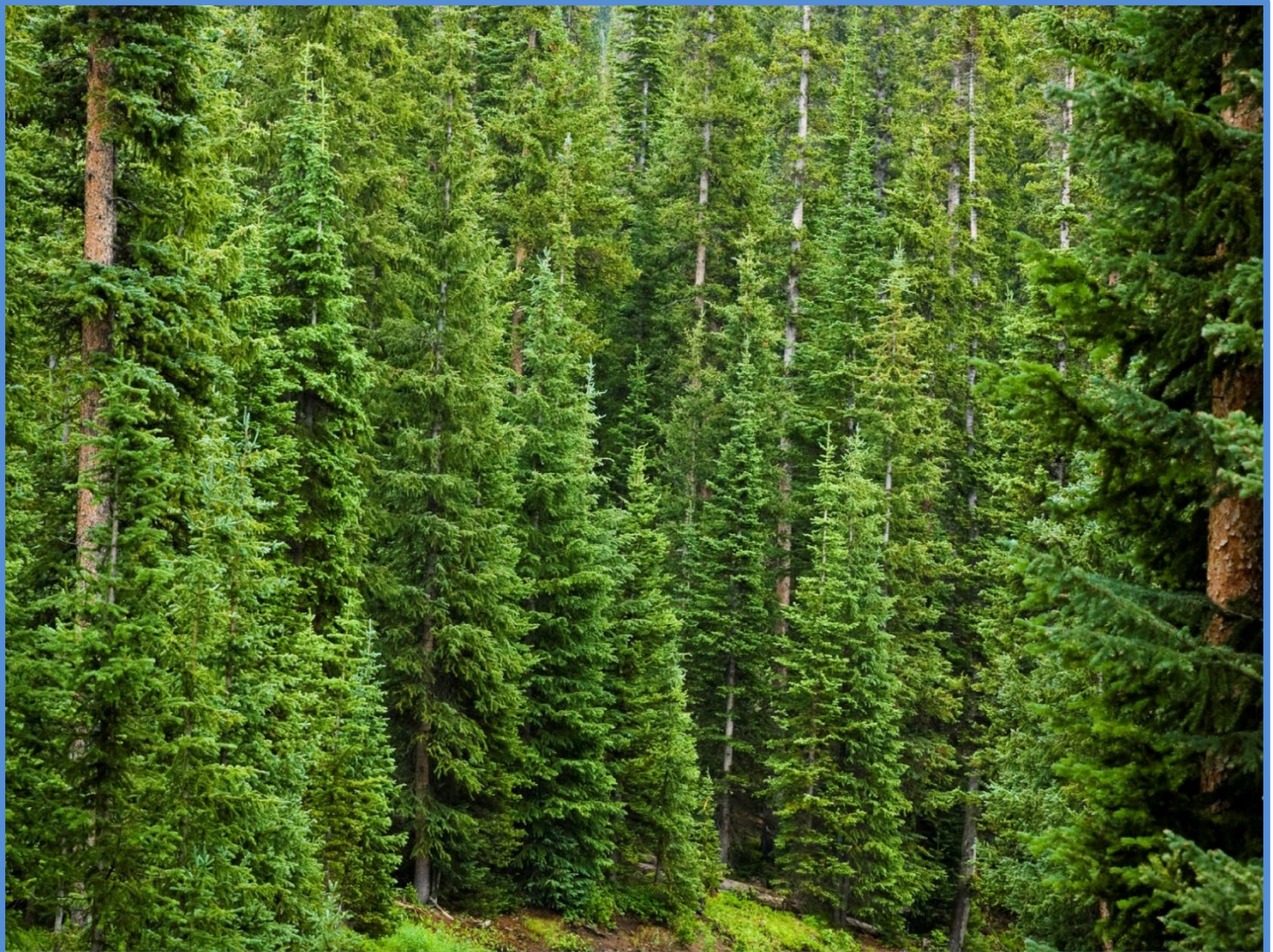


# BPA MOD-032 MODEL DATA REQUIREMENTS & REPORTING PROCEDURES

VERSION 1.7 UPDATED 11/09/21



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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 PC area to the Electric Reliability Organization (ERO) or its designee per MOD-032 Requirement R4. This responsibility may be delegated to Area Coordinators as established by WECC. In the event BPA delegates data submittal responsibilities to Area Coordinators, those Area Coordinators are to submit the data to WECC without alteration.

BPA's Data Maintainer (DM) area is established by all data within BPA's PC area excluding such data from qualifying entities who have elected to not submit data to BPA per below.

