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Session 5A **Session 5B** **Session 5C** **Session 5D**

Session 5A - Day 3, 22nd May 2014 (Thursday)
Smart Grid Operation, Control and Protection
Room : Room 1
Time : 2.00 p.m. - 3.30 p.m.
Chair : Jasronita Jasni

2.00	**Minimum Load-Shedding Calculation Approach Considering Loads Difference** *By: Zhiqiang Wang (North China Electric Power University, P.R. China); Lei Guo (North China Electric Power University, P.R. China); Kan Wu (North China Electric Power University, P.R. China); Wenxia Liu (North China Electric Power University, P.R. China); Jinghong Zhou (Economic Research Institute Jilin Electric Power Company Limited, P.R. China)*
2.15	**Probabilistic Framework for Evaluation of Smart Grid Resilience of Cascade Failure** *By: Sudha Gupta (University of Mumbai, India); Faruk Kazi (VJTI-Mumbai University, India)*
2.30	**Integrated Scheduling for Intelligent Regional Grid Based on Differential Evolution** *By: Lingyun Wang (IBM Research China, P.R. China); Weida Xu (IBM RESEARCH CHINA, P.R. China); Kexu Zou (IBM RESEARCH CHINA, P.R. China); Xinjie Lv (IBM, P.R. China); Feng Gao (IBM, P.R. China); Wenjun Yin (IBM, P.R. China)*
2.45	**A Human Machine Interface(HMI) Framework for Smart Grid System** *By: Siti Hajar Binti Raman (Universiti Teknikal Malaysia Melaka, Malaysia); Datuk Prof. Dr. Mohd Ruddin Ab Ghani (UTeM, Malaysia); Mohd. Ariff Mat Hanafiah (Universiti Teknikal Malaysia Melaka, Malaysia); Wan Nor Shela Ezwane Wan Jusoh (Universiti Teknikal Malaysia Melaka, Malaysia)*
3.00	**Short-Term Load Forecasting for the Electric Bus Station Based on GRA-DE-SVR** By: Xiaobo Xu (North China Electric Power University, P.R. China); Wenxia Liu *(North China Electric Power University, P.R. China); Xi Zhou (North China Electric Power University, P.R. China); Tianyang Zhao (North China Electric Power University, P.R. China)*
3.15	**Impact of Electric Vehicle's Integration into the Economic VAr Dispatch Algorithm** *By: Hossein Zeynal (KDU University College, Malaysia); Yap Jiazhen (Northumbria University, United Kingdom); Brian Azzopardi (Malta College of Arts, Science and Technology (MCAST), Malta); Mostafa Eidiani (Khorasan Institute of*

A Human Machine Interface (HMI) Framework for Smart Grid System

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Abstract— Smart Grid is a progressively important function in the electricity delivery system. Smart grid is requiring increasingly refined communication media. The system described in this paper consists of a human machine interface (HMI) which will monitor various physical activities that occur at Smart Grid. The HMI is designed using SCADA package software. The proposed system is using GSM as communication media that has the benefits of being simple in its scheme which supports to the complete low cost. The originality of the work lies in the low cost method. The proposed system is capable of transferring and receiving signals with the additional advantages of response tool.

Index Terms—Smart Grid, Supervisory Control and Data Acquisition (SCADA), Human Machine Interface (HMI).

I. INTRODUCTION

The term of 'Smart Grid' refers to a modernization of electricity distribution system that able to combine the action of all users (generator and consumer) linked to it. So that, smart grid is able to effectively transfer sustainable, safety and economic electricity supplies. In addition, the components that should have in Smart Grid are productive services and products together with intelligent controlling, monitoring, self-recover and communication technologies in order to:

-enhanced easy operations between the operation and connection of generators of all types and technologies

-allow consumers to involve in improving the operation of the system.

-deliver enhanced levels of security and reliability of supply.

-offer consumers with more choice and information of supply.

-can decrease the environmental effect of the whole electricity supply system.

Smart grid architecture must include technology, environmental effect, commercial and market considerations, regulatory outline, ICT (Information & Communication Technology), standardization usage, migration plan and societal desires and governmental edicts.

Clearly, smart grid is the solution to fulfill the aim of the electricity user and societal which is to:

-controlled network prices: with incentives for the most proficient use of the network organization.

