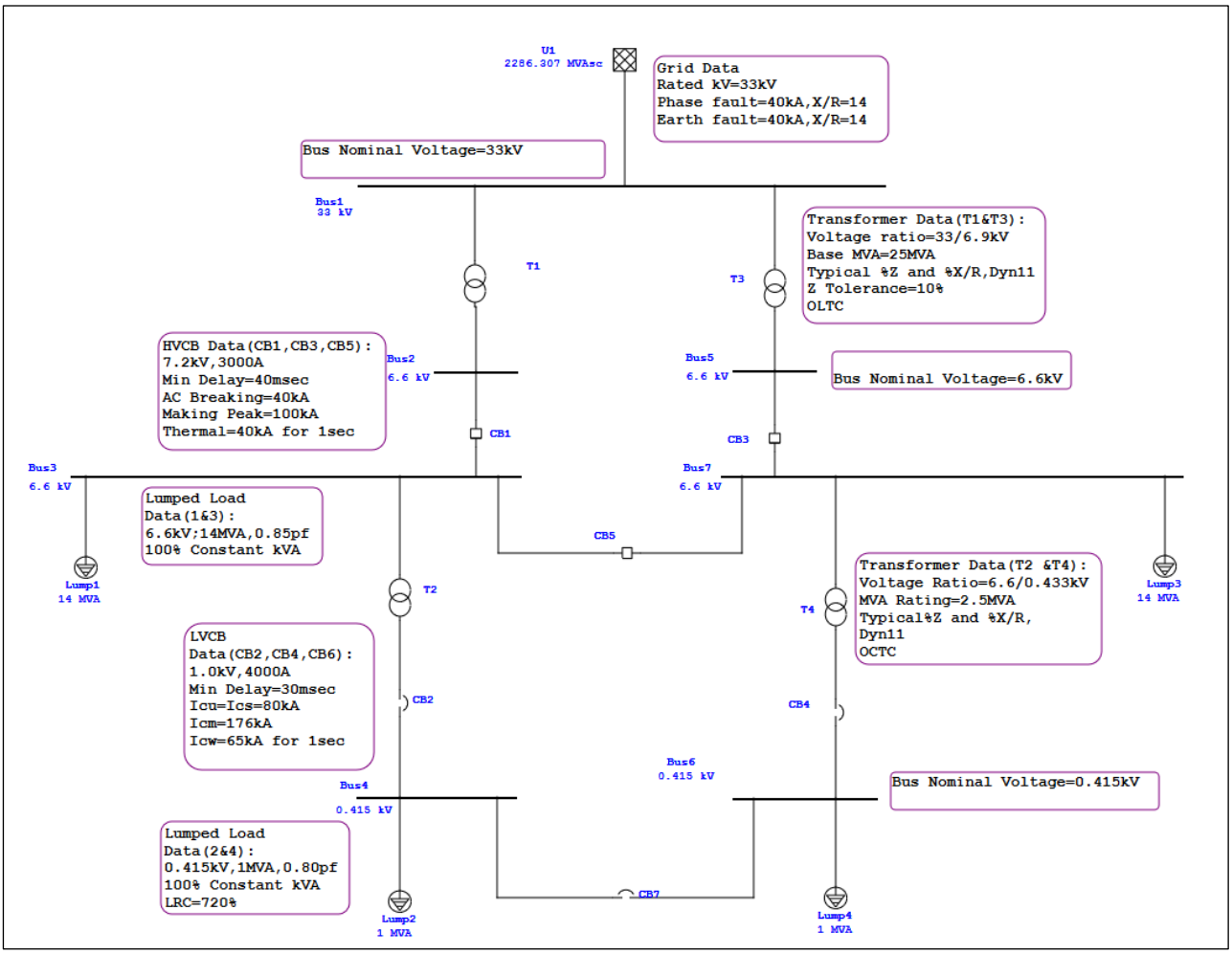
Faulted Motor Transients

Purpose and Description

The purpose of this exercise is to study the behavior of induction machine during faults. A loading shedding scenario will be explained using a voltage relay.

Procedure

1. Open LF-Example1.oti file from load flow exercise. Notice a single line diagram as shown below.



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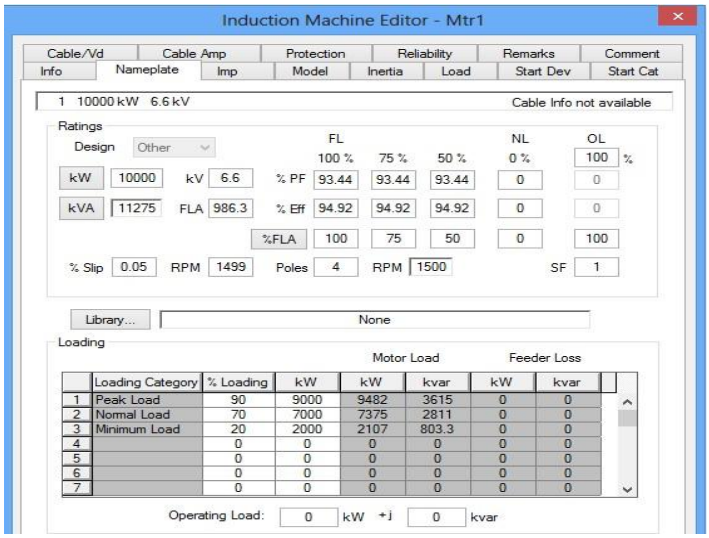
2. Run a scenario ‘Peak LFC’ using scenario wizard.
3. Drag and drop an induction machine on OLV, connect it to Bus3 and proceed entering kW rating, poles & load factors as shown below. (Assume kW rating of Induction machine to 10000 to arrive at actual kW rating from Load flow results).



4. Go to Model Page, click on Parameter Estimation and enter locked rotor & full load data with 0.01 precision as shown below and click estimate.

