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Design of voltage type sensor for 415 VAC / Rayhaizie
Abdul Malek.

**DESIGN OF VOLTAGE TYPE SENSOR
FOR 415 VAC**

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MAY 2006

**“I hereby certify that I have read and understood the following project thesis.
To my opinion this thesis is sufficient in term of scope and quality to achieve
partial fulfillment of requirement for the Degree of Bachelor in Electrical
Engineering (Industrial Power).”**

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Date : 4TH MAY 2006

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**This Report Is Submitted In Partial Fulfillment of Requirements for the Degree
of Bachelor in Electrical Engineering (Industrial Power)**

**Fakulti Kejuruteraan Elektrik
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MAY 2006

“I admit this report is written by me except the summary and extraction for each I have been clearly presented.”

Signature  _____

Name of Author : RAYHAIZIE BIN ABDUL MALEK

Date : 4TH MAY 2006

My beloved father and mother

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ABSTRACT

Voltage type sensor for 415 volt is equipment where to sense any fault at the power supply and consumer circuit. The design would emphasis on any differences value in voltage especially in voltage drop. The main components that would be the heart of this design is the under voltage relay. The under voltage relay would detect any problem in the main circuit and also the power supply especially voltage drop. Voltage sensor has 2 main parts to build it. They are voltage sensor circuit and alarm circuit. This voltage type sensor is equipped with alarm and siren that would alarm when any problems arise in the power supply in the system. A backup battery would automatically turn on and supply the circuit during the break down. It would be turned off and be recharged when the system operates in normal condition. Voltage sensor is one of the parts of distribution system. The voltage sensor is having connections with battery backup, three phase circuit breaker and a busbar.

ABSTRAK

Pengesan jenis voltan untuk 415 volt merupakan salah satu alat pengesan kegagalan voltan pada bekalan kuasa dan litar pengguna. Rekabentuk ini boleh mengesan sebarang perubahan nilai voltan terutama kejatuhan voltan. Peralatan utama yang digunakan dalam rekabentuk ini ialah under voltage relay. Under voltage relay boleh mengesan sebarang perubahan voltan pada litar utama terutama kejatuhan voltan. Pengesan voltan mempunyai dua bahagian yang harus dibina iaitu litar pengesan voltan dan litar tanda amaran. Pengesan voltan mempunyai alat tanda amaran dan siren dimana ianya berfungsi sekiranya sebarang masalah dalam sistem bekalan kuasa iaitu bekalan bateri akan berfungsi secara automatik sekiranya bekalan kuasa mempunyai masalah. Bekalan bateri tidak berfungsi apabila dalam keadaan normal. Pengesan voltan merupakan salah satu bahagian dalam sistem pengagihan dan ianya disambungkan bersama bekalan bateri, pemutus litar 3 fasa dan busbar.

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CHAPTER 1

INTRODUCTION

1.1 Overview

The purpose of this project was to apply principles of under voltage relay to make a voltage sensor circuit where it is suitable to use in power system especially at the distribution system. In distribution system, there are many types of faults. The alternative solution to upgrade the protection system especially voltage rise is to make a new protection equipment such as voltage sensor.

The voltage sensor is one of the combination circuits in distribution circuit such as battery backup, power supply switching, backup line and etc. The information from other circuits is important in order to get the best design for voltage sensor. From this information, the voltage sensor design for the distribution system will be effective to sense the different voltage values in the system.

Before designing a voltage sensor circuit for 415 Vac, the component will be used must be searched and learnt and understood their functions. The circuit will be designed consist of two parts which are voltage sensor and signal warning. The kind and rating for each component and battery must be surveyed to make sure the components are available in the market.

1.2 Project Objectives

The first objective of this project is to design a voltage sensor circuit which can automatically sense the voltage drop and voltage rise in the power supply system.

Second objective for this design is to protect any consumer power supply from voltage drop in the system. It can give signal to the technical staff when power supply problem related to voltage drop and voltage rise occur. It is like an auto-switch and gives supply to several important equipment such as communication and computer systems

1.3 Scope Of The Project

The purpose of this sensor is to detect unwanted and intolerable conditions especially voltage drop in the power system which may occur in the power supply. It can avoid any fault to the equipment like computer system by using a relay. It will give the signal like siren when the power supply is in fault condition like voltage drop from normal voltage of 415 volt.

