Load Flow Analysis

Generator load sharing

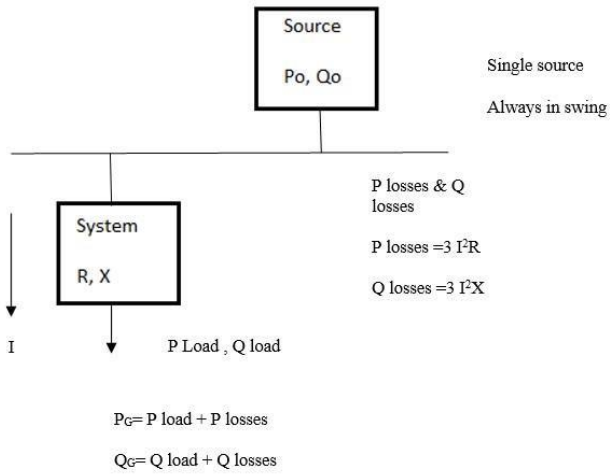
Theoretical concepts

If there is a single source in a system (whether generator or grid), this single source should be set to "swing" mode (also called slack mode).

Types of buses considered in load flow

Bus type	Bus	Quantities specified	To be calculated by Load flow
P,Q	Load bus	P,Q	V, δ
P,Q (Mvar control)	Generation bus	P,Q	V, δ
P,V (Voltagecontrol)	Generation bus	P,V (with Q limit)	Q, δ
V, δ (Swing bus)	Generation bus	V, δ	P,Q

Only one bus or generator source should be in swing mode. Other sources can be in P, Q or P, V (with Q limit) mode.



P_{load}, Q_{load} are known at every bus before load flow model is prepared. Losses i.e. P_{losses} & Q_{losses} remain unknown till load flow solution is complete. To estimate losses, run load flow to find the solution, for which one of the sources will supply P_{losses} & Q_{losses}.This type of source is called as "Swing" source where V & δ are specified & P_G, Q_G are calculated by Load Flow analysis.

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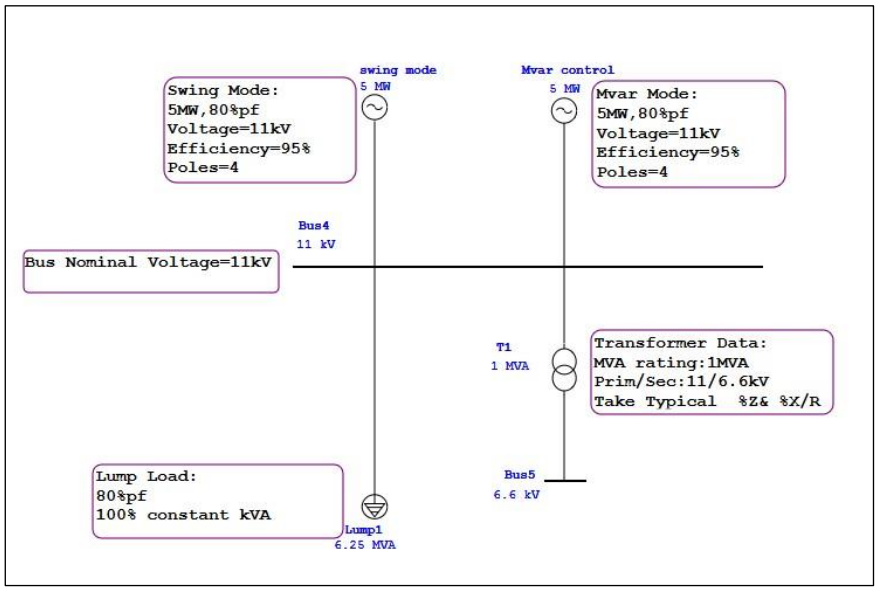
Purpose and Description

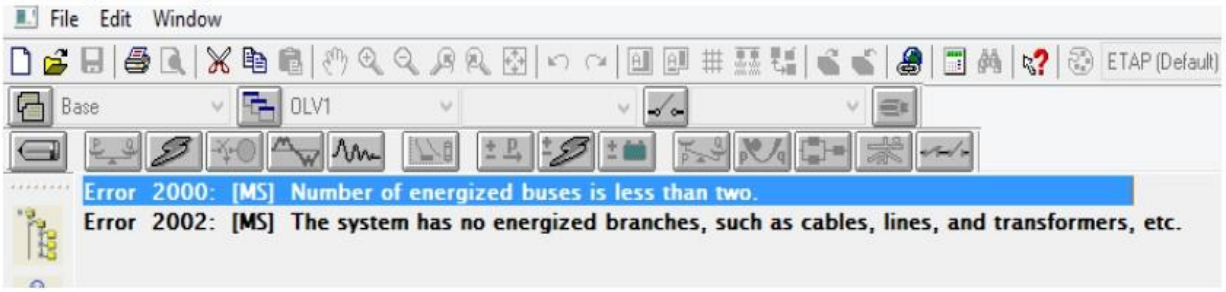
This section explains the Load sharing methodology between different generators.
This exercise involves creating the below shown SLD and entering the corresponding data. The detail modelling of the SLD is shown in the subsequent steps.

Procedure

1. Construct a single line diagram as shown below. Assume the 5 MW generator with power factor as 80% and efficiency as 95%.



