A Term Project Report on

“STABILITY ANALYSIS OF VOLTAGE AND FREQUENCY IN GRID CONNECTED MODE AND ISLANDED MODE”

SuSbmitted in partial fulfillment of the requirement for the First Semester of

“Power Engineering”

Of

Indian Institute of Technology, Ropar

Submitted by

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In Subject of

“SIMULATION & ANALYSIS OF MODERN POWER SYSTEMS (EE-513)”

Under the guidance of

Prof. Dr. Ranjana Sodhi.

AIM: - 1) Control Strategies to get Vref & Fref during Islanded mode

2) Control strategies for Power Sharing between DG as per load change

3) Implementation of control strategies on 9-BUS system

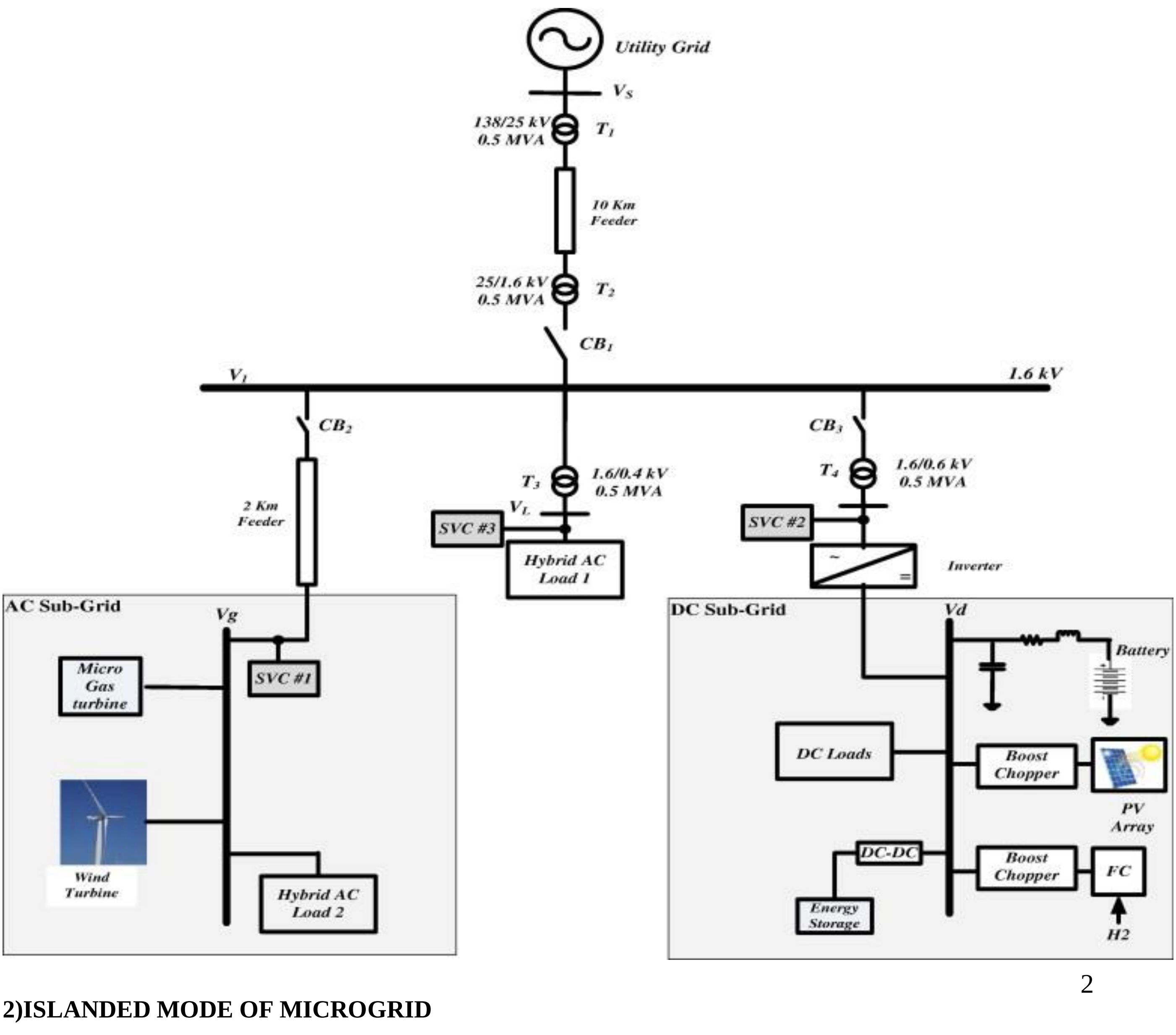
SOFTWARE USED: - MATLAB- SIMULINK

INTRODUCTION: -

Basically, Grid-connected mode and islanded mode refer is two different operational states of a power system, when we connected renewable energy sources like solar or wind power.

1)**Grid connected mode**
we simply connect the renewable energy sources with the grid. In Grid connected mode , system will get Vref and frequency reference from the grid .
operation: -

1) System generates electricity and even after consumption, any excess power can be fed back in to the grid
2) We use inverters to convert DC power generated by solar panel or wind turbines directly in to AC POWER that should we compatible with the grid



