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FAULT IDENTIFICATION & LOCATION OF UNDERGROUND DISTRIBUTION SYSTEM USING FAULT PASSAGE INDICATOR (FPI)

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ABSTRACT:

The main purpose of this study is to use FPI to find ground defects. India's electricity demand is increasing day by day. Now, DISCOM is working hard to control electricity consumption in its region. Many anti-stop devices are now faulty. Added FPI or Wrong Path Indicator to the branch to fix this issue. Discom is installing 11KV/33KV underground electricity distribution infrastructure especially in big cities or densely populated areas to reduce short circuits and faults. Today, SAIFI/CAIFI and SAIDI/CAIFI Performance Index are used to measure the performance of distribution companies in India. The central government monitors SAIFI and SAIDI quarterly to identify private/state DISCOM restrictions through key criteria. The electricity distribution system is constantly being developed to gain customers, reduce losses and improve electricity distribution. The transmission system is vulnerable to disturbances such as relay failure and confusion regarding power transmission, tripping, and fault location. This device can be set up as food, increasing safety by reducing or even eliminating confusion about the problem. The number and location of FPIs can affect the reliability of the network, resulting in additional costs for utilities and consumers. This work is done using the IEEE 4 bus [8][9][10].

Keywords- Fault Identification, Fault Passage Indicator (FPI), Fault Location Detection, Underground Distribution System, Simulink.

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1. INTRODUCTION

An electric generator is called a generator that distributes electricity from the distribution center to the local area. Electrical distribution equipment consists of all buildings and equipment that connect transmission lines to equipment used by customers. Substations are part of conventional electrical equipment. Distribution feeder circuits. to change. The power line consists of wires, poles, transformers and other equipment necessary to provide electricity to customers at the appropriate voltage and at the distribution center. In the power distribution system, the high voltage is usually 11000 V, and the low voltage is 400 V and 220 V. Generally, the main distribution voltage is 11 kV, 66 kV and 33 kV, although it varies from country to country.

Power distribution systems use both overhead and underground systems to distribute electricity. Power distribution systems use both overhead and underground systems to distribute electricity. Traditionally, electricity is distributed to consumers through the distribution system, which involves placing overhead power lines at various service locations. Transformers and other equipment for overhead machinery are installed on poles or other supports. Conductors, insulation systems, screens and sheaths are the main components of underground electrical equipment. The electrical conductors at the heart of the equipment are usually made of copper, which is used for extra high voltage (EHV). A hybrid overhead / underground distribution system is a system where transformers and medium voltage lines are overhead and low voltage lines are underground.

Today, SAIFI/CAIFI and SAIDI/CAIFI Performance Index are used to measure the performance of distribution companies in India. Central government monitors SAIFI and SAIDI quarterly to include private/state DISCOM as a priority.

SAIFI: Average Frequency Index used by the distribution industry as a measure of reliability. It shows how often the customer is affected for a long time. It is expressed as the number of voltages in a period.

SAIDI: Average Range Index used by the business division to measure reliability. Shows how long each customer has been without power for a given period of time. It is usually measured in minutes or hours, which are predetermined units of time.

India's electricity demand is increasing day by day. Now DISCOM is working hard to maintain electricity on its land. In private cities or densely populated areas, EDAS installs 11KV / 33KV underground infrastructure to prevent outages and power outages during maintenance. Fault tracing and locating in underground systems is more difficult than in overhead networks. The Fault Channel indicator is designed to assist fault location, which is currently the most important tool for improving the distribution of electrical equipment. A device called a Fault Path Indicator or FPI can be used to indicate electrical problems in the power distribution network remotely or locally. In underground or overhead distribution networks, it is useful to find the problem quickly so that the problems can be solved more easily. The results are good and the important "SAIDI" plays an important role in the development of the FPI index, there are two types of FPI: FPI for O/H network and FPI for U/G network. This project focuses on FPI for U/G networks.

