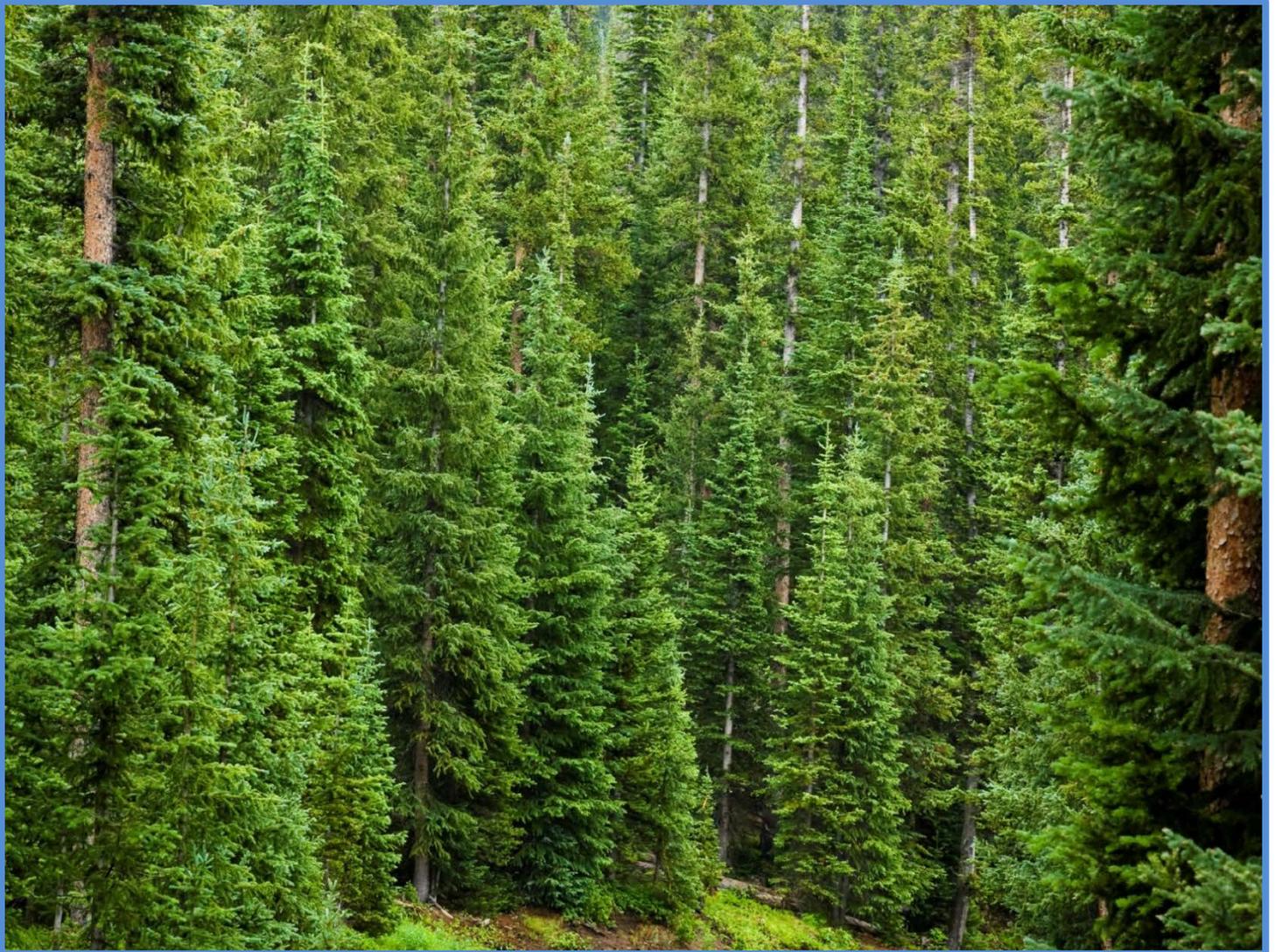


# BPA MOD-032 MODEL DATA REQUIREMENTS & REPORTING PROCEDURES



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# 1 Introduction

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## 1.1 Purpose

The Western Electricity Coordinating Council (WECC) develops a series of powerflow and dynamics simulation Base Case models, which are used by the Bonneville Power Administration (BPA) and its customers for performing planning, operations, and economic studies needed to fulfill various North American Electric Reliability Corporation (NERC) and Tariff compliance obligations.

Pursuant to Requirement 1 of MOD-032<sup>1</sup>, BPA as a registered Planning Coordinator (PC) and its registered Transmission Planners (TP) have jointly established a set of common procedures for submitting data needed for developing the WECC interconnection Seasonal Base Case models.