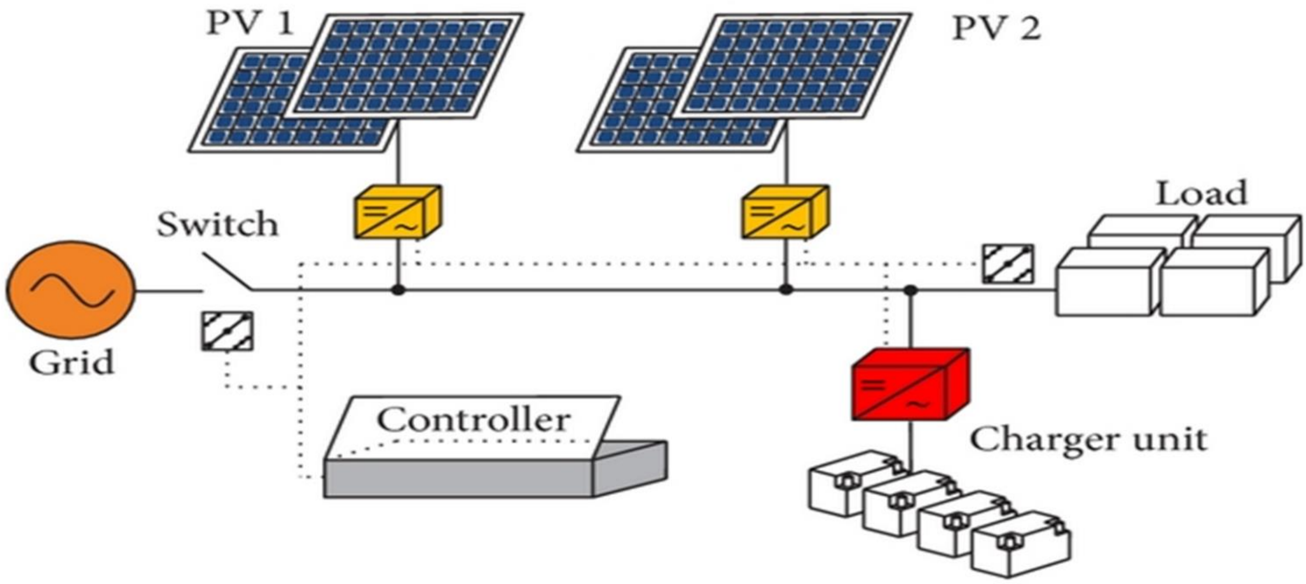
2)ISLANDED MODE OF MICROGRID

When we disconnect microgrid from the utility Grid. a renewable energy operates independently of the utility grid

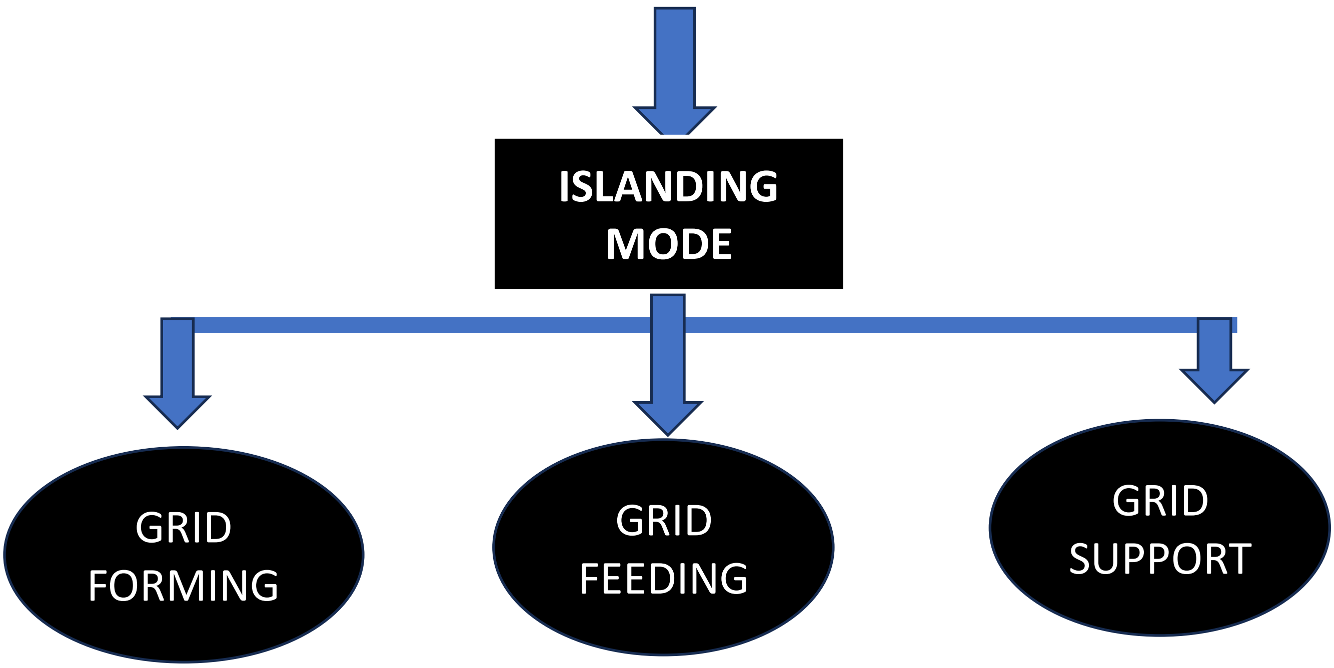
Here we have problem i.e it is not getting freq reference and voltage reference from the grid