-safety of supply aims: with the aim of having uninterrupted electricity supply.

-long term sustainability : CO_2-emission decrease[1-2].

Generally, smart grid is consists of an intelligent power generation, transmission and distribution system that manage electricity demand in sustainable, economic and reliable manner and develop on advanced infrastructure. Figure 1 and Figure 2 are shown the difference structure between the conventional power grid and the smart grid.

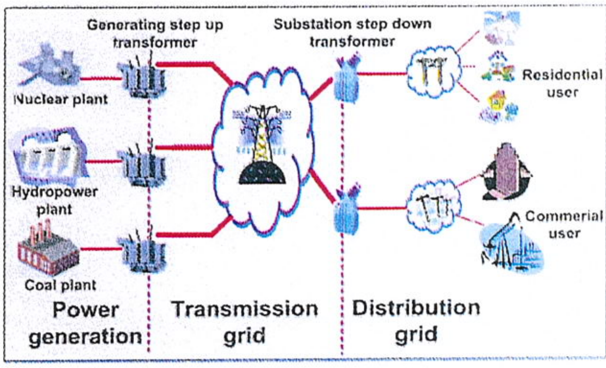

Figure 1: An Example of the Conventional Power Grid [3].

Usually, electricity is generates by converting the potential energy available in certain material (e.g. coal and nuclear) into electrical energy by electromechanical generator. This process is occurring at large power generating plants that located away from higher populated zones. Then, the electric power generated by these plants is transferred to power transmission grid through step up transformer. The transmission network transfers the power at the long ranges to substations. After that, the power is stepped down to distribution level voltage once arrive at the substation. Finally, after reach at the service site, the power will through the step-down transformer again to obtain the required service voltage(s).

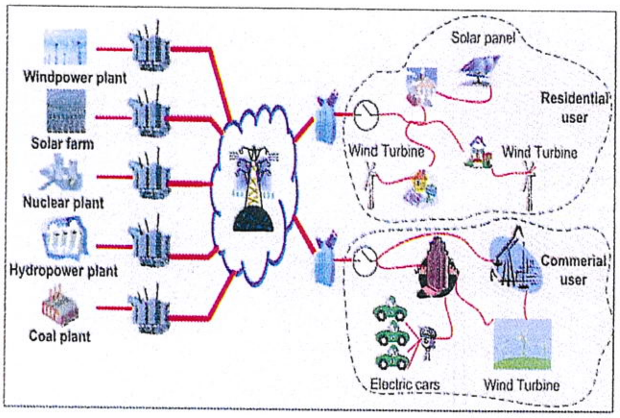

Figure 2: An Example of the Smart Grid [3].

However, in smart grid, the energy generation and transmission is more flexible. Generally, it is divides by two parts which is macrogrid and microgrid. The macrogrid refer to the conventional power grid where the microgrid refer to the distribution side that able to generating electricity using renewable energy sources such as wind and solar through distributed energy generations[2]. Moreover, smart grid is provides highly consistent electric power supply because have the multiple distributed generator and the microgrid that able to function independently when disconnected with the macrogrid.

Besides, the function of smart grid is self-healing, consumer participation, resist attack, high quality power, accommodate generation options, enable electricity market, optimize assets an enable high penetration of intermittent generation sources [4]. But, one of the challenges in the move towards an intelligent electricity supply system smart grid based is the nature of the connections between the transmission and distribution networks. Because of the tremendously changing nature of network consumers, it make the electricity generation is becoming less controllable and the electricity consumption is become high. So that, the changes must be made in the architecture and technology used for the transmission distribution networks and also their system communication [1-2]. By implementing SCADA in Smart Grid, this is one of the technologies to resist the challenges. Infrastructure like electricity which is controlled by SCADA can play a big role in smart grid [2, 4].

One of the main features in implementing the Smart Grid for power supply system is the need of very efficient and user friendly of HMI for SCADA. And, this paper focus on developing a HMI by using Indusoft Web Studio (IWS) software which will show the type of framework that needed for SCADA application in smart grid.

II. OVERVIEW OF SCADA

In term of SCADA, Supervisory Control means giving an operator the ability to control processes and equipment without having to run out in the field and do everything manually. Besides, Data Acquisition means collecting process information from all over plant, display it, and storing it for future reference [7].

