WECC

# Data Preparation Manual

## *for Interconnection-wide Cases*

Applicable to the 2020 Base Case Compilation Schedule

System Data Work Group

Data Subcommittee

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## Introduction

The WECC Data Preparation Manual (DPM) is intended to provide an outline of data requirements and reporting procedures necessary for Data Submitters to support creation of Interconnection-wide cases for power flow and dynamic data.

Interconnection-wide cases are used to perform Near-Term and Long-Term Transmission Planning studies (seasonal Operating Transfer Capability (OTC) studies, WECC path rating studies, and regional- and local-area studies etc.). Following the data requirement and reporting procedures, as specified in the DPM, will help WECC meet the needs with the creation of Interconnection-wide cases.

This DPM may be used by WECC members and any other entities owning/operating facilities in the Western Interconnection. The System Data Work Group (SDWG), which reports to the Data Subcommittee (DS), is responsible for maintaining the DPM with oversight from the DS and other Reliability Assessment Committee (RAC) subcommittees. Data Submitters are responsible for making data and models available to WECC that accurately represent facilities for which they have been designated as the Data Submitter. WECC staff is responsible for collecting, archiving, modeling and making available, solved Interconnection-wide cases for use by WECC members and others that have met the WECC data security requirements.

**Navigating the electronic version of the DPM:**

Internal document hyperlinks: Throughout this DPM, there are many references to *internal* supporting information. These internal hyperlinks are configured such that when you see a reference that begins with "See" or "Refer to" followed by text enclosed with double quotes. Mouse over that text and you will be given the option of following the link to the supporting section of this document.

## Definitions

**Area**: An Area is a subset of the Western Interconnection-wide case composed of generators and connected contiguous elements to assist in the coordinated development of a WECC Interconnection-wide case. The Areas are defined by the SDWG and listed in "Appendix 2 – Area, Zone and Bus Number Assignments."

**Balancing Coordinator**: Balancing Coordinator (not a NERC functional entity) is a Data Submitter who submits interchange schedules between Areas in coordination with adjacent Balancing Coordinators.

**Data Submitter:** Data Submitter (not a NERC functional entity) refers to a responsible entity that provides the data detailed in the DPM to support the creation of Interconnection-wide cases.

**Generation Netting:** The representation of a generator(s) through the modeling of a load element with the real and reactive power requirements set to the net of generation and load. Alternatively, Generation Netting may be the representation of a generator(s) using a load element with a negative Real Power demand setting. Generation Netting may be used only in dynamic simulations by including the Generator element in the Netting section of the Positive Sequence Load Flow (PSLF) DYD file for a given WECC Base Case.

**Interconnection-wide Case(s):** Models representing the entire Western Interconnection, which may include WECC Base Cases.

**Master Dynamics File (MDF):** File in PSLF DYD format containing dynamic data for use in the compilation of all WECC Base Cases.

**Master Tie-Line File:** File in PSLF EPC format containing steady-state data used to model elements of the existing Western Interconnection that represent the tie-lines between Areas and other modeling data that pertains to multiple Areas.

**Planned Facilities:** Facilities that have not yet met their in-service date at the time data is submitted for inclusion in a base case. See the "General Data Requirements and Reporting Procedures" section.

**PSLF:** General Electric's Positive Sequence Load Flow software tool for electrical transmission analysis.

**PSS®E:** Siemens PTI's Power System Simulator for Engineering software tool for electrical transmission analysis.

**Retail-Scale Distributed Energy Resources (R-DER):** A set of distributed energy resources that offsets customer load, including residential, commercial, and industrial customers.

**Utility-Scale Distributed Energy Resources (U-DER):** A set of distributed energy resources directly connected to, or closely connected to, the distribution bus or connected to the distribution bus through a dedicated, non-load serving feeder.

**WECC Base Case(s):** A set of solved and solvable steady-state and dynamic data representing a specific operating scenario of the Western Interconnection compiled by WECC staff, using the models and data provided by the Data Submitters.

**WECC Staff:** Employees of WECC who participate in the modeling and coordination of steady-state and dynamic data for use in creating WECC Interconnection-wide cases.

## General Data Requirements and Reporting Procedures

The data requirements and reporting procedures included in this Data Preparation Manual are intended to provide guidance for Data Submitters to support creation of Interconnection-wide cases. Data Submitters should develop processes to obtain and compile the requested data.

### Data Requirements

Data format and content requirements for the development of Interconnection-wide cases are broken into two data types: steady state and dynamic. Sections IV and V address each data type respectively. An additional data requirements section is provided to address the modeling of contingencies and remedial action schemes.

In consideration of including Planned Facilities in submitted data, the following guidelines should be followed:

- the facilities are expected be in-service on the scheduled base case posting date;
- the facilities are expected to be in-service in the month and year represented in the case; or
- the facilities are required to support proposed generation facilities that are modeled in-service in the case.

All data must be the best available data.

Generator dynamic data resulting from equipment testing should be provided if it is available. If test data is not available, design data should be provided. If design data is not available, generic Dynamic data should be provided. In-service equipment should be supported by test data while far-term planned equipment may be modeled using generic dynamic data.

### Reporting Procedures

The schedule for Data Submitters to follow is specified in the request for data submission from WECC staff. A preliminary schedule for providing data for Interconnection-wide case creation is also included in the Base Case Compilation Schedule.

## Steady-State Data Requirements

To provide consistency in data submittals and help avoid potential solution problems, follow the guidelines below to the maximum extent possible. However, WECC recognizes deviations from the guidelines may occasionally be needed. For these situations, Data Submitters are requested to provide the SDWG and Modeling and Validation Work Group (MVWG) with the rationale for exceptions. The Interconnection-wide base cases include the following steady-state data requirements:

- With the exception of collector-based generation such as wind and solar, all Bulk Electric System (BES) elements, as presently defined by NERC, within the Western Interconnection shall be represented in WECC Base Cases without equivalencing.
- Non-Bulk Electric System elements may also be included in WECC Base Cases and follow the data submittal requirements in this DPM. Any equivalencing of non-Bulk Electric System

elements shall be modeled to yield almost identical performance of a full representation in both steady state and dynamic analysis.

- Non-Bulk Electric System elements shall be included if they have significant interaction with BES elements. Non-Bulk Electric System elements that may have a significant interaction with BES elements may exhibit any of the following characteristics:
  - Facilities that are operated at or above 50 kV
  - Facilities that are operated in parallel with BES elements
  - Facilities with connected individual generation resources >=10 MVA or aggregate generation resources >=20 MVA
  - Facilities with connected reactive resources >=10 Mvar
- Non-Bulk Electric System Local Networks and Radial Systems that feed only load or parallel/looped systems that are normally operated in a radial configuration could generally be excluded from modeling.
- Steady-state power flow data submitted to WECC shall represent the existing Bulk Electric System elements plus planned transmission and generation facilities as described elsewhere in this document and as deemed appropriate by the Data Submitter.
- Paths defined in the WECC Path Rating Catalog shall be modeled to include all elements consistent with the path definition.
- Data fields that are strings shall not contain commas, single quotes, double quotes, or apostrophes.
- Key element identifiers (e.g., number, name, base voltage, ID) that indicate an element representing the same equipment shall be consistent between base cases.
  - Devices with alpha characters shall consistently use either uppercase or lowercase IDs.
  - Bus names with alpha characters shall consistently be either uppercase or lowercase.
- Uniqueness shall not depend on names and IDs being case sensitive.
- The requested data is listed below in the tables of data requirements. Any description provided for the field shall be followed.
- Bus naming guideline: Although the criterion for bus names is that 'Bus names shall be unique within the same Base Voltage class,' bus names should be the same for all equipment located in the same vicinity. For example, two substations that are in different Areas could both be named "Midway." Names could be set to "MIDWAY" at one location, and to "MDWAY" at the other.

The SDWG strongly suggests that naming of new buses added to the model adhere to the stated guideline. It recommends, but it is not mandatory, to eliminate spaces in bus names and substitute underscore characters instead. It is the responsibility of the Data Submitter adding the bus information to assure there is no name duplication.

## AC and DC Buses

**General Requirements:**

1. Buses usually represent all of the equipment in a substation that is at the same voltage level and connected. If desired, multiple bus sections within a substation can be represented by separate buses connected by Connectors or AC Transmission Line models that can be opened or closed as needed. Buses may also represent a node on a transmission line such as a tapping point or change in ownership.
2. Location of the bus will be identified by the combination of Area, Zone and/or Owner fields. Optionally, the latitude and longitude fields can be submitted using decimal degrees with data entered not to exceed five decimal places. Additionally, latitude and longitude fields are required with the substation data in the "AC Substation" section.

