REMOTE CONTROL AND MAINTENANCE IN HEATING PLANT WITH USE OF SCADA SYSTEM

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Abstract: In this work, remote control of substation systems in heating plants has been overviewed along with their maintenance with the aid of SCADA system. A special review has been made in consideration of the enhancement and implementation of new systems of remote control and preventive maintenance.

Problems that occur in the process of managing and maintaining substations have been presented and overviewed primarily from the aspect of improving the safety of the system and savings in the power consumption as well as savings in maintenance costs.

The goal which should be achieved with the enhancement, presented in this work, relates to: enhancement of the remote control system, tracking, monitoring and maintenance of the equipment, as well as the use of new technologies.

Key words: REMOTE CONTROLLING SYSTEM, MAINTENANCE, OPTIMIZATION OF THE SYSTEM, ENERGY EFFICIENCY, SCADA, PLC.

1. Introduction

In the last several years, completely integrated systems of maintenance represent a subject that has often been talked about. In practice, these systems are still rare. Complete informational integration of the maintenance system could be achieved only through a mutual database with an unlimited flow of information in the sense of complete visibility of the technical system, maintenance performance and the expressed functionalities of the reporting process [Domanović2008, Szega, M., Rusinowski, H., Bury, Z. 2011]. The fundamental functionality of these systems enable the access to digital technical data (digital technical manuals, interactive diagnostic instructions, electronic work orders, electronic data exchange, data considering the performed maintenance activities, etc.), regardless of the source. This way, the users of information systems of the integrated maintenance IMIS (Integrated Maintenance Information System), by using handheld devices and distributing information in real time from different locations, have a complete insight on the current status of the technical systems, but also, all data from the so called maintenance history. At the same time, users at higher management positions find it easier to plan and monitor the exploitation of the resources [Matijević, M., Mišašinović, V., Tomanović, U., Petrović V., 2005; Ung, G.W., Lee, P.H., Koh, L.M., Choo, F.H., 2010].

Maintaining good practice in the process of managing and maintaining technical systems does not represent an easy and routine task for the management. The reasons for this are numerous, from the concept of maintenance, resources available to the company, development and availability of the management information systems, to the organizational culture and the readiness to introduce and accept changes. It is generally accepted that without software support for the maintenance management there is neither effective nor efficient maintenance. It is not seldom that a maintenance system in practice operates in one stable way, without recurrent lines of the heating grid, as well as monitoring other

2. Material and method

2.1. Remote control with the aid of SCADA system

SCADA system represents a group of purposeful, distributed in space, interconnected computer modules, whose mutual goal is to fulfill the functions of surveillance and/or managing the physical process in real time. Basic function of SCADA system is a cyclical acquisition of digitalized values of different physical sizes that determine the state of a random technological process [Tinham, B., 1990].

By forming the basis of the measured data in the computer, basis for the check and the review of the status of the physical process, that is, for performing efficient supervision on it. At the same time, by applying the installed directing algorithm, it is possible to determine and request the corrective activities, i.e. to manage the physical system.

In heating substations there is a need for measurement and supervision of different sizes and parameters, such as: temperature of the water in the primary and secondary circle, the amount of heat consumed by individual users, status of pumps, status of electric motor valves and electromagnetic valves, distribution of the temperature of initial and recurrent lines of the heating grid, as well as monitoring other
parameters and their transmission to the supervisory and management system at the dispatcher centre. [Zhang, M., Jia, T., Xu, G., Jin, L., Sun, X., 2008; Lakhoua, M.N., 2010].

On the basis of gathered data, calculation of daily energy balance is performed (production and consumption of heat energy, efficiency of the heating plant and heating grid, sold energy etc.), and analysis of individual consumption of every user of heating energy is performed during a randomly selected period. On the other side, internet users can constantly track their own consumption.

Today, the transmission of information and management data in heating systems is realized in several ways: through modern connections in fixed phone grid, GSM modem, with digital radios and through the internet.

3. Results and discussion

SCADA systems consist of several hierarchically separated unities:

- Measuring equipment and executive authorities – gear installed on appropriate devices in the process itself, by which information about performance of the process are acquired and give commands which influence the change in performance.

- Remote M/E (management – executive) modules – enable computer system to be fit with the measuring equipment and executive authorities. In the set of these modules there are elements for communication, as well as operating panels.

- Remote stations – microcomputer controller, which consists of distant modules or is connected to them through appropriate communication lines. The controller gathers measuring signals from entry modules, gives managing signals through exit modules, supervises the status of process equipment and signals the alarms [Ordean, M., Chiorean, D., Rogoz, I., Lehene, C., Stoian, I., Stancel, E., 2006]. Also, the remote stations send the needed information to the central station and take commands from it.

Fig. 2 Complex command-information configuration of SCADA software on example of Heat Plant from Subotica

- Communication system – enables the transmission of information between distant stations and the dispatcher centre. This equipment includes all of the elements used in the forming of industrial computer networks.

- Central station - central computer where supervision and process management are enabled. The supervisory and managing centers are equipped with a PC or some kind of forceful computer system. These computers are supported with the application of the HMI type (engl. Human-Machine Interface) which enables interactive dialogue with the computer for the given system of supervision and management. Depending on the complexity of the entire system, existence of more central stations is possible.