Qualifying entities within BPA's PC area, excluding those, which have a TOP agreement with BPA, may elect to submit their data directly to an Area Coordinator instead of to BPA as their PC. A qualifying entity is one that either has the ability to submit data directly to an Area Coordinator or submits to another TP or PC that can submit data to an Area Coordinator. In the event such entities choose to not submit data to BPA, and notify BPA in writing, then BPA will not be responsible for submitting their data to the associated Area Coordinators.

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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 & 3. In addition, when asked, data owners are required to submit facility-rating information per FAC-008, GIC data per TPL-007, dynamic testing schedule supporting MOD-026 and MOD-027, 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).

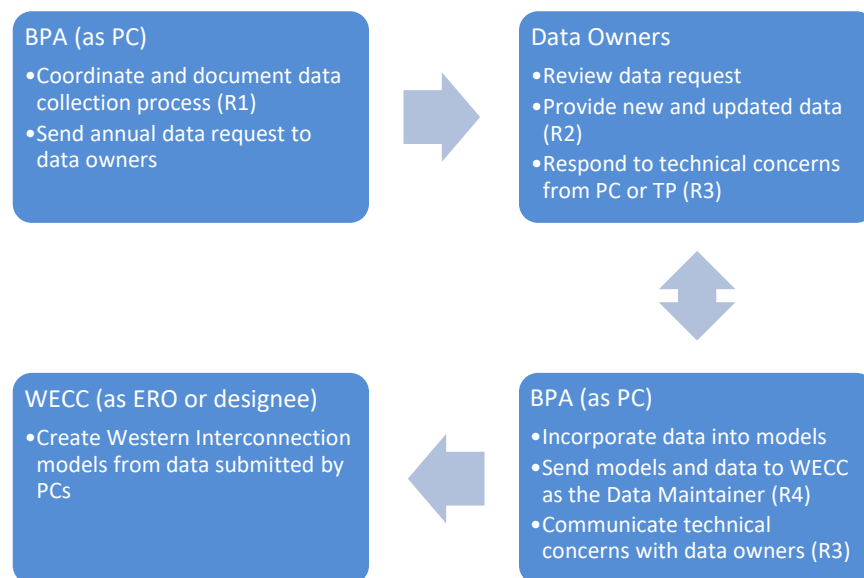


Figure 1-1: Generic MOD-032 Modeling Process Overview

## 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 below:

- 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.



- Entities that are not NERC registered will be notified if any data is required to model its system for reliability purposes.

### 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				
Description	Model Year	Heavy Winter	Heavy Summer	Light Spring
Near Term	1-2	X	X	X
Mid Term	5	X	X	
Long Term	9-10	X	X	

Example: Data Requests are sent in 2021. These data requests would be received in 2022, planning studies performed in 2022, and labeled as the 2023 System Assessment. Case scenarios would thus include a 2024-2025, 2028, and 2032-2033 case respectively.



## 1.5 Schedule

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 Entities are required to submit data to WECC (via the appropriate Area Coordinator) or to their Planning Coordinator via this schedule.

For data within BPA’s DM area, MOD-032 and TPL-007 data requests will be sent out as required per the standards to the responsible entities with an expected data submission of 30 days after initial request, unless otherwise stated. FAC-008 data requests will be sent out as needed.

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. Sections below also summarize additional data requested in BPA’s PC area.



### 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 facility ratings data will be requested on an as-needed basis whereas MOD-032 is an annual process. Therefore, FAC-008 and MOD-032 may be requested simultaneously to ensure consistency between the submittals. Responsible entities may submit ratings using its own report provided the data align with each field in BPA’s request. Seasonal ratings in the MOD-032 submission must correspond to and support the limiting element for related facilities listed in the FAC-008 submission. Transformer ratings must be in MVA, and all other elements must be in Amps. Below is an itemized list of minimum requirements for valid data submission for FAC-008.

The data owner shall provide:

- The two most limiting elements in each facility that are *owned* by the entity.
  - ~~The entity shall provide~~ normal and emergency ratings in *both* seasonal and ambient formats.
- A ratings methodology which supports the data owner’s system, including:
  - treatment of normal and emergency ratings,
  - duration assumptions of emergency ratings,
  - treatment of ring bus or breaker-and-half schemas,
  - other scenarios as applicable to properly model ratings.
- *A rating that supports the modeling data provided in the MOD-032 data submission.*



## 1.9 Data Submission Process and Format

Responsible entities (see section 1.3) shall submit data to BPA as the PC on an annual basis. BPA will submit received data to WECC as the Data Maintainer. Entities may elect to submit data themselves or to another entity as their Data Maintainer (see Section 1.1), provided they notify BPA in writing at [CSR@bpa.gov](mailto:CSR@bpa.gov). Entities with a TOP agreement with BPA agree to use BPA as the Data Maintainer to submit data to WECC.

