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Solution to support remote control and monitoring in operating unmanned substations via the internet

[(1)]Dang Ngoc Trung, [(2)]Tran Thi Thanh Hai
[1,2]*Thai Nguyen University ofTechnology, Thai Nguyen, Viet Nam*
Corresponding Author: Dang Ngoc Trung

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ABSTRACT: Deploying the model of unmanned or semi-manned substations, remote control centers is an inevitable direction to automate and modernize the power system, build a smart grid, and contribute to improving energy efficiency. labor productivity, reduce costs, increase system efficiency, ensure safe and uninterrupted power supply. The station control system is designed based on international standards to ensure openness, convenience for replacement, expansion, upgrade, reliability, and high independence. When a single control device fails, other components will not be affected. This paper has proposed a structure for communicating control signals and monitoring terminals in an unmanned substation over the internet with a monitoring interface designed on Visual studio. The research results are verified through experimental models.

KEYWORDS: Smart Grid, Unmanned Substation, Automatic Substation, , Intelligent Controller, Intelligent Substation.

I. INTRODUCTION

Today, the world's science and technology is increasingly making remarkable achievements, especially the applications of 4.0 technology that are gradually being put into production. In recent years, one of the typical researches and applications can be mentioned is the construction of a Smart Grid with automation in the field of power generation, which brings many benefits such as: power quality, loss reduction, labor reduction…[2], [3], [4].

Building remote control centers and unmanned substations in the field of smart transmission grids, set out to solve the current problem of the increasing number of substations, it is necessary to upgrade improve transport operation capacity through computer-integrated systems, improve athletes' professional and professional capacity, computer-based physical manipulation, and reduce transportation costs. Substations need to be centralized into one or more centers to easily monitor, manage transport operations, and coordinate work in the transmission and distribution grid and minimize the impact of errors due to operation. caused transport [1].

The remote control center acts as a central control system to control substations designed and installed according to the model without an operator on duty at the station. The remote control center will control the opening and closing of electrical equipment at the remote control centers. The current and future trend of building remote control centers will operate the entire power transmission network from 110kV, 220kV to 500kV including substations, power transmission grids, etc. At the same time, also create a link between remote control centers and remote control centers with other regional dispatching centers.

The unmanned substation directly acts as the base connection points to remote control centers. The direct unmanned substation is equipped with highly automated control and protection devices such as a self-diagnostic computer control system, the ability to open and close a single compartment or the entire substation. on a single command station, continuous security and image monitoring systems, thermal monitoring systems for equipment, thermal sensors for automatic lighting reference opening and closing. Directly unmanned substations and remote control centers form a single central file system and electrical system operation.

To perform the control & monitoring function, the control system needs to be installed with a complete set of software written in a high-level programming language, compatible with the latest popular computer systems and operating systems of the company. Server. Moreover, to

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facilitate the expansion of connection with protection control equipment of different manufacturers; then the communication procedure between these devices must apply the IEC 61850 standard. Currently, control and monitoringinformation from the local or regional power system control center to the stations is transmitted via fiber optic network.

This article proposes a solution to support remote control and monitoring in operating TBAKNT via the internet, on the basis of using Visual Studio monitoring software. Specifically, building the actual control structure and monitoring interface on the real device, the digital relay SEL-751A, to illustrate the problem of fault operation simulating the maximum current at a single phase at the substation. no one on duty.

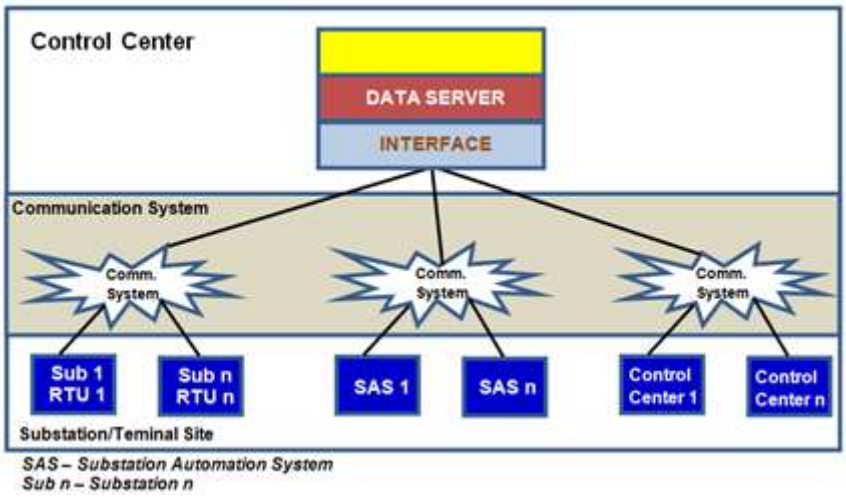

Figure1. Structure of central control system

II. INTRODUCTION TO SCADA/EMS MONITORING SYSTEM AND SEL-751A DIGITAL RELAY

According to research [5], currently, unmanned substations are equipped with SCADA/EMS monitoring systems to help operate, accurately handle and monitor all situations of the power system intuitively and reliably. In SCADA/EMS system, RTU terminal, Gateway is a very important element. It is important to collect and reflect the status of the equipment participating in the operation in the power grid. It is the first step in the entire information processing process of the SCADA/EMS system.