**Table 1: Data Requirements (Buses)**

| Field | Description | Requirements |
|---|---|---|
| Number | Bus number | B1. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Bus numbers.<br>B2. WECC staff shall provide DC Bus numbers. |
| Name | Bus name<br>• Alphanumeric string containing 1- to-12 characters<br>• At least one non-numeric character | B3. Bus names shall be unique within the same Base Voltage class. |
| Base Voltage | Nominal voltage class of Bus (kV) | |
| Bus Type | AC Bus type {0,1,2,-2}<br>• 0 = swing bus (voltage magnitude and phase fixed)<br>• 1 = load bus (unconstrained voltage angle and magnitude) | |

| Field | Description | Requirements |
|---|---|---|
| | • 2 = generator bus (voltage control [terminal or remote] within generator limits)<br>• -2 = generator bus with unlimited reactive power limits<br>Other bus types may be used to indicate OFF status.<br>Bus type -4 and smaller is the accepted convention for deleted buses.<br>DC Bus type {1,2}<br>• 1 = for a rectifier<br>• 2 = for an inverter | |
| DC System Number | DC system number<br>(not required for AC Bus) | B4. WECC staff shall assign a DC system number for each DC system prior to model submission. |
| Scheduled Voltage | Scheduled voltage (pu)<br>• 5 decimals<br>• Default: 1.00000 | B5. If the Bus is regulated by a generator or other device, the scheduled voltage shall be specified in per unit with respect to the Base Voltage of the Bus.<br>B6. If the Bus is not regulated, the scheduled voltage is optional and for information purposes only. |
| Vmax | Maximum pre-contingency System Operating Limit (SOL) voltage provided to applicable Reliability Coordinator (pu) | |
| Vmin | Minimum pre-contingency System Operating Limit (SOL) voltage provided to applicable Reliability Coordinator (pu) | |
| Area | Area in which Bus is located | B7. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area. |
| Zone | Zone in which Bus is located | B8. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area. |

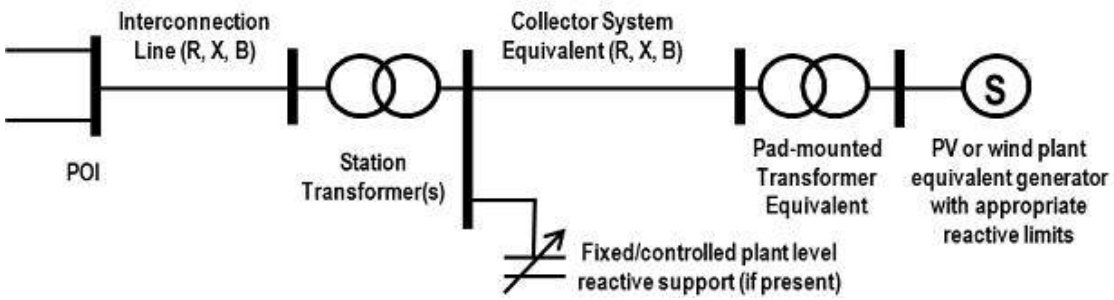
| Field | Description | Requirements |
|---|---|---|
| Owner | Owner Number | B9. Owner Number shall be the Transmission Owner, Generator Owner or Data Submitter (as established by a written agreement).<br>B10. WECC staff shall assign Owner Numbers to required entities. |
| Substation | Substation in which Bus is assigned | B11. Buses relative to GIC analysis shall be assigned to a substation |
| Balancing Authority | Balancing Authority Area in which Bus is located | B12. All buses shall be assigned to a Balancing Authority Area |
| Data Maintainer | Maintainer of model designation | B13. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym |

## Generation

1. Generators selected for Area Slack Control, including the system slack, shall meet the same technical requirements as selecting generators for automatic generation control (AGC) of a Balancing Authority Area. Generators selected for AGC typically have the following attributes:
    a. Changes in MW output cause small changes in generator angle (suggested; dAngle/dP < 0.15 degrees/MW).
    b. Generation is dispatchable.
    c. Maximum MW output typically greater than 100 MW.
    d. Unit is expected to be in service for time frame represented in the WECC base case.
2. Modeling of generators shall comply with the following:
    a. If the individual-generator-unit capacity is 10 MVA or larger and the generator is connected to the WECC transmission system at 60 kV or higher, then submit steady-state data and dynamics data for each generator.
    b. If the aggregated-generator-unit capacity is 20 MVA or larger, the generators are connected to the WECC transmission system at 60 kV or higher, and it is not a collector-based generation facility− then submit steady-state data and dynamics data for each generator. (Wind and solar farms are examples of collector-based generation facilities.)
    c. If the aggregated-generation capacity is 20 MVA or larger, is connected to the WECC transmission system at 60 kV or higher, and is a collector-based generation facility, then steady-state data and dynamics data should be submitted for the aggregated generation capacity as a single-unit generator model.

d. Modeling of Utility-Scale Distributed Energy Resources (U-DER) should comply with the following:
    i. Individual U-DER facilities with an aggregated generation capacity of 10 MVA or larger should be modeled explicitly at the low side of a transformer and include a dynamic model.
    ii. Individual U-DER facilities with an aggregated generation capacity under 10 MVA should be included in a load model at the low side of the transformer. See "Data Requirements (Loads)" for modeling details and details on modeling Retail-Scale Distributed Energy Resources (R-DER).
e. Generating facilities without DYD data shall be netted in the DYD file and have their Non-Conforming Load Flag set appropriately. Steady-state and dynamic generator data shall be consistent.

3. Synchronous motors 10 MVA and larger shall be modeled as individual machines, using a generator model with negative Real Power output and constant Reactive Power (Q) output.
4. Induction motors shall be modeled as a load with the intent of using an induction motor model (MOTORW).
5. Synchronous condensers shall be modeled individually using a generator model.
6. Generator step-up transformers shall be modeled explicitly; therefore, they shall not be modeled using the internal generator step-up transformer feature of a generator model. All related parameters shall be set to the default values. See "Data Requirements (Transformers)."
7. Station service loads (ID = 'SS') shall be represented explicitly as separate loads on the generator bus. See "Data Requirements (Loads)."
8. Wind and photovoltaic plants shall be represented through an equivalent generator(s), equivalent low-to-intermediate-voltage transformer, equivalent collector system, and substation transformer between the collector system and the transmission bus. See the WECC Wind Power Plant Power Flow Modeling Guide and PV Plant Power Flow Modeling Guide.



9. Large industrial sites may include imbedded generation. Industrial aggregated generation capacity of 10 MVA and larger shall be represented in power flow instead of netting with the total load. If a generator is connected to the low side of the bulk-power-delivery transformer, then the transformer must be represented in the power flow, and the generator and load must be connected to the low-voltage side of the transformer.

10. Generator maximum Real Power (Pmax) in power flow must be consistent with the turbine capabilities defined in the Master Dynamics File.

**Table 2: Data Requirements (Generation)**

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Bus Numbers | Number of the Bus to which the generator is attached<br>• See "Data Requirements (Buses)" | | |
| Unit ID | Two-character Generator identifier | | |
| Status | Generator status<br>• 1 = in-service<br>• 0 = out-of-service | D1. Out-of-service units shall have status set to zero.<br>D2. Retired units shall be deleted rather than having status set to zero. | |
| Pgen | Real Power output (gross MW) | D3. Pgen shall be at or within the unit Pmax and Pmin parameters for units that are in-service. | If Status = 1: Pmin ≤ Pgen ≤ Pmax |
| Qgen | Reactive power output (Mvar) | | |
| Pmax | Maximum Real Power output (MW) | D4. Pmax shall reflect the maximum Real Power output of the unit, also known as 'gross' capability.<br>D5. Pmax shall not be greater than the maximum capability of the unit represented by the governor model. | Pmax ≤ Governor Max |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Pmin | Minimum Real Power output (MW) | D6. Pmin shall reflect the minimum Real Power output of the unit.<br>D7. Pmin shall be less than or equal to Pmax. | Pmin ≤ Pmax |
| Qmax | Maximum reactive power output (Mvar) | D8. Qmax shall reflect the appropriate maximum reactive power output of the unit. | |
| Qmin | Minimum reactive power output (Mvar) | D9. Qmin shall reflect the appropriate minimum reactive power output of the unit.<br>D10. Qmin shall be less than or equal to Qmax. | Qmin ≤ Qmax |
| Q Alloc Factor | Reactive power regulating assignment factor<br>• 0.0 – 1.0<br>• > 0.0 for AVR control<br>• 0.0 for constant PF control or gen Status=0 | | |
| Q Table Flag | Reactive capability curve flag<br>• 0 = do not use capability curve<br>• 1 = use capability curve if it exists | D11. Q-Table data used for internal studies shall be included in WECC Base Case submittals.<br>D12. Pmax value shall exist on the Q Table if used. | |
| Base Load Flag | Base Load Flag<br>• 0 = non-base load unit (responds to low frequency with additional mechanical power)<br>• 1 = base load unit (cannot respond to low frequency with additional mechanical power)<br>• 2 = base load unit (cannot respond to low and high | D13. Base Load Flag Shall be consistent between steady-state and dynamics models | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| | frequency with mechanical power) | | |
| Turbine Type | • 0 = unknown<br>• 1 = steam turbine (except steam of combined cycle)<br>• 2 = combined cycle steam part<br>• 3 = steam cross-compound<br>• 4 = combined cycle total unit (planned gens and details for separate model not available)<br>• 5 = hydro<br>• 6 = Internal Combustion Engine (diesel, piston, reciprocating)<br>• 7 = diesel turbo charged<br>• 11 = GT (single shaft, does not include turbine part)<br>• 12 = aero derivative GT<br>• 13 = single-shaft combined cycle<br>• 14 = Synchronous condenser (no turbine)<br>• 19 = Turbines used in a Binary Cycle (including geothermal)<br>• 20 = type unknown wind turbine<br>• 21 = type 1 wind turbine (onshore only)<br>• 22 = type 2 wind turbine (onshore only)<br>• 23 = type 3 wind turbine (onshore only)<br>• 24 = type 4 wind turbine (onshore only)<br>• 25 = wind turbine (offshore)<br>• 29 = combined cycle combustion turbine part<br>• 31 = photovoltaic (unknown or mix)<br>• 32 = photovoltaic (fixed)<br>• 33 = photovoltaic (tracking)<br>• 40 = DC tie (generators representing DC ties)<br>• 41 = motor/pump<br>• 42 = energy storage – battery<br>• 43 = energy storage – flywheel<br>• 44 = energy storage – other<br>• 46 = energy storage – compressed air<br>• 47 = energy storage – concentrated solar power<br>• 48 = fuel cell<br>• 51 = hydrokinetic, axial flow turbine<br>• 52 = hydrokinetic – wave buoy<br>• 53 = hydrokinetic – other<br>• 54 = energy storage – reversible hydraulic turbine<br>• 60 = static var compensator<br>99 = other | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Reg Bus | Bus with voltage controlled by this generator | D14. Regulation of a remote Bus that does not represent actual system operation shall be avoided. | |
| Vsched | Generator scheduled voltage (pu) | | |
| Area | Area in which generator is located | D15. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area. | |
| Zone | Zone in which generator is located | D16. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area | |
| Base MVA | Generator base (MVA) | D17. Unit Base MVA shall be equal to the MVA Base parameter of the unit's dynamic machine model. | Base MVA = Machine Base |
| Owner | Owner Number<br>• Up to eight owners allowed | D18. Owner Number shall be the Generator Owner.<br>D19. WECC staff shall assign Owner Numbers to required entities. | |
| G tap | Tap ratio of generator step-up transformer | D20. G tap shall be set to 1. | G tap = 1 |
| R TR | Resistance of generator step-up transformer | D21. R TR shall be set to 0. | R TR = 0 |
| XTR | Reactance of generator step-up transformer | D22. X TR shall be set to 0. | X TR = 0 |
| R Sub-transient | Sub-transient resistance of generator | | |
| X Sub-transient | Sub-transient reactance of generator | D23. X Sub-transient shall be equal to the sub-transient reactance represented in the unit dynamic machine model. | X Sub-transient = Xdpp (or Ldpp) |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Balancing Authority | Balancing Authority Area in which Generator is located | | |
| Data Maintainer | Maintainer of model designation | D24.Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym | |

## AC Transmission Lines

1. Series-connected reactive devices modeled in AC Transmission Lines shall be explicitly modeled.
2. AC Transmission Line models connecting two Areas, as defined by WECC, shall be maintained in the "Master Tie-Line File."
3. When breakers are explicitly represented in the model, they should be modeled as Breakers with the Connector Type field set to Breaker See "Data Requirements (Connectors)" section.
4. AC transmission lines modeled with impedance below X = 0.00029 pu (the threshold impedance in PSLF) shall not be used to represent a closed loop (ring bus representation).
5. Normal and emergency thermal rating fields for the seasonal scenario described in the base case data request letter shall be populated for all AC Transmission Line models.
6. PSS®E base case data includes only three facility ratings for transmission lines. Ratings 1 and 2 are used for seasonal normal and emergency ratings corresponding to the season of the case. Rating 3 is used for various other purposes. If directed, WECC staff will move ratings 1 and 2 into the appropriate seasonal ratings columns for the PSLF version of the base case being developed.
7. Line-connected transformers shall not be modeled using the internal line-connected transformer feature of a transmission line model; all related parameters shall be set to the default values. See "Data Requirements (Transformers)."
8. Data for AC lines will consider the length of the line when calculating line parameters. For example, long lines will be modeled with impedances adjusted to account for the uniform distribution of the series impedance and shunt admittance along the length of the line.

**Table 3: Data Requirements (AC Transmission)**

| Field | Description | Requirements | Measure |
|---|---|---|---|
| FROM Bus Number | Number of the bus to which the FROM end of the transmission line section is attached.<br>• See "Data Requirements (Buses)" | | |
| TO Bus Number | Number of the bus to which the TO end of the transmission line section is attached.<br>• See "Data Requirements (Buses)" | | |
| Circuit ID | Circuit identifier<br>• Two-character circuit identifier | X1. AC Transmission Line modeling equivalent circuits shall have Circuit ID set to '99' or 'EQ.' | |
| Section Number | Section number (1-9 in ascending order beginning at FROM end) | X2. AC Transmission Line with multiple sections shall number the sections consecutively, starting with '1.' | |
| Status | Branch status<br>• 0 = out-of-service<br>• 1 = in-service<br>• 2 = bypass | X3. AC Transmission Line shall have the anticipated status of the line in the case. | |
| R | Branch section positive sequence resistance | X4. Resistance used for modeling an AC Transmission Line shall conform to the modeling practices as deemed appropriate by the Data Submitter. | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| X | Branch section positive sequence reactance | X5. Reactance used for modeling an AC Transmission Line shall conform to the modeling practices as deemed appropriate by the Data Submitter. | |
| B | Branch section positive sequence susceptance | X6. Susceptance used for modeling an AC Transmission Line shall conform to the modeling practices as deemed appropriate by the Data Submitter. | |
| Rating MVA 1 | Summer Normal Branch Rating (MVA) | X7. Line rating required. | Rating MVA 1 > 0 |
| Rating MVA 2 | Summer Emergency Branch Rating (MVA) | X8. Line rating required. | Rating MVA 2 > 0 |
| Rating MVA 3 | Winter Normal Branch Rating (MVA) | | |
| Rating MVA 4 | Winter Emergency Branch Rating (MVA) | | |
| Rating MVA 5 | Fall Normal Branch Rating (MVA) | | |
| Rating MVA 6 | Fall Emergency Branch Rating (MVA) | | |
| Rating MVA 7 | Spring Normal Branch Rating (MVA) | | |
| Rating MVA 8 | Spring Emergency Branch Rating (MVA) | | |
| From Loss Assign. | Loss factor (0.0 - 1.0) used to assign losses<br>• 1.0 = 100% loss assigned to FROM end of AC Transmission Line<br>• 0.0 = 100% loss assigned to "TO" end of AC Transmission Line | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Area | AC Transmission Line Area location | X9. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area | |
| Zone | Transmission Line Zone location | X10. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area | |
| Ohms | Ohmic data flag<br>• 0 = impedances in pu<br>• 1 = impedances in ohms | | |
| Owner | Owner Number (1 through 8) | X11. Owner Number shall be the Transmission Owner of transmission facility and Generator Owner for lines within generation facility.<br>X12. WECC staff shall assign Owner Numbers to required entities. | |
| Data Maintainer | Maintainer of model designation | X13. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym | |

## Connectors

1. For the purpose of this DPM, Connectors should be considered as objects other than transmission lines, series capacitors, series reactors and transformers connecting two buses. Breakers can be modeled as Connectors.
2. MVA or Amp Ratings for Connectors are not required. The connected transmission line or transformer may include the connector rating if the connector is the most limiting element of the devices intended to be represented in the model.

**Table 4: Data Requirements (Connector)**

| Field | Description | Requirements | Measure |
|---|---|---|---|
| FROM Bus Number | Number of the bus to which the FROM end of the Connector is attached.<br>• See "Data Requirements (Buses)" | | |
| TO Bus Number | Number of the bus to which the TO end of the Connector is attached.<br>• See "Data Requirements (Buses)" | | |
| ID | Connector identifier<br>• Two-character identifier | | |
| Status | Connector status<br>• 0 = out-of-service<br>• 1 = in-service<br>• 2 = bypass | B1. Connector shall have the anticipated status of the line in the case. | |
| Connector Type | Connector device type<br>• Breaker<br>• Load break disconnect<br>• Disconnect<br>• Fuse<br>• Ground disconnect | | |
| Allow Consolidation | Flag for allowing topology processing to consolidate the Connector within a "superbus"<br>• YES<br>• NO | | |
| Rating MVA 1 | Summer Normal Connector Rating (MVA) | | |
| Rating MVA 2 | Summer Emergency Connector Rating (MVA) | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Rating MVA 3 | Winter Normal Connector Rating (MVA) | | |
| Rating MVA 4 | Winter Emergency Connector Rating (MVA) | | |
| Rating MVA 5 | Fall Normal Branch Connector (MVA) | | |
| Rating MVA 6 | Fall Emergency Connector Rating (MVA) | | |
| Rating MVA 7 | Spring Normal Connector Rating (MVA) | | |
| Rating MVA 8 | Spring Emergency Connector Rating (MVA) | | |
| Data Maintainer | Maintainer of model designation | B2. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym | |

## Transformers

### General Requirements

1. Transformers with no Tap Changing Under Load (TCUL) or phase-shifting capability shall have the Tap Control Type field to '1' and shall not have TCUL or phase-shifting data included in the cases. Conversion from the latest approved version of PSLF to other widely used programs may create model discrepancies with partial TCUL or phase-shifting data. Actual transformer equipment type shall be represented.
2. Transformer data can be entered on either the transformer base (transformer winding MVA base and winding voltage base) or the system model base (100 MVA and system nominal voltage base). Impedance values and tap position values shall use a consistent unit base value for a given transformer.
3. Transformer models connecting two Areas, as defined by WECC, shall be represented in the Master Tie-Line File (see "Appendix 2 – Area, Zone, and Bus Number Assignments" for designated Areas").
4. Normal and Emergency thermal rating fields corresponding to the seasonal scenario described in the base case data request letter shall be populated for all Transformer models.

5. PSS®E cases use ratings 1 and 2 for seasonal normal and emergency ratings corresponding to the season of the case. If directed, WECC staff will move ratings 1 and 2 into the appropriate seasonal ratings columns for the PSLF version of the base case being developed.
6. The Transformer Impedance Correction Table shall be maintained in the "Master Tie-Line File."