The purpose of this document is to outline the data reporting procedures needed to support the development of Seasonal Base Case models in a manner compliant with MOD-032, FAC-008, and TPL-007, that realistically simulates steady-state and dynamic behavior of the transmission system for powerflow, dynamics, and Geomagnetically Induced Current (GIC) studies. Data requirements outlined in this document are intended to be consistent with NERC requirements.

The PC is also responsible for submitting data for its Planning Coordinator area to the Electric Reliability Organization (ERO) designee per MOD-032 Requirement R4. This responsibility may be delegated to TPs in BPAs PC area or delegated to Area Coordinators as established by WECC. In the event BPA delegates data submittal responsibilities to an Area Coordinator, that Area Coordinator is to submit the data to WECC without alteration.

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<sup>1</sup> [http://www.nerc.com/\\_layouts/PrintStandard.aspx?standardnumber=MOD-032-1&title=Data for Power System Modeling and Analysis](http://www.nerc.com/_layouts/PrintStandard.aspx?standardnumber=MOD-032-1&title=Data for Power System Modeling and Analysis)



## 1.2 Process Overview

This process document can be found [here](#).

Figure 1-1 provides a high-level overview of the data submission process outlined in MOD-032. Additional details on the data submission processes are outlined in Sections 3 & 4. In addition, data owners are required to submit facility-rating information per FAC-008, GIC data per TPL-007, and generation ride through capabilities per PRC-024.

Data requests will typically come from BPA’s Customer Service Reliability Program (CSRP) team. When sending data or otherwise communicating with BPA, please use CSRP’s team mailbox:

[CSRP@bpa.gov](mailto:CSRP@bpa.gov).

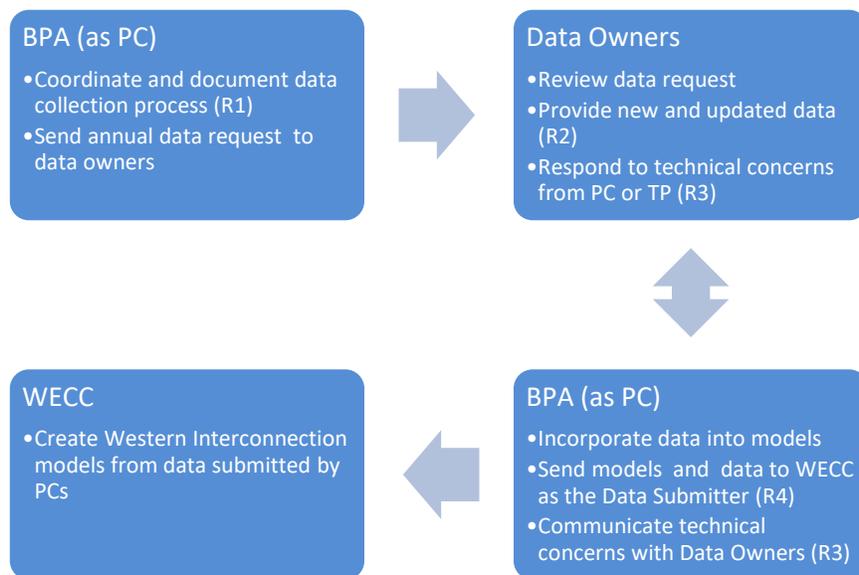


Figure 1-1: Generic MOD-032 Modeling Process Overview

## 1.3 Responsible Entities

Pursuant to requirements in MOD-032, FAC-008, TPL-007, PRC-024, and BPA’s LGIA, SGIA, NTMOA, BASA, TOP, and TP customer agreements, data owners are responsible for providing the data necessary to model their assets per criteria outlined in this document. Data owners and their respective data submission responsibilities are stated ahead:

- Generator Owners (GO) are responsible for submitting modeling data for their existing and approved future generating facilities and associated relays (see Section 3.2 regarding MOD-025/026/027, and PRC-024 data submittals).
- Transmission Owners (TO) are responsible for submitting data for modeling their existing and approved future transmission facilities.
- Entities that are only registered as a Balancing Authority (BA), Transmission Service Provider (TSP), or Resource Planner (RP) will be notified if any data is required.



### 1.4 Typical Scenarios

For each annual WECC planning cycle BPA will develop a set of powerflow cases as shown in Table 1-1. The typical scenarios developed could change from year to year based on BPA and member needs. At a minimum, scenarios needed for Transmission Planning and Operations, and MOD-032 compliance will be included. Specific scenarios will be posted on the [SRS website](#) annually for the upcoming year. General descriptions of the typical scenarios are provided below per the WECC Base Case Compilation Schedule:

- Winter Peak Load (HW) – the winter peak demand expected to be served.
- Winter Light Load (LW) – the winter demand expected to be served.
- Spring Peak Load (HSP) – the spring demand expected to be served.
- Summer Peak Load (HS) – the summer peak demand expected to be served.
- Summer Light Load (LS) – the summer demand expected to be served.

