SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING

TRANSIENT STABILITY ANALYSIS ASSIGNMENT

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1. INTRODUCTION

The objective of this assignment is to observe the behaviour of a synchronous generator driven by a hydraulic turbine with excitation and governor systems. The generator is connected to an infinite bus via a small transmission system.

2. SYSYEM UNDER CONSIDERATION

Simulink is used for the analysis. The demo system ***power_turbine.slx*** is used for the investigation. Carefully read the supporting documentation which describes the system. In particular, carry out the load flow and initialisation procedure before starting the simulation.

2.1. Initialisation

Consider the initial conditions of the system and determine the active and reactive power flow from the generator. Compare the active power output with the mechanical power input. Determine the active and reactive power flow at the 230kV source. Account for the differences.

2.2. Initial System Response

For a simulation duration of 2 seconds, carry out a simulation in response to the application to the fault. Plot the machine speed and confirm that stability is maintained.

2.3. Response of the Turbine Governor and Excitation Systems

Plot the mechanical power variation. Discuss the response of the turbine governor in response to the fault. Plot the generator field voltage and discuss the response of the excitation system in response to the fault. How are they each assisting the transient stability?

2.4. Mechanical/Electrical Power Variation and the Relationship between the Load Angle and the Machine Speed

Plot the electrical power output on the same graph as the mechanical power output. Plot the machine load angle and the machine speed and comment on the relationship between the two signals. Consider the difference between the mechanical and electrical power and relate this difference to the change which occurs in the generator speed.

2.5. Determination of the Critical Clearing Time

Determine the critical clearing time and angle for the fault. Consider the effect on the critical clearing time and angle of halving and doubling the inertia constant of the generator (H/2 and 2H) respectively.

2.6. Effect of the Limits on the Turbine Governor and Excitation Systems

Restore the fault duration to the previous value. Reduce the regulator power output limits of the excitation system to ±6pu and observe the system response. Restore the model to its original settings and re-solve the loadflow. Remove the excitation system and replace it with a constant field value, equal to that specified in the load flow. Simulate the system and observe the response. Comment on the result.

Restore the model to its original settings and re-solve the loadflow. Remove the Turbine and Governor model and replace it with a mechanical power input, equal to that specified in the load flow. Simulate the system and observe the response. Comment on the result.

3. PRESENTATION OF RESULTS AND ASSESSMENT

- To present your results, prepare a report which describes the analysis and the outcomes. Address each of the points identified in the sections above. In each case, discuss the significance of the results obtained.

- Record a brief presentation (less than 5 minutes) which summarises the outcome of your analysis. Submit this presentation with your written report.

- On the basis of your report and presentation, a short interview will be conducted to follow up on specific points.