

Transient Stability Analysis with PowerWorld Simulator



T6: Storage of Transient Stability Results



PowerWorld
Corporation

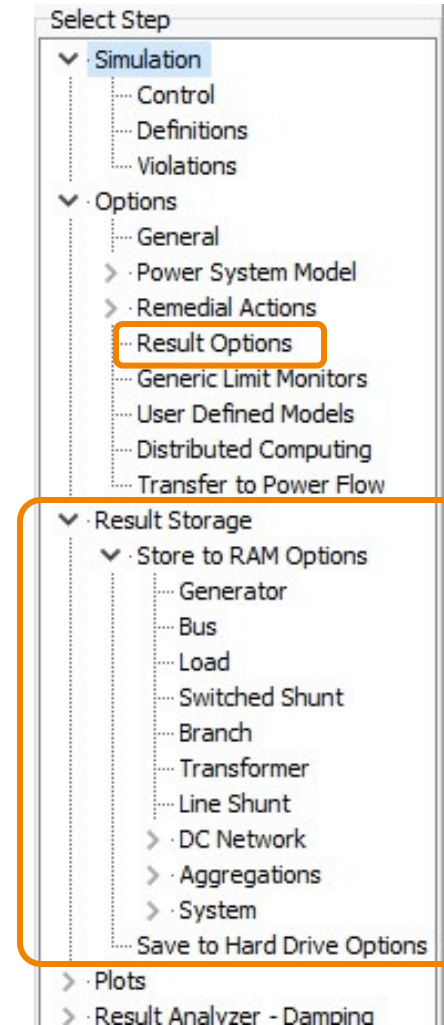
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Result Storage



- Result Options
- What results can be stored
- Where results can be saved
- How often to save results



Transient Stability Options: Result Options



- Viewed from the Result Options tab of the Options page of the Transient Stability Analysis dialog
- When to Begin Checking Min/Max Values
 - When performing a fault, obviously the voltages will be very low during the fault
 - Do not start checking these values until after the last event to avoid reporting these values
 - This allows you to capture how values recover after a fault clears

Options Modal Analysis

Note: Changes made to option entries are saved immediately and will be applied.

General Power System Model Remedial Actions Result Options General

Time to Begin Checking for Minimum and Maximum Results

☒ After last event

☐ Immediately

☐ Custom Time 0.000

☐ Never (Do Not Monitor)

Time to Begin Checking for Limit Monitors Results

☒ After last event - Time after last event: 0.000

☐ Immediately

☐ Custom Time 0.000

Angle Reference Options

Angle Reference

☒ Average of Generator Angles

☐ Weighted Average of Generator Angles

☐ Specified Angle Reference Generator Terminal Angle

☐ Specified Angle Reference Generator Internal Angle

☐ Synchronous Reference Frame (No Angle Shift)

Angle Reference Generator 1 (Bus1) #1 Find...

☐ Initialize with Reference Angle at Zero

Note: This reference is not used if infinite buses are modeled

Transient Stability Options: Result Options



- Viewed from the Result Options tab of the Options page of the Transient Stability Analysis dialog
- When to Begin Checking for Limit Monitoring Results
 - Do not start checking these values until after the last event to avoid reporting these values
 - Do not start checking these values after last event and the specified time
 - This allows you to capture how limit values behave and will be captured

Options Modal Analysis

Note: Changes made to option entries are saved immediately and will be applied.

General Power System Model Remedial Actions Result Options Get

Time to Begin Checking for Minimum and Maximum Results

☒ After last event

☐ Immediately

☐ Custom Time 0.000

☐ Never (Do Not Monitor)

Time to Begin Checking for Limit Monitors Results

☒ After last event - Time after last event: 0.000

☐ Immediately

☐ Custom Time 0.000

Angle Reference Options

Angle Reference

☒ Average of Generator Angles

☐ Weighted Average of Generator Angles

☐ Specified Angle Reference Generator Terminal Angle

☐ Specified Angle Reference Generator Internal Angle

☐ Synchronous Reference Frame (No Angle Shift)

Angle Reference Generator 1 (Bus1) #1 Find...

☐ Initialize with Reference Angle at Zero

Note: This reference is not used if infinite buses are modeled

Transient Stability Options: Result Options



- Angle Reference
 - If the slack bus is an infinite bus, this option is not used
 - the slack bus angle is reference
 - Otherwise, this option is used
 - *Average of Generator Angles*: the average of all rotor angles in the system
 - *Weighted Average of Generator Angles*: the average of all rotor angles weighted by each generator's MVA base
 - *Specified Angle Reference Generator Terminal Angle*: the terminal bus angle of the specified generator
 - *Specified Angle Reference Generator Internal Angle*: the internal bus angle of the specified generator
 - *Synchronous Reference Frame (No Angle Shift)*: all rotor angles are reported on the synchronous reference frame.
- Initialize the Reference Angle at Zero
 - An additional constant shift is applied to all angles throughout the entire simulation. Shift is equal to the initial reference angle

Angle Reference Options

Angle Reference

- ☒ Average of Generator Angles
- ☐ Weighted Average of Generator Angles
- ☐ Specified Angle Reference Generator Terminal Angle
- ☐ Specified Angle Reference Generator Internal Angle
- ☐ Synchronous Reference Frame (No Angle Shift)

Angle Reference Generator 1 (Bus1) #1 Find...

☐ Initialize with Reference Angle at Zero

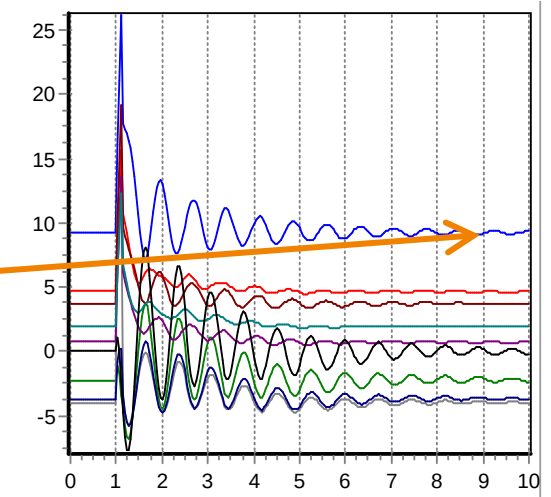
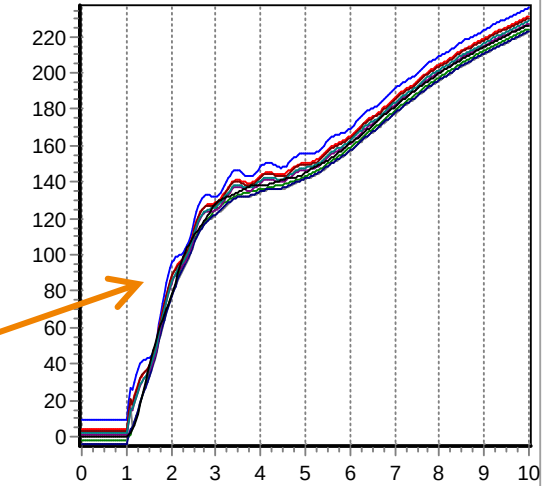
Note: This reference is not used if infinite buses are modeled

Transient Stability Options:

Result Options\Angle Reference

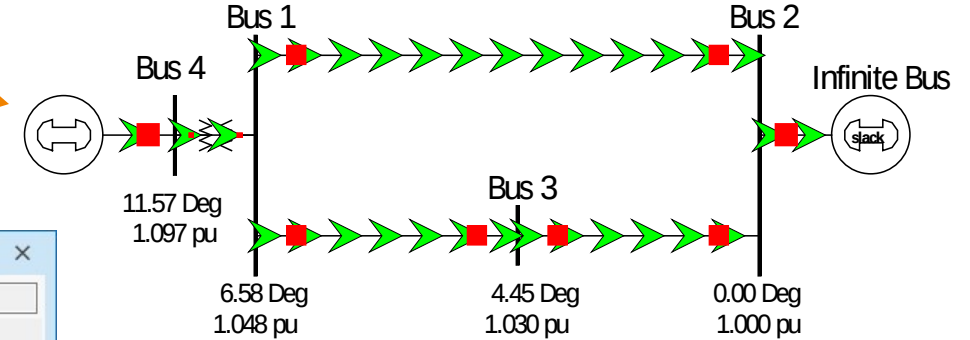
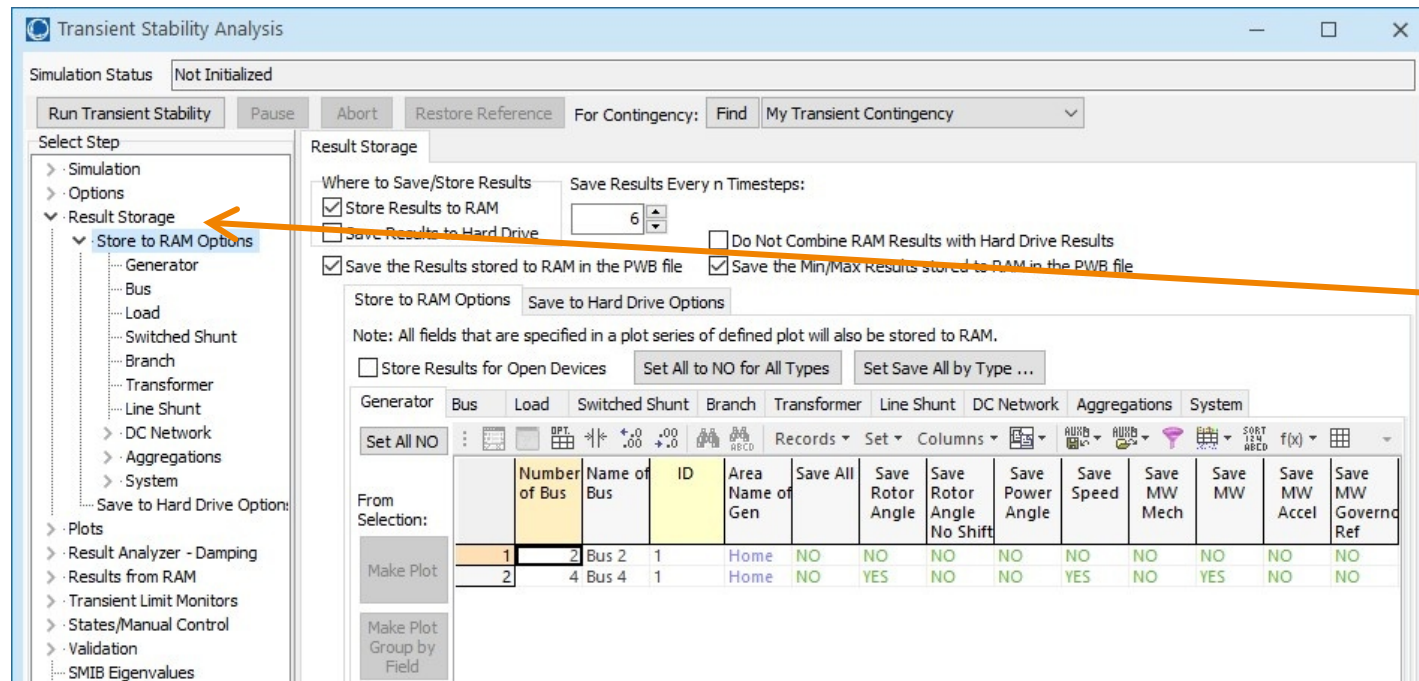


- Angle, No Shift shows the actual angles
 - Angles are with respect to a synchronous reference frame moving at nominal frequency
 - If actual frequency increases then the raw angles will all increase as time increases
 - System can still be stable as angles converge toward the same slope
- Angle field is with respect to a reference
 - The reference itself is calculated at every time step
 - Angle = Angle, No Shift – Reference
 - Angle plots for stable systems will converge toward a flat line



Result Storage

Open **Example_13_4_WithPlot** –
This case has already been set up



Open the Transient Stability Analysis Dialog from the ribbon tab to the Result Storage page



Determining the Results to Store for Viewing Afterward



For large cases, transient stability solutions can generate huge amounts of data. PowerWorld Simulator provides easy ways to choose which fields to save for later viewing. These choices can be made on the “Result Storage” page.

- Avoid storing too many values in RAM, or you may run out of memory and either cause the simulation to fail or slow down your computer
- If you need to save out a lot of data, saving to hard drive is a good option
 - After a run, you can still load results from hard drive back into RAM for viewing
 - Can visualize plot charts directly from the hard drive
- When using transient limit monitors, it may not be necessary to explicitly save any numerical results

Result Storage Page: Options



- On Result Storage page there are two check-boxes
 - Save Results to RAM
 - Save Results to Hard Drive
- Save Results Every n Timesteps
 - Results do not have to be stored for each time step. Increase this value to store them for only some timesteps
 - Note: This does NOT effect Max/Min Value Tracking, Generic Limit Monitoring, or Transient Limit Monitoring
 - They will always to look at every time step and report accordingly
- Save the Results stored to RAM in the PWB file
 - This can make the PWB pretty large

Result Storage Page: Options



- Two tabs on the Result Storage page to support
 - Store to RAM Options
 - Toggle fields to save for each object
 - Note: object fields that are part of a plot definition (as discussed in the Plot Definition section) will always be treated as though the respective field is toggled to *YES*
 - Option to **Set All to NO for All Types**
 - Option to **Set Save All By Type**
 - Store to Hard Drive Options
 - Choose directory location in which to save
 - File name will be the contingency name with extension *.TSR
 - Select object types to save
 - Area/Zone filters can be used to specify what to store
 - Note: An auxiliary file with the extension *.AUX will also be saved which stores the Min/Max Values, Summary, Events, and Solution Details information for the contingency as well

Result Storage Page



Where to save results

Can save results with the PWB file, but size of the file may significantly increase

Frequency of saved results

Transient Stability Analysis

Simulation Status: Not Initialized

Run Transient Stability | Pause | Abort | Restore Reference | For Contingency: Find | My Transient Contingency

Select Step

- > Simulation
- > Options
- > Result Storage
 - > Store to RAM Options
 - Generator
 - Bus
 - Load
 - Switched Shunt
 - Branch
 - Transformer
 - Line Shunt
 - > DC Network
 - > Aggregations
 - > System
 - Save to Hard Drive Options
- > Plots
 - > Result Analyzer - Damping
 - > Results from RAM
 - > Transient Limit Monitors
 - > States/Manual Control
 - > Validation
 - SMIB Eigenvalues
 - Modal Analysis
 - Dynamic Simulator Options

Process Contingencies

☒ One Contingency at a time
☐ Multiple Contingencies

Result Storage

Where to Save/Store Results

☒ Store Results to RAM
☐ Save Results to Hard Drive

Save Results Every n Timesteps: 6

☐ Do Not Combine RAM Results with Hard Drive Results
☒ Save the Min/Max Results stored to RAM in the PWB file

Store to RAM Options | Save to Hard Drive Options

Note: All fields that are specified in a plot series of defined plot will also be stored to RAM.