Table 1-1: Scenarios to be developed					
Model Year	Heavy Winter	Light Winter	Heavy Spring	Heavy Summer	Light Summer
1	X	X	X	X	X
5	X			X	
2	X			X	
10	X			X	

Example: For the 2019 data request, the years modeled would be 2020, 2025, and 2030 respectively.



## 1.5 Schedule

All Responsible Entities (GO, TO) are required to submit their data to their PC as requested.

Data submissions to WECC will be compliant with MOD-032 R4, and will follow the data request schedule as outlined by the WECC SRS documentation. The WECC data request schedule can be found on the [SRS website](#) under “Base Case Compilation Schedules.” In BPA’s PC area, all registered TP organizations are required to submit data to WECC (via the appropriate Area Coordinator) or to their Planning Coordinator via this schedule.

MOD-032, FAC-008, and TPL-007 data requests will be sent out annually (typically in January) to the data owners with an expected data submission of 30 days after initial request.

Dynamic data including relay models and models for generators will have an expected data submission of 60 days after initial request per PRC-024 requirements.

MOD-032 Attachment 1 lists the minimum data to be requested per the standard and is summarized by responsible entities below. Section 5 includes Attachment 1 for reference. BPA as a PC will confirm an entity’s participation in fulfilling their modeling obligation/compliance with MOD-032 R2. Sections below also summarize additional data requested in BPA’s PC area. A data request spreadsheet will be sent annually to customers and outlines data needed that year.



### 1.6 Generator Owner

In coordination with their interconnected TO, the GO shall provide the necessary data to model their generating facilities (see Section 3.2 for relation to MOD-026/027 data submittals). At a minimum, the GO shall provide the data listed in Section 5 below. Table 1-2 provides a summary of the data required to be submitted by the GO. As PC, BPA may specify supplemental information to be provided by applicable GOs in addition to Table 1-2, and Section 5.

Data for existing and planned generators with executed interconnection agreements should be submitted. Actual dispatch will be determined based on study needs.

**Table 1-2: Data to be submitted by the GO**

Steady-State	Dynamics	Short Circuit
Generator parameters PQ Capability Curves	Generator	For applicable Steady-State Items, provide:
Generator step-up (GSU) transformer data	Excitation System	Positive Sequence Data
Seasonal output capabilities	Turbine-Governor	Negative Sequence Data
Station Service Load under normal conditions	Power System Stabilizer	Zero Sequence Data
Reactive Power Compensation <sup>2</sup>	Protection Relays outlined in section 3.1.5	
In-service status		
Wind/PV Collector System		

<sup>2</sup> Additional reactive power support equipment (such as a switched shunt) used to maintain an acceptable power factor at the Point of Interconnection



### 1.7 Transmission Owner

The TO is responsible for providing the necessary data to model the items listed in Table 1-3, as well as Section 5 below. As PC, BPA may specify supplemental information to be provided by applicable TOs in addition to Table 1-3, and Section 5.

Table 1-3: Data to be submitted by the TO		
Steady-State	Dynamics	Short Circuit
System Topology:	Static VAR Systems	For applicable Steady-State Items, provide:
Buses	HVDC Facilities	Positive Sequence Data
AC Transmission Lines	FACTS Devices	Negative Sequence Data
HVDC transmission Facilities	Protection Relays	Zero Sequence Data
Transformers		Mutual Line Impedance Data
Limiting switchgear		
Reactive Power Compensation		
Static VAR Systems (SVS)		

### 1.8 FAC-008 Facility Ratings

FAC-008 is on an as needed basis whereas MOD-032 is an annual process. Therefore, FAC-008 and MOD-032 may be requested simultaneously as needed to insure consistency between the submittals. It is required to submit the ratings for the two most limiting elements in each facility including normal and emergency ratings in both seasonal and ambient formats. If it is more convenient to submit ratings using your own report please do so, but it is required that the ratings in your report align with each field in BPA’s request. Ratings in the MOD-032 submission must match the limiting element for that facility listed in the FAC-008 submission. Line, breakers, disconnects, etc. ratings must be in Amps, and transformer ratings in MVA.



## 1.9 Data Submission Process and Format

TO and GO registered entities are responsible for submitting data to BPA as the PC on an annual basis. TO and GO entities may agree in writing to have another entity collect and submit their data on their behalf to BPA as the PC. If this arrangement is used, the equipment owning entity (GO, TO) is required to notify CSRP in writing of the agreement at [CSRP@bpa.gov](mailto:CSRP@bpa.gov).