The supervisory SCADA system consists of the central server and client computers.

Fig. 3 Example SCADA monitoring system in Heat Plant Valjevo

The basic guideline in the choice and development of SCADA (Supervisory Control and Data Acquisition) system is to enable the users of the process of integration system with IT and other segments of the IT system and provide them with an open, flexible and multimedia interface support for the measuring of the parameters and managing processes [Lakhoua, M.N., 2009; Prickett, P., Davies, G., Grosvenor, R., 2011].

SCADA application gathers data from the controllers in substations, enables supervision, managing, adjusting and variation of the parameters of the PLC program. Change of the program in the PLC could also be performed remotely. SCADA enables activating the alarm (for example a mistake due to the reaction in the pump protection or a breakdown in communication with the controller), graphic processing of the gathered data, storing data, programming timers (for activating the heating process) for every substation etc. [Dang, T., 2007; Iacob, M., Andreescu, G.-D., Muntean, N., 2009].

Fig. 4 Layout screen with substation process schematics
For regulating the temperature of the heating water in the secondary circle, a curve is used according to which the temperature of the water for the heating is led (Tg) according to the outside temperature (Ts). Controller on the basis of the outside temperature takes the desired value from the curve (Tset) of the water temperature and tries to maintain it at this value by opening or closing the van valves. Every substations has its own curve, and curves could be changed from SCADA.

For the implementation of the given temperature a regulatory circle with a PID loop has been installed. Coefficients of PID regulation could be adjusted manually or adjusted with an automatic procedure for the adjustment. Every PLC in the substation communicates with an MBus protocol with a calorimeter through which conditions for the automatic payment of the debt according to power consumptions have been acquired [Stankov, S., Jovanović, Z., Icić, Z., 2010].

### 3.1. Requirements and expectations when applying SCADA system

When optimizing the system of district heating it is important to observe and carefully analyze the basic elements: production, distribution and users. Potential problems on the side of the user due to inadequate equipment in the process of the necessary regulation are transferred to distribution and production. This interrelated chain reaction of the subsystem creates direct losses and directly reduces the efficiency of the entire system. When preventing and promptly resolving the problems in heating distribution, apart from experience and a well trained technical staff, one should use as logistic support a contemporary and powerful tool (a software package), that will in any given time recognize, diagnose, and provide a quality solution to the problem. Thanks to the efficient systems of supervision and alarms, problems could be resolved even before the user is aware of their existence. For example, if the temperature of the water in distribution is not compatible, the system shall automatically activate the alarm to warn of the enormous energy consumption. The problems will be quickly resolved by using the remote control system [Valsalam, S.R., Sathyan, A., Shankar, S.S., 2008; Dang, T., 2007].

In the systems of district heating there are pumps and regulators that cause significant energy consumption. This fact is of great significance when optimizing grids for district heating. Managing the system based on outer climatic conditions won’t just simplify the managing of the facility, but it will also save power.

Basic conditions that heating substations tied to supervisory system SCADA should enable and which should be taken into account when choosing a particular model are [Lakhoua, M.N., 2009; Lakhoua, M.N., 2010]: remote monitoring of the heating system; remote managing of the system; local regulation; measuring the consumed heating energy; reporting states of emergency and forming reports.

Generally, via implementing the central system of remote supervision and managing through SCADA system one can expect: the delivery of needed (optimal) quantity of heating energy to the system; distribution of heating energy in the economically most efficient way; possibility of quickly adjusting to changing requests of the consumers; possibility of efficiently adjusting to different working regimes; software regulation of the projected flow; acquisition of working parameters.

### 4. Conclusion

In this work the remote control of substation systems has been overviewed along with their maintenance through the example of heating plants. A special review has been made considering the improvement and implementation of new remote control systems, and preventive maintenance as well. The heating substation is an important segment in the system of district heating, because its primary purpose is to provide objects with heating energy of a certain temperature. Therefore, maintainin and properly managing these heating substations is very important and complex, especially when it is heating season.

The goal which could be achieved through improvement, presented in this paper, relates to: improving remote managing systems, tracking, controlling and maintaining equipment, as well as applying new technologies.

Problems that go along with the managing process and maintainin substations are presented and viewed primarily from the aspect of improving the safety of the system and savings, wheter of energy consumption, whether in maintenance costs.

Today, functioning of an industrial process without the aid of automatic control is unimaginable. Sudden technological development in the last few decades has contributed to the development and modernization of the automatization system, and also brought new challenges with which engineers are faced when designing automated control systems. In this paper a thorough description of implementation and functioning of SCADA system has been provided, which represents one of the solutions to tracking activities and managing heating substations.

Implementation of modern supervisory control systems, with a reliable data transmission, provides the possibility of the insight in the complete facility for generating and distributing heating energy, as well as managing it from one place (dispatcher centre), which contributes to integration and synchronization of all subsystems and implementation of the managing algorithms in the purpose of attaining great savings and optimal exploitation of energy resources. Thanks to the implementation of modern telecommunication devices, precision and safety have been provided when transmitting information from remote objects to the dispatcher centre, as well as when transmitting managing signals to local regulators and executive authorities. Supervision and registering all tracked parameters and generating reports in the working mode of devices and equipment have been enabled.

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