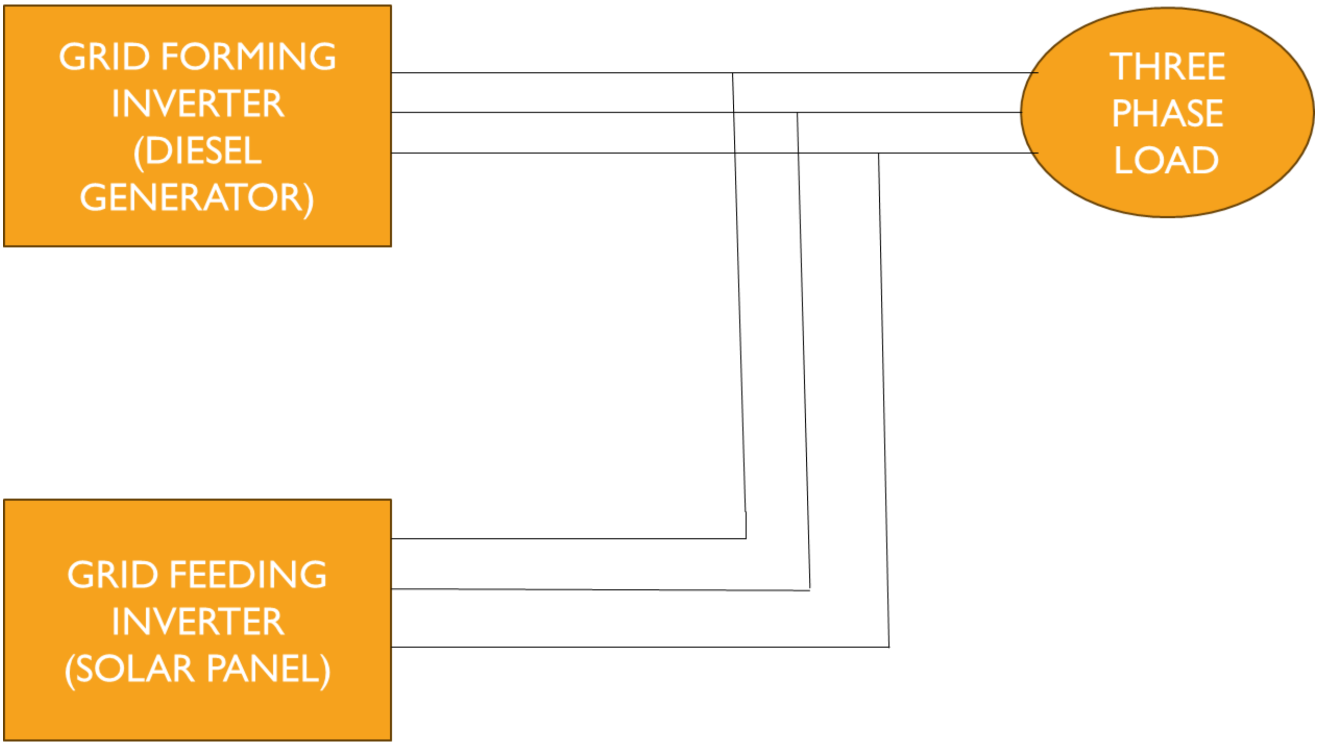
Operation

1)The system does not depend utility grid to draw electricity but generates its own power
2) islanded system stores extra energy in storage system like batteries
3) Even after fault , islanded system continue to operate



