
h6b	--	--	--	X	--	--		
h6bd	--	X	--	--	--	--		
hygov8	--	--	--	--	--	--		
hypid	--	X	--	--	--	--		
hyst1	--	--	--	--	--	--		
--	X	--	X	--	X	--	Use the WSIEG1 model instead. PSS/E WSIEG1 = PSLF IEEEG1.	
--	X	--	X	--	X	--	Model does not have an effective turbine model and an oversimplified governor model applicable only to first swing stability. Outdated. Typically	

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
							recommend using a hygov model instead (no parameter-by-parameter replacement though.)	
ieeeg3	X	X	X	X	X	X		
hygov4	--	X	--	X	--	X		
--	X	--	X	--	X	--	Should be converted to WSIEG1 (PSS/E) or IEEEG1 (PSLF); does not represent rate limits for control valve or intentional deadband.	
--	--	--	--	--	X	--		
pidgov	X	X	X	X	X	X		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
tgov1	X	X	X	X	X	X		
--	X	--	X	--	X	--	Detailed model used for special cases.	
tgov3	X	X	X	X	X	X	Detailed model used for special cases.	
--	--	--	--	--	--	--	Detailed model used for special cases.	
--	X	--	--	--	X	--	Detailed model that includes boiler controls; used for special studies.	
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
--	X	--	X	--I196	X	--		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
--	X	--	X	--	X	--	simple representations of a turbine-governor control system. Insufficient model capability and flexibility for most modern digital gas turbine-governor control systems.	Modeling Notification - Gas Turbine Governor Modeling
--	X	--	X	--	X	--		
g2wscc	X	X	X	X	X	X		
gpwscc	X	X	X	X	X	X	Use hyg3 or WSHYGP model.	WECC Approved Dynamic Model Library
hyg3	--	X	--	X	--	X		
ieeeg1	X	X	X	X	X	--		
lcfb1	X	X	X	X	X	X		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
genind	X	--	X	--	X	--		
motor1	X	X	X	X	X	X		
--	--	--	--	--	--	--		
--	--	--	--	--	--	--		
motorw	--	X	X	X	X	X		
_lwscc	X	--	X	X	X	--		
--	X	--	X	--	X	--		
--	--	--	--	--	--	--		
--	X	--	X	--	X	--		
cmpldw	--	X	X	X	X	X		
cmpldwg	--	--	--	--	--	--		
cmpldw2	--	X	--	--	--	--		
ld1pac	--	X	--	--	--	--		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
motorc	--	X	--	--	--	--	Experimental model.	PSLF Manual
svsmo1	--	X	X	X	--	X		
svsmo2	--	X	X	X	--	X		
svsmo3	--	X	X	X	--	X		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
--	X	--	X	--	X	--		
vwscc	X	X	X	X	X	X		
--	X	--	X	--	--	--		
msc1	X	X	X	--	--	--		
--	--	--	--	--	--	--		
--	X	--	X	--	X	--		
--	--	--	X	--	--	--		
--	--	--	X	--	--	--		
--	--	--	X	--	X	--		
--	X	--	X	--	X	--		
--	--	--	--	--	--	--		
--	X	--	--	--	X	--		
gp1	--	X	--	X	--	X		
gp2	--	X	--	--	--	X		
lhfrt	X	X	X	X	--	X		
--	X	--	X	--	--	--		
lhvrt	X	X	X	X	X	X		
--	X	--	X	--	X	--		
locti	X	X	x	--	X	X		
lsdt1	X	X	X	X	--	X		
lsdt2	--	X	X	X	--	X		
lsdt9	--	X	X	X	--	X		

GE PSLF (v. 19)	PowerWorld Simulator (v.19)		PowerTech DSATools (v. 16)		V&R Energy POM (2015)		Comments	Reference
	PSSE	PSLF	PSSE	PSLF	PSSE	PSLF		
ooslen	--	X	--	--	--	X		
ooslnq	--	X	--	--	--	--		
oosmho	--	X	--	--	--	--		
scmov	--	X	--	--	--	--		
--	--	--	--	--	--	--		
msc1	--	X	--	--	--	--		
msr1	--	X	--	--	--	--		
mslr1	--	X	--	--	--	--		
mss1	--	--	--	--	--	--		
mss2	--	--	--	--	--	--		
oel1	--	X	--	X	--	X		
ltc1	--	X	--	--	--	--		
vft	--	X	--	--	--	--		

Version	Date	Description
1	4/1/2017	Initial list posted.
2	4/25/2017	Disallowed LM2500, LM6000 based on no documentation and discussions with GE. Reformatted list. Added IEEE Std. 421.5-2016 new models to the list (not yet implemented in most software platforms).
3	4/27/2017	Added gegt1 to the list of not recommended models. Detailed model best used for detailed studies or islanding studies, but not for interconnection-wide modeling. GGOV1 more suitable for these studies. Change made based on SME input.
4	5/9/2017	Added blue color code to identify models that are industry accepted yet not yet implemented by software vendors.
5	5/12/2017	Added GENTPJ Modeling Notification to comments and reference for GENROU, GENROE, GENSAL, GENSAE. Rearranged models for readability.
6	6/7/2017	Changed CGEN1, GENSAE, TGOV2, TGOV3, TGOV4 to 'not recommended' from 'disallowed' based on PPMVTF input. Added comments on multiple models. Removed FRECHG model from 'not recommended'. Specialized model, but suitable under rare situations. Removed wt2e model from 'disallowed'. Disallowed SEX and TEXS based on subject matter expert input and simplistic representation of excitation system controls.
7	8/10/2017	Disallowed GAST, GAST2A, GASTWD, and WESGOV. Added link to Modeling Notification. NERC SAMS approved updated list.
8	8/21/2017	New version posted to NERC SAMS webpage.
9	9/21/2018	Added description of why IEEEG2 is not recommended. Added hygov2 to the list of not recommended models.
10	11/7/2018	Added reecb to the list of not recommended models, if momentary cessation is used by the resource.
11	11/9/2018	New version posted to NERC SAMS webpage.
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Appendix A – Dynamics Data Management System (DDMS)

