

Introduction to PowerWorld Simulator: Interface and Common Tools



19: Limit Monitoring Settings



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Limit Monitoring Settings



- Many tools in Simulator use power system limits of some type
 - Contingency analysis
 - Available Transfer Capability (ATC)
 - Optimal Power Flow (OPF)
 - Security Constrained Optimal Power Flow (SCOPF)
 - PV and QV Curve Tool (PVQV)
- Limits for power system elements include
 - MVA or Amp limits on transmission lines and transformers
 - MW limits on interfaces
 - High and low voltage limits for buses
 - Angle limits for Bus Pairs

Limit Monitoring Settings



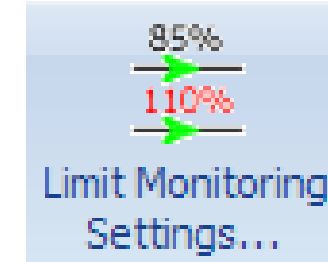
- By **DEFAULT, ALL** elements in the power system are monitored
- Use Limit Monitoring Settings to
 - Exclude elements in the power system that are of no interest for a particular study
 - Specify which limits should be monitored, or in the case of the OPF and SCOPF, which limits should be enforced
 - Specify which limit sets should be used for a particular study and how these limit sets should be applied
- Limit Monitoring Settings will be used extensively with the tools discussed in the remainder of the training

Limit Monitoring Settings



- Define settings for monitoring limits by selecting the **Tools** ribbon tab

Limit Monitoring Settings



- Create or modify Limit Groups and assign devices to different Limit Groups
- Different Line, Interface and Voltage limits can be assigned to each Limit Group, and each device within a Limit Group will adhere to its own Limit Group Settings

Limit Monitoring Settings



- In general, keep in mind that a bus, transmission line/transformer, interface, or bus pair limit is monitored only if the following conditions are met
 - Its Monitor field is set to YES
 - Its Limit Group is Enabled
 - Its Area is set to Report Limits and it meets the kV range for reporting
 - Its Zone is set to Report Limits and it meets the kV range for reporting

Limit Monitoring Dialog Tabs



- Area/Zone Reporting
 - You can specify which areas/zones to monitor and what kV ranges to monitor in these areas/zones
- Buses, Lines, Interfaces, Nomograms, and Bus Pairs show the individual elements of the power system
 - Important columns are
 - Monitor: specifies whether to monitor that specific element
 - Limit Group: specifies the Limit Group that the element belongs to
- Modify/Create Limit Groups
 - Use to create and modify Limit Groups.
 - By default all elements are in a limit group named Default

Limit Monitoring Dialog: Area/Zone Reporting Tabs



Limit Monitoring Settings and Limit Violations

Use the Modify/Create Limit Groups to tab to modify and create limit groups to which Buses, Lines and Interfaces can be assigned. Use the Buses, Lines and Interfaces tabs to assign elements to different limit groups. The Areas and Zones tabs are provided here for your convenience.

Save Monitoring Settings Close
Load Monitoring Settings Help

Elements to Show
 All Elements
 Monitored Elements
 Violating Elements

Number Of Violations

Low Voltage Buses	0
High Voltage Buses	0
Low-voltage Suspects	0
Lines/Transformers	0
Interfaces	0
Bus Pairs	0

Limit Group Values
 Limit Group: Default
 Group Disabled / Do Not Monitor

Lines & Transformers Interfaces Buses Bus Pairs

Percentage: 100.000000
 Normal Rating Set: A
 Contingency Rating Set: A
 Treat Line Limits as Equivalent Amps
 Do not monitor radial lines and buses (applied to all limit groups)
 (This option is not applied if using topology processing)

Buses Lines Interfaces Nomograms Bus Pairs Area Reporting Zone Reporting Modify/Create Limit Groups Rating Set Names

Filter: Advanced BusGroup Find... Remove Quick Filter

Areas and Zones are not assigned to limit groups. However, a power system element is only monitored if ALL of the following are true

1. Its Monitor field is set to YES
2. Its Limit Group is Enabled
3. Its Area is set to Report Limits and it meets the KV range for reporting
4. Its Zone is set to Report Limits and it meets the KV range for reporting

Because of this, the Area and Zone Lists are provided here for your convenience

	Area Num	Area Name	Report Limits	Report Min kV	Report Max kV
1	1	Top	YES	0.00	9999.00
2	2	Left	YES	0.00	9999.00
3	3	Right	YES	0.00	9999.00

Search Search Now Options

Limit Monitoring Dialog: Lines Tab



Limit Monitoring Settings and Limit Violations

Use the Modify/Create Limit Groups to tab to modify and create limit groups to which Buses, Lines and Interfaces can be assigned.