Control of Inverter based DG

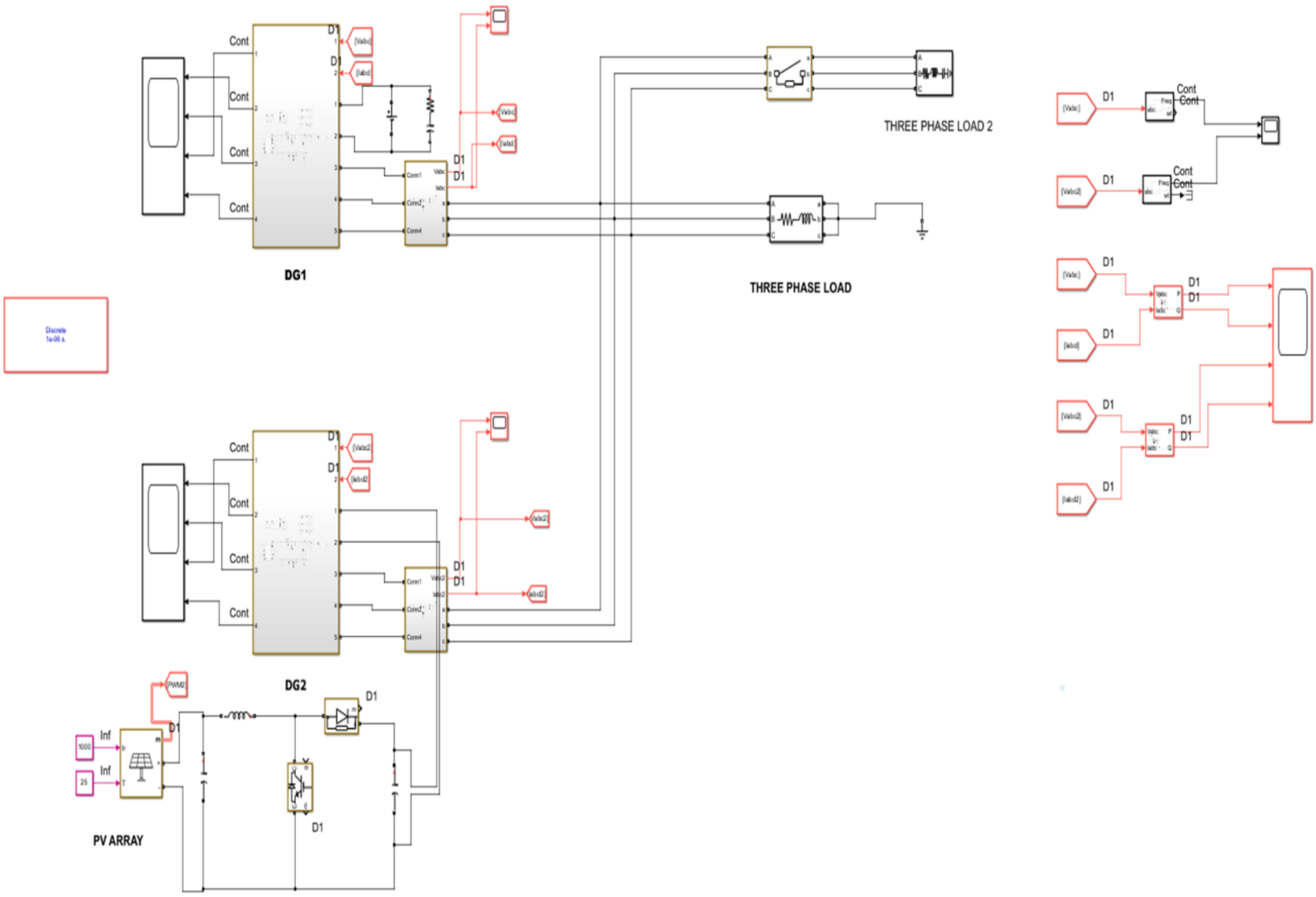




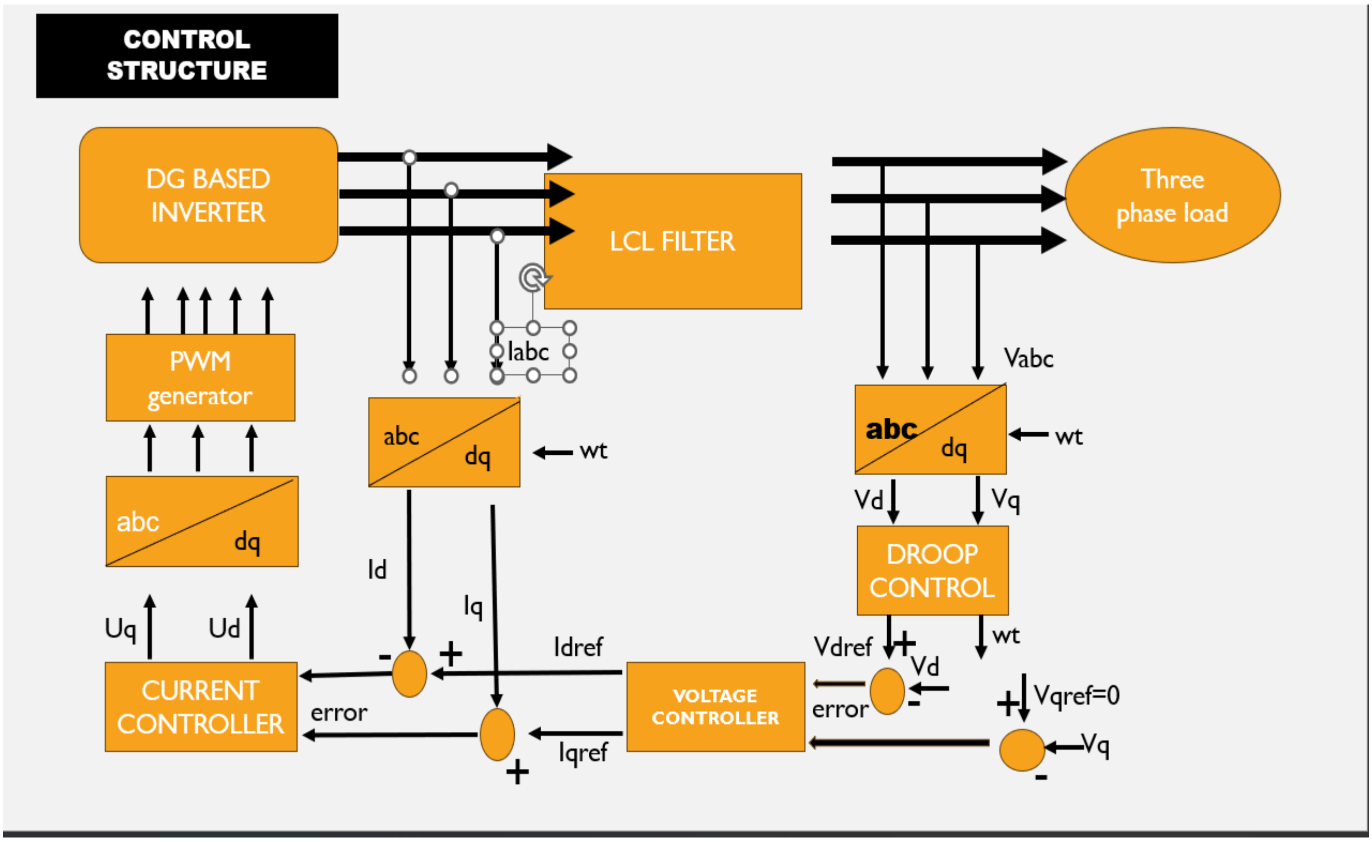
IN ISLANDED MICROGRID,

The grid-forming inverter gives a reference voltage level for the microgrid. This reference voltage serves as the reference for all connected loads and distributed energy resources within the microgrid. Similar to voltage, the inverter sets a reference frequency for the microgrid. the inverter maintains the frequency at a constant level (e.g., 50 Hz in the India).