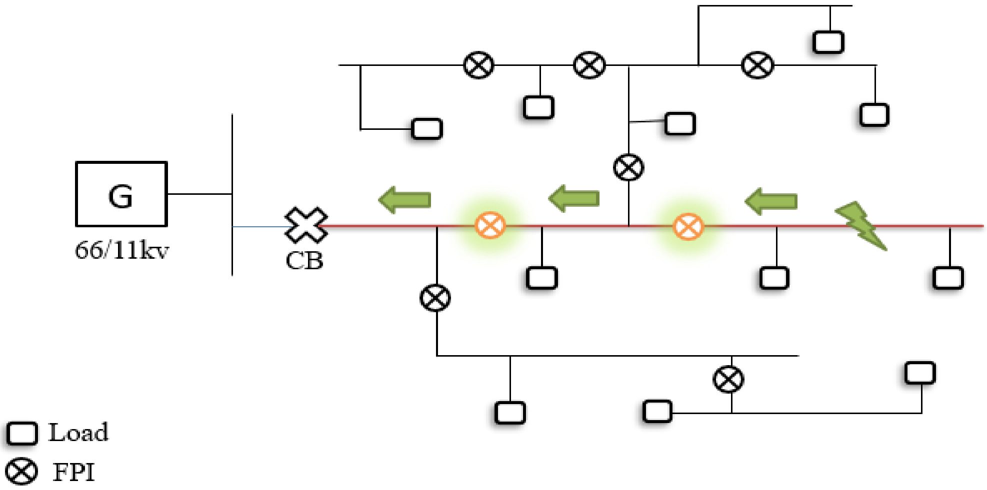


Figure 1. Block diagram of the system

2. SIMULATION COMPONENTS OF PROPOSED SYSTEM

2.1: Fault Passage Indicator (FPI)

A device called a Fault Path Indicator or FPI can be used to indicate electrical problems in the power distribution network remotely or locally.

It helps to quickly and quickly solve the problems on the ground line or overhead lines. The RMU has an additional fault channel indicator that helps identify damaged cables. The monitoring of the current fault from the equipment will be the basis for the indication of the fault.

Devices must be powered and connected to three phase split core CT (CBCT).

They must also be electric. These include a reset option below and a bright LED/flag indicator that is easily visible throughout the day.

1.Reset manually

2.After a predetermined amount of time, reset

3.having at least two extra potential free connections and electrically reset from a remote

Figure 2. Fault Passage Indicator [8]

2.2 Working Principle: In India, electricity is distributed via a three-phase high voltage system operating at 11 KV, 22 KV and 33 KV Three-phase grid vector sum is zero. For example, in the energy equation Ir + Iy + Ib = 0. However, unbalanced current will still flow to the neutral wire. Unbalanced current, also known as fault current, will be detected in a kill-through fault and will send a signal to the endpoint or SCADA system to indicate that the fault has moved from place to place.

This unit is available in network deployment and will be used to check fault location. Remember to avoid CBCT.

2.3 Scope of Work:

1. Research on the Fault Passage Indicator.

2. Examine the techniques presently employed to identify defects.

2.4 Application: Single- or three-phase ground FCIs are available in various combinations, remote or wireless signals. Disaster prevention, communication for SCADA integration, and intrusion prevention are all aspects of FCIs. Using historical load measurements, SEL Auto RANGER minimizes downforce from repeated conditions for ground applications. Minimum load current reset value must be set. Other models have identified the importance of travel specific to their intended use. The fault indicator comes with various reset options for maximum demand. There are models that reset manually after a predetermined time (especially useful for transient faults) or when the current or voltage is restored. Transformers, switchgears, dividers, junction boxes and joints are some of the grounding equipment that can be used in faults. Equipment can be placed in underground cellars and manholes or mounted on platforms above ground. The SCADA system receives the fault information from the fault indicator through integration and completes the fault location determination. The Portable Remote Fault Reader receives radio frequency related fault information from the ground application-specific Radio RANGER Wireless Fault Indication System. No gaps, leaks or access to dangerous underground areas on busy roads [17].

Figure 3. The Radio RANGER [17]

2.5 Overview Of FPI:

1. It can be designed using the Split-Core CT concept or Rogowsky coils.

2. It is used to test the product without capacity with the backup battery to find the power unit on the ground and

convert it to digital signal.

3.Connect the GPS circuit and SIM card to the FPI controller.

4. Create a mobile application server to receive problem reports.

Our FPIs are designed to cut OG lines. In a circuit, usually three fault channels (one for each phase) are disconnected. The following functions are performed by our FPIs: phase-to-phase and phase-to-earth fault detection Transient and continuous fault detection clipped phase current operation Data exchange Use unlicensed short circuits providing local trouble. Through the communication gateway multi-frequency radio frequency indicator light, which is important information for monitoring and fault detection. Our FPI uses at least 10 years of battery life [18].

