

Assignment 1

Dynamic Load and Fault Analysis of INPS using DPL

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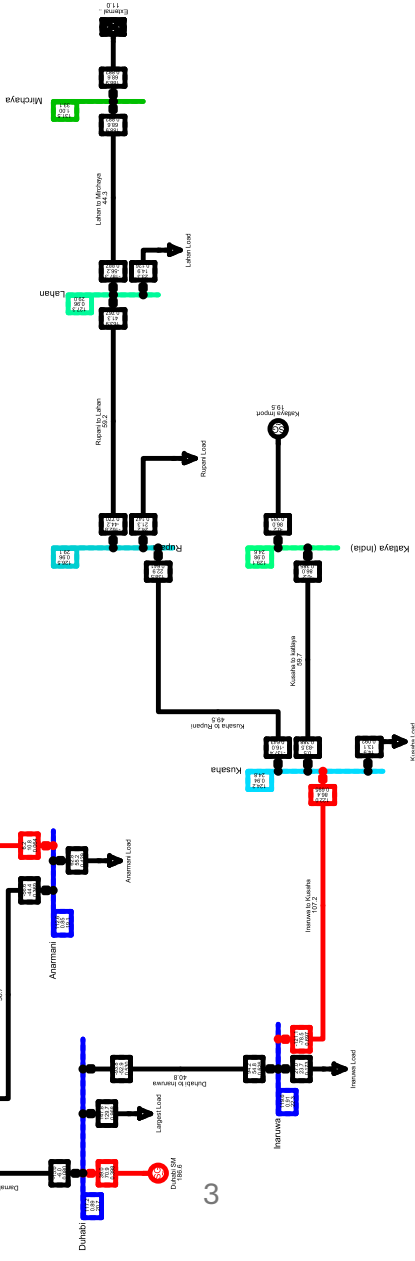


Objectives

Model	Section of the INPS system with at least five buses and two generators.
Analyze	Bus voltage variations under hourly load changes.
Examine	Effects of a self-clearing fault near the largest generator or critical line.
Present	Results for bus voltage, frequency, rotor angle, and other variables of interest.

Model and Simulation Setup

INPS Section	Eastern Region
No. of Buses	13
No. of Generators	6
Load Variation	Hourly Load Curve
Fault Type	3- Φ fault at bus connected to largest Generator (Godak)



Section 1

Load Flow Analysis using DPL

Steps Involved

- A DPL script is written to implement the following steps

Import
24 hr Load Data
from .xlsx file to Matrix

Run
Load Flow Analysis

Export Result
to .csv File

Load Profile Estimation

- In absence of load profile data, INPS load profile is used for estimating Hourly Load Profile

Obtain Hourly Load Profile of Nepal

Normalize Hourly Load profile of Nepal

$$\text{Normalized Load}_t = \frac{\text{INPS Load}_t}{\text{Maximum INPS Load}}$$

