Training Disclaimer: *ISO New England (ISO) provides training to enhance participant and stakeholder understanding. Not all issues and requirements are addressed by the training. Consult the effective NERC standards, Transmission, Markets and Services Tariff and the relevant Market Manuals, Operating Procedures and Planning Procedures for detailed information. In case of a discrepancy between training provided by ISO and NERC standards, and the Tariff or Procedures, the meaning of the Tariff and Procedures shall govern.*

January 24, 2023
Webex Broadcast

Generator Data Submittal Requirements – Planning

Webinar

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Compliance Manager| Reliability and Operations Compliance

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Acronyms and Description

AVR	automatic voltage regulator	**MTF**	merchant transmission facility
BES	bulk electric system	**MVAR**	megavolt-ampere reactive
CAMS	Customer Asset Management System	**NERC**	North American Electric Reliability
CCAT	Claimed Capability Audit Tool	**NPCC**	Northeast Power Coordinating Council
CNR	capacity network resource	**OATT**	Open Access Transmission Tariff
DCS	disturbance control standard	**OTF**	other transmission facility
DDMS	Dynamics Data Management System	**PAC**	Planning Advisory Committee
EMT	electromagnetic transient	**PF**	power factor
ERO	Electric Reliability Organization	**POI**	point of interconnection
ETU	elective transmission upgrade	**PSCAD**	power system computer-aided design
FACTS	devices/flexible alternating-current transmission system	**PSSE**	Power System Simulation for Engineers
FERC	Federal Energy Regulatory Commission	**PTF**	pool transmission facility
GO	generator owner	**PTO**	participating transmission owners
GSU	generator step-up transformer	**RNS**	regional network service
IBR	inverter based resources	**RP**	resource planner
IR	interconnection request	**SDMS**	Short Circuit Data Management System
IRTT	Interconnection Request Tracking Tool	**SIS**	System Impact Study
ITO	interconnecting transmission owner	**TO**	transmission owner
LNS	local network service		

Course Objectives

At the completion of the webinar session, you will be able to:

- Explain how to submit asset data
- Identify how to submit accurate asset data
- Restate the importance of submitting data in a timely manner
- Describe when and why ISO requires the data through the Procedures, Tariff, and/or North American Electric Reliability Corporation (NERC) standards

Course Topics

- **New and Existing Resources**
  - Need for System Impact Studies when Changes are Planned
  - Requirements for As-Purchased, As-Built, and As-Tested Data
- **ISO Tariff and ISO New England Procedures**
- **Data Requirements: Federal Energy Regulatory Commission (FERC) Jurisdictional and State (Non-FERC) Jurisdictional**
- **Planning Procedure 5-6 (Data and Modeling) Data Requirements:**
  - Power Flow
  - Short Circuit
  - Stability
  - Electromagnetic Transient (EMT) Data
  - PSS/e vs. Power System Computer-Aided Design (PSCAD) Benchmarking Report
- **Market Registration Data Submittals**
- **As Purchased and As-Built Data Requirements**
- **NERC Standards**
  - MOD-032-1 – Data for Power System Modeling and Analysis
  - MOD-026-1 – Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions
  - MOD-027-1 – Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions
- **Operating Procedures**
  - OP-14 – Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources
  - OP-16 – Transmission System Data
  - OP 24 – Protection Outages, Settings and Coordination
- **MOD-026-1 and MOD-027-1**
- **MOD-032-1 – Data for Power System Modeling Analysis**
- **Retiring Obsolete and NERC Non-Approved Models**
- **Future Changes to Standards and Requirements**
- **Useful Information**

New and Existing Resources

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Tariff Section I.3.9 Requires ISO to Review Changes Prior to Implementation

I.3.9.1 Submission and Review of Proposed Plan Applications:

Each Market Participant and Transmission Owner shall submit to the ISO at least sixty (60) days prior to the proposed in service date in such form, manner and detail as the ISO may reasonably prescribe, (i) ***any new or materially changed plan for additions to or changes*** *to any generating and demand resources or transmission facilities rated 69 kV or above* ***subject to control of such Market Participant*** *or Transmission Owner, and (ii) any new or materially changed plan for any other action to be taken by the Market Participant or Transmission Owner, except for retirements of or reductions in the capacity of a generating resource or a demand resource, which may have a significant effect on the stability, reliability or operating characteristics of the Transmission Owner's transmission facilities, the transmission facilities of another Transmission Owner, or the system of a Market Participant.*

Participate > Rules and Procedures > Transmission, Markets, and Services Tariff > Section 1 – General Terms and Conditions

When are System Impact Studies Required?

- **Per Tariff Section I.3.9**: **Any change must be evaluated by ISO prior to making the change**
  - Coordinate with PP5-1
- Any planned change must be submitted to PPA@ISO-NE.com
- Generator changes with the most Tariff misunderstanding are for:
  - Automatic voltage regulator (AVR) upgrades
  - Generator step-up transformer (GSU) impedance
  - Capacity increases
  - Disturbance control standard (DCS) impacting control system performance (i.e., frequency performance)
  - Generator control systems that impact governor model

Participate > Rules and Procedures > Transmission, Markets, and Services Tariff > Section 1 – General Terms and Conditions

Entity Obligation to Provide Data

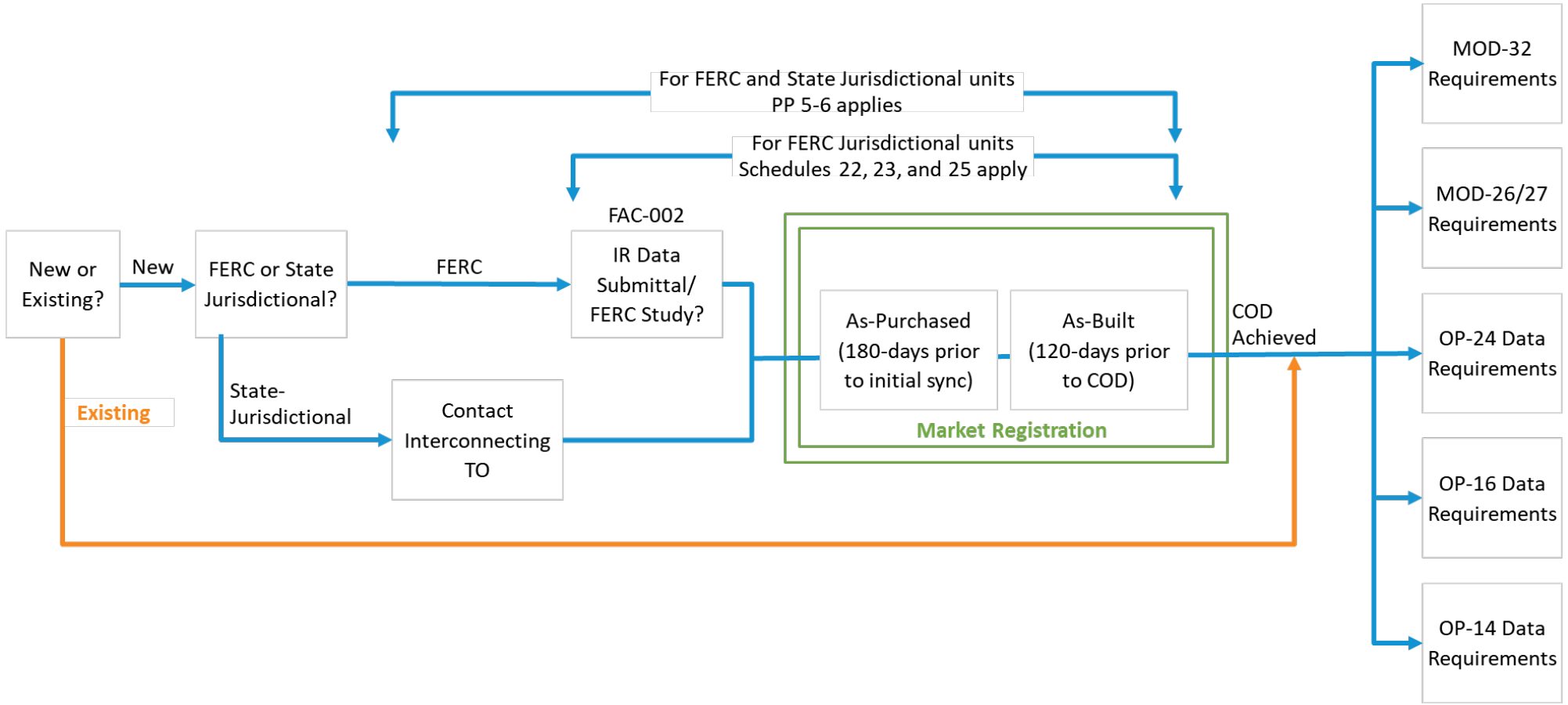
- As described in Section I.3.9, the Market Participant provides data for generation facilities
- ISO has a contractual relationship with the market participant per the Open Access Transmission Tariff (OATT)
  - **Reporting Obligations:** The *network customer* shall be responsible for all information required by the Electric Reliability Organization (ERO), Northeast Power Coordinating Council (NPCC), the applicable participating transmission owners (PTOs) or the ISO. The network customer shall respond promptly and completely to the ISO's and the applicable PTO(s)'reasonable requests for information, including but not limited to, data necessary for operations, maintenance, regulatory requirements, and analysis.
  - **Network Customer:** A network customer is a transmission customer receiving regional network service (RNS) or load network service (LNS).

    A transmission customer under Section II of this Tariff includes a market participant or a non-market participant taking regional network service, through or out service, MTF service, OTF service, ancillary services, or local service.

Participate > Rules and Procedures > Transmission, Markets, and Services Tariff > Section 1 – General Terms and Conditions

Process Flow for New and Existing Resources

- New resources follow the blue path
- Existing resources (with no changes) follow the orange path



FERC Jurisdictional

New and modified interconnections to transmission facilities proceed through the **FERC jurisdictional** interconnection process

State Jurisdictional

New or modified interconnections to distribution facilities predominantly proceed through the **State jurisdictional** interconnection process

*A distribution-connected generator developer should **contact the owner of the distribution facilities** to determine whether the facilities are **state** or **FERC jurisdictional**. The distribution company and the ISO will coordinate the identification of jurisdiction – as necessary.*

Source: Distribution-Connected Generation Guidance - ISO New England

Data Submittal Process Timeline

New FERC Jurisdictional Resources

Follow the **ISO interconnection process** provided in this guide.

Get started →

1 Register for an IRTT Account

2 Submit an Interconnection Request

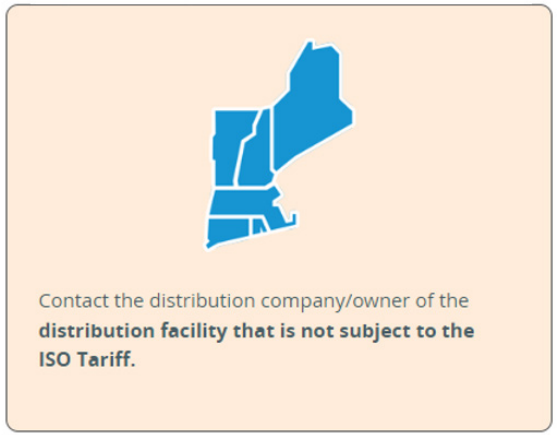
3 Undergo the Interconnection Study Process

4 Execute an Interconnection Agreement

5 Register Your Asset

Data Submittal Process Timeline

State (Non-FERC) Jurisdictional Resources



Contact interconnecting transmission owner (TO)

Provide data as requested by the interconnecting TO

Interconnecting TO and ISO New England will work in tandem

Questions

ISO Tariff and ISO Procedures

Brad Marszalkowski

Senior Engineer

Schedules 22, 23, & 23

- **Schedule 22 – Large Generator Interconnection Procedures**
  Provides the terms and conditions for interconnecting large generating facilities (more than 20 MW) to the administered transmission system
- **Schedule 23 – Small Generator Interconnection Procedures**
  Provides the terms and conditions for interconnecting small generating facilities (20 MW or less) to the administered transmission system
- **Schedule 25 – Elective Transmission Upgrade Interconnection Procedures**
  Provides the terms and conditions for interconnecting a new Pool Transmission Facility, Merchant Transmission Facility or Other Transmission Facility to the administered transmission system. An Elective Transmission Upgrade is not a Generator Interconnection Related Upgrade, a Regional Transmission Upgrade, or a Market Efficiency Transmission Upgrade

For more information, visit: Participate > Rules and Procedures > Transmission, Markets, and Services Tariff > Open Access Transmission Tariff (OATT)

Modeling Data for Schedules 22 & 23

Appendix 1	Attachment A – Technical Data Required for Interconnection System Impact Study *(if applicable)*	Attachment A-1 – Supplementary Wind and Inverter-Based Generating Facility Form *(if applicable)*	Attachment B – Interconnection Request Technical Data Required for Interconnection Feasibility Study *(if applicable)*
• Feasibility Study or System Impact Study • Point of interconnection • Type of facility • In-service data • Site control • Generator ratings • Transformer ratings and impedances	• Power system computer-aided design (PSCAD) model [electromagnetic transient analysis] (if applicable) • Induction generator data (if applicable)	• Geographic map of project (layout and connection to grid) • One-line diagram • Collection system detail and aggregate impedance sheets • Inverter and generator step-up transformer (GSU) information • Protection settings • Unit reactive power control • Power flow model (detailed and equivalent) • Dynamic simulation model	Reduced requirements since no stability or electromagnetic transient (EMT) analysis performed – Collection system detail and aggregate impedance sheets – Inverter generator step-up transformer (GSU) information – Protection settings – Unit reactive power control – Power flow model (detailed and equivalent)

All of these documents can be found at the end of their respective Schedule

Specific Language Schedule 22 – Large Generator Interconnection Agreement

Generators >= 20 MW

24.3 Updated Information Submission by Interconnection Customer. *The updated information submission by the Interconnection Customer, including manufacturer information, shall occur no later than one hundred eighty (180) Calendar Days prior to the Initial Synchronization Date. Interconnection Customer shall submit a completed copy of the Large Generating Facility data requirements contained in Appendix 1 to the LGIP…*

24.4 Information Supplementation. *Prior to the Commercial Operation Date, the Parties shall supplement their information submissions described above in this Article 24 with any and all "as-built" Large Generating Facility information and "as-tested" performance information that differs from the initial submissions or, alternatively, written confirmation that no such differences exist. The Interconnection Customer shall conduct tests on the Large Generating Facility as required by Good Utility Practice such as an open circuit "step voltage" test on the Large Generating Facility to verify proper operation of the Large Generating Facility's automatic voltage regulator…*

For more information, visit: Schedule 22 – Large Generator Interconnection Procedures

Modeling Data for Schedule 25 - Elective Transmission Upgrade (ETU)

Appendix 1	Attachment A – Technical Data Required for Interconnection System Impact Study *(if applicable)*	Attachment A-1 – Cluster System Impact Study Application Form *(if applicable)*	Attachment B – Interconnection Request Technical Data Required for Interconnection Feasibility Study *(if applicable)*
• Project name • Specific ETU technology (HVDC/AC/controllable/ non-controllable) • Transfer capability • Flow (unidirectional/ bidirectional) • Internal or external ETU • Site control • In-service date	Power system computer-aided design (PSCAD) model [electromagnetic transient analysis] (if applicable)	Request inclusion into Cluster Interconnection System Impact Study	Reduced requirements since no stability or electromagnetic transient (EMT) analysis performed – Geographic map – One-line diagram – Proposed POI – AC transmission line data – Transformer data – Fixed or switched shunt data – DC transmission data (line-commutated converter or voltage source converter technology)