☐ Store Results for Open Devices | Set All to NO for All Types | Set Save All by Type ...

Generator	Bus	Load	Switched Shunt	Branch	Transformer	Line Shunt	DC Network	Aggregations	System				
Set All NO													
From Selection:	Number of Bus	Name of Bus	ID	Area Name of Gen	Save All	Save Rotor Angle	Save Rotor Angle No Shift	Save Power Angle	Save Speed	Save MW Mech	Save MW	Save MW Accel	Save MW Govern Ref
Make Plot	1	2	Bus 2	1	Home	NO	NO	NO	NO	NO	NO	NO	NO
Make Plot Group by Field	2	4	Bus 4	1	Home	NO	YES	NO	YES	NO	YES	NO	NO
Make Plot Group by Object													

Scroll over to view which generator fields are currently saved

Save All Settings To | Load All Settings From | Show Transient Contour Toolbar | Auto Insert... | Critical Clearing Time Calculator... | Help | Close

Save Results To RAM



Select what objects and fields to store to from the RAM Options tab

Many tabs are available here which correspond to different object types

Generator Tab

Toggle which fields to store

Generator Tab

From Selection:

Make Plot

Make Plot Group by Field

Make Plot Group by Object

Number of Bus	Name of Bus	ID	Area Name of Gen	Save All	Save Rotor Angle	Save Rotor Angle No Shift	Save Power Angle	Save Speed	Save MW Mech	Save MW	Save MW Accel	Save MW Governed Ref	Save Mvar
1	2 Bus 2	1	Home	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2	4 Bus 4	1	Home	NO	YES	NO	NO	YES	NO	YES	NO	NO	YES

Each object type has many different fields that may be saved, including any dynamic states

Rotor Angle, Speed, Terminal MW, Terminal MVar, and Field Voltage are being saved for Generator 4 1

Save Results to RAM



Result Storage

Where to Save/Store Results
☒ Store Results to RAM
☐ Save Results to Hard Drive

Save Results Every n Timesteps:

☐ Do Not Combine RAM Results with Hard Drive Results
☒ Save the Min/Max Results stored to RAM in the PWB file

Store to RAM Options | **Save to Hard Drive Options**

Note: All fields that are specified in a plot series of defined plot will also be stored to RAM.

☐ Store Results for Open Devices

Set All to NO for All Types | **Set Save All by Type ...**

Generator	Bus	Load	Switched Shunt	Branch	Transformer	Line Shunt	DC Network	Aggregations	System
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4

Set All NO

Toggle all to NO for the current object type or for all object types

Change Save All by Type

Types of Devices: ☐ Check All

☐ Area
☐ Branch
☐ Bus
☐ Bus Pair
☐ Case Information
☐ DC Transmission Line
☐ Generator
☐ Save Exciter State
☐ Save Machine State
☐ Save Governor State
☐ Save Stabilizer State
☐ Save Pref Ctrl State
☐ Save Plant Ctrl State
☐ Save Aero State
☐ Save AGC State
☐ Save Relay State
☐ Save UEL State
☐ Save OEL State
☐ Save SCL State
☐ Save Paux Ctrl State
☐ Injection Group
☐ Interface

☐ Line Shunt
☐ Save Line Shunts State
☐ Load
☐ Save Load State
☐ Save Relay State
☐ Save Dist Equiv State
☐ Save Dist Gen State
☐ Measurement Model
☐ Save Measurement Object State
☐ Model Expression
☐ Model Plane
☐ Multi-Terminal DC Converter
☐ Save DC Conv State
☐ Multi-Terminal DC Record
☐ Save MTDC Line State
☐ Substation
☐ Switched Shunt
☐ Save Shunt State
☐ Transformer
☐ Voltage Source Converter DC Line
☐ Save VSC DC Line State
☐ Zone

☐ Apply only to devices meeting the area/zone filters

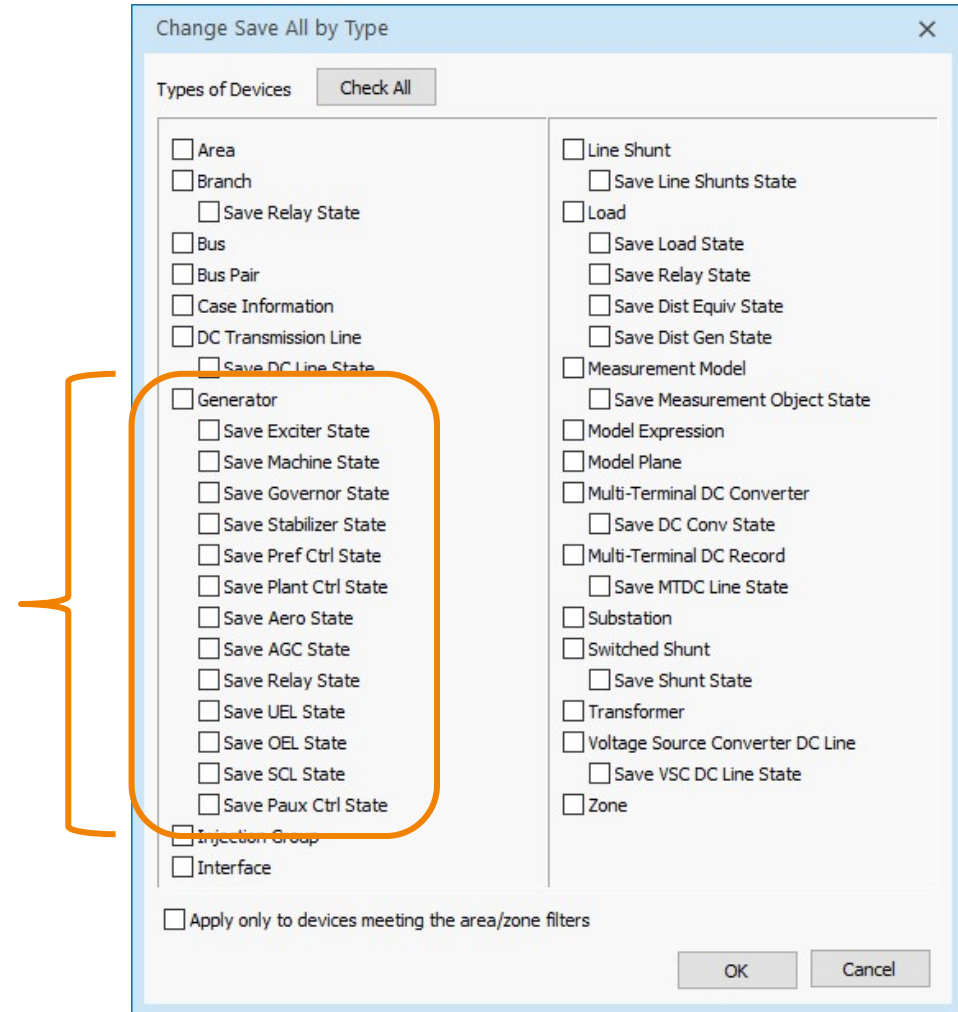
OK Cancel

Choose types for which to toggle the "Save All" column to YES

Dynamic States, Inputs, and Other Fields



- Later in the Plot Designer, you will see that some types of objects can have dynamic models
 - States
 - Inputs
 - Other Fields
- For the purpose of Result Storage, if you set *States of **** to YES, then States, Inputs, and Other Fields are all stored.