SCADA works by transferring data that collected by the field devices interface (e.g. remote terminal unit (RTU) or programmable logic control (PLC)) that allocate at electrical distribution system and the devices is transmitted the data to master station that consist of HMI[5-6].

Components of SCADA [7]:

- Field devices interface

Field devices interface is divided by remote terminal unit (RTU) or programmable logic controller (PLC). They are function to change electronic signals received from field data interface devices into the language (known as communication protocol) used to transfer data over communication channel.

In the propose system, it used RTU due to the needed of wide range coverage for smart grid [8-12].

- Communication system

Communication network means the equipment needed to transfer data to and from different sites. Table 1 shows the difference type of wireless system for communication media in SCADA.

Table 1: Possible wireless technologies for Smart Grid[13].

Wireless Technology	Data Rate	Approximate Coverage	Potential Smart Grid Applications
Wireless LAN	1-54Mbps	100 m	Distribution protection and automation
WiMAX	70Mbps	48 km	Wireless Automatic Meter Reading (WMAR)
GSM	60-240Kbps	10-50 km	SCADA and monitoring for remote distribution
ZigBee	20-250Kbps	10-100 m	Direct load control of home appliances
MobileFi	20Mbps	Vehicular Std.	Communication for PEVs and remote monitoring
Digital Microwave	155Mbps	60 km	Transfer trip (point-to-point)
Bluetooth	721Kbps	1-100 m	Local online monitoring applications

In the proposed system, it used GSM as communication media because it has low transmission bit error rate, low cost, wide signal coverage and high level of security[14].

HMI

HMI software divides by two types which is Visual Basic (VB) software and SCADA packages software. Examples of SCADA software packages have in the market such as Indusoft Web Studio by An Invensys Company, InTouch by Wonderware Company, WinCC by Siemens Company, RsView by Rockwell Company and others. SCADA packages are one of quicker and easier HMI application development.

III. HMI FRAMEWORK

This section introduces Indusoft Web Studio which is the software to program the HMI in SCADA applications.

The HMI offers the shot required between the operators, who works in the control room that far away from field sites. The HMI system represents the interface between human (operators) and field sites components. There is an interface between the operator and Indusoft Web Studio and an interface between Indusoft Web Studio and RTU. The RTU is the component that controls the process.

The HMI system able to allow the operators to visualize all the function as the system is operating. Consequently, HMI need to have monitoring and controlling screen (as shown in Figure 3) to make the operators able to control the process without go to the plant. E.g. the operators can change set points value or turn off/on relay through the HMI screen.

Besides, the HMI must be able to have log-in application (as shown in Figure 4) to make sure only the responsible operators or engineers can run the HMI.

Then, Figure 5 is shows the trending screens to display the parameter value (e.g. voltage or current) that measure by sensors. This screen also allows the operators and engineers to view the data and able to detect problem before the fault occur.

Besides, Figure 6 is shows the alarming screen which is function to alert the operators when a critical condition is occurs.

Finally, Figure 7 is shows the archiving screens to save the previous data.