PARALLEL OPERATION OF TWO INVERTER BASED DG



CONTROL STRUCTURE



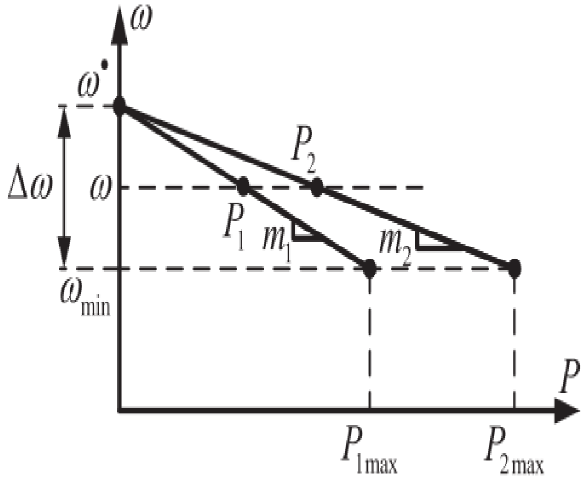
DROOP CONTROL TECHNIQUE FOR POWER SHARING

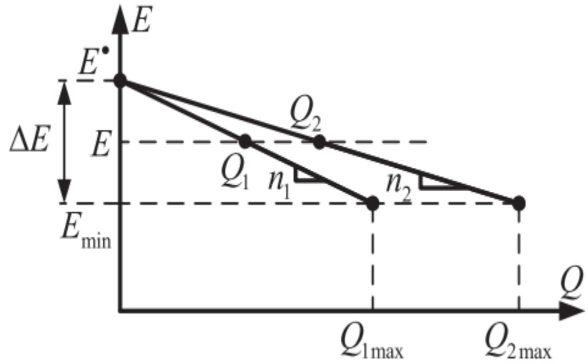
Droop control is based on the concept that as the power demand increases, the frequency or voltage of the power source decreases, and vice versa. This relationship is expressed as a droop characteristic, which defines the rate at which the frequency or voltage changes with respect to load variations.
As the load on the system increases, the frequency of the power source decreases proportionally. Generators or inverters respond to this frequency deviation by adjusting their output power to help share the load.
In this case, as the load increases, the voltage of the power source decreases. Again, generators or inverters adjust their output power in response to the voltage deviation.
The relationship between power output and frequency or voltage in a droop-controlled system is often expressed by the following

$P = P_{\text{ref}} - \text{Droop} \times (\text{Frequency or Voltage Deviation})$ where:

- P is the actual power output,
- P_{ref} is the reference power output,
- Droop is the droop setting, and
- Frequency or voltage deviation is the difference between the measured and reference frequency or voltage.

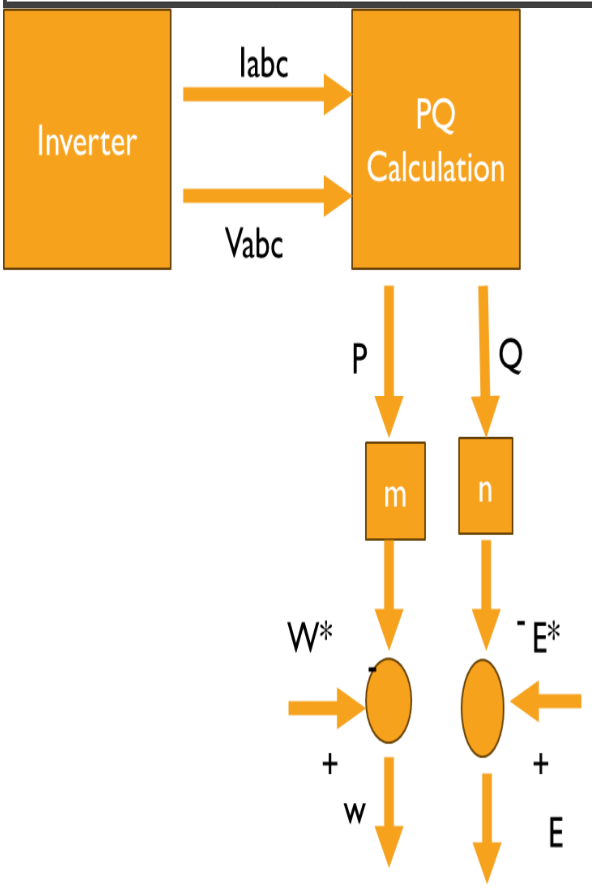
Assigning a 2.5 % frequency droop to a converter means that its frequency deviates 1.25 HZ in response to a 1.0 pu change in active power
Assigning a 2.5% voltage droop to a converter means that its voltage vary around 9.5v at 380 v with 1 Pu change in reactive power