Please refer to the ISO DDMS User Guide that is available at https://www.iso-ne.com/static-assets/documents/2016/12/ddmsexternaluserguide.pdf

Appendix B – Sample Steady State Data

Steady-State	Units	Example	Description
1. Each Bus [TO,GO]			
Bus name, location, description, etc.			Discuss Parameters with Base Case Working Group (BCWG)
a. nominal voltage	kV	345 kV	Nominal bus voltage (e.g, 138, 230, 345, etc.)- not the voltage that the bus is operated at or scheduled to. BCWG developed
b. area, zone, and owner	area	101	Discuss Parameters with Base Case Working Group
c. bus number where available	#no	101999	Range Assignment to BCWG
	zone	1	BCWG
	owner	1	BCWG
2. Aggregate Demand at each bus [LSE]			
a. real power*	MW	85 MW	Discuss Parameters with Base Case Working Group
b. reactive power*	MVArMVAr	15 MVAr	Discuss Parameters with Base Case Working Group (cross check with Planning Guide)
c. in-service status (normal status)*	[online/ offline]	1/0; on/off	Discuss Parameters with Base Case Working Group
d. load type (e.g., firm, interruptible, scalable, etc.)	type load	firm, interruptible, scalable, temperature sensitive, etc.	Discuss Parameters with Base Case Working Group
e. Load location identifier (Station and load name or bus number and load ID)		ASTATION/ALOAD or ABus#/ID	Discuss Parameters with Base Case Working Group

3. Generating Units [GO, proposed Generation Facility Owner]			
a. real power capabilities - gross maximum and minimum values	Gross Max	450 MW	Sustained real power output (generally stated as megawatts, MW) at the generator terminals under the expected peak seasonal operating conditions (e.g., Summer, Winter, Spring, and Fall) at its gross continuous capability.
	Gross Min	75 MW	For dispersed Hydro, Solar and Wind Gen: Discuss Parameters with Base Case Working Group
b. reactive power capabilities - maximum and minimum values at real power capabilities in 3a above			Maximum sustained overexcited and underexcited reactive output at the generator terminals, at the real power capability (3a above) or capability curve under the expected seasonal operating conditions and at rated MW power of generator. These values should be based on the most limiting constraints as shown in PRC-019 coordination curves
At max MW gross	MVAr	+200 MVAr/-100 MVAr	
At min MW gross	MVAr	+250 MVAr/-150 MVAr	
c. station service (SS) auxiliary load (provide data in the same manner as that required for aggregate Demand under item 2, above).	See item 2	15 MW, 2 MVAr	typical, see NX-12D
d. regulated bus* and voltage set point* (as typically provided by the TOP)			See OP-12 and OP-12 Appendix B
e. machine rated MVA (specify cooling conditions that correspond to rated MVA below as applicable)	MVA	500 MVA	Nameplate MVA Base

f. generator step up transformer data (provide same data as that required for transformer under item 6, below)			See NX-9 Form
g. generator type (hydro, wind, fossil, solar, nuclear, etc)			GDDM Application
h. in-service status*			CROW Outage Application or PPA retirement status
4. AC Transmission Line or Circuit (series capacitors and reactors shall be explicitly modeled as individual line segments) [TO,GO]			
a. impedance (positive sequence)			positive sequence impedance of transmission line - see ISO-NE NX-9A instructions
Base Voltage	kV	345 kV	
Base MVA	MVA	100 MVA	
length of line	mi	80 mi	
i. resistance	100 MVA Base	0.0192	Transmission Line Resistance - see ISO-NE NX-9A instructions
ii. reactance	100 MVA Base	0.0575	Transmission Line Reactance - see ISO-NE NX-9A instructions
b. susceptance (line charging) Total	100 MVA Base	0.0264	Transmission Line Susceptance (B) - see ISO-NE NX-9A instructions
c. ratings (normal and emergency, two seasons)*			Transmission Line Ratings - see ISO-NE NX-9A instructions and OP-16
Normal	MVA	100	
LTE	MVA	120	
STE	MVA	133	
DAL	MVA	140	
d. equipment status (normal equipment status)*	[1, in service/ 0, out-of-service]	1, in service	Enter outage information in CROW. Retirement PPA.
e. other information			
5. DC Transmission systems – identified by DC line name or number [TO]			
a. System Description			Identify # of terminals, line configuration (monopole, bipole) and location of rectifier and inverter