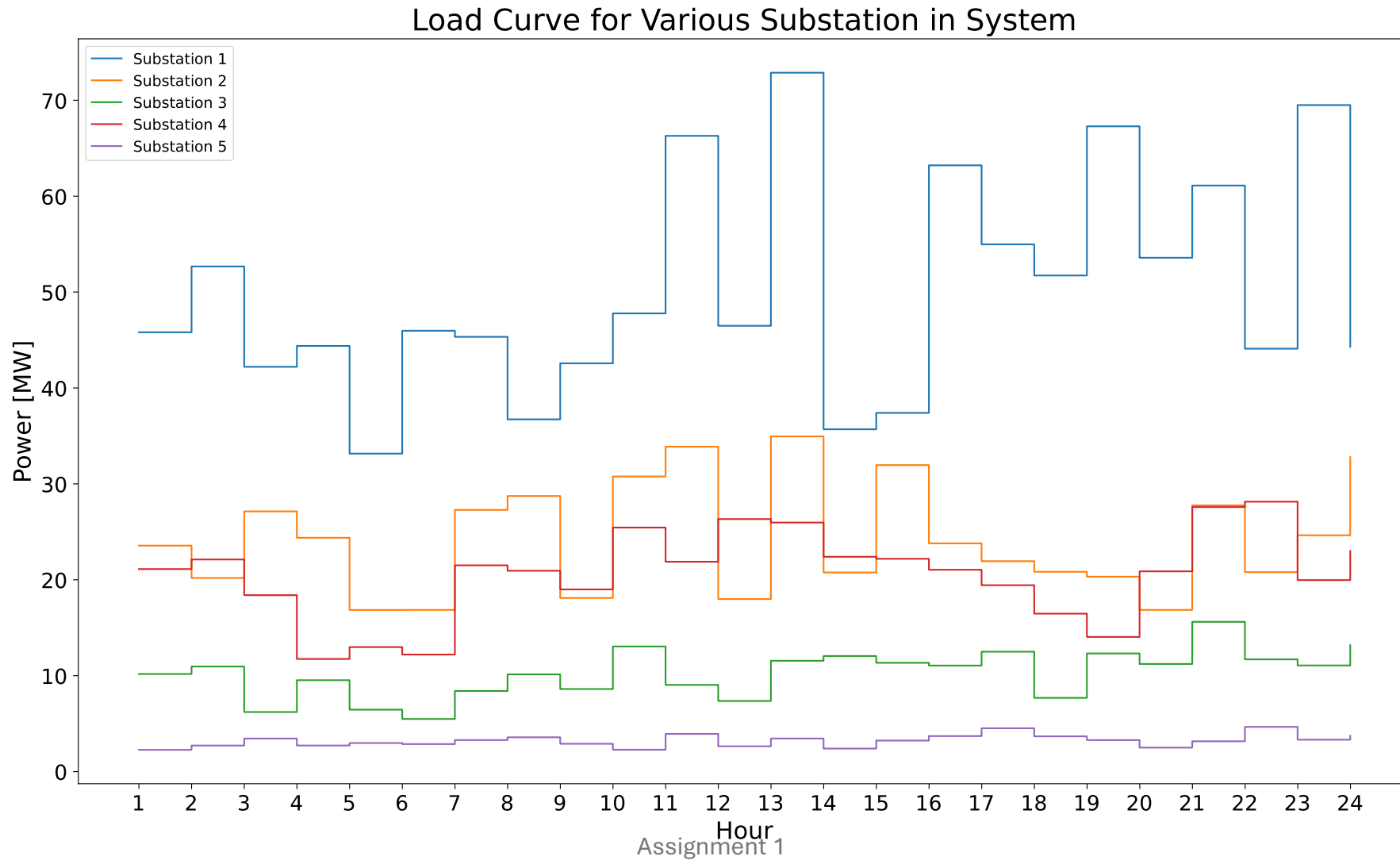
where, $t = 1, 2, \dots, 24$

Estimate Substation Load Profile