All of these documents can be found at the end of their respective Schedule

Specific Language Schedule 25 – Elective Transmission Upgrade (ETU) Interconnection Agreement

24.3 Updated Information Submission by Interconnection Customer. *The updated information submission by the Interconnection Customer, including manufacturer information, shall occur no later than one hundred eighty (180) Calendar Days prior to the Trial Operation Date. Interconnection Customer shall submit a completed copy of the Elective Transmission Upgrade data requirements contained in Appendix 1 to the ETU IP.*

24.4 Information Supplementation. *Prior to the Commercial Operation Date, the Parties shall supplement their information submissions described above in this Article 24 with any and all "as-built" Elective Transmission Upgrade information and "as-tested" performance information that differs from the initial submissions or, alternatively, written confirmation that no such differences exist. The Interconnection Customer shall conduct tests on the Elective Transmission Upgrade as required by Good Utility Practice to verify proper operation of the Elective Transmission Upgrade's voltage regulation capability, and of other automatic controls for which the Elective Transmission Upgrade is reliant upon for acceptable performance, as described and requested by the System Operator. Documentation of the test results will be provided to the System Operator.*

For more information, visit: Schedule 25 – Elective Transmission Upgrade Interconnection Procedures

Questions

Data Requirements: Federal Energy Regulatory Commission (FERC) Jurisdictional and State (Non-FERC) Jurisdictional

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FERC Jurisdictional

Data Requirements

Interconnection Request Data

- One-line diagrams
- Modeling data
  - Steady-state
  - Short circuit
  - Stability
  - Electromagnetic transient (EMT) (if applicable)
- Collection system detail impedance sheet (if applicable)
- Reactive capability curve (aka PQ* curve)
- Inverter/turbine manufacturer data
- Site control (geographic map)

**aka real/reactive – PQ curve*

Interconnection Request Data

One-Line Diagram Checklist

- ☑ Does it show all the inverters?
- ☑ Does the inverter-associated data match Attachment A?
- ☑ Does it show the generator step-up transformer (GSU) and/or station transformer's impedance data?
- ☑ Does this align with the X/R from the interconnection request Attachment A/Siemens PSS/e data?
- ☑ Does it show where it is interconnecting?
- ☑ If tapping a line, does it show a three-breaker ring bus? The distance from a terminal station?
- ☑ If not connecting to the pool transmission facility (PTF), does the interconnecting transmission owner (ITO) require a specific reconfiguration?

Interconnection Request Data

Modeling Data Checklist

Steady-State

☑ Does data in the .raw/.idv file match Attachment A, A-1, and interconnection request (IR) data?

Short Circuit

☑ Was a converter-interfaced resource (CIR) model provided?

Stability

☑ Are the dynamic models provided standard library models?

Electromagnetic Transient (EMT) *if applicable*

☑ Is the model capable of running at a minimum time step of 20 microseconds?

☑ Does the model support the power system computer-aided design (PSCAD) *snapshot* feature?

☑ Does the model support the PSCAD *multiple run* feature?

Manufacturer Data Samples – Fossil Generation

ESTIMATED GENERATOR ELECTRICAL DATA

This data is an estimate only, and is based on the generator electrical design.
Actual manufacturing tolerances will cause some variation from these values.
Armature "VOLTS" and "AMPS" are rms values.

MGD GENERATOR DESIGN NUMBER DATE

ATB-2 7111 /0 KVA, 3600 RPM, 18000 VOLTS, 0.85 PF, 46.0°C H2 30.0 PSIG
188445 KW, 305 I1 AMPS, 0.50 SCR, 805 FLD VOLTS, 0 FT ALT, WYE CONN

REACTANCE DATA - (PER UNIT)	DIRECT AXIS		QUADRATURE AXIS	
SATURATED SYNCHRONOUS	X/DV		X/QV	
UNSATURATED SYNCHRONOUS	X/DI		X/QI	
SATURATED TRANSIENT	XP/DV			
UNSATURATED TRANSIENT	XP/DI		XP/Q	
SATURATED SUBTRANSIENT	XPP/DV		XPP/QV	
UNSATURATED SUBTRANSIENT	XPP/DI		XPP/QI	
SATURATED NEGATIVE SEQUENCE	X/2V			
UNSATURATED NEGATIVE SEQUENCE	X/2I			
SATURATED ZERO SEQUENCE	X/0V			
UNSATURATED ZERO SEQUENCE	X/0I			
LEAKAGE REACTANCE, OVEREXCITED	X/LM,OEX			
LEAKAGE REACTANCE, UNDEREXCITED	X/LM,UEX			

FIELD TIME CONSTANT DATA - (SEC AT 125C) DIRECT AXIS			QUADRATURE AXIS	
OPEN CIRCUIT	TP/D0		TP/Q0	
THREE PHASE SHORT CIRCUIT TRANSIENT	TP/D3		TP/Q	
LINE TO LINE SHORT CIRCUIT TRANSIENT	TP/D2			
LINE TO NEUTRAL SHORT CIRCUIT TRANSIENT	TP/D1			
SHORT CIRCUIT SUBTRANSIENT	TPP/D		TPP/Q	
OPEN CIRCUIT SUBTRANSIENT	TPP/D0		TPP/Q0	

ARMATURE DC COMPONENT TIME CONSTANT DATA - (SEC AT 100C)		
THREE PHASE SHORT CIRCUIT	T/A3	
LINE TO LINE SHORT CIRCUIT	T/A2	
LINE TO NEUTRAL SHORT CIRCUIT	T/A1	

ARMATURE WINDING SEQUENCE RESISTANCE DATA - (PER UNIT)		
POSITIVE	R/1	1.00
NEGATIVE	R/2	1.01
ZERO	R/0	1.00

Reactance, Resistance and Time Constant data may be interpreted per IEEE 115, section VII.
The base reactance ("UNIT") is calculated by the armature kV squared / MVA.
base reactance = 5

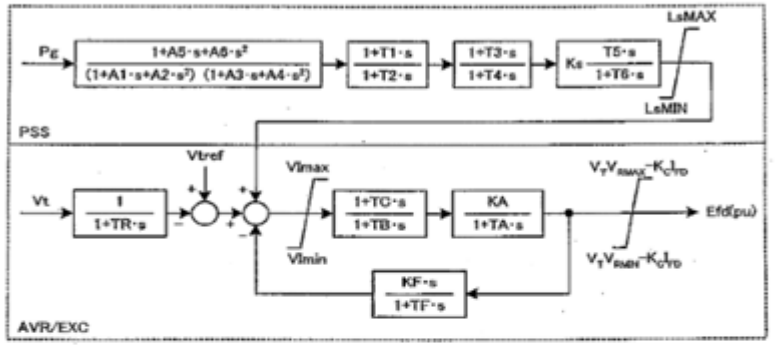
GE Power Generation — GENERAL ELECTRIC COMPANY SCHENECTADY, NY — SIZE A — CAGE CODE — DRAWN — ISSUED — SCALE — SHEET 2

MITSUBISHI ELECTRIC CORPORATION

TRANSFER FUNCTION DIAGRAM of STATIC EXCITATION SYSTEM for STG
(The model converted the MELCO's model into the IEEE model)

The transfer function converted the MELCO's model into the IEEE model is shown as follows;

- AVR/EXC model ··· IEEE ST1 model.
- PSS model ··· IEEE ST model



Base of 1(pu);
Vtref, Vt: Rated generator terminal voltage
Efd: Field voltage at generator no-load and rated voltage
Pg: Generator active power

AVR/EXC Constants

TR	=		(sec)
TC	=		(sec)
TB	=		(sec)
KA	=		(pu/pu)
TA	=		(sec)
KF	=		(pu/pu)
TF	=		(sec)
VIMAX	=		(pu)
VIMIN	=		(pu)
VRMAX	=		(pu)
VRMIN	=		(pu)
KC	=		(GTG/STG)

PSS Constants

A1	=		(sec)
A2	=	0.0	(pu/pu)
A3	=		(sec)
A4	=		(sec)
A5	=		(sec)
A6	=		(sec)
Ks	=		(sec)
T1	=		(sec)
T2	=		(sec)
T3	=		(pu)
T4	=		(pu)
T5	=		(sec)
T6	=		(sec)
LsMAX	=		(pu)
LsMIN	=		(pu)

Table 2
Derivation of "GGOV1" Model Constants and Typical Values

GGOV1 Model Constant	Value Derived from Hardware-Based Model	Model Constant using typical data
r	= p.u. value of droop setting = %Droop/100	0.0 p.u.
rselect	= 1 to select electric power feedback	
Tpelec	= Electric power transducer lag time constant	
Kimw	= 0 (supervisory control loop not applied)	
Kpgov	= K_1*Kp*K_2 / r	
Kigov	= K_1*K_2 / (Ti * r)	p.u./sec
Kdgov	= 0	0
Kturb	= turbine power output vs. fuel flow gain	p.u.
Wfnl	= fuel flow at no load	p.u.
Vmax	= maximum valve position limit. Typically set to limit short-term load increases to 0.10 p.u.. Set to smaller value of: a) Wfnl + (Po + 0.10)/Kturb, or b) [Po = initial steady-state power in p.u.]	Smaller value of a) or b) at left.
Vmin	= minimum valve position limit	
Tact	= Tv	sec.
flag	= 0 (fuel flow independent of speed)	0
Tb	= Te	sec.
Tc	= 0	
Teng	= 0	
aset	= 10 (set to high value to effectively disable acceleration limiter)	
Ka	= 10 (set so acceleration limiter loop not applied)	
Ldref	= 10 (set to high value to effectively disable loop)	
All Other "ggov1" Constants	Set to the "Default Data" values provided in the "ggov1" model description in the PSLF instruction manual.	Set to PSLF Default Data values

Wind and Solar Manufacturer Model Examples

The time constant of the washout filter determines the ramp rate limit imposed on changes to the power order signal. This function is always in service and is not disabled by setting apcflg to 0. Example data for both the APC and power response rate limit functions are shown in Table 4-12.

Table 4-12. Active Power Control and Rate Limit Function Parameters.

Variable Name	PSLF Parameter	Recommended Value
T_w (sec)	tw	
apcflg	apcflg	
T_{pav} (sec)	tpav	
P_a (pu)	pa	
P_{bc} (pu)	pbc	
P_d (pu)	pd	
F_a (pu)	fa	
F_b (pu)	fb	
F_c (pu)	fc	
F_d (pu)	fd	
P_{max} (pu)	pmax	
P_{min} (pu)	pmin	

4.3.5 WindINERTIA Model

System disturbances that include the loss of generation normally result in transient depressions of system frequency. The rate of frequency decline, the depth of the frequency excursion, and time required for system frequency to return to normal are affected by the dynamic characteristics of generation connected to the grid. In the first few seconds following the loss of a large generating plant, the frequency dynamics of the system are dominated by the inertial response of the generation. Conventional synchronous generation inherently contributes some stored inertial energy to the grid, reducing the initial rate of frequency decline and allowing slower governor actions to stabilize grid frequency.

Most modern MW-class wind generation does not exhibit this inertial response. However, GE's WindINERTIA™ feature provides an inertial response capability for wind turbines, similar to that of conventional synchronous generators, for large under-frequency grid events. Note that this control is asymmetric: it only responds to low frequencies. High frequency controls are handled separately by the APC described above. Fast supplemental controls, added to the fast power electronics and mechanical controls of the WTG, take advantage of the inertia in the rotor. For these large underfrequency events, this feature temporarily increases the power output of the wind turbine in the range of 5% to 10% of the rated turbine power. The duration of the power increase is on the order of several seconds. This benefits the grid by

Table 3-1: Parameter description of REGCAU1

CONs	Eterm	Description
CON(1)	Tg	Converter time constant (s)
CON(2)	Rrpwr	Low Voltage Power Logic (LVPL) ramp rate limit (pu)
CON(3)	Brkpt	LVPL characteristic voltage 2 (pu)
CON(4)	Zerox	LVPL characteristic voltage 1 (pu)
CON(5)	Lvpl1	LVPL gain (pu)
CON(6)	Volim	Voltage limit (pu) for high voltage reactive current management
CON(7)	Lvpnt1	High voltage point for low voltage active current management (pu)
CON(8)	Lvpnt0	Low voltage point for low voltage active current management (pu)
CON(9)	Iolim	Current limit (pu) for high voltage reactive current management (specified as a negative value)
CON(10)	Tfltr	Voltage filter time constant for low voltage active current management (s)
CON(11)	Khv	Overvoltage compensation gain used in the high voltage reactive current management
CON(12)	Iqrmax	Upper limit on rate of change for reactive current (pu)
CON(13)	Iqrmin	Lower limit on rate of change for reactive current (pu)
CON(14)	Accel	Acceleration factor (0 < Accel <=1)

Table 3-2: Parameter description of REGCAU1

VARs	Description
VARs (1)	Previous terminal voltage
VARs (2)	Previous terminal voltage angle
VARs (3)	Reactive current overvoltage correction
VARs (4)	Initial machine reactive power from power flow

Table 3-2: Parameter description of REECAU1 – CONs

CONs	Eterm	Description
CON(1)	Vdip (pu)	Low voltage threshold to activate reactive current injection logic
CON(2)	Vup (pu)	Voltage above which reactive current injection logic is activated
CON(3)	Trv (s)	Voltage filter time constant
CON(4)	dbd1 (pu)	Voltage error dead band lower threshold (<=0)
CON(5)	dbd2 (pu)	Voltage error dead band upper threshold (>=0)
CON(6)	Kqv (pu)	Reactive current injection gain during over and under voltage conditions
CON(7)	Iqhl (pu)	Upper limit on reactive current injection Iqinj
CON(8)	Iqll (pu)	Lower limit on reactive current injection Iqinj
CON(9)	Vref0 (pu)	User defined reference (if 0, model initializes it to initial terminal voltage)
CON(10)	Iqfrz (pu)	Value at which Iqinj is held for Thld seconds following a voltage dip if Thld > 0
CON(11)	Thld (s)	Time for which Iqinj is held at Iqfrz after voltage dip returns to zero (see Note 1)
CON(12)	Thld2 (s)	Time for which the active current limit (IPMAX) is held at the faulted value after voltage dip returns to zero (>=0)
CON(13)	Tp (s)	Filter time constant for electrical power
CON(14)	QMax (pu)	Limit for reactive power regulator
CON(15)	QMin (pu)	Limit for reactive power regulator
CON(16)	VMAX (pu)	Max. limit for voltage control
CON(17)	VMIN (pu)	Min. limit for voltage control
CON(18)	Kqp (pu)	Reactive power regulator proportional gain
CON(19)	Kqi (pu)	Reactive power regulator integral gain

.raw and .idv Files

- Also described in *Dynamics Data Management System (DDMS) User Guide* on ISO website at Participate > Support > User Guides
- Actual PSS/e import files that represent generator performance are required to ensure that generator modeling is accurate and represents the facility as actually configured and tuned

Manufacturer or Consultant As-Tested Data

- Excitation system including power system stabilizer
  - For Large Generator Interconnection Schedule 22
  - For NERC MOD-026 testing
    - Provides the actual response to voltage excursion
    - Ensures field programmable settings provided to ISO
- Governor (including DCS)
  - For NERC MOD-027 testing
  - Provides the actual response to power excursion
  - Tested values to ensure that field is programmable
  - Settings have been provided to ISO

Interconnection Request Data

Collection System Detail Impedance Sheet (if applicable) Checklist

- ☑ Does it accurately list the cable impedances?
- ☑ If there is an overhead cable, has it been accounted for?
- ☑ Does it accurately account for the number of inverters in the calculation?
- ☑ If the project one-line shows cable impedances, do they match impedance sheet?
- ☑ Does the generator step-up transformer (GSU) and/or station transformer impedance data (item number 5 and item number 14 in Attachment A-1) match the impedance sheet?