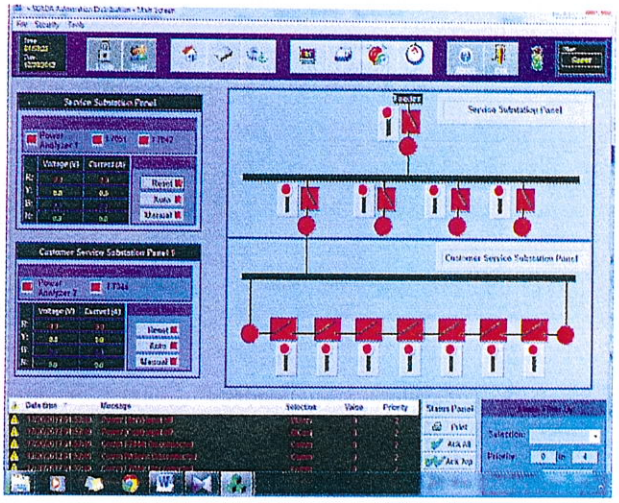

Figure 3: Monitoring and Controlling Screen

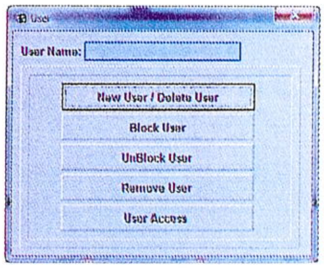

Figure 4: Log-in Screen

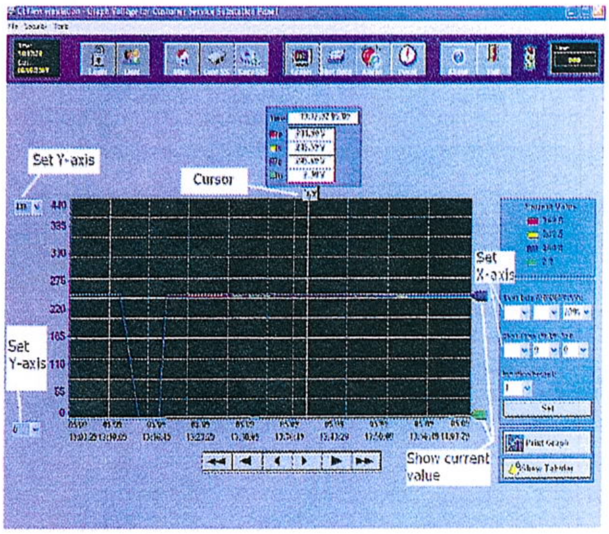

Figure 5: Trending Screen

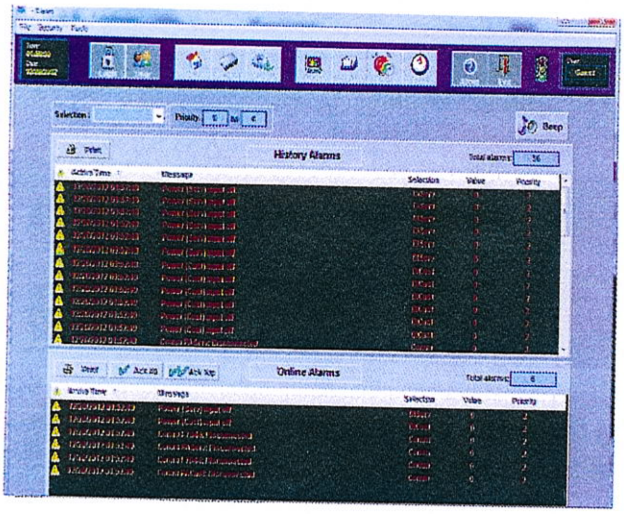

Figure 6: Alarming Screen

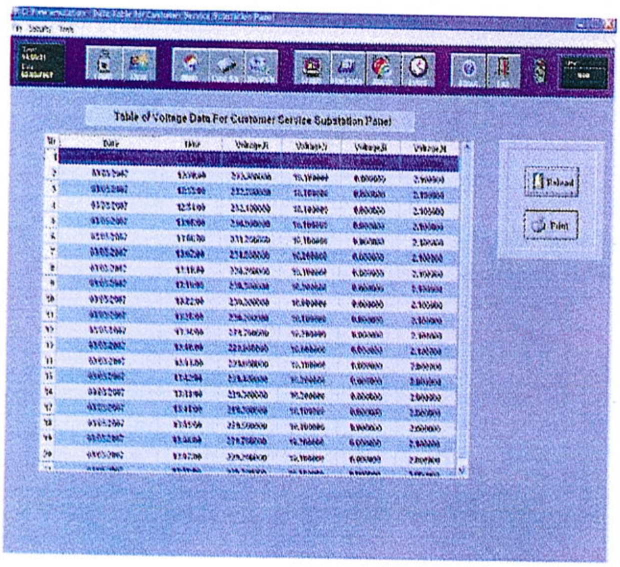

Figure 7: Archiving Screen

IV. CONCLUSIONS

This paper is contributed to implement SCADA application for smart grid and using GSM as communication media. This paper also proposed the type of HMI layout that needed for SCADA such as monitoring and controlling, logging, trending, alarming and archiving screen. In contrast, there are more advantages by implementing SCADA such as increases reliability through automation, eliminates the need for manual data collection and enable operators to quickly spot and address problems.

V. ACKNOWLEDGMENT

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