PowerSimulator Model Formats

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Overview — PowerSimulator Model Formats

Overview

PowerSimulator model formats describe a set of comma-separated-value (CSV) files used to transfer an electrical model.

A separate CSV file is used for each of the object types below. If no objects exist for a given type, that CSV file can be omitted. The first line of each CSV file is a header containing the attribute names for that object as described in this documentation, and each object of that type is written to the file in the subsequent lines.

Initial or subsequent dynamic case information is not part of the scope of this format, but can be specified using the PowerSimulator Case transfer format instead.

Usage Guidelines

- Only include attributes for an object that are actually available from the source data. Any unused attributes should be left blank. If no object in a CSV file uses an attribute, that entire column can be omitted.

- Avoid invented objects or attributes.

- There can be one file per object type, and the filenames must be exactly as documented.

- Each object must have a unique "ID" within the model. The same ID can not be re-used even in different CSV files.

- The import mechanism relies on the column name, not the order of the columns.

- Attributes within each file must be spelled exactly as documented.

- Attributes within each file can appear in any order.

Revision History
Revision 1.12   December 18, 2015
Add number of taps positions to both phase and ratio tap changes. Add neutral KV to phase shifter tap.
Revision 1.11   June 10, 2015
Relocate containment for area and organization to the Node object instead of Substation
Revision 1.10   August 28, 2014
Add continuous tap model to PhaseTapChanger
Revision 1.9   September 24, 2013
Correct RelayOperate to drop ID field
Revision 1.8   September 23, 2013
Add voltage, frequency, and current relays
Revision 1.7   June 4, 2013
Add load area
Revision 1.6   May 28, 2013
Require object ID's to be unique across the entire model. ID's can not be reused even in a different CSV file
Revision 1.5   Apr 17, 2013
Cleanup language for RatioTapChanger to indicate IsRegulation field means that the tap has the capability to regulate, regardless of a specific case.
Revision 1.4   Nov 20, 2012

Remove NormalTap for RatioTapChanger as it is part of case data. The model format should not be concerned with initial or other states.

Revision 1.3   Nov 19, 2012

Add frequency bias to control area. Add ModelParameter.csv to handle model metadata including csv version compliance.

Revision 1.2   April 30, 2012

Add GeneratingUnit relationship to SynchronousMachine. Relax uniqueness of ID, ID's must now be unique within a file, not across the entire system.

Revision 1.1   April 27, 2012

Remove NormalStep and RegulatedNode from PhaseTapChanger, add Transformer reference to TransformerWinding

Revision 1.0   April 19, 2012

Initial Revision

Name

ControlArea.csv — File definition for ControlArea.csv

Description

Attributes

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name   Control Area Name.

Description   Control Area Description

FrequencyBias   Frequency Bias of the area (MW/0.1Hz)

Name

CurrentRelay.csv — File definition for CurrentRelay.csv

Description

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model. *An ID must not be repeated even if it was previously used in a different CSV file.*
Name	CurrentRelay Name
CurrentLimit	Current Limit (amperes)
Delay	Trip time (seconds)
Direction	Current Direction: • Both • Positive • Negative
ProtectedEquipment	ID of equipment to protect. A CurrentRelay can protect a Line, TransformerWinding, or a PhaseShifter.
ProtectedEquipmentNode	ID of node on the desired side of the protected branch device.

Name

FrequencyRelay.csv — File definition for FrequencyRelay.csv

Description

Attributes

ID
Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name
FrequencyRelay Name

LimitType
Limit Type:

- Over

- Under

FrequencyLimit
Frequency Limit (Hz)

Delay
Trip time (seconds)

ProtectedEquipment
ID of equipment to protect. A FrequencyRelay can protect a Node, SynchronousMachine(GeneratingUnit), or a Load.

