Power system Operation

Complex Engineering Problem

Problem Statement:

Transient Stability is major challenging task in power system, to find critical angle and time of transient stability is major concern, generators remain in stable conditions if fault is recovered within time, otherwise it is difficult to handle such type of conditions. The behavior is different for different types of generators (Synchronous, Induction and Doubly Fed Induction Generators). In this CEP, the behavior of Induction and DFIG generators will be analyzed under same type of faults.

Figure Number. 1, shows a single-line diagram of a three-phase, 60-Hz synchronous generator, connected through a transformer and parallel transmission lines to an infinite bus. All reactance's are given in per-unit on a common system base. If the infinite bus receives 1.0 per unit real power at 0.95 p.f.

Assume the synchronous generator is replaced with an induction generator and shunt capacitor in order to represent a wind farm with the same initial real and reactive power output as in previous model. The induction generator parameters are H=0.9 per unit-seconds, Ra= 0:013, Xa= 0.067, Xm = 3.8, R1=0.0124, X1=0.17 (all per unit using the 100 MVA system base).

Assume the synchronous generator is replaced with a Type 3 DFIG generator in order to represent a wind farm with the initial current into the infinite bus set to 1.0 (unity power factor). The DFIG reactance Xeq =0.8 per unit using a 100 MVA system base.

The major fault occurs at bus 3, assuming fault lasts longer than 3 cycles, calculation for figure 1 should have done for calculating the critical clearing time to remain system stable.

WP1 Depth of knowledge (WK3 - Engineering Fundamentals, WK5 - Engineering Design, WK6-Engineering Practice, WK8 - Research Literature)

A good literature review must be done of power system stability in order to find solution of critical clearing angle for different generators, and depth of knowledge is necessary to calculate the equations of ($P_e, E^{/}$). Moreover, system also has been designed and implemented in Power World Simulator for verification of results.

WP3 Depth of Analysis:

Selection of different parameter in calculations and for simulation require deep analysis of topic and simulation expertise.

WP2 Conflicting Requirements:

Moreover, the **comparisons** of results for different generators will also reflect different behavior of generators under stability conditions.

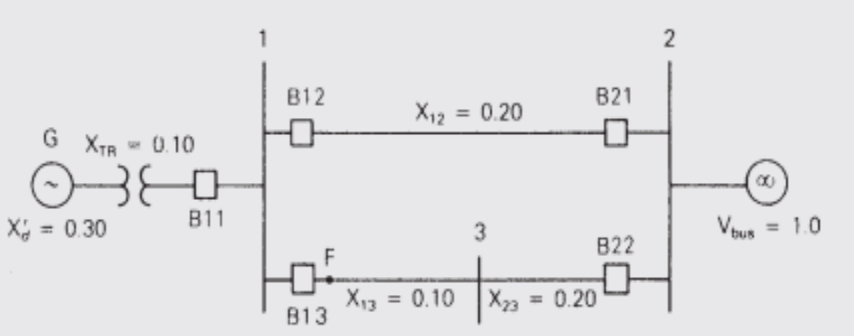

Figure number 1: representation of power system that contains 3 buses, including slack bus and infinite power bus.

Rubrics of CEP:

Performance	Meets Expectations (100-80%)	Average (80-40%)	Does not meet Expectations. (40-0%)	
Simulation of techniques [2] CLO2	Selects accurate critical time, and parameters in simulation to solve problems and accurate results of stability from simulation.	Selects up to some extent accurate critical time, and parameters in simulation to solve problems and near to accurate results of stability from simulation.	Selects wrong critical time, and parameters in simulation to solve problems and invalid results of stability from simulation.	
Report of CEP [4] CLO2	Submit the CEP Report (Including Literature Review, mathematical work, procedure, and observations) on due time	Submit the CEP report (Including Literature Review, procedure, and observations) manual less accurate and not having information.	Submit the CEP report (Including Literature Review, mathematical work, and observations) manual less accurate and after due date.	
Mathematical work [4] CLO2	Selection of accurate mathematical equations, parameters, and no error during calculations	Selection of appropriate mathematical equations, parameters, and minor errors during calculations.	Selection of wrong mathematical equations, parameters, and major errors during calculations.	
[10]				

CLO4	**Carryout steady state and transient stability studies for a power system using numerical techniques.**	**PLO3**	**Cognitive**	**C4 Medium**

Deadline of submission: 13-04-2023