**Table 5: Data Requirements (Transformers)**

| Field | Description | Requirements | Measure |
|---|---|---|---|
| FROM Bus Number | Number of the bus to which the FROM end of the transformer is attached.<br>• See "Data Requirements (Buses)" | | |
| TO Bus Number | Number of the bus to which the "TO" end of the transformer is attached.<br>• See "Data Requirements (Buses)" | | |
| Circuit ID | Circuit identifier<br>• Two-character circuit identifier | T1. Transformer modeling equivalent circuits shall have Circuit ID set to '99' or 'EQ.' | |
| Status | Transformer Status<br>• 0 = out-of-service<br>• 1 = in-service<br>• 2 = secondary open<br>• 3 = tertiary open<br>• 4 = primary open | T2. Transformers shall have the anticipated status of the transformer in the case. | |
| Tap Control Type | Transformer type code<br>• 1 or 11 = Fixed<br>• 2 or 12 = TCUL<br>• -2 or -12 = TCUL-Disabled<br>• 4 or 14 = Phase-Shifting<br>• -4 or -14 = Phase-Shifting Disabled | T3. TCUL-Disabled and Phase-Shifting Disabled should be used to represent a temporary physical change in transformer control or to address potential modeling issues | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Regulated Bus Number | Number of Bus with voltage regulated or "TO" bus number for phase-regulated transformers. | T4. Regulation of a remote bus that does not represent actual system operation shall be avoided. | |
| Impedance Table Number | Impedance correction table number. | | |
| Tert Bus Number | Tertiary winding Bus number<br>• See "Data Requirements (Buses)" | | |
| 3wpt Bus Number | Internal '3-winding point' Bus number<br>See "Data Requirements (Buses)" | T5. This bus number shall be unique to the transformer and be consistent in all cases | |
| Area | Area in which Transformer is located | T6. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area. | |
| Zone | Zone in which Transformer is located | T7. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area. | |
| FROM-TO Base MVA | Transformer MVA base (primary-to-secondary for 3-wndg) | | |
| FROM-Tert Base MVA | MVA base – primary-to-tertiary for 3-wndg | | |
| TO-Tert Base MVA | MVA base – tertiary-to-secondary for 3-wndg | | |
| R FROM-TO | Resistance primary-to-secondary | | |
| X FROM-TO | Reactance primary-to-secondary | | |
| R FROM-Tert | Resistance primary-to-tertiary | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| X FROM-Tert | Reactance primary-to-tertiary | | |
| R TO-Tert | Resistance secondary-to-tertiary | | |
| X TO-Tert | Reactance secondary-to- tertiary | | |
| FROM Winding Nom Volt | Primary winding nominal voltage (kV) | | |
| TO Winding Nom Volt | Secondary winding nominal voltage (kV) | | |
| Tert Winding Nom Volt | Tertiary winding nominal voltage (kV) | | |
| FROM Fixed Tap | Primary winding fixed-tap position (pu) | | |
| TO Fixed Tap | Secondary winding fixed-tap position (pu) | | |
| Tert Fixed Tap | Tertiary winding fixed-tap position (pu) | | |
| Variable V Tap or Variable Angle | TCUL tap position (primary winding) or phase angle position | T8. Variable V Tap or Variable Angle shall be at or within Max Var. Tap and Min Var. Tap for Transformers that are in-service. | Min Var. Tap ≤ V Tap ≤ Max Var. Tap |
| Step Size | TCUL (pu) or phase-shift (angle in deg) step | T9. Step Size shall reflect the capability of the transformer. | |
| FROM Angle | Primary-winding phase angle (deg) | | |
| TO Angle | Secondary-winding phase angle (deg) | | |
| Tertiary Angle | Tertiary-winding phase angle (deg) | | |
| G-Core Loss | Magnetizing conductance (pu) | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| B Magnetizing | Magnetizing susceptance (pu) | | |
| Rating 1 | **Summer Normal** Branch Rating (MVA) (primary winding for 3-winding xfmr) | T10. Transformer rating required. | Rating MVA 1> 0 |
| Rating 2 | **Summer Emergency** Branch Rating (MVA) (primary winding for 3-winding xfmr) | T11. Transformer rating required. | Rating MVA 2> 0 |
| Rating 3 | **Winter Normal** Branch Rating (MVA) (primary winding for 3-winding xfmr) | | |
| Rating 4 | **Winter Emergency** Branch Rating (MVA) (primary winding for 3-winding xfmr) | | |
| Rating 5 | **Fall Normal** Branch Rating (MVA) (primary winding for 3-winding xfmr) | | |
| Rating 6 | **Fall Emergency** Branch Rating (MVA) (primary winding for 3-winding xfmr) | | |
| Rating 7 | **Spring Normal** Branch Rating (MVA) (primary winding for 3-winding xfmr) | | |
| Rating 8 | **Spring Emergency** Branch Rating (MVA) (primary winding for 3-winding xfmr) | | |
| TO Winding Rating MVA 1 | Ratings – secondary winding for 3-winding xfmr | | |
| TO Winding Rating MVA 2 | Ratings – secondary winding for 3-winding xfmr | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| TO Winding Rating MVA 3 | Ratings – secondary winding for 3-winding xfmr | | |
| Tert Wind. Rating MVA 1 | Ratings – tertiary winding for 3-winding xfmr | | |
| Tert Wind. Rating MVA 2 | Ratings – tertiary winding for 3-winding xfmr | | |
| Tert Wind. Rating MVA 3 | Ratings – tertiary winding for 3-winding xfmr | | |
| FROM Loss Assign | Loss assignment factor (primary winding for 3-winding xfmr) (pu) | | |
| TO Loss Assign | Loss assignment factor - secondary winding for 3-winding xfmr (pu) | | |
| Tert Loss Assign | Loss assignment factor – tertiary winding for 3-winding xfmr (pu) | | |
| Max Var. Tap | Maximum TCUL ratio (pu or deg) | T12. Max Var. Tap shall be greater than Min Var. Tap. | |
| Min Var. Tap | Minimum TCUL ratio (pu or deg) | | |
| Max Cont. V or MW | Maximum voltage (power) at controlled bus (pu or MW) | T13. Max Cont. V shall be greater than Min Cont. V. | |
| Min Cont. V or MW | Minimum voltage (power) at controlled bus (pu or MW) | | |
| Ohms | Ohmic data flag<br>• 0 = impedances in pu<br>• 1 = impedances in ohms | | |

| Field | Description | Requirements | Measure |
|---|---|---|---|
| Owner | Owner Number (1 through 8) | T14. Owner Number shall be the Transmission Owner for transmission facility and Generator Owner for generator facility.<br>T15. WECC staff shall assign Owner Numbers to required entities. | |
| Data Maintainer | Maintainer of model designation | T16. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym | |

## Fixed-Shunt Reactive Elements

### General Requirements

1. Fixed-shunt elements that are directly connected to a bus shall be represented as bus shunts.
2. Fixed-shunt elements that directly connect to and switch with a transmission line shall be represented as line shunts.
3. Fixed-Line Shunt models connected to an AC Transmission Line model connecting two Areas, as defined by WECC, shall be represented in the "Master Tie-Line File" if requested by the process detailed in the data submission request.
4. Fixed-shunt reactive devices inside wind and solar projects must be modeled explicitly in power flow.

**Table 6: Data Requirements (Fixed Shunts)**

| Field | Description | Requirement |
|---|---|---|
| FROM Bus Number | Number of the Bus to which the FROM end of the transmission line on which the shunt is connected for line shunts, or number of the Bus at which shunt is connected for bus shunts.<br>• See "Data Requirements (Buses)" | |
| TO Bus Number | Number of the Bus to which the TO end of the transmission line on which the shunt is connected, for line shunts, or 0 for bus shunts.<br>• See "Data Requirements (Buses)" | |

| Field | Description | Requirement |
|---|---|---|
| Shunt ID | Shunt identifier<br>• Two-character shunt identifier | F1. Line shunt connected to the FROM end of the transmission line shall have Shunt ID starting with 'F.'<br>F2. Line shunt connected to the TO end of the transmission line shall have Shunt ID starting with 'T.' |
| Circuit ID | AC Transmission Line circuit identifier for line shunts or blank for bus shunts<br>• Two-character circuit identifier | |
| Section Number | Number of AC Transmission Line section to which shunt is connected if line shunt, or '0' if bus shunt | |
| Shunt Status | Shunt status<br>• 0 = out-of-service<br>• 1 = in-service | F3. Fixed shunts shall have the anticipated status of the shunt in the case. |
| Area | Area in which fixed shunt is located | F4. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area. |
| Zone | Zone in which fixed shunt is located | F5. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area. |
| G | Actual shunt conductance (pu) | |
| B | Actual shunt susceptance (pu) | |
| Owner | Owner Number (1 – 4) | F6. Owner Number shall be the Transmission Owner or Generator Owner.<br>F7. WECC staff shall assign Owner Numbers to required entities. |
| Data Maintainer | Maintainer of model designation | F8. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym |

## Controlled Shunt Reactive Devices

### General Requirements

1. Controlled shunt reactive device models should be used to represent the following devices explicitly in power flow:
   - Mechanically switched shunt capacitors and reactors;
   - Static var compensators;
   - STATCOMs; and/or
   - Thyristor-switched shunt capacitors and reactors.
2. Controlled shunt reactive devices inside wind and solar projects must be modeled explicitly in power flow.
3. The number of explicitly modeled shunts on a bus should be minimized to aid solving.