All data requests will require data for the next 10 years. All data requested in sections 2, 3 and 4 shall be assessed and submitted for the 10 years following the year of the request.

Dynamics modeling data needs to be submitted in the form of a GE Positive Sequence Load Flow Software (PSLF) \*.dyd file. Models are developed using the PSLF program. Data submitted should be compatible with the PSLF version currently specified by BPA.

Standard WECC approved library models shall be used to represent all active elements (generators, static VAR compensators, etc.). Approved Dynamics model library can be found in the WECC Approved Dynamic Model Library on the [MVS website](#).

BPA will provide a spreadsheet requesting data by equipment type. By submitting data, or indicating that no data has changed, the responsible entity is agreeing that all data has been reviewed, and verified, thus complying with this data request.

Figure 1-1 is a generic representation of data reporting within the BPA PC area. As represented by the dotted line in the chart below, some TPs may elect to submit their data directly to their Area Coordinator who will in turn submit data to WECC. TPs will also continue to share data with BPA on an annual basis. BPA will compile data from applicable TOs and GOs and submit data to the Area Coordinator who will in turn submit it to WECC for compilation.



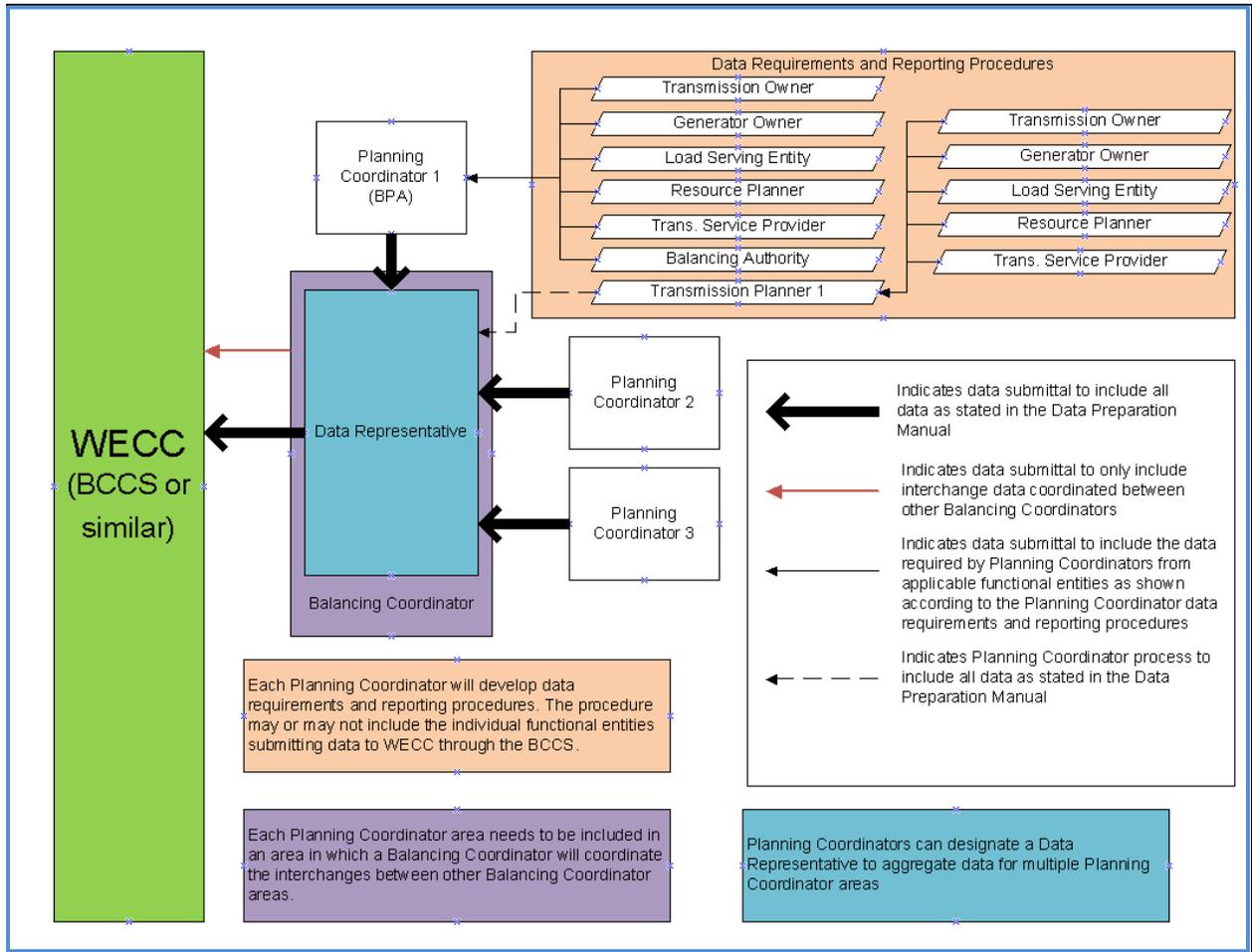


Figure 1-2: MOD-032 Process Overview



## 2 Steady State Model Development

### 2.1 Level of Detail

On at least an annual basis, each data owner is required to submit the following model data to BPA for incorporation into the WECC Seasonal Powerflow Models using BPA's database:

- Transmission projects that are Planned and Funded or In Service with the associated in service date and retirement of facilities with the expected de-energization dates.
- Generators with executed Generator Interconnection Agreements (GIA)<sup>3</sup> and associated network upgrades. At a minimum, all generators with a nameplate 10 MVA or larger or a facility with an aggregated nameplate 20 MVA or larger must be modeled in detail and are to be submitted by applicable GOs.
- Bus/load/generation and devices profiles, which include:
  - Load type.
  - Corresponding generation limits and level (Pmin, Pmax, Qmin, Qmax, and Pgen); Generation limits to be submitted by GO, Generation level to be submitted by TOs.
  - Settings on regulating equipment such as transformers, switched shunts, and HVDC data; to be submitted by data owner.
  - Data needed to support GMD assessments including, but not limited to substation grounding resistance, line DC impedance, and transformer connection type.
- Updates and/or corrections to approved future generation and transmission projects.
