

**DEVELOPMENT OF LOW VOLTAGE DISTRIBUTION
AUTOMATION SYSTEM BASED ON REMOTE TERMINAL UNIT,
ABB RTU211**

Mohamad Yazid Bin Abdul Razak

**Bachelor of Electrical Engineering
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**TITLE : THE DEVELOPMENT OF LOW VOLTAGE DISTRIBUTION
AUTOMATION SYSTEM BASED ON REMOTE TERMINAL UNIT,
ABB RTU 211**

NAME	MOHAMAD YAZID BIN ABDUL RAZAK
IC NO.	911229-01-5903
MATRIX NO.	B011010225
COURSE	BACHELOR OF ELECTRICAL ENGINEERING (CONTROL, INSTRUMENTATION & AUTOMATION) - BEKC
SUPERVISOR NAME	PROF MADYA ARIFF BIN MAT HANAFIAH

DECLARATION

“ I hereby declare that I have read through this report entitle Development of Low Voltage Distribution Automation System Based on Remote Terminal Unit, ABB RTU211 and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation) ”

Signature :

Supervisor’s Name :

Date :

**DEVELOPMENT OF LOW VOLTAGE DISTRIBUTION AUTOMATION
SYSTEM BASED ON REMOTE TERMINAL UNIT, ABB RTU211**

MOHAMAD YAZID BIN ABDUL RAZAK

**A report submitted in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering (Control, Instrumentation and Automation)**

Faculty of Electrical Engineering

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2014

I declare that this report entitle “The Development Of Low Voltage Distribution Automation System Based On Remote Terminal Unit, ABB RTU 211” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in condition of any other degree.

Signature :

Student's Name : MOHAMAD YAZID BIN ABDUL RAZAK

Date :

Dedicated , in thankful appreciation for support, encouragement and understandings

To:

My supervisor Prof Madya Mohd. Ariff Bin Mat Hanafiah ;

My beloved mother and father , Zaiton Binti Haji Satimin and Abdul Razak Bin Mat Jamil;

My family members and all friends

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ABSTRACT

During these days, distribution automation system is developing. The technology of remotely monitors the distribution system, facilitates supervisory control of devices and provides decision support tools to improve the system performance is very demanding. Based on the research, the protection system of the distribution on 415/240 V has not been implemented yet. Therefore, this project is one of the three parts in developing the fast response distribution automation system. This report content the brief description on the distribution automation advantages, functionality and reliability. The substation development are based on the Remote Terminal Unit, ABB RTU211 input and output. In this project, the designing of the 415/240 V substation has been done as well as the controller. As for this substation, the incoming, outgoing and the load controller and the whole documentation of this project completion have also been included. The approach of this system is the identification faults that might occurs, how to detect and what action to be taken for these situations. The overall picture of this system will be discussed more inside this report by considering the scope and limitations.

ABSTRAK

Pada masa sekarang, sistem automasi pengagihan sedang giat membangun. Teknologi mengawal sistem agihan dengan jarak jauh memudahkan kawalan penyeliaan alat dan membekalkan alat-alat sokongan untuk memperbaiki data dengan prestasi sistem yang sangat berkembang. Berdasarkan penyelidikan, sistem perlindungan pengagihan di 415 / 240 V belum dilaksanakan lagi. Oleh sebab itu, projek ini ialah salah satu daripada tiga bahagian dalam memajukan sistem automasi pengagihan reaksi pantas. Laporan ini mengisi perihal ringkas di kelebihan-kelebihan automasi pengagihan, fungsi dan kegunaannya. Pembangunan pencawang ini berdasarkan Remote Terminal Unit, ABB RTU211 data masukan dan data keluarannya. Dalam projek ini, rekaan 415 / 240 pencawang V telah dibuat serta pengawal. Bagi pencawang ini, masukan, dan juga keluaran dan pengawal beban telah didokumentasi keseluruhan penyiapan projek ini. Pendekatan sistem ini ialah mengenal pasti kesalahan-kesalahan yang mungkin berlaku , bagaimana untuk mengesan dan apa tindakan menyangka situasi-situasi ini. Keseluruhan gambaran sistem ini akan dibincang lebih bahagian dalam laporan ini dengan mempertimbangkan skop dan had yang telah ditetapkan.

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LIST OF ABBREVIATION

DAS – Distribution Automation System

RTU – Remote Terminal Unit

Modbus – Serial Communication Protocol

ASCII - American Standard Code for Information Interchange

TCP/IP - Transmission Control Protocol/Internet Protocol

FLISR - Fault Location, Isolation and Service Restoration

HMI – Human Machine Interface

CT – Current Transformer

CHAPTER 1

INTRODUCTION

1.1 Project Title

The Development of Low Voltage Distribution Automation System Based on Remote Terminal Unit, ABB RTU 211.