Results: Time Values From RAM

Example_13_4_WithPlot.pwb



Click “Run Transient Stability”

The results saved to RAM will appear in the Results tab

There are many options for filtering and viewing results - discussed in the Reviewing Results section

The screenshot displays the 'Transient Stability Analysis' window. The 'Simulation Status' is 'Finished at 10.000000'. The 'Run Transient Stability' button is highlighted with an orange arrow. The 'Results from RAM' tab is selected, showing a table of time values. The table has columns for Time, Gen Bus 4 #1 Rotor Angle, Gen Bus 4 #1 Speed, Gen Bus 4 #1 MW, Gen Bus 4 #1 Mvar, and Gen Bus 4 #1 Efd. The table contains 21 rows of data. The 'Results from RAM' section is highlighted with an orange arrow. The 'Process Contingencies' section shows 'One Contingency at a time' selected. The 'Save All Settings To' button is highlighted with an orange arrow.

	Time	Gen Bus 4 #1 Rotor Angle	Gen Bus 4 #1 Speed	Gen Bus 4 #1 MW	Gen Bus 4 #1 Mvar	Gen Bus 4 #1 Efd
1	0	30.0469	1	99.9996	58.5303	2.7098
2	0.05	30.0469	1	99.9999	58.5303	2.7098
3	0.1	30.0469	1	100.0001	58.5303	2.7098
4	0.15	30.0469	1	100.0001	58.5303	2.7098
5	0.2	30.0469	1	100.0001	58.5303	2.7098
6	0.25	30.0469	1	100.0001	58.5303	2.7098
7	0.3	30.0469	1	100	58.5303	2.7098
8	0.35	30.0469	1	99.9999	58.5303	2.7098
9	0.4	30.0469	1	99.9999	58.5303	2.7098
10	0.45	30.0469	1	100	58.5303	2.7098
11	0.5	30.0469	1	100	58.5303	2.7098
12	0.55	30.0469	1	100	58.5303	2.7098
13	0.6	30.0469	1	100	58.5303	2.7098
14	0.65	30.0469	1	100	58.5303	2.7098
15	0.7	30.0469	1	100	58.5303	2.7098
16	0.75	30.0469	1	100	58.5302	2.7098
17	0.8	30.0469	1	100	58.5302	2.7098
18	0.85	30.0469	1	100	58.5302	2.7098
19	0.9	30.0469	1	100	58.5302	2.7098
20	0.95	30.0469	1	100	58.5302	2.7098
21	1	30.0469	1	100	58.5302	2.7098

Save Results to Hard Drive

Open the Save to Hard Drive Options tab

Select "Save Results to Hard Drive"

It's possible to save to both RAM AND Hard Drive

Specify directory for saving the results

Transient Stability Analysis

Simulation Status: Finished at 10.000000

Run Transient Stability | Pause | Abort | Restore Reference | For Contingency: Find | My Transient Contingency

Select Step

- > Simulation
- > Options
- > Result Storage
 - Store to RAM Options
 - Generator
 - Bus
 - Load
 - Switched Shunt
 - Branch
 - Transformer
 - Line Shunt
 - > DC Network
 - > Aggregations
 - > System
- > Save to Hard Drive Options
- > Plots
- > Result Analyzer - Damping
- > Results from RAM
 - > Time Values
 - > Minimum/Maximum Values
 - Summary
 - Events
 - Solution Details
 - Power Flow States
 - > Transient Limit Monitors
 - > States/Manual Control
 - > Validation
 - SMIB Eigenvalues
 - Modal Analysis
 - Dynamic Simulator Options

Process Contingencies

☒ One Contingency at a time

☐ Multiple Contingencies

Result Storage

Where to Save/Store Results

☒ Store Results to RAM

☒ Save Results to Hard Drive

Save Results Every n Timesteps: 6

☐ Do Not Combine RAM Results with Hard Drive Results

☒ Save the Results stored to RAM in the PWB file

☒ Save the Min/Max Results stored to RAM in the PWB file

Store to RAM Options | **Save to Hard Drive Options**

Directory in which to store all results TSR files for all contingencies

Location: Browse...

For each transient contingency, one file will be written to this directory.
The filename will be the name of the contingency with the *.TSR file extension.
Note: If no directory is specified, then the director of the case file will be used.
Note: Using a directory on your local computer is recommended.

Storage of States, Other Fields, and Input Fields

☐ Also store states for each object

☒ Also store other fields for each object

☒ Also store input fields for each object

☐ Only store every result for objects which meet the Area/Zone Filters

Edit Area/Zone Filters

TSR File Archiving

☐ Enable Auto-Archive of TSR Files

Maximum Number of Archive Files: 6

Object Types to Include

	Store	Filter Objects	State	Other	Input
Generators	☒ Define		☐	☐	☐
Buses	☒ Define		☐	☐	☐
Loads	☐ Define		☐	☐	☐
Switched Shunts	☒ Define		☐	☐	☐
Branches	☐ Define		☐	☐	☐
Line Shunts	☐ Define		☐	☐	☐
DC Lines	☒ Define		☐	☐	☐
VSC DC Lines	☒ Define		☐	☐	☐
Multi-Terminal DC	☒ Define		☐	☐	☐
MTDC Converters	☒ Define		☐	☐	☐
Areas	☐ Define		☐	☐	☐
Zones	☐ Define		☐	☐	☐
Substations	☐ Define		☐	☐	☐
Interfaces	☐ Define		☐	☐	☐
Injection Groups	☐ Define		☐	☐	☐
Bus Pairs	☐ Define		☐	☐	☐
System	☐		☐	☐	☐
Measurement Objects	☐		☐	☐	☐
Model Planes	☐		☐	☐	☐
Model Expressions	☐		☐	☐	☐

Save All Settings To | Load All Settings From | Show Transient Contour Toolbar | Auto Insert... | Critical Clearing Time Calculator... | Help | Close

Area/Zone Filters may be used

Specify what objects to save



Save Results to Hard Drive



- The only options for storing results to the Hard Drive are
 - Specify Object Types
 - Filter by Area/Zone/Owner Filters
- What fields are stored to the *.TSR file?
 - All stability fields
 - All dynamic model states
 - All dynamic model inputs
 - All dynamic model other fields
- TSR File Archiving
 - When a new set of results are created, old TSR files will be archived using a file name of type
 - *MyFileName_1.tsr, MyFileName_2.tsr, etc...*

Load from Hard Drive



Transient Stability Analysis

Simulation Status: Finished at 10.000000

Run Transient Stability | Pause | Abort | Restore Reference | For Contingency: Find | My Transient Contingency

Select Step

- Simulation
- Options
- Result Storage
 - Store to RAM Options
 - Generator
 - Bus
 - Load
 - Switched Shunt
 - Branch
 - Transformer
 - Line Shunt
 - DC Network
 - Aggregations
 - System
 - Save to Hard Drive Options
- Plots
- Result Analyzer - Damping
- Results from RAM
 - Time Values
 - Minimum/Maximum Values
 - Summary
 - Events
 - Solution Details
 - Power Flow States
- Transient Limit Monitors
- States/Manual Control
- Validation
- SMIB Eigenvalues
- Modal Analysis
- Dynamic Simulator Options

Process Contingencies

One Contingency at a time | Multiple Contingencies

Load from Hard Drive File into RAM results specified by Store to RAM Options | Clear Time Values from RAM | Save All Settings To | Load All Settings From | Show Transient Contour Toolbar | Auto Insert... | Critical Clearing Time Calculator... | Use

Results from RAM | Modal Analysis

Time Values | Minimum/Maximum Values | Summary | Events | Solution Details | Power Flow States

Generator | Bus | Load | Switched Shunt | Branch | Transformer | Line Shunt | DC Network | Aggregations | System

Column Order: Object then Field

Column Filtering: Filter | Modify...