- To ensure the quality of the SCADA/EMS system, it is required that RTU terminals have the ability to operate continuously, stably and with the highest accuracy.
- The main function of SCADA/EMS is control, monitoring and data acquisition/management of the power system, built on the basis of a telemetry system.

SCADA (Supervisory Control And Data Acquisition) is an automation technology that controls SCADA is the process of collecting real-time data from objects to process, represent, store, analyze and control those objects. that object. A SCADA system has the following basic structure:

- Remote Terminal Unit (RTU): remote terminal – performs processing and control tasks in real time.
- Master Terminal Unit (MTU): coordination center, performing high-level control and data processing in real-time. One of the basic functions of the MTU is to provide the human-observer interface with the system.
- Communication System (CS): communication channel needed to transmit data from distant locations to the MTU and transmit control signals to the RTU.

EMS (Energy Management System) can be understood as a set of tools that allow system operators to analyze, evaluate, and make decisions on power system control. EMS is used at dispatch centers, because EMS always requires access to data collected from the real system and the EMS itself participates as a part of the SCADA of the power system, so the term is used. SCADA/EMS.

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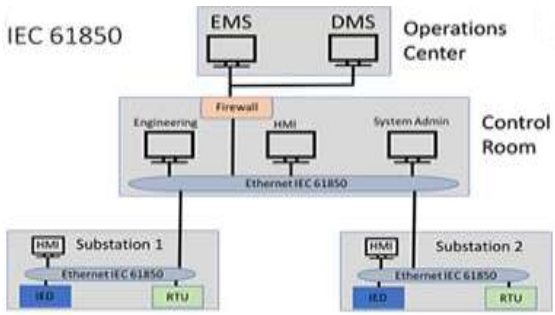

Figure 2.SCADA monitoring with IEC 61850 at substations

SEL-751A is a Relay designed for load protection, busbar or transformer etc. The basic functions of the Relay are: fast tripping protection, time dependent overcurrent protection, voltage protection functions and some optional functions including frequency protection. All models of the SEL-751A have a screen to monitor the above functions.

III. BUILDING SOLUTIONS FOR CONTROL AND MONITORING OF REMOTE MOTORCUTERS THROUGH THE INTERNET THROUGH DIGITAL RELAY SEL-751A IN ONLINE STATION OPERATION

Stemming from the current reality, with unmanned stations in general and 110kV stations - West of Thanh Hoa city (Vietnam) in particular, besides the use of signal transmission lines, fiber optic lines and other problems. control devices such as: relays, IDE...for some situations at the station level that are "frozen" without the ability to improve or expand applications such as: detecting failures of the transformer (via voice) acoustic noise or transformer housing temperature), fault detection at connections, circuit breakers, isolators, etc. (through temperature), detection of cracks on the surface of insulation (via camera image))… Therefore, in the operation of an unmanned station at the station level, it is always desirable to add support monitoring control solutions to the management and operation of the stations. From that fact, the content of the thesis proposes the control and monitoring structure to support the 110kV substation - West of Thanh Hoa city via the internet as follows:

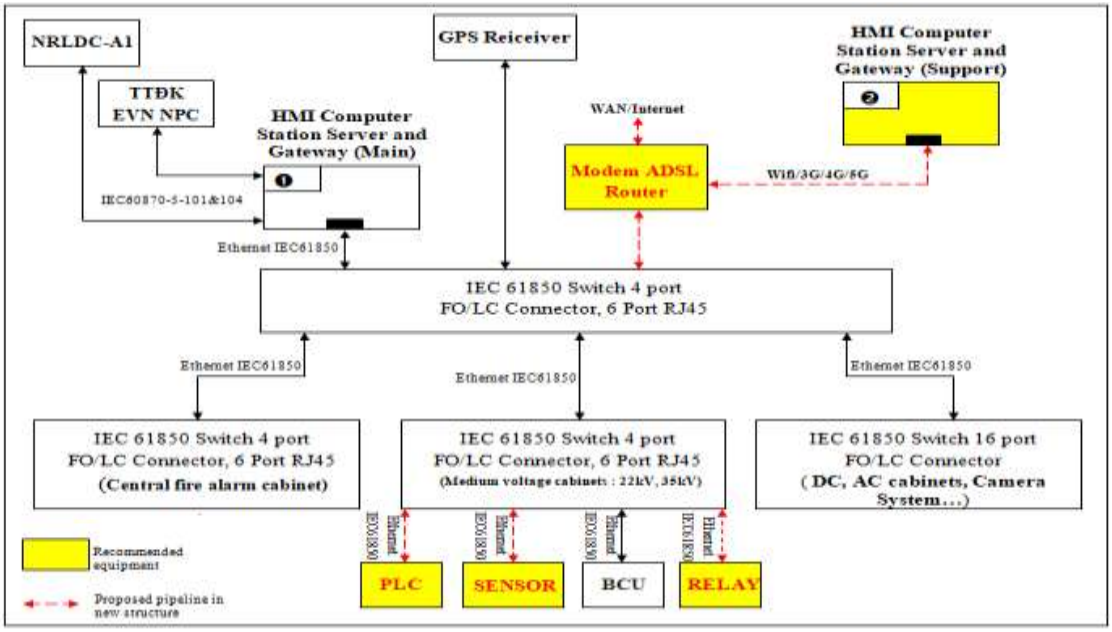

Figure 3. New proposed supervisory control structure for 110kV substation – West of Thanh Hoa city (Viet Nam)

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With the control and supervision structure as shown in Figure 3.5, two parallel monitoring and control channels will be formed. One is: the signals collected and processed at the station will be transmitted via network cable and fiber optic cable to monitor the station's operation, and at the same time send the signal to the regional remote control center and the A1 dispatching center. … Second: on the basis of signals collected and processed during operation from digital relays, BCUs, etc. at medium voltage cabinets, fire alarm cabinets, etc., via ethernet transmission in coordination with optical fiber transmission lines of electricity, the content of the topic has proposed to add additional signals collected through devices such as PLCs, sensors... All these devices are connected to network switches (IEC 61850) from which to participate. On the network connection, the collected and processed signals are sent to the HMI Computer Station Server and Gateway (Support) (HMI(2)) monitoring screen, which works in parallel with the monitoring on the HMI(1) screen.

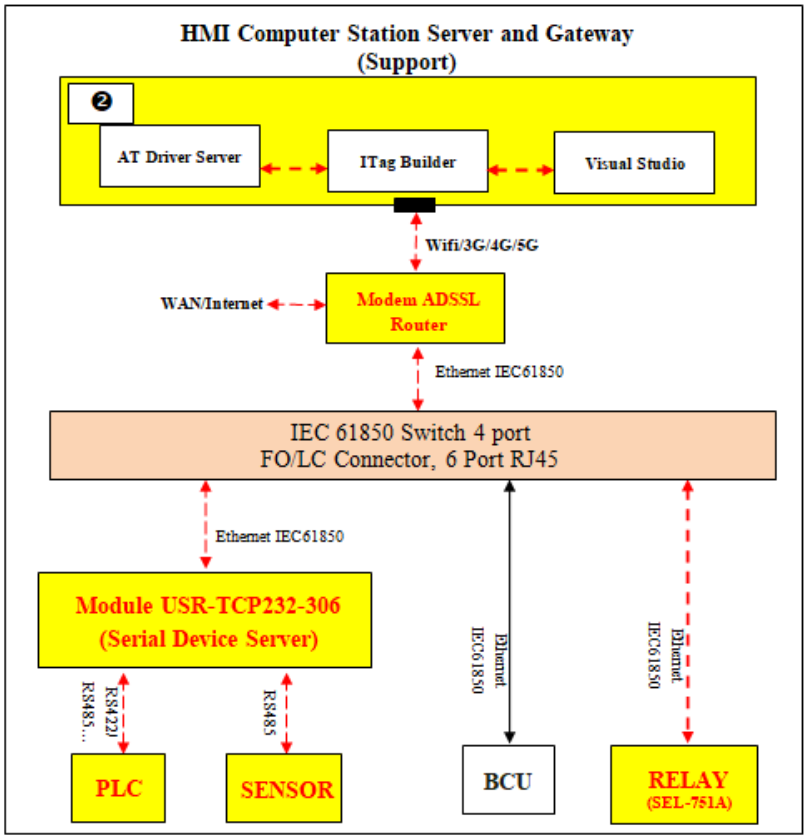

Figure 4. The proposed method of monitoring data collection and processing

According to Figure 4, besides signals from BCUs, Relays, etc., put on the transmission channel via ethernet network cable (actually Modbus TCP/IP signal), the signals from PLC, Sensor... are converted through the USR module. -TCP232-306 from RS232/RS422/RS485 to Ethernet, and then put through the IEC 61850 network switch to connect to the ADSL Router modem and send the signal over the internet to HMI(2). To design the monitoring interface and data collection and processing for HMI(2) using software AT Driver Server, Itag Builder Server, Visual Studio.