1.4 Problem Statement

In distribution system, the voltage may drops or rises from its rated value. Voltage drop may come from the distribution line supplying to a specific load whereby the load could be any consumer which causes the consumer voltage to drop from its rated value. Likewise, the voltage may rise from its rated value due to the improper operation of the voltage regulating equipment such as transformers or capacitors. Both of these problems are to be dealt in this project and a voltage sensor circuit for low voltage side of the distribution system will be designed.

Under voltage conditions can seriously damage the electrical equipment. Usually, the low voltage relay is constructed from plunger relays with normally

closed contact where it is closed when the relay is de-energized and opened contact in normal condition. The relay can't hold when the voltage rise or low voltage condition. So, in the low voltage condition, the circuit breaker is low causing to trip.

There are many types of faults in when transmitted voltage to consumer. Among of them is line to ground and double line to ground. It is happened when the distribution line touch to ground.

1.4.1 Lack Of Knowledge About The Theoretical

Usually, this is one of the mistakes done by the students. They always have problems when it comes to find or search the information needed or data collection about the project they handle. In this project, all information from literature survey has been to studied before starting the project design and implementation. Enough information has been gained from literature survey and the actual components of the voltage sensor circuit have been identified.

1.4.2 Time Management

The time management planning is important and must be carefully managed to get the smooth project progress. The best time apportionment in each part for the design and installation or wiring can help the students to do their successfully project. So, the solution for this problem is to use Gantt chart. This is one-way to make a well-done project if students follow the tasks that have been planned in the Gantt chart and help to save the time from wasting.

1.4.3 Difficulty To Get The Component

When searched in the internet or component catalogues, it was hard to select the best choice of price cost, rating and brand. Under voltage relay was the

most difficult one to get the best choice in voltage sensor circuit and that took some time to build voltage sensor circuit.

CHAPTER 2

LITERATURE REVIEW

2.1 Background

Usually voltage sensor is placed at the distribution substation or at the electrical panel. It is used to sense any difference of the voltage such as voltage rise. The voltage sensor is one of protection equipment where it gives the signal to the circuit breaker to trip and signal warning when it is in fault condition.

2.2 Power Distribution System

Electricity distribution is the process to deliver and distribute the electricity to the consumer circuits. In other words, the distribution is in between transmission line and user purchase from an electricity retailer. It is generally considered to include medium-voltage power lines, low-voltage electrical substation, pole-mounted transformer to set down the voltage from transmission line system, low-voltage distribution wiring and electrical meters and protection system.

Distribution networks are typically of two types, they are either radial or interconnected (ring). A radial network leaves the station and passes through the network area with no connection to any other supply. This is typical of long rural lines with isolated load areas. An interconnected network is generally found in more urban areas and will have multiple connections to the other points of the supply. Radial connection will have a problem when the source or line has problem or faults but different from interconnected connection where it has source connected to line. If

one source has a problem or line was fault, other source will take over to supply electricity [15].