Power Demand ↓
Freq increases ↑

BASIC DIAGRAM OF CONVENTIONAL DROOP CONTROL



$w = w^* - mP$

$E = E^* - nQ$

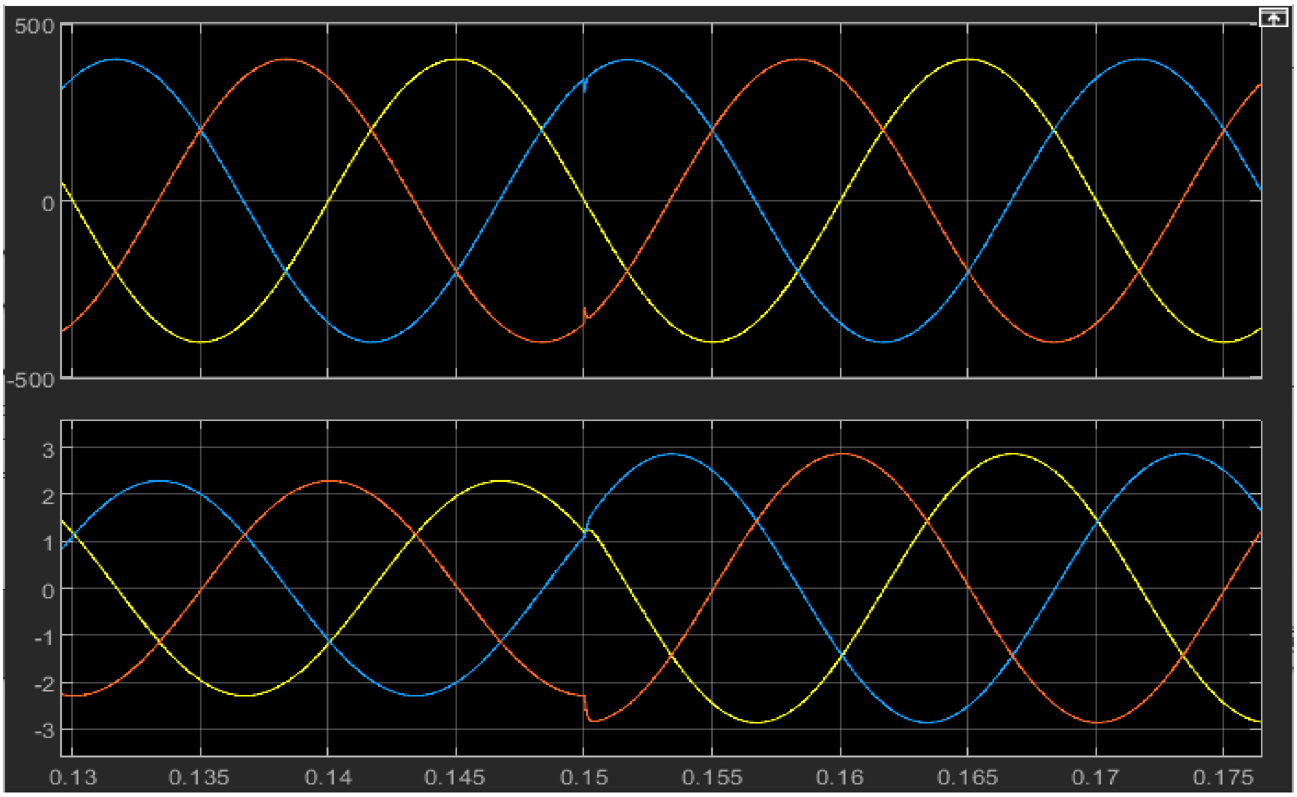
$m = \frac{\Delta w}{Pmax}$

$n = \frac{\Delta E}{Qmax}$

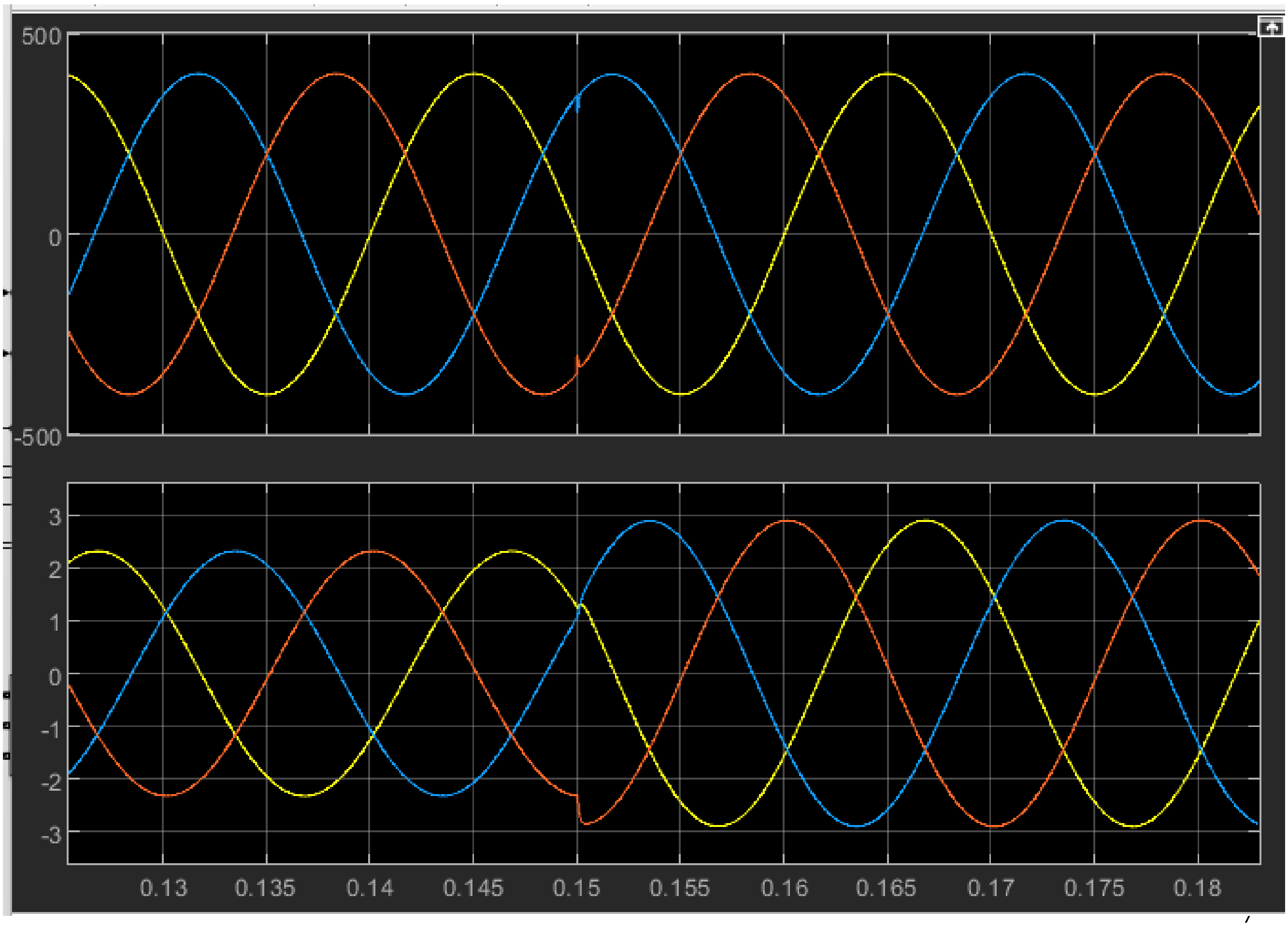
W^* = rated freq
E^* = rated voltage amplitude
m = freq droop coeficents
n = voltage droop coefficient
$\Delta w = maximum\ allowed\ deviation\ of\ freq$
$\Delta E = maximum\ allowed\ deviation\ of$ VOLTAGE

