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Reg. No	2019-EE-373, 381, 383
Marks/Grade	

EXPERIMENT NO. 10

Perform transient stability analysis of generators for calculating the critical angle.

Objective:

At the end of this lab session students will be able

- To accurately select the rotor angle of generator for calculating the critical angle, and stability of system.

Introduction:

Transient stability involves the response to large disturbances, which may cause rather large changes in rotor speeds, power angles and power transfers. Transient stability is a fast phenomenon usually evident within a few second. Power system stability mainly concerned with rotor stability analysis.

$$P_e = P_d = \frac{|E_g||V_t|}{x_d} \sin \delta$$

$$= P_{\max} \sin \delta \dots \dots \dots (38)$$

Where $|E_g|$ is the rms internal voltage, $|V_t|$ is the rms terminal voltage, x_d is the direct axis reactance (or the synchronous reactance in a round rotor machine) and δ is the electrical power angle.

To find the critical time for stability of power system

$$t = \sqrt{\frac{4H}{\omega_{syn} P_{mp.u.}} (\delta(t) - \delta_0)}$$

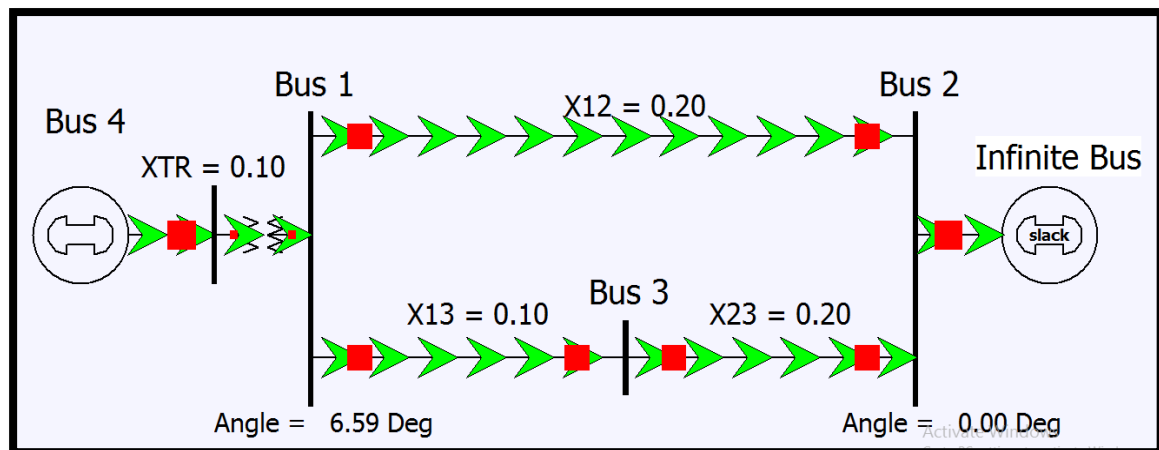
Setting and results of power diagrams:

Figure10.1: Two bus power system in PWS

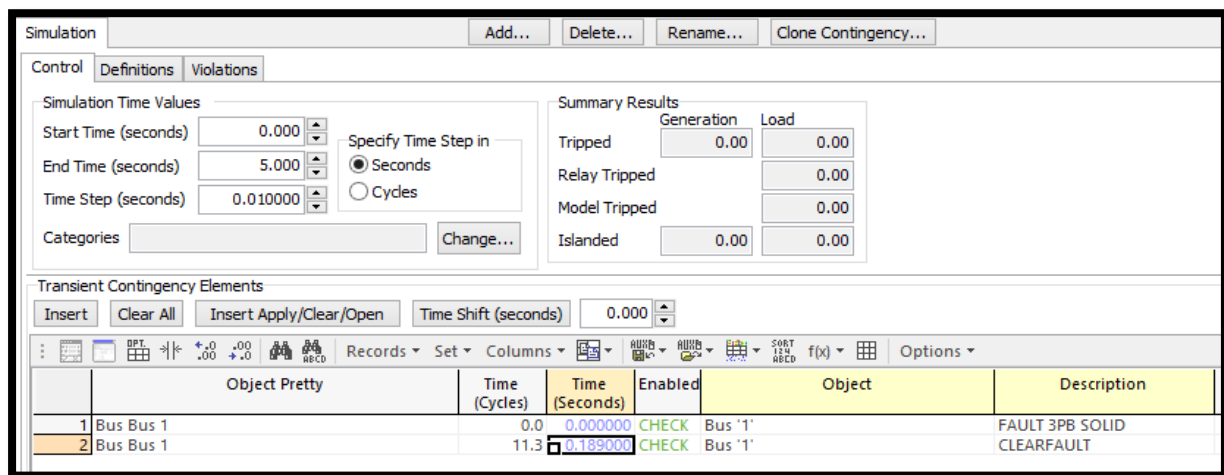


Figure10.2: Set the time at (t=0.1890sec)