The battery has enough charge to support at least one radio communication per hour with the communication chart and at least 400 hours of flashing of the fault indicator for 24 hours. Outdoor use of the Fault Crossing Indicator is acceptable. Therefore, the components of the fault channel are protected from direct sunlight to avoid damage from solar radiation. It has a degree of protection up to IP-55 or IP-65, depending on the need [18].

2.6 Range Of FPI:

Communication Capabilities: - Types of Communication and Non-Communication

Voltage Rating: - 3.3kv to 66kv

Fault Types: - transient and permanent, overcurrent and earth

Fault Reporting system: - Through SMS and/or Through Scada [18].

The concept of Faulty Transition Indicator (FPI) or Faulty Circuit Indicator (FCI) has been used for nearly 70 years. In its simplest form, FPI represents the maximum fault current flowing through a power line. In the past, high voltage (HV) transmission lines were used instead of distribution boards to connect generators. This fact together with the radial operation of medium voltage (MV) distribution networks ensures a unidirectional current flow: from the grid to the consumer, even with network topologies such as loops [10].

So, in this case, when there is a fault, the only way for the current to flow is to go from the network to the problem. Overcurrent fault detection also assumes that the fault occurs downstream of the FPI. Linen or his crime squad will follow several FPISs placed on the grid to finally find the cable fault. The issue will occur between the first unaffected FPI and the last FPI exposed. In general, when seeing the power lines, detailed information is needed in the area where the problem is, there should be more methods and methods to show the exact location of the fault. Broken parts can be repaired or replaced. Depending on the component and how easy it is to repair or replace, it can take hours or days to regain power [10].

3. SIMULATION MODEL AND SIMULATION RESULTS

1. Case Study IEEE 4 Bus System

The Fault Passage Indicator (FPI) is implemented on IEEE 4 bus radial system shown in Fig.1. It consists of 4 buses as shown below:

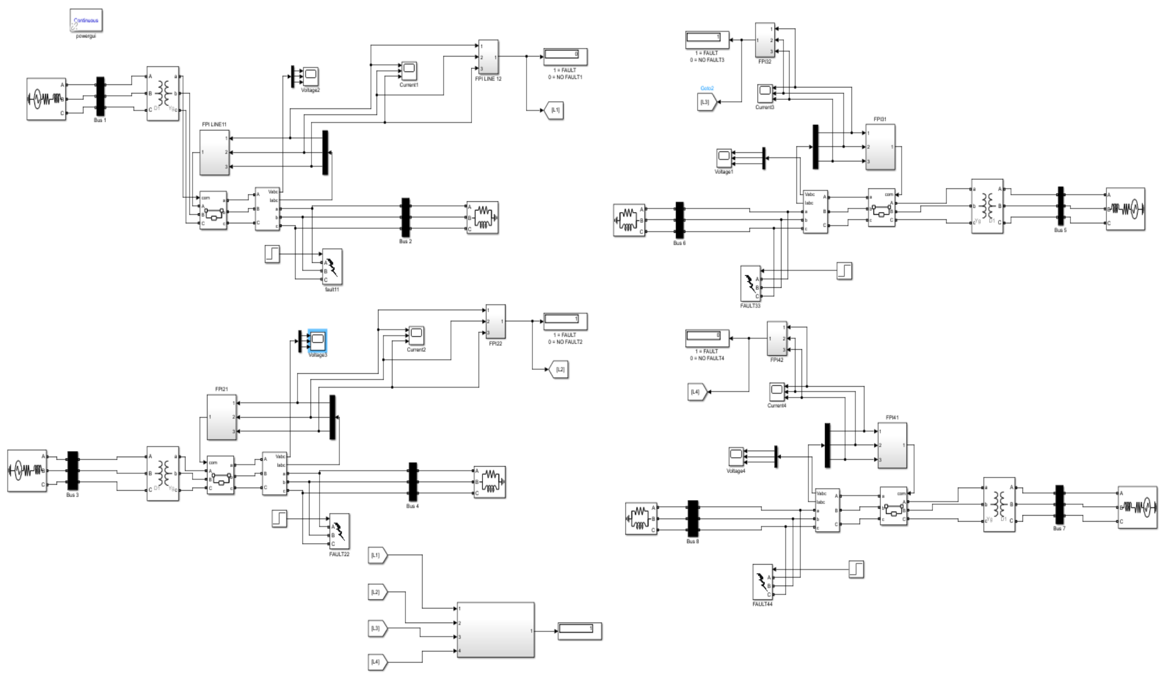


FIGURE 4: Fault Passage Indicator (FPI) Implemented on 4bus system.