Choose Fields to Dis...

- ☒ Aero State
- ☒ AGC State
- ☒ App Imp/R
- ☒ App Imp/X
- ☒ Efd
- ☒ Exciter State
- ☒ Governor State
- ☒ I pu
- ☒ Ifd
- ☒ Machine State
- ☒ Mvar
- ☒ MW
- ☒ MW Accel
- ☒ MW Governor Ref
- ☒ MW Mech
- ☒ OEL State
- ☒ Paux Ctrl State
- ☒ Plant Ctrl State
- ☒ Power Angle
- ☒ Pref Ctrl State

Time

Time	Gen Bus 4 #1 Rotor Angle	Gen Bus 4 #1 Speed	Gen Bus 4 #1 MW	Gen Bus 4 #1 Mvar	Gen Bus 4 #1 Efd
1	0	30.0469	1	99.9996	58.5303
2	0.05	30.0469	1	99.9999	58.5303
3	0.1	30.0469	1	100.0001	58.5303
4	0.15	30.0469	1	100.0001	58.5303
5	0.2	30.0469	1	100.0001	58.5303
6	0.25	30.0469	1	100.0001	58.5303
7	0.3	30.0469	1	100	58.5303
8	0.35	30.0469	1	99.9999	58.5303
9	0.4	30.0469	1	99.9999	58.5303
10	0.45	30.0469	1	100	58.5303
11	0.5	30.0469	1	100	58.5303
12	0.55	30.0469	1	100	58.5303
13	0.6	30.0469	1	100	58.5303
14	0.65	30.0469	1	100	58.5303
15	0.7	30.0469	1	100	58.5303
16	0.75	30.0469	1	100	58.5303
17	0.8	30.0469	1	100	58.5302
18	0.85	30.0469	1	100	58.5302
19	0.9	30.0469	1	100	58.5302
20	0.95	30.0469	1	100	58.5302
21	1	30.0469	1	100	58.5302
22	1.05	30.0469	1	100	58.5302
23	1.1	30.0469	1	100	58.5302
24	1.15	30.0469	1	100	58.5302
25	1.2	30.0469	1	100	58.5302
26	1.25	30.0469	1	100	58.5302
27	1.3	30.0469	1	100	58.5302
28	1.35	30.0469	1	100	58.5302
29	1.4	30.0469	1	100	58.5302
30	1.45	30.0469	1	100	58.5302
31	1.5	30.0469	1	100	58.5302
32	1.55	30.0469	1	100	58.5302
33	1.6	30.0469	1	100	58.5302
34	1.65	30.0469	1	100	58.5302
35	1.7	30.0469	1	100	58.5302
36	1.75	30.0469	1	100	58.5302
37	1.8	30.0469	1	100	58.5302
38	1.85	30.0469	1	100	58.5302
39	1.9	30.0469	1	100	58.5302
40	1.95	30.0469	1	100	58.5302
41	2	30.0469	1	100	58.5302
42	2.05	30.0469	1	100	58.5302
43	2.1	30.0469	1	100	58.5302
44	2.15	30.0469	1	100	58.5302
45	2.2	30.0469	1	100	58.5302
46	2.25	30.0469	1	100	58.5302
47	2.3	30.0469	1	100	58.5302
48	2.35	30.0469	1	100	58.5302
49	2.4	30.0469	1	100	58.5302
50	2.45	30.0469	1	100	58.5302
51	2.5	30.0469	1	100	58.5302
52	2.55	30.0469	1	100	58.5302
53	2.6	30.0469	1	100	58.5302
54	2.65	30.0469	1	100	58.5302
55	2.7	30.0469	1	100	58.5302
56	2.75	30.0469	1	100	58.5302
57	2.8	30.0469	1	100	58.5302
58	2.85	30.0469	1	100	58.5302
59	2.9	30.0469	1	100	58.5302
60	2.95	30.0469	1	100	58.5302
61	3	30.0469	1	100	58.5302
62	3.05	30.0469	1	100	58.5302
63	3.1	30.0469	1	100	58.5302
64	3.15	30.0469	1	100	58.5302
65	3.2	30.0469	1	100	58.5302
66	3.25	30.0469	1	100	58.5302
67	3.3	30.0469	1	100	58.5302
68	3.35	30.0469	1	100	58.5302
69	3.4	30.0469	1	100	58.5302
70	3.45	30.0469	1	100	58.5302
71	3.5	30.0469	1	100	58.5302
72	3.55	30.0469	1	100	58.5302
73	3.6	30.0469	1	100	58.5302
74	3.65	30.0469	1	100	58.5302
75	3.7	30.0469	1	100	58.5302
76	3.75	30.0469	1	100	58.5302
77	3.8	30.0469	1	100	58.5302
78	3.85	30.0469	1	100	58.5302
79	3.9	30.0469	1	100	58.5302
80	3.95	30.0469	1	100	58.5302
81	4	30.0469	1	100	58.5302
82	4.05	30.0469	1	100	58.5302
83	4.1	30.0469	1	100	58.5302
84	4.15	30.0469	1	100	58.5302
85	4.2	30.0469	1	100	58.5302
86	4.25	30.0469	1	100	58.5302
87	4.3	30.0469	1	100	58.5302
88	4.35	30.0469	1	100	58.5302
89	4.4	30.0469	1	100	58.5302
90	4.45	30.0469	1	100	58.5302
91	4.5	30.0469	1	100	58.5302
92	4.55	30.0469	1	100	58.5302
93	4.6	30.0469	1	100	58.5302
94	4.65	30.0469	1	100	58.5302
95	4.7	30.0469	1	100	58.5302
96	4.75	30.0469	1	100	58.5302
97	4.8	30.0469	1	100	58.5302
98	4.85	30.0469	1	100	58.5302
99	4.9	30.0469	1	100	58.5302
100	4.95	30.0469	1	100	58.5302
101	5	30.0469	1	100	58.5302
102	5.05	30.0469	1	100	58.5302
103	5.1	30.0469	1	100	58.5302
104	5.15	30.0469	1	100	58.5302
105	5.2	30.0469	1	100	58.5302
106	5.25	30.0469	1	100	58.5302
107	5.3	30.0469	1	100	58.5302
108	5.35	30.0469	1	100	58.5302
109	5.4	30.0469	1	100	58.5302
110	5.45	30.0469	1	100	58.5302
111	5.5	30.0469	1	100	58.5302
112	5.55	30.0469	1	100	58.5302
113	5.6	30.0469	1	100	58.5302
114	5.65	30.0469	1	100	58.5302
115	5.7	30.0469	1	100	58.5302
116	5.75	30.0469	1	100	58.5302
117	5.8	30.0469	1	100	58.5302
118	5.85	30.0469	1	100	58.5302
119	5.9	30.0469	1	100	58.5302
120	5.95	30.0469	1	100	58.5302
121	6	30.0469	1	100	58.5302
122	6.05	30.0469	1	100	58.5302
123	6.1	30.0469	1	100	58.5302
124	6.15	30.0469	1	100	58.5302
125	6.2	30.0469	1	100	58.5302
126	6.25	30.0469	1	100	58.5302
127	6.3	30.0469	1	100	58.5302
128	6.35	30.0469	1	100	58.5302
129	6.4	30.0469	1	100	58.5302
130	6.45	30.0469	1	100	58.5302
131	6.5	30.0469	1	100	58.5302
132	6.55	30.0469	1	100	58.5302
133	6.6	30.0469	1	100	58.5302
134	6.65	30.0469	1	100	58.5302
135	6.7	30.0469	1	100	58.5302
136	6.75	30.0469	1	100	58.5302
137	6.8	30.0469	1	100	58.5302
138	6.85	30.0469	1	100	58.5302
139	6.9	30.0469	1	100	58.5302
140	6.95	30.0469	1	100	58.5302
141	7	30.0469	1	100	58.5302
142	7.05	30.0469	1	100	58.5302
143	7.1	30.0469	1	100	58.5302
144	7.15	30.0469	1	100	58.5302
145	7.2	30.0469	1	100	58.5302
146	7.25	30.0469	1	100	58.5302
147	7.3	30.0469	1	100	58.5302
148	7.35	30.0469	1	100	58.5302
149	7.4	30.0469	1	100	58.5302
150	7.45	30.0469	1	100	58.5302
151	7.5	30.0469	1	100	58.5302
152	7.55	30.0469	1	100	58.5302
153	7.6	30.0469	1	100	58.5302
154	7.65	30.0469	1	100	58.5302
155	7.7	30.0469	1	100	58.5302
156	7.75	30.0469	1	100	58.5302
157	7.8	30.0469	1	100	58.5302
158	7.85	30.0469	1	100	58.5302
159	7.9	30.0469	1	100	58.5302
160	7.95	30.0469	1	100	58.5302
161	8	30.0469	1	100	58.5302
162	8.05	30.0469	1	100	58.5302
163	8.1	30.0469	1	100	58.5302
164	8.15	30.0469	1	100	58.5302
165	8.2	30.0469	1	100	58.5302
166	8.25	30.0469	1	100	58.5302
167	8.3	30.0469	1	100	58.5302
168	8.35	30.0469	1	100	58.5302
169	8.4	30.0469	1	100	58.5302
170	8.45	30.0469	1	100	58.5302
171	8.5	30.0469	1	100	58.5302
172	8.55	30.0469	1	100	58.5302
173	8.6	30.0469	1	100	58.5302
174	8.65	30.0469	1	100	58.5302
175	8.7	30.0469	1	100	58.5302
176	8.75	30.0469	1	100	58.5302
177	8.8	30.0469	1	100	58.5302
178	8.85	30.0469	1	100	58.5302
179	8.9	30.0469	1	100	58.5302
180	8.95	30.0469	1	100	58.5302
181	9	30.0469	1	100	58.5302
182	9.05	30.0469	1	100	58.5302
183	9.1	30.0469	1	100	58.5302
184	9.15	30.0469	1	100	58.5302
185	9.2	30.0469	1	100	58.5302
186	9.25	30.0469	1	100	58.5302
187	9.3	30.0469	1	100	58.5302
188	9.35	30.0469	1	100	58.5302
189	9.4	30.0469	1	100	58.5302
190	9.45	30.0469	1	100	58.5302
191	9.5	30.0469	1	100	58.5302
192	9.55	30.0469	1	100	58.5302
193	9.6	30.0469	1	100	58.5302
194	9.65	30.0469	1	100	58.5302
195	9.7	30.0469	1	100	58.5302
196	9.75	30.0469	1	100	58.5302
197	9.8	30.0469	1	100	