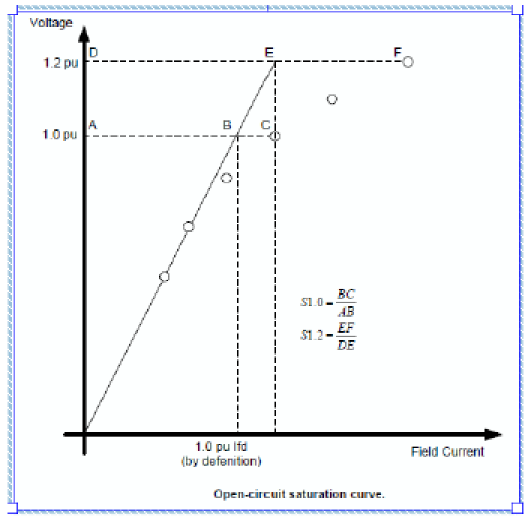
b. line parameters			scheduled DC voltage, control mode (blocked, power, current), power order, dc resistance
c. converter transformer parameters			transformer ratio, tap setting, tap step
d. rectifier and inverter data			firing angles, firing angle limits, # of bridges
e. filter/shunt bank data			Provide information on any filter or shunt banks at the rectifier or inverter
f. equipment status (normal equipment status)*	[1, in service/ 0, out-of-service]	1, in service	Realtime - EMS System
6. Transformer (voltage and phase-shifting) [TO,GO]			
a. nominal voltages of windings			Transformer Nameplate (See OP-16 Appendix B and C)
High Side	kV	220	
Low Side	kV	100	
Tertiary	kV	44	
b. impedance(s)			Transformer Impedance at fixed tap setting and nominal tap setting. Specify the Base MVA for each impedance.
High - Low	P.U.@__MVA	0.005 + j 0.1012 @ 100 MVA	Resistance and Reactive values are calculated for the current tap settings from these impedances and other information on the test report. These impedance values are calculated as shown in the OP-16 Appendix documents.
High - Tertiary	P.U.@__MVA	0.002 + j 0.0702 @ 100 MVA	
Low - Tertiary	P.U.@__MVA	0.002 + j 0.0533 @ 100 MVA	
c. tap ratios (voltage or phase angle)*			NX-9
voltage	P.U.	1.0375	
phase angle	degrees	3 degrees	
d. minimum and maximum tap position limits			Transformer Nameplate (See OP-

			16 Appendix for instructions)
minimum	P.U. or degrees	0.95	
maximum	P.U. or degrees	1.05	
e. number of tap positions (for both the Under Load Tap Changer and No Load Tap Changer)		1 - 5	Transformer Nameplate (See OP-16 Appendix for instructions); For non-linear tap positions, add a transformer and impedance corrections tables.
f. regulated bus (for voltage regulating transformers)*			Transformer Nameplate (See OP-16 Appendix for instructions)
g. regulated voltage limits or MW band limits*			Transformer Nameplate (See OP-16 Appendix for instructions)
Vmax			
Vmin			
g. MVA ratings (normal and emergency)*			See OP-16 Appendix for instructions; If 3 winding, there should be separate ratings for each winding.
Normal	MVA	100	
LTE	MVA	133	
STE		166	
DAL	MVA	170	
h. in-service status*			Outages per CROW/Retirements per FCA/PPA
i. mode of operation (fixed, discrete, continuous, etc.)	Mode	fixed	Transformer Nameplate (See OP-16 Appendix for instructions)
j. equipment status (normal equipment status)*	[1, in service/ 0, out-of-service]	1, in service	Outages per CROW/Retirements per FCA/PPA
k.. Transformer identifier (Station/Transformer name or High/Low/Tertiary bus numbers and ID)		ASTATION/ATRANSFORMER or HBus#/LBus#/TBus#/ID	Discuss Parameters with ISO Base Case Working Group
7. Reactive compensation (shunt capacitors and reactors) [TO]			See ISO Operating Procedure OP-16 Appendix D
Nominal voltage	kV	34.5	

a. admittances (MVAr) of each capacitor and reactor	MVAr	50 MVAr	See ISO Operating Procedure OP-16 Appendix D
b. regulated voltage band limits	[kV max, kV min] P.U. or kV	[1.05, 0.95]	See ISO Operating Procedure OP-16 Appendix D
c. mode of operation (fixed, discrete, continuous, etc.)	mode	discrete	See ISO Operating Procedure OP-16 Appendix D
d. regulated bus*		HS	See ISO Operating Procedure OP-16 Appendix D
e. in-service status*			
f. share of reactive contribution for voltage regulation*	%	100	See ISO Operating Procedure OP-16 Appendix D
g. Shunt location identifier (Station and device name or bus number and ID)		ASTATION/ASHUNT or ABus#/ID	See ISO Operating Procedure OP-16 Appendix D
8. Static Var Systems [TO]			
a. reactive limits	MVAr	+50, -40 MVAr; or 50 MVAr capacitive, 40 MVAr inductive	See OP-16 Appendix Z
b. voltage set point*	P.U. / kV	1.025 pu, 235.75 kV	See OP-16 Appendix Z
c. fixed shunt switching, if applicable			
d. share of reactive contribution for voltage regulation*			
e. equipment status (normal equipment status)*	[1, in service/ 0, out-of-service]	1, in service	Realtime - EMS System/Outages per CROW/Retirements per FCA/PPA
f. Shunt location identifier (Station and device name or bus number and ID)		ASTATION/ASHUNT or ABus#/ID	See this document Appendix A