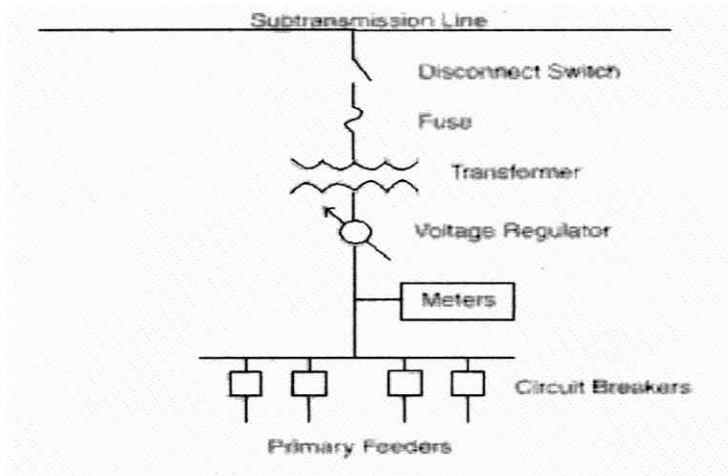


Figure 2.1: Simple distribution substation

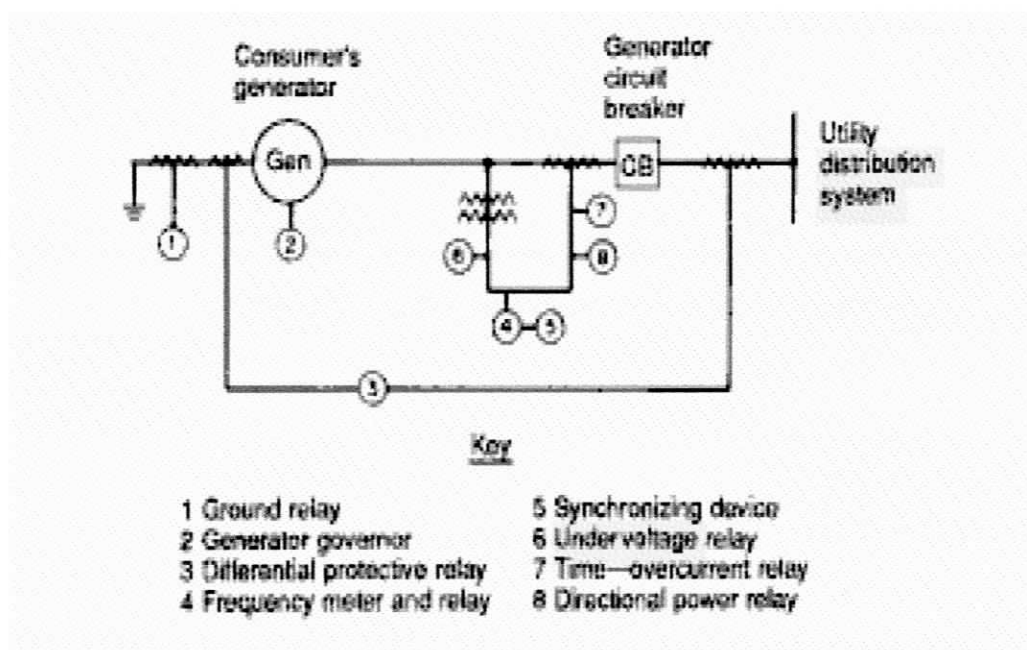


Figure 2.2: One Line Diagram Showing Protection Relaying For Consumer Cogeneration