Use the Buses, Lines and Interfaces tabs to assign elements to different limit groups.

The Areas and Zones tabs are provided here for your convenience.

Save Monitoring Settings

Load Monitoring Settings

Elements to Show

- All Elements
- Monitored Elements
- Violating Elements

Number Of Violations

- Low Voltage Buses: 0
- High Voltage Buses: 0
- Low-voltage Suspects: 0
- Lines/Transformers: 0
- Interfaces: 0

Limit Group Values

Limit Group: **Default**

Group Disabled / Do Not Monitor

Lines & Transformers | Interfaces | Buses

Percentage: 100.0

Normal Rating Set: **A**

Contingency Rating Set: **A**

Treat Line Limits as Equivalent Amps

Do not monitor radial lines and buses (applied to all limit groups)

Buses | **Lines** | Interfaces | Nomograms | Area Reporting | Zone Reporting | Modify/Create Limit Groups

Records | Geo | Set | Columns | Options

	From Number	From Name	To Number	To Name	Circuit	Monitor	Limit Group	Limiting Flow Used	Limit Used	% of Limit
1	1	One	2	Two	1	YES	Default	236.0	627.6	
2	1	One	3	Three	1	YES	Default	180.0	271.9	
3	2	Two	3	Three	1	YES	Default	166.8	334.7	
4	2	Two	4	Four	1	YES	Default	142.5	418.4	
5	2	Two	5	Five	1	YES	Default	317.7	418.4	
6	2	Two	6	Six	1	YES	Default	172.9	836.7	
7	3	Three	4	Four	1	YES	Default	147.9	418.4	
8	4	Four	5	Five	1	YES	Default	72.6	251.0	
9	7	Seven	5	Five	1	YES	Default	247.6	836.7	

Limit Monitoring Dialog: Limit Groups Tab



Limit Monitoring Settings and Limit Violations

Use the Modify/Create Limit Groups to tab to modify and create limit groups to which Buses, Lines and Interfaces can be assigned.

Use the Buses, Lines and Interfaces tabs to assign elements to different limit groups.

The Areas and Zones tabs are provided here for your convenience.

Save Monitoring Settings

Load Monitoring Settings

Elements to Show

- All Elements
- Monitored Elements
- Violating Elements

Number Of Violations

Low Voltage Buses	0
High Voltage Buses	0
Low-voltage Suspects	0
Lines/Transformers	0
Interfaces	0

Limit Group Values

Limit Group: **Default**

Group Disabled / Do Not Monitor

Lines & Transformers | **Interfaces** | **Buses**

Percentage: 100.0

Normal Rating Set: **A**

Contingency Rating Set: **A**

Treat Line Limits as Equivalent Amps

Do not monitor radial lines and buses (applied to all limit groups)

Buses | **Lines** | **Interfaces** | **Nomograms** | **Area Reporting** | **Zone Reporting** | **Modify/Create Limit Groups**

Use this tab to modify/create limit groups to which Buses, Lines, and Interfaces can be assigned.

	Limit Group	Disabled	Branch %	Line Rate Set	CTG Line Rate Set	Amps or MVA	Interface %	Int. Rate Set	CTG Int. Rate Set	Low PU Volt	High PU Volt	Ctg Low PU Volt	Ctg High PU Volt	Bus Low Rate Set	Bus High Rate Set
1	Default	NO	100.00	A	A	Amp/MVA	100.00	A	A	0.9000	1.1000	0.9000	1.1000	A	A

Limit Monitoring Dialog



- Elements to Show
 - Determine which elements should be displayed in the grids contained on the dialog tabs
- Number of Violations
 - Summary of how many elements have violations
- Limit Group Values
 - Limit Group
 - Select the Limit Group name to set options using the Lines & Transformers, Interfaces, and Buses tabs (Top Right)
 - Group Disabled/Do Not Monitor
 - Check this box to ignore all power system element limits in the Limit Group.
 - Do not monitor radial lines and buses (applied to all limit groups)
 - Check this box to ignore limits caused by radial lines and buses
- Most Limit Group options can be set in the upper right portion of the dialog, the Modify/Create Limit Groups tab, or the Limit Group Dialog

Elements to Show	
<input checked="" type="radio"/> All Elements	
<input type="radio"/> Monitored Elements	
<input type="radio"/> Violating Elements	

Number Of Violations	
Low Voltage Buses	0
High Voltage Buses	0
Low-voltage Suspects	0
Lines/Transformers	0
Interfaces	0

Graphical Summary of Branch Limit Monitoring Settings



Branch Records (Interface records work in a similar manner)

LineAMVA, LineAMVA:1, ...