Also, four faults have been introduced in the above system. In the system, 8 FPIs have been installed, two at every bus for voltage and current monitoring respectively. This system is capable of monitoring multiple loads like Industrial, Domestic and Commercial and Residential Load. Current and voltage measurement blocks have also been implemented in the system.

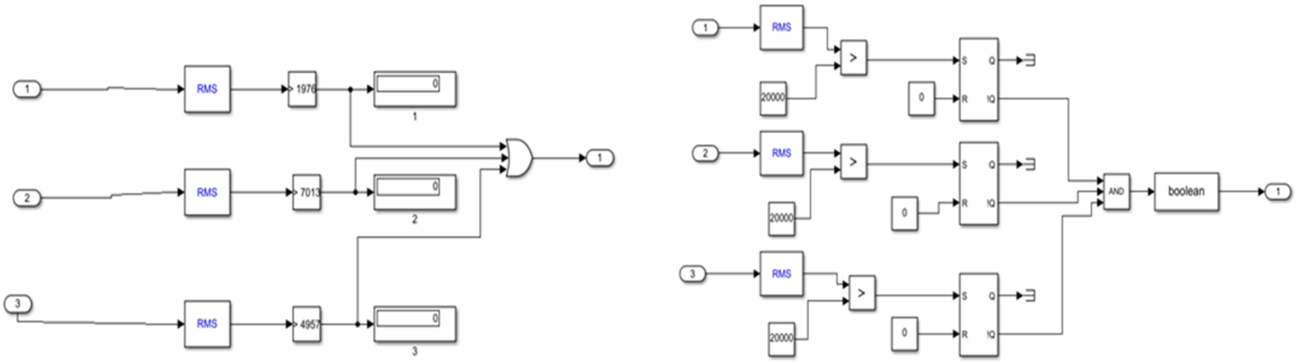


Figure 5: (a) FPI for Current for monitoring and identifying the fault Current across all the buses.

(b) FPI for Voltage for monitoring and identifying the fault Voltage across all the buses.

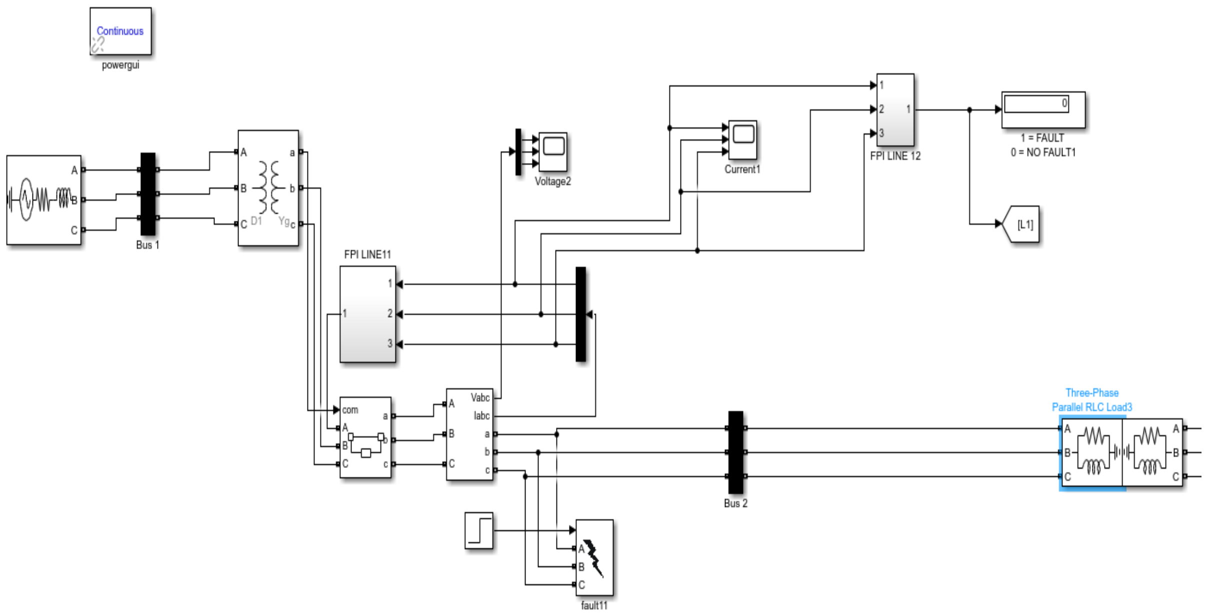
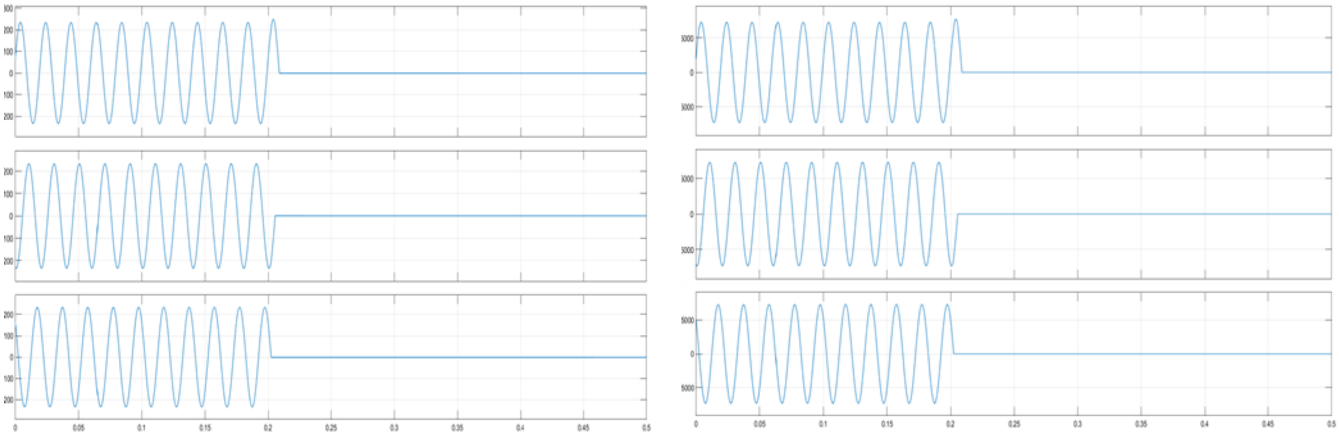