**Table 7: Data Requirements (Controlled Shunts)**

| Field | Description | Requirement |
|---|---|---|
| Bus Number | Number of Bus at which device is connected<br>• See "Data Requirements (Buses)" | |
| SVD ID | SVD identifier<br>• Two-character identifier | |
| SVD Status | SVD status<br>• 0 = out-of-service<br>• 1 = in-service | S1. Controlled shunts shall have the anticipated status of the shunt in the case. |
| SVD Control Type | Device type<br>• 0 = Fixed<br>• 1 = Discrete<br>• 2 = Continuous<br>• 3 = All or Nothing<br>• 4 = Discrete control using Voltage Dead Band<br>• 5=WECC SVC<br>• 6=WECC STATCOM<br>• 7=WECC TSC/TSR | |
| Regulated Bus | Number of the Bus regulated by this shunt<br>• See "Data Requirements (Buses)" | S2. Regulation of a remote Bus that does not represent actual system operation shall be avoided. |

| Field | Description | Requirement |
|---|---|---|
| Area | Area in which Controlled Shunt is located | S3. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area. |
| Zone | Zone in which Controlled Shunt is located | S4. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area. |
| G Actual | Actual shunt conductance (pu) | |
| B Actual | Actual shunt susceptance (pu) | |
| B Min | Minimum susceptance of continuous element (pu) | |
| B Max | Maximum susceptance of continuous element (pu) | |
| Voltage Dead Band | Voltage control bandwidth divided by two (pu) (types 3 and 4) | S5. Voltage Dead Band shall prevent regulated voltage from exceeding the Voltage Dead Band with a single Controlled Shunt step.<br>S6. The minimum dead band shall be 0.02. |
| B Step | Susceptance of each switched element in nth stage (pu) (types 1-4, 7) | S7. Step size shall reflect the capability of the controlled shunt. |
| No. of Steps | Number of equal admittance steps in nth switched stage (types 1-4, 7) | S8. Number of steps shall reflect the capability of the controlled shunt. |
| B Min | Minimum total susceptance for device (pu) | |
| B Max | Maximum total susceptance for device (pu)<br>Maximum current for type 6 (pu) | |
| XC | Compensating (slope) reactance (pu) (types 5, 6, and 7) | |
| B Min SH | Minimum B for switching shunts (pu) (types 5, 6, and 7) | |
| B Max SH | Maximum B for switching shunts (pu) (types 5, 6, and 7) | |
| STSB | Slow reset control on/off status (pu) (types 5, 6, and 7) | |

| Field | Description | Requirement |
|---|---|---|
| B Min SB | Minimum B for slow reset (pu) (pu) (types 5 and 7) | |
| B Max SB | Maximum B for slow reset (pu) (pu) (types 5 and 7) | |
| VRFMIN | Minimum Voltage reference for slow reset (pu) (types 5, 6, and 7)<br>Minimum Voltage reference for types 3 and 4 if Voltage Dead Band <= 0 | |
| VRFMAX | Maximum Voltage reference for slow reset (pu) (types 5, 6, and 7)<br>Maximum Voltage reference for types 3 and 4 if Voltage Dead Band <= 0 | |
| dVdB | System dV/dB for slow reset (pu) (types 5, 6, and 7) | |
| Ni | Number of steps in shunt | |
| Owner | Owner Number (1 through 4) | S9. Owner Number shall be the Transmission Owner or Generator Owner.<br>S10. WECC staff shall assign Owner Numbers to required entities. |
| Balancing Authority | Balancing Authority Area in which Shunt is located | |
| Data Maintainer | Maintainer of model designation | S11. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym |

## Loads

### General Requirements

1. Real and reactive power for each load shall be provided.
2. Motors 10 MVA or larger shall be modeled as machines (see "Data Requirements (Generation)").
3. Station service at modeled generation facilities with station service load greater than or equal to 1 MW shall be modeled explicitly. As noted in the table below, load modeling generator station service shall have Load ID set to 'SS.'
4. A Long ID shall be provided for each load in accordance with the WECC MVWG Load-Long ID Instructions (LID_Instructions), either within the case data provided, or in a separate spreadsheet

file. Data Submitter shall select an appropriate Long ID that correctly represents the dynamic load characteristics. See "Dynamic Data Requirements (Load Requirements)."

5. Modeling of Distributed Energy Resources (DER) should comply with the following:
    a. If data is available, all Retail Scale Distributed Energy Resources (R_DER) and only individual Utility-Scale Distributed Energy Resources (U-DER) with an aggregated output below 10 MVA should be modeled using the distributed generation fields in the load model.
    b. See "Data Requirements (Generation)" for details on modeling U-DER with an aggregated generation capacity of 10 MVA or larger.
6. Industrial loads and embedded generation not consistent with the R-DER modeling section shall be modeled on the low side of the transformer, as shown in the figure below.

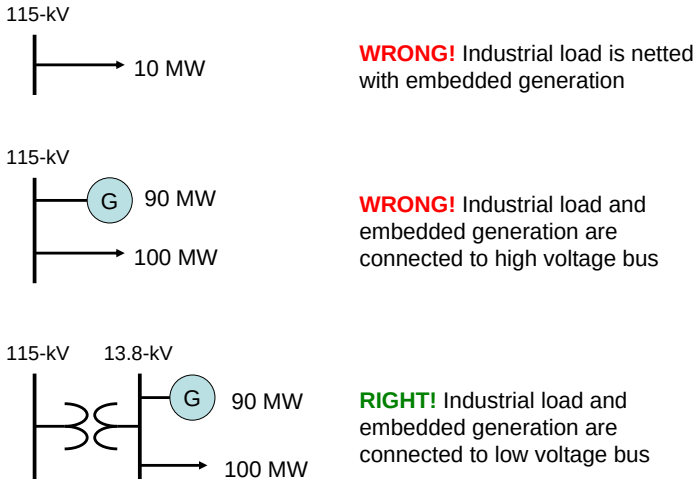



**Table 8: Data Requirements (Loads)**

| Field | Description | Requirement |
|---|---|---|
| Bus Number | Number of Bus at which load is connected<br>• See "Data Requirements (Buses)" | |
| Load ID | Two-character identifier | L1. Load modeling generator station service shall have Load ID set to 'SS.'<br>L2. Loads at the same Bus shall have unique Load ID. |
| Load Status | • 0 = load out-of-service<br>• 1 = load in-service | L3. Load shall have the anticipated status of the load in the case. |

| Field | Description | Requirement |
|---|---|---|
| Non-Conforming Flag | • 0 = load will change with scaling<br>• 1 = load does not change with scaling | L4. Non-conforming Flag shall be set to '1' for loads that should not be changed in load scaling operation of power flow software. |
| Area | Load Area in which located | L5. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated Area. |
| Zone | Load Zone in which located | L6. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated ranges of Zones used by Area. |
| Const MVA P | Constant MVA Real Power load | |
| Const MVA Q | Constant MVA reactive power load | |
| Dist Status | • 0 = generator out-of-service<br>• 1 = generator in-service | |
| Dist Gen P | Real Power output (MW) | |
| Dist Gen Q | Reactive power output (Mvar) | |
| Const CUR P | Constant current Real Power load | L7. Const CUR P shall not be used. |
| Const CUR Q | Constant current reactive power load | L8. Const CUR Q shall not be used. |
| Const Y P | Constant admittance Real Power load | L9. Const Y P shall not be used. |
| Const Y Q | Constant admittance reactive power load | L10. Const Y Q shall not be used. |
| Owner | Owner Number | L11. Owner Number shall be the Transmission Owner for transmission loads, Generator Owner for station service, Distribution Service Provider for distribution loads.<br>L12. WECC staff shall assign Owner Numbers to required entities. |
| Long ID | Climate zone and substation type identification | L13. Seven-character identifiers of the climate zone and load type – the first three characters represent the climate zone, followed by underscore, and three characters |

| Field | Description | Requirement |
|---|---|---|
| | | representing the substation/feeder load mix type. Details are included in the LID_Instructions and Composite Load Model Implementation documents. |
| Balancing Authority | Balancing Authority Area in which Load is located | |
| Data Maintainer | Maintainer of model designation | L14. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym |

## DC Transmission Lines

### General Requirements

1. Include (at a minimum) the following DC Transmission Line (overhead and underground) requirements: line parameters, Normal and Emergency Ratings, control parameters, rectifier data, and inverter data.
2. Megawatt set-point of converter data shall be equal to or less than the DC Transmission Line Rating.

**Table 9: Data Requirements (DC Transmission)**

| Field | Description | Requirement | Measure |
|---|---|---|---|
| ifrom | DC 'FROM' bus number | | |
| ito | DC 'TO' bus number | | |
| ck[2] | DC line identifier | | |
| projid | Project Identifier | | |
| st | DC line status | | |
| dcsys | DC system number | | |
| Area | Area number | | |
| Zone | Zone number | | |
| r | DC line resistance | | Ohms |
| l | DC line inductance | | Henries |
| c | DC line capacitance | | microfarad |
| rate[8] | DC current ratings | | Amps |

| | | | |
|---|---|---|---|
| aloss | DC line loss assignment factor | | per unit |
| nown[8] | Owner Number | | |
| Balancing Authority | Balancing Authority Area in which DC bus & converter are located | | |
| Data Maintainer | Maintainer of model designation | D1. Refer to "Appendix 2 – Area, Zone and Bus Number Assignments" for designated member system acronym | |

## Area Interchange Schedules

### General Requirements

1. Area Interchange schedules shall be coordinated between Areas to meet the objectives of the data request letter and maintain consistency in the imports/exports modeled.
2. The sum of net Area Interchange Schedules for the Interconnection-wide case shall be equal to zero.
3. WECC staff shall set the Real Power Net Interchange Tolerance equal to 1.0 MW for each Area.

## Master Tie-Line File

When requested by the process detailed in the data submission request the Master Tie-Line File (MTLF) contains:

- Master lists of Owners, Balancing Authority Areas and Zones;
- Path definitions and ratings for paths in the WECC Path Rating Catalog;
- Lists of lines and transformers that interconnect Areas; and
- Placeholder for Area-to-Area transactions for the existing system.