Result Storage Example



- Open **TS9Bus Bus Fault.pwb**
- Go to Run Mode and open Transient Stability
- Go to the Result Storage page
- Case is configured to Store Results to RAM
 - *Save All* = YES for all generators
 - *Save All* = YES for all buses
- Click **Run Transient Stability**
- To see what's stored in RAM and the Hard-Drive you can go to the Plots page or the Results page



Result Storage: Plots

Device Type = *Bus*

Plots

Plot Designer Plot Definition Grids

Device Type **Bus**

Choose Fields

- ☒ Frequency
- ☐ Frequency in PU
- ☐ Gen Mvar
- ☐ Gen MW
- ☐ Load Mvar
- ☐ Load MW
- ☐ ROCOF (Hz per Second)
- ☒ Status

Choose Objects

Sort by ☐ Name ☒ Number

1 (Bus1)	[16.50 kV]
2 (Bus 2)	[18.00 kV]
3 (Bus 3)	[13.80 kV]
4 (Bus 4)	[230.0 kV]
5 (Bus 5)	[230.0 kV]
6 (Bus 6)	[230.0 kV]
7 (Bus 7)	[230.0 kV]
8 (Bus 8)	[230.0 kV]
9 (Bus 9)	[230.0 kV]

Select All Clear All

☐ Show only objects available in results

**Green Text
= in RAM**

Device Type = *Load*

Plots

Plot Designer Plot Definition Grids

Device Type **Load**

Choose Fields

- ☒ Dist Mvar
- ☐ Dist MW
- ☐ I AMPS
- ☐ I angle
- ☐ I pu
- ☐ Mvar
- ☐ MW
- ☐ MW Nominal Tripped

Choose Objects

Sort by ☐ Name ☒ Number

5 (Bus 5) #1	[230.0 kV]
6 (Bus 6) #1	[230.0 kV]
8 (Bus 8) #1	[230.0 kV]

Select All Clear All

☐ Show only objects available in results

**Black Text
= not in RAM**

Results Storage: Results\Time Values From RAM

TS9Bus Bus Fault.pwb



Device Type = *Bus*

Results from RAM

Time Values Minimum/Maximum Values Summary Events Solution Details Power Flow States

Generator **Bus** Load Switched Shunt Branch Transformer Line Shunt DC Network Aggregations System

Column Order: Object then Field

Column Filtering Filter: Modify... Use Area/Zone Filters

Choose Fields to Display:

- ☒ Frequency
- ☒ Frequency in PU
- ☒ Gen Mvar
- ☒ Gen MW
- ☒ Load Mvar
- ☒ Load MW
- ☒ ROCOF (Hz per Seco...
- ☒ Status
- ☒ V (kV)
- ☒ V angle
- ☒ V Angle (rad)
- ☒ V angle No shift
- ☒ V pu

Check All Uncheck All

	Time	Bus Bus1 V pu	Bus Bus1 V angle	Bus Bus1 Frequency	Bus Bus1 Gen MW	Bus Bus1 Gen Mvar	Bus Bus1 Load MW	Bus Bus1 Load Mv
1	0	1.04	0.0002	60	71.6385	27.0451	0	
2	0.02	1.04	0.0002	60	71.6389	27.0451	0	
3	0.04	1.04	0.0002	60	71.6396	27.0451	0	
4	0.06	1.04	0.0001	60	71.6406	27.0451	0	
5	0.08	1.04	0.0001	60	71.6417	27.045	0	
6	0.1	1.04	0.0001	60	71.6429	27.045	0	
7	0.12	1.04	0	60	71.6442	27.0449	0	
8	0.14	1.04	0	60	71.6454	27.0449	0	
9	0.16	1.04	0	60	71.6466	27.0449	0	
10	0.18	1.04	0	60	71.6476	27.0448	0	
11	0.2	1.04	0	60	71.6484	27.0448	0	
12	0.22	1.04	0	60	71.6489	27.0448	0	
13	0.24	1.04	0	60	71.6492	27.0447	0	
14	0.26	1.04	0	60	71.6493	27.0448	0	
15	0.28	1.04	0.0001	60	71.649	27.0448	0	
16	0.3	1.04	0.0001	60	71.6485	27.0448	0	
17	0.32	1.04	0.0001	60	71.6479	27.0449	0	
18	0.34	1.04	0.0001	60	71.647	27.0449	0	
19	0.36	1.04	0.0001	60	71.6461	27.045	0	
20	0.38	1.04	0.0001	60	71.6451	27.0451	0	
21	0.4	1.04	0.0002	60	71.6441	27.0452	0	
22	0.42	1.04	0.0002	60	71.6432	27.0453	0	
23	0.44	1.04	0.0002	60	71.6424	27.0454	0	