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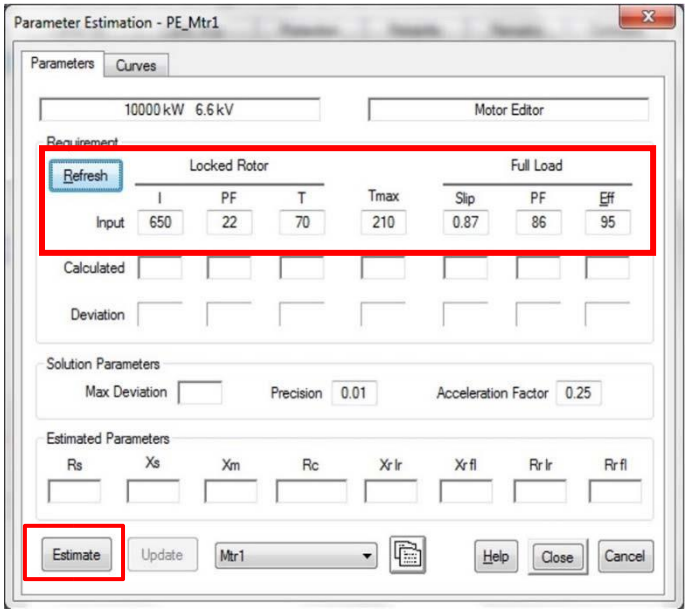
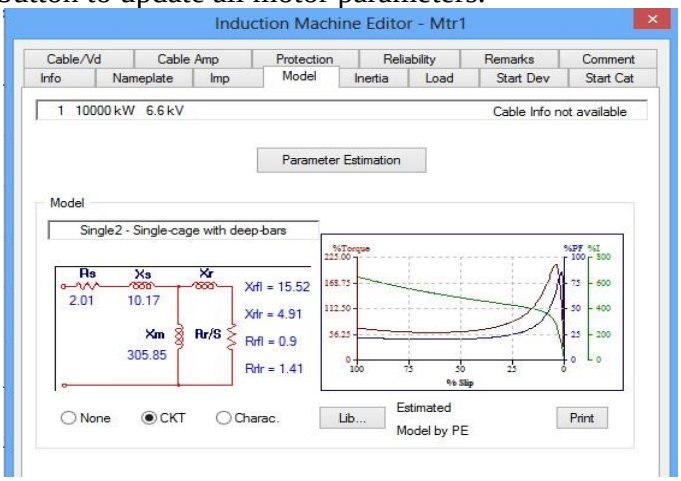


5. Click on update button to update all motor parameters.



Note: Parameter estimation is an iterative process, the results of your calculation might be slightly different.

6. Go to Load Page, check polynomial radio button & pick model "K1+K2.W**2" from Model ID dropdown button.

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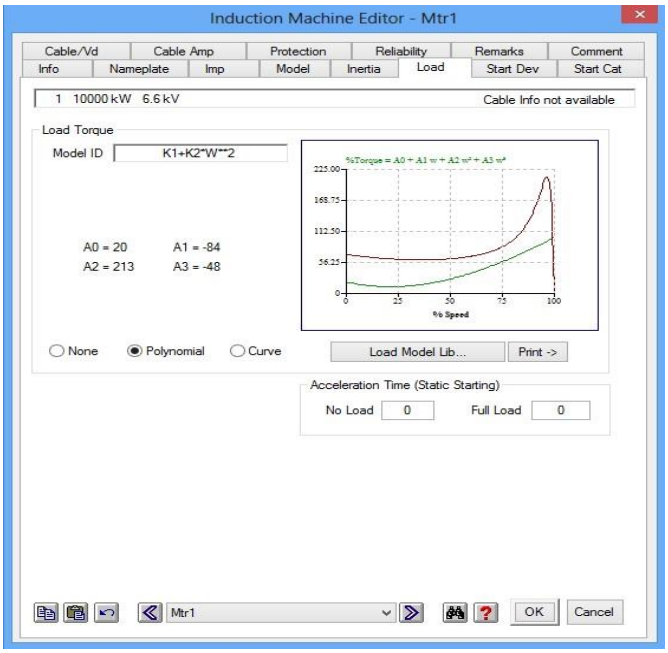

7. Run peak load flow with both motor & lumped load.
   For Peak load flow following results are obtained.
   The lumped load consumption is 10710 kW & 6637 kVar and the motor consumption with 10000kW & 90% load factor is 9373 kW & 5827 kVar.
   So to select right name plate kW instead of 10,000 kW and to achieve Motor consumption = Lumped load consumption = 10710 kW following calculation is performed.

Consumption	Rating
9373 kW	10,000 kW
10710 kW	?

   Motor Rating = 10710 × 10000/ 9373
   = 11440 kW ... (Nameplate rating of equivalent motor)