Appendix C – Dynamics

Dynamics:	Units	Example	Description
1. Generator [GO,RP(for planned resources only)] a. Synchronous machines, including, as appropriate to the model:			
i. Base MVA	MVA	100 MVA	Generator Nameplate Base MVA
i. inertia constant - H	unitless	4.3	Generator Data - Valid Manufacturers Databook or Expert Generator Consultant Report; Looking for the full shaft constant including generator, turbine, and rotating exciter masses.
ii. saturation parameters			Generator Data - Valid Manufacturers Databook or Expert Generator Consultant Report. The figure below may be used to determine actual data points

S1.0	unitless	0.1	 Open-circuit saturation curve.
S1.2	unitless	0.45	
Dynamics: While the following information is typically needed for most dynamic models, need to include description about GO and PC/TP working together on specifics			“Best available data,” until the first round of MOD-026 and MOD-027 testing has been completed. .
xd (unsaturated synchronous reactance, direct axis)	P.U.	1.67	
xq (unsaturated synchronous reactance, quadrature axis)	P.U.	1.6	
x'd (unsaturated transient synchronous reactance, direct axis)	P.U.	0.265	

x'q (unsaturated transient synchronous reactance, quadrature axis)	P.U.	0.46	
x"d (unsaturated subtransient synchronous reactance, direct axis)	P.U.	0.205	
x"q (unsaturated subtransient synchronous reactance, quadrature axis)	P.U.	0.205	
xl (leakage reactance, over/under excited)	P.U.	0.15	
v. generator time constants			"Best available data," until the first round of MOD-026 and MOD-027 testing has been completed; If Generator has been rewound, update this information post rewind.
T'd0 (Open Circuit, Direct axis time constant)	s	3.7	"Best available data," until the first round of MOD-026 and MOD-027 testing has been completed.
T"d0 (Open Circuit, subtransient direct axis time constant)	s	0.032	
T'q0 (Open Circuit, Quadrature axis time constant)	s	0.47	
T"q0 (Open Circuit, subtransient quadrature axis time constant)	s	0.06	

			Note: any occurrence of a non-zero "D" associated with any generator model (GENROU, GENSAL, GENCLS, etc.) will cause unintended interference in the frequency response of PSS/E case or model. Reason is in PSSE the damping coefficient is referenced against the nominal frequency such that it will not only add a damping but a governing effect as well. GENCLS shouldn't be used in dynamic case except as an equivalent generator on the opposite end of a HVDC tie.
b. Other technologies, including, as appropriate to the model:	see 1a above		Generator Data - Valid Manufacturers Databook or Expert Generator Consultant Report
i. inertia constant (Combined Turbine-Generator - H)			
ii. damping coefficient set to zero if not provided by mfg			
iii. saturation parameters (S/1.0, S/1.2)			
iv. direct and quadrature axes reactances and time constants	See 1a above		
2. Excitation System [GO] (See example block diagram below)	model definition parameters	See IEEE 421.5 as well as sample excitation system model below.	"Manufacturer or Expert Consultant data," until the first round of MOD-026 and MOD-027 testing has been completed.

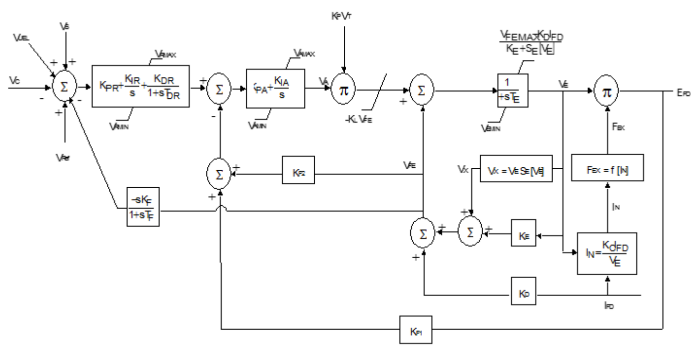
3. Governor [GO]	model definition parameters	See sample governor model below.	Model - Valid Manufacturers Databook or Expert Generator Consultant Report; **Note**: It is recommended Governor models be accompanied by baseload descriptions. For example: 0-Valves are free to move with frequency, 1- governor shall close valves, but not open them, 2- governor shall not change valve position. 3 – governor shall open valves but not close them, (and reported separately for max, min and intermediate load). The gas turbine engines of a combined cycle plant for example would then be a 1 when on firing temperature control, a 3 at min load and a 0 in-between. A combined cycle steam turbine would be a 1 at full load (VWO) and a 0 at other loads.
a. Response Limiting		ramp rate limiters/ degree-of-response caps	These cause the actual reaction to a disturbance to be less than that dictated by the governor alone. Such “outer loop controls” are often not included in the model data one receives from an OEM but must be indicated. Reference NERC Alert – February 5, 2015, Generator Governor Frequency Response
4. Power System Stabilizer [GO]	model definition parameters	See sample PSS model below.	“Manufacturer's or Expert Consultant data,” until the first round of MOD-026 and MOD-027 testing has been completed.
5. Demand [LSE] - consistent with system load representation (composite load model) and components as a function of frequency and voltage			ISO New England worked with NPCC SS-38 to develop a specific dynamic load model for New England. This provided New England state specific dynamic load models for peak and light loading.
6. Wind Turbine Data [GO]	model definition parameters		“Manufacturer's or Expert Consultant data,” until the first round of MOD-026 and MOD-027 testing has been completed.