Interconnection Request Data

PQ Curve Checklist

- ☑ Does the megawatt (MW) and megavolt-ampere reactive (MVAR) capability at stated power factor (PF) match the reactive capability curve (aka PQ curve)?
- ☑ Does the PQ curve show the inverter's ability to generate Q at zero P?
- ☑ Is the project MW temperature-dependent? Was a temperature curve provided?

Data should be submitted to Interconnection Request Tracking Tool (IRTT)

Interconnection Request Tracking Tool (IRTT)

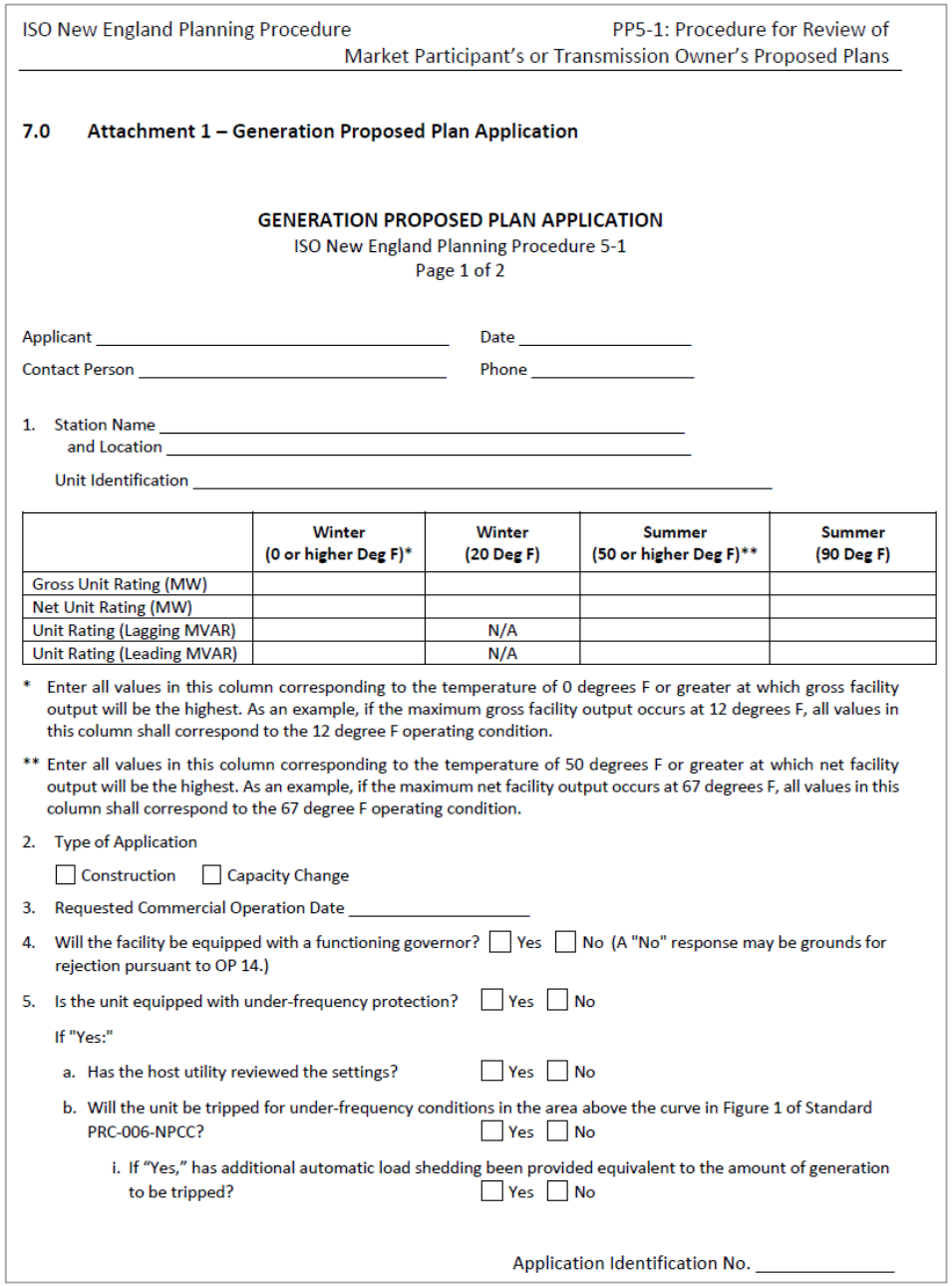
Resources for How Data is Submitted

- Participate > Support > User Guides > Interconnection Request Tracking Tool (IRTT) User Guide
- Videos:
  - How to Create a New Interconnection Request
  - How to Submit a Small Generator Interconnection Request in IRTT
  - How to Submit a Large Generator Interconnection Request in IRTT

    How to Submit Elective Transmission Upgrade Interconnection Request in IRTT

Generation Interconnection Data Forms

- PP05-1 Attachment 1 – Generation Proposed Plan Application
- Other attachments



ISO New England Planning Procedure — PP5-1: Procedure for Review of Market Participant's or Transmission Owner's Proposed Plans

7.0 Attachment 1 – Generation Proposed Plan Application

GENERATION PROPOSED PLAN APPLICATION
ISO New England Planning Procedure 5-1
Page 1 of 2

Applicant _____ Date _____
Contact Person _____ Phone _____

1. Station Name _____
   and Location _____
   Unit Identification _____

	Winter (0 or higher Deg F)*	Winter (20 Deg F)	Summer (50 or higher Deg F)**	Summer (90 Deg F)
Gross Unit Rating (MW)				
Net Unit Rating (MW)				
Unit Rating (Lagging MVAR)		N/A		
Unit Rating (Leading MVAR)		N/A		

* Enter all values in this column corresponding to the temperature of 0 degrees F or greater at which gross facility output will be the highest. As an example, if the maximum gross facility output occurs at 12 degrees F, all values in this column shall correspond to the 12 degree F operating condition.

** Enter all values in this column corresponding to the temperature of 50 degrees F or greater at which net facility output will be the highest. As an example, if the maximum net facility output occurs at 67 degrees F, all values in this column shall correspond to the 67 degree F operating condition.

2. Type of Application
   ☐ Construction ☐ Capacity Change
3. Requested Commercial Operation Date _____
4. Will the facility be equipped with a functioning governor? ☐ Yes ☐ No (A "No" response may be grounds for rejection pursuant to OP 14.)
5. Is the unit equipped with under-frequency protection? ☐ Yes ☐ No
   If "Yes:"
   a. Has the host utility reviewed the settings? ☐ Yes ☐ No
   b. Will the unit be tripped for under-frequency conditions in the area above the curve in Figure 1 of Standard PRC-006-NPCC? ☐ Yes ☐ No
      i. If "Yes," has additional automatic load shedding been provided equivalent to the amount of generation to be tripped? ☐ Yes ☐ No

Application Identification No. _____

State (Non-FERC) Jurisdictional

Initially Non-FERC Generation Participating in ISO Markets

- When generation that was installed through the state (non-FERC) process participates in the ISO markets then it becomes subject to the ISO Tariff and associated documents including operating procedures
- Generator facility must provide steady-state, dynamics, and short-circuit data in accordance with the operating procedures
  - Generator must also provide other data required by the Tariff and other documents

Questions

Planning Procedure 5-6 (Data and Modeling)

Brad Marszalkowski

Senior Engineer

Topics

Data Requirements:

- Power Flow
- Short Circuit
- Stability
- Electromagnetic Transient (EMT) Data
- PSS/e vs. Power System Computer-Aided Design (PSCAD) Benchmarking Report

Steady State

Power Flow Data and Models

- Must be site specific
- Must be PSS/e .raw or .idv format
- Should be parameterized to represent the in-service equipment at the facility
- All elements and topology up to and including the point of interconnection (POI) must be represented
  - Generators
  - Lines
  - Transformers
  - Shunts
  - Buses
  - Dynamic reactive devices/flexible alternating-current transmission system (FACTS)
  - Station service loads
- See Appendix B Compliance Bulletin – MOD-032 and ISO New England's Model Data Requirements and Reporting Procedures

Short Circuit Data and Modeling

- Must be site specific
- Must be Aspen .olr format
- Should be parameterized to represent the in-service equipment at the facility
- All elements and topology up to and including the point of interconnection (POI) must be represented
  - Generators
  - Lines
  - Transformers
  - Shunts
  - Buses
  - Dynamic reactive devices/flexible alternating-current transmission system (FACTS)
  - Station service loads

Stability Data and Modeling

- Must be site specific
- Must be PSS/e .dyr format (standard library models **only** after January 1, 2017)
- Shall be parameterized to represent the in-service equipment at the facility
- All elements that have a dynamic response shall be included generators
  - Dynamic reactive devices/flexible alternating-current transmission system (FACTS)
- Must follow modeling requirements of PP05-6 – Interconnection Planning Procedure for Generation and Elective Transmission Upgrades and requirements described in Compliance Bulletin – MOD-032 and ISO New England's Model Data Requirements and Reporting Procedures

Electromagnetic Transient (EMT) and Modeling

- Must be site specific
- Must be power system computer-aided design (PSCAD) format
- Should be parameterized to represent the in-service equipment at the facility
- All elements and topology up to and including the point of interconnection (POI) must be represented
  - Generators
  - Lines
  - Transformers
  - Shunts
  - Buses
  - Dynamic reactive devices/flexible alternating-current transmission system (FACTS)
  - Station service loads

PSS/e vs. PSCAD Benchmarking Report

Benchmarking Analysis and Report

- Refer to Planning Procedure 5-6, Section 3.4.1
- Benchmarking analysis to confirm acceptable performance of the PSS/E model in comparison to the PSCAD model shall be performed
  - Equivalent PSCAD network should include enough buses away to simulate an N-1 scenario while maintaining a connection to the external grid
- Statement of model compliance
- List of plant specific settings
- Results documentation
  - Plots and related discussion regarding acceptability

PSS/e Model Requirements

- Refer to Planning Procedure 5-6, Appendix B
- Standard library models only
  - Unless planned acceptance into standard library list
- Permanent bus numbers should be used
- Models should initialize in accordance with MMWG criteria
  - Example:

    20 Second No-Fault Simulation (a/k/a “flat start”): This test consists of a 20-second simulation with no disturbance applied. The test will be considered to be passed if the following criteria are met:

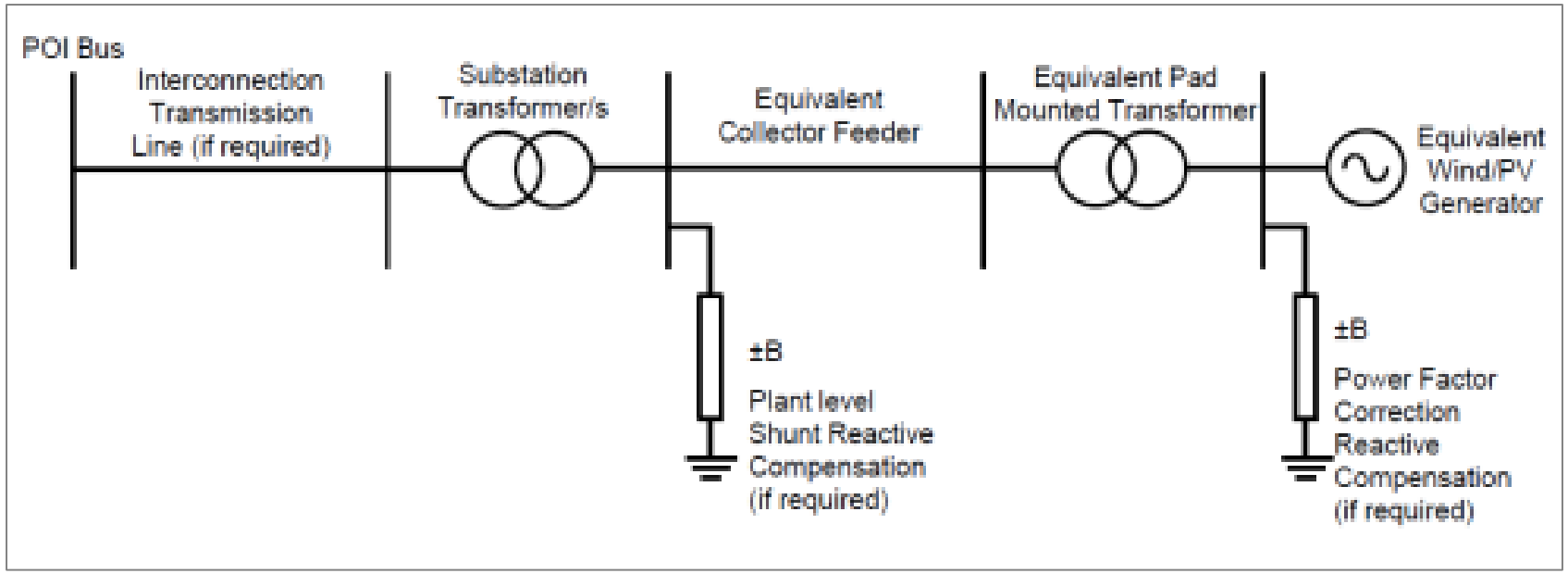
    i. No generator MW change of 0.1 MW or more
    ii. No generation MVAR change of 0.1 MVAR or more
    iii. No line flow changes of 0.3 MW or more
    iv. No line flow changes of 0.3 MVAR or more
    v. No voltage change of 0.0001 p.u. or more

PSCAD Model Requirements

- Refer to Planning Procedure 5-6, Appendix C
- Model accuracy
  - Should represent full detailed inner control loops
  - Should represent all pertinent control features
  - Must represent electrical and mechanical configurations such as filters and specialized transformers
- Model usability
  - Run at a minimum time step of 20us
  - Have control inputs readily available to the user
- Model efficiency
  - Initialize quickly, <1-3 seconds is preferred
  - Support multiple instances of the same model
  - Support multi run and snapshot features

Aggregated Models

- Refer to Planning Procedure 5-6, Appendix D
- Models
  - All inverter based resources (IBRs) need full steady state, short circuit, dynamic, and EMT models aggregated to the string level
  - Western Electricity Coordinating Council (WECC) solar and wind modeling guidelines are recommended



How Do the Standards Apply to this Data?

For Schedule 22, data is required as proposed,
as purchased, as built, and as tested

Questions

Market Registration Data Submittals

Brad Marszalkowski

Senior Engineer

ISO Tariff and ISO Procedures

- Schedule 22 – Large Generator Interconnection Procedures & Schedule 23 – Small Generator Interconnection Procedures required *As-Purchased* and *As-Built* data and model submissions
- OP-14 Technical Requirements For Generators, Demand Response Resources, Asset Related Demands, and Alternative Technology Regulation Resources requires models to be submitted for those new resources registering as generators
- OP-16 Transmission System Data
- OP-24 Protection Outages, Settings and Coordination
- PP05-6 Interconnection Planning Procedure for Generation and Elective Transmission Upgrades

As-Purchased and As-Built Data Requirements

Brad Marszalkowski

Senior Engineer

As-Purchased Data Requirements

As-Purchased Data Requirements

- Required as part of market registration per Schedule 22
- Required to be submitted at least 180 days prior to initial sync
- Confirmation of no changes or disclosure of changes to the following data and models
  - Powerflow
  - Short circuit
  - Stability
  - Electromagnetic transient (EMT)

For more information, visit: PP05-6 Interconnection Planning Procedure for Generation and Elective Transmission Upgrades

As-Purchased Data Requirements, *continued*

- Both of these must be submitted to the Dynamics Data Management System (DDMS):
  - **Steady-state modeling** file (.raw/.idv)
    - X source of generator MUST = X”d of dynamic model
  - **Dynamic modeling file** (.dyr)
- Model should be identical to what comes out of the System Impact Study (SIS) excepting the addition of permanent bus numbers for the temporary ones used on the study

Material Modification Considerations

See PP5-1 – Facility changes, such as but not limited to the following, do not require proposed plan

- Routine protection and relaying changes only if there will be no increase in the fault clearing times and no material change in elements tripped for all events that would be analyzed pursuant to the proposed plan application process
- Minor adjustments of parameters of continuously acting control systems from what had been previously approved under a proposed plan application
  - Such adjustments must be conveyed to the ISO as part of the applicant's ongoing data provision requirements
- Disconnect switches
- Replacement in kind or with greater energy dissipation of surge arrestors
- Station automation, SCADA, communications, metering
- Rehabilitation with like equipment that does not affect transmission capability
- Static wire changes
- Counterpoise changes
- Replacement in kind of line terminal equipment and bus conductor to increase thermal capability
  - Such changes require market participant to submit revised NX-9 data to ISO in accordance with OP 16 *Transmission System Data*

For more information, visit: PP05-6 Interconnection Planning Procedure for Generation and Elective Transmission Upgrades

Material Modification Considerations, *continued*

Subject to material modification determination

- See PP5-6 Appendix E – Procedures for Material Modification Determinations

- Changes that are deemed material:
  - Any increase to the energy capability or capacity capability output of a generating facility or elective transmission upgrade (ETU) above that specified in an interconnection
  - A change from network resource (NR) interconnection service to capacity network resource (CNR) interconnection
  - An extension of three or more cumulative years in the commercial operation date, in-service date, or initial synchronization date of the large generating facility or ETU, unless provisions of Section 4.4.5 of the Schedules 22 or 25 are satisfied

Changes such as those involving automatic voltage regulators, transformer impedance, and governor performance definitely require study per the Tariff, Section I.3.9

As-Built Data Requirements

As-Built Data Submittal

- Required as part of market registration per Schedule 22
- Required to be submitted at least 120 days prior to commercial operation date
- Confirmation of no changes or disclosure of changes to the following data and models
  - Power flow
  - Short circuit
  - Stability
  - Electromagnetic transient (EMT)
- See Schedule 22 – Large Generator Interconnection Procedure, Section 24.4

Subject to same material modification determination process as as-purchased submittal

Verification (Large Generating Facilities Only)

- Generators subject to Schedule 22 are *large* (i.e., over 20 MW capacity)
- Open circuit *step voltage* test to verify proper operation of the facility's automatic voltage regulator (AVR)
  - Large generating facility at synchronous speed
  - Automatic voltage regulator on and in voltage control mode
  - Five percent change in large generating facility terminal voltage initiated by a change in the voltage regulators reference voltage

Applicability and Submittal Process Timeline for Existing Resources

- Once a generator becomes commercial, there are different applicability criteria:
  - Existing – Keeping data up-to-date in accordance with OP-14
    - Generator defined per Section II.A.
    - Generator data is provided per Section II.A.11 "To define a Generator, the Lead MP shall submit any technical data with respect to a Generator that ISO *determines to be necessary* for ISO to carry out its responsibility of reliably and efficiently operating the power system…"
  - NERC Mod Standard 26/27 – 100 MVA units and above
  - MOD-032 – Applicable to facilities that are part of the bulk electric system (BES)
  - OP-24 – Protection models generators 75 MVA and above
  - OP-16 – Short-circuit data, in line with OP-14 applicability
- MOD-032 and OP-14 annual recertification
  - Recertified every 13 months – Dynamic Data Management System (DDMS) and Short Circuit Data Management System (SDMS) automated request one year since last recertification

Questions

NERC Standards

John Pearson

Compliance Manager

Topics

- MOD-032-1 – Data for Power System Modeling and Analysis
- MOD-026-1 – Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions
- MOD-027-1 – Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

MOD-032-1 – Data for Power System Modeling and Analysis

Purpose: *To establish consistent modeling data requirements and reporting procedures for development of planning horizon cases necessary to support analysis of the reliability of the interconnected transmission system.*

- Steady-state
- Dynamics
- Short circuit

MOD-032-1 – Data for Power System Modeling and Analysis

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

Purpose: *To verify that the generator excitation control system or plant volt/var control function model (including the power system stabilizer model and the impedance compensator model) and the model parameters used in dynamic simulations accurately represent the generator excitation control system or plant volt/var control function behavior when assessing bulk electric system (BES) reliability.*

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

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

Purpose: *To verify that the turbine/governor and load control or active power/frequency control model and the model parameters, used in dynamic simulations that assess bulk electric system (BES) reliability, accurately represent generator unit real power response to system frequency variations.*

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

Questions

Operating Procedures

John Pearson

Compliance Manager

Topics

- OP-14 – Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources
- OP-16 – Transmission System Data
- OP-24 – Protection Outages, Settings and Coordination

OP-14 – Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources

- Station one-line diagrams
- Power System Simulation for Engineers (PSSE) dynamic models for generators of 5 MW or greater, when required by ISO
  - Generator, including wind turbines, photovoltaic systems, fuel cells, and any other resource, that delivers MW to the electric power system and meets the definition of a generator in this operating procedure
  - Excitation system
  - Governor
  - Power system stabilizer (if equipped)
  - Model shall be acceptable as listed in ISO Compliance Bulletin MOD-032 – Model Data Requirements and Reporting Procedures
- EMT (PSCAD) models when required by ISO
- Generator Technical Data per Appendix A of OP-14
- Form NX-12D, Generator Reactive Data (NX-12D), per Appendix B of OP-14

OP-14 – Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources

OP-16 – Transmission System Data

- Applies to modeled generators per OP-14
- Appendix A (NX-9A) – Generators with *longer* interconnecting generator leads
- Submission of an NX-9A for a line segment internal to a substation is not required when the following conditions are met and the exemption has been approved by the ISO NX-9 administrator:
  - Total reactance (x) of segment (all owners) is less than 0.01 (percent on a 100 MVA base)
  - Segment is not part of a three-terminal line tap
  - MW and MVAR of segment are not metered
    - All potentially limiting equipment is included in the rating calculation of the adjacent equipment
- Form NX-9B, Transformer-FIXED/GSU per OP-16 Appendix B
- Form NX-9D, Static Capacitor/Reactor per OP-16
- Short-circuit data per OP-16 Appendix K

OP-16 – Transmission System Data

OP-16 – Transmission System Data, Appendix B

I. EQUIPMENT REQUIREMENTS

Data for all transformers designated as part of the Bulk Electric System[1] (BES) or with at least one winding connecting to the New England Transmission System[2] at a voltage of 69 kV or greater shall be provided by the Transmission Owners and Market Participants who own the equipment.[3]

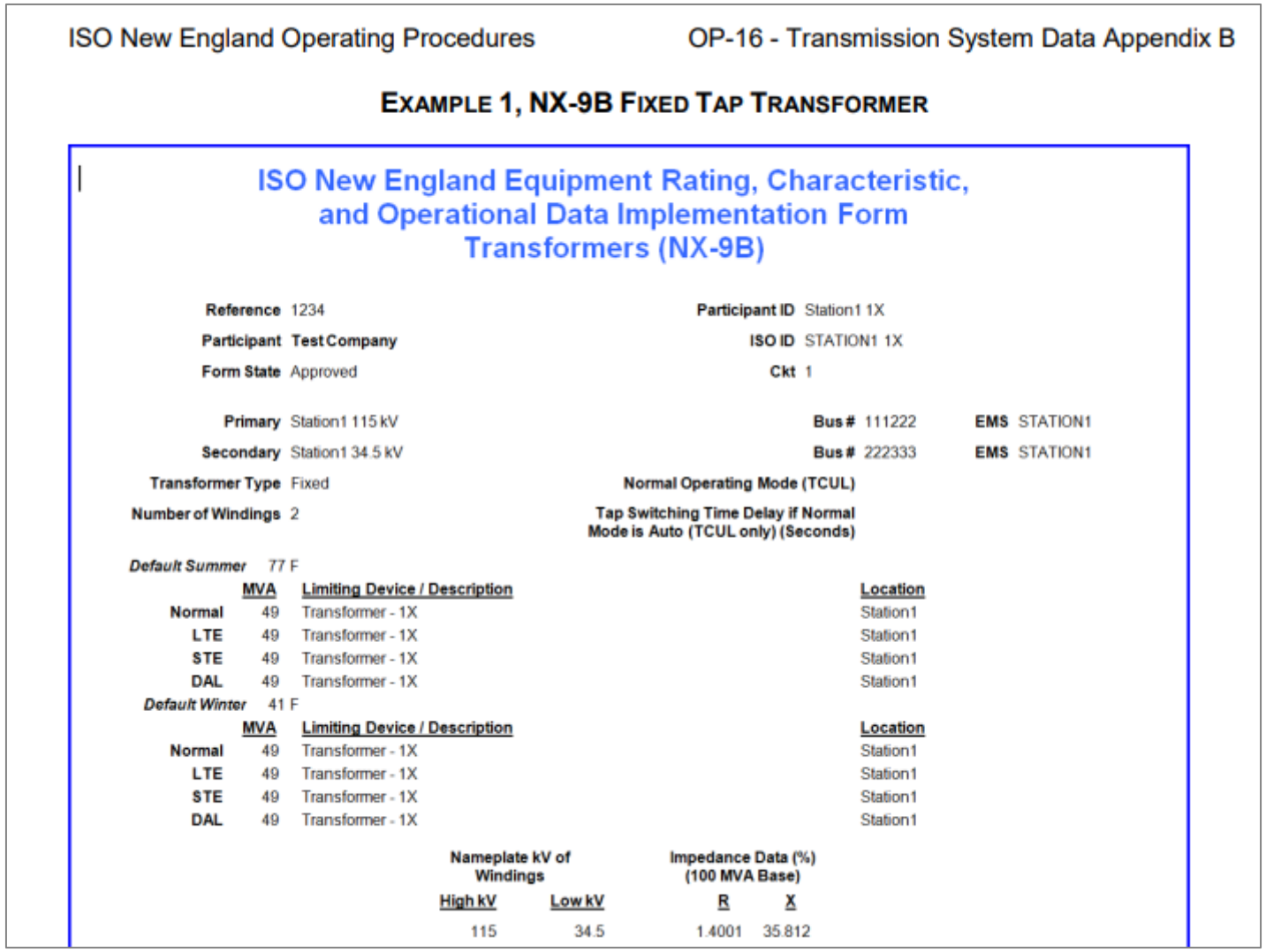
- Data for all generator step-up transformers (GSUs) attached to generators 1 MW or greater that participate in the Real-Time Energy Market, including generators connecting via a line of any voltage level that is dedicated solely to the generation interconnection (i.e., via an express feeder), will be evaluated for impact to the ISO EMS Network Model. Based on this evaluation, NX-9B data forms may be required. When required, the NX-9B data forms shall be provided by the Lead MP for the Generator Assets.

- NX-9B data forms are not required for GSUs that connect a generator to the transmission system via a line(s) that also serves customer load.

- NX-9B data forms are not required for GSUs associated solely with Settlement Only Generators.

NX-9B data forms for transformers or individual wind turbine or solar GSUs connected at voltages that are less than 69 kV may be required when ISO determines that the data is necessary for reliable operation of the New England Transmission System. When required by ISO, the TO or MP shall submit the data within thirty (30) calendar days of ISO's notification.

Examples From OP-16 Appendix B



EXAMPLE 1, NX-9B FIXED TAP TRANSFORMER

ISO New England Equipment Rating, Characteristic, and Operational Data Implementation Form Transformers (NX-9B)

Reference 1234
Participant Test Company
Form State Approved

Participant ID Station1 1X
ISO ID STATION1 1X
Ckt 1

Primary Station1 115 kV — **Bus #** 111222 — **EMS** STATION1
Secondary Station1 34.5 kV — **Bus #** 222333 — **EMS** STATION1
Transformer Type Fixed
Number of Windings 2

Normal Operating Mode (TCUL)
Tap Switching Time Delay if Normal Mode is Auto (TCUL only) (Seconds)

Default Summer 77 F

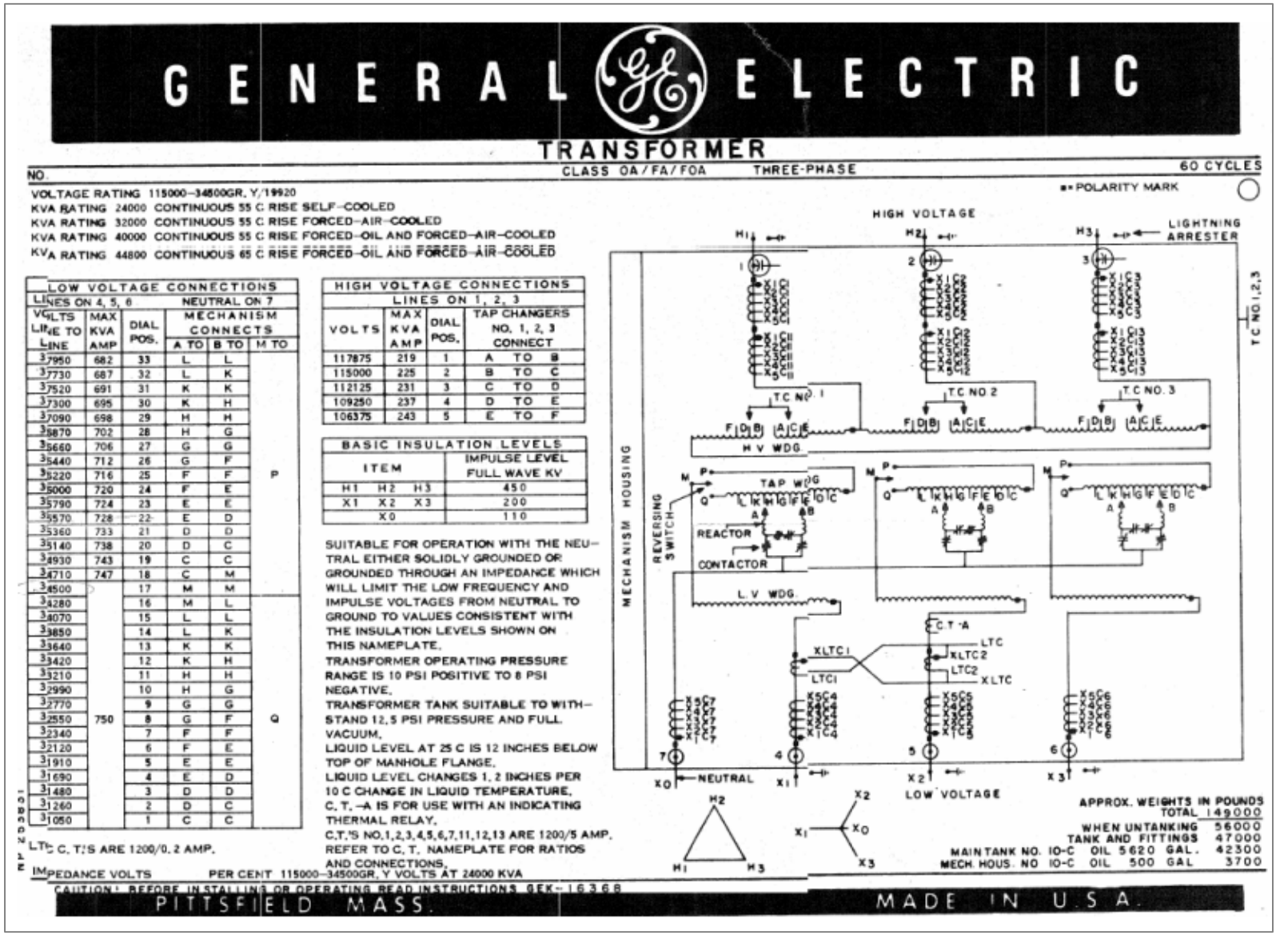
	MVA	Limiting Device / Description	Location
Normal	49	Transformer - 1X	Station1
LTE	49	Transformer - 1X	Station1
STE	49	Transformer - 1X	Station1
DAL	49	Transformer - 1X	Station1