8. Model dynamic motor at 6.6 kV voltage with above derived value as shown below.

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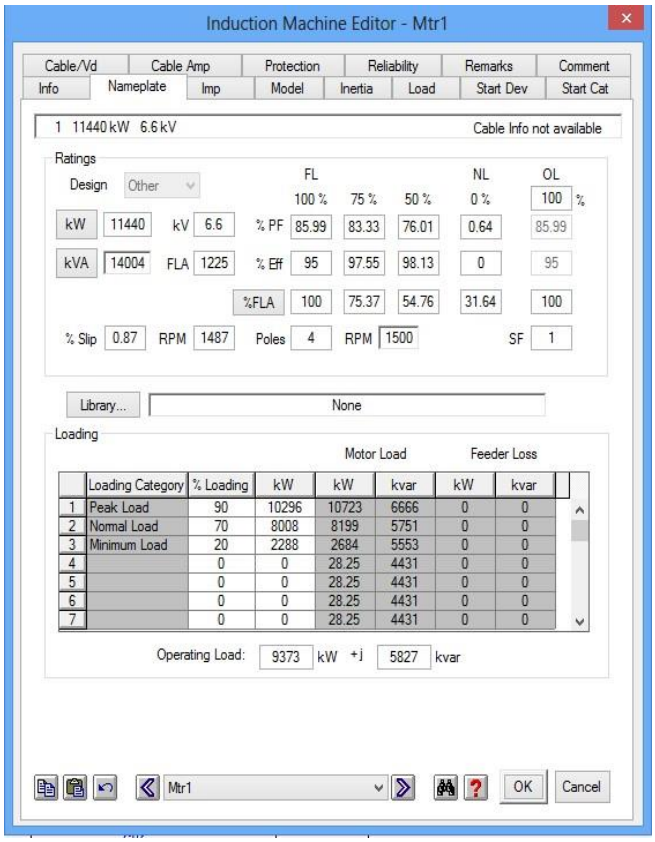
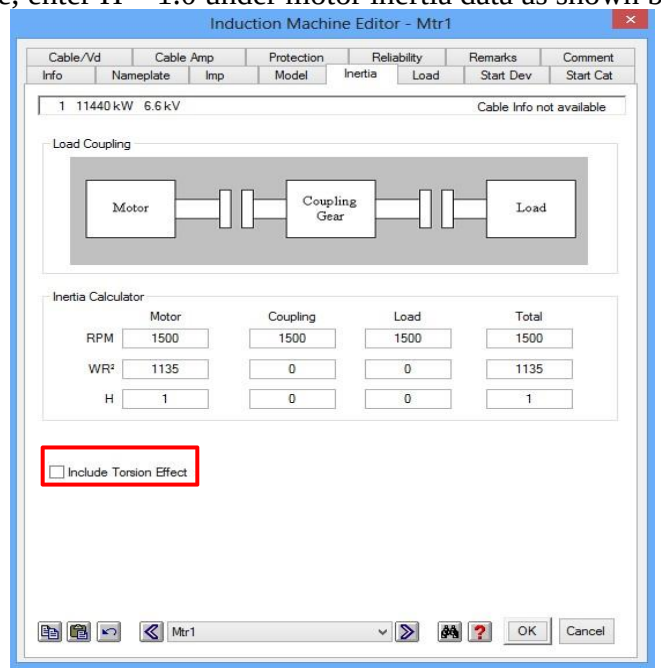


9. Go to Inertia Page, enter H = 1.0 under motor inertia data as shown below.



10. Copy left side bus final Dynamic bulk motor to right side bus.
11. Add HVCBs on lumped load and motor connected to Bus3 & Bus7. Open CB8 & CB9 as shown below.

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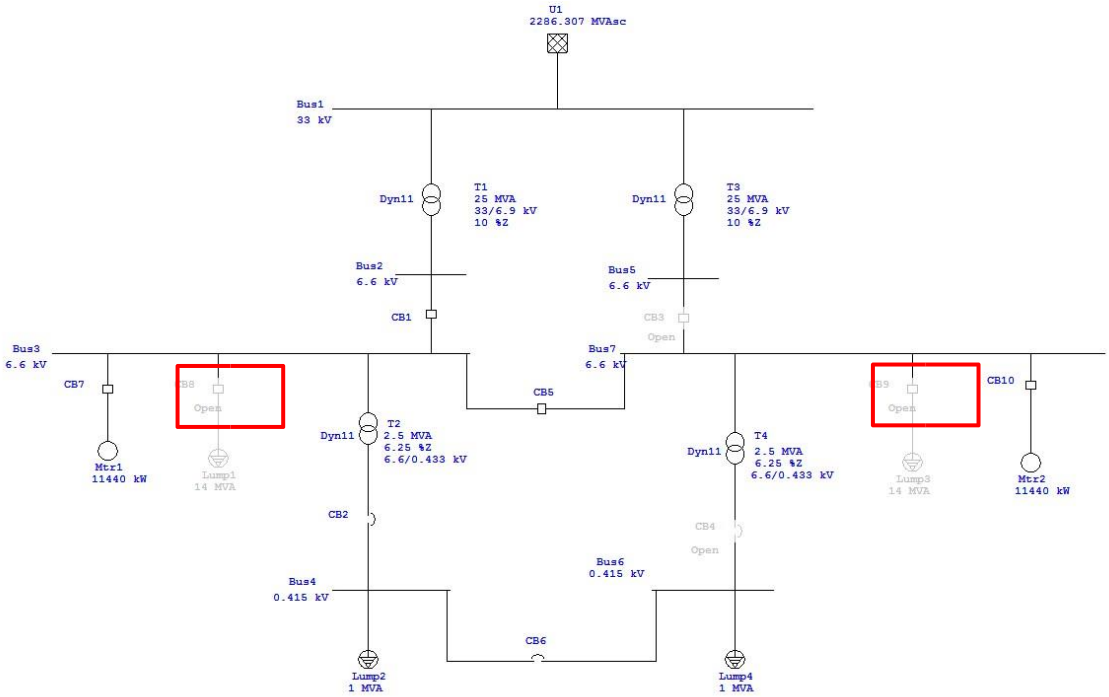
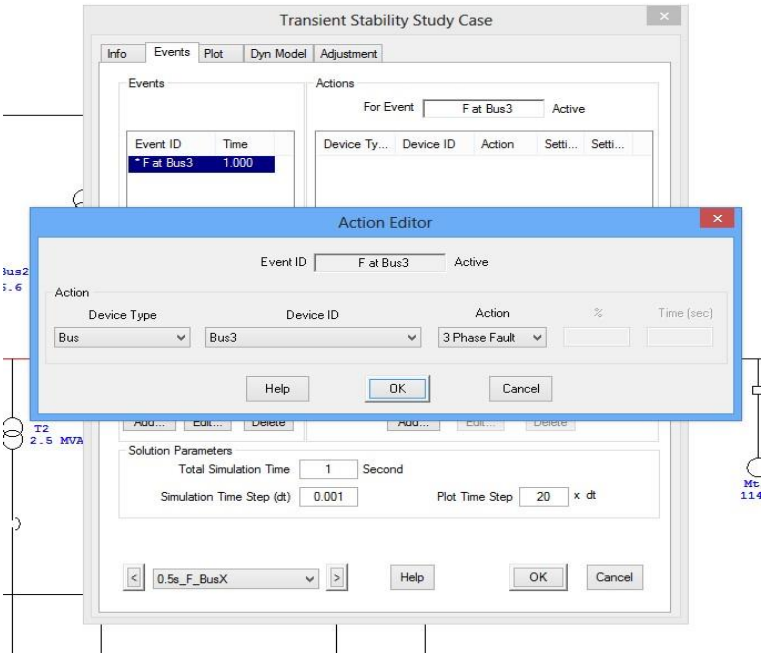