RESULTS :-

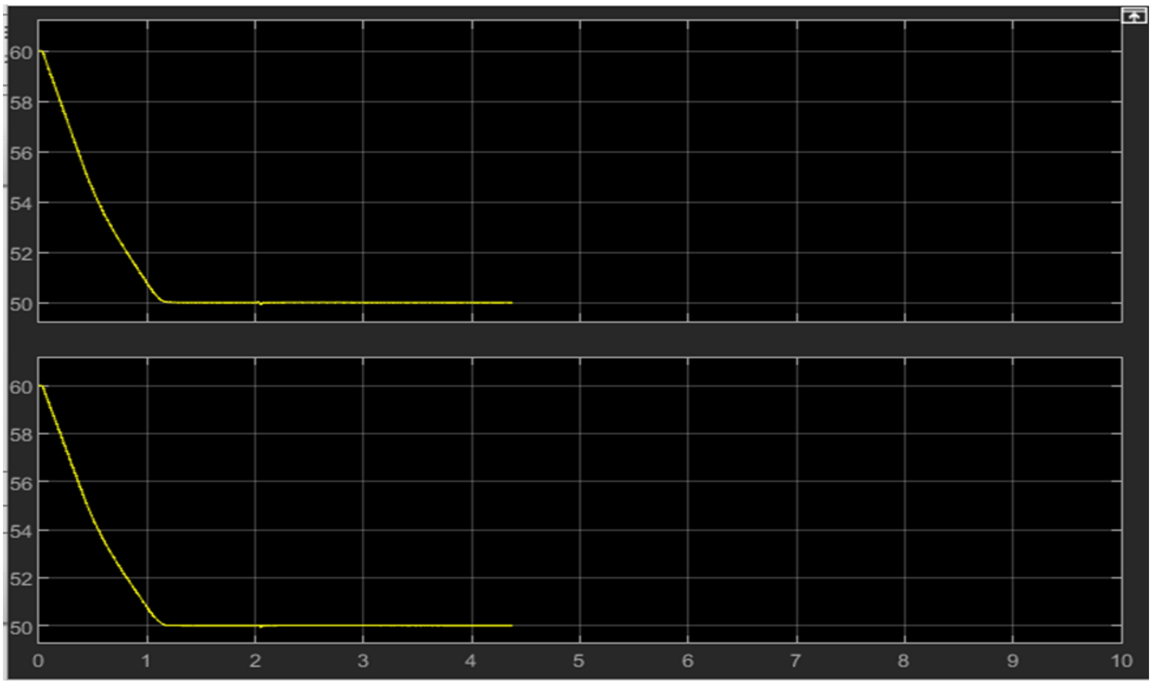
VOLTAGE AND CURRENT AT DG-1



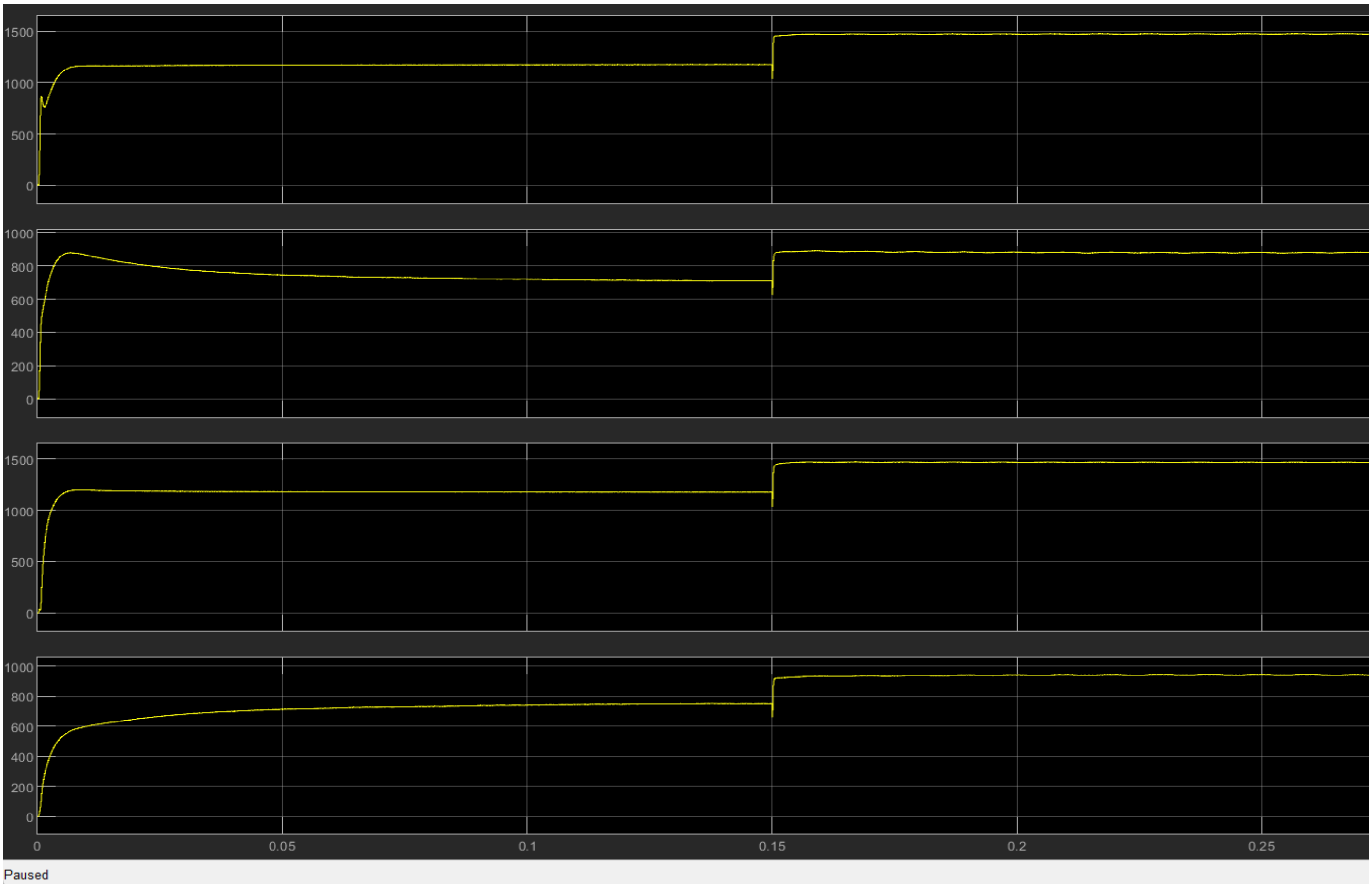
VOLTAGE AND CURRENT AT DG 2



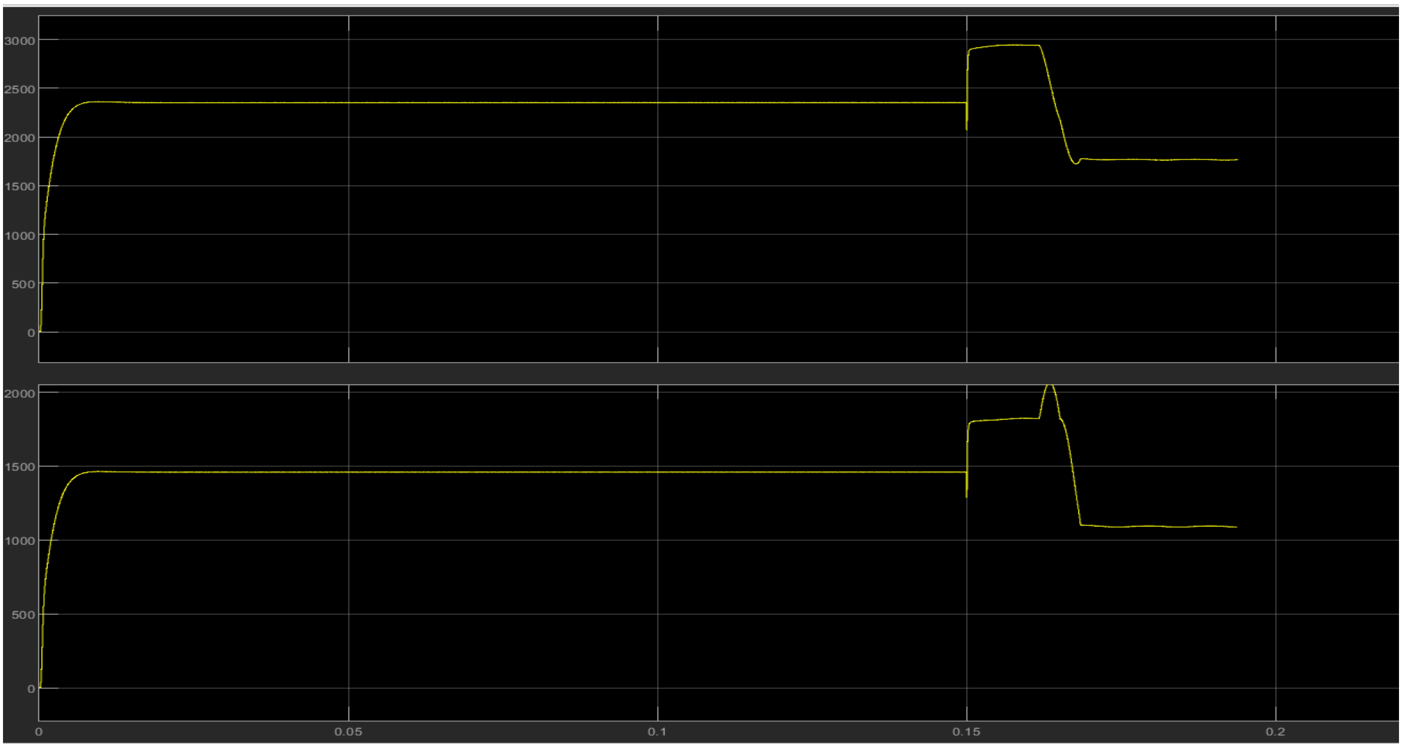
FREQUENCY MATCHING AT BOTH DG



POWER SHARING BETWEEN BOTH DG



LOAD SHEDDING DONE AT 0.15 sec



CONCLUSION

In a parallel operation of multiple sources (generators or inverters), each unit is equipped with droop control. As the load on the system changes, the frequency or voltage deviations trigger adjustments in power output from each source. This results in proportional power sharing among the units, maintaining system stability.

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- A review of droop control techniques for microgrid Usman Bashir Tayaba,∗, Mohd Azrik Bin RoslanaLeong Jenn Hwaia, Muhammad Kashifa,ba University Malaysia Perlis, Malaysiab University Malaysia Sawarak, Malaysia