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SUMMARIZED INFORMATION FROM MULTIPLE PLANTS IN ONE MONITORING SYSTEM: ADVANTAGES AND DISADVANTAGES ON EXAMPLE OF BOILERS

OBJEDINJENI PRIKAZ INFORMACIJA IZ VIŠE POGONA U JEDNOM NADZORNOM SISTEMU: PREDNOSTI I MANE NA PRIMERU KOTLOVA

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ABSTRACT

Supervisory Control And Data Acquisition (SCADA) systems reached great progress by virtue of the strong development of computer and communication technologies that allow acquisition from distributed places through modern communication networks and protocols, central data processing and presentation on high resolution screens. Summarized information in one monitoring system is the solution that provides material savings. This paper analyzes advantages and disadvantages of this approach with respect to initial costs, maintenance costs and robustness and reliability. It provides real data from implemented system in boiler plant in company Victoriaoil in Šid (Serbia). Data acquisition is configured using WinCC Siemens software. This implementation allows significant savings but preserves high performance of the system.

***Key words**: summarized information, SCADA, data acquisition, boiler plant.*

REZIME

Sistemi za nadzor i upravljanje su prethodnih godina doživeli značajan napredak, pre svega zahvaljujući snažnom razvoju računarskih i komunikacionih tehnologija. Moderne komunikacione tehnologije omogućavaju lako prikupljanje velikih količina podataka iz udaljenih delova sistema putem savremenih mreža i komunikacionih protokola. Zahvaljujući razvoju računarskih tehnologija dostupni su nam brzi i pouzdani server računari na kojima je moguće detaljno obraditi prikupljene podatke. Prikupljeni i obrađeni podaci tada mogu da se prikažu u skladu sa zahtevom operatera na ekranima visoke rezolucije. Softveri za konfiguraciju nadzorno upravljačkih sistema, iako razvijani od strane mnogih kompanija, imaju sličnu arhitekturu i sličan princip naplate licenci u zavisnosti od broja procesnih veličina koje se koriste, broja računara, veza između računara, itd. Jedan od principa koji omogućava značajne materijalne uštede jeste sistem objedinjenog prikaza. Ovaj sistem podrazumeva da se na jednom računaru omogući prikaz podataka iz više posebnih delova pogona ili čitavih sistema. Ovaj rad analizira prednosti i mane spajanja više manjih nadzornih sistema u jedan objedinjeni sistem. Prednosti i mane su analizirane sa aspekta početnih materijalnih troškova potrebnih za inicijalnu izvedbu, zatim troškova i lakoće održavanja ovakvih sistema i na kraju sa stanovišta robusnosti i pouzdanosti objedinjenih sistema. Analiza je rađena na primeru objedinjenog prikaza u nadzornom sistemu kotlarnice. Ovaj sistem je implementiran u fabrici Victoriaoil u Šidu. Nadzor je izveden uz pomoć softvera za interfejs između čoveka i računara WinCC kompanije Siemens. Kao rezultat ovakvog načina prikupljanja i obrade podataka ostvarene su značajne uštede a sačuvana visoka pouzdanost i performanse nadzornog sistema.

***Ključne reči:** objedinjeni prikaz, nadzorno upravljački sistemi, prikupljanje podataka, kotlarnica.*

INTRODUCTION

There is a growing demands placed in front of modern monitoring and control system. It should be reliable, safe, fast, robust and not too much expensive at the same time. Further, today's monitoring system have to be easy for use and user friendly. Furthermore, it must allow operator to have all necessary information in one place (server PC in the control room) presented in desired manner, stored in large and fast databases, accessible in several defined formats and adjusted for on-demand reports. There is available software on the market, developed by different companies, which allow configuration of the monitoring systems that apply all of the above. The most general name for such software is Human-Machine Interface (HMI) and more specific in process industry Supervisory Control And Data Acquisition (SCADA) systems (*Bailey and Wright, 2003; Stuart, 2004*). Although SCADA systems are developed by different companies (Siemens, Schneider, Omron, GE Intelligent Platforms, 3S-Smart Software Solutions, etc.) they have similar architecture and editors, and similar licensing policy. There is however a few variations in license prices comparing with the given performances.