12. Go to transient analysis module, create a new study case with name "0.5s_F_BusX".
13. Go to events page and create an event to simulate 3 phase fault on Bus 3 at 1 sec as shown below.



14. Similarly create one more event to clear the fault on Bus 3 at 1.5 sec. Add action for this event in Action Editor as shown below.

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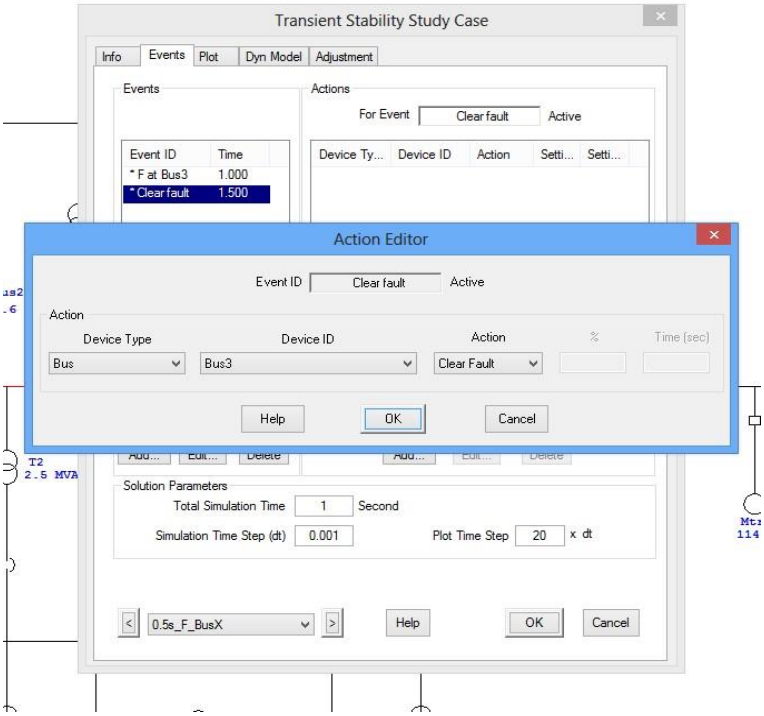
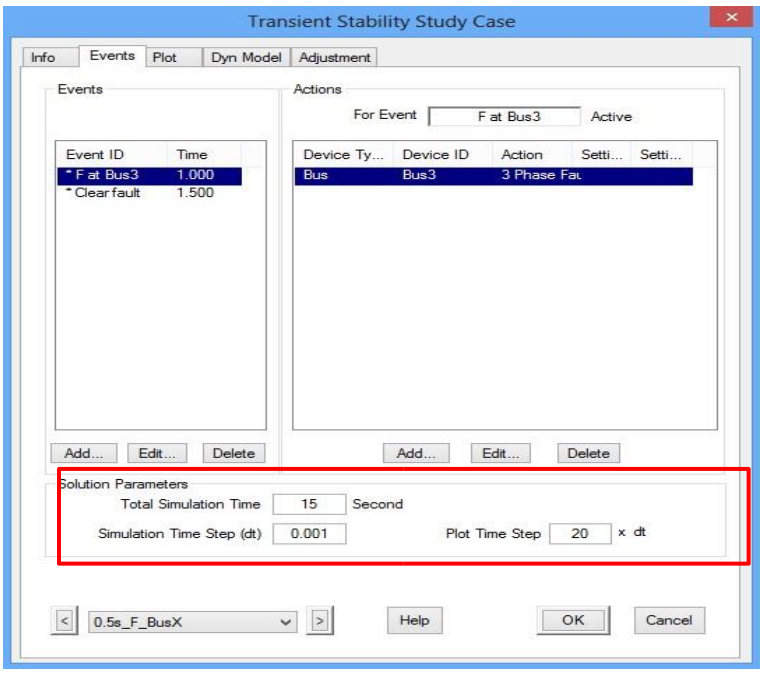


15. Set total simulation time as 15 sec with time step of 0.001 and plot time step of 20 x dt as shown in Solution Parameters.



