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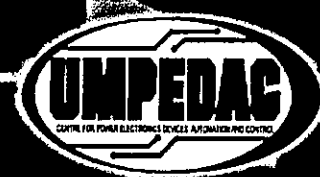
PECs 2012

"Sustaining Renewable Energy Development for the Future"

SYMPOSIUM

Jointly organized by:

UTeM
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UMPEDAC
CENTRE FOR POWER ELECTRONICS DEVICES AUTOMATION AND CONTROL

17th DECEMBER 2012
MAIN HALL, UNIVERSITI TEKNIKAL MALAYSIA MELAKA

5.0 Control & Automation

DEVELOPMENT OF REMOTE TERMINAL UNIT (RTU) FOR THE NEW FUNCTION OF DISTRIBUTION AUTOMATION SYSTEM (DAS)

W. N. S. E. Wan Jusoh*

M.A. Mat Hanafiah, M.R. Ab. Ghani, A. Jidin, S.H. Raman

Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka (UTeM), Durian Tunggal, Melaka, Malaysia

B010810285@student.utem.edu.my, ariff@utem.edu.my, dpdruddin@utem.edu.my, auzani@utem.edu.my

Abstract--In this modern world, demand for electricity is in need continuously. Such this requirement is to be fulfilled every time. Electrical distribution system is where the electricity supply is received every time. This proposed intelligent system is based on a novel modeling and algorithm and the software support system. If any electrical zone is in faulty, all operational tasks will be handled by a non-expensive distribution automation system through it intelligent RTU by providing the best solutions without human intervention. Only Intelligent RTU together with the SCADA is capable to perform intelligent decisions on the distribution automation tasks. An intelligent Microcontroller based RTU for distribution automation system is proposed to innovate and renovate the downstream part of the power distribution system including the most advance communication networking system. This method utilizes automation concept of creating an intelligent RTU through modification and innovations.

Keywords--RTU algorithm; intelligent microcontroller; SCADA; Software; Communication networking.

I. INTRODUCTION

An RTU as a title implies, is a standalone data cquisition and control unit which monitoring and control equipment at some remote location from the central station. The functions of RTU can be categorized as follow [1]:

- Acquisition of information such as measured values, signals, meter readings.
- Transmit commands or instruction (binary plus type or continuous), set points, control variables and monitoring as a function of time
- Recognition of changes in signal input states plus time data allocation and sequential recording of events by central computer
- Processing of information transmitted to and from the telecommunication equipment such as data compression, coding and protection.

A. Overview of new function of DAS

New Function of DAS which is power quality monitoring at Distribution Networks such as primary substation, distribution substation, switching station, automated switches that was installed either overhead or underground distribution line, high/low voltage customers and distribution transformer. Table 1 explained the Power quality problems, they are:

Table 1: Power Quality Problem [2]

Problems	Explanations
Voltage sags (dips)	• Reduction in voltage for a short time • Duration: less than 1 min but more than 8ms (0.5 cycle) • Magnitude reduction between 10-90 percent of the normal root mean square (rms) voltage at 60Hz
Voltage swells	• Momentary over-voltage • Voltage variations exceed 110% of nominal voltage and last for less than 1 minute • Less frequently than voltage sags • Long duration over-voltage • Major cause: capacitor switching, the dropping of load and missetting of voltage taps on transformer • Side cause: single line to ground fault
Under voltage	• Voltage drop below 90% of nominal voltage for more than 1 minute • 'Brownouts': non-technical term (should be avoided) – recognized by end users when their light dim and motor slow down

Interruption	• Complete loss of voltage (drop to less than 10% of nominal voltage in one/more phase
	• IEEE defines three type of interrupt:
	  ➤ Momentary
	  ➤ Temporary (short duration)
	  ➤ Long duration (sustained)

| Voltage unbalance	• Deviation of each phase from the average voltage of all three phase • Can calculate the voltage unbalance ratio equals maximum deviation from average voltage divided by average voltage multiples (100%)
Voltage fluctuations	• Rapid changes in voltage within the allowable limits of voltage magnitude of 0.95 to 1.05 of nominal voltage • Cause: incandescent and fluorescent light blink rapidly (flicker) • Change in light intensity occurs at frequency 6-8Hz • Visible to human eyes
Harmonics	• Major source of sine waveform distortion • Increased use of nonlinear equipment can cause harmonic to common • Integral multiples of fundamental frequency of sine wave, harmonic are multiples of 60Hz fundamental voltage and current • Cause: nonlinear load (examples: adjustable speed drives, solid state heating controls, switched mode power supplies in computer, static Uninterruptible Power Supplies (UPS) system)