Default Winter 41 F

	MVA	Limiting Device / Description	Location
Normal	49	Transformer - 1X	Station1
LTE	49	Transformer - 1X	Station1
STE	49	Transformer - 1X	Station1
DAL	49	Transformer - 1X	Station1

Nameplate kV of Windings		Impedance Data (%) (100 MVA Base)	
High kV	Low kV	R	X
115	34.5	1.4001	35.812

OP-16B Also Requires a Nameplate Data



GENERAL ELECTRIC

TRANSFORMER

NO. CLASS OA/FA/FOA THREE-PHASE 60 CYCLES

VOLTAGE RATING 115000–34500GR. Y/19920

KVA RATING 24000 CONTINUOUS 55 C RISE SELF–COOLED

KVA RATING 32000 CONTINUOUS 55 C RISE FORCED–AIR–COOLED

KVA RATING 40000 CONTINUOUS 55 C RISE FORCED–OIL AND FORCED–AIR–COOLED

KVA RATING 44800 CONTINUOUS 65 C RISE FORCED–OIL AND FORCED–AIR–COOLED

POLARITY MARK

LOW VOLTAGE CONNECTIONS

LINES ON 4, 5, 6 NEUTRAL ON 7

VOLTS LINE TO LINE	MAX KVA AMP	DIAL POS.	MECHANISM CONNECTS A TO	B TO	M TO
37950	682	33	L	L	P
37730	687	32	L	K	
37520	691	31	K	K	
37300	695	30	K	H	
37090	698	29	H	H	
36870	702	28	H	G	
36660	706	27	G	G	
36440	712	26	G	F	
36220	716	25	F	F	
36000	720	24	F	E	
35790	724	23	E	E	
35570	728	22	E	D	
35360	733	21	D	D	
35140	738	20	D	C	
34930	743	19	C	C	
34710	747	18	C	M	
34500	750	17	M	M	Q
34280		16	M	L	
34070		15	L	L	
33850		14	L	K	
33640		13	K	K	
33420		12	K	H	
33210		11	H	H	
32990		10	H	G	
32770		9	G	G	
32550		8	G	F	
32340		7	F	F	
32120		6	F	E	
31910		5	E	E	
31690		4	E	D	
31480		3	D	D	
31260		2	D	C	
31050		1	C	C	

LTC C. T.'S ARE 1200/0.2 AMP.

IMPEDANCE VOLTS PER CENT 115000–34500GR. Y VOLTS AT 24000 KVA

HIGH VOLTAGE CONNECTIONS

LINES ON 1, 2, 3

VOLTS	MAX KVA AMP	DIAL POS.	TAP CHANGERS NO. 1, 2, 3 CONNECT
117875	219	1	A TO B
115000	225	2	B TO C
112125	231	3	C TO D
109250	237	4	D TO E
106375	243	5	E TO F

BASIC INSULATION LEVELS

ITEM	IMPULSE LEVEL FULL WAVE KV
H1 H2 H3	450
X1 X2 X3	200
X0	110

SUITABLE FOR OPERATION WITH THE NEUTRAL EITHER SOLIDLY GROUNDED OR GROUNDED THROUGH AN IMPEDANCE WHICH WILL LIMIT THE LOW FREQUENCY AND IMPULSE VOLTAGES FROM NEUTRAL TO GROUND TO VALUES CONSISTENT WITH THE INSULATION LEVELS SHOWN ON THIS NAMEPLATE.

TRANSFORMER OPERATING PRESSURE RANGE IS 10 PSI POSITIVE TO 8 PSI NEGATIVE.

TRANSFORMER TANK SUITABLE TO WITHSTAND 12.5 PSI PRESSURE AND FULL VACUUM.

LIQUID LEVEL AT 25 C IS 12 INCHES BELOW TOP OF MANHOLE FLANGE.

LIQUID LEVEL CHANGES 1.2 INCHES PER 10 C CHANGE IN LIQUID TEMPERATURE.

C. T. –A IS FOR USE WITH AN INDICATING THERMAL RELAY.

C.T.'S NO.1,2,3,4,5,6,7,11,12,13 ARE 1200/5 AMP. REFER TO C. T. NAMEPLATE FOR RATIOS AND CONNECTIONS.

CAUTION: BEFORE INSTALLING OR OPERATING READ INSTRUCTIONS GEK–16368

HIGH VOLTAGE

LIGHTNING ARRESTER

MECHANISM HOUSING

REVERSING SWITCH

TC NO. 1 TC NO 2 TC NO. 3

H V WDG

TAP WDG

REACTOR

CONTACTOR

L V WDG

C.T.-A

LTC

XLTC1 XLTC2 LTC1 LTC2 X LTC

NEUTRAL

LOW VOLTAGE

APPROX. WEIGHTS IN POUNDS

TOTAL 149000

WHEN UNTANKING 56000

TANK AND FITTINGS 47000

MAIN TANK NO. 10-C OIL 5620 GAL. 42300

MECH. HOUS. NO 10-C OIL 500 GAL 3700

PITTSFIELD MASS. MADE IN U.S.A.

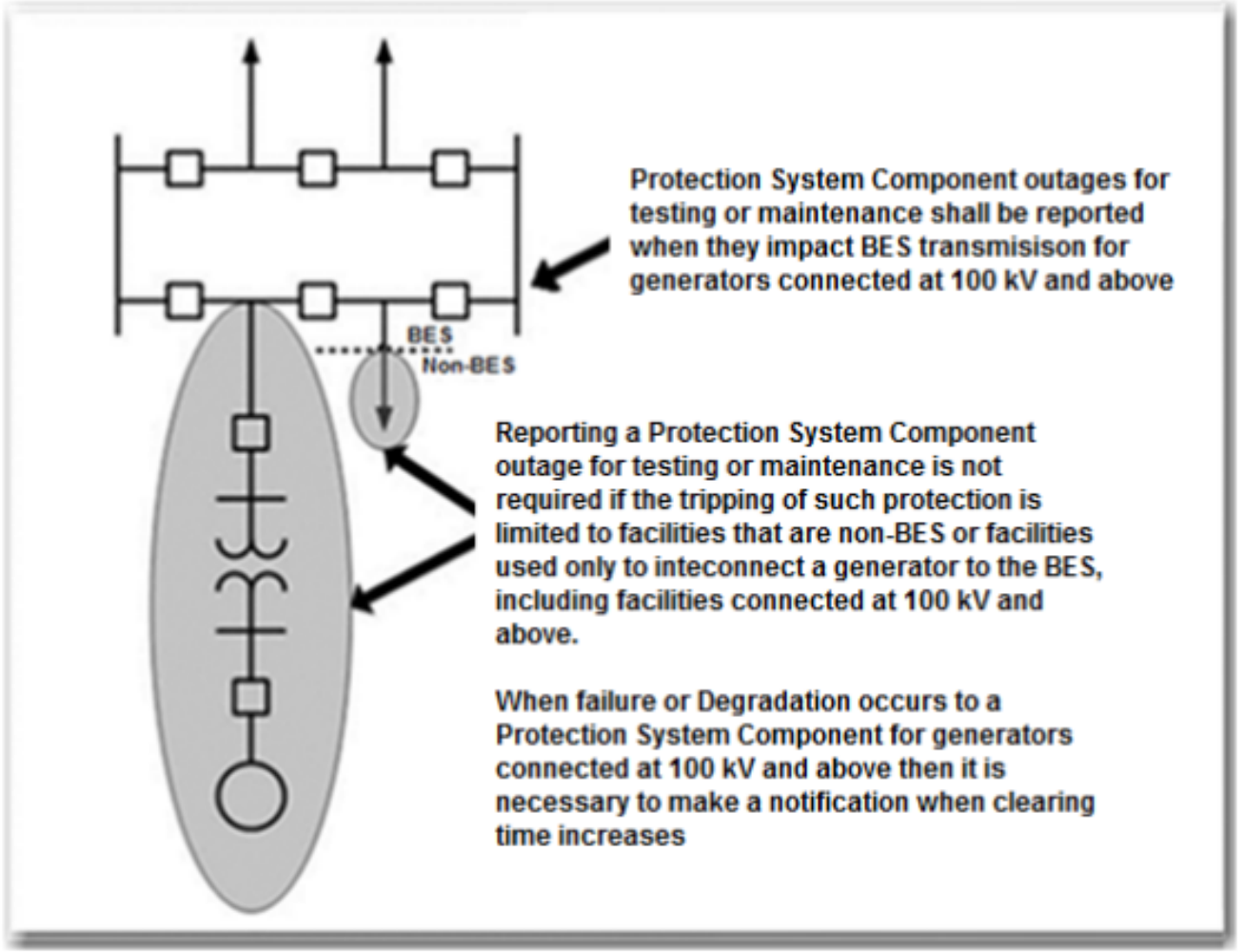
OP-24 – Protection Outages, Settings and Coordination

- Appendix A – Generator Relay Settings Information
- Appendix B – Transmission Relay Characteristics
- Data is submitted for generator relay settings using Dynamics Data Management System (DDMS)
- Data for new generators 75 MVA and above submitted using DDMS prior to commercial operation

OP-24 – Protection Outages, Settings and Coordination

When Generator Protection Outages Must Be Reported Per OP-24

Figure 2 - Outage Reporting for Generator Protection System Components



OP-24 Applicability and Emergency Settings Changes

VI. Relay Characteristics Provided to ISO

A. Modifying Relay Settings for Emergencies

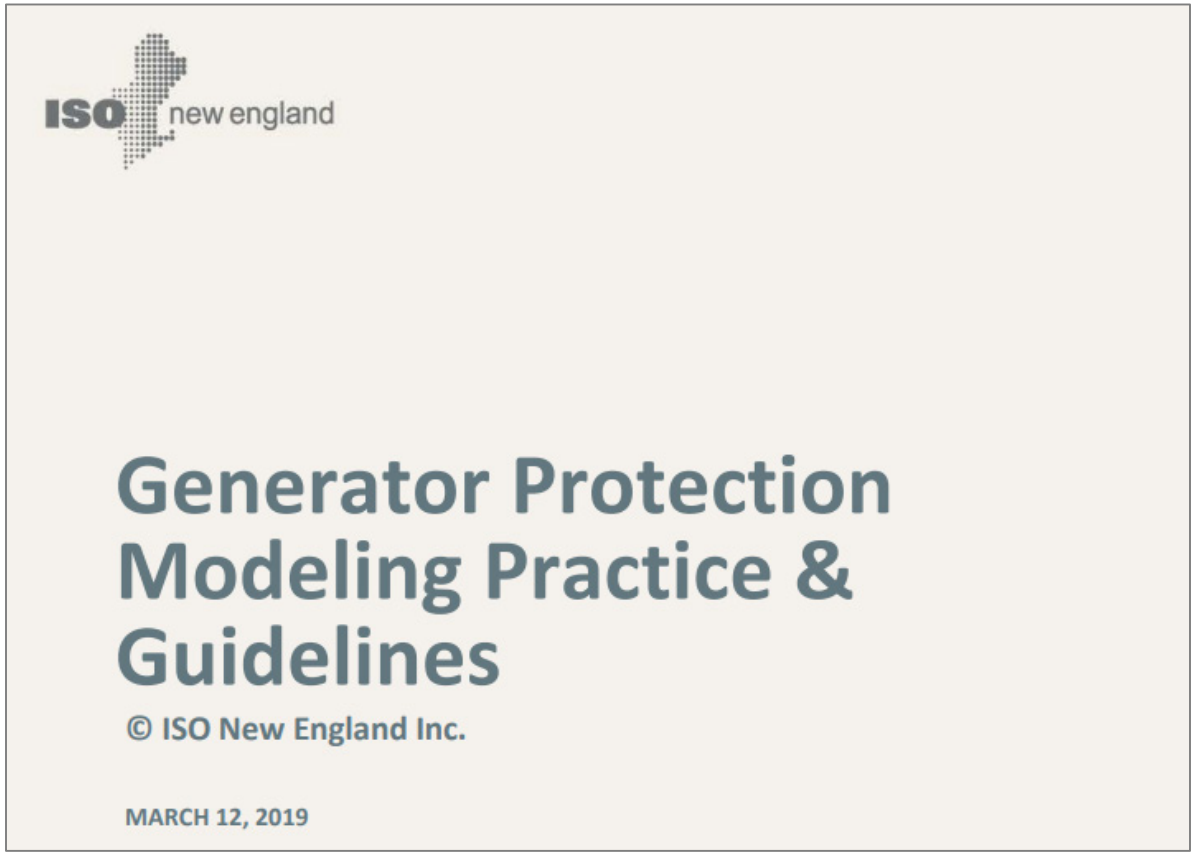
When necessary to ensure the reliability of the power system (for example, by reducing the risk of a misoperation), a TO or GO may make relay settings modifications before notifying ISO. Specifically, in such an emergency, a TO or GO may provide the notifications described in Section V within seven (7) Business Days after the date of the emergency, and the notifications shall also include a description of the emergency.

B. Protection System Components for Generating Facilities

1. Applicable Facilities

Lead MPs for GOs shall perform periodic reviews of relay characteristics for generation facilities with a single point of interconnection over 100 kV with gross plant/facility aggregate nameplate rating greater than or equal to 75 MVA and at any other facility where the ISO has indicated in writing to the Lead MP for the GO, that the characteristics are needed for reliability studies.