16. Set the options on the Dyn Model page of transient stability study case as shown below.

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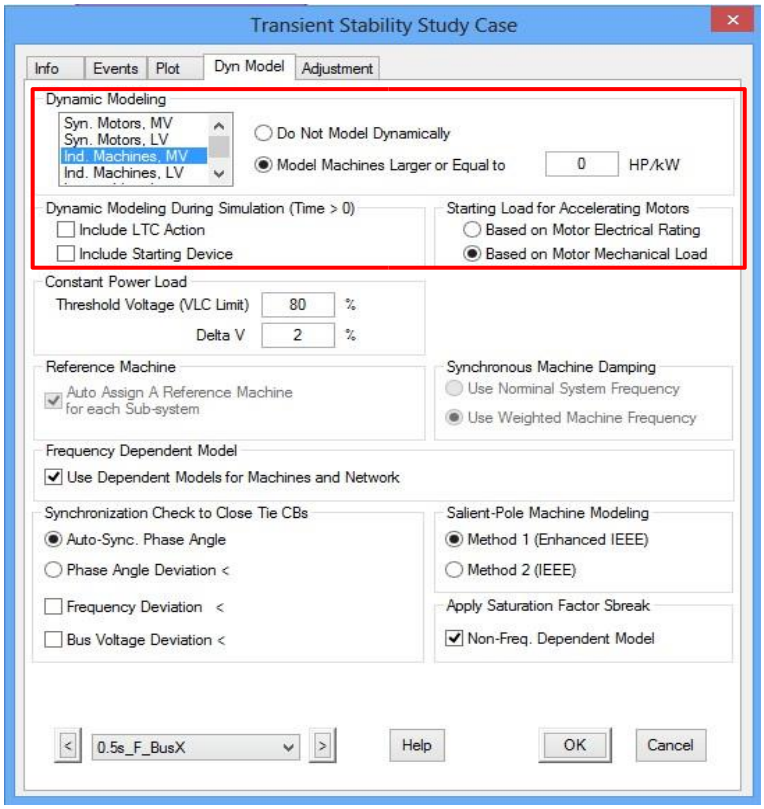
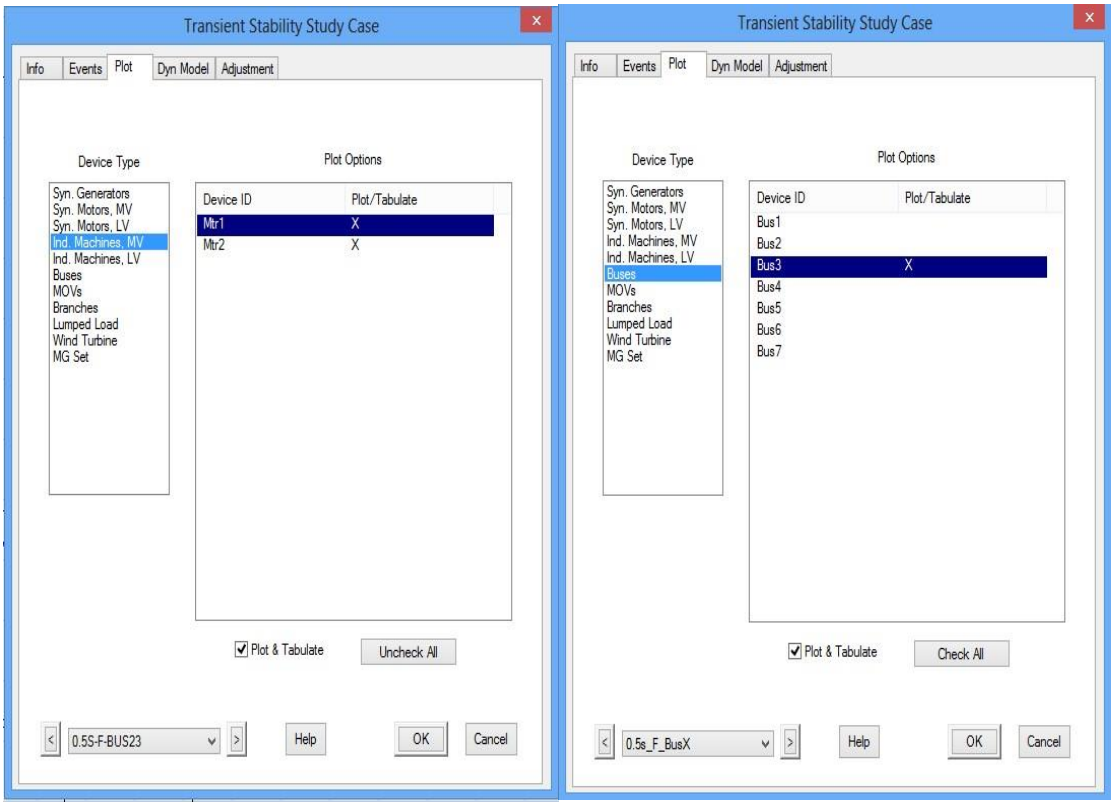


17. Go to plot page, check for following motor & bus plots in transient stability study case as shown below.



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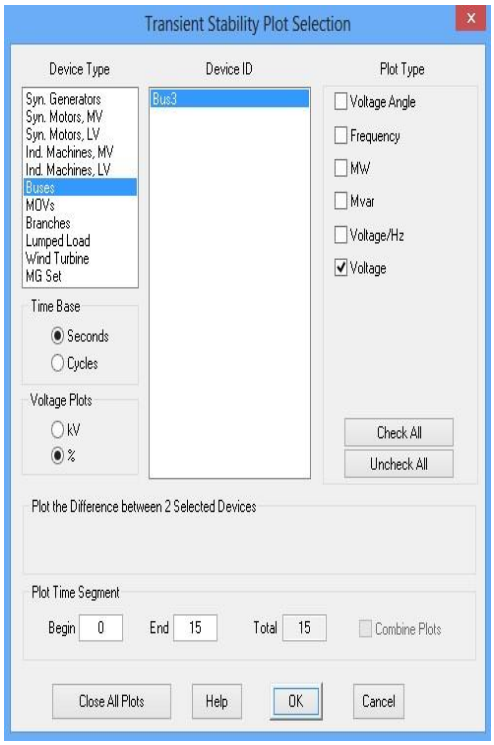
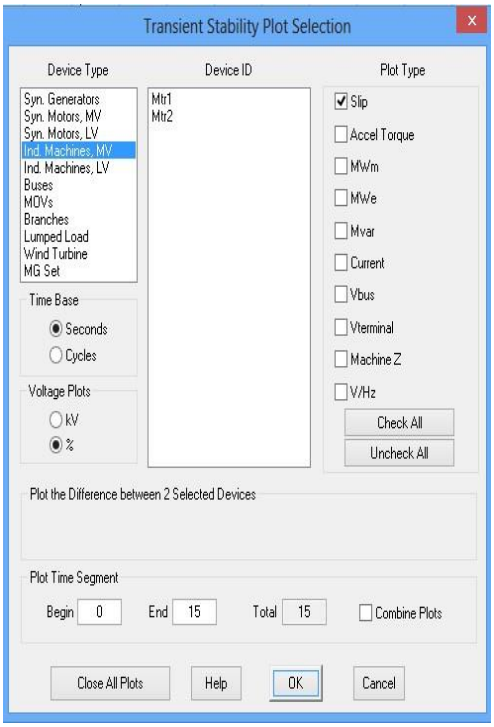
18. Run transient stability and click on transient stability plots to check the results for bus and motor as shown below.