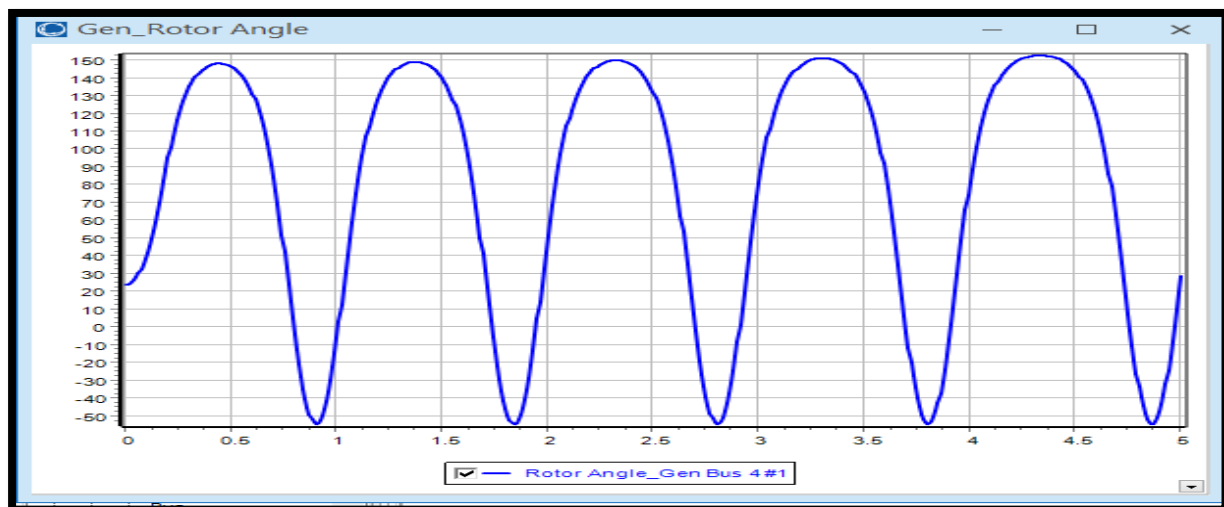


Figure10.3: Generator rotor angle curve at time 0.1890sec and it is stable

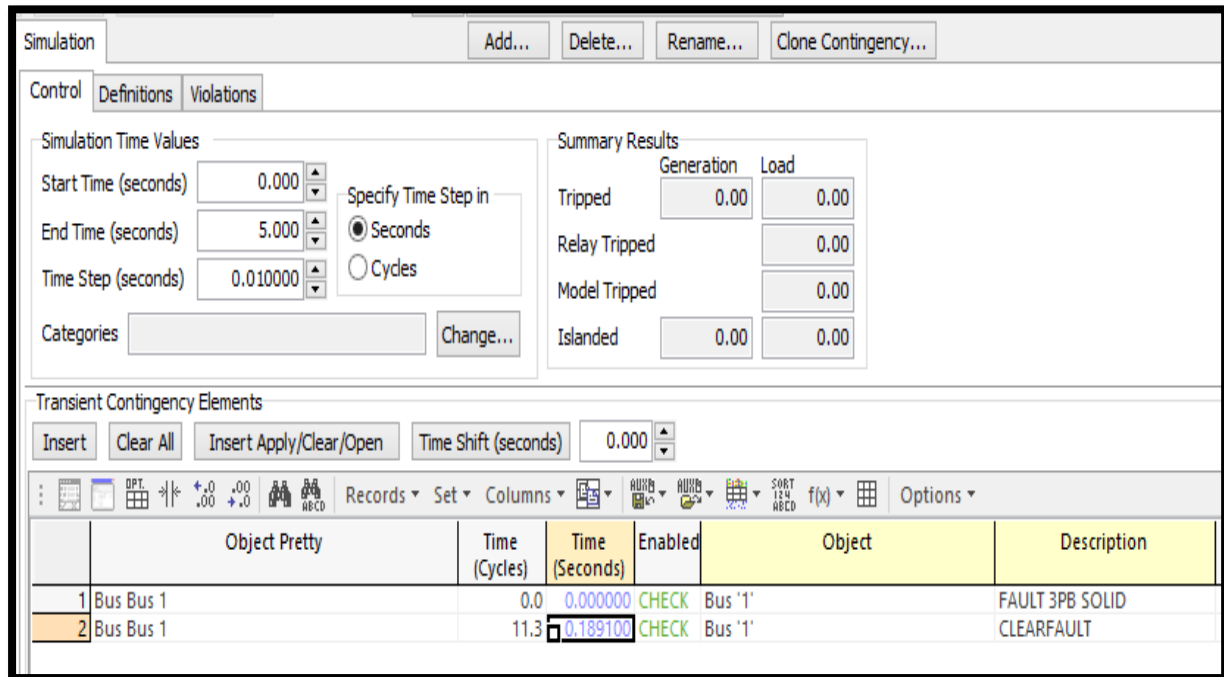