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.). The Approved Dynamics Model library can be found on the WECC [MVS website](#).

BPA will provide a spreadsheet requesting data by equipment type. By submitting data, or by 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.



## 2 Steady State Model Development

### 2.1 Level of Detail

- If requested, each data owner is required to submit applicable data requested in the Annual Data Exchange template. Data requested in the template will be used by BPA for incorporation into the WECC Seasonal Powerflow Models. Examples of the data reflected in the template may include but is not limited to 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 entities.
- Bus/load/generation and devices profiles, which include:
  - Load type
  - Corresponding generation limits and level (Pmin, Pmax, Qmin, Qmax, and Pgen). This includes generator reactive capability curves (PQ Curves) as is used per PRC-019.
  - Settings on regulating equipment such as transformers, switched shunts, and HVDC data.
  - 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, including 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 ensure 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 [CSR@bpa.gov](mailto:CSR@bpa.gov).

If the data has not changed since the last submission, responsible entities 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:** Idea stage or vision plans.
  - **Proposed:** Projects that require additional review and are subject to change.
  - **Planned:** Projects that have completed the planning process and there is intent to permit and construct the project.
  - **Funded/Construction:** Projects that have money allocated, and will be in, or are already in construction.
  - **In Service:** Facility is energized.
  - **Corrections:** Changes, error or actual, to be submitted 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/ Retirement	Planned/Funded/Construction/ In Service/Corrections
Steady-State	NOT MODELED	MODELED
Dynamics		
Short Circuit		
GIC		
FAC-oo8		



### 2.1.3 Ratings

Ratings submitted under MOD-032 need to satisfy the following requirements:

- Ratings shall be provided in MVA.
- Ratings shall be determined based on the most limiting element for all equipment comprising a given branch in the model.
- Ratings shall align with data submitted under FAC-008.
- Entities should use their own facility rating methodology (if available) to correlate ambient temperatures to Seasons for each equipment type.
- Ratings shall be given for each season below:
  - Summer Normal (Continuous)
  - Summer Emergency (30-minutes or longer)
  - Winter Normal (Continuous)
  - Winter Emergency (30-minutes or longer)
  - Fall Normal (Continuous) \*
  - Fall Emergency (30-minutes or longer) \*
  - Spring Normal (Continuous) \*
  - Spring Emergency (30-minutes or longer) \*

\* Spring and Fall ratings are only required if an entity's ratings methodology supports their determination. When an entity does not have Spring or Fall seasonal ratings, the Summer ratings will be used instead.

Ratings submitted under FAC-008 need to satisfy the following requirements:

- Normal and emergency ratings shall be submitted in MVA for transformers and AMPS for all other equipment types.
- Normal and emergency ratings shall be submitted in the range of temperatures from -15°C to 40°C.
  - Ratings shall also include values at the designated seasonal temperatures as identified in the entity's facility ratings methodology.
- Emergency rating duration shall be submitted for all elements.
- 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 with an equivalent generator(s), an equivalent pad-mount transformer, an equivalent collector system, a substation transformer between the collector system and the transmission bus, and a transmission line (if applicable).
- See 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 0-20 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.

If requested, each responsible entity 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.

Dynamics data submitted annually for MOD-032 is in addition to requirements in the BPA “GO Model Data Submission Process” document. Data will not be requested from responsible entities whose models for their generator type are still under development within WECC.

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 responsible entities must still adhere to all requirements and data collection procedures outlined in 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 of 20 MVA or larger must be modeled. 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 \*
- Reactive Line Drop Compensation Model \*
- Over Excitation Limiter \*
- Under Voltage Ride Through Relays \*
- 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 responsible entity 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 entity 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

Static VAR Compensators (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 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 responsible entity; however, detailed protection relay models need to be submitted when:

- Voltage and frequency ride through capabilities of any generator when these relays 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.

For the customers belonging to the Transmission Planner Coordinated Functional Registration program, fulfillment of the short-circuit data collection portion of the Annual Data Exchange is described in the Transmission Planner Coordinated Functional Registration agreement. 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 the entity will work with TEZP to determine an acceptable format.

This data shared with WECC as requested, as approved by applicable entities, and is 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 data 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. BPA additionally may request data from responsible entities as outlined in section 1.3. 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.
1.7	11/09/2021	Various/TPMG	Updated language to better clarify: data collection and submission process, required consistency between FAC-008 and MOD-032 submissions, Data Maintainer clarifications and TOP Customer requirements, planned vs. funded definitions, specifications for requested ratings, and other errata and language changes for consistency throughout the document.