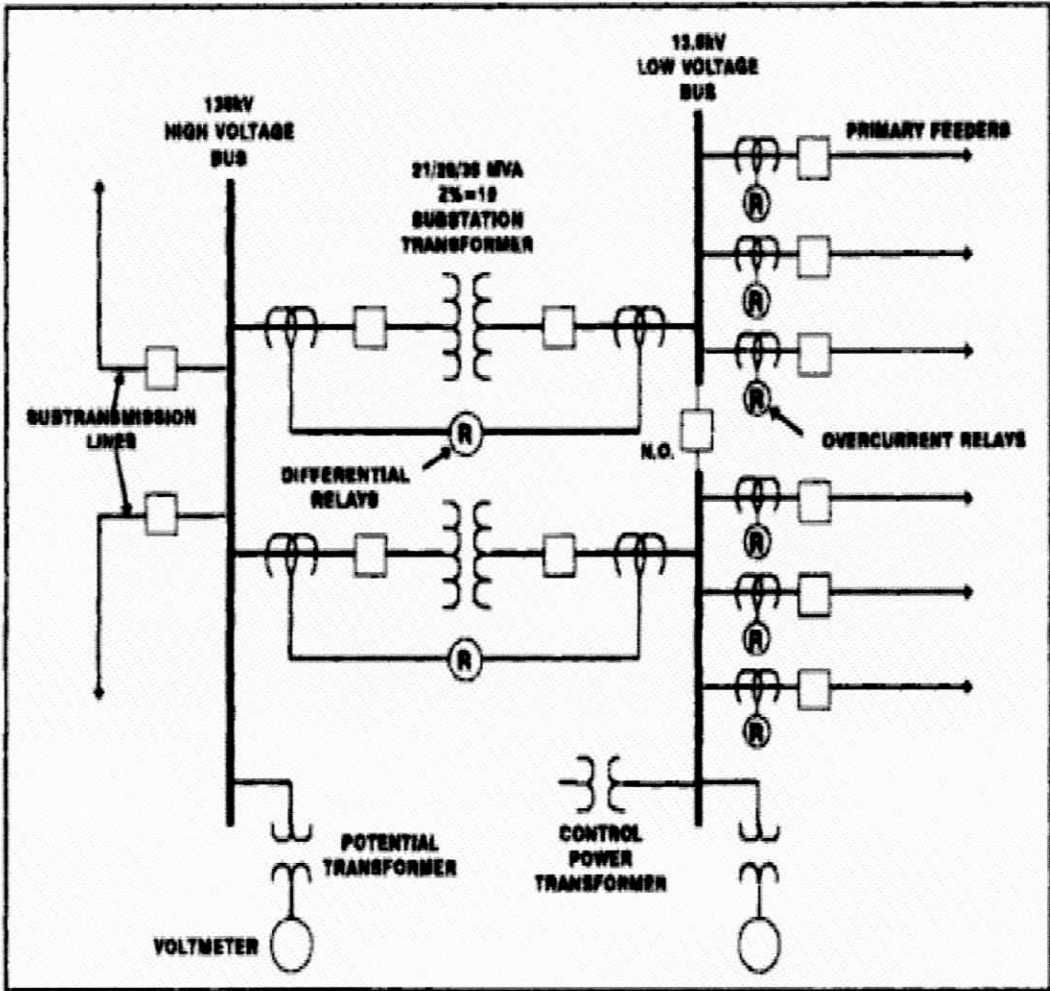


Figure 2.3: Average Distribution Substation Arrangement



Figure 2.4: Model For Distribution Panel

2.3 Under Voltage

The under voltage is one of the problems in power system. It means that the value of voltage drops from the real value. This happens because the specific load using in a circuit is not suitable to use or the equipment used have a problems. So, it can create a problem to the other equipment like machine, computer network system and etc. Voltage drop is a reduction in voltage in an electrical circuit. This effect is observable in a variety of different situations, and can be deliberate or an undesirable side-effect [7].

The electrical breakdown has several similar but distinctly different meanings. The cause for this problem is the electric circuit or system such as lack of functioning electricity supply. The faults are one of the reasons that the power supply fail to give a signal. The protection equipment like protection relay and others will

cut off the power supply and further protect the consumer circuit and equipment from damage.

In electrical distribution system losses due to voltage unbalance, over- and under-voltage, low power factor, undersized conductors, leakage to ground, and poor connections can account for less than 1% to over 4% of total electrical energy consumption. At three industrial facilities, average electrical distribution system losses accounted for 2% of annual energy use. Losses due to poor connections represent one-third of these losses and account for 40% of the savings after corrective actions were taken.

Poor connections or inadequate conductor sizes result in excessive energy losses.

The increased resistance converts electrical energy into heat and imposes additional loads on the distribution system. Maintenance of connections is generally referred to as termination maintenance. Termination maintenance is generally a cost-effective electrical distribution system and energy savings measures.

Causes of poor connections include:

1. Loose cable terminals and bus bar connections
2. Corroded terminals and connections
3. Poor crimps
4. Loose, worn or poorly adjusted contacts in motor controllers or circuit breakers
5. Loose, dirty, or corroded fuse clips on manual disconnect switches

Distribution system losses due to poor electrical contacts appear as hot spots caused by increased resistance or electric power (I^2R) losses. These hot spots may be detected by infrared thermography or a voltage drop survey. Inexpensive hand-held infrared thermometers can quickly and safely reveal hot spots.

Terminations should be regularly inspected. Replacing fuse clips or cleaning breaker fingers can be very cost-effective. The cost of cleaning or replacement is low

compared to the significant energy savings and secondary benefits, including reduced downtime due to unscheduled equipment outages and improved safety due to reduced fire hazards [4].

2.4 Conducting a Voltage Drop Survey

A voltage-drop survey can usually be done in house with existing equipment such as a hand-held voltmeter. Voltage drop measurements should be taken from the input of each panel to the panel output for each load. For a typical motor circuit, measurement of the voltage drop is taken from the bus bar to the load side of the motor starter. Comparison of the magnitude of the voltage drop for each phase with the voltage drop for the other phases supplying the load is done. A voltage drop difference of over 15% indicates that testing should be initiated to identify poor circuit connections. Even with good balance, an excessive voltage drop indicates that component voltage drop testing should be initiated.

2.3 Relay

2.3.1 Solid-State Relay

Relays have many applications. Relays are used for small appliances such as energizing electric buzzers and bells. For voltage sensor of 415 Vac relay are used to reset the siren.

There are two parts in the relay such as a coil and contacts. Relays are composed of a coil of wire around a steel core, a switch and a spring that holds the contacts in place. When electrical current flows through the coil, the relay will be energized and becomes like an electromagnet. So, the contact relay will open or close depending normally close and normally open contacts. It means that the contact will change over like an automatic switch to open or close the circuit. When the electrical current stops the relay coil functions the opposite. The rating for the relay was is 240 Vac and 5A [16].