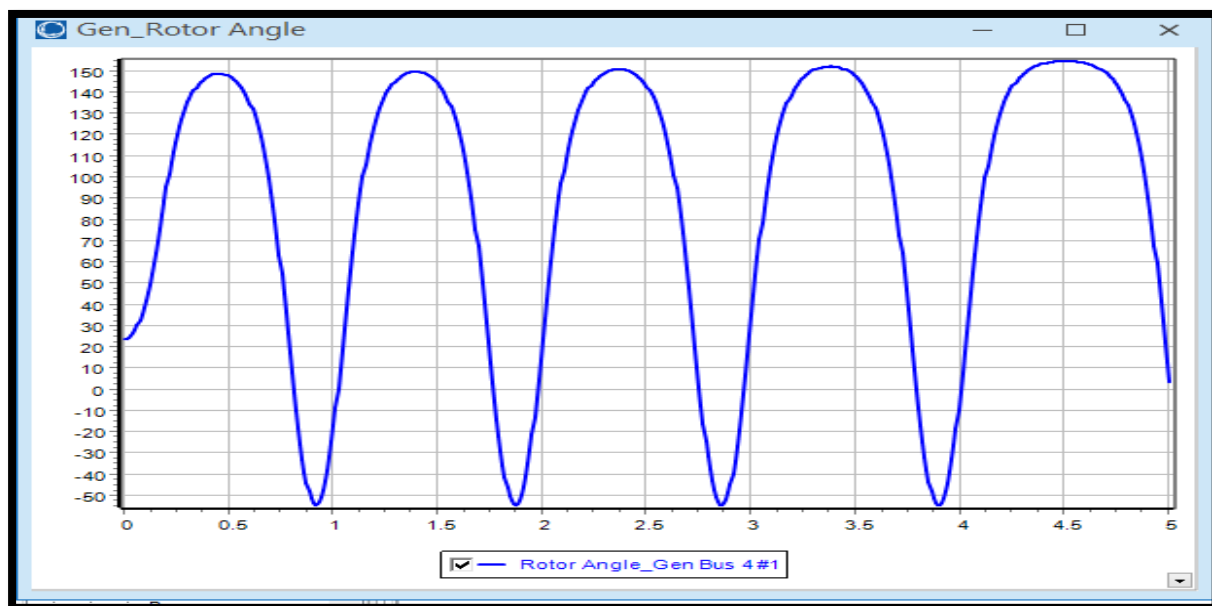
Figure10.4: Set time at $t=0.1891\text{sec}$ 

Figure10.5: Generator rotor angle curve at time 0.1891sec and at this time it is stable.

