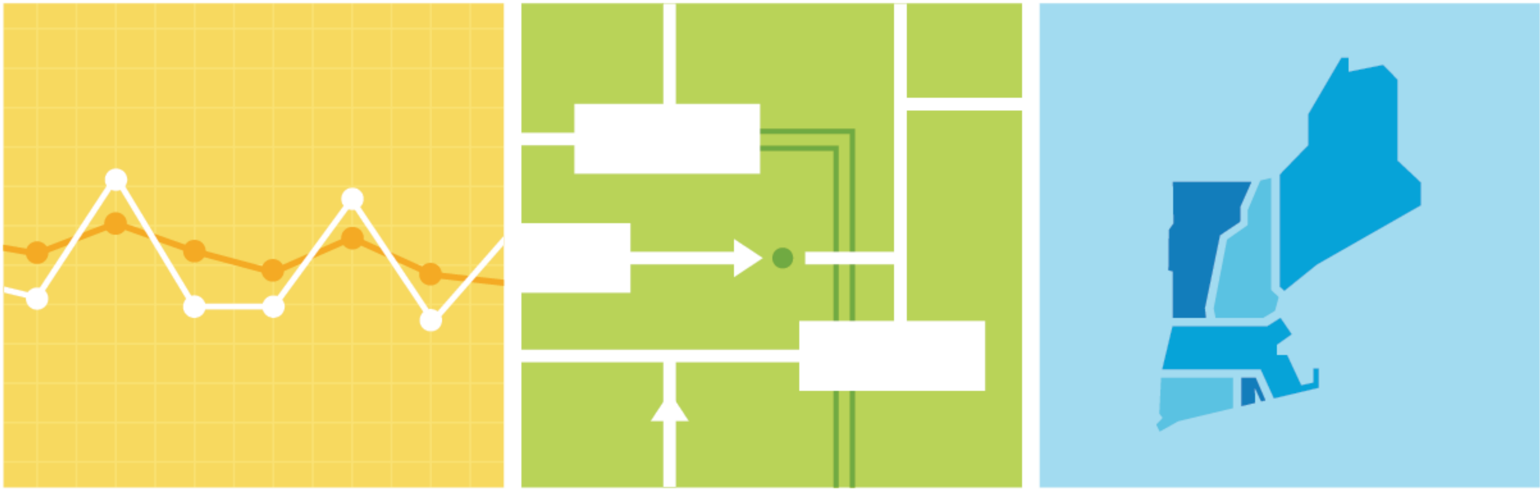
Compliance Bulletin – MOD-032 and ISO New England's Model Data Requirements and Reporting Procedures

SEPTMBER 29, 2023



Preface/Disclaimer

In case of a discrepancy between this Compliance Bulletin and a NERC Reliability Standard or an ISO New England Operating Procedure, the NERC Reliability Standard or the ISO New England Operating Procedure 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 TPL-007-4 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

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)

REFERENCES Continued:	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

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Section 1
Introduction

The ISO New England Transmission, Markets and Services Tariff and NERC Standard MOD-032-1 (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 documents and processes in place that provide 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 be listed as acceptable per the NERC List of Acceptable Models for Interconnection-Wide Modeling as further described in Section 8.0

Section 2
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 voltage with 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)

With FERC approval of removing the Load Serving Entity (LSE) as a functional registration category, 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, and the Load Modeling Guide for ISO New England Network Model. 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)

TPL-001 Studies use Qualified Capacity for Steady State as used in the CELT report and use winter NRC for dynamics cases. Generator Interconnection Studies use winter NRC for steady state and dynamics.

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. Changes to a unit's capacity or capability shall be reported before they occur (if planned) or when they occur (if unplanned) per the timing and other requirements of the ISO New England Operating Documents (including, but not limited to, Schedules 22 and 23 to the ISO New England Open Access Transmission Tariff).

