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Issues of Semi-automatic Air Processing using a DCS System

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It's well known that trends worldwide are towards automation. We look for having automatic, or worst case semi-automatic, processes, systems, machines, with the purpose to produce a finished good in the shortest time. Consider we have a semi-automatic system used to obtain air separation. The entire system is 'supervised' by a so called DCS (Distributed Control System) with the role to command several vanes with different functions. Human factor interferes with DCS only for digital data input. The system converts digital information in analogical signals in order to control pressure or flow. The issues of interest addressed in the present paper concern losses and gains brought by automation for this particular case of study.

Keywords*: vane, semi-automatic, distributed control system, air separation*

1. Introduction.

General direction in industrial field of any nature relates to obtaining a product in the shortest time, with minimal costs. In today's competitive production environment, process industries demand a totally integrated control and optimization solution that can increase productivity, reliability, efficiency, safety, quality and other characteristics of industrial control systems [1]. Owners are driven to search for solutions to improve their competitive edge and to enhance their return on investment.

Therefor automation and automatic systems are imposed in industrial field of any form. There are two types of known systems used for automatic plant control: programmable logic controller (PLC) and distributed controlled system (DCS). The majority of process plants today have both DCS for core processes and PLC for non-core process functions installed for controls [2].

2. Distributed controlled system (DCS) in industry field

The DCS from its construction has been conceived for configuration, using standard control entities that are automatically bind to a convenient faceplate, thus driving to standardization. For configuring a card, everything required is to connect it to a field point and apply alarm logic, history, version control and other functions, gaining time and improving quality. For example, if one has a two input, one output valve, there is a specific function block library so there is no need to create the logic [2].

Consider a DCS for air processing plant. The entire system works altogether in order to obtain, by air separation, oxygen, nitrogen and argon. Mechanism is as simple to the outside, as complex if analyzed in detail. A generic image of processing air assembly is shown in figure 1. The air basically passes through a series of processes which are monitored and controlled by DCS with case of intervention of human factor if needed.

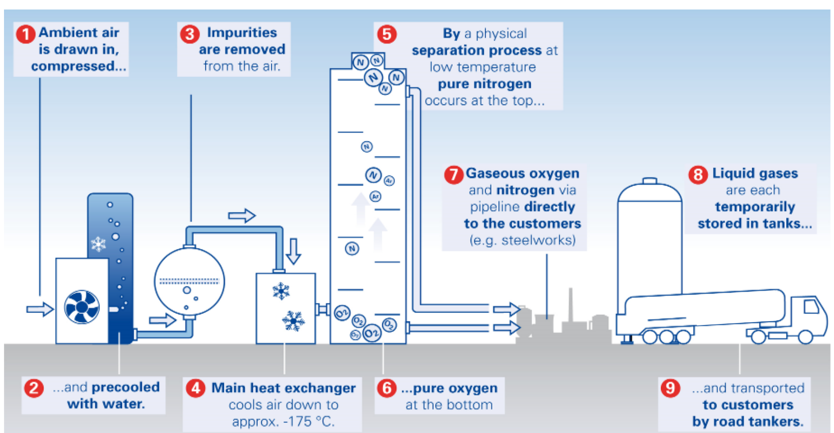

Figure 1. Air separation unit model [3]

A distributed control system (DCS) is assigned to a control system commonly of a process or any form of active system, in which the controller components are distributed throughout the system with each cell sub - system driven by one or more controllers. The complete assembly of controllers is linked by networks for data transmission and devices surveillance, [5]. DCS is a generic terminology used to describe systems that supervise and conduct distributed instrumentation. It is divided in five functional levels: level 1-sensors and control valves; level 2- IN/OUT modules and associated distributed processors; level 3-monitoring computers; level 4-production control; level 5-production scheduling. DCS uses set-point control and feedback loops to monitor and interfere with flow of processing. A schematic feedback loop is shown in figure 2.

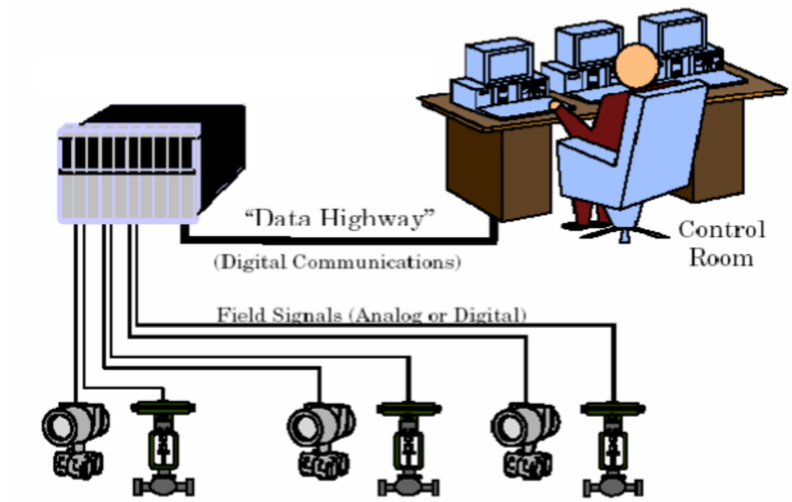

Figure 2. DCS feedback loop [4]

In case of air separation processes, DCS monitors and controls, through six computers, pressure of air and of resulted gasses, flow of gas or liquid, temperature of air, gas, liquid. Over these parameters human factor can interfere. In addition, the performance of equipment is only supervised, through temperature sensors and accelerometers mounted on appliances.

