Slow Bus Changeover

Theoretical concepts

Slow supply changeover is defined as one in which the length of time between disconnect of the motor from the power supply and closing onto the same or another power supply is delayed until the motor rotor flux linkages have decayed sufficiently so that the transient current and torque associated with the bus transfer or reclosing will remain within acceptable level.

Slow changeover scheme is adopted where bus voltage reduces after a supply trip or fault trip (i.e. voltage goes below 80% for more than 200msec).

In such situations to restore supply for all trip motors, under voltage load shedding followed by subsequent load restoration will be required based on the auto trip and restart scheme requirement. Typically motor restart occurs after 4 secs of reduced supply.

The ETAP example here is for slow bus transfer.

In most industrial system the following criteria is applied with respect to voltage dips or interruptions such as those arising as a consequence of system short circuits or disturbances from grid intake supplies:

- Voltage dips resulting in consumer terminal voltages down to 80% of rated equipment voltage shall not affect plant operations;
- Voltage dips resulting in consumer terminal voltages below 80% of rated equipment voltage for a duration of not more than 0.2sec shall, on voltage restoration, result in the instantaneous re-energisation of consumers performing an essential and/or vital service to the extent achievable within the constraints imposed by the electrical system
- Voltage dips resulting in consumer terminal voltages below 80% of rated equipment voltage for a duration between 0.2sec and 4sec shall, on voltage restoration, result in a sequential re-energisation of selected consumers.

Normally, plant operations can ride through voltage dips of up to 4sec, depending on the type of process involved.
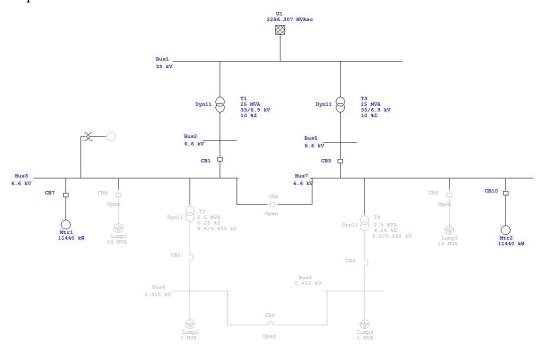
Slow Bus Changeover

Purpose and description

The purpose of this exercise is to study auto restarting of group of motors in stages after a they are transferred from tripped bus to healthy bus i.e. all the motors (except the critical motor) on tripped bus are allowed to reaccelerate after transferring to healthy bus.
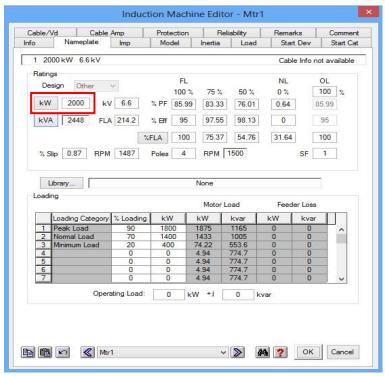
Procedure

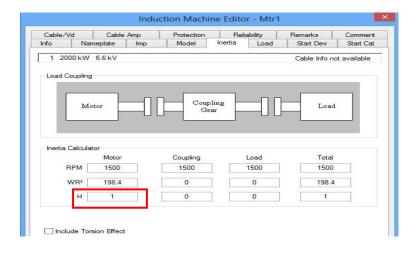1. Open the fast bus transfer model from the fast bus transfer exercise as shown below.

2. Double click on Grp_Mtr1, go to nameplate page and change the kW rating to 2000.
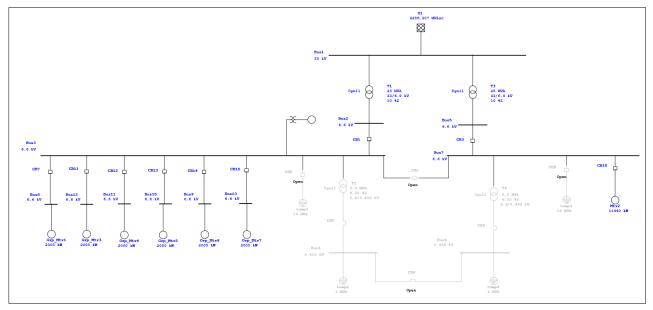
Slow Bus Changeover

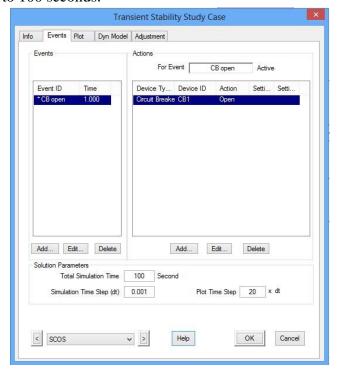3. Go to Inertia page and enter H=1 as shown below.

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4. Add an extra bus at motor terminal. Copy the modelled motor 5 times along with the terminal bus & Circuit breaker and connect them to Bus3 as shown below.