Control Definitions Violations

Simulation Time Values

Start Time (seconds) 0.000

End Time (seconds) 5.000

Time Step (seconds) 0.010000

Specify Time Step in ☒ Seconds ☐ Cycles

Categories Change...

Summary Results

	Generation	Load
Tripped	0.00	0.00
Relay Tripped		0.00
Model Tripped		0.00
Islanded	0.00	0.00

Transient Contingency Elements

Insert Clear All Insert Apply/Clear/Open Time Shift (seconds) 0.000

	Object Pretty	Time (Cycles)	Time (Seconds)	Enabled	Object	Description
1	Bus Bus 1	0.0	0.000000	CHECK	Bus '1'	FAULT 3PB SOLID
2	Bus Bus 1	11.4	0.189200	CHECK	Bus '1'	CLEARFAULT

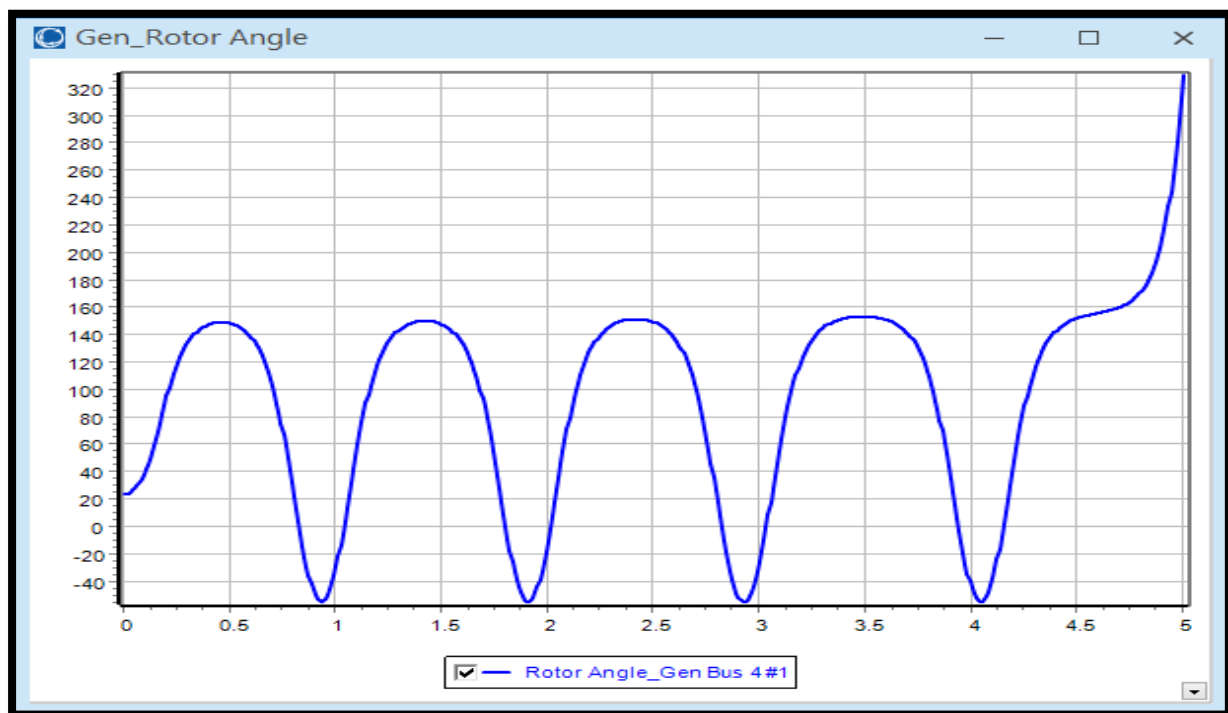
Figure10.6: Set time at $t=0.1892\text{sec}$ 

Figure10.7: Generator rotor angle curve at time 0.1892sec and at this time it lead toward instability.