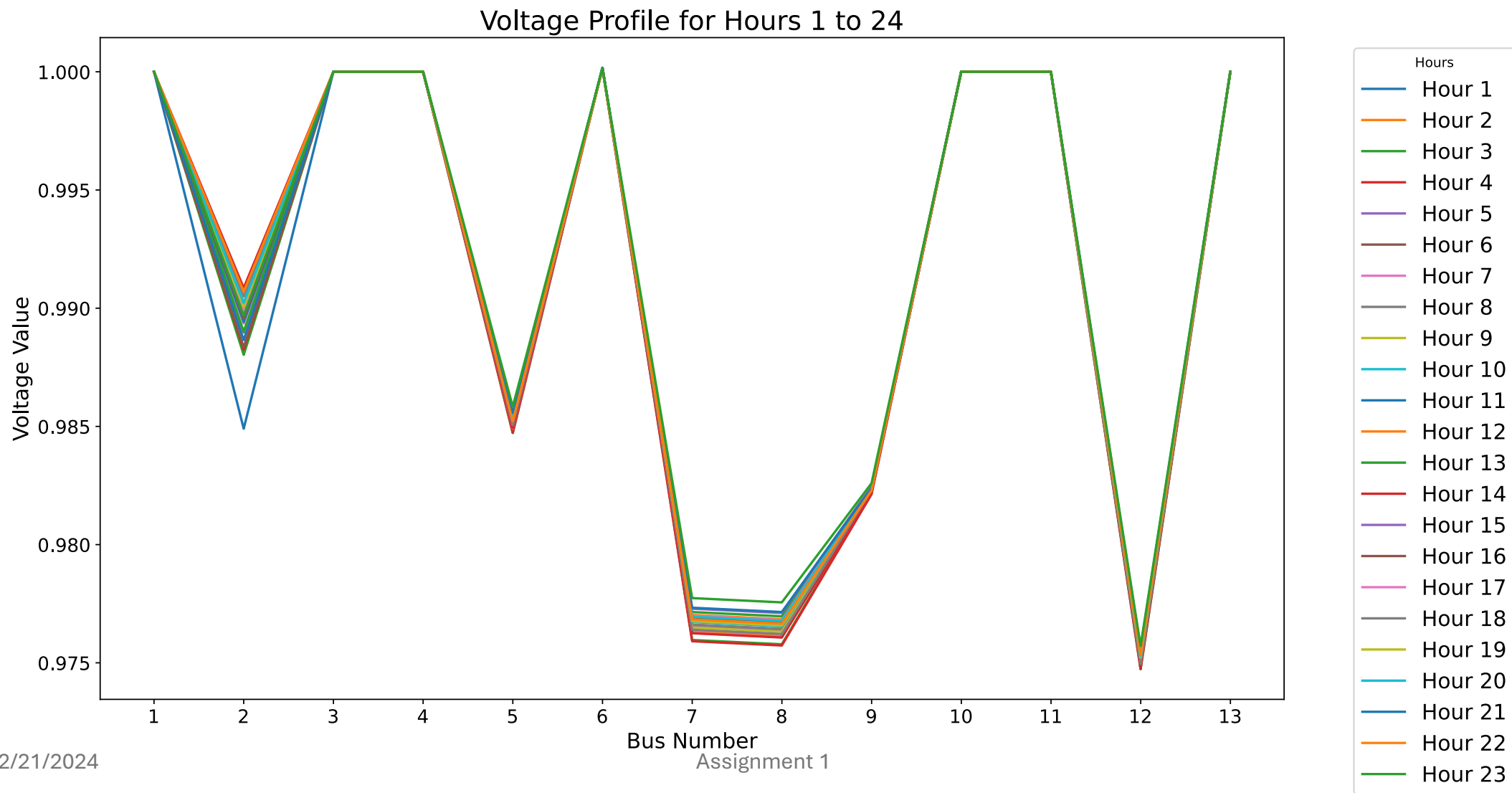
$$\text{Demand}_{t,i} = (\text{Maximum Demand})_i \times (\text{Normalized Load})_t$$