Name

GeneratingUnit.csv — File definition for GeneratingUnit.csv

Description

A single or set of synchronous machines for generating AC power. In order to create a Generating Unit, one or more SynchronousMachine(s) are required.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model. *An ID must not be repeated even if it was previously used in a different CSV file.*
Name	Generating Unit Name
GeneratingUnitType	Generating Unit Type: • Hydro • Thermal
MinOperatingMW	Minimum operating active power limit the dispatcher can enter for this unit.
MaxOperatingMW	Maximum operating active power limit the dispatcher can enter for this unit.
RatedGrossMinMW	The gross rated minimum generation.
RatedGrossMaxMW	The gross rated maximum generation.
ControlDeadband	Unit control error deadband (MW). No pulses are sent to unit if MW change is less than this deadband.
ControlResponseRate	Unit response rate (MW/sec). Active power change for a control pulse of 1 second in the most responsive loading level of the unit.
StepChange	Unit allowable step change (MW).
SpinReserveRamp	Spin reserve ramp (MW/min).
GenControlMode	Unit control mode: • Setpoint • Pulsed
GovernorSCD	Governor speed changer droop (percent).
GovernorMPL	Governor motor position limit (PU)

Name

Line.csv — File definition for AC Lines

Description

AC Line Segments

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model. *An ID must not be repeated even if it was previously used in a different CSV file.*
Name	Line Name
Circuit	Additional name that can be associated with the line
Node1	ID of the Node to which this object is connected on the "From" side.
Node2	ID of the Node to which this object is connected on the "To" side.
R	Per-Unit Resistance (100 MVA Base).
X	Per-Unit Reactance (100 MVA Base).
Bch	Per-Unit Charging susceptance (100 MVA Base)
Length	Line length (mile)
NormalOperatingLimit	Normal Operating Line limit (MVA)
ShortTermLimit	Short-Term Line limit (MVA)
EmergencyLimit	Line limit (MVA)

Name

Load.csv — File definition for Load.csv

Description

Attributes

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name   Name

Node   ID of the Node to which this object is connected.

LoadArea   ID of the LoadArea containing this load if applicable.

Name

LoadArea.csv — File definition for LoadArea.csv

Description

Provides a mechanism to group loads together to support system load distribution.

Attributes

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

      An ID must not be repeated even if it was previously used in a different CSV file.

Name   Load Area Name.

IsNonConforming Set to true if all loads contained within this group will be nonconforming.

Name

ModelParameter.csv — File definition for ModelParameter.csv

Description

This file allows for general parameter / value pairs. The file should have two columns described in the "Attributes" section below. Recognized parameters are described in the second section

Attributes

ParameterName   Parameter Name

ParameterValue   Parameter Value

Recognized Parameters

ModelFormatVersion   Version of PowerSimulatorModelFormat used

ModelName   Name of model

ModelDescription   Model description

ModelDataVersion   Model data version

SimulationFrequencySetpoint Frequency setpoint for simulation

Name

Node.csv — Import format for Nodes

Description

A conductor with negligible impedance to connect equipment within a single substation

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	Node Name.
NominalKV	Nominal Voltage in KV
Substation	ID of substation containing this node
Organization	ID of related Organization.
ControlArea	ID of related ControlArea.
IsBusBarSection	set to true if this is a bus bar section, false or empty otherwise
FrequencySourcePriority	Frequency Source Priority within the area. Integer, range 0 - 999. 1 = highest priority, 999 = lowest, 0 = not a frequency source.

Name

Organization.csv — File definition for Organization.csv

Description

Name of company or other organization

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name   Organization Name.

Name

PhaseTapChanger.csv — File definition for PhaseTapChanger Objects

Description

PhaseTapChanger.

Attributes

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

                                An ID must not be repeated even if it was previously used in a different CSV file.

Name   Tap Changer Name

TapNode   ID of the Node where the tap is located.

TransformerWinding   ID of the TransformerWinding where the tap is located.

StepSize   Phase shift per step position (DEG). A positive value indicates a positive phase shift from the winding where the tap is located to the other winding (for a two-winding transformer).

                                Tap capabilities can either be specified using the discrete values, or the continuous. The discrete values will be used when both ar provided.

MinTap   Lowest possible tap step position

MaxTap   Highest possible tap step position

NeutralTap   Tap position at Zero Phase shift

MinAng   angle minimum (DEG)

MaxAng   angle maximum (DEG)

TapPositions   number of tap positions

NeutralKV   Nominal nameplate voltage

IsRegulating   true if tap is used to regulate MW flow.

MinRegMW   Minimum MW when regulating active power

MaxRegMW   Maximum MW when regulating active power

InitialDelay   Seconds delay of initial tap change

SubsequentDelay   Seconds delay of subsequent tap change

Name

PrimeMover.csv — File definition for PrimeMover.csv

Description

The machine used to develop mechanical energy used to drive a generator.

Attributes

ID
: Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

  An ID must not be repeated even if it was previously used in a different CSV file.

Name
: Prime Mover Name

SynchronousMachine
: ID of the SynchronousMachine

Type
: Prime Mover Type:

  - HydroTurbine

  - SteamTurbine

  - CombustionTurbine

Name

RatioTapChanger.csv — File definition for RatioTapChanger Objects

Description

RatioTapChanger.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model. *An ID must not be repeated even if it was previously used in a different CSV file.*
Name	Tap Changer Name
TransformerWinding	ID of the TransformerWinding where the tap is located.
TapNode	ID of the Node where the tap is located.
StepSize	Tap step size (percent of Nominal KV)
MinTap	Lowest possible tap step position
MaxTap	Highest possible tap step position
NeutralTap	Tap position at Neutral KV
NeutralKV	Nominal nameplate voltage
MinRatio	Min Tap Ratio (PU voltage)
MaxRatio	Max Tap Ratio (PU voltage)
TapPositions	Number of tap positions
IsRegulating	True if tap can change under load to regulate voltage
MinKV	Minimum voltage limit
MaxKV	Maximum voltage limit
RegulatedNode	ID of Regulated Node
InitialDelay	Seconds delay of initial tap change
SubsequentDelay	Seconds delay of subsequent tap change

Name

ReactiveCapabilityCurve.csv — File definition for ReactiveCapabilityCurve.csv

Description

Reactive Capability of a SynchronousMachine. At least two MW points should be present for each SynchronousMachine. Curve points are defined here only for machines defined explicitly in the SynchronousMachine file.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
SynchronousMachine	ID of the SynchronousMachine
MW	MW at MVAr limits
MinMVAr	Minimum MVAR limit
MaxMVAr	Maximum MVAr limit

Name

RelayOperate.csv — File definition for RelayOperate.csv

Description

Attributes

RelayID   ID of relay (required)

OperatedEquipmentID   ID of operated circuit breaker (required).

Action   Action:

- BreakerTrip

- BreakerClose

Name

SeriesCapacitor.csv — File definition for SeriesCapacitor

Description

SeriesCapacitors

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	Series Capacitor Name
Circuit	Additional name that can be associated with the device
Node1	ID of the Node to which this object is connected on the "From" side.
Node2	ID of the Node to which this object is connected on the "To" side.
R	Per-Unit Resistance (100 MVA Base)
X	Per-Unit Reactance (100 MVA Base)
NormalOperatingLimit	Normal Operating limit (MVA)
ShortTermLimit	Short-Term limit (MVA)
EmergencyLimit	Emergency Limit (MVA)

Name

SeriesReactor.csv — File definition for SeriesReactor

Description

SeriesReactors

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	Series Reactor Name
Circuit	Additional name that can be associated with the device
Node1	ID of the Node to which this object is connected on the "From" side.
Node2	ID of the Node to which this object is connected on the "To" side.
R	Per-Unit Resistance (100 MVA Base)
X	Per-Unit Reactance (100 MVA Base)
NormalOperatingLimit	Normal Operating limit (MVA)
ShortTermLimit	Short-Term limit (MVA)
EmergencyLimit	Emergency Limit (MVA)

Name

ShuntCapacitor.csv — File definition for a Shunt Capacitor

Description

Shunt Capacitor.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model. *An ID must not be repeated even if it was previously used in a different CSV file.*
Name	Name
Node	ID of the Node to which this object is connected.
MVAr	MVAr at nominal KV.
HasRegulator	Must be "true" or "yes" if device has a regulator. Any other string (or empty) means false.
RegulatedNode	ID of the regulated Node.
MinKV	If regulated, minimum KV of bus before device is switched in.
MaxKV	If regulated, Maximum KV of bus before device is switched out.
EnergizeDelay	If regulated, seconds until device is energized.
DeenergizeDelay	If regulated, seconds until device is de-energized.