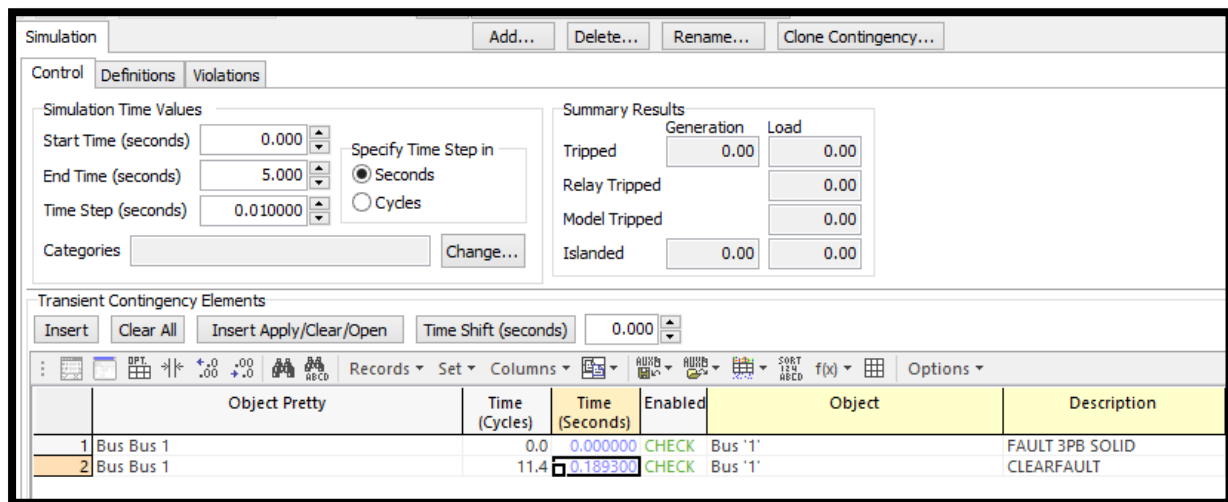
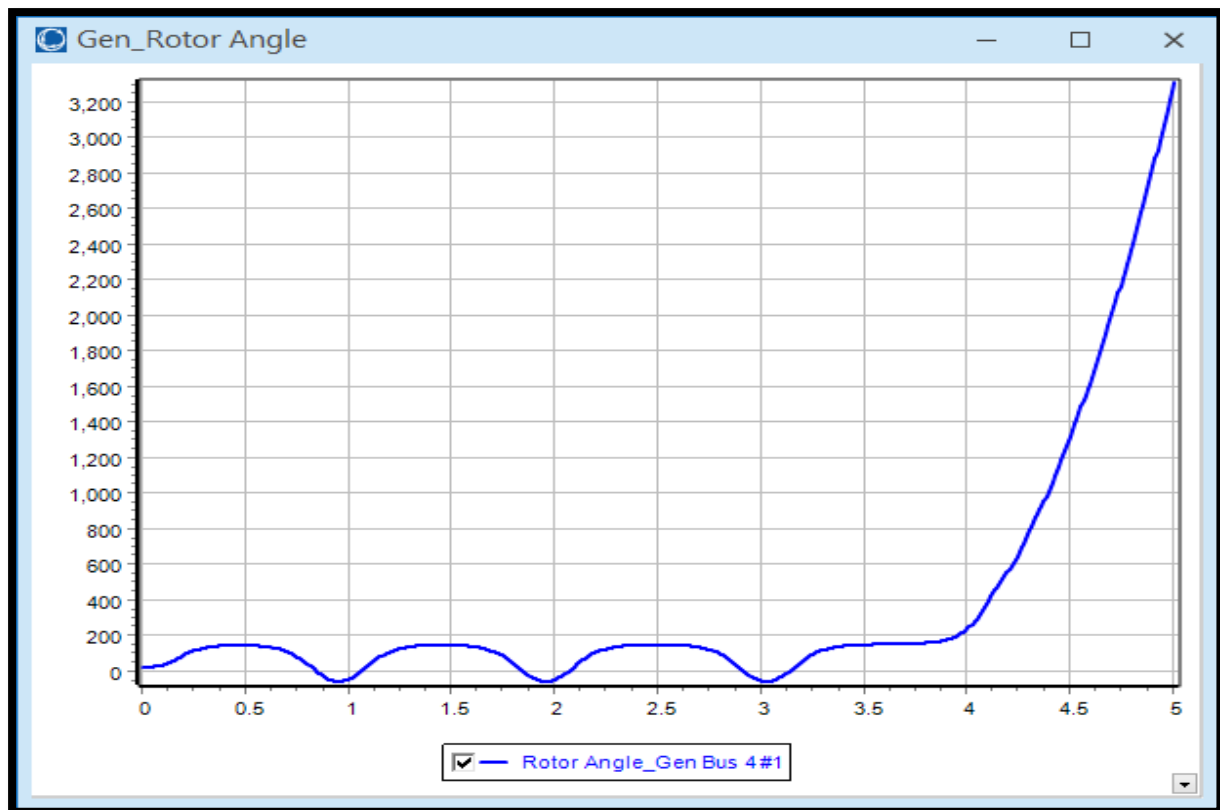
Figure10.8: Set time at $t=0.1893\text{sec}$ 