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 condensers). Capability testing results shall be in accordance with the Generator Interconnection Agreements. Changes to a unit's capacity or capability shall be reported before they occur (if planned) or when they occur (if unplanned) per the timing and other requirements of the ISO New England Operating Documents (including, but not limited to, Schedules 22 and 23 to the ISO New England Open Access Transmission Tariff).

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 Data Management System (DDMS). 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 - Reactive Compensation Devices

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 Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) and studies based on different case types/scenarios for planning base-cases including:

Summer Peak	Shoulder Peak	Winter Peak
Minimum Load	Spring Light Load	

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

Section 3
Dynamics Information

The Dynamics Data Management System (DDMS) 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 compatible 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 for Generators 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)

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 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.

See steady state sensitivity cases for equivalent dynamics cases.

Section 4
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 Compliance Bulletin shows the level of detail associated with short circuit information. ISO also provides forms for short circuit data updates.

Short circuit cases use full generator output and all lines in service.

Section 5
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.

Section 6
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.

Section 7
Geomagnetic Disturbance Data

The ISO PP11 – Planning Procedure to Support Geomagnetic Disturbance Analysis and its Appendix 2 describes the level of detail and necessary data for Geomagnetic Disturbance (GMD) analysis.

Section 8
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 8-1 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 8-1
Data Recertification for Existing Equipment

Equipment Type	Per Document/Process	Annual Recertification[1]
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 RealPower	Market Rule 1/CCAT	Seasonal[2]
S.S. – Generator Min/Max Reactive	ISO OP-14/NX Application	Generator updateswhen change occurs
Steady State Generator Aux Load	ISO OP-14/NX Application	January by 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[3]
S.S. Generator Unit In-Service Status	OP-5/CROW	Outage Specific

[1] 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.

[2] Generator Owners schedule individual Seasonal Claimed Capability Testing with ISO-NE

[3] CAMS implementation of NX-12

Table 8-1 (continued)
Data Recertification for Existing Equipment

Equipment Type	Per Document/Process	Annual Recertification[4]
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

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.

[4] 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.

Section 9
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 equipment and can provide information to obtain those models from Siemens. The NERC Dynamic Modeling Recommendations - Recommended Modeling Practices and List of Unacceptable Models[5] details acceptable models. ISO does not accept user-written models to represent generation or transmission equipment at this time.

5 https://www.nerc.com/pa/RAPA/ModelAssessment/Documents/Dynamic%20Modeling%20Recommendations.pdf#:~:text=All%20models%20should%20be%20detailed%20and%20accurate%20representations,clear%2C%20consistent%2C%20sufficiently%20detailed%2C%20and%20comprehensive%20modeling%20requirements.

Section 10
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

Section 11
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 FacilityOwner]			
a. real power capabilities - gross maximum and minimumvalues	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) auxiliaryload (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 correspondto 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)			DDMS Application
h. in-service status*			CROW Outage Application or PPA retirement status
4. AC Transmission Line or Circuit (series capacitors andreactors shall be explicitly modeled as individual linesegments) [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 ornumber [TO]			
a. System Description			Identify # of terminals, line configuration (monopole, bipole) and location of rectifier and inverter

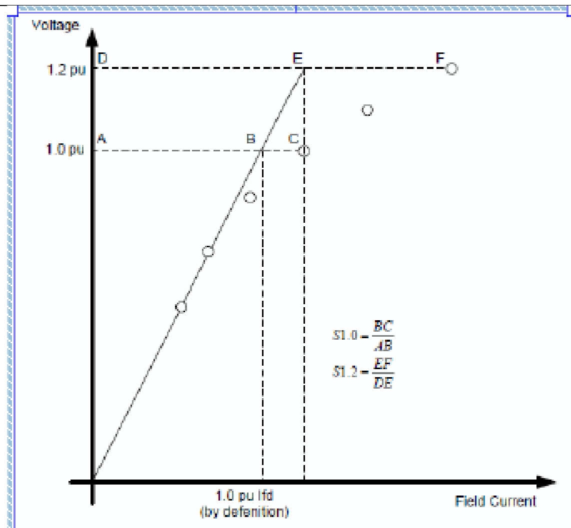
b. line parameters			scheduled DC voltage, control mode (blocked, power, current), power order, dc resistance
c. converter transformer parameters			transformer ratio, tap setting, tap step
d. rectifier and inverter data			firing angles, firing angle limits, # of bridges
e. filter/shunt bank data			Provide 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 andphase-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 tapsetting 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 otherinformation on the testreport. 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	MVA	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]			
Nominal voltage	kV	34.5	See ISO Operating Procedure OP-16 Appendix D
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	See OP-16 Appendix Z

