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An Overview on Detection of Temporary Fault and Permanent Fault for 3 Phase Load

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Abstract: ***To Maintain reliability in Power System it is important to protect the 3 phase devices like inductive, resistive, etc against various faults occurring in it. This fault should be identified and analysed quickly for their remedies. The Project Aim is to develops an Automatic Tripping mechanism for the three-phase system. In the case of a temporary fault, the output of the project resets automatically within second. While in event of Permanent fault condition the permanent Trip. Due to these faults, the power system may suffer from considerable damage. This can lead to disturbance in power supply and may cause a standstill to various industries linked to the system. In a three phase power system, these faults are classified as LG (Line to Ground), LL (Line to Line), 3L (Three lines). This system can overcome such problem which by sensing the fault automatically and disconnects the system from the supply so that large scale damage to the system equipment can be avoided. The system automatically differentiates between a temporary disturbance and a permanent fault and appropriately cuts the supply for a short duration or long respectively. The purpose of this project is also to send the information to the mobile by using Global system for Mobile Communication (GSM) technology.***

Keywords: Fault Analysis, Auto Reclosing Mechanism, Relays faults, Power Transformers, Voltage Regulator.

I. INTRODUCTION

An electric power system, a fault is any instant which is not normal electric current or unbalanced condition of system. As we consider, a short circuit is a fault in which current bypasses the normal load and an open circuit fault occurs if a circuit is interrupted by some failure. In three-phase system, a fault should carry one or more phases. In ground fault or earth fault charge flows into the earth. In power systems, many of devices detect the fault or abnormal condition and operate the circuit breaker to prevent the fault or save system from damages.

As from the studies 70% to 90% of faults are occurred in overhead transmission line which are transient. There are many transient fault, such as damages of insulation, swinging wires and little time contact with other objects. These faults are cleared by operating the circuit breakers or can be cleared by de-energizing the line at short period for clearing the fault. The other 30% to 10% faults are occurred in overhead line which are permanent or long duration fault. permanent or long duration fault occurred by broken wire which results one phase to ground fault or joining the two phase together which is occurred in overhead line as well as in the underground cable. these fault cleared by finding them in line and repair which results permanent trip of line.

Here Auto reclosing mechanism success rates vary from one company to another, because most of faults can be successfully cleared by proper use of tripping and reclosing the line. The line is turn off when fault take place and reclose the line when fault and fault arc is removed from line. This mechanism reduced the line outage time due to fault and provide continues supply to the consumer and also maintain the system.

Three phase fault analysis and its protection mechanism main function is to ensure safety of equipments and maintain power system stability at high speed. In order to protect the equipment's of power system from faults, knowledge about system faults, their detection, and safe isolation of the faulted area is needed.

A. Types of Faults

1) Symmetric and Asymmetric Faults

Symmetric (Balanced Faults)

These are very severe faults and occur infrequently in the power systems. These are of two namely Three Lines to Ground (L-L-L-G) and Three Lines (L-L-L). The occurrence of these faults is merely 2-5% in power systems.

Asymmetric Faults (Unbalanced Faults)

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These are very common as they occur way more time than Symmetric Faults and are less severe than former faults. These mainly constitutes of Line to Ground which is the most common fault (65-70%) , Line to Line (5-10%) and Double Line to Ground (15-20%) Faults.

In Line to Ground fault, a conductor makes contact with Earth or Ground. A Line to Line fault occurs when two conductors make contacts with each other mainly while swinging of lines due to winds. When two conductors make contact with Ground then it a Double Line to Ground faults.

2) Type of Faults on a Three Phase System

- L-to-G Fault (Line to Ground)
- L-to-L Fault (Line to Line)
- L-to-L-to-G Fault (Two lines to Ground)