Figure10.9: Generator rotor angle curve at time 0.1893sec and at this time it leads toward instability.

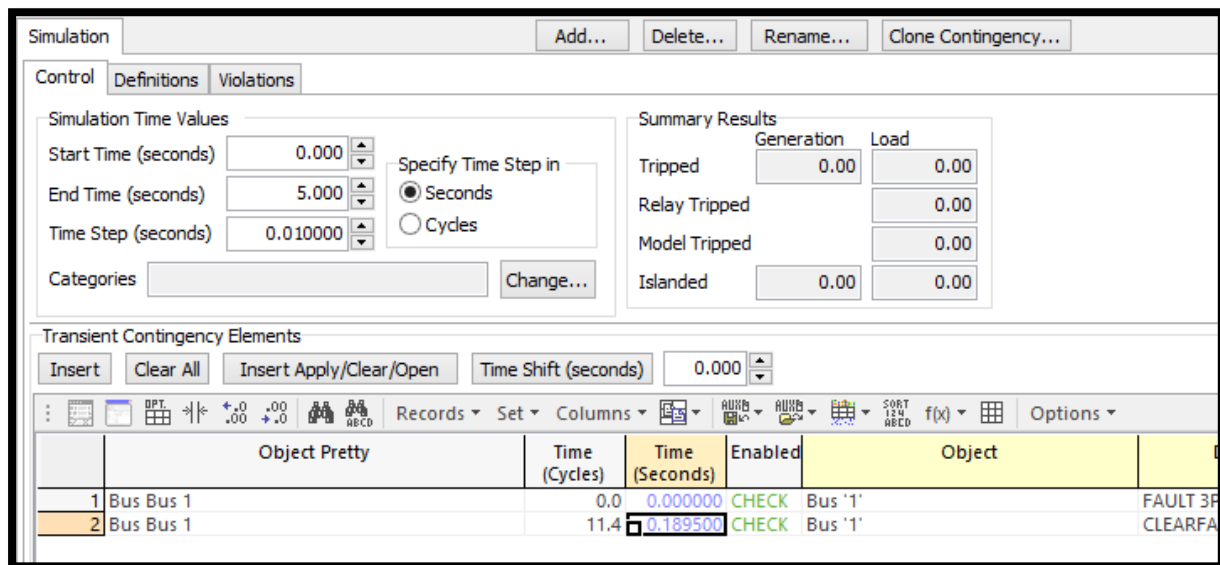
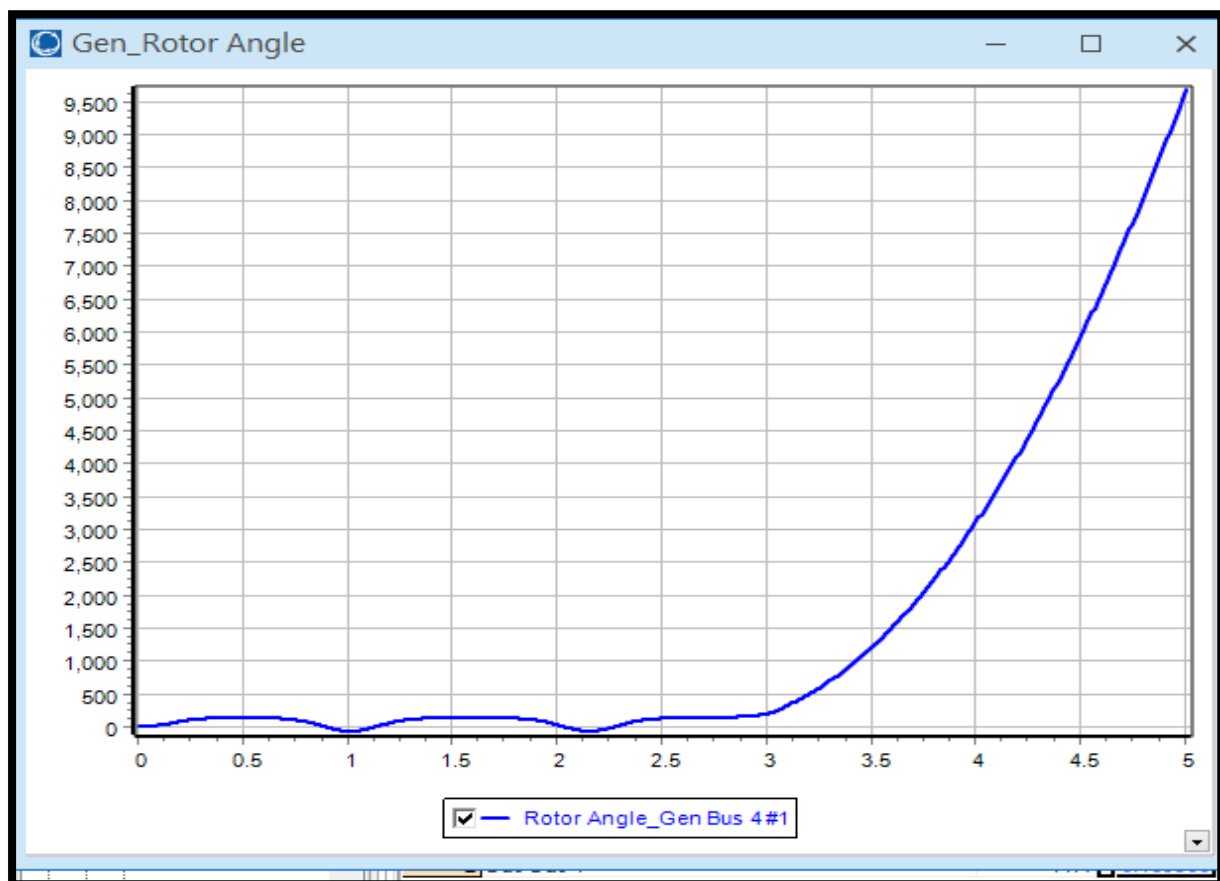
Figure10.10: Set time at $t=0.1894\text{sec}$ 

Figure10.11: Generator rotor angle curve at time 0.1894sec and at this time it is unstable.

Generator Information for Present

Bus Number: [dropdown] Find By Number
 Bus Name: Bus 4 Find By Name
 ID: 1 Find ...
 Area Name: Home (1)
 Labels: no labels
 Generator MVA Base: 100.00

Status: ☐ Open ☒ Closed View Bus Dialog
 Energized: ☐ NO (Offline) ☒ YES (Online)
 Fuel Type: UN (Unknown) [PW=0] [EPC=0]
 Unit Type: UN (Unknown) [PW=0] [EPC=0]

Power and Voltage Control Costs OPF Faults Owners, Area, etc. Custom Stability Weather

Machine Models Exciters Governors Stabilizers Other Models Step-up Transformer Terminal and State