Resulting Limits that are used *LineAMVA:14*

	<i>LSName</i>			<i>LSName</i>							
	Normal Rating Used	Contingency Rating Used	Limit Group	A	B	C	D	E	F	G	H
Branch 1	31	71	My Group	11	21	31	41	51	61	71	81
Branch 2	33	73	My Group	13	23	33	43	53	63	73	83
Branch 3	35	75	My Group	15	25	35	45	55	65	75	85
Branch 4	37	77	My Group	17	27	37	47	57	67	77	87
Etc...			Etc...								

LimitSet Records

My Group	C	G
Limit Group Name	Normal Rating	Contingency Rating

LSName

LSLineRateSet

LSLineRateSet:1

Limit Monitoring Dialog: Lines & Transformers Tab (Top Right)



- Parameters pertain to the presently selected Limit Group (can also be viewed/edited on the Modify/Create Limit Groups Tab)
- Line/Transformer Percentage
 - The percentage to which Simulator’s study tools will limit a line. Typically this is 100%, but it can be modified.
- Line/Transformer Normal Rating Set
 - Specifies the Rating Set used in the power flow and other tools when no contingency is applied
 - You may define up to 15 different ratings for transmission lines or transformers, lettered A through O. Rating values are stored in stored in Branch fields
- Line/Transformer Contingency Rating Set
 - Specifies the Rating Set used for post-contingency monitoring of Lines/Transformers during Contingency Analysis

Limit Monitoring Dialog: Lines & Transformers Tab (Top Right)



- Treat Line Limits as Equivalent Amps
 - Limits for transmission lines and transformers are always entered in MVA. However, when reporting limit violations, it is common to check transmission line limits in terms of their amp loading.
 - For reference, the amp rating of a line is derived from the MVA rating using the formula

$$AmpRating = \frac{MVARating}{\sqrt{3} * BaseKV} * 1000$$

Limit Monitoring Dialog: Interfaces Tab (Top Right)



- Interface Percentage
 - The percentage to which Simulator’s study tools will limit an interface. Typically this is 100%, but it can be modified.
- Interface Normal Rating Set
 - Specifies the Rating Set used in the power flow and other tools when no contingency is applied
 - You may define up to 15 different ratings for Interfaces, lettered A through O. Rating values are stored in Interface fields.
- Interface Contingency Rating Set
 - This field specifies the rating set used for post-contingency monitoring of Interfaces during Contingency Analysis.

Limit Monitoring Dialog: Buses Tab (Top Right)



- Low Voltage Limit (Normal and Contingency)
 - By default, monitored buses will be flagged as violated if they fall below this per unit voltage
- High Voltage Limit (Normal and Contingency)
 - By default, monitored buses will be flagged as violated if they go above this per unit voltage
- Voltage Rating Sets
 - Determine the rating set to use if buses are using bus specific limits
 - Four different high and low limits, A, B, C, and D, can be defined for each bus
 - Use Specific Limits field must be YES for a bus to use one of these voltage rating sets

Graphical Summary of Bus Limit Monitoring Settings



Bus Records

Resulting Limits that are used

BusVoltLimLow:1,... BusVoltLimHigh1,...
BusVoltLimLow:4 BusVoltLimHigh:4

	Resulting Limits that are used				LSName	BusVoltLim	BusVoltLimLow				BusVoltLimHigh			
	Low Limit	CTG Low Limit	High Limit	CTG High Limit			Limit Group	Use Bus-Specific	Low A	Low B	Low C	Low D	High A	High B
Bus 1	0.94	0.91	1.06	1.07	My Group	YES	0.94	0.93	0.91	0.89	1.05	1.06	1.08	1.07
Bus 2	0.95	0.95	1.05	1.05	My Group	NO								
Bus 3	0.95	0.95	1.05	1.05	My Group	NO								
Bus 4	0.96	0.92	1.08	1.09	My Group	YES	0.96	0.94	0.92	0.90	1.07	1.08	1.10	1.09
Etc...					Etc...									