7. Photovoltaic systems [GO]	model definition		"Manufacturer's or Expert Consultant data," until the first round of MOD-026 and MOD-027 testing has been completed.
	parameters		
8. Static Var Systems and FACTS [GO, TO, LSE]	model definition		"Manufacturer's or Expert Consultant data," until the first round of MOD-026 and MOD-027 testing has been completed.
	parameters		
9. DC system models	model definition		"Manufacturer's or Expert Consultant data,"
	parameters		
10. Model Name and Parameters		IEEE421.5	If a standardized model from the approved library of models is not used, provide block diagram below.
11. Source of Model		IEEE Exciter Models	Source of the Model being used
12. Voltage regulator compensation (line drop or reactive droop)	%	Rc + jXc	Note- Reactive droop is typically only used for generators tied to a common generator bus (ie, no dedicated GSU for each generator). See Line Drop Compensation diagram below.

Sample Excitation System Modeling Data

IEEE AC7B

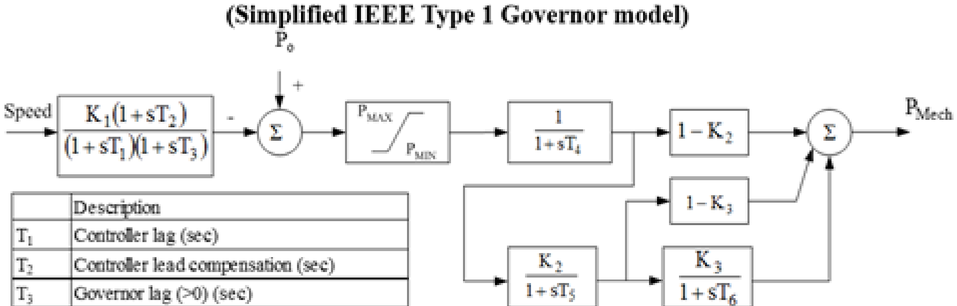
IEEE AC7B		
CON	Value	DESCRIPTION
J		T_R (s) regulator input filter time
J+1		K_{PR} (pu) regulator proportional gain
J+2		K_{IR} (pu) regulator integral gain
J+3		K_{DR} (pu) regulator derivative gain
J+4		T_{DR} (s) regulator derivative block time constant
J+5		V_{RMAX} (pu) regulator output maximum limit
J+6		V_{RMIN} (pu) regulator output minimum limit
J+7		K_{PA} (pu) voltage regulator proportional gain
J+8		K_{IA} (pu) voltage regulator integral
J+9		V_{AMAX} (pu) regulator output maximum limit
J+10		V_{AMIN} (pu) regulator output minimum limit
J+11		K_P (pu)
J+12		K_L (pu)
J+13		K_{F1} (pu)
J+14		K_{F2} (pu)
J+15		K_{F3} (pu)
J+16		T_F (s) time constant (>0)
J+17		K_C (pu) rectifier loading factor proportional to commutating
J+18		K_D (pu) demagnetizing factor, function of AC exciter reactances
J+19		K_E (pu) exciter constant related to self-excited field
J+20		T_E (s) exciter time constant
J+21		V_{FEMAX} (pu) exciter field current limit (>0)
J+22		V_{EMIN}
J+23		E1
J+24		S_E(E1)
J+25		E2
J+26		S_E(E2)



1

Sample Governor model for generator

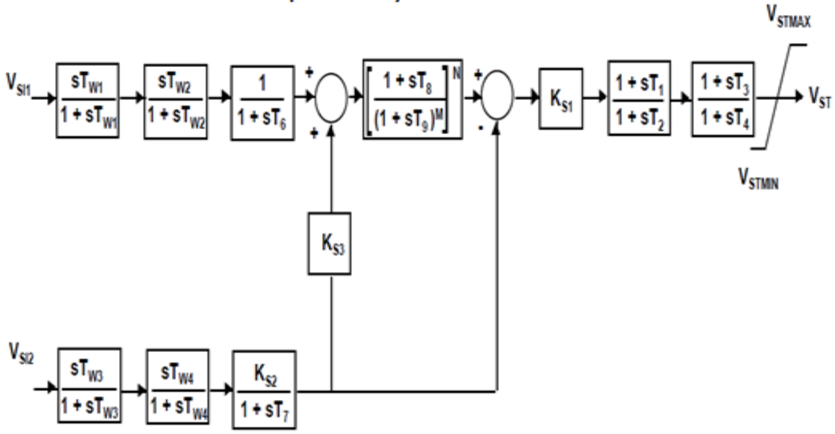
IEESGO
(Simplified IEEE Type 1 Governor model)



	Description
T_1	Controller lag (sec)
T_2	Controller lead compensation (sec)
T_3	Governor lag (>0) (sec)
T_4	Delay due to steam inlet volumes associated with steam chest and inlet piping (sec)
T_5	Reheater delay including hot and cold leads (sec)
T_6	Delay due to IP-LP turbine, crossover pipes, and LP end hoods (sec)
K_1	1/per unit regulation
K_2	Fraction
K_3	Fraction
P_{MAX}	Upper power limit
P_{MIN}	Lower power limit