		50 MVAr capacitive, 40 MVAr inductive	
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

Section 12
Appendix C - Dynamics

Dynamics:	Units	Example	Description
1. Generator [GO,RP (for plannedresources 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 Databookor Expert Generator Consultant Report; Lookingfor 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 figurebelow 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			"Best available data," (typically found in manufacturer documentation) 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,quadr ature 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)	See 1a above		

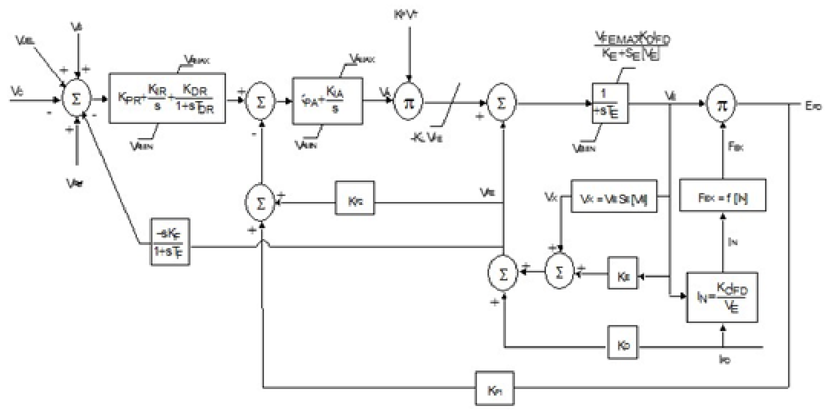
iv. direct and quadrature axes reactances and time constants			
2. Excitation System [GO] (See example block diagram below)	model definition parameters	See IEEE 421.5 as well as sample excitation system model below.	"Manufacturer or Expert Consultant data," until the first round of MOD-026 and MOD-027 testing has been completed.
3. Governor [GO]	model definition	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, minand intermediate load). The gas turbine engines of a combined cycle plantfor 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.
	parameters		
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 beindicated. Reference NERC Alert – February5, 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 testinghas 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 todevelop a specific dynamic load model for NewEngland. This provided New England state specific dynamic load models for peak and lightloading.
6. Wind Turbine Data [GO]	model definition		"Manufacturer's or Expert Consultant data," until the first round of MOD-026 and MOD-027 testinghas been completed.
	parameters		
7. Photovoltaicsystems [GO]	model definition		"Manufacturer's or Expert Consultant data," until the first round of MOD-026 and MOD-027 testinghas 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 testinghas been completed.
	parameters		
9. DC systemmodels	model definition		"Manufacturer's or Expert Consultant data,"
	parameters		
10. Model Name and Parameters		IEEE421.5	If a standardized model from the approved libraryof 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 (linedrop 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		
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)