1.2 Project Overview

In every distribution system, there are substations controlling the power supply to the consumers. The requirements of every distribution system is the proper voltage, availability of power on demand and the reliability. A good distribution system should ensure the voltage variations at consumers terminal are within permissible limits.

The distribution substation contain the incoming, outgoing and the load. The low voltage switching system and back-up system needed to meet the efficient distribution system network.

This project are focus on developing one substation with the controller circuit based on input output of ABB RTU211.

1.3 Problem Statement

Electrical interruption always occur in industrial environment and it makes the electrical quality of the distribution system performance not at its best. The interruption of operations in industrial such as blackout, electrical frequency and voltage causes huge effects on the big scale industry with high growth of economy. Nowadays, the demand on the intelligent power distribution system will overcome the blackouts and maintaining the high quality of electricity.

In Distribution Automation System, DAS, there are three major parts. Firstly, the fault detection system, which is the input and the output to be controlled by the controller. Secondly is the Remote Terminal Unit, RTU configuration system. This RTU will act device that send and receive the data from the feeder to the Human Machine Interface, HMI. Which this also known as Supervisory Control and Data Acquisition, SCADA system. The third Part is the HMI development. This is the interface for the user to control the DAS in a control room.

The identification of response to the system will be develop during the first stage which is the control circuit of the feeder. This includes how the data sent and how the data receive from and to the Remote Terminal Unit, ABB RTU211.

1.4 Project Objectives

1. To study the process of faults identification by Remote Terminal Unit in Distribution Automation System.
2. Design the substation and its control circuit for Low Voltage Distribution Network System based on the ABB RTU211's input and output.
3. To verify the operation of the Distribution Automation system control circuit.

1.5 Project Scope

Major objective of this project is to develop the Ring Bus System which will be explained in the next point. By narrowing down a little bit, the scope of the project has been decided into one of three substations needed. In any substation the feeder, RTU, and the HMI are needed.

Based on the major parts mentioned in the Problem Statement earlier, this project are focussing on the first part which is the development of the input and output of the fault detection system which is also called as the feeder.

This system is applicable on the 415/240 kV distribution system. This project will develop one the substations which covers the incoming, outgoing and the load of electrical distribution system. It also covering the control circuit to be controlled by the RTU.

1.6 Contribution of Project

The design of the first substation of these three substation will be the master of all the consumer below it. The main idea of this project is to develop the fast response fault management system for the distribution automation system of 415kV / 240kV.

Based on the Figure 1.1, it shows the ring system that connected with two main supply and three substations. It shows the normal condition of the network distribution system. The main supply can supply all three substations if there is faults occurs between substation 1 and 2 or substation 2 and 3.

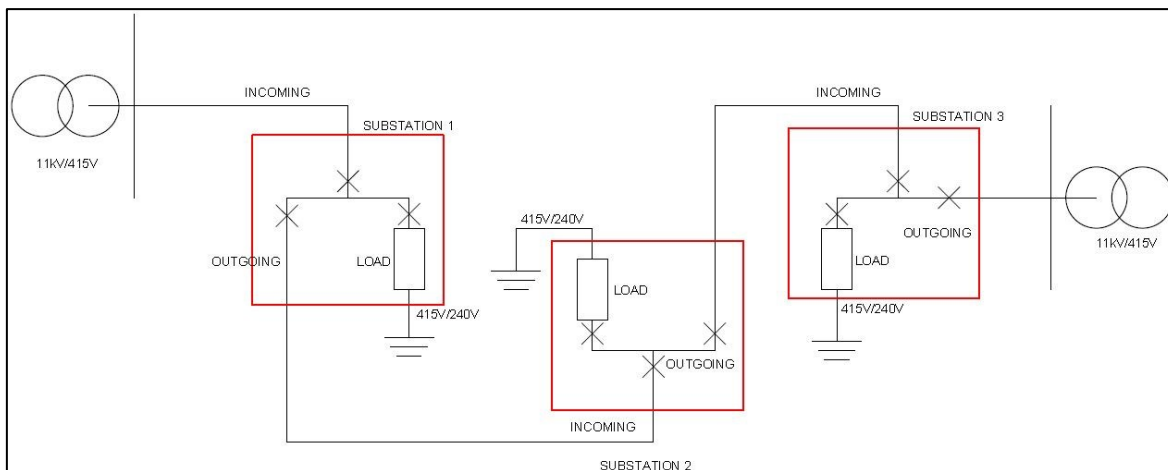


Figure 1.1: The main idea of distribution system.

CHAPTER 2

LITERATURE REVIEW

2.1 Distribution Automation System (DAS)

The purpose of Distribution Automation System (DAS) is to controlling, monitor, intelligence and connectivity from the substation to the customer and distributed resources [1]. DAS is able to monitor, coordinate and operate customers components in real time mode [2].