Modeling Generator Protection



OP-24 Generator Protection Modeling Practice & Guidelines

Sources of Protection Data Will Likely Be Relay Test Sheets

Section 3 - Sources of Protection Settings Information

Modelers may find several sources of relay protection settings, including completed relay test sheets (uncompleted sheet form shown in Figure 1) that are typically maintained as records of relay testing. Generator manufacturers may also provide suggested settings for protective devices and relay manufacturers provide typical settings. Relay instruction books such as those available from ABB, General Electric, Schweitzer Engineering, Siemens and others describe the function and application of relays and provide typical settings. In any case, modelers must translate these sources of data into models that are useful with simulation programs.

Sample's Testing, LLC — Relay Test Form

DESCRIPTION:

Manufacturer		Instruct. Book	
Pickup Range		CT Ratio	
Drawing No.		VT Ratio	
Relay Type		Device #	
Test Type/Set #		Test Set Calibration Date	
Other			

VISUAL AND MECHANICAL INSPECTION:

Crosscheck Nameplate with elementary drawings ☐			
Settings per Owner Provided Coordination Study ☐			
Cover Gasket ☐	Condensation/Rust ☐	Contact Condition ☐	Contact Condition ☐
Glass Intact ☐	Bearing Condition ☐	Glass Cleaned ☐	Power Supply ☐
Foreign Material ☐	Bearing Clearance ☐	Connections Tight ☐	Disc Clearance ☐
Other/Notes			

Suggestion – Obtain Protection Model Information During Commissioning

SIEMENS

PSS®E 33.5
PSS®E Model Library

Line Relay Model Data Sheets
DISTR1

11.2 DISTR1

mho, Impedance, or Reactance Distance Relay

Relay is located from bus	#_____	IBUS,
To bus	#_____	JBUS,
Circuit identifier	#_____	ID,
relay slot (1 or 2)	#_____	RS.
This model uses CONs starting with	#_____	J,
and VARs starting with	#_____	L,
and ICONs starting with	#_____	M.

CONs	Value	Description
J		Zone 1 operating time (cycles)
J+1		Zone 1 reach (diameter or reactance) (pu)
J+2		Zone 1 centerline angle in degrees (0 for reactance relay)
J+3		Zone 1 center distance (0 for reactance relay)
J+4		Zone 2 pickup time (cycles)
J+5		Zone 2 reach (diameter or reactance) (pu)
J+6		Zone 2 centerline angle (0 for reactance relay)
J+7		Zone 2 center distance (0 for reactance relay)
J+8		Zone 3 pickup time (cycles)

Questions

MOD-026-1 and MOD-027-1

Brad Marszalkowski

Senior Engineer

Topics

- MOD-026-1 – Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions
- MOD-027-1 – Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

When Does Resource Need to Provide Data?

To more efficiently perform reviews, ISO requires MOD-026 and MOD-027 data to be provided at the same time per OP-14

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

What Data Does Resource Need to Provide?

- Applicability to Generator Owners per 4.2.1 Generation in the Eastern or Quebec Interconnections with the following characteristics:
  - 4.2.1.1 Individual generating unit greater than 100 MVA* (gross nameplate rating)
  - 4.2.1.2 Individual generating plant consisting of multiple generating units that are directly connected at a common BES bus with total generation greater than 100 MVA (gross aggregate nameplate rating)
- **R2.** Each Generator Owner shall provide for each applicable unit, a verified generator excitation control system or plant volt/var control function model, including documentation and data (as specified in Part 2.1) to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1.

  [Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]

*megavolt-ampere

What Data Does Resource Need to Provide?

2.1. Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s), or both. Each verification shall include the following:

2.1.1. Documentation demonstrating the applicable unit's model response matches the recorded response for a voltage excursion from either a staged test or a measured system disturbance,

2.1.2. Manufacturer, model number (if available), and type of the excitation control system including, but not limited to static, AC brushless, DC rotating, and/or the plant volt/var control function (if installed),

2.1.3. Model structure and data including, but not limited to reactance, time constants, saturation factors, total rotational inertia, or equivalent data for the generator,

2.1.4. Model structure and data for the excitation control system, including the closed loop voltage regulator if a closed loop voltage regulator is installed or the model structure and data for the plant volt/var control function system,

2.1.5. Compensation settings (such as droop, line drop, differential compensation), if used, and

2.1.6. Model structure and data for power system stabilizer, if so equipped.

Provide prior to excitation system change per OATT!

What Data Does Resource Need to Provide?, *continued*

R3. Each Generator Owner shall provide a written response to its Transmission Planner within 90 calendar days of receiving one of the following items for an applicable unit:

- Written notification from its Transmission Planner (in accordance with Requirement R6) that the excitation control system or plant volt/var control function model is not usable,
- Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the excitation control system or plant volt/var control function model, or
- Written comments and supporting evidence from its Transmission Planner indicating that the simulated excitation control system or plant volt/var control function model response did not match the recorded response to a transmission system event.

Written response shall contain either the technical basis for maintaining the current model, the model changes, or a plan to perform model verification (in accordance with Requirement R2).

[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]

Provide prior to excitation system change per OATT!

What Data Does Resource Need to Provide?, *continued*

R4. Each Generator Owner shall provide revised model data or plans to perform model verification(in accordance with Requirement R2) for an applicable unit to its Transmission Planner within 180 calendar days of making changes to the excitation control system or plant volt/var control function that alter the equipment response characteristic. **[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]**

R5. Each Generator Owner shall provide a written response to its Transmission Planner, within 90 calendar days following receipt of a technically justified unit request from the Transmission Planner to perform a model review of a unit or plant that includes one of the following: **[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]**

- Details of plans to verify the model (in accordance with Requirement R2), or
- Corrected model data including the source of revised model data such as discovery of manufacturer test values to replace generic model data or updating of data parameters based on an on-site review of the equipment.

Provide prior to excitation system change per OATT!

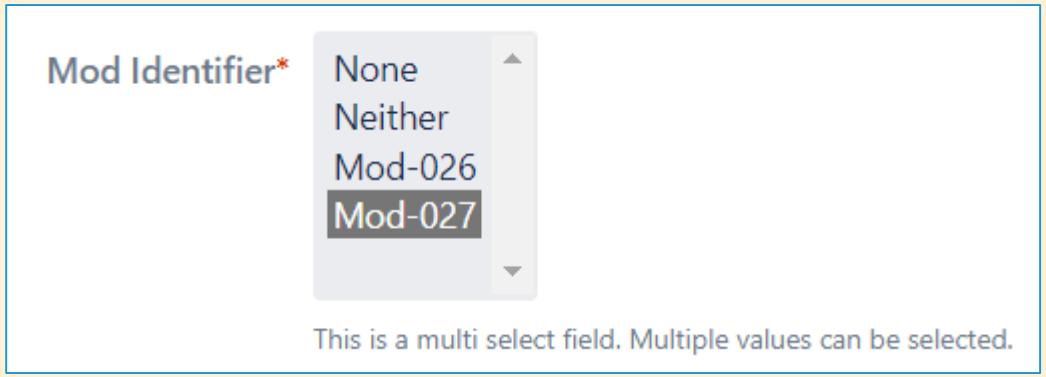
When is the Data Needed?

- See *Effective Date* section in the Standard
- Per Schedule 22, Articles 24 and 25 for new generators or existing generators that are being modified prior to making the modification per Tariff, Section I.3.9
- For further reference see Compliance Bulletin – MOD-026, MOD-027 & Tariff Provision of Validated Dynamics Models to ISO New England

How is Data Submitted?

All data submissions and updates are via the *Dynamic Data Management System (DDMS)* by the lead market participant including entering new data for an existing resource

Note: MOD Identifier in DDMS must be selected at the time of submission for all MOD-026/MOD-027 DDMS issues. All other submissions should choose “Neither.”



Potential Issues

Issue: Data submittals in DDMS

Implications: Delayed approval

- Steady-state data delivered in an improper format
- Report provided without .raw/.idv files
- Mismatched parameters (i.e., X”d ≠ Steady-State Xsource)

Issue: Incomplete DDMS submittal

Implications: Delayed approval – DDMS issue reverted back to "Correction Required" status

- MOD-026 Report provided without .idv/.raw or .dyr files

CORRECTION REQUIRED	CORRECTION REQUI...
Resolution:	Unresolved
Security Level:	SL - ISO Employees-Customer

Questions

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

What Data Does Resource Need to Provide?

Applicability to Generator Owners per 4.2.1 Generation in the Eastern or Quebec Interconnections with the following characteristics:

- **4.2.1.1** Individual generating unit greater than 100 MVA (gross nameplate rating).
- **4.2.1.2** Individual generating plant consisting of multiple generating units that are directly connected at a common BES bus with total generation greater than 100 MVA (gross aggregate nameplate rating).

R2. Each Generator Owner shall provide, for each applicable unit, a verified turbine/governor and load control or active power/frequency control model, including documentation and data (as specified in Part 2.1; *see next slide*) to its Transmission Planner in accordance with the periodicity specified in MOD-027 Attachment 1.

[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]

What Data Does Resource Need to Provide?, *continued*

2.1. Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units rated less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s) or both. Each verification shall include the following:

2.1.1. Documentation comparing the applicable unit's MW model response to the recorded MW response for either:

- A frequency excursion from a system disturbance that meets MOD-027 Attachment 1 Note 1 with the applicable unit on-line,
- A speed governor reference change with the applicable unit online, or A partial load rejection test,

2 2.1.2. Type of governor and load control or active power control/frequency control equipment,

2.1.3. A description of the turbine (e.g. for hydro turbine - Kaplan, Francis, or Pelton; for steam turbine - boiler type, normal fuel type, and turbine type; for gas turbine - the type and manufacturer; for variable energy plant-type and manufacturer), … *continued on next slide*

What Data Does Resource Need to Provide?, *continued*

2.1.4. Model structure and data for turbine/governor and load control or active power/frequency control, and

2.1.5. Representation of the real power response effects of outer loop controls (such as operator set point controls, and load control but excluding AGC control) that would override the governor response (including blocked or nonfunctioning governors or modes of operation that limit Frequency Response), if applicable.

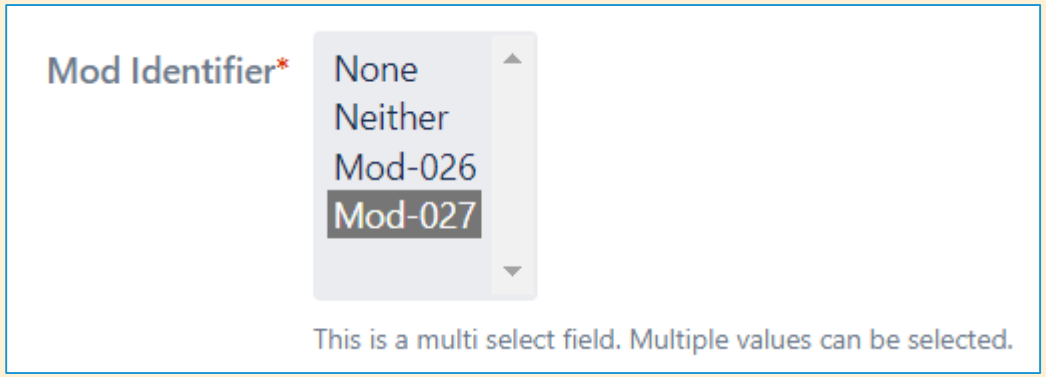
When is the Data Needed?

- See *Effective Date* section in the Standard
- Per Schedule 22, Articles 24 and 25 for new generators or existing generators that are being modified

How is Data Submitted?

All data submissions and updates are via the *Dynamic Data Management System (DDMS)* by the lead market participant including entering new data for an existing resource

Note: MOD Identifier in DDMS must be selected at the time of submission for all MOD-026/MOD-027 DDMS issues. All other submissions should choose “Neither.”



Questions

MOD-032-1 – Data for Power System Modeling and Analysis

John Pearson

Compliance Manager

What Data Does Resource Need to Provide?

- Data as specified by planning coordinator and transmission planners
- Steady-State – for power flow assessment to assure facilities are not overloaded (thermal)
- Dynamics – for stability performance assessments
- Short-Circuit Data – for circuit breaker capability and protection setting coordination
- Data is listed in MOD-032 Attachment 1 with details for New England included in the following slides

What Data Does Resource Need to Provide?

Steady State

MOD-032 Attachment 1 – Data Reporting Requirements	
(Items marked with an asterisk indicate data that vary with system operating state or conditions. Those items may have different data provided for different modeling scenarios)	
3. Generating Units [generator owner (GO), resource planner (RP) (for future planned resources only)]	Qualified capacity/Claimed Capability Audit Tool (CCAT) program listings. Data for future projects by ISO tech lead (FERC) or local transmission owner (non-FERC) based on developer submittals. PMAX (maximum power) for new or modified units based on System Impact Studies. *Note: maintain interconnection power rights even if generator has temporary power limit.*
a. real power capabilities - gross maximum and minimum values	
b. reactive power capabilities - maximum and minimum values at real power capabilities in 3a above	From OP-12 Appendix B
c. station service auxiliary load for normal plant configuration	NX-12D
d. regulated bus and voltage set point (as typically provided by the transmission operator (TOP))	OP-12 Appendix B & D and NX-12 D
e. machine MVA base	Dynamic Data Management System (DDMS) and NX-12 Tech Data
f. generator step-up transformer data (provide same data as that required for transformer under item 6, next slide)	See transformers below (NX-9B)
g. generator type (hydro, wind, fossil, solar, nuclear, etc.)	Collected from System Impact Study (SIS) reports used; assign owners based on type in PSS/e
h. in-service status	ISO outage software (CROW)

What Data Does Resource Need to Provide?