IEEE AC7B

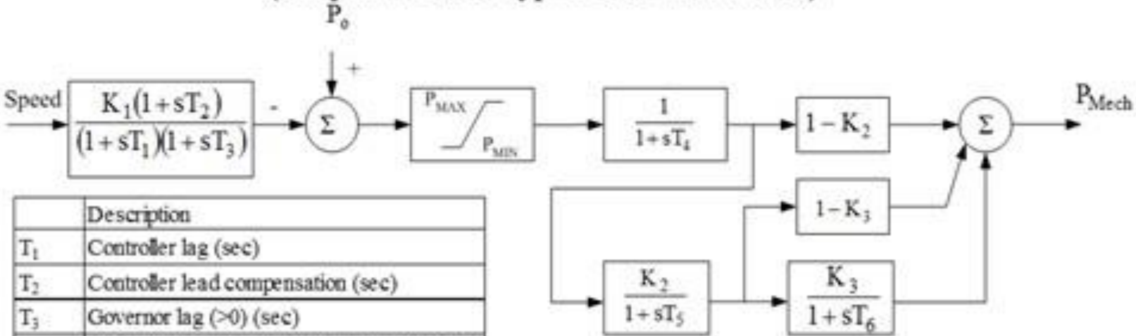


1

Sample Governor model for generator

IEESGO

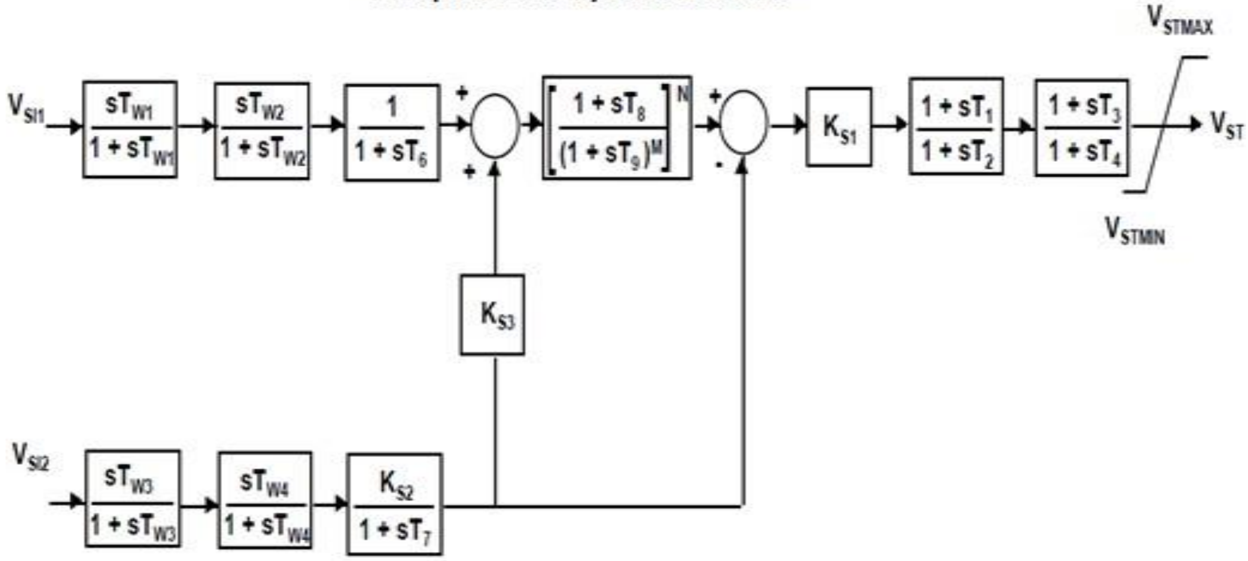
(Simplified IEEE Type 1 Governor model)