- Any corrections that need to be made to existing system data modeling. Data owners shall provide facility retirement updates.
- Any other information requested by BPA, as the PC, deemed necessary for modeling.

GOs will coordinate with their interconnected TO in order to insure that their data is consistent with the TO submitted topology. GOs may submit their data directly to BPA or work with their interconnected TO to submit the data to BPA on their behalf. If GO's have arranged with their interconnected TO to submit data on their behalf, this must be communicated in writing to BPA at [CSRP@bpa.gov](mailto:CSRP@bpa.gov).

If the data has not changed since the last submission, data owners will have the option of indicating that the data has not changed in the data request spreadsheet provided.

The data submitted must be sufficient to perform reliability and economic studies on the bulk electric system (BES) as defined by NERC<sup>4</sup>. To that extent, relevant data associated with sub-BES facilities may also need to be provided.

<sup>3</sup> <http://www.bpa.gov/transmission/Doing%20Business/Tariff/Pages/default.aspx>

<sup>4</sup> [http://www.nerc.com/pa/RAPA/BES%20DL/bes\\_phase2\\_reference\\_document\\_20140325\\_final\\_clean.pdf](http://www.nerc.com/pa/RAPA/BES%20DL/bes_phase2_reference_document_20140325_final_clean.pdf)



**2.1.1 Definitions**

- Data Types

- **Steady-State:** Required to represent the normal operation of the power system to include GIC data necessary to support the analysis of the power system during a Geomagnetic Disturbance (GMD) event.
- **Dynamics:** Supports the analysis of power system stability.
- **Short Circuit:** Positive, Negative, and Zero sequence data as well as any mutual line impedance data.

- Project Statuses

- **Conceptual:** Conceptual or vision plans.
- **Proposed:** Projects that require additional review and are subject to change.
- **Planned / Funded:** Projects that have completed the planning process and there is intent to permit and construct the project.
- **In Service:** In Service.
- **Corrections:** Changes, error or actual, to be submitted for correction in all future Base Cases.
- **Retirement:** Equipment that will be permanently removed from service.

**2.1.2 Modeling Criteria**

Inclusion of projects in the Base Case models is shown in Table 2-1.

Table 2-1: Project Inclusion Criteria		
Type & Status	Conceptual/Proposed	Planned/Funded/In Service/Corrections
Steady-State	NOT MODELED	MODELED
Dynamics		
Short Circuit		
GIC		
FAC-oo8		

**NOTE** – Entities should use their own inclusion criteria methodology if available, the above is what BPA’s methodology currently states.



### 2.1.3 Ratings

Ratings between data submissions shall remain consistent. MOD-032 assumes most limiting element when requesting rating data and should reflect the ratings submitted with FAC-008.