Load from Hard Drive File into RAM results specified by Store to RAM Options Clear Time Values from RAM Clear Min/Max Values

Results

Device Type = *Load*

Results from RAM

Time Values Minimum/Maximum Values Summary Events Solution Details Power Flow States

Generator Bus **Load** Switched Shunt Branch Transformer Line Shunt DC Network Aggregations System

Column Order: Object then Field

Column Filtering Filter: Modify... Use Area/Zone Filters

Choose Fields to Display:

- ☒ Dist Equiv State
- ☒ Dist Gen State
- ☒ Dist Mvar
- ☒ Dist MW
- ☒ I AMPS
- ☒ I angle
- ☒ I pu
- ☒ Load State
- ☒ Mvar
- ☒ MW
- ☒ MW Nominal Tripped
- ☒ Relay State
- ☒ Status

Check All Uncheck All

	Time
1	0
2	0.02
3	0.04
4	0.06
5	0.08
6	0.1
7	0.12
8	0.14
9	0.16
10	0.18
11	0.2
12	0.22
13	0.24
14	0.26
15	0.28
16	0.3
17	0.32
18	0.34
19	0.36
20	0.38
21	0.4
22	0.42
23	0.44
24	0.46
25	0.48
26	0.5
27	0.52

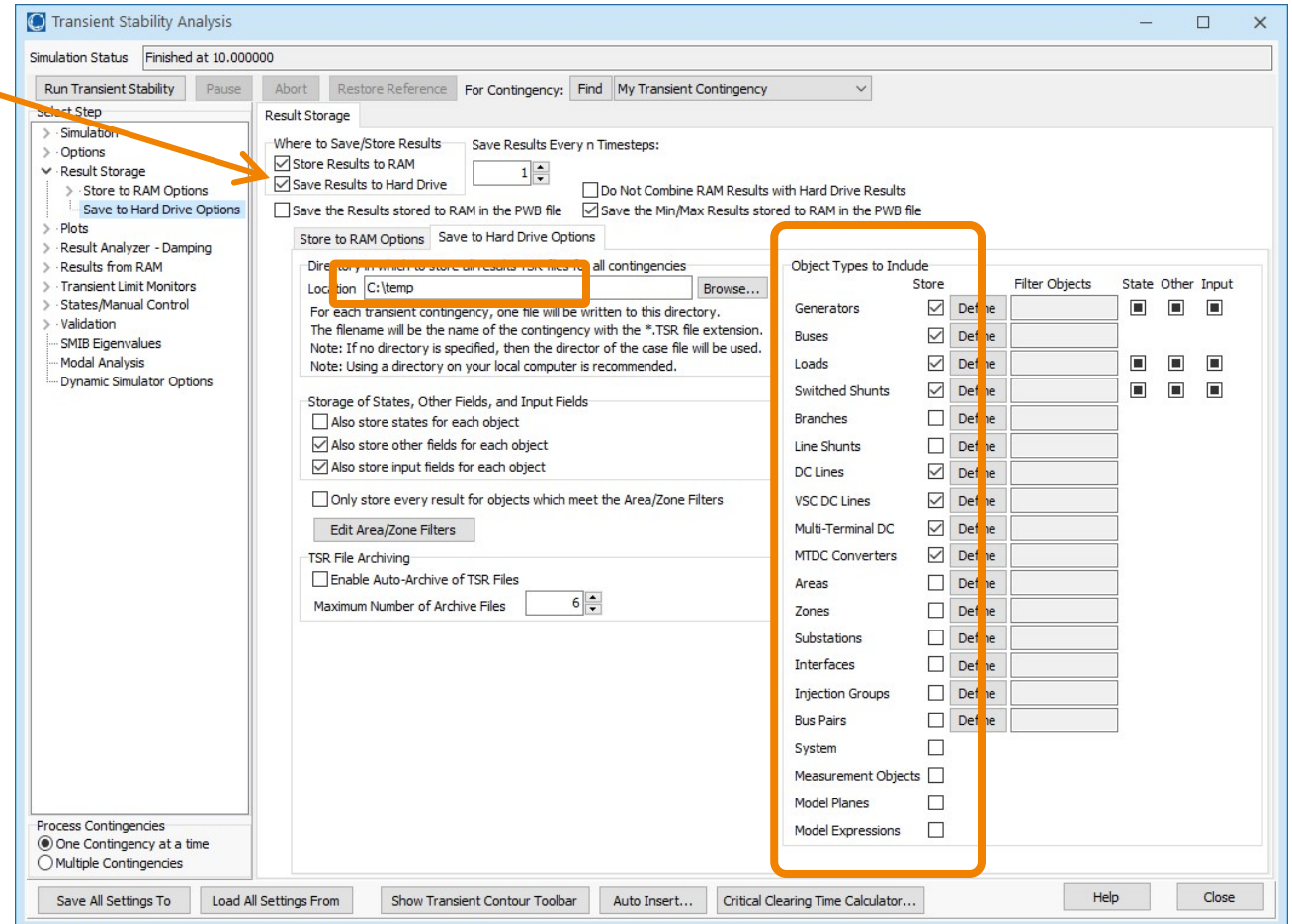
Load from Hard Drive File into RAM results specified by Store to RAM Options Clear Time Values from RAM Clear Min/Max Values

No Results

Result Storage: Save Results to Hard Drive



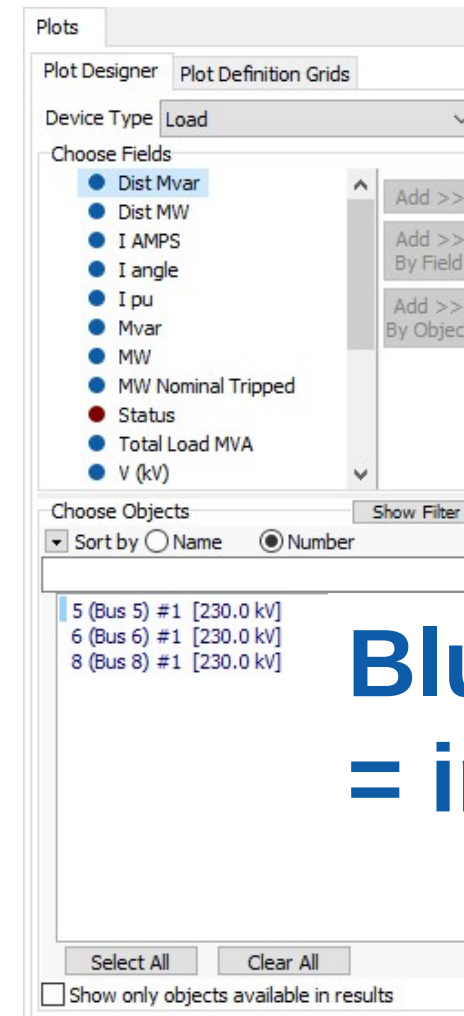
- Configure to Store Results to Hard Drive
- Click **Run Transient Stability** again.
- Navigate in Windows Explorer to see that the TSR file has been created