B. RTU DA System
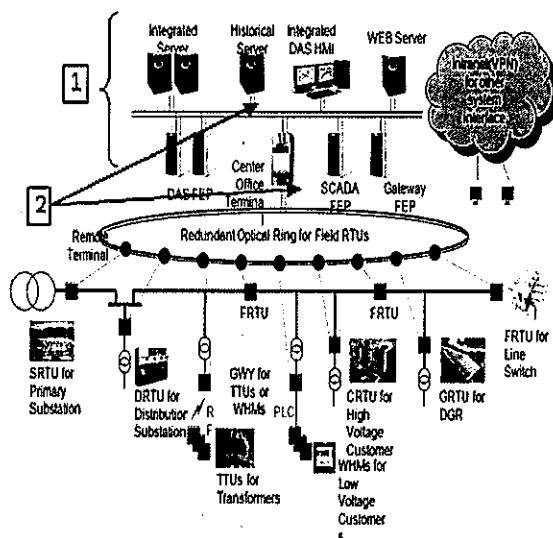
Figure 1: RTU Distribution Automation [4]

DAS main parts:

1. CCS (Central Control System)
• Has complex configuration with dual server with raid 5 clustering dual HDDs, 2 HMIs and FEPs.
• This system use window 2000 as operating software MS SQL servers as DBMS and middlewave

2. *Communication media* between CCS and Optical Fiber because high reliability and fast transmission.

But

If utility only use SCADA function without file transfer, it can just use wireless or power line carrier as a communication media

3. The RTUs

Depends on where they are used for, so far they are installed at seven critical places as explained in Table 2:

Table 2: Seven kinds of RTU [3]

Type of RTU:	Description:

FRTU (Feeder RTU)	• Installed in control box of automated switch
	• Function:
	  ➢ Collects analog data (voltage and current in 3 phase)
	  ➢ Transfer digital data (on/off status, fault indicator detection, voltage phase missing and angle mismatch of automated switches.

SRTU (Substation RTU)	• RTU for primary substation
DRTU (Distribution RTU)	• RTU for distribution substation/switching station
CRTU (Customer RTU)	• RTU for medium voltage customer
TTU-M (Transformer Terminal Unit – Master)	• Master of transformer terminal unit in secondary side of medium voltage or low voltage transformer • It for monitoring pole mounted transformer use RF (Radio Frequency) and digital electronic meter (WHM) in low voltage customer
WHM	✓ Digital Electronic Meter for AMR is installed in low voltage customer

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	**For AMR (Automate Meter Reading) use power line carrier (PLC)
GRTU	✓ RTU for distribution generator

II. CONCLUSION

In this modern world, demand for electricity is in need continuously. Such this requirement is to be fulfilled every time. However, one cannot expect to get electricity every second in the every hour continuously. Electrical distribution system is where the electricity supply is received every time. Substations supply electricity to the distribution system includes [6]:

- No proper protection system for the distribution system
- No automation system for the distribution system
- If fault occurs, it depends solely on human intervention, this practice takes long time and it involves the cost of intervention itself
- Neural conductors are made of copper which are susceptible to thefts
- If fault occurs to the system, the transformer must be disconnected otherwise over-voltages will result the transformer will be overheated and burned

All of the above problems can be solved by proposing non-expensive intelligent distribution automation system.

ACKNOWLEDGMENT

REFERENCES

[1]   M.M. Ahmed, Supervisory Control and Data Acquisition System based customized Remote Terminal Unit for Distribution Automation System, *IEEE International conference on Power and Energy (PECon 08), December 1-3, 2008, Johor Bharu, Malaysia.*

[2]   H. Lee Willis et all, Electric Power Distribution and Reliability, chp2 Reliability Metrics and Indices, 2009, pp.41-50

[3]   Robert Uluski, Communication for distribution automation, Power grid international and power electrical light, 2012

[4]   IEEE Power Engineering Society, "Specification and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control", *IEEE Std. C37.-1995, IEEE Standard Definition, New York, 1994, pp-12.*

[5]   Krisna, C.R, Pandurangam, J.V., Clinard, K.N, Krishna Rao, M.V. and Peri, R., "Development and Evaluating of a Distribution Automation System for Indian Utility", *IEEE Transaction on Power Delivery, 1995, Vol. 10, No.1, pp.1*

[6]   Lee, Heung-Jae and Park, Y.M, "A Restoration Aid Expert System for Distribution Subsations", *IEEE Transactions on Power Delivery, 1996, Vol. 11, No. 4, pp 1.*