LimitSet Records

Use Bus-Specific

NO : means the LimitSet Low Per Unit and High Per Unit Values are used
YES : means that the Rating Set Values are used (same as for Branches)

My Group	0.95	1.05	A	C	B	D
Limit Group Name	Low Per Unit	High Per Unit	Low Ratings Set	Contingency Low Set	High Ratings Set	Contingency High Set

LSName

LSPULow

LSPUHigh

LSBusLowRateSet

LSBusHighRateSet

LSctgBusLowRateSet

LSctgBusHighRateSet

Limit Monitoring Dialog: Bus Pairs Tab (Top Right)



- **Bus Pairs Percentage**
 - The percentage to which Simulator’s study tools will monitor a Bus Pair angle.
- **Bus Pairs Normal Rating Set**
 - Specifies the Rating Set used in the power flow and other tools when no contingency is applied
 - You may define up to 4 different ratings for Bus Pairs, lettered A through D. Rating values are stored in Interface fields.
- **Bus Pairs Contingency Rating Set**
 - This field specifies the rating set used for post-contingency monitoring of Bus Pairs during Contingency Analysis.

Limit Group Dialog



- Right-click on one of the limit groups and choose Show Dialog to bring up the Limit Group Dialog

% Flow	\$/MWh
100.0	10
105	50
110	60

Piece-wise Linear Limit Cost function for use with unenforceable constraints in OPF and SCOPF. This will be discussed later in the Markets Course.

Limit Group Dialog



- Limiting End
 - For a transmission branch, the percent loading will normally be slightly different at each end of the branch with the AC power flow
 - Set to Higher Flow or Lower Flow (Higher Flow is common)

Limit Group Dialog

Contingency Options



- Contains many of the same options specified with Contingency Analysis Advanced Limit Monitoring
- Options specified with Limit Group override those specified with Contingency Analysis

The screenshot shows the 'Limit Group Dialog' window with the 'Contingency Options' tab selected. The 'Limit Group Name' is set to 'Default'. There are buttons for 'Add New Limit Group' and 'Rename Limit Group'. A 'Disabled' checkbox is present. The 'Contingency Options' section includes:

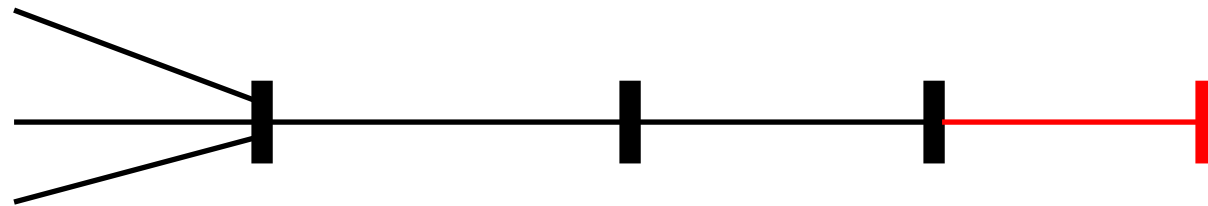
- Use group specific contingency options
- Never report violations if the ...
 - Increase in line/transformer flows \leq 0.00 %
 - Decrease in low bus voltage \leq 0.0000 pu
 - Increase in high bus voltage \leq 0.0000 pu
 - Increase in interface flows \leq 0.00 %
- Report as a violation if a bus becomes disconnected
- How to Monitor Voltage Changes
 - Monitor per unit changes
 - Monitor percentage changes
- Always report as a violation if the ...
 - Increase in line/transformer flows \geq 0.00 %
 - Decrease in low bus voltage \geq 0.0000 pu
 - Increase in high bus voltage \geq 0.0000 pu
 - Increase in interface flows \geq 0.00 %

At the bottom, there are buttons for 'OK', 'Delete', 'Cancel', 'Print', and 'Help'.

Radial Elements



- Radial buses are connected to the rest of the system by a single line. A line is considered radial if it is this branch.
 - Often are a “problem” due to bad data
 - Generator output is larger than the step-up transformer’s limit
 - Large load connected to system by line with limit less than the load value
 - This is a modeling problem, and you may want to just ignore all such violations
 - Note: only the last bus and line are classified radial in this figure



- Check **Do not monitor radial lines and buses** to ignore limit violations (global setting that applies to ALL branches and buses)

Simulator Tip



- Make extensive use of the Advanced Filtering to help you set up Limit Monitoring Settings
 - Once you apply an advanced filter that limits what you are viewing to only those elements you want to change, you can use Toggle All on the local menu to set the Monitor Field, or the Limit Group Field to the value you are interested in

Showing Limit Violations for the present power system



- Set **Elements to Show** to **Violating Elements** to filter the lists of elements to only those that have a violation
- Select the Buses, Lines, Interfaces, Nomograms, or Bus Pairs tab to view violated elements of that type
- Violations are reported only for those devices that the Limit Monitoring Settings are set to monitor

Slide Intentionally Left Blank