- Ratings shall be provided in MVA.
- BPA's Methodology facilities:
  - 1/A = Summer Thermal (Continuous)
  - 2/B = Summer Emergency (30-minutes)
  - 3/C = Winter Thermal (Continuous)
  - 4/D = Winter Emergency (30-minutes)
  - 5/E = Fall Thermal (Continuous)
  - 6/F = Fall Emergency (30-minutes)
  - 7/G = Spring Thermal (Continuous)
  - 8/H = Spring Emergency (30-minutes)

**NOTE** – Entities should use their own facility rating methodology (if available) to correlate ambient temperatures to Seasons for each equipment type.

- FAC-008
  - Normal and emergency ratings shall be submitted in AMPS for lines and MVA for transformers including
    - The range of temperatures from -15°C to 40°C
    - Each season with the ambient temperature, that is consistent per the entities facility rating methodology and shall be reflected within MOD-032's ratings.
  - Emergency rating duration shall be submitted
  - Each entity shall submit their latest facility rating methodology.

### 2.1.4 Modeling of Wind Farms and PV Power Plants

- Wind and photovoltaic projects shall be represented through an equivalent generator(s), equivalent low-voltage to intermediate-voltage transformer, equivalent collector system, and substation transformer between the collector system and the transmission bus.
- Also: [WECC Wind Power Plant Powerflow Modeling Guide](#) and [PV Plant Powerflow Modeling Guide](#)



# 3 Dynamics Model Development

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## 3.1 Level of Detail

Dynamics simulations analyze the transient response of the power system following a disturbance. These simulations are in a timeframe of 0 to 20 seconds with a typical time step of  $\frac{1}{4}$  cycles. As such, it is necessary to develop a model that sufficiently represents the automatic response of all active elements to a disturbance on the power system.

On an annual basis, each data owner is required to submit the following model data:

- Dynamic models to represent approved future active elements such as but not limited to generators, Flexible Alternating Current Transmission System (FACTS) devices, or fast switching shunts.
- Updates to existing dynamic models.
- If the data has not changed since the last submission, indicate that the data has not changed in the attached data request spreadsheet.
- Data will not be requested from GO's whose models for their generator type are still under development within WECC.

Dynamics data submitted annually for MOD-032 is in addition to requirements in the BPA "GO Model Data Submission Process" document.

A separate request will be sent every 10 years per the BPA "GO Model Data Submission Process" document that requires testing and new data be submitted. All applicable entities must still adhere to all requirements and data collection procedures outlined by BPA's "GO Model Data Submission Process" document. BPA's "GO Model Data Submission Process" document is available on request by emailing [CSRP@bpa.gov](mailto:CSRP@bpa.gov).

GOs are expected to submit directly to BPA unless they have arranged with the interconnecting TO to submit data on their behalf. If this arrangement is used, it must be communicated in writing to BPA at [CSRP@bpa.gov](mailto:CSRP@bpa.gov).



### 3.1.1 Generators

At a minimum, all generators with a nameplate 10 MVA or larger or a facility with an aggregated nameplate 20 MVA or larger must be modeled in detail. A detailed model of a generator must include:

- Generator Model
- Excitation System Model
  - May be omitted if unit is operated under manual excitation control
- Turbine-Governor Model
  - May be omitted if unit doesn't regulate frequency
- Power System Stabilizer Model
  - May be omitted if device is not installed or not active
- Reactive Line Drop Compensation Model
  - May be omitted if device is not installed or not active
- Over Excitation Limiter
  - May be omitted if device is not installed or not active
- Under Voltage Ride Through Relays
  - May be omitted if device is not installed or not active
- Under Frequency Ride Through Relays
  - May be omitted if device is not installed or not active

Generators with detailed modeling must use a dynamic model from the [WECC Approved Dynamic Model Library](#) found on the [MVS website](#). If a suitable model is not in the approved library, the data submitter may request a model be added to the standard list by providing BPA with a technical justification for doing so. BPA will present the technical justification to the MVS for approval and inform the data submitter if the model has been accepted or not.

Several legacy models have been omitted from the [WECC Approved Dynamic Model Library](#) since they can be directly converted to newer dynamic models with minimal effort and without changes to simulation results. In instances where detailed dynamic modeling is unavailable, generic data may be used. Generators without detailed modeling will be netted.

### 3.1.2 Static VAR Compensators & Synchronous Condensers

SVC and synchronous condensers are reactive power devices that can vary the amount of reactive power supplied or absorbed within the simulated timeframe (0-20 seconds). These devices must be modeled in sufficient detail in order to simulate its expected behavior.

### 3.1.3 HVDC

All HVDC transmission facilities must be represented with a sufficiently detailed model to simulate its expected behavior. For future HVDC transmission, facilities where exact design specifications are not known generic HVDC models should be used.