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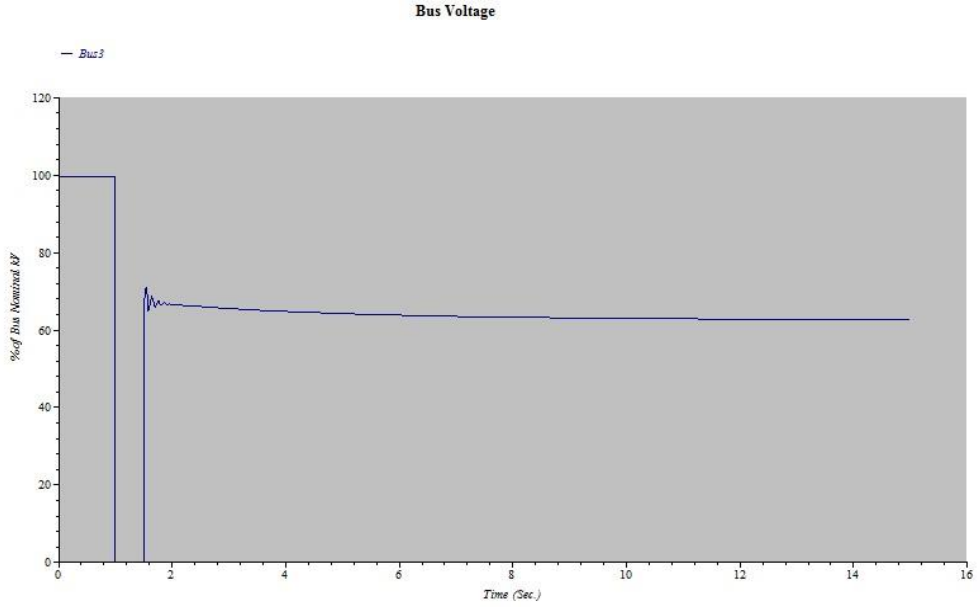
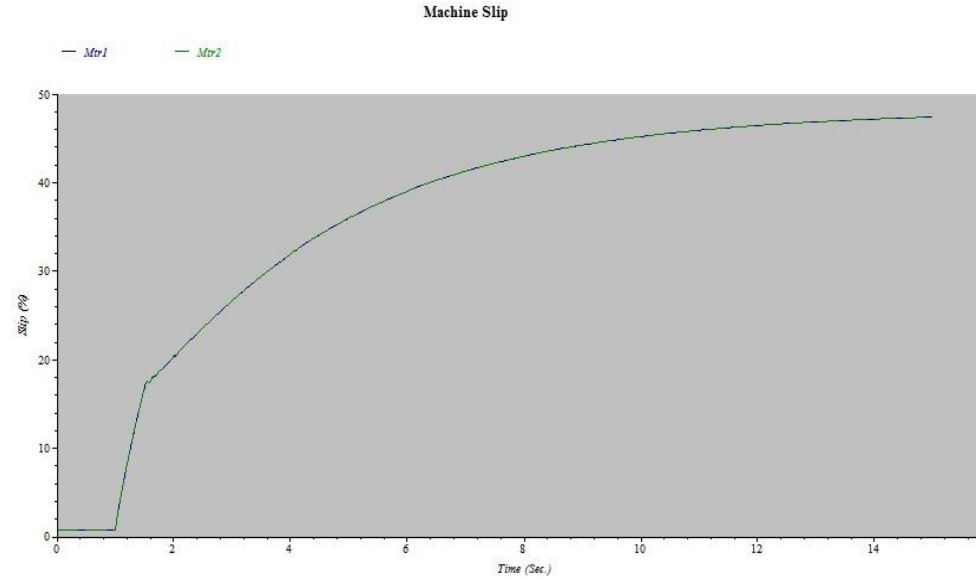
Bus3 Voltage



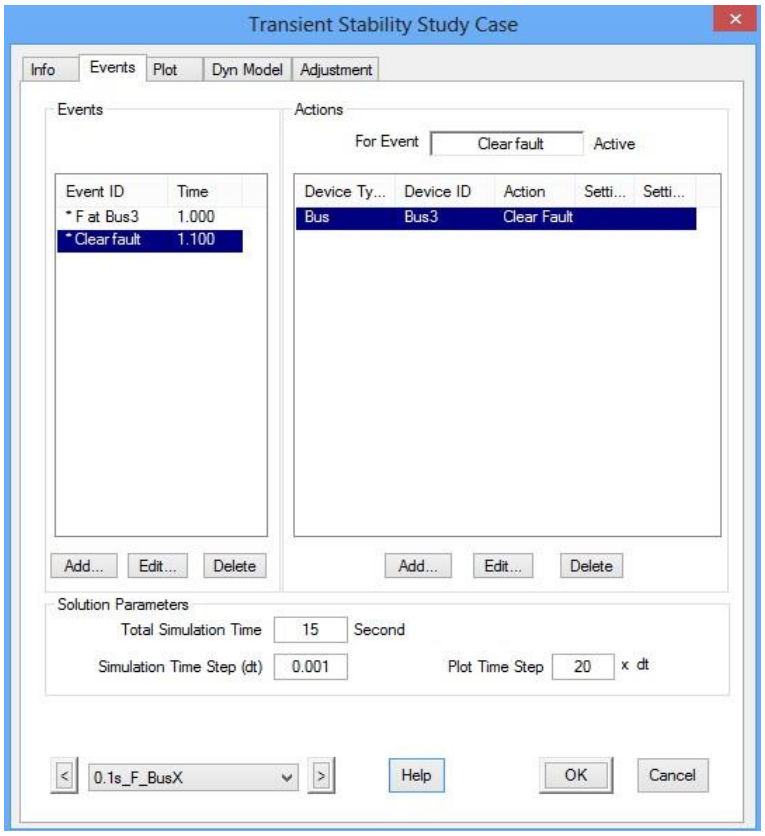
Motor Slip



For fault on Bus3, motors slow down. After the fault clearance at 0.5 sec, the motors draw heavy current from the system resulting in bus voltage collapse which leads to collapse in motor torques and motors get stalled.

