Host Utilities

TATA POWER

BSES Rajdhani Power Limited

BSES Yamuna Power Limited

ORGANIZER

ISGF India Smart Grid Forum

India SMART UTILITY Week 2025

Supporting Ministries

MINISTRY OF POWER
GOVERNMENT OF INDIA

MINISTRY OF NEW AND RENEWABLE ENERGY
GOVERNMENT OF INDIA

NITI Aayog

MINISTRY OF POWER
GOVERNMENT OF INDIA
CENTRAL ELECTRICITY AUTHORITY

Session : (ISUW) 2025

Improving Frequency Regulation and Reliability in Renewable Energy Based Distribution Networks through Advanced Inertia Control and Optimized Fault Passage Indicators (FPIs)

Presented By

ADITYA KUMAR PATI, TEAM LEAD, TPWODL,ODISHA

CONTENTS

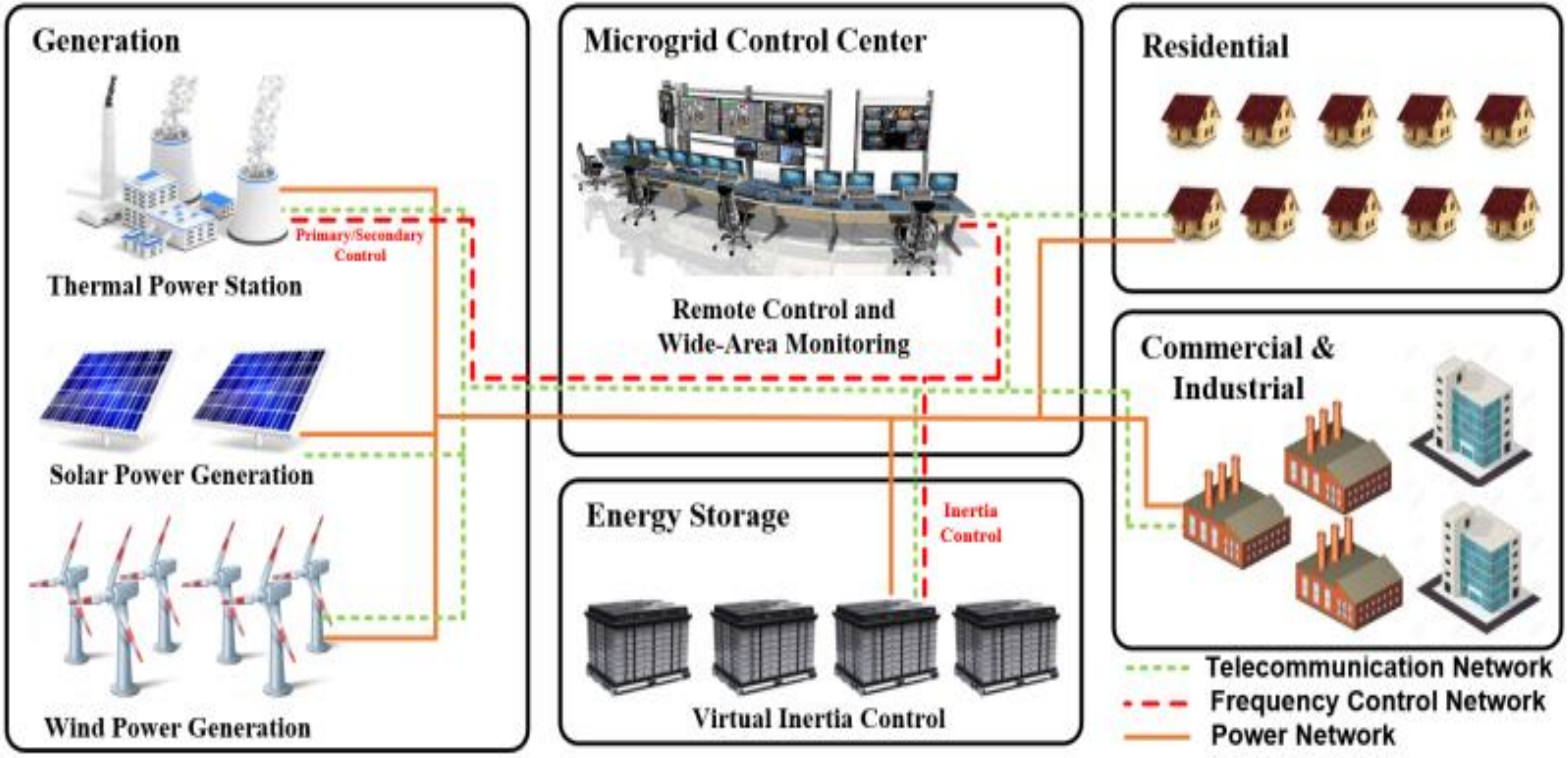