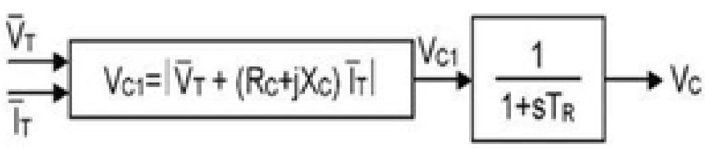
2

Sample Power System Stabilizer



IEEE Type PSS2A Dual Input Stabilizer Model

Line Drop Compensation Diagram



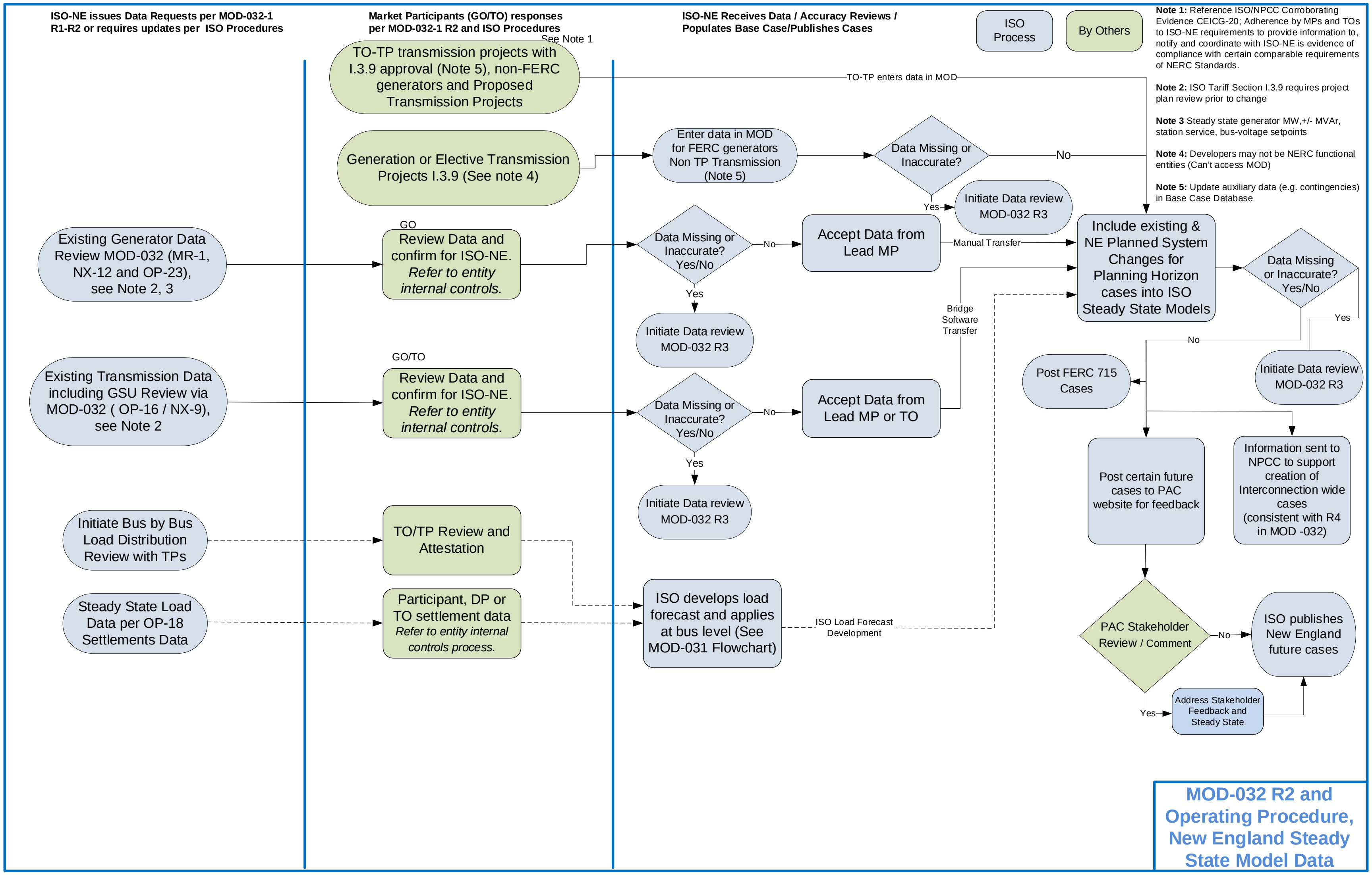
Appendix D – Short Circuit

Short-circuit	**Units**	**Example**
1. Short Circuit Impedance Data		
a. Positive Sequence Data – provide for all applicable elements in column "steady-state" [GO, TO] **Transmission Line** **Transformer to include winding connection type**	R1 + jX1 in P.U. ____ MVA Base	
c. Zero Sequence Data – provide for all applicable elements in column "steady-state" [GO,TO] **Transmission Line** **Transformer to include winding connection type**	R0 + jX0 in P.U. ____ MVA Base	
2. Mutual Line Impedance Data [TO] . This data shall be provided for each line to which the subject line is coupled. The impedance is also polarity sensitive.	R + jX in P.U. ____ MVA Base	
5. Generator Saturated Synchronous, Transient, Subtransient and Negative-sequence reactances		
a. xd (saturated synchronous reactance, direct axis)	P.U.	1.67
b. x'd (saturated transient synchronous reactance, direct axis)	P.U.	0.265
c. x"d (saturated subtransient synchronous reactance, direct axis)	P.U.	0.205