The basic purpose of a SCADA monitoring system is to present all collected data to the operator, especially unnecessary conditions and failures from the plant. For gathering the data, SCADA system is most often relying on the Programmable Logic Controllers (PLCs). PLC is the main control unit in the control system. It collects the data from sensors, transmitters and other field machineries through the digital and analogue inputs and through communication networks.

The information (data from the plant) that need to be reached is often distributed on several distant locations. Wherever this is a case, usual control solution is control at the field. It assumes the local PLC and touch panel at every distributed location.

This paper analyzes the connection possibilities between PLCs each other and between PLCs and SCADA system. Moreover, it presents several tactical choices that we need to make whenever designing SCADA system. The main focus of the paper is to find the best option to collect all necessary information from the distributed PLCs and to deliver it to the operator on PC screens.

MATERIAL AND METHOD

When designing SCADA system first thing is to analyze all the possibilities for collecting the data from the field (sensors and equipment) to the PLCs. It depends to a large degree of the PLC types (PLCs for small scale, medium scale and high performance PLCs) and their hardware configuration (available digital and analogue extension modules). Further, PLC communication possibilities must be considered. Some choices on CPU (Central Processing Unit) type must be made. In some applications additional communication processors must be included in PLC hardware configuration for achieving desired type of communication. During this step special attention needs to be paid to prices of the communication processors comparing with the communication rates and number of signals to be transmitted. The most common industry solutions (*Clarke and Reynders, 2004*) are Multi-Point Interface (MPI), Profibus, Industrial Ethernet, Profinet, optical cables, etc. In most applications CPUs have integrated MPI or/and Profibus and SCADA PCs have integrated Ethernet ports. In this case the choice must be maid whether Ethernet communication processor will be included in PLC or MPI/Profibus card will be inserted in PC. First choice gives us faster communication rates but is much more expansive, especially when the number of PLCs is large. Detail survey of practical connections in process industry with cost analysis is published in (*Nikolić et al., 2009; Nikolić et al., 2010a; Nikolić et al., 2010b*).

When all the information is gathered in the PC control room then the second step is to choose the number of SCADA PCs and their interconnections. The main condition in this step is the number of operators per shift and the number of screens needed for presentation of the process state. Usually, there is a need for one PC for each operator. Today's industrial PCs commonly support two screens, but additional two screens can be added if display card of higher quality is present. The number of PCs is very important. On one hand, reducing the number of PCs will decrease the material costs significantly because SCADA licenses are paid for each PC separately. On the other hand, the more PCs are present the higher redundancy is achieved. Parallel to these conditions, the number of signals to be presented on each PC is significant because the license price depends on that too. Some savings may be achieved by implementing server/client connections between PCs. In this case full license needs to be installed only on server PC, and the lowest license on client PCs. But, for this purpose server operating system must be installed on server PC (much more expensive) and additional server/client license is required. Practically savings are achieved only if there is need for three or more PCs or/and if there is need for a very large number of signals (more than 10,000) per PC. Disadvantage of this approach is that there is no full redundancy present, because server can continue work if client is not functioning but not vice versa. If server stops working all clients are useless. Additional considerations may be included on combination of standalone PCs and server/client groups and also redundant servers may be implemented if needed but on additional costs. Some practical solutions of SCADA systems in process industry is published in (*Bugarski et al., 2007; Bugarski et al., 2008; Bugarski et al., 2009a; Bugarski and Nikolić 2009b; Bugarski et al., 2010*).

RESULTS AND DISCUSSION

One practical solution of SCADA system design is implemented in company for production of raw and refined oils, biodiesel and protein meal Victoriaoil in Šid (Serbia). The whole plant is divided in several distant locations with 17 distributed PLCs and 9 local touch panels. 5 SCADA PCs presents the data from the whole plant gathered with those 17 PLCs. One of the SCADA system is monitoring SCADA that presents summarized information from several distributed boiler plants. Fig. 1 shows the interconnectivity of the PLCs, touch panels and SCADA PCs.