where,
 $t = 1, 2, \dots, 24$, $i = 1, 2, \dots, 5$

Estimated Load Curve



Bus Voltage profile after Load Flow



Section 2

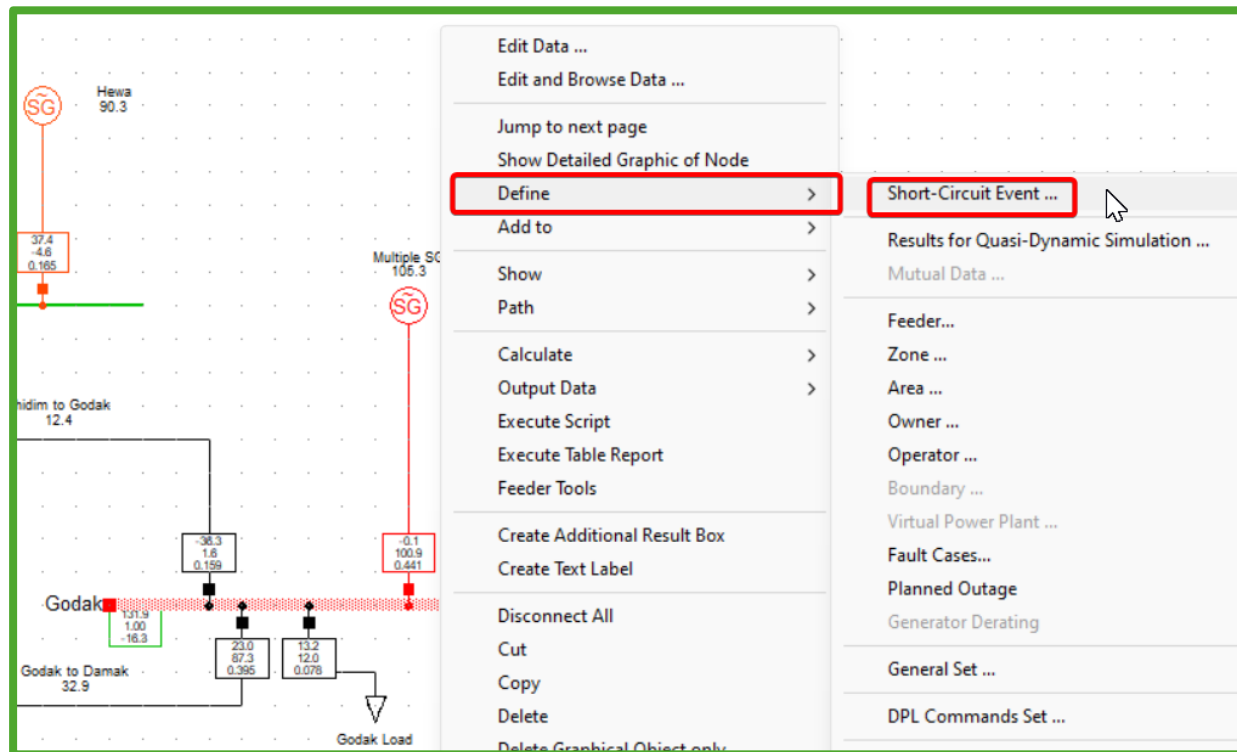
RMS Simulation

Setup for RMS Simulation

Fault in	Godak Bus
Fault Applied at	10 sec
Fault Cleared at	10.2 sec
Fault Type	3- Φ fault at bus connected to largest Generator (Godak)
Variables Monitored	Bus Frequency, Rotor Angle, Rotor Speed

Applying Fault in Largest Generation

- self-clearing fault near the largest generator

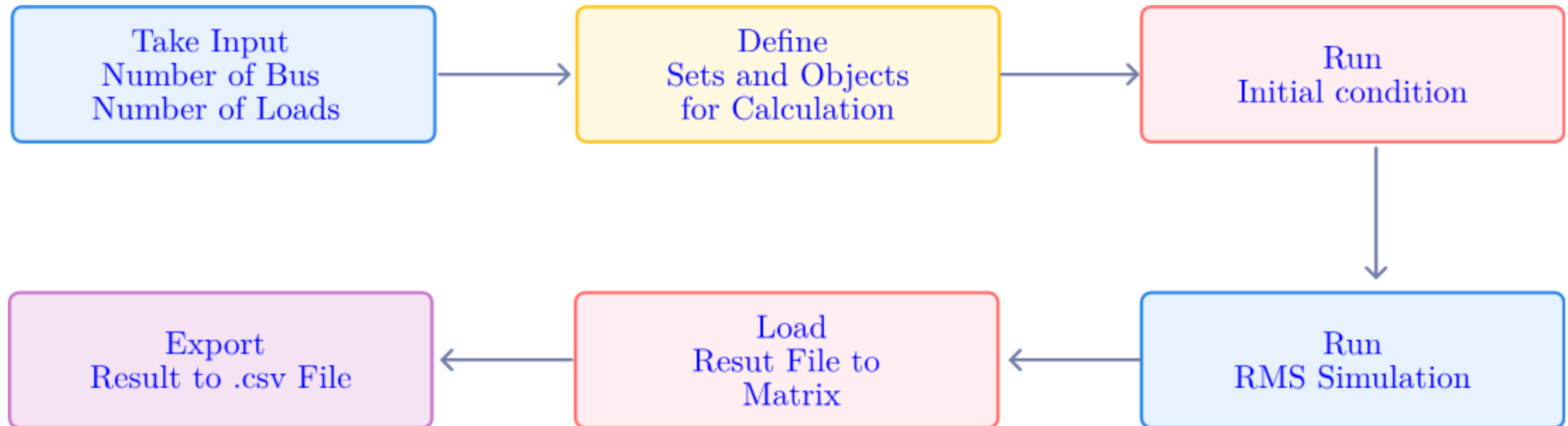


Simulation Events/Fault - Study Cases\Case 1\Simulation Events/Fault :