II. SCHEMATIC DIAGRAM

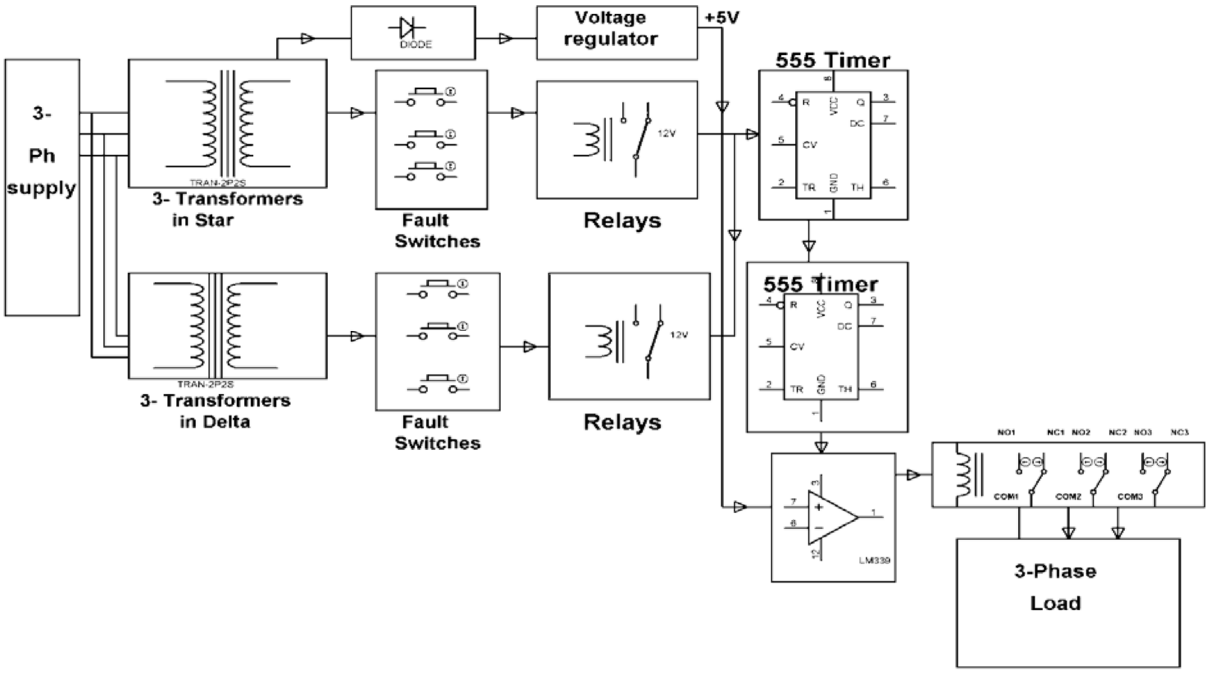


Fig. 1 Block Diagram

III. OPERATIONAL PROCEDURE

The transformers and lamp bulbs are connected to a three-phase power supply rated at 230V. Once the board is powered, all relay coils receive DC voltage, causing the common points to disconnect from the Normally Closed (NC) contacts and move to the Normally Open (NO) contacts. When the push buttons are pressed, the relay disconnects, making the common points move to the NC position, providing a logic low at the trigger pin (Pin 2). The output (Pin 3), which is linked to the reset pin (Pin 4), develops high logic and is indicated by the flashing D11 LED of the 555 Timer (U3), which is in Astable Mode.

If any push button is briefly pressed, the 555 Timer (U1) in Monostable Mode disables U3, making the output of U3 go to zero. This indicates a temporary fault. However, if any push button is pressed for an extended period, the output of the 555 Timer (U3) in Monostable Mode provides an extended active situation for the timer. The output of U3 charges capacitor C13 through R11, and the output (Pin 1) of the Operational Amplifier (LM 358), which acts as a comparator, becomes high. This high output, in turn, drives the 3 CO relay through transistor Q1, switching off the 3-phase load. This indicates a permanent fault. In the event of a temporary fault, pressing a push button for a short duration disables U3 in Monostable Mode, which sets the output of U3 to zero. However, for a permanent fault, pressing a push button for a longer duration causes the output of the 555 Timer (U3) in Monostable Mode to provide a more extended duration of an active situation for U3. The output of U3 charges capacitor C13 through R11. The output (Pin 1) of the Operational Amplifier (LM 358), which acts like a comparator, becomes high, driving the 3 CO relay through transistor Q1 to switch off the three-phase load.

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IV. WORKING PRINCIPLE

This project uses six Step-Down transformers to handle the Circuit under low voltage conditions of a 12V 3-phase fault analysis power system. The primary of three transformers is connected to a 3-phase supply in a star configuration, and the secondary is also connected in a star configuration. The other set of three transformers is connected in a star configuration to the 3-phase supply, and their outputs are connected in a delta configuration. The outputs of each transformer are rectified, filtered, and supplied to relay coils. Six push buttons are connected to each relay coil to simulate LL Fault or 3L Fault conditions. The normally closed contacts of the relays are connected in parallel, and the common point is grounded. The parallel connection point of the relay is connected to pin 2 of a 555 timer in Monostable mode via a resistor R5. The output of the U3 555 timer IC is given through an Op-amp LM358 via wire 1 and 2, which is inverted at pin 3. The inverting input is fixed voltage from a potential divider RV2. When the 3-phase supply is connected, all six relay coils receive DC voltage, and the common point disconnects from NC and moves to the normally open points, providing a logic high to the 555 timer U1 and keeping it in Monostable mode. When the push button connected to the relay is pressed, the relay disconnects, and the process contacts move to the normally closed position, providing a logic low trigger to pin 2 of the 555 timer to generate an output, which brings the U3 timer into Astable mode. The Astable operation takes place at the output, which is indicated by an LED. If the fault is temporary, and the push button is released immediately, the output goes to zero. In the event of the push button being pressed for a longer duration, the Monostable output remains active, and the Astable timer output charges capacitor C13 and R11, causing the output of a comparator to go high, which drives the relay to switch off the three-phase load.

V. APPLICATIONS

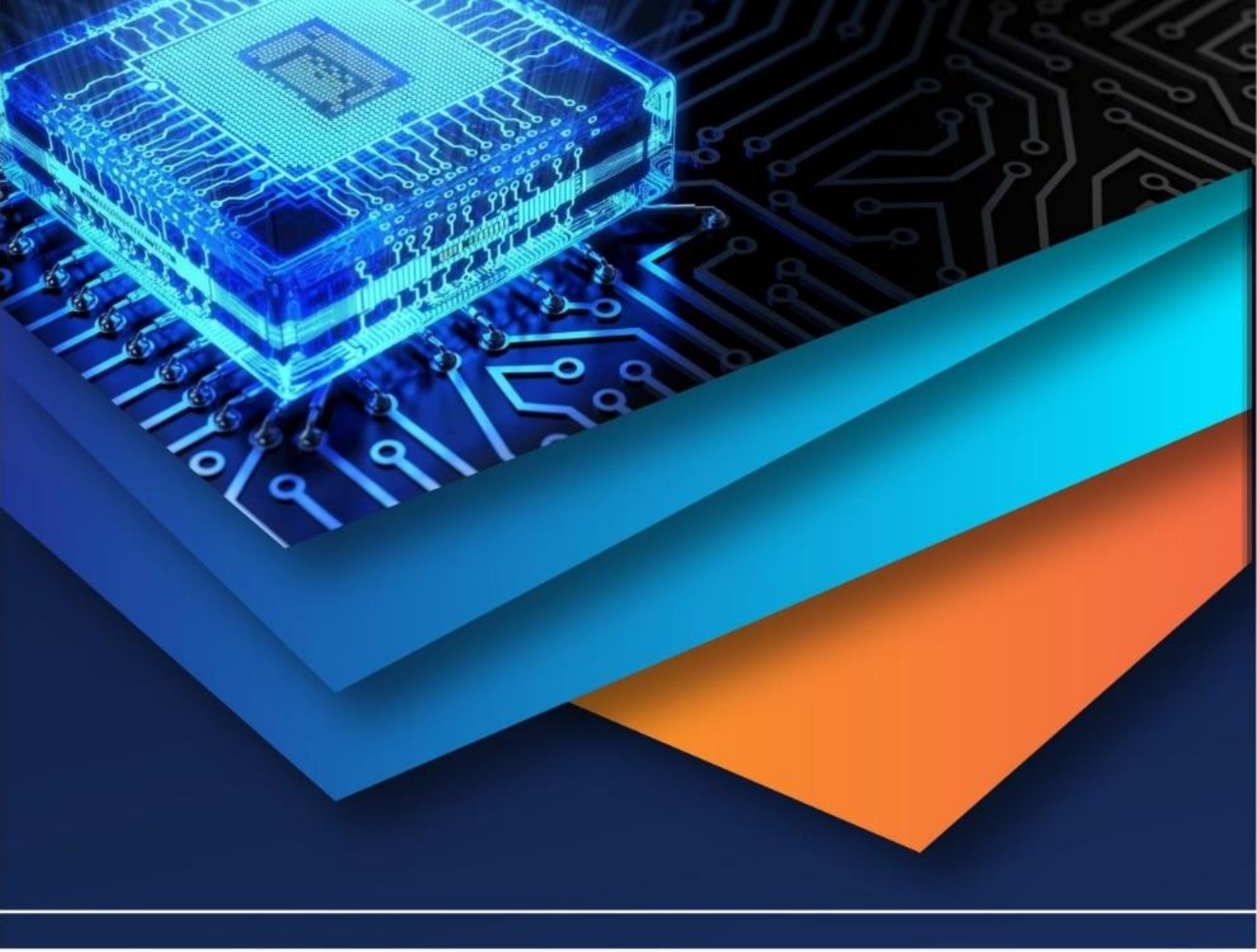
1) Applied in transmission and distribution system.
2) Used in substation.
3) For clearing temporary fault in industries and commercial sectors.
4) Apartments.

VI. CONCLUSION

This Three Phase fault analysis system is built using Six Single Phase Transformers out of which three are wired in Star-Star configuration and the rest 3 are connected in Delta connections. The input to the transformers is 220 volt and output is 12 volt. For introducing faults on the low voltage side set of switches are used that create LL, LG, and 3L faults. The supply returns to the load in the case of a Temporary fault and is referred as a temporary trip while for Permanent fault disconnect the supply and load shall result in a Permanent trip and send the information to the authorities by using Global system for Mobile Communication (GSM) Module. As compare to other protection system it can be used for protection of line faults which occur in power system hence this system is more economical compared to other type of protecting system against three phase fault.

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