Insert Delete Gen MVA Base: 100.0 Show Block Diagram Create VCurve

Type: Active - GENCLS ☒ Active (only one may be active) Set to Defaults

Parameters:

H	3.00000
D	18.00000
Ra	0.00000
Xdp	0.30000
RComp	0.00000
XComp	0.00000

OK Save Save to Aux Cancel Help Print

Figure no.10.12: Setting of the damping factor at 18 from generator stability tab

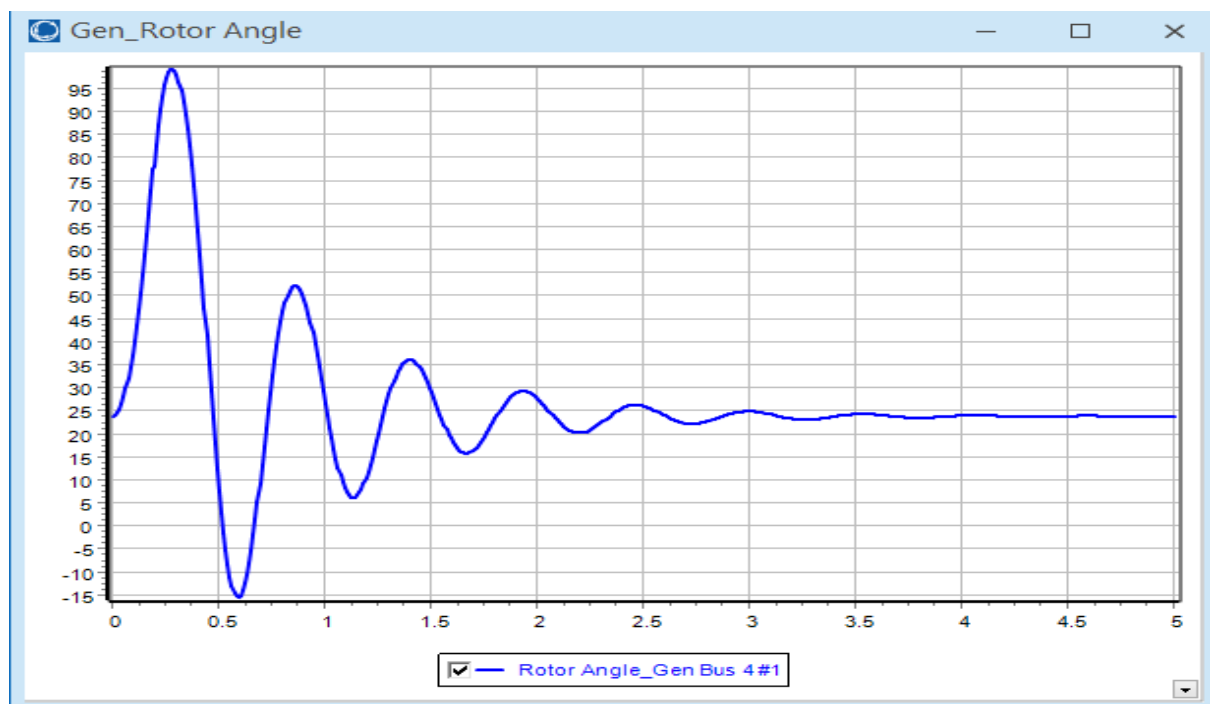


Figure10.13: Generator rotor angle curve at time 0.1891sec while damping factor of generator is $D=18$.

Observation and Conclusion:

Transient stability analysis is an important process for assessing the stability of a power system under transient conditions. This analysis is used to determine the critical clearing angle, which is the maximum angle between the voltage phasors of two synchronous generators that can be maintained without the system becoming unstable. The transient stability analysis involves simulating the behavior of the power system in response to a disturbance, such as a fault or sudden change in load. The analysis calculates the time-domain response of the system and determines the critical angle beyond which the system loses stability. However, transient stability analysis of generators is crucial for determining the critical clearing angle and ensuring the stability of a power system. This analysis helps to identify potential stability issues and provides valuable information for designing protective relays and other control systems to prevent blackouts and other power system failures.