	Time	Object	Out of Service
		StaBar*, Elm Term*, ...	
▶	10.0	Godak	<input type="checkbox"/>
▶	10.2	Godak	<input type="checkbox"/>

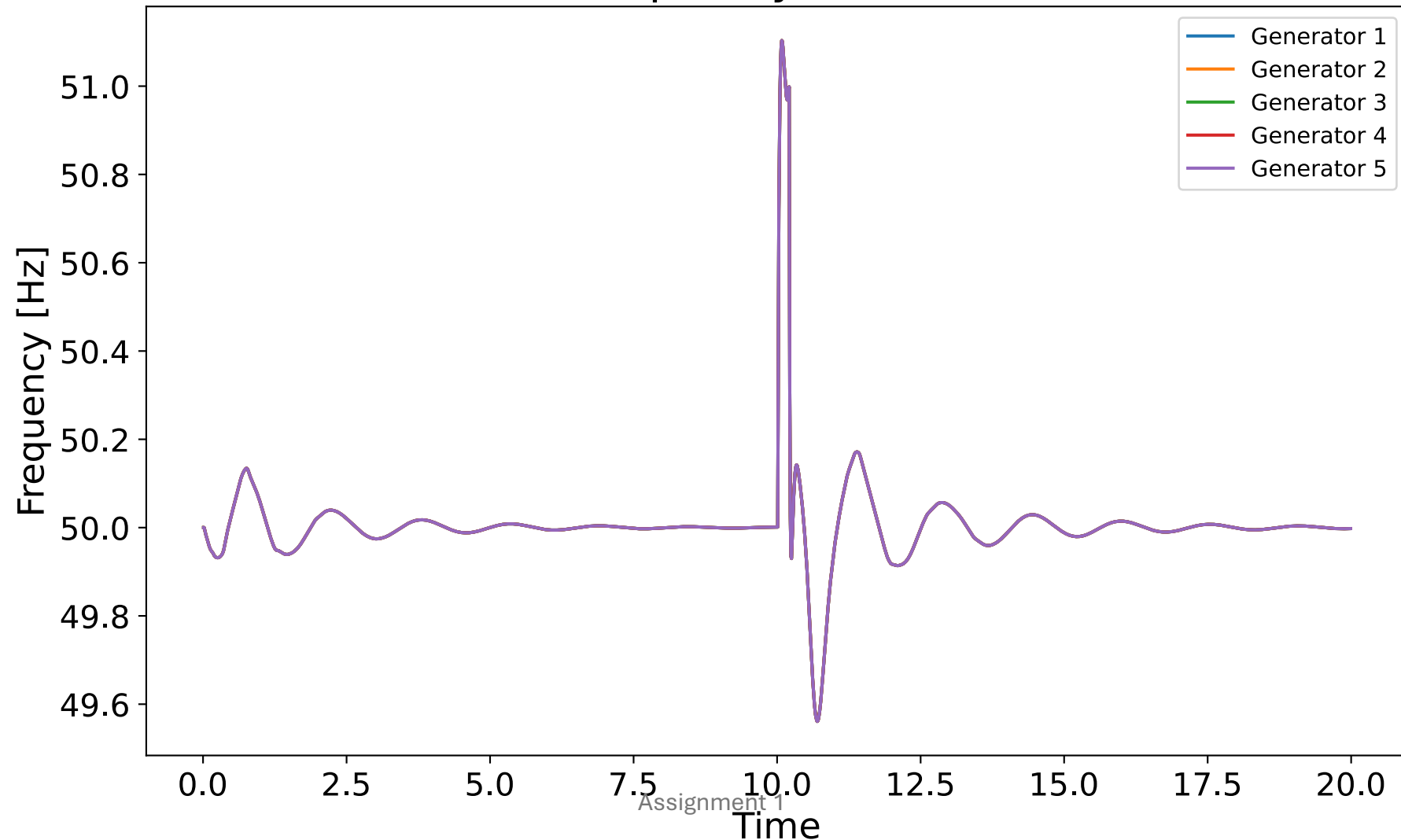
Steps Involved