Steady State, continued

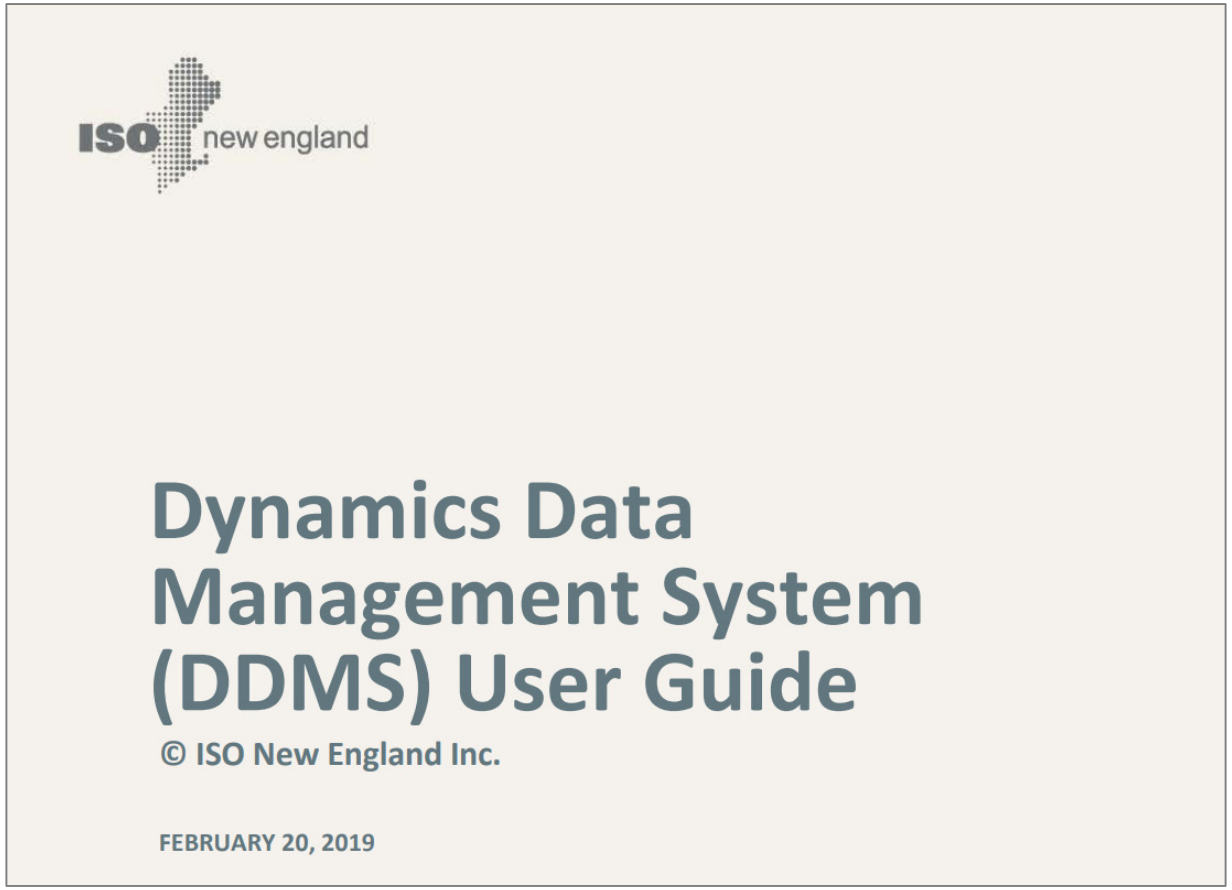
MOD-032 Attachment 1 – Data Reporting Requirements	
(Items marked with an asterisk indicate data that vary with system operating state or conditions. Those items may have different data provided for different modeling scenarios).	
4. AC Transmission Line or Circuit [transmission owner (TO)] a. impedance parameters (positive sequence) b. susceptance (line charging) c. ratings (normal and emergency)* d. in-service status*	All existing AC transmission line characteristic information used in PSS/e is obtained via NX-9A in accordance with ISO Operating Procedure OP-16 and OP-16 Appendix A. ISO outage software (CROW) is for in-service status. New projects provide data per PP5- ISO Planning Procedure PP 5-1 Attachment 3 and also include the line MVA ratings, line impedance (positive sequence), and charging (susceptance).
6. Transformer (voltage and phase-shifting) [transmission owner (TO)] a. nominal voltages of windings b. impedance(s) c. tap ratios (voltage or phase angle) d. minimum and maximum tap position limits e. number of tap positions (for both the OLTC (On Load Tap Changer) and NLTC (No-Load Tap Changer)) f. regulated bus (for voltage regulating transformers) g. ratings (normal and emergency) h. in-service status*	Existing transformer and phase shifter characteristics are obtained with NX-9B and NX-9C respectively in accordance with OP-16, OP-16 Appendix B and Appendix C. ISO outage software (CROW) is for in-service status. New projects provide data per 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.
9. Other information requested by the planning coordinator or transmission planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]	TPL-007 NERC filing stated that GMD (geomagnetic disturbance) data was covered by MOD-032.

What Data Does Resource Need to Provide?

Dynamics

MOD-032 Attachment 1 – Data Reporting Requirements	
(If a user-written model(s) is submitted in place of a generic or library model, it must include the characteristics of the model, including block diagrams, values and names for all model parameters, and a list of all state variables)	
1. Generator [GO, RP (for future planned resources only)]	All dynamic characteristics are collected except demand are collected with the Dynamics Data Management System (DDMS). OP-14 and OP-16 Appendix J procedures provide requirement for DDMS data entry.
2. Excitation System [GO, RP (for future planned resources only)]	
3. Governor [GO, RP (for future planned resources only)]	
4. Power System Stabilizer [GO, RP (for future planned resources only)]	
5. Wind Turbine Data [GO]	
6. Photovoltaic systems [GO]	
7. Static Var Systems and FACTS [GO, TO, LSE]	
10. Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]	

Dynamics Data Resource



Dynamic Data Management System (DDMS) User Manual

Example – .raw Model for 500 MW Machine

Nominal kV at generator terminals

```
123456,'SAMPLE GEN    ',  18.0000,2, 101, 113,  16,0.98596, -46.2963
0 / END OF BUS DATA, BEGIN LOAD DATA
```

Station service load, MW component

Station service load, MVAR component

```
123456,'1 ',1, 101, 119,     15.000,      6.000,      0.000,      0.000,      0.000,      0.000,  16,0
0 / END OF LOAD DATA, BEGIN FIXED SHUNT DATA
0 / END OF FIXED SHUNT DATA, BEGIN GENERATOR DATA
```

Base MVA of generator (used in per-unit calculations)

Stator resistance (per-unit, on generator MVA base)

Sub-transient reactance (per-unit, on generator MVA base; must match X''d in machine's dynamic model)

```
123456,'1 ',    500.000,    123.000,    200.000,-100.000,1.02900,123400,    600.000, 1.00000E-3, 2.20000E-1, 0.00000E+0, 0.00000E+0,1.00000,0,   100.0,    500.000,     60.000,  16,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
123400,123456,      0,'1 ',2,2.1, 0.00000E+0,-2.63500E-2,2,'SAMPLE GSU  ',1, 106,1.0000
 5.00000E-4, 2.00000E-2,    100.00
336.375, 345.000,   30.000,    550.00,    550.00,    550.00, 0,       0,362.2500,327.7500, 1.10000, 0.90000,  33, 0, 0.00000, 0.00000,  0.000
18.000,   18.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
0 / END OF AREA DATA, BEGIN TWO-TERMINAL DC DATA
0 / END OF TWO-TERMINAL DC DATA, BEGIN VSC DC LINE DATA
0 / END OF VSC DC LINE DATA, BEGIN IMPEDANCE CORRECTION DATA
0 / END OF IMPEDANCE CORRECTION DATA, BEGIN MULTI-TERMINAL DC DATA
0 / END OF MULTI-TERMINAL DC DATA, BEGIN MULTI-SECTION LINE DATA
0 / END OF MULTI-SECTION LINE DATA, BEGIN ZONE DATA
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA, BEGIN SWITCHED SHUNT DATA
0 / END OF SWITCHED SHUNT DATA, BEGIN GNE DATA
0 / END OF GNE DATA
Q
```

Generator step-up transformer data (please submit through NX-9; NX-9 is the official location of this data, not DDMS.)

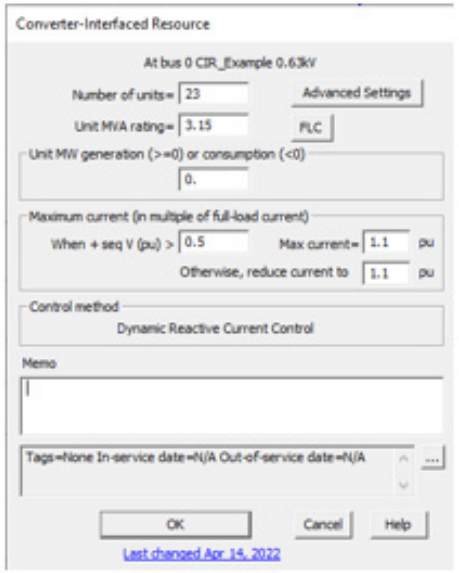
What Data Does Resource Need to Provide?

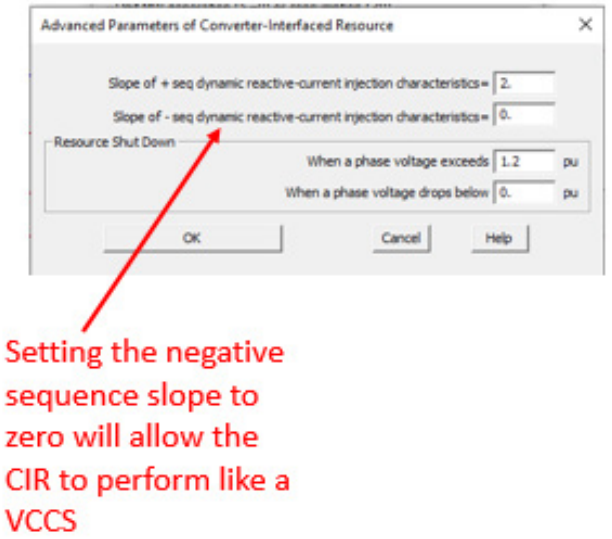
Short Circuit

MOD-032 Attachment 1 – Data Reporting Requirements	
1. Provide for all applicable elements in column “steady-state” [GO, RP, TO]	For generator owners (GOs) using SDMS (Short Circuit Data Management System)
a. Positive sequence data	See OP-16 K / SDMS
b. Negative sequence data	See OP-16 K a/ SDMS
c. Zero sequence data	See OP-16 K / SDMS
3. Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]	

Short Circuit Model Example for Inverter-Based Resources

Appropriate Representation with CIR Models





Provide the following information in the form of a change file (CHF) up to the point of interconnection (POI):

- Maximum current values (in multiple of full-load current) based on the specific inverter
- Resource shut down voltage
- Are devices associated with project capable of injecting negative sequence current under fault conditions?
- In cases where the device can inject negative sequence current, also provide that information including negative sequence slope

Comparisons of Simulations to Actual System Events

Can ISO Really Use These Things and Do They Really Work?

APPMV@iso-ne.com

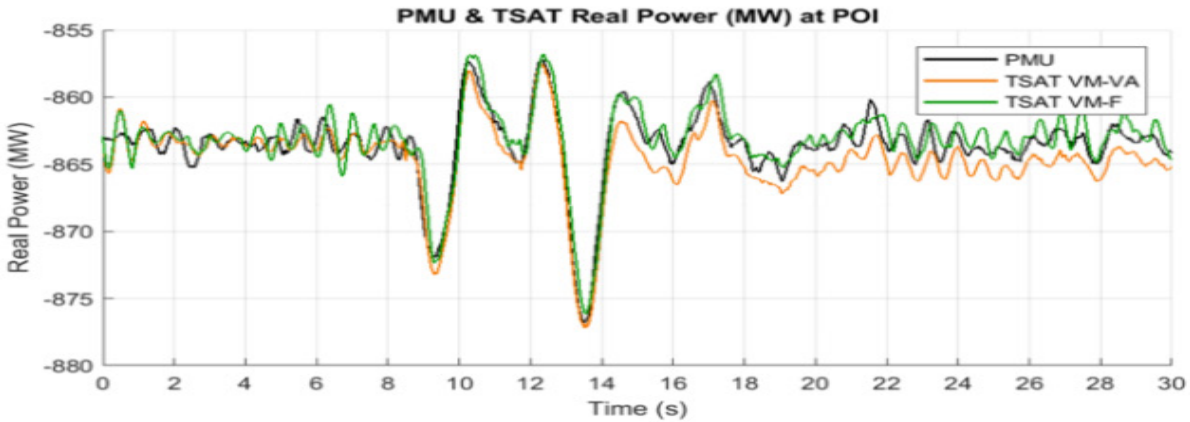
APPMV Results: 2022-

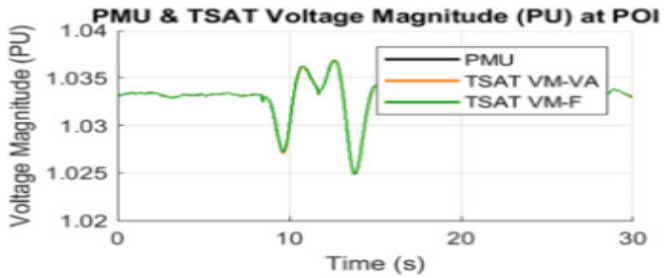
To Marszalkowski, Bradley; Pearson, John;

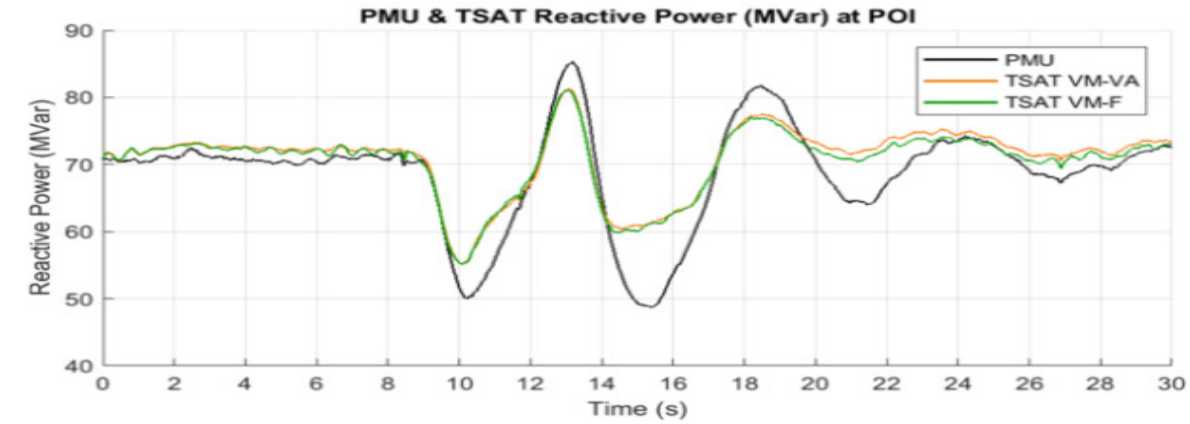
Comparison plots are also attached:

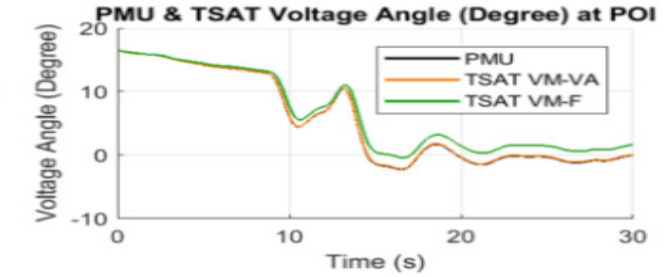
Generator/Plant: **| Model Status: In Use | DDMS:**

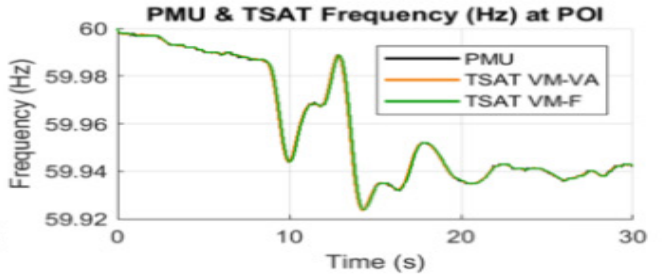
PMU vs. Playback DDMS: (In Use) | Event Time: 2022-





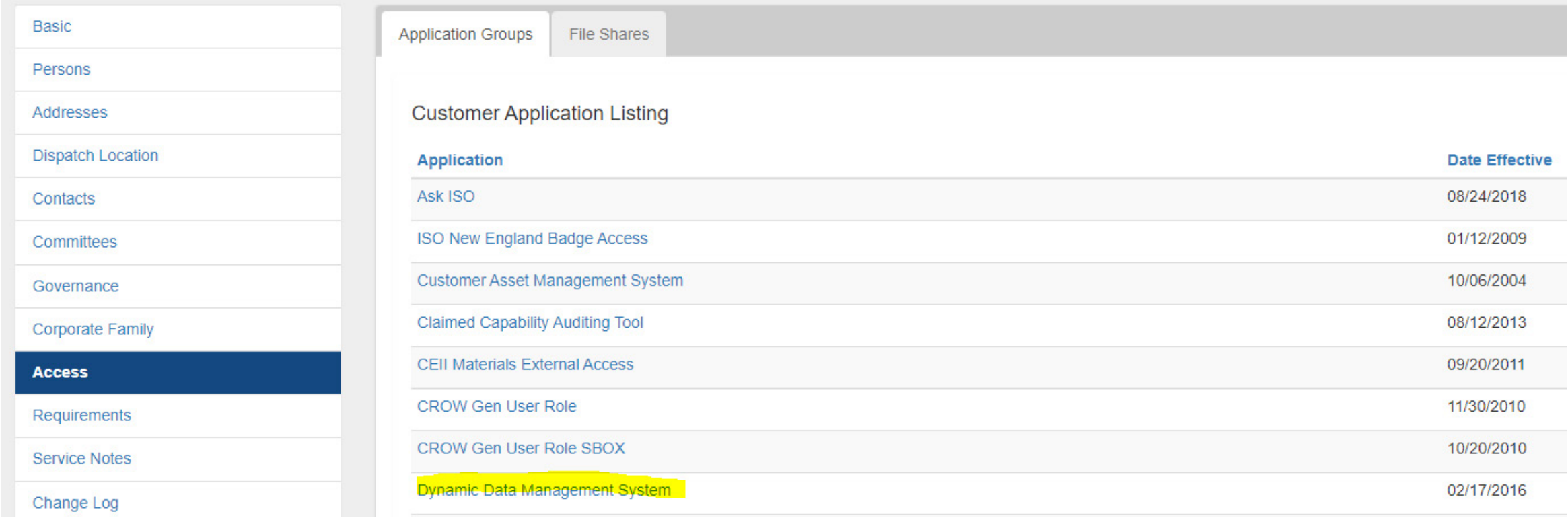






Recertification

- With Dynamic Data Management System (DDMS)
- Lead market participant lists personnel with DDMS access in Customer Asset Management System (CAMS)



When is the Data Needed?