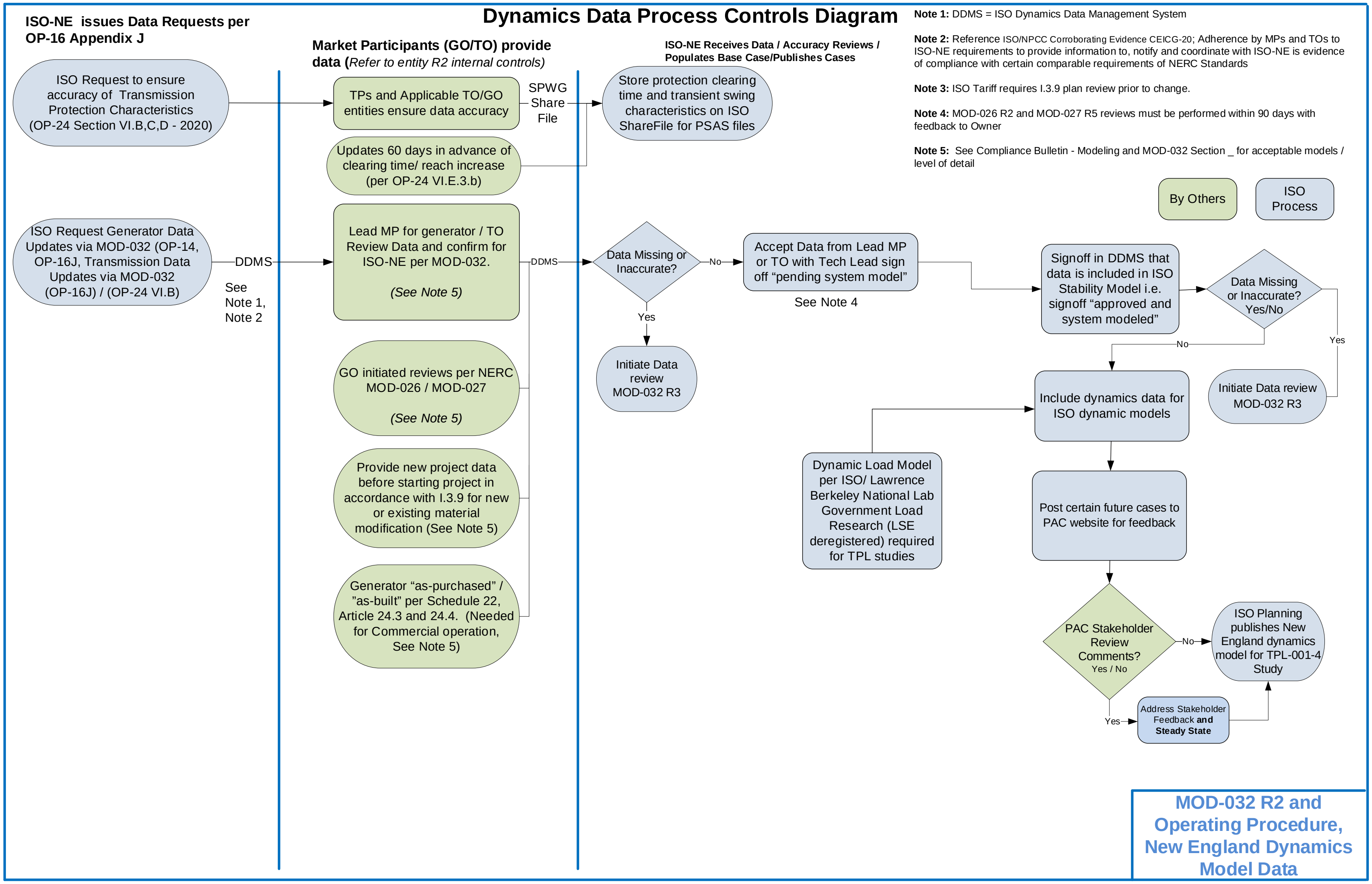
d. X2 (negative sequence reactance)	P.U.	0.205
Short-circuit	**Units**	**Example**
6. Generator and Transformer Grounding Impedance		
a. Zero Sequence Grounding Resistance for an Impedance Grounded Generator/Transformer	ohms	0.635
b. Zero Sequence Grounding Reactance for an Impedance Grounded Generator/Transformer	ohms	0.635
c. Nominal Voltage level of grounding impedance	kV	12
d. Vh (kV)	kV	14.4
e. Vl (kV)	kV	0.24
f. MVA base	MVA	506