SCADA PC (middle LAN network in Fig. 1) summarizes information from PLCs in boiler plants (middle LAN and lower MPI network in Fig. 1). For communication between SCADA and PLCs Ethernet is chosen because there was existing Ethernet network in boiler part of the plant and because Ethernet is modern and fast communication protocol, broad-based in information technology sector and more frequent in industry. Some of the PLCs are locally connected to the MPI network and through the BoilersB1+B2 PLC cross-linked to LAN. This was the cheapest solution, because no extra communication processors were needed in the PLCs, the number of the signals from those PLCs is rather small and there was no need for fast communication so MPI was satisfying.

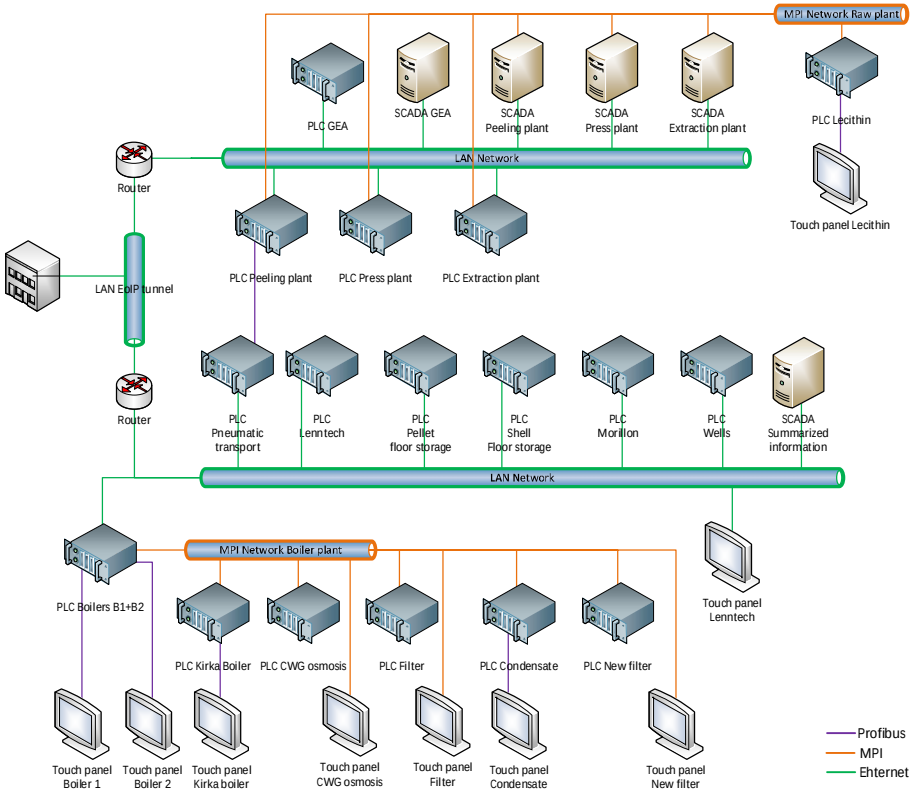

Fig. 1. Interconnectivity of PLCs, touch panels and SCADA PCs in Victoriaoil

It is chosen to use only one stand-alone SCADA PC because of license savings. It is interesting to mention that even several engineers developed separate SCADA applications all of them was joined in one overall summarized information SCADA. SCADA PC has two full HD resolution screens connected and operators can simultaneously monitor two different parts of the

boiler plant on them. Fig. 2 and 3 show parts of the two screenshots of SCADA application. Fig. 2 presents the Boiler B1 part and Fig. 3 presents Kirka Boiler part.