- Annual updates and recertification
- ISO makes requests but does not assume compliance responsibility (e.g., if you don’t get a request and you think that you should then contact ISO Participant Support & Solutions)

How Do the Standards Apply to this Data?

Applicable to Generator Owners – Requirements R2 and R3

MOD-032 R2. Each Balancing Authority, Generator Owner, Load Serving Entity, Resource Planner, Transmission Owner, and Transmission Service Provider shall provide steady-state, dynamics, and short circuit modeling data to its Transmission Planner(s) and Planning Coordinator(s) according to the data requirements and reporting procedures developed by its Planning Coordinator and Transmission Planner in Requirement R1. For data that has not changed since the last submission, a written confirmation that the data has not changed is sufficient.

[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]

How Do the Standards Apply to this Data?, *continued*

Applicable to Generator Owners – Requirements R2 and R3

MOD-032 R3. Upon receipt of written notification from its Planning Coordinator or Transmission Planner regarding technical concerns with the data submitted under Requirement R2, including the technical basis or reason for the technical concerns, each notified Balancing Authority, Generator Owner, Load Serving Entity, Resource Planner, Transmission Owner, or Transmission Service Provider shall respond to the notifying Planning Coordinator or Transmission Planner as follows:

[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]

3.1. Provide either updated data or an explanation with a technical basis for maintaining the current data;

3.2. Provide the response within 90 calendar days of receipt, unless a longer time period is agreed upon by the notifying Planning Coordinator or Transmission Planner.

Potential Issues

Issue: Inaccurate Steady-State Data

Implications:

- Equipment overheating and damage
- Unexpected trips

Issue: Inaccurate Dynamics Data

Implications:

Generator oscillation (Reference POWER SYSTEM STABILIZER TUNING STUDY FOR THE MILLENNIUM POWER PARTNERS GENERATING PLANT IN CHARLTON, MA, March 2006)

Issue: Inaccurate Short Circuit Data

Implications:

- Circuit breaker failure – unable to interrupt fault

Potential Issues

Issue: Non-Compliance and Inaccurate Data

Implications:

- ❖ Don’t meet either MOD-032 requirements or OP-14 (or both)
- ❖ Data may not represent latest field configuration

Questions

Retiring Obsolete and NERC Non-Approved Models

John Pearson

Compliance Manager

Retiring Obsolete Models

- A NERC listing of obsolete models can be found in the Compliance Bulletin – MOD-032 and ISO New England's Model Data Requirements and Reporting Procedures
- Retire obsolete models in accordance with NERC recommendations

Compliance Bulletin Reference

Compliance Bulletins

ISO Compliance Bulletin Refers to NERC Acceptable Model List with Details

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

NERC Acceptable Model Posting

NERC LIST OF ACCEPTABLE MODELS FOR INTERCONNECTION-WIDE MODELING

Use of this model is not recommended. Other models are more suitable.
Use of this model is considered unacceptable. Future model submittals or renewals using this model should be prohibited. Modeling limitations or discrepancies known.
Tracking of industry-accepted models that are not yet been implemented by the software vendors.

Model Type	Model Description	Unacceptable Models	Siemens PSSE	GE PSLF	Comments
Machine Model	Round Rotor Generator Model (IEEE Std 1110 §5.3.2 Model 2.2)		GENROU	genrou	Treatment of saturation. Use GENTPJ. See Modeling Notification.
	Salient Pole Generator Model (IEEE Std 1110 §5.3.1 Model 2.1)	✓	GENSAL	gensal	Treatment of saturation. Use GENTPJ. See Modeling Notification.
	Round Rotor Generator Model (IEEE Std 1110 §5.3.2 Model 2.2)		GENROE	--	Treatment of saturation. Use GENTPJ. See Modeling Notification.
	Salient Pole Generator Model (IEEE Std 1110 §5.3.1 Model 2.1)		GENSAE	--	Treatment of saturation. Use GENTPJ. See Modeling Notification.
	Round Rotor Generator with DC Offset Torque Component		GENDCO	gensdo	
	Cross Compound WECC Type F		--	gencc	
	Generator Type F		--	gentpf	
	Generator Type J		GENTPJ1	gentpj	
	Classical Generator Model (IEEE Std 1110 §5.4.2)	✓	GENCLS	gencls	Does not allow for representation of excitation system and turbine/speed governor models.
	Third Order Generator Model		CGEN1	--	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.
	Transient Level Generator Model	✓	GENTRA	--	Simplified model without subtransient effects; prone to numerical problems.
	Salient Pole Frequency Changer Model		FRECHG	--	
	Synchronous Generator Model combining GENQSC and GENESC		--	genqec	
	"Two-cage" or "One-Cage" Induction Generator		CIMTR1, CIMTR3	genind	
Signal Playback Models	Play-In of Voltage and/or Frequency Signal		PLBVF1	gencls	
	Frequency Playback Model		PLBVF1	gencls	
	Play-In of Generator Field Voltage		--	plefd	
	Delivers Played-In Signal to Dynamic Simulation Models		--	plnow	
	Play-In of Voltage Regulator and Governor Reference Settings		--	plref	
	Play-In Turbine Power		--	pltp	
	Thevenin Source of Defined Voltage Amplitude and Frequency		--	gthev	
	Generic Type 1 WTG Generator Model (Fixed-speed induction generator)		WT1G1	wt1g	
	Generic Type 2 WTG Generator Model (Variable slip induction generator with variable rotor resistance)		WT2G1	wt2g	
	Generic Type 3 WTG Generator/Converter Model - PSSE (Doubly-fed induction generator)	✓	WT3G1	--	2nd Generation Renewable Models replace these; numerical issues in base cases.
	Generic Type 3 WTG Generator/Converter Model - PSLF (Doubly-fed induction generator)	✓	WT3G2	wt3g	2nd Generation Renewable Models replace these; numerical issues in base cases.
	Generic Type 4 WTG Generator/Converter Model - PSSE (Variable speed generator with full converter)	✓	WT4G1	--	2nd Generation Renewable Models replace these; numerical issues in base cases.
	Generic Type 4 WTG Generator/Converter Model - PSLF (Variable speed generator with full converter)	✓	WT4G2	wt4g	2nd Generation Renewable Models replace these; numerical issues in base cases.

Future Changes to Standards and Requirements

John Pearson

Compliance Manager

Future Changes to Standards and Requirements

- FAC-002 material modification being defined as a qualified change
- MOD-026 and MOD-027 proposal to combine into one standard
  - Proposal to modify applicability to include more generation facilities
- ISO reviewing appropriate PMAX (maximum power) with Planning Advisory Committee (PAC)
- Inverter-based resources are becoming much more prevalent on the power system as that occurs; ISO will need more data from smaller resources

Useful Information

John Pearson

Compliance Manager

Interconnection Process Training

Title and Link	Description	Viewing Time
Interconnection Process (recording) & Interconnection Process (presentation)	Explains to prospective companies the requirements to submit an interconnection request for small generating facilities, large generating facilities, and elective transmission upgrades. It will describe the interconnection process timeline once assigned a queue position.	~58 minutes
How to Add a Generator to a Small Generator Interconnection Request in IRTT (video)	Explains how to add a generator to a Small Generator Interconnection Request (SGIR) using the Interconnection Request Tracking Tool (IRTT).	~6.5 minutes
How to Complete a Supplemental Wind and Inverter-based Generating Facility Form in IRTT (video)	Explains how to complete a Supplemental Wind and Inverter-based Generating Facility Form using the Interconnection Request Tracking Tool (IRTT). This called Attachment A for small generators and Attachment A-1 for large generators.	~9.5 minutes
How to Create a New Company in IRTT (video)	Explains how to create a new company in the Interconnection Request Tracking Tool (IRTT) software.	~6 minutes
How to Create a New Interconnection Request or Edit an Existing Draft in IRTT (video)	Explains how to create a new interconnection request or open an existing draft interconnection request in the ISO New England Interconnection Request Tracking Tool (IRTT). The steps apply to any interconnection request (small, large, elective transmission upgrade).	~7 minutes
How to Create New Accounts in IRTT (video)	Explains how to create new user accounts, assign user roles, and allow user access to interconnection requests in the Interconnection Request Tracking Tool (IRTT) software.	~9.5 minutes
How to Submit a Large Generator Interconnection Request in IRTT (video)	Explains how to complete and submit a Large Generator Interconnection Request (LGIR) using the Interconnection Request Tracking Tool (IRTT).	~10.5 minutes
How to Submit a Small Generator Interconnection Request in IRTT (video)	Explains how to complete and submit a Small Generator Interconnection Request (SGIR) using the Interconnection Request Tracking Tool (IRTT).	~17 min

Resource Links

- Distribution-Connected Generation Guidance - ISO New England
- Participate > Applications and Status Changes > Interconnection Process Guide
- Participate > Applications and Status Changes > Interconnection Process Guide > Is the ISO New England Interconnection Process Right for You?
- Interconnection Request Submission Job Aid
- Interconnection Request Tracking Tool (IRTT) User Guide
- Compliance Bulletins
- Dynamic Data Management System (DDMS) User Manual
- OP-24 Generator Protection Modeling Practice & Guidelines

Questions

Contact Participant Support and Solutions

Ask ISO
ISO NEW ENGLAND PARTICIPANT SUPPORT

Submit a request via Ask ISO *(preferred)*
https://askiso.force.com/

Email AskISO@iso-ne.com

Phone

(413) 540-4220 (call center)

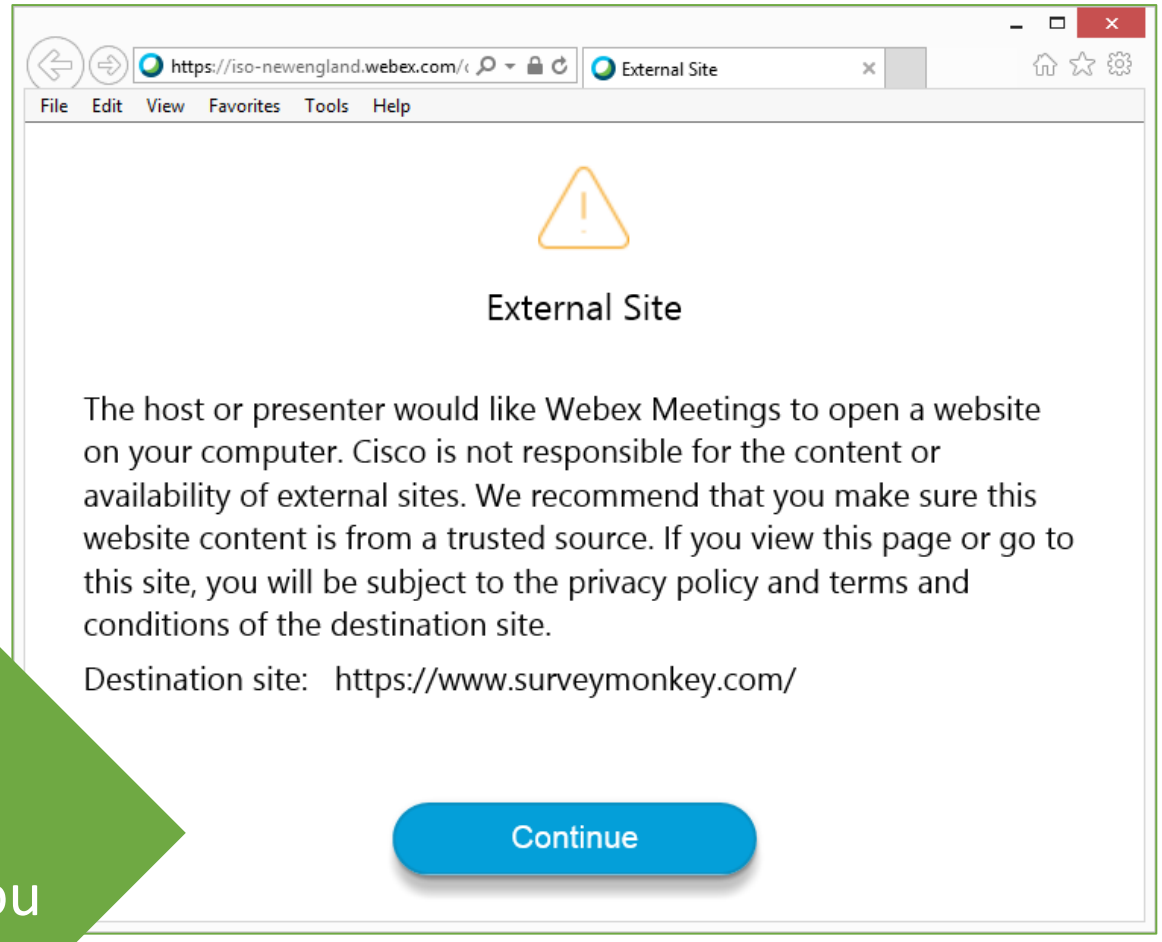
(833) 248-4220

Pager ***(for emergency inquiries outside of business hours)***

(877) 226-4814

Business hours and additional contact details are available from the Participant Support page

Visit the Participant Support page



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We want to hear from you!

When you complete today's evaluation, please take a moment to let us know what topics you'd like to see included for future webinars