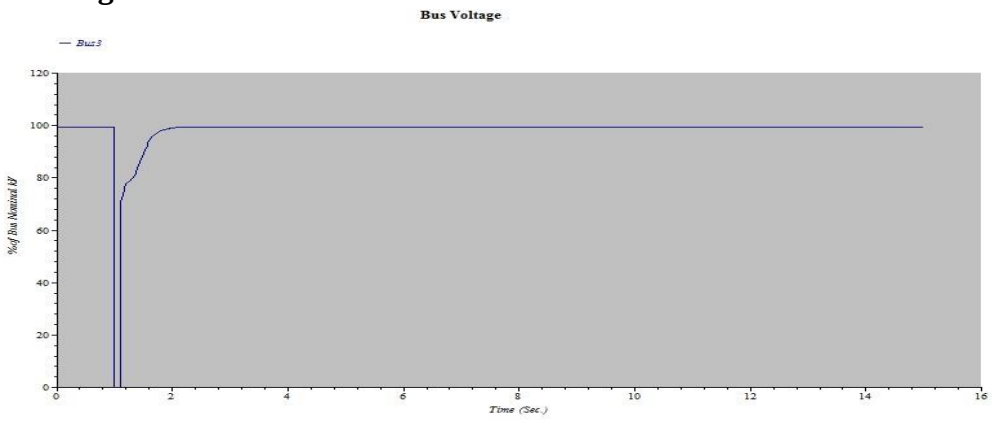
19. Similarly, create new study case with name "0.1s_F_BusX". Create 3-phase fault on Bus3 at 1 sec and clear the fault at 1.1 sec in the events page as shown below.

Faulted Motor Transients



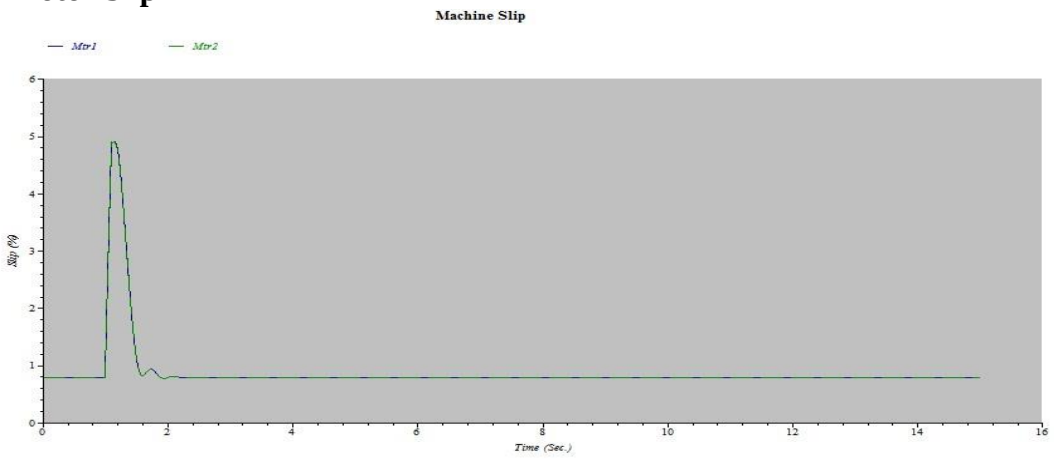
20. Run transient stability and click on transient stability plot to check the results for bus and motor.

Bus3 Voltage



Faulted Motor Transients

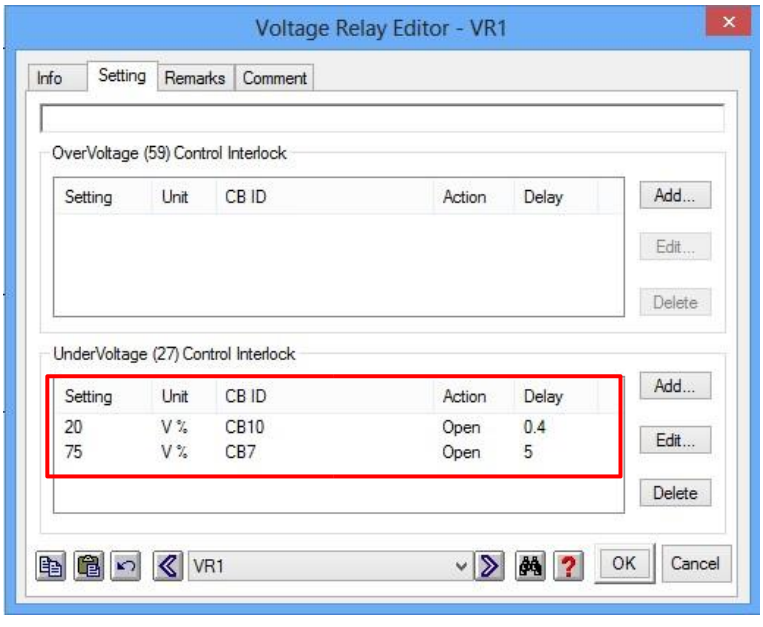
Motor Slip



For 0.1 sec fault on Bus3, motors slow down slightly. After the fault clearance, the reactive power demand of the motor is less as compared to the earlier case. Hence the motor bus voltage recovers satisfactorily as shown above.