### General Requirements Used to Build Interconnection-Wide Cases

1. WECC staff shall maintain the MTLF.
2. WECC staff shall post the current MTLF in the present year's base-case files on the WECC website.
3. The MTLF is used in the compilation of all base cases to ensure consistency of steady-state data common to multiple Areas.
4. Updates to the MTLF shall be coordinated between Areas and submitted to WECC staff in an EPC file format or excel spreadsheet format as necessary by the Data Submitter.
5. The MTLF shall be maintained and applied to all WECC base cases. The tie-line data pertaining to planning horizon cases will be handled on a case-by-case basis.

**Data Requirements (Area Interchange)**

1. Tie-Lines –Existing transmission lines (including line shunts) and transformers connecting two Areas shall have steady-state data submitted to WECC staff for inclusion in the MTLF (see Section "AC Transmission Lines" and "Transformers" respectively). Tie changes are not captured when only included in the case data submissions. These changes or updates must be submitted separately from typical case data submissions (or as separate files included within the case data).
2. Zones – Zone Names and Zone Numbers shall be maintained in the MTLF in accordance to the process detailed in the data submission request. Zone assignments to the WECC member systems can be found in Appendix 2 (see "Appendix 2 – Area, Zone and Bus Number Assignments").
3. WECC staff shall identify paths (as listed in the WECC Path Rating Catalog) in accordance to the process detailed in the data submission request. The Interface Number shall match the WECC path number. Rating 1 shall be used for the Path Transfer Limit for prevailing flow direction and Rating 2 shall be used for the secondary flow direction Path Transfer Limit.
4. WECC path element information shall be maintained in the MTLF in accordance to the process detailed in the data submission request. Data Submitters shall provide updates to WECC staff as changes are made or as facilities are placed in-service.
5. Facility owners of DC buses, lines, and converters that are part of any Area tie-line shall provide the steady-state data to be maintained in the MTLF. (see Section "DC Transmission Lines").
6. Transformer Impedance Correction Table – Impedance correction parameters to be used for TCUL transformers and phase-shifting transformers shall be maintained in the MTLF in accordance to the process detailed in the data submission request.
7. Owner Data – A list of Owner Numbers, names, and four-character abbreviations shall be maintained in the MTLF in accordance to the process detailed in the data submission request.
8. Transaction Data – There must be a transaction for any ties between Areas. WECC Staff manages this data in accordance to the process detailed in the data submission request on a case-by-case basis.
9. Balancing Authority – WECC staff will maintain a list of Balancing Authority Areas (BAA) used in the existing operation of the transmission system.

## AC Substations

**General Requirements:**

1. Substations represent all the buses in a substation. These collections of buses are connected by transformer, bus sectionalizing breakers, switches and/or short transmission lines.

**Table 10: Data Requirements (AC Substations)**

| Field | Description | Requirement |
|---|---|---|
| Sub Number | Substation Number | Each substation shall have a unique number that matches one of the buses contained in the substation |
| Sub Name | Substation Name | Up to 12 characters with a unique name (substation name from West-wide System Model (WSM) is recommended) |
| Sub Latitude | Geographic Latitude | Actual latitude data of the substation in decimal degrees |
| Sub Longitude | Geographic Longitude | Actual longitude data of the substation in decimal degrees |

## Dynamic Data Requirements

The Dynamic data for the Western Interconnection is maintained in the Master Dynamics File (MDF). To provide consistency in data submittals and help avoid potential solution problems in the reliability analysis of the interconnected transmission system, Data Submitters shall submit dynamic data to WECC per the guidelines listed herein. However, WECC recognizes deviations from the guidelines may occasionally be needed. For these situations, submitters are requested to provide the SDWG and MVWG with the rationale for exceptions. In all cases, dynamic data must be consistent with steady-state data provided for each WECC Base Case. Data Submitters are responsible for providing data for facilities in the WECC-approved format.

Dynamic data is submitted as soon as any new data becomes available. Dynamic data may become available outside the scheduled case building process due to individual entity equipment testing programs, such as the generator testing program.

Dynamic data for new generators and updates for existing generators are submitted via the WECC Generating Unit Model Validation Policy. This Policy includes the roles and responsibilities of the Generator Owner, the Transmission Planner, and WECC.

Approved dynamic models conform to the WECC Dynamic Modeling Procedure. All dynamic models contained in the MDF shall be those approved by the MVWG. If the model you want to use is not on the approved list, you must go through the MVWG and follow the WECC Dynamic Modeling Procedure.

The following approach to dynamic data shall apply Interconnection-wide:

- Generators and other dynamic devices shall be represented with approved dynamic data as recommended by the MVWG to represent the designated dynamic equipment modeled in

WECC Base Cases. The approved models can be found within the Approved Dynamic Model Library

- When new models have been added to or obsolete models have been removed from the Approved Dynamic Model Library, Data Subcommittee and SDWG will determine an appropriate implementation schedule and scope for submitting the necessary data required by the newly approved models.
- Estimated or typical manufacturer's dynamic data based on facilities of similar design and characteristics may be used to represent planned generators and other dynamic devices if specific design data cannot be obtained. MVWG maintains the Typical Machine Data document. Specific dynamic design data shall be submitted per the WECC Steady-State and Dynamic Data Criterion. See "General Data Requirements and Reporting Procedures."
- Where there is a difference between the requirements of this document and the WECC Generating Unit Model Validation Policy, the WECC Generating Unit Model Validation Policy shall preside.
- Typical dynamics studies are up to 60 seconds from the initiating event. All models, on the Approved Dynamic Model Library list that can respond within that time frame, shall be submitted.

## Generation Requirements

1. Dynamic data for generators, synchronous condensers, excitation systems, voltage regulators, turbine governor systems, power system stabilizers, and other associated generation equipment shall be derived from test results obtained by adhering to the WECC Generating Unit Model Validation Policy for each unit represented in WECC Base Cases according to thresholds as specified in Section IV. This includes, as appropriate to the model, items such as inertia constant, damping coefficient, saturation parameters, and direct and quadrature axis reactances and time constants.
2. Generator Owners shall submit power plant data in accordance to the voltage and MVA size thresholds for aggregating generator models described in the Section IV. See "Data Requirements (Generation)."
3. Netting of planned generators represented in WECC Base Cases shall conform to the threshold requirements of the Section IV.
4. The MWCAP parameter in the dynamic turbine-governor model shall be greater than or equal to the Pmax parameter of the generator steady-state model to avoid governor initialization problems.
5. Power System Stabilizer (PSS) Dynamic data shall be submitted for all generators that have active PSS. See the WECC Policy Statement on Power System Stabilizers document.

6. Existing generators shall follow the WECC Generator Unit Model Validation Policy.
7. User defined models for collector based generator (Wind and Solar plants) representation shall be avoided.

## Load Requirements

Model voltage and frequency characteristics explicitly for each individual load if possible. However, use the Composite Load Model for loads when frequency and voltage characteristics are not explicitly known. The goal of this section is to model effects of voltage and frequency on load as accurately as possible.

1. A composite load model shall exist for each load modeled in the steady-state data.
2. Keep dynamic load data characteristics consistent with reported steady-state data.
3. For loads less than 5 MW, Data Submitters will work with WECC staff to establish a default load representation record for each Area to represent loads not modeled with the Composite Load Model. This is to avoid the load representation defaulting to constant power (PSLF default). If actual dynamic load characteristics are not available, load should be modeled as constant current P, and constant impedance Q. Bus specific exceptions to the default load representation must be submitted to WECC staff for inclusion in the MDF.

## Underfrequency Load Shedding (UFLS)

1. Include UFLS records for all loads that have UFLS relays on the interconnected system.
2. The pickup frequency of each stage shall be lower than that of the previous stage. UFLS must comply with WECC-coordinated off-nominal requirements as specified in the WECC Off-Nominal Frequency Load-Shedding Plan document.
3. Pertinent load data must be included in the MDF. All UFLS data in the MDF must match bus, load, and/or branch identifiers in the cases.
4. The UFLS models must correspond to UFLS information provided to the WECC Underfrequency Load-Shedding Review Group in accordance with WECC Underfrequency Load-Shedding Criterion.
5. To include data in Planning cases, submit the data with the case development and identify as planning data.

## Undervoltage Load Shedding (UVLS)

1. UVLS records must be included for all loads that have under-voltage relays on the interconnected system.
2. The pick-up and time-delay settings must be coordinated for each stage with the previous stage.

3. Pertinent load data must be included in the MDF. All UVLS data in the MDF must match bus, load, and/or branch identifiers in the cases.

### Relays

Relay models as approved for use by the SDWG must be included per the time line and scope it establishes for primary relays. Data submitters are also strongly encouraged to submit all relevant backup relay modeling data.

### Back-to-Back DC Ties

Netting is allowed for back-to-back DC ties. Back-to-back DC ties shall be represented as generation in the power flow, but netted in dynamic data. The record should include an ID designation of 'DC' on the generator record.

### DC Lines, SVC and D-var systems

1. Device-specific dynamic data for dynamic devices shall be modeled, including but not limited to, static var compensators and controllers, high-voltage direct-current systems, flexible AC transmission systems, and automatically switched shunt and series capacitors or reactors.
2. DC lines and SVC systems shall be modeled, to the maximum extent possible, to accurately reflect actual system performance.
3. DC bus numbering must be coordinated with WECC staff prior to model submission.

## Remedial Action Scheme and Associated Contingency Data

Remedial Action Scheme (RAS) and associated Contingency data shall be shared with WECC and WECC shall securely store the information separate from the Interconnection-wide cases.