Figure 6: No Fault Condition

In the above figure, no fault has been introduced in the system, therefore, the FPI would show “0” reading for this condition and therefore the utility does not have to worry about the system.



(a) (b)

Figure 7: (a)Waveforms of Voltage
(b) Waveforms of Current

The above figure 7(a) and 7(b) show the waveforms of Voltage and Current respectively. As seen in the waveform, there is no fault introduced in the system, therefore the FPI would show "0" reading in the FPI. And the waveforms are smooth and not distorted.

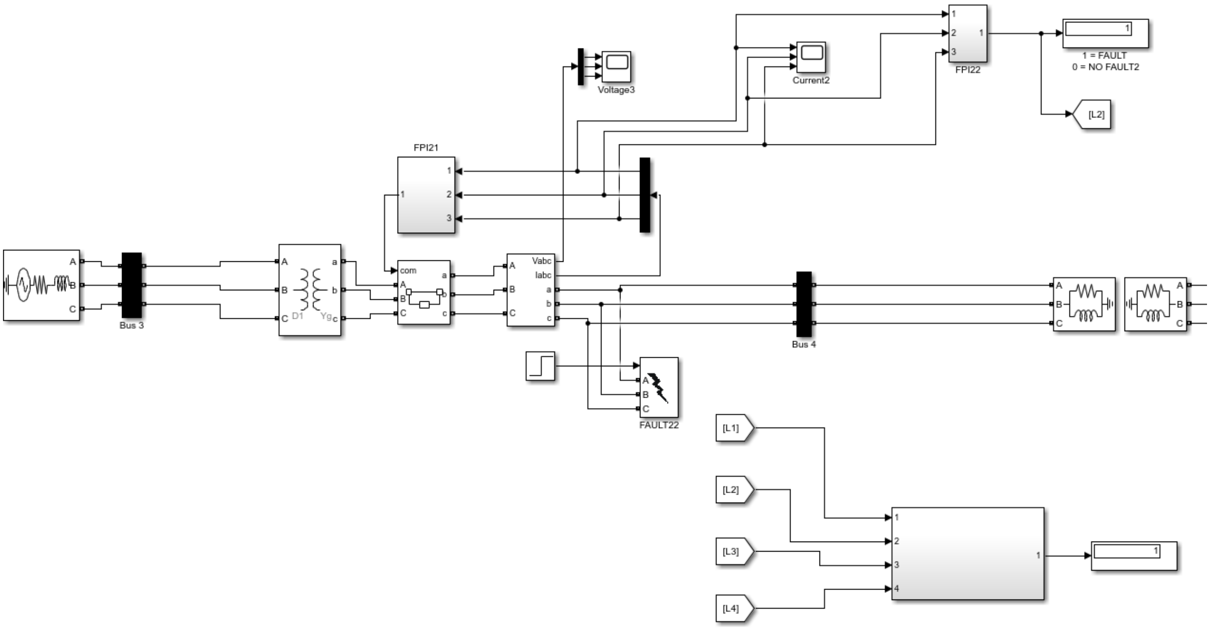
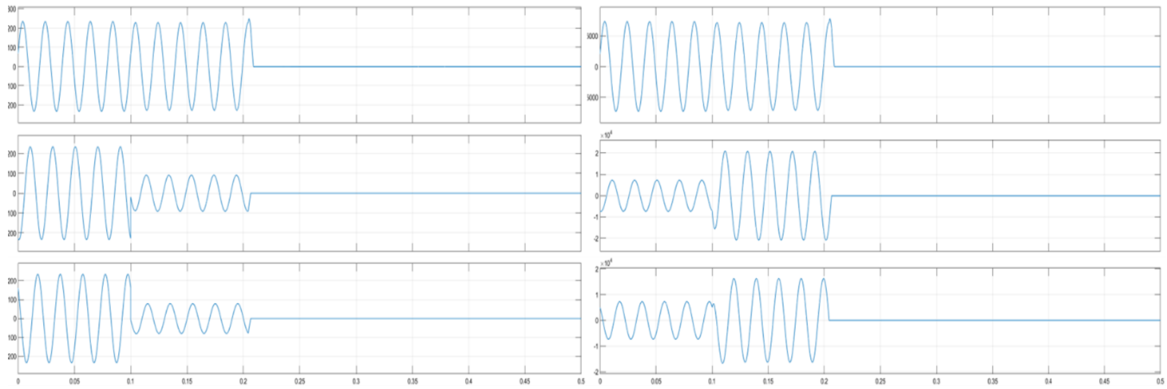


Figure 8: Fault Condition

The above system shows the condition where a fault is introduced in the system which would eventually lead to distortion in the waveform of the current and voltage.



(a) (b)

Figure 9: (a) Waveforms of Voltage
(b)Waveforms of Current

The above figure 9(a) and 9(b) show the waveforms of Voltage and Current respectively. As seen in the waveform, as there is fault introduced in the system, therefore the FPI would show “1” reading in the FPI, and the waveforms are seen to be distorted. In the above figure, a Line to Line to Ground Fault was introduced in the system and as seen in the waveforms, two out of three phases are seen to be distorted. Therefore, presence of LLG Fault is proven.

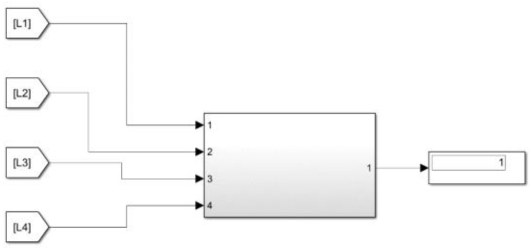


Figure 10: Utility Meter

The utility meter is assumed to be present on the utility side and it is monitored by the utility. In case of a fault in the system, the FPI would show ‘1’ and the personnels would have to identify and locate the fault in the radial system between the two FPIs that have detected the presence of fault in the bus.

4: CONCLUSION AND FUTURE EXPANSION

In the earlier chapters, the Identification & Location of Distribution system are described, the current chapter presents the conclusion of the approach developed and also discuss simulation results. The chapter also suggests more research which can be done to make the approach more robust and adaptable.

1.Conclusion

This project presented the Identification and Location using FPI and analysis of IEEE4 bus System. An automatic fault location method for distribution networks is presented in this study. The system, which makes use of relays, recloser controls, and FPIs, is appropriate for feeders that have several portions with various impedance characteristics [9].

2.Future Expansion

Fault location identification has just been presented in this study. Isolation and network reconfiguration algorithms may be created to operate in tandem with the fault location algorithm to produce a full module in the OMS program. The efficacy of the entire algorithm may be assessed by doing a performance analysis of the entire system.

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