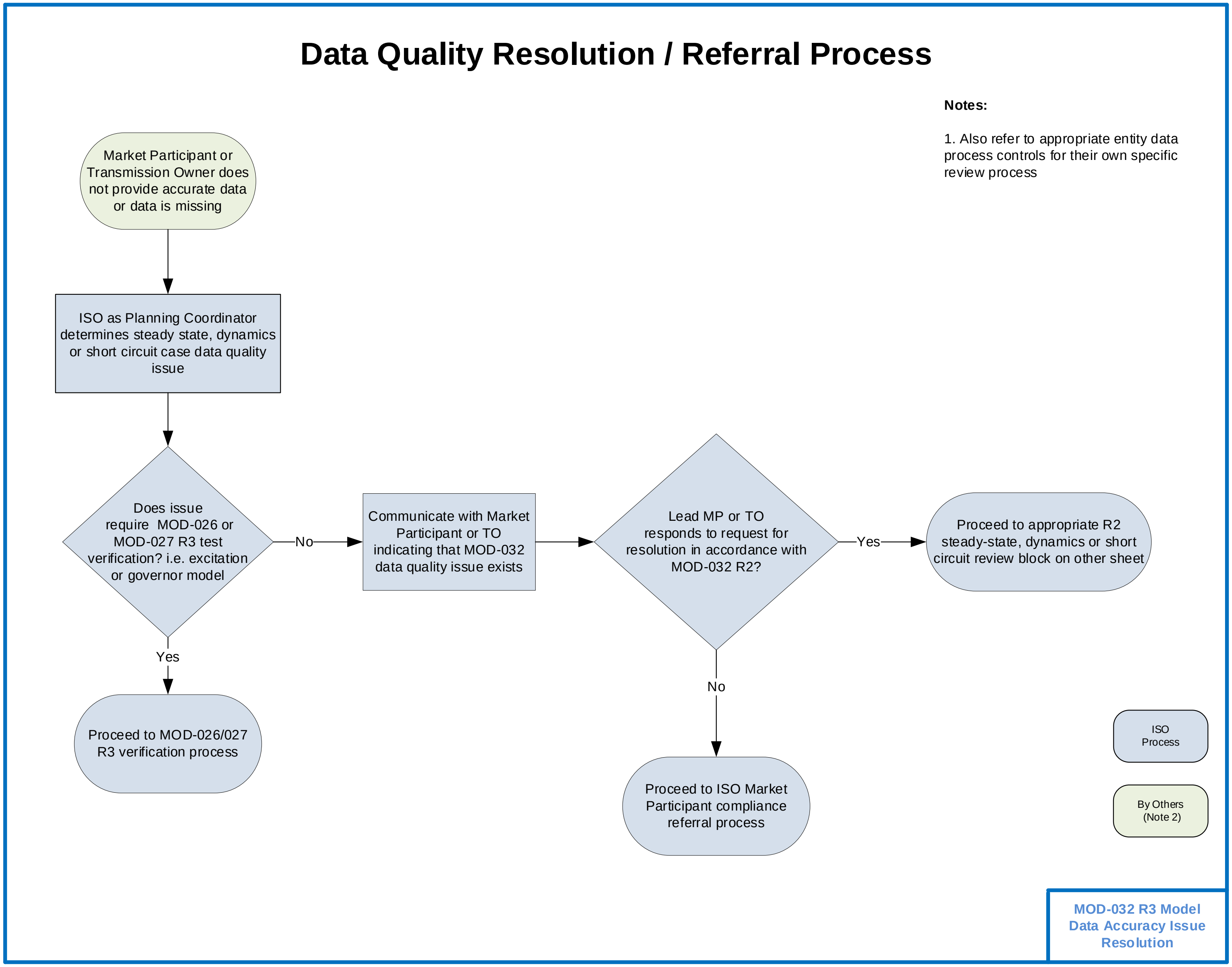
Appendix E – Process Flow Diagrams

Appendix E – Process Flow Diagrams



Appendix E – Process Flow Diagrams




Data Quality Resolution / Referral Process
Notes:
1. Also refer to appropriate entity data process controls for their own specific review process
Market Participant or Transmission Owner does not provide accurate data or data is missing
ISO as Planning Coordinator determines steady state, dynamics or short circuit case data quality issue
Does issue require MOD-026 or MOD-027 R3 test verification? i.e. excitation or governor model
No
Communicate with Market Participant or TO indicating that MOD-032 data quality issue exists
Lead MP or TO responds to request for resolution in accordance with MOD-032 R2?
Yes
Proceed to appropriate R2 steady-state, dynamics or short circuit review block on other sheet
Yes
Proceed to MOD-026/027 R3 verification process
No
Proceed to ISO Market Participant compliance referral process
ISO Process
By Others (Note 2)
MOD-032 R3 Model Data Accuracy Issue Resolution

ISO New England Compliance Bulletin MOD-032 Document History

Rev. No.	Date	Reason
Rev 0	July 1, 2015	Initial Issue
Rev 1	June 16, 2016	Remove short circuit and transmission dynamics equipment appendices that became OP-16 Appendix J and K, remove NX screenshots, remove generator dynamics appendix that was supersceded by new wording in OP-14. Modify DDMS description as system is in-service. Reflect developer entry of DDMS data. Correct SS HVDC review. Include DYR and RAW file illustrated descriptions. Add PSSe Version 33 required for models. ISO/TP Base Case Working Group review pending.
Rev 2	April 26, 2017	7/19/2016 Review with ISO/TP BCWG. Minor modification to section 2.5, 4/26/2017 Reference to Geomagnetic Data per TPL-007, minor updates
Rev 3	July 31, 2017	Review with ISO/TP BCWG. Clarify dedicated load and reactive device language
Rev 4	January 2018	Add Obsolete Models listing per OP-14 Approval with NERC Modeling Notifications as basis for change. Issue initial dynamics data requests in January. Issue initial short circuit requests in September.
Rev 4.1	March 2018	Clarify language regarding GENROU model and add gas turbine governor model information.
Rev 5	August 7, 2018	Add process flow diagrams and data transfer tables as Appendix E to illustrate data provision and review progression. Review with ISO/TO-TP Base Case Working Group.
Rev 6	March 15, 2019	Retitle to indicate ISO requirements for lower MVA generators than NERC BES, Add precedence label, revise process flow diagrams and update to current version of NERC acceptable models, indicate data submissions by ISO request, add specific language for IBR, reviewed with Base Case Working Group