EMINENCE 5.0

MATLAB Simulation Task

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MATLAB Task – Simulating the Power Grid

System Overview

- System type: High-voltage transmission feeding a low-voltage distribution network with distributed generation.

- Main bus voltages: 132 kV, 11 kV, 400V 3-phase, 50 Hz.

- Generation sources:

  Gas Turbine (Synchronous generator) — 1 MW, 11 kV bus, grid-forming capability.

  Hydro Generator (Synchronous generator) — 2 MW, 12 kV bus.

  Diesel Generator — 4 MW, 10 kV bus

- Loads:

  Critical loads: 500 kW (hospital, control center) at 400 V.

  Non-critical loads: 1.5 MW (industrial, commercial) at 400 V.

  Total nominal connected load: 2 MW.

Modeling Stage Requirements

1. Generation

You have to simulate for 3 generators with following ratings.

Generator	Nominal Power	Voltage (kV)	Frequency	Configuration	Type
Generator 1	1 MW	11	50	Yg	PV
Generator 2	2 MW	12	50	Yg	PV
Generator 3	4 MW	10	50	Yg	PV

Above Parameters should be set for each generator (Hint: Go to the Properties)

2. Transmission Stage

Each Generator Output Voltage should be step up to match 132 KV Transmission Grid Voltage. Add power transformers for each generator before synchronizing with the transmission grid.

- Transformer Parameters

Set Transformer Primary and Secondary Voltages according to the required bus voltages. Assume any parameters required for the transformer to maintain required voltages.

3. Grid Sub Station (GSS)

Transmission Line voltages (132 kV) must be step down to 11 kV by using a transformer. Assume any parameters required for the transformer to maintain required voltages.

4. Distribution Stage

Need to Step down the distribution voltage (11 kV) to the low voltage (= 400V)

5. Loads

Add a 2MW Three phase star/delta load as the Installed load. Get the Voltage as 400V.

6. Protection and circuit breakers

Add circuit breakers for each generator to isolate and circuit breakers for the load also required. Add more circuit breakers where necessary.

7. Grid Measurements

Add measurement blocks as shown in the grid infrastructure and add measurements blocks where necessary.

Grid Infrastructure

You have to develop the power grid system according to the infrastructure given at the end of the task.

Discussion

1. Plot voltage and current waveforms at the load by using a Scope/oscilloscope and hence calculate the load power.

2. Observe each generator power (Mw) contribution for the following load scenarios.
    *   For 2MW load
    *   For 5MW Load
    *   For Full Load

In the answer script, draw a table consisting each Generator's Output for the above load scenarios. Also include generator voltages and currents at each instance.

3. Discuss what happen when the load becomes 12 MW and verify this using simulation results. (Waveforms or any visible simulation outputs)

4. Calculate the total power loss for the 2 MW Load demand.

Task Guidelines

Maintain each bus voltage within $\pm5\%$ range.

Answer script should be in PDF format including all the answers for the discussion, waveforms, diagrams, calculations and results.

Task Submission

1. Submit a .slx file of your task to the given GitHub repository within the allocated time.
2. Submit a .pdf file including all the answers and should be submitted with the MATLAB file.

G — Synchronous Generator

M — Measurement Blocks

—/_ — Circuit Breaker

⧙⧘ — Step Up/Down Transformer

132 kV

Generator Transformer

Transmission Line

Power Transformer

11 kV

Distribution Transformer

400 V