	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

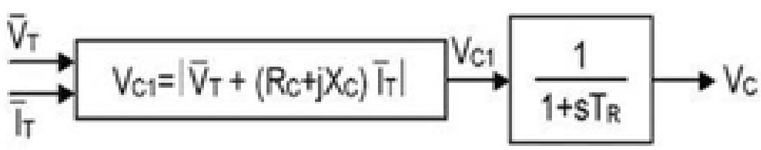
2

Sample Power System Stabilizer



IEEE Type PSS2A Dual Input Stabilizer Model

Line Drop Compensation Diagram

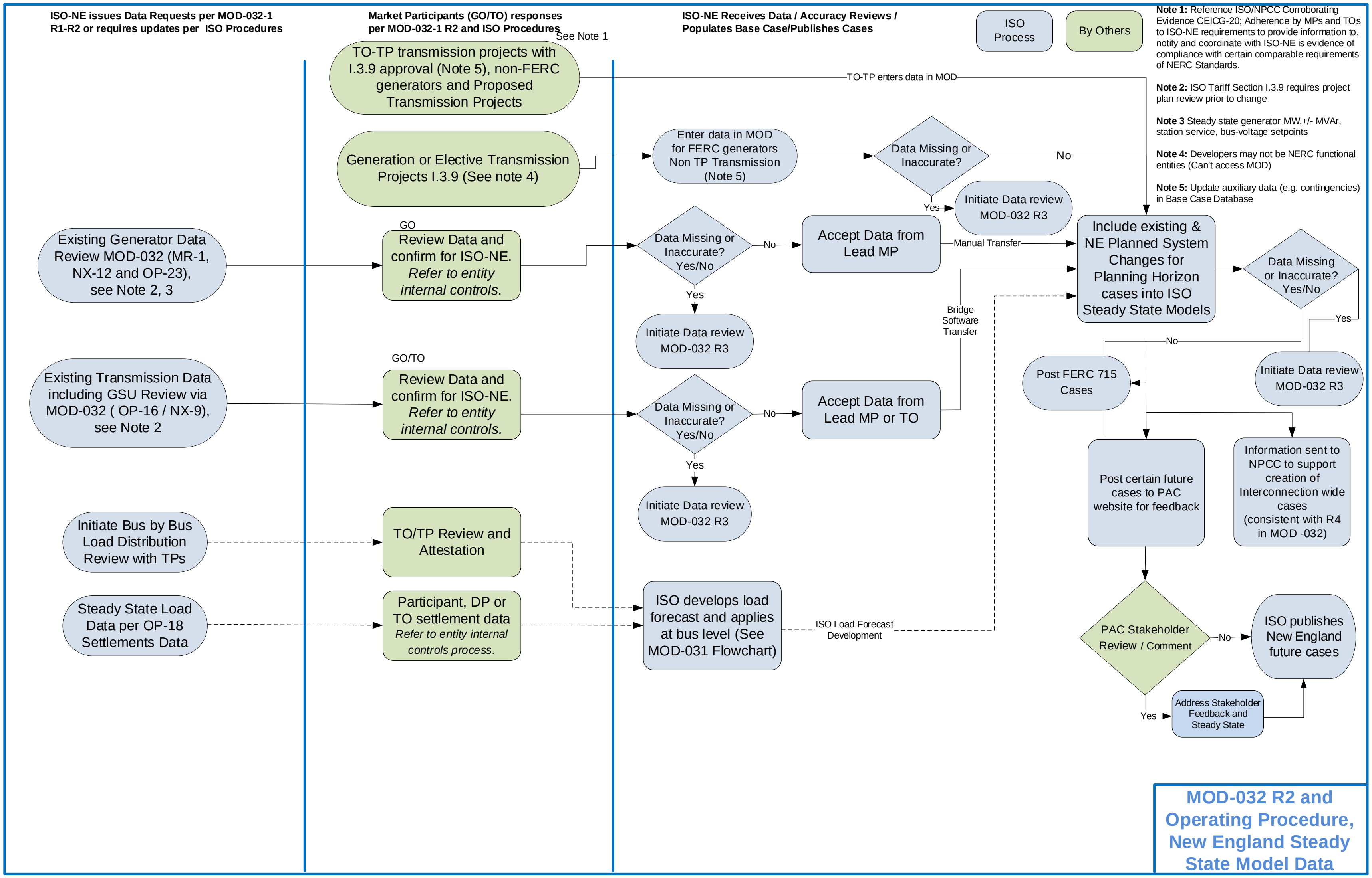