Distribution system is able to identify various electrical faults in the system feeder as well as delivering the high quality and reliable electrical supply. This system is able to accommodate various power plants with versatile resources. This is an important responsibility of the distribution company [15].

The DAS built with improved technology that enables to mobile monitoring and control breakers and switches on distribution network in real-time including the distribution substations [7].

2.1.1 Fault Location, Isolation and Service Restoration, FLISR

The acronym for FLISR is stand for Fault Location, Isolation and Service Restoration. After occurrence of any fault, the key challenge to any power distribution utility is to locate/ detect the faulty section, Isolate the faulty section and restore un-faulted areas, as quickly as possible. Faster the restorations after fault- better its impact on Reliability Indices (tangible benefit) and grater is customer satisfaction (intangible benefit) [4].

2.1.2 Advantages of Distribution Automation System (DAS) [5]

Operational & Maintenance benefits:

- Outage duration is reduced by using the auto restoration scheme makes the improvement of reliability.
- Means of automatic VAR control can improve voltage control.
- Man hours and man power will be reduced.
- Operational data information is accurate and useful planning constructed.
- Fault detection and behaviour analysis are improvised.
- System process schedule and component loading are improvised.

Financial benefits:

- The increment of revenue due to quick regeneration.
- System capacity employed will be improvised.
- Quality of provider will be improvised for customer retention.

Customers related benefits:

- Operation reliability is better.
- Industrial/Commercial customers will minimize interruption cost.
- Quality of provider is improvised.

2.2 Remote Terminal Unit, RTU

RTU hardware which are configured as the data acquisition device to acquire electrical parameters data from line, process information and the transmission of commands and instructions to component in DAS [3]. Besides that, RTU is built with an open ended distributed processing configuration consisting of main processor, peripheral I/O modules, termination panels, power supplies & communication equipment/interface [6].

The basic functionality of ABB RTU 211 has been tabulated in Table 2.1. It includes the hardware's features of power quality monitor, fault detection and the protection function, communication type, temperature monitoring and the firmware upgrade of the RTU.

2.2.1 Basic Functionality of RTU

Table 2.1: The Ability of ABB RTU 211

Hardware	Functionality
Power Quality Monitor	<ul style="list-style-type: none"> • Power drop • Power rise Power Interruption Total Harmonic Distortion-Voltage • Total Harmonic Distortion-Current • Current TDD • Current Unbalance Ratio • Over and Under Voltage
Fault detection and the protection function	<ul style="list-style-type: none"> • Handle new algorithm of fault indicator and restraint of inrush current • Sectionalize function

	<ul style="list-style-type: none"> • Detection the direction of fault current flowing • Fault detection in non-grounding feeder • Save and transmit the current wave and voltage wave in fault
Communication type	<ul style="list-style-type: none"> • DNP3.0 • Modbus, Bluetooth • RS-232, Rs-485, Ethernet
Temperature monitoring	Give the temperature and humidity data of inside and outside control box
Firmware upgrade	Remote firmware upgrade by file transfer function

Table 2.1 shows the ability of the remote terminal unit model ABB RTU 211.

2.2.2 Advantages of RTU

- One engineering tool for the complete RTU family
- Reduced operating and maintenance costs through advanced diagnostic tools
- Integrated Human Machine Interface (HMI) functionality, PLC functions and network components in one RTU system
- Reduced engineering hours through efficient engineering tools
- Small number of configurable hardware components for all applications reduces spare part costs
- One solution, from pole top RTUs to large complex trans- mission RTUs, with consistent system functionality.[6]

2.3 Overcurrent

It basically means that an over current exists when the current (A) exceeds the rating of the equipment or the ampere capacity of the cable conductor [9]. The cause of an overcurrent is the overload on the circuit, a short circuit or even the ground fault. IEC 60255 defines a number of standard characteristics as follows:

- Standard Inverse (SI)
- Very Inverse (VI)
- Extremely Inverse (EI)
- Definite Time (DT)

2.4 Earth Fault

Earth fault current is a current that flows directly from phase conductors to earth. It may also refer to a current that flows from protective conductors from the point of an insulation breakdown [10].

To avoid earth fault current, a protection is implemented by professionals. Protection requires interruption to the supply of a current to a circuit or system. Interruption is only set to occur when current leakage to the Earth is detected. The current leakage must be higher than the pre-determined threshold, if it exceeds it, than interruption occur.

2.5 Switchboard

A switchboard is a distribution board (DB) that receives a large amount of power and dispatches it in small packets to various electrical equipment [11]. It has power-controlling devices such as breakers, switches along with protection devices such as fuses, etc. Switchboards in general are divided into the following four classes [11]: