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System Losses and Derates in PVSim: Balance of System Loss Modeling

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PVSim Balance of System Loss Inputs

- Static model option:

Balance of System Losses

Loss scheme:

DC System

Calculate wiring loss

Array Wiring: Ave. array radius: meters Feeder gauge:

Ave. feeder length: meters No. feeders/inverter:

Use static wiring loss

DC wiring loss: %

Array Mismatch: Mismatch Loss: %

Inverter: Nominal efficiency: 97.0 % Total inverter kVA: 9120

AC System

Calculate AC losses Use static AC losses

Transformers and AC Collection: MV transformer efficiency: %

HV transformer efficiency: %

AC wiring loss: %

Auxiliary load loss: %

Operational Efficiency: System availability: %

PVSim Balance of System Loss Inputs

- Dynamic model option:

Balance of System Losses

Loss scheme:

DC System

Calculate wiring loss

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Use static wiring loss

DC wiring loss %

Array Mismatch: Mismatch Loss: %

Inverter: Nominal efficiency: 97.0 % Total inverter kVA: 9120

AC System

Calculate AC losses Use static AC losses

Padmount Transformer and MV Collection:	Transformer no-load loss:	<input type="text" value="0.09"/> %	HV Step-Up Transformer and HV Transmission:	Transformer no-load loss:	<input type="text" value="0"/> %
	Transformer rated load loss:	<input type="text" value="1.13"/> %		Transformer rated load loss:	<input type="text" value="0"/> %
	Auxiliary load loss:	<input type="text" value="0.18"/> %		Auxiliary load loss:	<input type="text" value="0"/> %
	MV collector rated load loss:	<input type="text" value="0.19"/> %		Tx line rated load loss:	<input type="text" value="0"/> %

Grid Inter-connection: Max. system kVA at POI: Curtail excess power at interconnect

Inverter power factor:

Collector voltage factor:

Account for nighttime losses

Operational Efficiency: System availability: %

DC Wiring Loss Model

DC System

Calculate wiring loss

Array Wiring: Ave. array radius: meters Feeder gauge: ▼

Ave. feeder length: meters No. feeders/inverter: ▼

Use static wiring loss

DC wiring loss %

Array Mismatch: Mismatch Loss: %

Inverter: Nominal efficiency: 97.0 % Total inverter kVA: 9120

- Voltage drop calculated across strings and feeders:

$$P_{loss} = \sum(V_{drop_string} * I_{string}) + \sum(V_{drop_feeder} * I_{feeder})$$

- Conductor sizing estimated from max short-circuit current if the user is unsure of exact parameters

Inverter Efficiency & Clipping

DC System

Calculate wiring loss

Array Wiring: Ave. array radius: meters Feeder gauge: ▼

Ave. feeder length: meters No. feeders/inverter: ▼

Use static wiring loss

DC wiring loss %

Array Mismatch: Mismatch Loss: %

Inverter: Nominal efficiency: 97.0 % Total inverter kVA: 9120

- Sandia Performance Model for Grid-Connected Photovoltaic Inverters¹
- Dynamic (with temperature) AC capacity model

[1] King, D. Gonzalez, S., Galbraith, G., Boyson, W., 2007, Performance Model for Grid-Connected Photovoltaic Inverters

Auxiliary Load Loss

AC System

Calculate AC losses Use static AC losses

Padmount Transformer and MV Collection:	Transformer no-load loss:	<input type="text" value="0.09"/>	%	HV Step-Up Transformer and HV Transmission:	Transformer no-load loss:	<input type="text" value="0"/>	%
	Transformer rated load loss:	<input type="text" value="1.13"/>	%		Transformer rated load loss:	<input type="text" value="0"/>	%
	Auxiliary load loss:	<input type="text" value="0.18"/>	%		Auxiliary load loss:	<input type="text" value="0"/>	%
	MV collector rated load loss:	<input type="text" value="0.19"/>	%		Tx line rated load loss:	<input type="text" value="0"/>	%
Grid Inter-connection:	Max. system kVA at POI:	<input type="text" value="9120"/>		<input checked="" type="checkbox"/> Curtail excess power at interconnect			
	Inverter power factor:	<input type="text" value="0.99"/>					
	Collector voltage factor:	<input type="text" value="1.03"/>					
	<input checked="" type="checkbox"/> Account for nighttime losses						
Operational Efficiency:	System availability:	<input type="text" value="98.0"/>	%				

- Auxiliary loads are modeled as a constant reduction in output
- User can choose whether or not to include nighttime losses

Transformer & AC Line Losses

AC System

Calculate AC losses Use static AC losses

Padmount Transformer and MV Collection:	Transformer no-load loss:	<input type="text" value="0.09"/>	%	HV Step-Up Transformer and HV Transmission.	Transformer no-load loss:	<input type="text" value="0"/>	%
	Transformer rated load loss:	<input type="text" value="1.13"/>	%		Transformer rated load loss:	<input type="text" value="0"/>	%
	Auxiliary load loss:	<input type="text" value="0.18"/>	%		Auxiliary load loss:	<input type="text" value="0"/>	%
	MV collector rated load loss:	<input type="text" value="0.19"/>	%		Tx line rated load loss:	<input type="text" value="0"/>	%
Grid Inter-connection:	Max. system kVA at POI:	<input type="text" value="9120"/>		<input checked="" type="checkbox"/> Curtail excess power at interconnect			
	Inverter power factor:	<input type="text" value="0.99"/>					
	Collector voltage factor:	<input type="text" value="1.03"/>					
	<input checked="" type="checkbox"/> Account for nighttime losses						
Operational Efficiency:	System availability:	<input type="text" value="98.0"/>	%				

- Transformer loss:

$$P_{loss} = P_{no_load_loss} + P_{variable_load_loss}$$

- AC line loss:

$$P_{loss} = P_{variable_load_loss}$$

- Variable loss calculation:

$$P_{variable_load_loss} = P_{rated_load_loss} * \left(\frac{P_{in}}{PF * VF * P_{rated}} \right)^2$$

Balance of System Loss Accounting

Annual Losses & Adjustments vs. STC (%)	
<i>Inter-Array Shading Loss</i>	0.00
<i>Site Shading Loss</i>	0.00
<i>Soiling Loss</i>	-3.00
<i>Tracker Misalignment Loss</i>	0.00
<i>Angle-of-Incidence Loss</i>	-0.97
<i>Air Mass Adjustment</i>	0.16
<i>Operating Temperature Adjustment</i>	-7.23
<i>Efficiency vs. Irradiance Adjustment</i>	-1.47
<i>Module Flash Adjustment</i>	0.23
<i>Module Light-Induced Degradation Adjustment</i>	0.00
<i>Module Mismatch Loss</i>	-1.00
<i>DC Wiring Loss</i>	-1.50
<i>Inverter DC Limit Loss</i>	0.00
<i>Inverter Efficiency Adjustment</i>	-1.68
<i>Inverter AC-Capacity Clipping Loss</i>	-0.01
<i>LV Auxiliary Load Loss</i>	-0.01
<i>Padmount Transformer Loss</i>	-1.00
<i>MV Collector Loss</i>	-0.20
<i>MV Auxiliary Load Loss</i>	-0.20
<i>HV Step-Up Transformer Loss</i>	-0.20
<i>Transmission Line Loss</i>	-0.60
<i>Interconnect Curtailment Loss</i>	0.00
<i>Annual Availability</i>	98.0

End-of-Interval Timestamp	Array Losses		AC Balance of System Losses						
	Wiring Loss (W)	Mismatch Loss (W)	LV Aux. Load Loss (kW)	Padmount Transformer Loss (kW)	MV Collector Loss (kW)	Substation Aux. Load Loss (kW)	HV Step-Up Transformer Loss (kW)	Transmission Line Loss (kW)	Interconnection Curtailment Loss (kW)
01/01 10:00:00	45.0	30.1	0.10	0.21	0.40	0.05	0.10	0.34	0

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