INTRODUCTION

- A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. A good quality of the power system requires both frequency and voltage to remain at standard values during operation. The active power and reactive power have combined effects on the frequency and voltage.

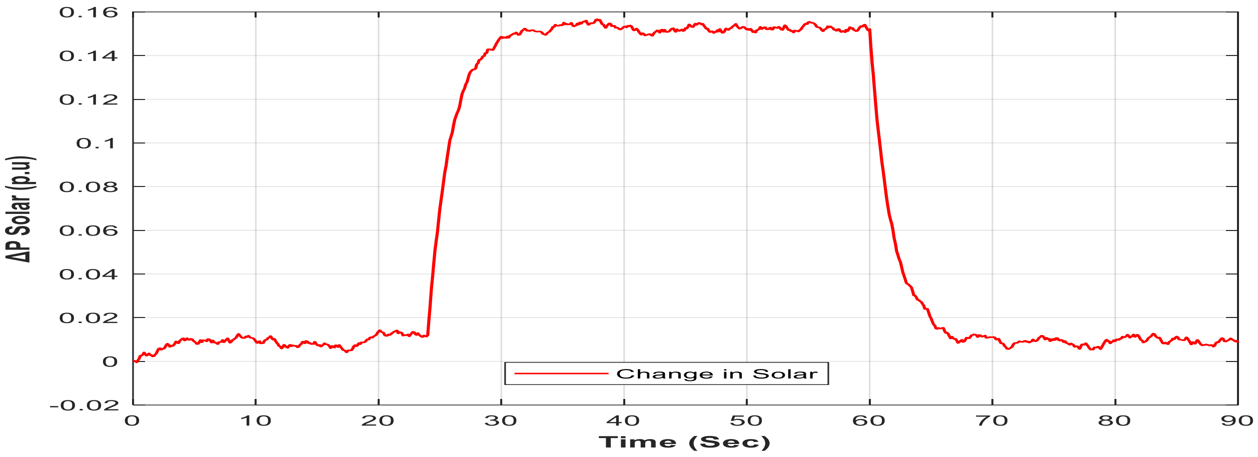
- Virtual Inertia Control A growing number of Voltage Source Converter (VSC) based generators in modern power systems results in a decrease of inertia and, consequently, to frequency instability. Hence, reduction of inertia in the system threatens frequency stability. Virtual inertia is a solution in the described premises.