Result Storage: Hard Drive



- Plot Designer – Hard Drive Results objects in Blue
 - These results may be plotted directly
- Time Values From RAM
 - Still not available

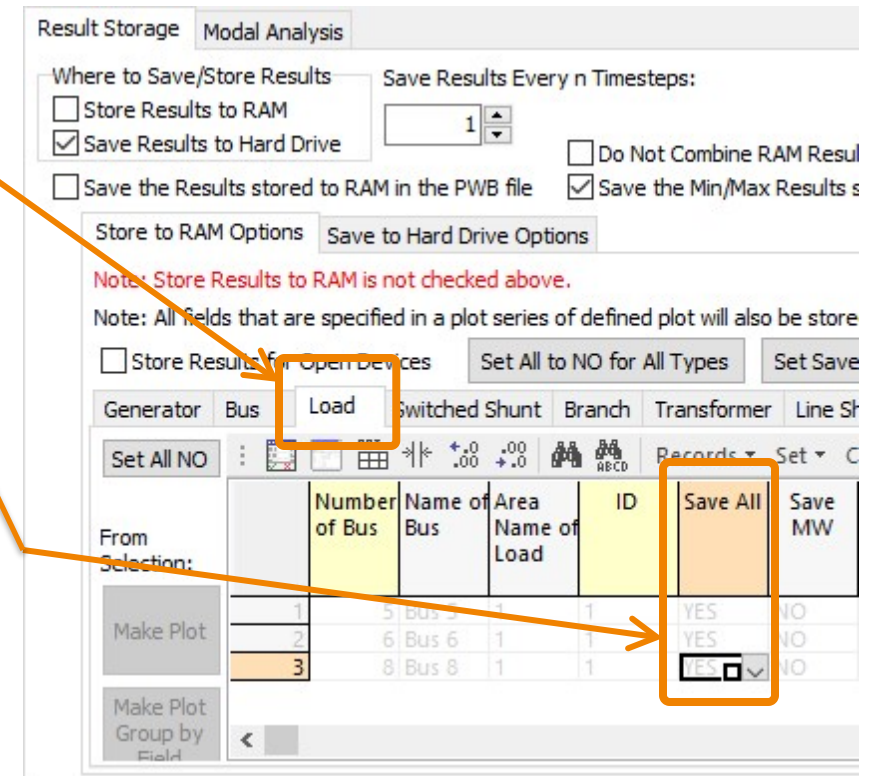
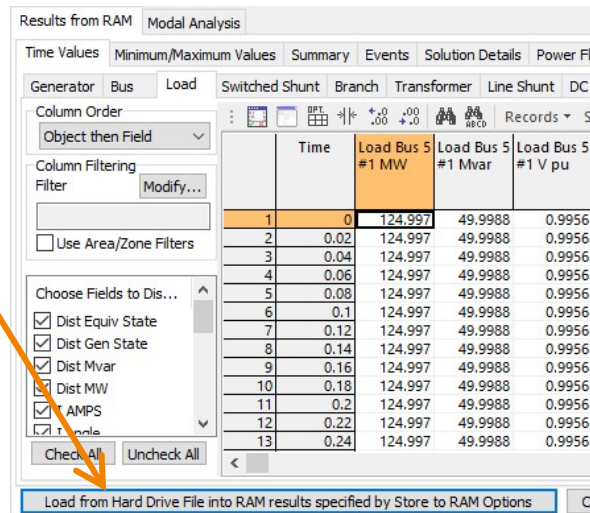


**Blue Text
= in Hard Drive**

Load Hard Drive Results into the RAM Results



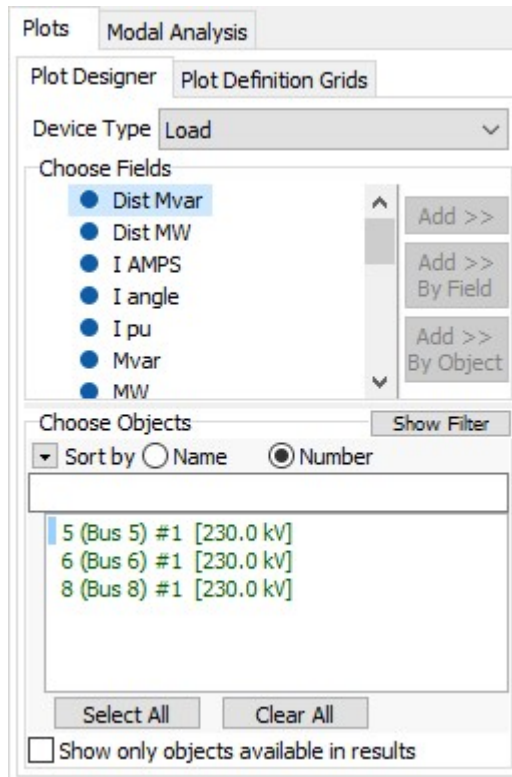
- Possible to load results from Hard Drive for viewing in tables
 - Go back to Results Storage, Store to RAM Options
 - Go to Load
 - Specify *Save All* = YES for all loads
 - Go back to Results from RAM and click **Load from Hard Drive File into RAM ...**



Load Hard Drive Results into the RAM Results



- Plots, Green Text for objects
- **Time Value From RAM** – available



Results from RAM Modal Analysis

Time Values Minimum/Maximum Values Summary Events Solution Details Power Flow States

Generator Bus Load Switched Shunt Branch Transformer Line Shunt DC Network Aggregations System

Column Order Object then Field

Column Filtering Filter Modify...

☐ Use Area/Zone Filters

Choose Fields to Dis...

- ☒ Dist Equiv State
- ☒ Dist Gen State
- ☒ Dist Mvar
- ☒ Dist MW
- ☒ I AMPS
- ☒ I angle
- ☒ I pu
- ☒ Load State
- ☒ Mvar
- ☒ MW
- ☒ MW Nominal Tripped

Check All Uncheck All

	Time	Load Bus 5 #1 MW	Load Bus 5 #1 Mvar	Load Bus 5 #1 V pu	Load Bus 5 #1 V angle	Load Bus 5 #1 I pu	Load Bus 5 #1 I angle	Load Bus 5 #1 Status
1	0	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
2	0.02	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
3	0.04	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
4	0.06	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
5	0.08	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
6	0.1	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
7	0.12	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
8	0.14	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
9	0.16	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
10	0.18	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
11	0.2	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
12	0.22	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
13	0.24	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
14	0.26	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
15	0.28	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
16	0.3	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
17	0.32	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
18	0.34	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
19	0.36	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000
20	0.38	124.997	49.9988	0.9956	-3.9885	1.3522	-25.7899	1.0000

Load from Hard Drive File into RAM results specified by Store to RAM Options Clear Time Values from RAM Clear Min/Max Values, S

Plotting Results and Result Storage



- Bringing data into “RAM” is not necessary for creating plots
- When you choose to create plots as will be discussed shortly the following hierarchy is followed for each *plot series*
 - Result stored in RAM are used first
 - If RAM not available, results stored to Hard Drive are used
 - Finally, if still no results, nothing is plotted.
- Thus one chart, could contain information from RAM and from Hard Drive

Plotting Results and Result Storage



- Instructor – play around with plots to show results storage

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