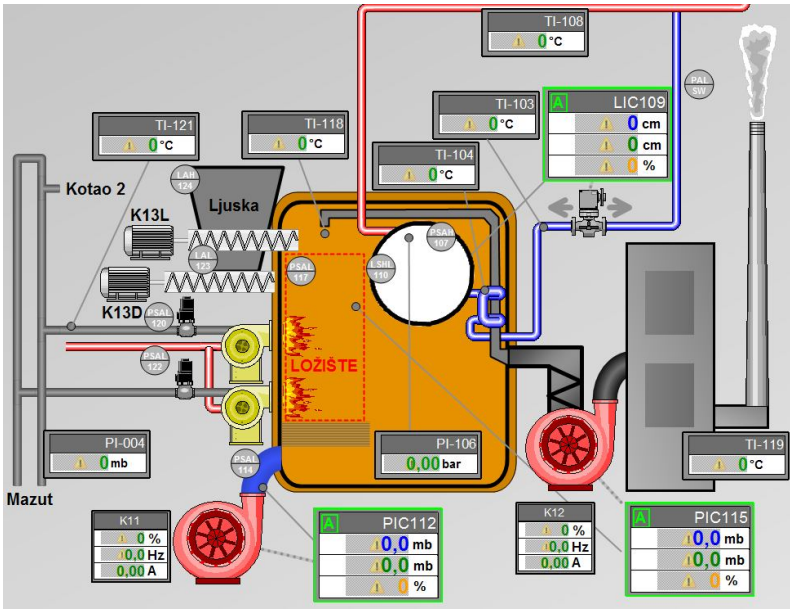

Fig. 2. Screenshot of Boiler B1 part of SCADA

All information that operator needs to monitor is present on these screens. Analogue values are presented in output fields and digital signals are presented with different colors of the machineries. There are additional screens that presents other parts of the boiler process and more screens presenting historical data in the form of tables, graphs and trends. Additional screen is developed for showing the alarm and warning messages and one more for connectivity diagnostics.

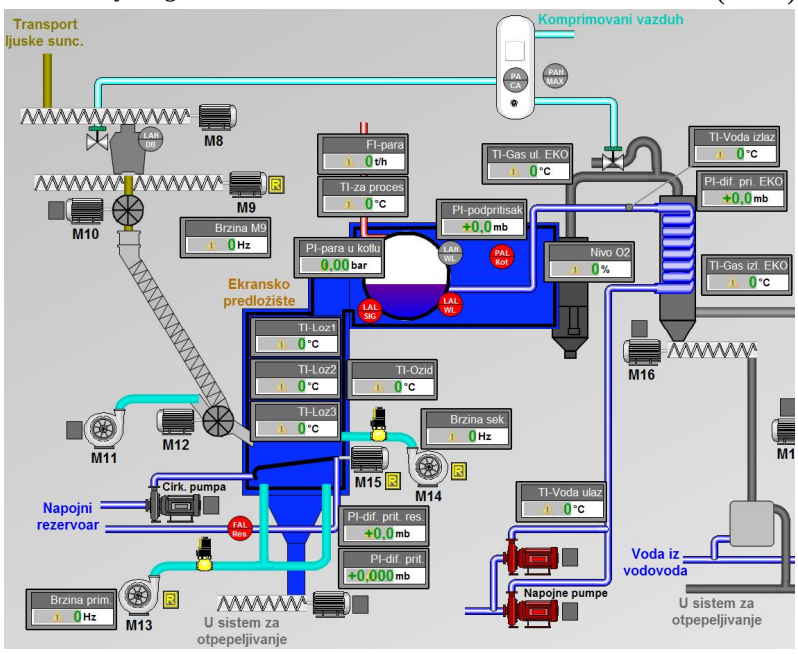

Fig. 3. Screenshot of Kirka Boiler part of SCADA

CONCLUSION

This paper have presented analysis of different ways to design the practical, modern, fast and reliable SCADA monitoring system. Some issues about the choice of network connections, hardware configuration of PLCs and relation of the license prices to PC configuration were analyzed in detail. One practical example of SCADA application installed on one PC in control room in Victoriaoil Company in Šid (Serbia) is presented. Presented design of SCADA system is very good solution for monitoring the summarized information from several distributed PLCs in boiler plant. It joins several independent SCADA applications into one and thus provides license savings. Collection of field data from PLCs is realized through Industrial Ethernet protocol which is fast and safe. Procedure for SCADA choices presented in this paper can be repeated in any other industry application only if the whole procedure is done from the choice of PLC hardware configuration, choice of communication networks, number of PCs and screens, selection of license types and operating systems.

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