- A DPL script is written to implement the following steps

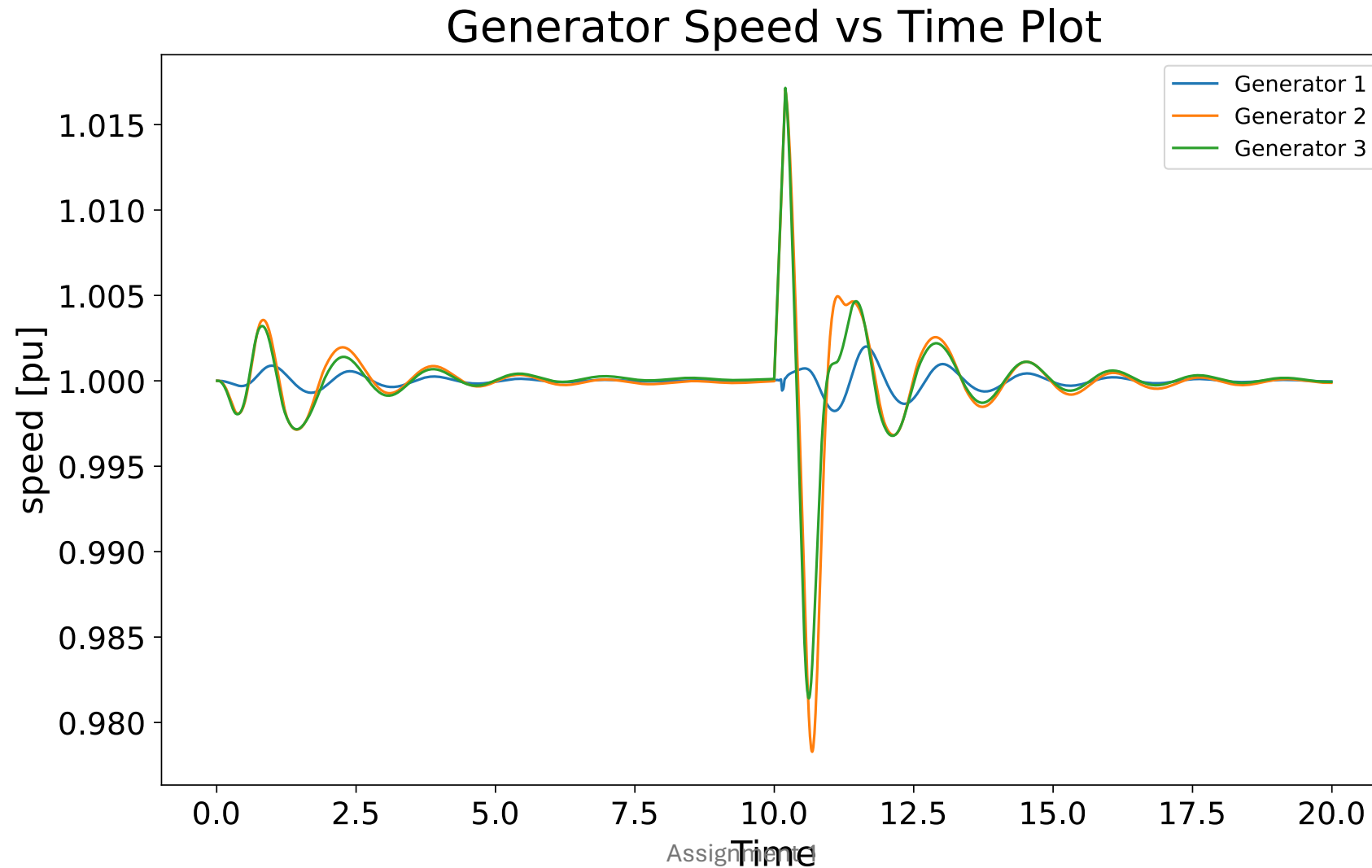


Plot for Bus Frequency

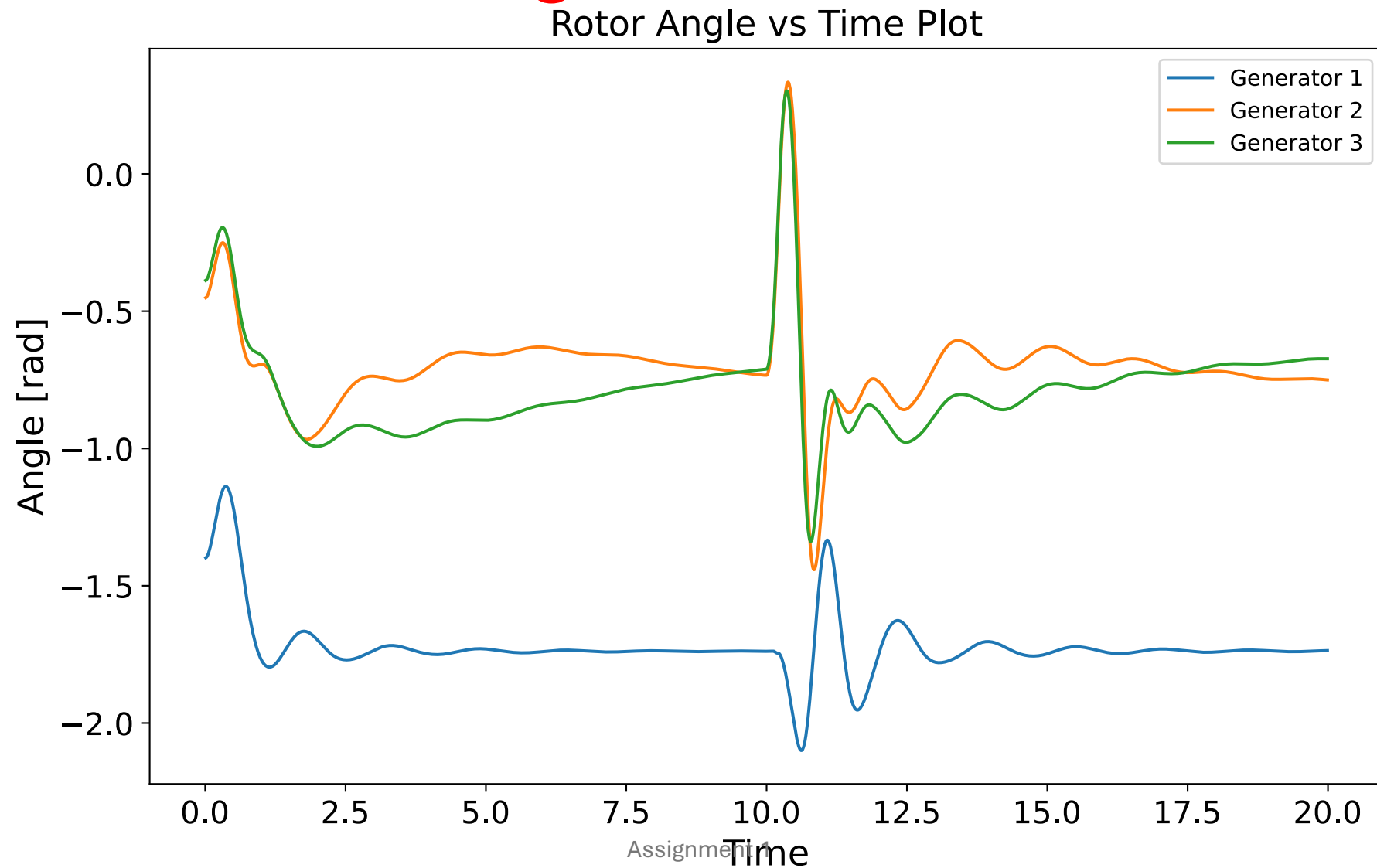
Bus Frequency vs Time Plot



Plot for Generator Speed



Plot for Rotor Angle



Conclusions

- Dynamic Programming Language (DPL) is particularly useful for analyzing larger systems due to its flexibility and capability to handle complex power system simulations effectively.