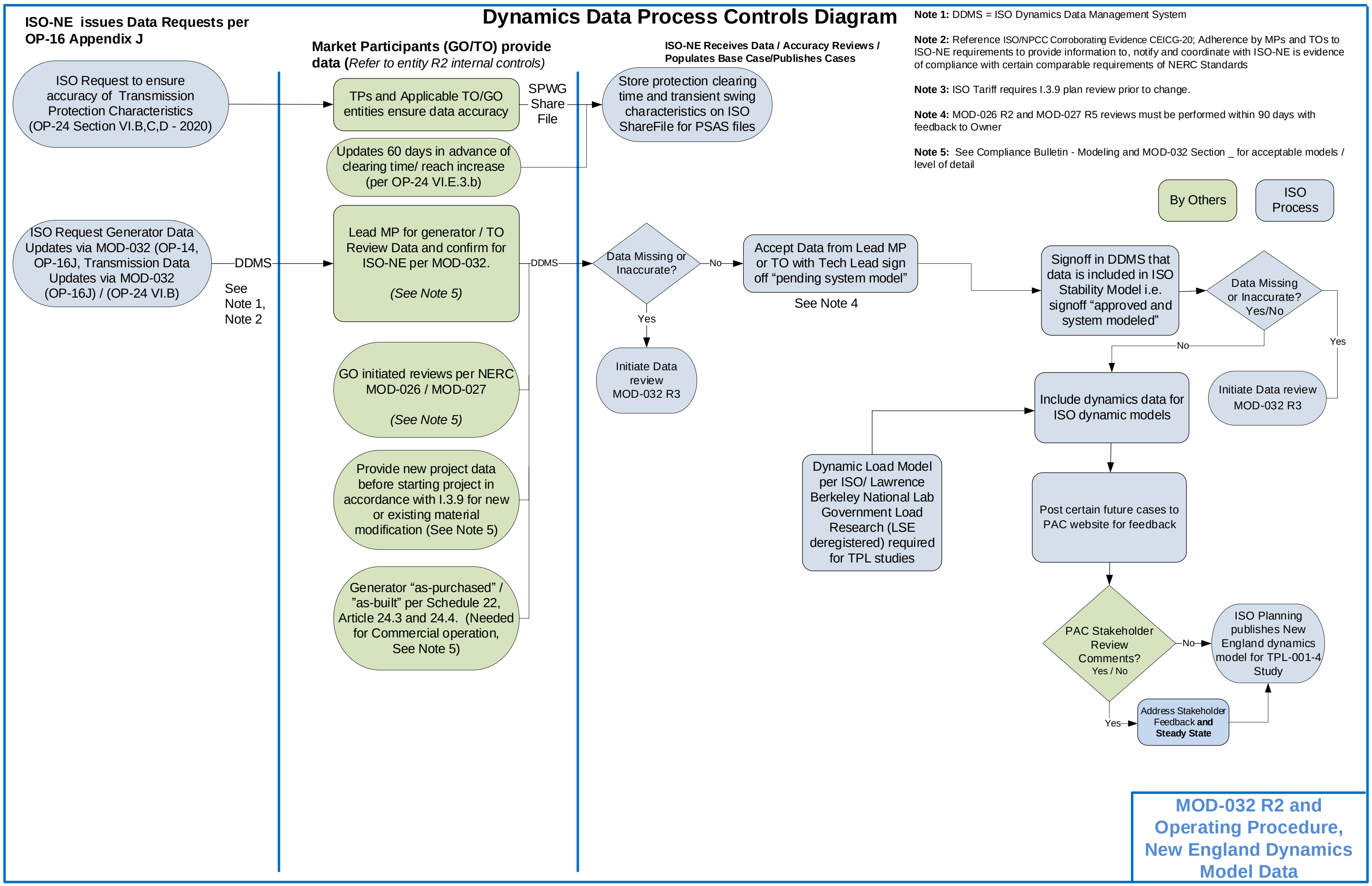
Section 13
Appendix D – Short Circuit

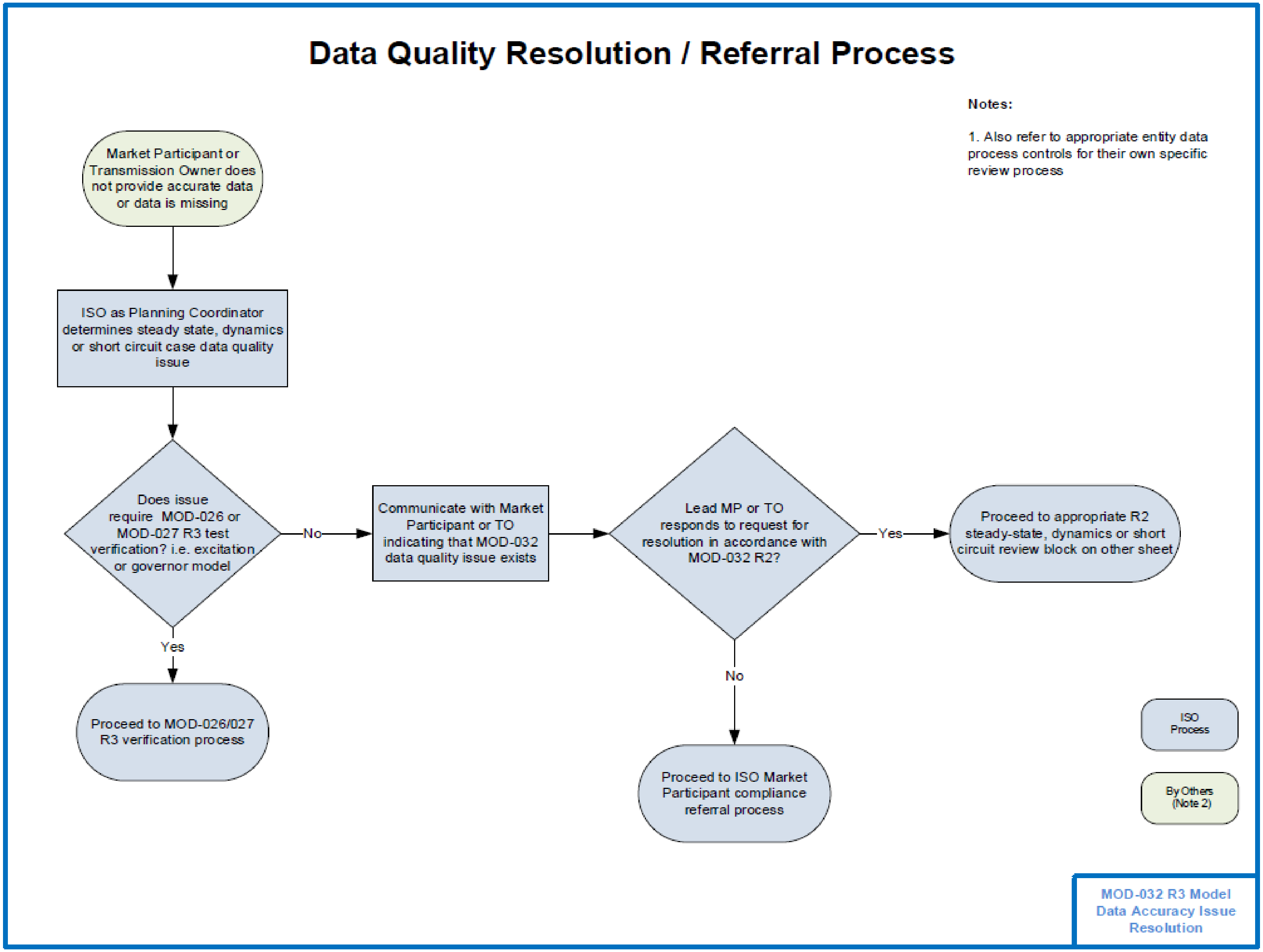
Short-circuit	Units	Example
1. Short Circuit Impedance Data		
a. Positive Sequence Data – provide for all applicable elements in column "steady-state" [GO, TO] Transmission Line Transformer to include winding connection type	R1 + jX1 in P.U. ________ MVA Base	
c. Zero Sequence Data – provide for all 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