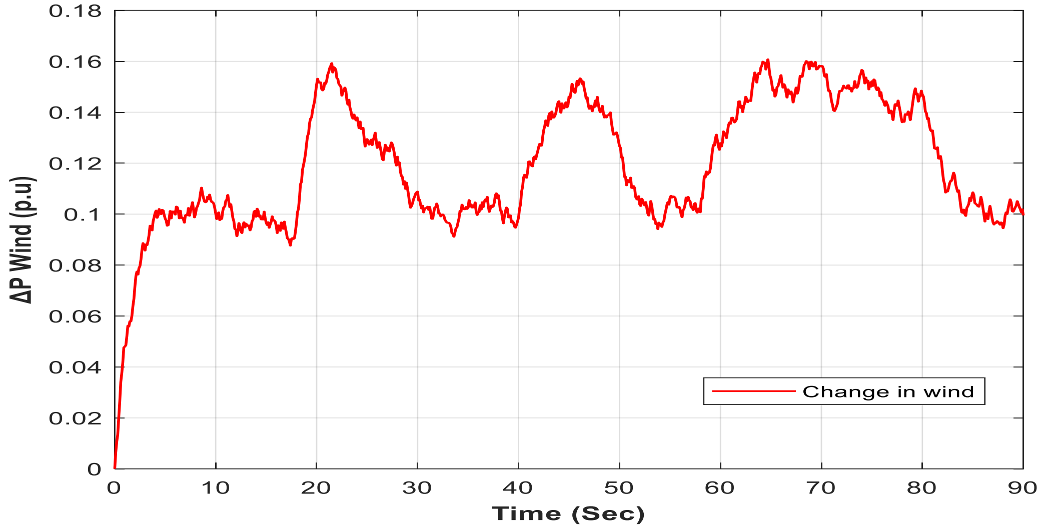
- *Fault Passage Indicators (FPI) is improving the reliability of the network, these devices can be deployed along the feeder to reduce, or even eliminate, the uncertainty about the fault location. The number and location of FPIs affects the network reliability that can lead to extra charge on the distribution companies as well as the consumers.*