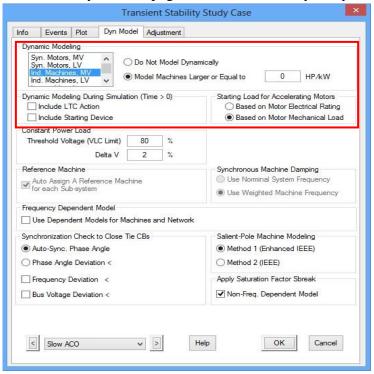**Note:** For this exercise group of motors in each group are shown as lumped.

5. Go to Transient Stability Analysis module and create a new study case with name 'SCOS'

6. Go to Events page and create an event to open CB1 at 1 sec as shown below. Set Total Simulation Time to 100 seconds.
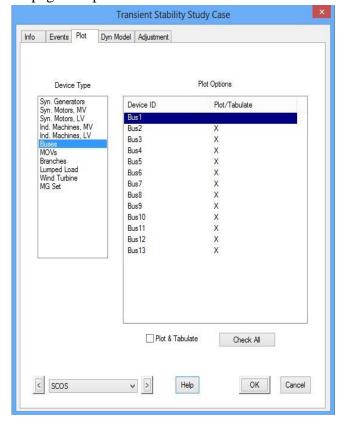
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7. Set the options on the Dyn Model page of transient stability study case as shown below.
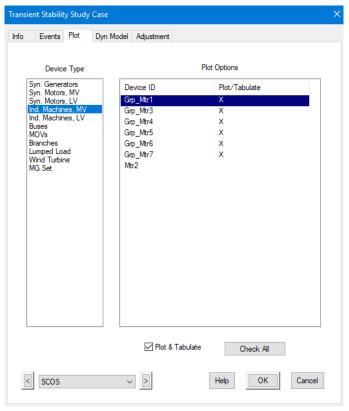

8. Click on Plot page and plot the elements/devices of interest.

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9. Click on the Voltage Relay, go to setting page & trip all motors except critical motor when voltage falls below 80% for more than 200msec (0.2sec). Restart motors after 5 sec before which bus coupler is closed with the bus A (tripped bus) as voltage goes to 20%.

In this example one motor is assumed to be critical and allowed to accelerate.

Enter the below mentioned data in Undervoltage (27) Control Interlock.

% Voltage Setting	Circuit Breaker ID	Action	Time Delay in seconds
80	CB11	Open	0.2
80	CB12	Open	0.2
80	CB13	Open	0.2
80	CB14	Open	0.2
80	CB15	Open	0.2
20	CB5	Close	0.5

Note: CB5 is closed at 0.5 sec so that resultant volts per hertz (V/Hz) vector between the motor residual V/Hz vector and the incoming source V/Hz vector at the instant of transfer or reclosing does not exceed 1.33 per unit V/Hz on the motor rated voltage and frequency bases. This note is valid only for Mtr1 which is a critical motor.
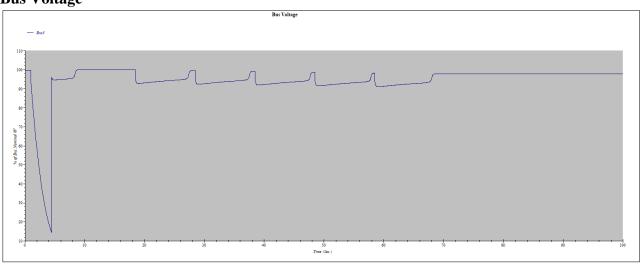
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10. In the Overvoltage (59) Control Interlock, enter the below mentioned data in Voltage Relay Control Interlock Editor.

% Voltage Setting	Circuit Breaker ID	Action	Time Delay in seconds
90	CB11	Close	14
90	CB12	Close	24
90	CB13	Close	34
90	CB14	Close	44
90	CB15	Close	54

Note: The sequence and time and group of motors to be selected to ensure that during restart, voltage dip on healthy system is not severe and in within the satisfactorily limit. With above sequence of motors the results show voltage recovery is satisfactory.

11. Run Transient Stability, click on Transient Stability Plot & plot the bus voltages & motor slips.
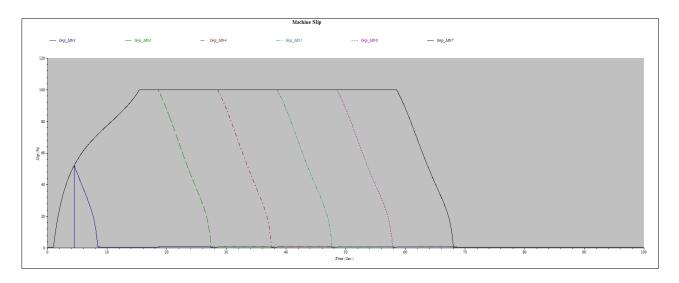
Bus Voltage

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Motor slips

Slow changeover scheme is adopted where bus voltage reduces after a supply trip or fault trip (i.e. voltage goes below 80% for more than 200msec)

In such situations to restore supply for all trip motors, under voltage load shedding followed by subsequent load restoration will be required based on the auto trip and restart scheme requirement.

Typically motor restart occurs after 4 secs of reduced supply.