2. Note: Transformer and bus are required to run the ETAP. Otherwise, ETAP shows the following message:



3. Select Swing mode for G1 and P, Q mode i.e. Mvar control mode for G2.
4. In rating page of G2, enter the following data in all the generating categories.
   P_{G2}=2.5MW
   Q_{G2}=1.875 Mvar……. (50% Load)

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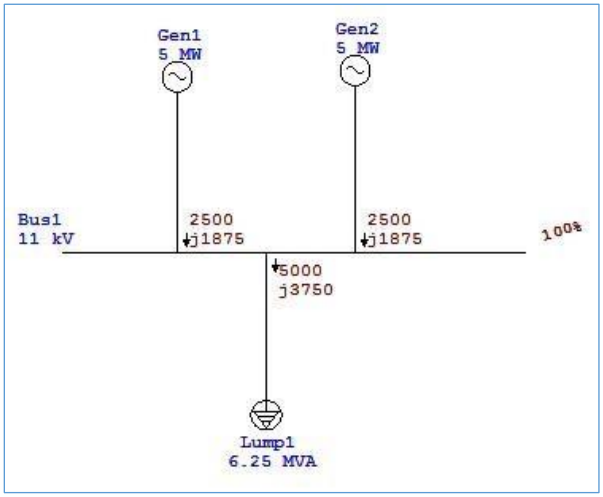
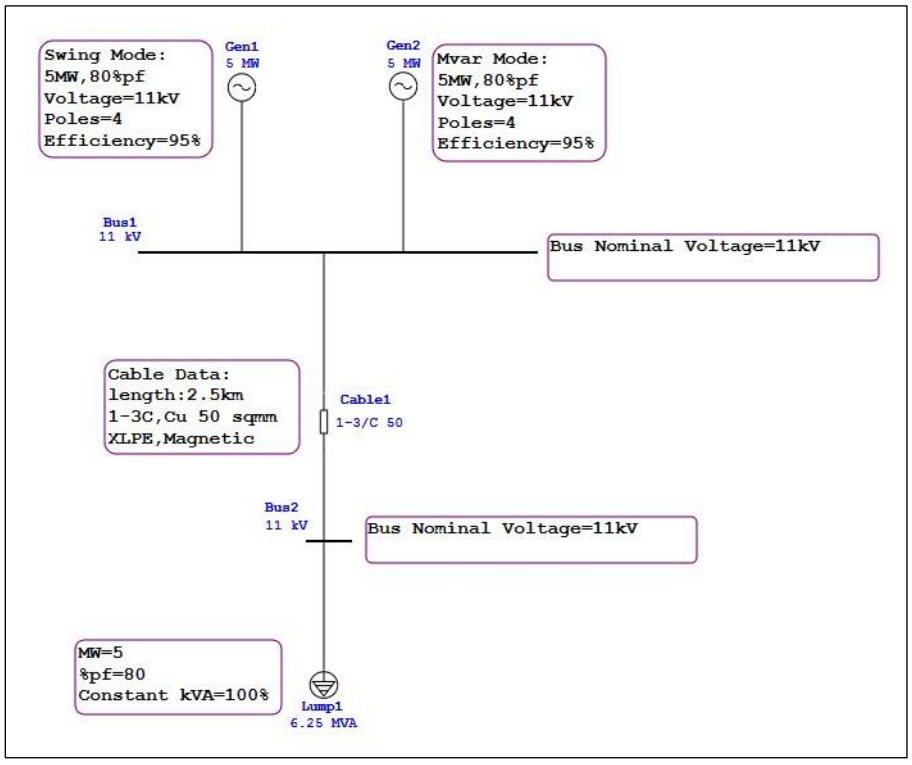
5. Run Normal Load flow from scenario wizard and notice that two generators are sharing the load equally as shown below.



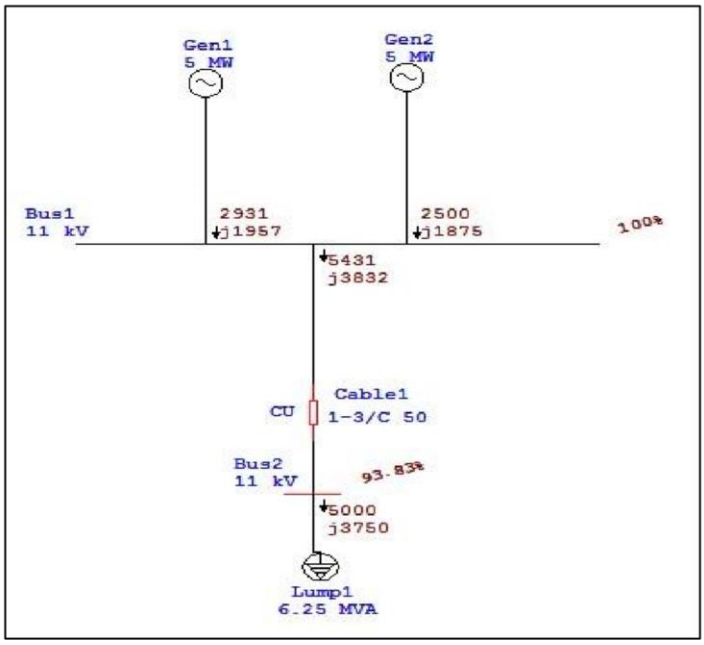
6. Let us check how to share the load equally between generators when the network contains active and reactive power losses. To know that, connect a cable between generator and load terminal bus with the data shown below.



7. Prior to Load Flow analysis total losses are unknown, so divide known load MW & Mvar in equal proportion between G1 & G2.

Load Flow Analysis

7. Set P & Q of G2 to
   P_{G2} = 2.5 MW
   Q_{G2} = 1.875 Mvar } (50 %)
8. Run Load Flow and check that G1 is supplying 50% of total load and real & reactive power losses in the system as shown below.



9. For equal sharing of load considering losses,
   Set G2 to
   P_{G2} = 5.431/2 = 2.7155 MW
   Q_{G2} = 3.832/2 = 1.916 Mvar

Load Flow Analysis

10. Run Normal Load Flow to check that two generators are sharing the load equally as shown below.