### 3.1.4 Load

The dynamic behavior of load must be modeled in sufficient detail to meet NERC TPL and TOP compliance obligations. Providing a specific dynamic load characteristic model or the load composition is acceptable.

The composition of the load shall be defined as referenced in the [MVS Load Long ID Instructions](#). Based on the composition of the load, an appropriate dynamic representation will be developed using models available in the PSLF dynamics library, likely a composite load model (CMPLDW).

Dynamics models for UVLS and UFLS are required when installed. Approved models can be found in the [WECC Approved Dynamic Model Library](#) found on the [MVS website](#).

### 3.1.5 Additional Protection Relays

Generic protection relays are applied during the simulation that scan for bus voltages, out-of-step conditions, and against generic protection zones for transmission lines. These generic protection relays only monitor system conditions.

Equipment specific detailed protection relays may also be submitted at the discretion of the data owner; however, detailed protection relay models need to be submitted when:

- Voltage and frequency ride through capabilities of any generation facility with this capability are present.
- 3-phase over current relays are required when it is the primary form of protection.
- Other relay models are required by the [WECC Approved Dynamic Model Implementation Schedule](#)

## 3.2 Dynamics Data Checks

Once the dynamic models are created, a set of data checks to flag potential issues with the data submitted will be performed. In addition to the data checks, a sample set of disturbances are run to assist in model review. Dynamics data checks are documented in the BPA [“GO Model Data Submission Process”](#) document for MOD-026 and MOD-027.



# 4 Short-Circuit Model Development

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## 4.1 Level of Detail

Short-circuit data is required for all generators, shunts, transformers, and lines that are required to be submitted in sections 2 or 3.

MOD-032 requires that short-circuit data should be shared openly between applicable NERC functional entities. Applicable entities are responsible to submit all data consistent with the short-circuit requirements in Attachment 1.

The short circuit data collection process will be handled in the Annual Data Exchange for the Transmission Planner Coordinated Functional Registration agreement participants. All other applicable entities will continue to follow the process identified below.

Applicable entities shall submit this data to BPA's SPC Technical Services Group (TEZP) annually starting in July and no later than the third week of November. Any modeling data submitted after this time will not be included in the following calendar year model.

The data should be provided in whatever native format the applicable entity uses to perform their short-circuit studies (ASPEN or CAPE). If a short-circuit software model is not available then work with TEZP to determine an acceptable format.

This data shared with WECC as requested, as approved by applicable entities, and not part of regular (MOD-032 R4) data submittals. WECC does not currently create interconnection-wide cases for the use of short-circuit analysis.



# 5 MOD-032 - Attachment 1

The table, below, indicates the information that is required to effectively model the interconnected transmission system for the Operations Planning Horizon and Planning Horizons including FAC-008 and TPL-007 data. Data must be shareable on an interconnection wide basis to support use in the Interconnection-wide cases. A Planning Coordinator may specify additional information that includes specific information required for each item in the table below. Each functional entity responsible for reporting the respective data in the table is identified by brackets “[functional entity]” adjacent to and following each data item. The data reported shall be as identified by the bus number, name, and/or identifier that is assigned in conjunction with the PC, TO, or TP.

<p><b>steady-state</b> <i>(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)</i></p>	<p><b>dynamics</b> <i>(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)</i></p>	<p><b>short circuit</b></p>
<ol style="list-style-type: none"> <li>1. Each bus [TO]                             <ol style="list-style-type: none"> <li>a. nominal voltage</li> <li>b. area, zone and owner</li> </ol> </li> <li>2. Aggregate Demand<sup>5</sup> [LSE]                             <ol style="list-style-type: none"> <li>a. real and reactive power*</li> <li>b. in-service status*</li> </ol> </li> </ol>	<ol style="list-style-type: none"> <li>1. Generator [GO, RP (for future planned resources only)]</li> <li>2. Excitation System [GO, RP(for future planned resources only)]</li> <li>3. Governor [GO, RP(for future planned resources only)]</li> <li>4. Power System Stabilizer [GO, RP(for future planned resources only)]</li> <li>5. Demand [LSE]</li> <li>6. Wind Turbine Data [GO]</li> <li>7. Photovoltaic systems [GO]</li> <li>8. Static Var Systems and FACTS [GO, TO, LSE]</li> </ol>	<ol style="list-style-type: none"> <li>1. Provide for all applicable elements in column “steady-state” [GO, RP, TO]                             <ol style="list-style-type: none"> <li>a. Positive Sequence Data</li> <li>b. Negative Sequence Data</li> <li>c. Zero Sequence Data</li> </ol> </li> <li>2. Mutual Line Impedance Data [TO]</li> <li>3. Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]</li> </ol>

<sup>5</sup> For purposes of this item, aggregate Demand is the Demand aggregated at each bus under item 1 that is identified by a Transmission Owner as a load serving bus. An LSE is responsible for providing this information, generally through coordination with the Transmission Owner.