Name

ShuntReactor.csv — File definition for a Shunt Reactor

Description

Shunt Reactor.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	Name
Node	ID of the Node to which this object is connected.
MVAr	MVAr at nominal KV.
HasRegulator	Must be "true" or "yes" if device has a regulator. Any other string (or empty) means false.
RegulatedNode	ID of the regulated Node.
MinKV	If regulated, minimum KV of bus before device is switched in.
MaxKV	If regulated, maximum KV of bus before device is switched out.
EnergizeDelay	If regulated, seconds until device is energized.
DeenergizeDelay	If regulated, seconds until device is de-energized.

Name

Substation.csv — File definition for Substation.csv

Description

Collection of equipment.

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name   Substation Name.

Name

SynchronousMachine.csv — File definition for SynchronousMachine.csv

Description

Single machine operating as a generator, synchronous condenser, or pump.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	Synchronous Machine Name
Node	ID of the Node to which this object is connected.
GeneratingUnit	ID of the GeneratingUnit.
MinKV	Minimum voltage limit for the unit.
MaxKV	Maximum voltage limit for the unit.
RegulatedNode	ID of Regulated Node
R	Resistance PU on 100MVA Base
X	Reactance PU on 100MVA Base
Inertia	Inertia constant of generator or motor and mechanical load (MW-s)/MVA
ControllingSwitch	ID of controlling Switch.

Name

SVC.csv — File definition for a SVC

Description

Static Var Compensator.

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

              An ID must not be repeated even if it was previously used in a different CSV file.

Name   Name

Node   ID of the Node to which this object is connected.

MinMVAr   Minimum MVAr

MaxMVAr   Maximum MVAr.

Slope   The characteristics slope of an SVC defines how the reactive power output changes in proportion to the difference between the regulated bus voltage and the voltage setpoint. kV/MVAr, per unit based on Max MVAR (%)

Name

Switch.csv — File definition for a Switch

Description

Switch device capable of making, carrying, and breaking currents.

Attributes

ID   Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name   Switch Name

Node1   ID of the Node to which this object is connected.

Node2   ID of the Node to which this object is connected.

SwitchType   ID of SwitchType

Name

SwitchType.csv — File definition for a SwitchType

Description

User-defined switch types

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	SwitchType Name
OpenUnderLoad	Set to true if device can open under load
CloseUnderLoad	Set to true if device can close under load

Name

Transformer.csv — File definition for Transformer Objects

Description

Power Transformers.

Attributes

ID
Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.

An ID must not be repeated even if it was previously used in a different CSV file.

Name
Transformer Name.

Circuit
Additional name used to identify a circuit.

WindingCount
Number of Windings

Name

TransformerWinding.csv — File definition for TransformerWinding Objects

Description

TransformerWinding.

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model.
	An ID must not be repeated even if it was previously used in a different CSV file.
Name	Winding Name
Transformer	ID of the Transformer object containing this winding.
Node1	ID of the Node to which the winding is connected.
Node2	ID of the Node to which the winding is connected.
R	Resistance of the winding P.U. on 100MVA Base
X	Reactance of the winding P.U. on 100MVA Base
Gmag	Per-Unit Magnetizing conductance on 100MVA Base
Bmag	Per-Unit Magnetizing susceptance on 100MVA Base
PhaseShift	Fixed phase angle (degrees) through the branch, positive into the from-side bus
NormalOperatingLimit	Normal Operating limit (MVA)

Name

VoltageRelay.csv — File definition for VoltageRelay.csv

Description

Attributes

ID	Unique identifier (String). Attribute is required to exist. Must be unique from all other object identifiers in the model. *An ID must not be repeated even if it was previously used in a different CSV file.*
Name	VoltageRelay Name
LimitType	Limit Type: • Over • Under
VoltageLimit	Voltage Limit (per-unit)
Delay	Trip time (seconds)
ProtectedEquipment	ID of equipment to protect. A VoltageRelay can protect a Node, SynchronousMachine(GeneratingUnit), Shunt, or a Load.