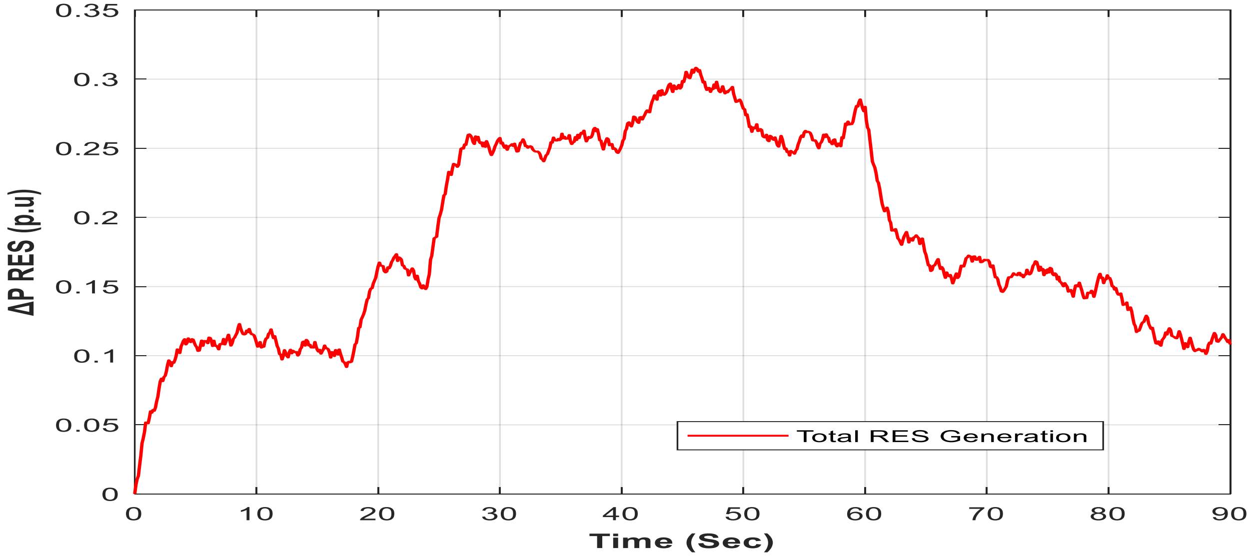
STRUCTURE OF STUDIED MICROGRID

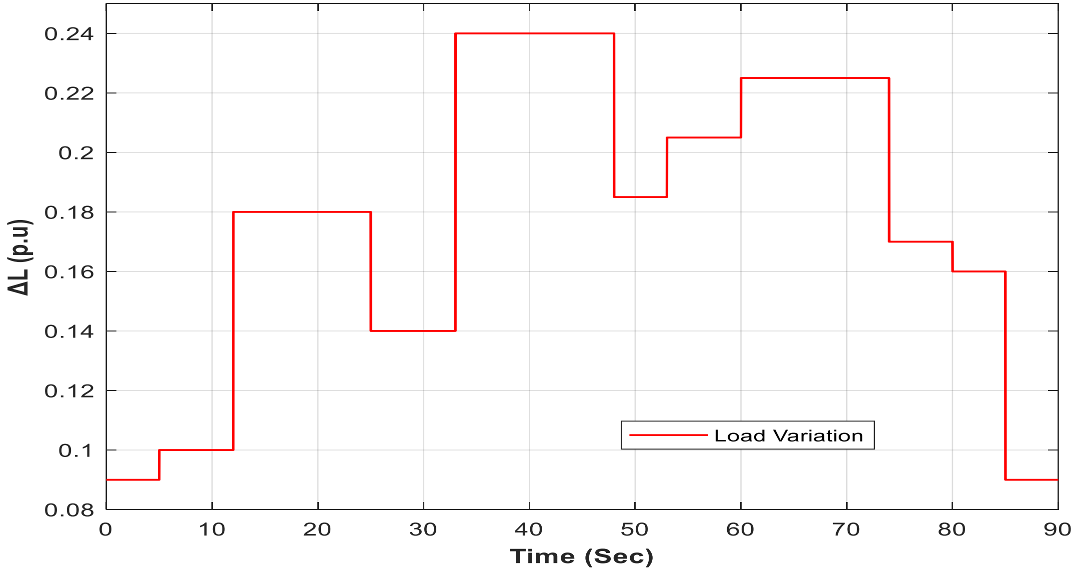


GENERATION AND LOAD VARIATIONS

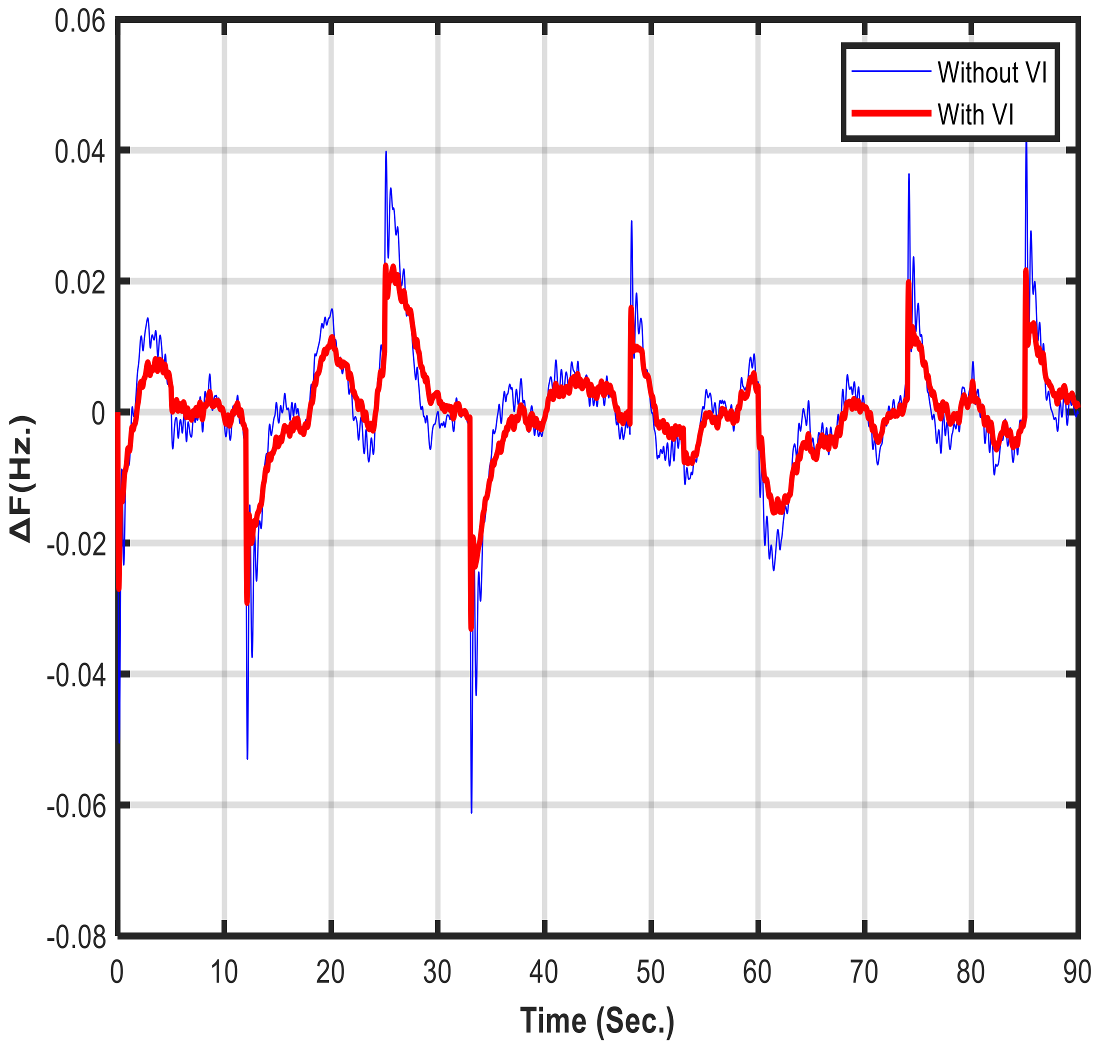


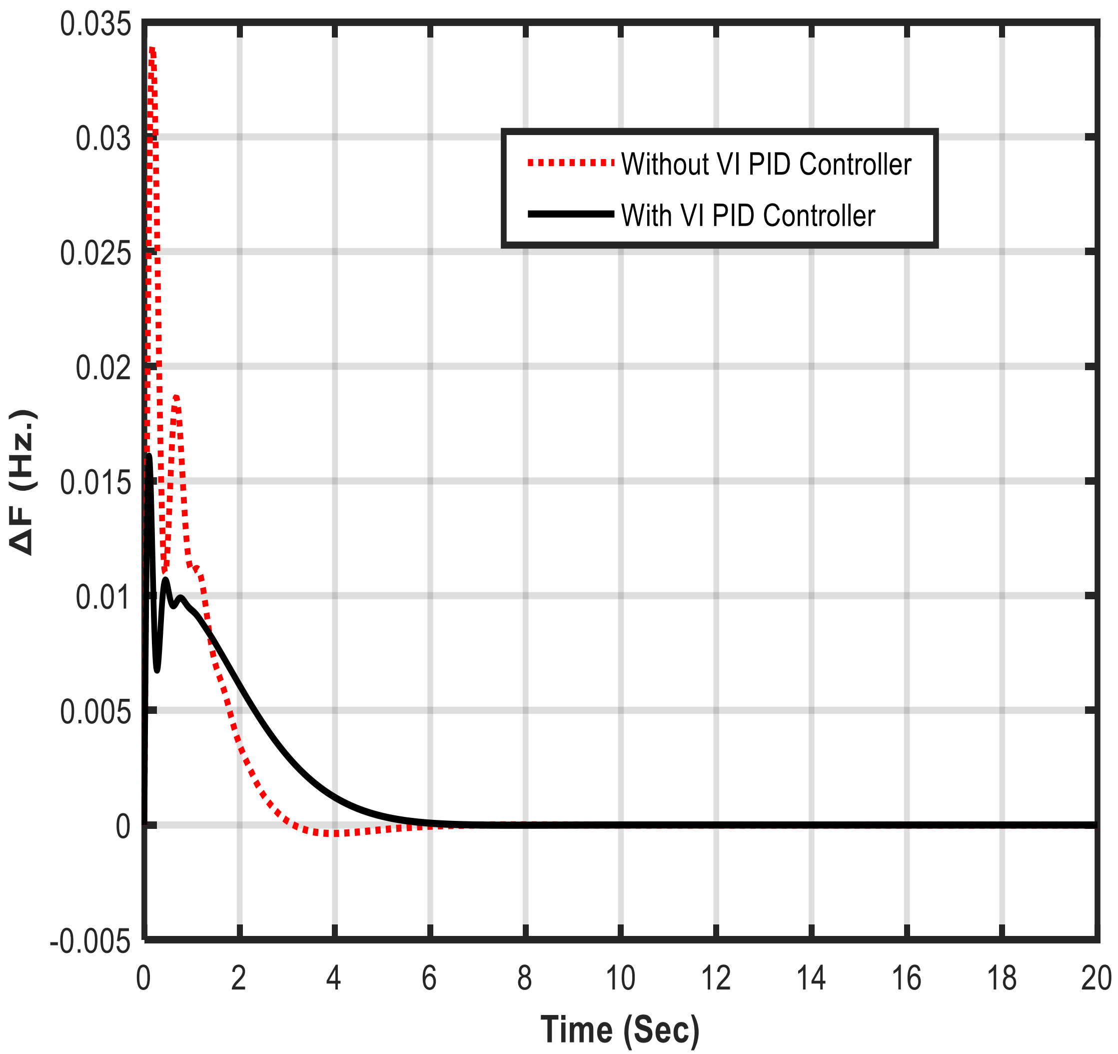




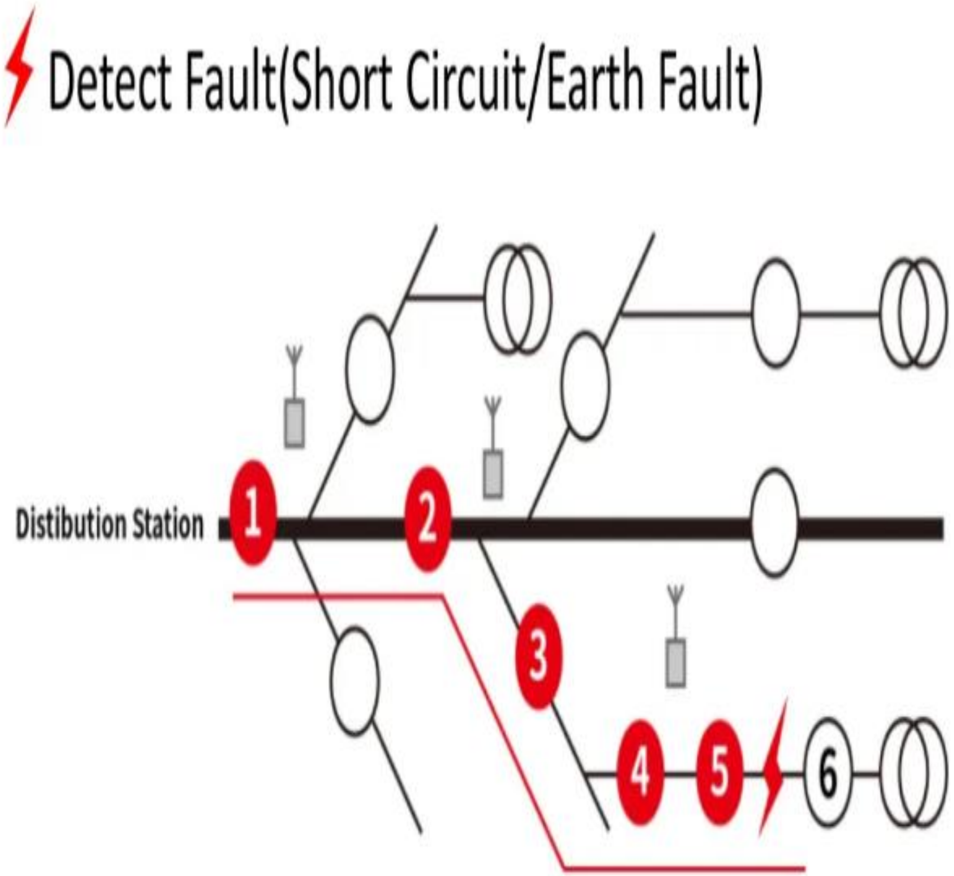


ANALYSIS OF RESULTS

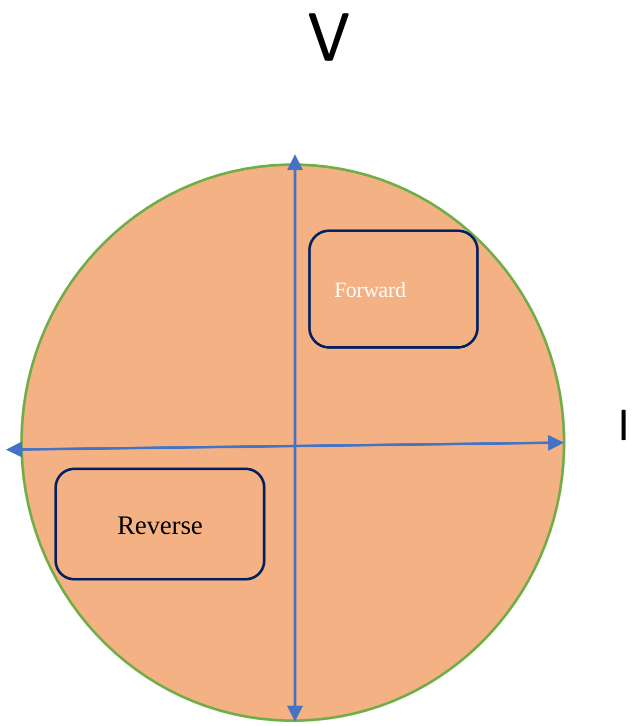




Optimized Fault Passage Indicators (FPIs)



VOLTAGE AND CURRENT VECTOR



The quadrature polarization technique may be adjusted with a fixed phase angle shift (e.g., ±30°, ±60°) to better suit different grid conditions.