<p>3. Generating Units<sup>6</sup> [GO, RP (for future planned resources only)]</p> <ul style="list-style-type: none"> <li>a. real power capabilities - gross maximum and minimum values</li> <li>b. reactive power capabilities - maximum and minimum values at real power capabilities in 3a above</li> <li>c. station service auxiliary load for normal plant configuration (provide data in the same manner as that required for aggregate Demand under item 2, above).</li> <li>d. regulated bus* and voltage set point* (as typically provided by the TOP)</li> <li>e. machine MVA base</li> <li>f. generator step up transformer data (provide same data as that required for transformer under item 6, below)</li> <li>g. generator type (hydro, wind, fossil, solar, nuclear, etc.)</li> <li>h. in-service status*</li> </ul> <p>4. AC Transmission Line or Circuit [TO]</p> <ul style="list-style-type: none"> <li>a. impedance parameters (positive sequence)</li> <li>b. susceptance (line charging)</li> <li>c. ratings (normal and emergency)* - per line and per facility</li> <li>d. in-service status*</li> </ul> <p style="padding-left: 40px;">&gt;200 kV - DC resistance</p> <p>5. DC Transmission systems [TO]</p> <p>6. Transformer (voltage and phase-shifting) [TO]</p> <ul style="list-style-type: none"> <li>a. nominal voltages of windings</li> <li>b. impedance(s)</li> </ul>	<p>9. DC system models [TO]</p> <p style="text-align: center;">Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]</p>	
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<sup>6</sup> Including synchronous condensers and pumped storage.



<ul style="list-style-type: none"> <li>c. tap ratios (voltage or phase angle)*</li> <li>7. DC Transmission systems [TO]</li> <li>8. Transformer (voltage and phase-shifting) [TO] <ul style="list-style-type: none"> <li>a. nominal voltages of windings</li> <li>b. impedance(s)</li> <li>c. tap ratios (voltage or phase angle)*</li> <li>d. minimum and maximum tap position limits</li> <li>e. number of tap positions (for both the ULTC and NLTC)</li> <li>f. regulated bus (for voltage regulating transformers)*</li> <li>g. ratings (normal and emergency)* - per line and per facility</li> <li>h. in-service status*</li> <li>i. &gt;200 kV – Core Type</li> <li>j. &gt;200 kV – AutoTransformer</li> <li>k. &gt;200 kV – Winding connection type</li> <li>l. &gt;200 kV – DC resistance</li> <li>m. &gt;200 kV – Blocking devices</li> </ul> </li> <li>9. Reactive compensation (shunt capacitors and reactors) [TO] <ul style="list-style-type: none"> <li>a. admittances (MVars) of each capacitor and reactor</li> <li>b. regulated voltage band limits* (if mode of operation not fixed)</li> <li>c. mode of operation (fixed, discrete, continuous, etc.)</li> <li>d. regulated bus* (if mode of operation not fixed)</li> <li>e. in-service status*</li> <li>f. &gt;200 kV – Winding connection type</li> </ul> </li> <li>10. &gt;200 kV – Shunt DC resistance Static Var Systems [TO] <ul style="list-style-type: none"> <li>a. reactive limits</li> <li>b. voltage set point*</li> <li>c. fixed/switched shunt, if applicable</li> <li>d. in-service status*</li> </ul> </li> </ul>		
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Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]

- ii. Static Var Systems [TO]
  - a. reactive limits
  - b. voltage set point\*
  - c. fixed/switched shunt, if applicable
  - d. in-service status\*

Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]



## 6 Version Control Block:

Version	Date	By	Summary of Changes
1.0	6/30/2015	Ron Sporseen/TPCR	Initial Posting
1.1	1/25/2016	Ron Sporseen/TPCR	Update to section 1.3, responsible entities
1.2	4/15/2016	James Randall/TPMG	Various edits to sections 1.4, 1.5 & errata
1.3	4/19/2017	Various/TPMG & TPCR	Remove LSE and other various edits
1.4	11/9/2018	Various/TPMG	Added TPL-007 and FAC-008 data reporting requirements.
1.5	11/26/2019	James Randall/TPMG Lukas Boler/TPMG Tom Daufel/TPCR	Edited for consistency and included rating criteria between FAC-008 and MOD-032. Added PRC-024 language.
1.6	10/01/2020	Various/TPMG	Updated 1.8 FAC-008 due to change in internal process for data collection. Included other minor errata and language changes for consistency.