Additional Case with Load shedding:

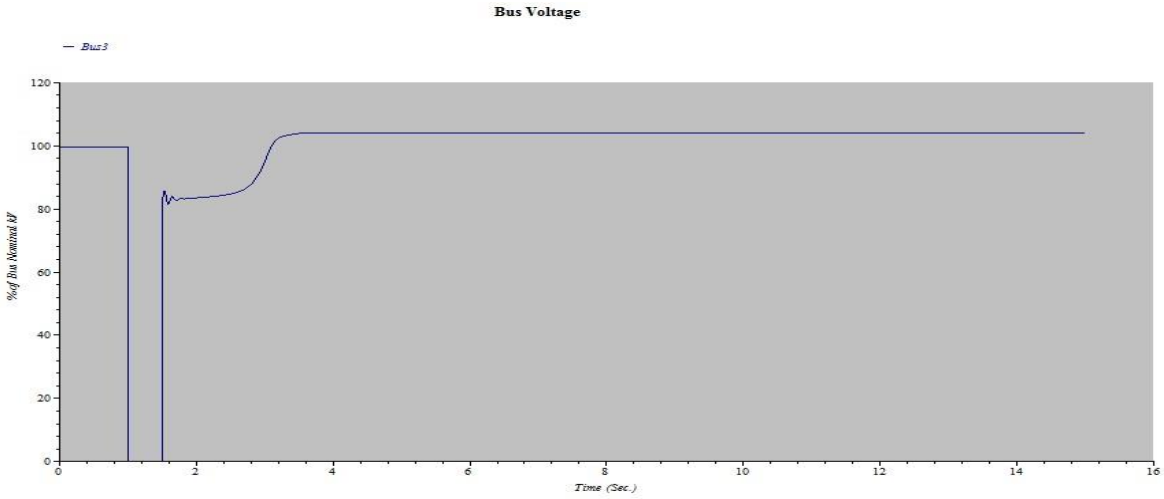
21. Drag & drop voltage relay in OLV and connect to Bus3 with following Under Voltage settings.



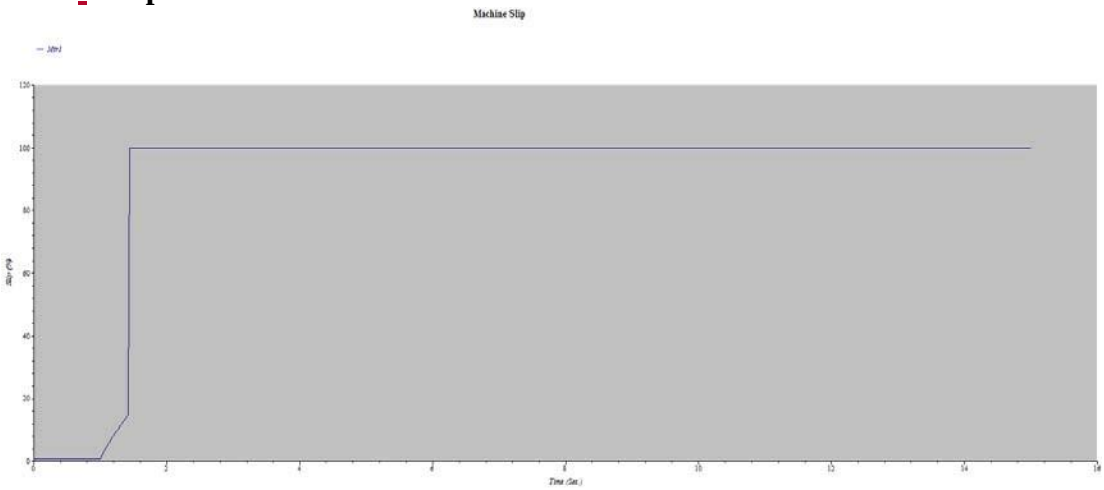
22. Run transient stability with "0.5s_F_BusX" case and plot to check the results for bus and motor.

Faulted Motor Transients

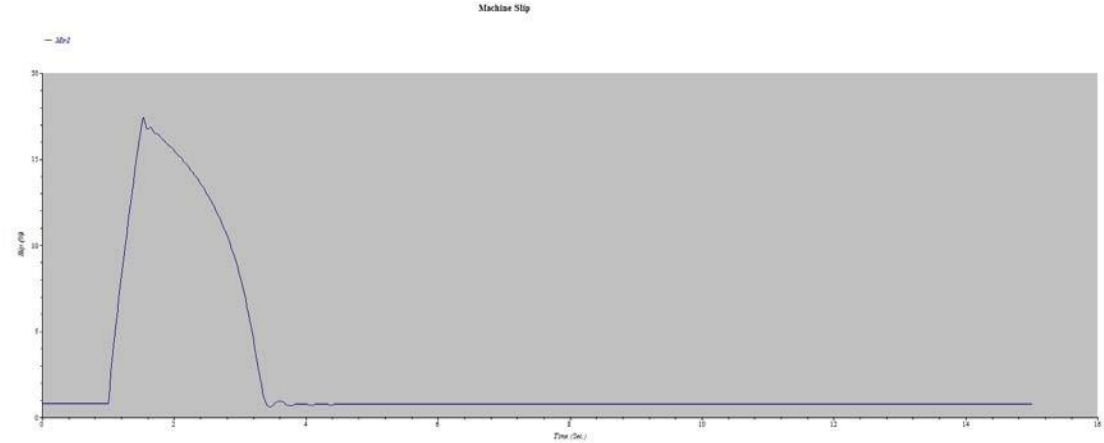
Bus3 Voltage



Motor 1 Slip



Motor 2 Slip



Note: This case is the remedy for study case "0.5s_F_BusX", with two stage under voltage load shedding scheme implemented at Bus3.