$TA=|VCB|\cdot|IA|\cdot\cos(\theta_{VCB}-\theta_{IA})$

$TB=|VAC|\cdot|IB|\cdot\cos(\theta_{VAC}-\theta_{IB})$

$TC=|VBA|\cdot|IC|\cdot\cos(\theta_{VBA}-\theta_{IC})$

CONCLUSION

- The proposed VSI scheme, outperforms previous systems in terms of frequency stability. By reducing the maximum frequency deviation nearly 45 percentages, the system shows a substantial enhancement in performance, ensuring better grid reliability and stability, particularly in systems with increasing integration of renewable energy sources. Thus, the superiority of the proposed controller can be observed from the above graphs and tables in different cases.
- The optimum location for an FPI depends on several factors, including the specific type of fault being detected (ground, phase-to-phase, etc.), the topology of the power grid, the presence of critical equipment, and the likelihood of faults occurring in specific sections of the grid. In general, FPIs should be placed. Carefully considering these factors, the placement of FPIs can significantly enhance the reliability, speed, and accuracy of fault detection and isolation in the power system.

ORGANIZER

ISGF India Smart Grid Forum

Host Utilities

TATA POWER

BSES Rajdhani Power Limited

BSES Yamuna Power Limited

Supporting Ministries

सत्यमेव जयते
MINISTRY OF POWER
GOVERNMENT OF INDIA

सत्यमेव जयते
MINISTRY OF NEW AND RENEWABLE ENERGY
GOVERNMENT OF INDIA

सत्यमेव जयते
NITI Aayog

सत्यमेव जयते
MINISTRY OF POWER
GOVERNMENT OF INDIA
CENTRAL ELECTRICITY AUTHORITY

India SMART UTILITY Week 2025

THANK YOU

For discussions/suggestions/queries email: ***isuw@isuw.in***

www.isuw.in

Links/References (If any)