The following approach should be taken when providing contingency and RAS data:

- All models should be provided upon request by Data Submitters in their preferred format until the WECC common format is available in the providers preferred software.
- RAS models should be provided if the affected elements are modeled in the case.
- All models should identify the data owner by naming the models with the member system acronym and an underscore at the front. (i.e. 'member system acronym' 'descriptive model name')
- RAS and associated contingency models shall be provided for all operations base cases. These are denoted by an "-OP" in the base case compilation schedule. New models shall be provided when the RAS are placed in use by the Operations department of each member, while existing

models need only be updated when changes occur. Data Submitters shall notify WECC staff if any already provided models are no longer online and should be removed.

- RAS data will be made available on the WECC website. It will only be accessible to those users who are logged in and authorized to access it.

*WECC receives data used in its analyses from a wide variety of sources. WECC strives to source its data from reliable entities and undertakes reasonable efforts to validate the accuracy of the data used. WECC believes the data contained herein and used in its analyses is accurate and reliable. However, WECC disclaims any and all representations, guarantees, warranties, and liability for the information contained herein and any use thereof. Persons who use and rely on the information contained herein do so at their own risk.*

# Appendix 1 – Late Data Procedure

The objective of the Late Data Procedure is to preserve the original schedule for the development of base cases in accordance with each year's Base Case Compilation Schedule, and the Case Description sheet in the data request letter for each case. The Late Data Procedure describes Data Submitter and staff data submittal responsibilities as well as actions to be taken for actual delays or anticipated delays in the submittal of data, or for the submittal of unusable data. This procedure does not take effect until one of the following occurs:

- A data submittal date has been missed; or
- There is sufficient reason to believe that a submittal date will be missed; or
- It is determined that the submitted data is not usable.

Success of the case development program depends on timely and accurate data submittal, review, and support of the development of each base case. A Data Submitter not meeting a scheduled response date listed in the Base Case Compilation Schedule with a usable response could result in a delay in the case development schedule if left uncorrected.

Examples of unusable data:

- Data from two neighboring Data Submitters with inter-area schedules that do not match; and
- Data with such significant problems that it cannot be used for the comment phase of the development process which; therefore, delays the progress of the case development.

Any unusable data received by WECC staff must be corrected by the Data Submitter to not further impair the schedule or it will be rectified in accordance with this Late Data Procedure, as will any late data or anticipated late data.

## Data Submitter and Staff Responsibilities

It is the responsibility of the Data Submitters to submit timely and accurate data in accordance with the Base Case Compilation Schedule and the Case Description sheet in the data request letter. A schedule can be impaired either by data being submitted after the scheduled due date or by the submission of unusable data, even if it is submitted on time.

If, in the judgment of WECC staff, it appears that the schedule will be impaired due to lack of usable data response by the Data Submitters, it will be the responsibility of WECC staff to provide the data for the case in question.

## Actions to Take

There are two actions specified by this procedure in the event the WECC staff must exercise its late data responsibilities for a delinquent entity. The first is the action of assuming the responsibility for

submitting the data and the second is the notification of such action. If the staff takes over the responsibility for the submittal of data for the delinquent entity, the data to be submitted should always be the *best data available* in the judgment of the person submitting the data. The data should be submitted in such a way that the original schedule is maintained or not further impaired.

When WECC staff takes over data submittal responsibility for a Data Submitter:

1. WECC staff will notify the Data Submitter and copy the notification of the action taken to:
    a. RAC and Data Subcommittee representatives of the Data Submitter; and
    b. SDWG.
2. When the case involved is an operating case, the staff will send a notification letter to:
    a. The Operating Committee (OC) and the Operating Transfer Capability Policy Group Study Group (OTCPGSG).

The notification will consist of the nature and extent of the action taken, and reasons. Those who consistently abuse the base-case development process by submitting late or unusable data may be significantly compromising the reliability of the Western Interconnection transmission system.

## Backfitting of Late Data

The Late Data Procedure allows for the WECC staff to take over data submittal responsibilities for a Data Submitter in the event that entity is unable to submit usable data in accordance with the defined schedule. If the Data Submitter's data should subsequently become available, the data shall be submitted to the WECC staff to partially or fully replace that which was previously submitted. However, the staff may refuse to accept this backfit data if, in its judgment, the backfit data is no better than the data already in the case or if there would be unacceptable impairment of the schedule by accepting the backfit data.

## Modifications to Approved Base Cases

After a base case has been approved by WECC staff there may be a need to make changes to that case, or a group of approved cases. These changes can be submitted to WECC staff and posted on the Base Case Modifications Page. The data submitter is responsible for data validation and is responsible that the submitted data does not impede the accuracy of the case solution. WECC groups and members that actively use approved cases are encouraged to coordinate case updates they identify via this process and to subscribe to the Base Case Modifications page to receive updates.

Data Submitters are encouraged to have criteria for data changes that should be submitted to WECC, keeping in mind the need for case accuracy and the impact to other entities. Changes to tie-lines between adjoining utilities should be coordinated.

Suggested Criteria:

BES facilities that *should* be submitted to WECC for inclusion in its list of Base Case Modifications:

- Missing or duplicate lines or transformers.
- Impedance errors that would impact a major path.
- Ratings errors that would impact a major path.
- Missing or duplicate loads that would impact a major path.
- Missing or duplicated generation resources that would impact a major path.
- Significant load or generation profile changes that would impact a neighboring area.
- Any other changes that would have an impact on a neighboring area or utility.

# Appendix 2 – Area, Zone and Bus Number Assignments

## Southwest Region

| | |
|---|---|
| Area Number Range | 10 – 19 |
| Zone Number Range | 100 – 199 |
| | 840 – 859 |
| | 1000 – 1999 |
| Bus Number Range | 10,000 – 17,999 |
| | 19,000 – 19,999 |
| | 84,000 – 85,999 |
| | 100,000 – 180,000 |
| | 190,000 – 199,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 10 | 100 - 109<br>1000 - 1099 | New Mexico | PNM | 10,000 – 10,999<br>100,000 – 109,999 |
| | 120 -139<br>1200 - 1399 | New Mexico | TSGT | 12,000 – 12,999<br>120,000 – 129,999 |
| | | | LAC, NAPI, TNP | 13,000 – 13,999<br>130,000 – 139,999 |
| 11 | 110 – 119<br>1100 - 1199 | El Paso | EPE | 11,000 – 11,999<br>110,000 – 119,999 |
| 14 | 140 - 149<br>840 - 859<br>1400 - 1499 | Arizona | APS | 14,000 – 14,999<br>84,000 – 85,999<br>140,000 – 149,999 |
| 15 | 150-159<br>1500-1599 | SRP | SRP, APA | 15,000 – 15,999<br>150,000 – 159,999 |
| 16 | 160-169<br>1600 - 1699 | TEP | TEP, UES | 16,000 – 16,999<br>160,000 – 169,999 |
| 17 | 170-179<br>1700 - 1799 | AEPCO | AEPC, Others | 17,000 – 17,999<br>170,000 – 179,999 |
| 18 | 180 – 188<br>1800 - 1889 | Nevada | NEVP | 18,000 – 18,899<br>180,000 – 188,999 |
| 19 | 190-199<br>1900-1999 | WAPA-L.C. | WAPA-L.C. | 19,000-19,999<br>190,000-199,999 |

## Southern California Region

| | |
|---|---|
| Area Number Range | 20 – 26 |
| Unused Areas | 27 – 29 |
| Zone Number Range | 200 – 299 |
| | 2000 – 2999 |
| Bus Number Range | 18,900 – 18,999 |
| | 20,000 – 29,999 |
| | 94,000 – 95,999 |
| | 200,000 – 299,999 |
| | 189,000 – 189,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 20 | 200 – 209<br>2000 - 2099 | Mexico – CFE | CFE | 20,000 – 20,999<br>200,000 – 209,999 |
| 21 | 210 – 219<br>2100 – 2199 | Imperial, CA | IID | 21,000 – 21,999<br>210,000 – 219,999 |
| 22 | 220 – 239<br>2200 – 2399 | San Diego | SDGE | 22,000 – 22,999<br>220,000 – 229,999 |
| | | | Others | 23,000 – 23,999<br>230,000 – 239,999 |
| 24 | 240 – 259<br>2400 – 2599 | So Calif | SCE | 24,000 – 24,999<br>240,000 – 249,999 |
| | 890 – 899 | | VEA, GLW | 18,900 – 18,999<br>189,000 – 189,999 |
| | 940 – 959<br>290 – 299<br>2900 – 2999 | | | 94,000 – 95,999<br>29,000 – 29,999<br>290,000 – 299,999 |
| | | | CDWR, MWD, Others | 25,000 – 25,999<br>250,000 – 259,999 |
| 26 | 260 – 289<br>2600 – 2899 | LADWP | LDWP | 26,000 – 26,999<br>260,000 – 269,999 |
| | | | BURB, GLEN | 27,000 – 27,999<br>270,000 – 279,999 |
| | | | Others | 28,000 – 28,999<br>280,000 – 289,999 |