Section 14 Appendix E – Process Flow Diagrams




Dynamics Data Process Controls Diagram
ISO-NE issues Data Requests per OP-16 Appendix J
Market Participants (GO/TO) provide data (Refer to entity R2 internal controls)
ISO-NE Receives Data / Accuracy Reviews / Populates Base Case/Publishes Cases
Note 1: DDMS = ISO Dynamics Data Management System
Note 2: Reference ISO/NPCC Corroborating Evidence CEICG-20; Adherence by MPs and TOs to ISO-NE requirements to provide information to, notify and coordinate with ISO-NE is evidence of compliance with certain comparable requirements of NERC Standards
Note 3: ISO Tariff requires I.3.9 plan review prior to change.
Note 4: MOD-026 R2 and MOD-027 R5 reviews must be performed within 90 days with feedback to Owner
Note 5: See Compliance Bulletin - Modeling and MOD-032 Section _ for acceptable models / level of detail
By Others
ISO Process
ISO Request to ensure accuracy of Transmission Protection Characteristics (OP-24 Section VI.B,C,D - 2020)
TPs and Applicable TO/GO entities ensure data accuracy
SPWG Share File
Store protection clearing time and transient swing characteristics on ISO ShareFile for PSAS files
Updates 60 days in advance of clearing time/ reach increase (per OP-24 VI.E.3.b)
ISO Request Generator Data Updates via MOD-032 (OP-14, OP-16J, Transmission Data Updates via MOD-032 (OP-16J) / (OP-24 VI.B)
DDMS
See Note 1, Note 2
Lead MP for generator / TO Review Data and confirm for ISO-NE per MOD-032.
(See Note 5)
DDMS
Data Missing or Inaccurate?
No
Yes
Initiate Data review MOD-032 R3
Accept Data from Lead MP or TO with Tech Lead sign off “pending system model”
See Note 4
Signoff in DDMS that data is included in ISO Stability Model i.e. signoff “approved and system modeled”
Data Missing or Inaccurate? Yes/No
No
Yes
Initiate Data review MOD-032 R3
GO initiated reviews per NERC MOD-026 / MOD-027
(See Note 5)
Include dynamics data for ISO dynamic models
Provide new project data before starting project in accordance with I.3.9 for new or existing material modification (See Note 5)
Dynamic Load Model per ISO/ Lawrence Berkeley National Lab Government Load Research (LSE deregistered) required for TPL studies
Post certain future cases to PAC website for feedback
Generator “as-purchased” / ”as-built” per Schedule 22, Article 24.3 and 24.4. (Needed for Commercial operation, See Note 5)
PAC Stakeholder Review Comments? Yes / No
No
ISO Planning publishes New England dynamics model for TPL-001-4 Study
Yes
Address Stakeholder Feedback and Steady State
MOD-032 R2 and Operating Procedure, New England Dynamics Model Data


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
Yes
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
No
Proceed to appropriate R2 steady-state, dynamics or short circuit review block on other sheet
Proceed to MOD-026/027 R3 verification process
Proceed to ISO Market Participant compliance referral process
ISO Process
By Others (Note 2)
MOD-032 R3 Model Data Accuracy Issue Resolution

Section 15 Appendix D – 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
Rev 6.1	February 7, 2020	Change to latest NERC List of Acceptable Models
Rev 6.2	April 30, 2020	Clarify selected language on real and reactive power
Rev 7	August 25, 2022	Review with ISO/TP BCWG. Use link to NERC Acceptable Models Listing. Miscellaneous updates.
Rev 8	September 29, 2023	Review with ISO/TP BCWG. Minor updates with reformatting.