In the research limit to illustrate the control and monitoring structure of parallel data and information with optical fiber transmission through the internet, in the article content, it is assumed to build a monitoring model illustrating the protection of data. protection against short-circuit current (50) for phase A 22kV coil of transformer 110kV-T2- West Thanh Hoa city (via digital relay SEL-751A and circuit breaker 432).The experimental model is deployed as shown in Figure 6.

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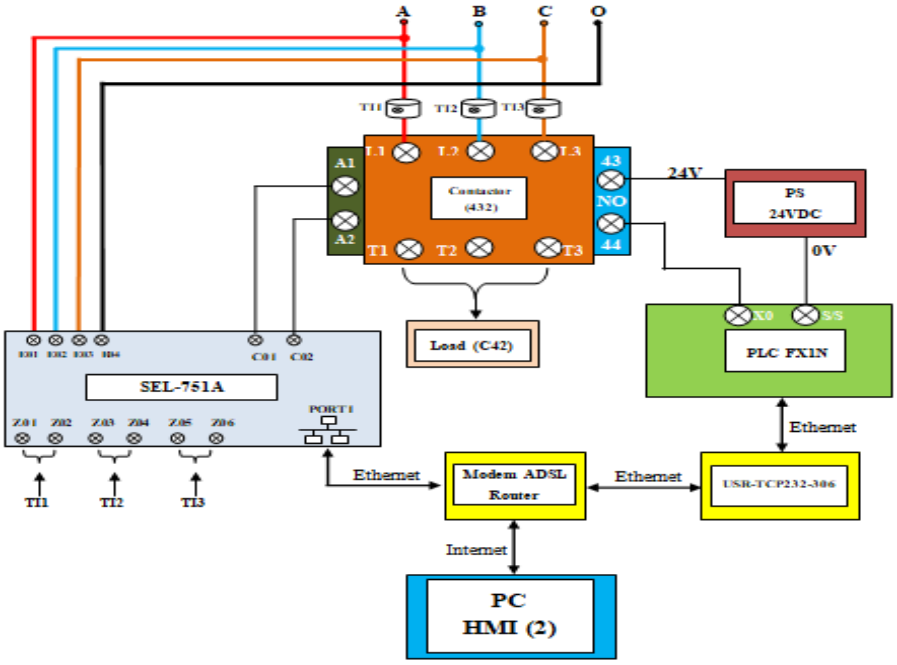

Figure 5. Circuit diagram of the 432 circuit breaker operating model (illustrated) using digital relay SEL-751A

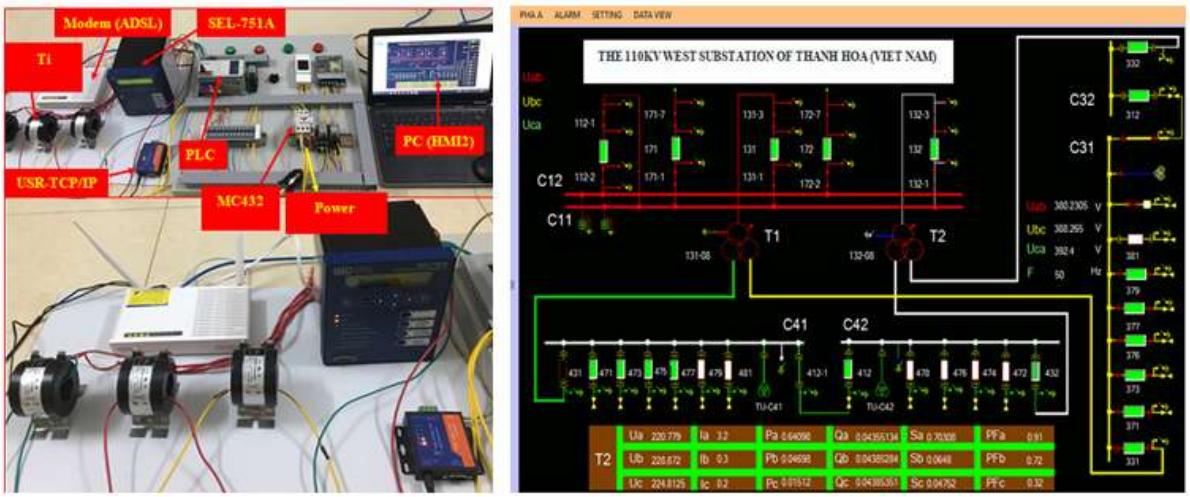

Figure6. Experimental model to verify the proposed solution

IV. CONCLUSION

Through the testing process on actual equipment, we have checked the stability and accuracy of the unmanned substation monitoring and control solution proposed in this paper. By using PLC Mitsubishi FX as the central controller, combined with a monitoring interface built in collaboration with software: Visual studio, Itag Builder, AT driver server has proven the practicality of the solution recommended.

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