## Northern California Region

| | |
|---|---|
| Area Number Range | 30 |
| Unused Areas | 31 – 39 |
| Zone Number Range | 300 – 399<br>3000 – 3999 |
| Bus Number Range | 30,000 – 39,999<br>300,000 – 399,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 30 | 300 – 399<br>3000 – 3999 | PG and E | PG&E | 30,000 – 36,999<br>300,000 – 369,999 |
| | | | SMUD | 37,000 – 37,499<br>370,000 – 374,999 |
| | | WAPA | SNR | 37,500 – 37,899<br>375,000 – 378,999 |
| | | | REU | 37,900 – 37,999<br>379,000 – 379,999 |
| | | | NCPA | 38,000 – 38,199<br>380,000 – 381,999 |
| | | | MID | 38,200 – 38,399<br>382,000 – 383,999 |
| | | | TID | 38,400 – 38,599<br>384,000 – 385,999 |
| | | | CDWR | 38,600 – 38,899<br>386,000 – 388,999 |
| | | | Others | 38,900 – 39,999<br>389,000 – 399,999 |

## Northwest Region

| | |
|---|---|
| Area Number Range | 40 |
| Unused Areas | 41 – 49 |
| Zone Number Range | 400 – 499<br>4000 – 4999 |
| Bus Number Range | 40,000 – 49,999<br>90,000 – 90,999<br>400,000 – 499,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 40 | 400 – 499<br>4000 – 4999 | Northwest | BPA, other Federal, WPPSS, Detailed Federal hydro | 40,000 – 41,999<br>44,000 – 44,499<br>400,000 – 419,999<br>440,000 – 444,999 |
| | | | PSE | 42,000 – 42,999<br>420,000 – 429,999 |
| | | | PGE | 43,000 – 43,999<br>430,000 – 439,999 |
| | | | PACW | 44,500 – 45,599<br>445,000 – 455,999 |
| | | | SNPD | 45,600 – 45,999<br>456,000 – 459,999 |
| | | | GCPD | 46,000 – 46,199<br>460,000 – 461,999 |
| | | | EWEB | 46,200 – 46,399<br>462,000 – 463,999 |
| | | | SCL | 46,400 – 46,599<br>464,000 – 465,999 |
| | | | TPWR | 46,600 – 46,799<br>46,900 – 46,999<br>466,000 – 467,999<br>469,000 – 469,999 |
| | | | CHPD | 46,800 – 46,899<br>468,000 – 468,999 |
| | | | Others – Public | 47,000 – 47,499<br>470,000 – 474,999 |
| | | | Others – Private or IOU | 47,500 – 47,999<br>475,000 – 479,999 |
| | | | AVA | 48,000 – 49,999<br>480,000 – 499,999 |
| | | | All members | 90,000 – 90,999 |

## Canadian Region

| | |
|---|---|
| Area Number Range | 50, 52, 54 |
| Unused Areas | 51, 53, 55 – 59 |
| Zone Number Range | 500 – 599 |
| | 5000 – 5999 |
| Bus Number Range | 50,000 – 59,999 |
| | 80,000 – 81,999 |
| | 500,000 – 599,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 50 | 500 – 519<br>5000 – 5199 | BC Hydro | BCHA | 50,000 – 51,999<br>500,000 – 519,999<br>80,000 – 81,999 |
| 52 | 520 – 539<br>5200 – 5399 | Fortis BC | FBC | 52,000 – 53,999<br>520,000 – 539,999 |
| 54 | 540 – 599<br>5400 – 5999 | Alberta | AESO | 54,000 – 59,999<br>540,000 – 599,999 |

## Central Region

| | |
|---|---|
| Area Number Range | 60, 62 – 65 |
| Unused Areas | 61, 66 – 69 |
| Zone Number Range | 600 – 699 |
| | 6000 – 6999 |
| Bus Number Range | 60,000 – 69,999 |
| | 600,000 – 699,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 60 | 600 – 619<br>6000 – 6199 | Idaho | IPC | 60,000 – 60,999<br>600,000 – 609,999 |
| | | | BPA, Others | 61,000 – 61,999<br>610,000 – 619,999 |
| 62 | 620 – 629<br>6200 – 6299 | Montana | NWMT | 62,000 – 62,999<br>620,000 – 629,999 |
| 63 | 630 – 639<br>6300 – 6399 | WAPA UGP | WAUW | 63,000 – 63,999<br>630,000 – 639,999 |
| 64 | 640 – 649<br>6400 – 6499 | Sierra | SPP | 64,000 – 64,999<br>640,000 – 649,999 |
| 65 | 650 – 699<br>6500 - 6999 | Pace | PACE-UT, WY, ID | 65,000 – 69,999<br>650,000 – 699,999 |

## Eastern Region

| | |
|---|---|
| Area Number Range | 70, 73 |
| Unused Areas | 71, 72, 74 – 79 |
| Zone Number Range | 700 – 799<br>7000 - 7999 |
| Bus Number Range | 70,000 – 79,999<br>700,000 – 799,999 |

| Area No. | Zone Range | Area Name | Member System | Member System Bus Range |
|---|---|---|---|---|
| 70 | 700 – 719<br>770 - 789<br>7000 – 7199<br>7700 – 7899 | PSColorado | PSC, WPE, TSGT | 70,000 – 70,999<br>700,000 – 709,999<br>71,000 – 71,999<br>710,000 – 719,999<br>77,000 – 77,999<br>770,000 – 779,999 |
| | | | PRPA | 78,000 – 78499<br>780,000 – 784,999 |
| | | | CSU | 78,500 – 78,999<br>785,000 – 789,999 |
| 73 | 720 – 769<br>790 – 799<br>730 – 799<br>7300 – 7999 | WAPA R.M. | TSGT | 72,000 – 72,999<br>720,000 – 729,999 |
| | | | WALM | 73,000 – 73,999<br>730,000 – 739,999 |
| | | | BHPL | 74,000 – 74,999<br>740,000 – 749,999 |
| | | | BEPC | 76,000 – 76,999<br>760,000 – 769,999 |
| | | | WAUC | 79,000 – 79,999<br>790,000 – 799,999 |

## Temporary Assignment

If requested, SDWG will assign and maintain the assignment of bus and zone numbers through coordination with the Data Submitter.

| | |
|---|---|
| Area Number Range | Not Applicable |
| Zone Number Range | 8000 - 8999 |
| Bus Number Range | 800,000 – 850,000 |

| Temporary Assignment |
|---|
| |

## Miscellaneous Assignment

| | | |
|---|---|---|
| Area Number Range | Not Applicable | |
| Zone Number Range | Not Applicable | |
| Bus Number Range | 97,000 – 99,999<br>897,000 – 899,999<br>997,000 – 999,999 | **Dummy Buses** |
| Bus Number Range | 1-9,999 | **Internal Use Buses** |

**Revision History**

| Version | Version Date | Editor(s) | Revision Description |
|---|---|---|---|
| | June 26, 2012 | Mark Mallard<br>Gordon Comegys<br>Doug Tucker | • Added Turbine Type field for Generators<br>• Expanded bus number ranges for Areas<br>• Added dynamic data submittal requirement to include all devices that could respond within 60 seconds if an approved model exists |
| | October 12, 2012 | Doug Tucker<br>Gordon Comegys<br>Don Streebel | • Added language for sub-100-kV elements<br>• Fixed minor changes in text |
| | July 18, 2014 | Jonathan Young<br>Doug Tucker | • Accommodate BES Definition<br>• Reword UVLS sections<br>• Added Short Circuit Data info<br>• Added Contingency and Remedial Action Scheme Data<br>• Bus number ranges slightly changed<br>• Few member Acronyms changed<br>• Fixed minor changes in text |
| BCCS | BCCS Version | Jonathan Young | • Incorporated BCCS methodologies |
| BCCS-4 | December 12, 2014 (SRWG Approval) | Jonathan Young<br>J. Ramey | • Added four-digit zone number ranges<br>• WECC Technical Writer edits and formatting |
| BCCS-5 | January 21, 2015 | Jonathan Young<br>John Gross | • Incorporated MOD-032-1 implementation plan concepts |
| BCCS-5.1 | April 24, 2015 | John Gross | • Incorporated PCC comments regarding MOD-032 implementation plan approach. PCC did not approve version BCCS-5. |
| 6 | August 12, 2015 | Jonathan Young<br>John Gross<br>Andrew Christensen | • Incorporated TSS comments to remove direct references to modeling standards.<br>• Removed references to BCCS and reinstated Master Tie-Line File language. |
| 7 | August 9, 2016 | Jonathan Young | • Substations<br>• Added language for BAs |

| | | | |
|---|---|---|---|
| 7 | August 10, 2016 | Nicholas Hatton | • Minor updates as directed by WECC technical writer |
| 8 | August, 2017 | Sirisha Tanneeru | • Added four DPM change requests – Change WAPA L.C. from Area 14 to Area 19, Turbine Type, Transformer Type, Swing Criteria and Branch Type<br>• Changed existing WECC group names to the new RAC groups<br>• Removed Short-circuit data requirement section |
| 9 | November 11, 2017 | Sirisha Tanneeru | • Implemented RAS and APS Zones DPM change requests |
| 10 | January 24, 2018 | Sirisha Tanneeru | • Tech Writer edits |
| 11 | January 24, 2018 | Sirisha Tanneeru | • Updated Appendix 2 so Area-Bus-Zone aligned<br>• Added TSGT to Area 73<br>• Added Bus Low and High Voltage Limits<br>• GWT added to zone 189/1899<br>• Added new Areas (15, 16, 17) |
| 12 | November 30, 2018 | Lukas Boler | • Clarified Balancing Authority as Balancing Authority Area (BAA)<br>• Added Data Maintainer field<br>• Added turbine types 48 and 60 |
| 13 | August 2019 | Elena Melloni | • Updated template<br>• Added turbine types 32 and 33<br>• PRPA and CSU area designation change<br>• Added modifications to approved base cases section<br>• Added DER modeling to generation, load and definition section |
| 14 | April 2020 | Yara Khalaf | • Updated VEA/GLW Area Distinction from Area 18 to 24 |