3. Monitoring and controlling process of air separation

DCS for air separation plant processes consists of six workstation, as previously mentioned, two peripherals, five control units and a server, all connected to a network, as presented in figure 3. An overview of components controlled by DCS is shown in figure 4. The assembly of air processing comprise of air compressors, heat exchangers, main engine, water circuits for air cooling, water pumps, oil pumps, air purification station, turbines, vaporizers, storage containers.

Problem formulation is as follows: DCS and human factor controls air production process by collecting information regarding a series of parameters such as requested product quantity(flow control), quality (gas or liquid consistency, purity, temperature, pressure). All these parameters are established and introduced into DCS software as set-points and can be modified at any moment by engineer and are used by DCS in real time.

Production plant follows customer order scheduling and maintains a buffer area. Engineer determines and provides DCS necessary data to actuate upon vanes flaps opening according to ramp-up trend, in order to follow production schedule.

Inputs are digital values, as well as DCS's "response" which is in charge with digi-tal-analogic conversion of the information.

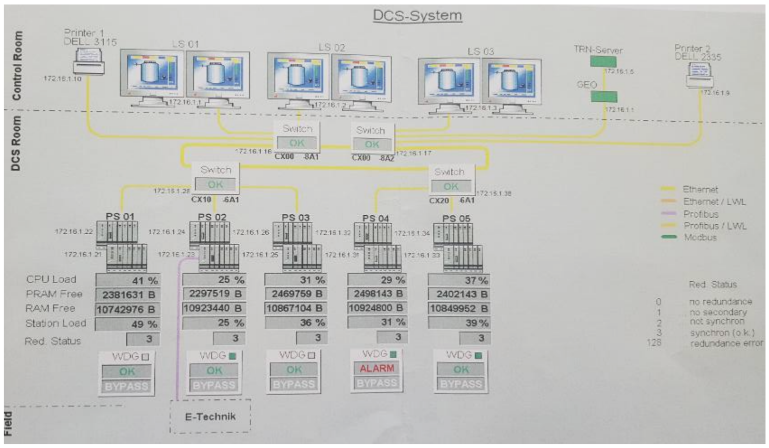

Figure 3. DCS for air separation plant

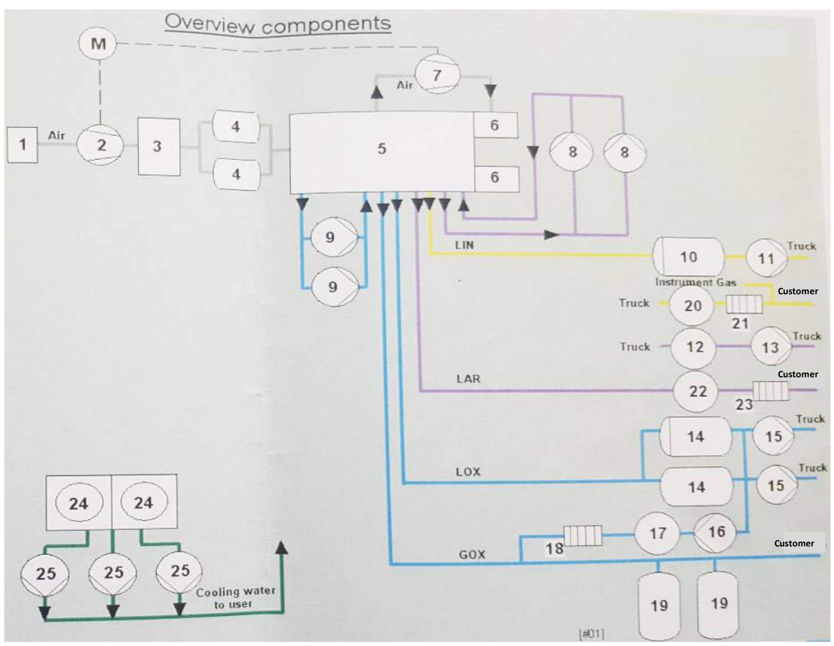

Figure 4. Plant installation for air separation-overview

On the other hand, considering equipment and installation engaged in work flow, parametric values (temperatures and displacements in different positions of apparatus) are only supervised and collected in databases for further trends analyses (figure 5). For these situations set-points are given by equipment manufacturer and introduced in the DCS one time, by engineer, as alarm value and critical value of functioning conditions. Temperature sensors and accelerometers are mounted on most critical locations of machines like engine bearings and windings. Nevertheless, the plant installation is subjected to periodical revision.

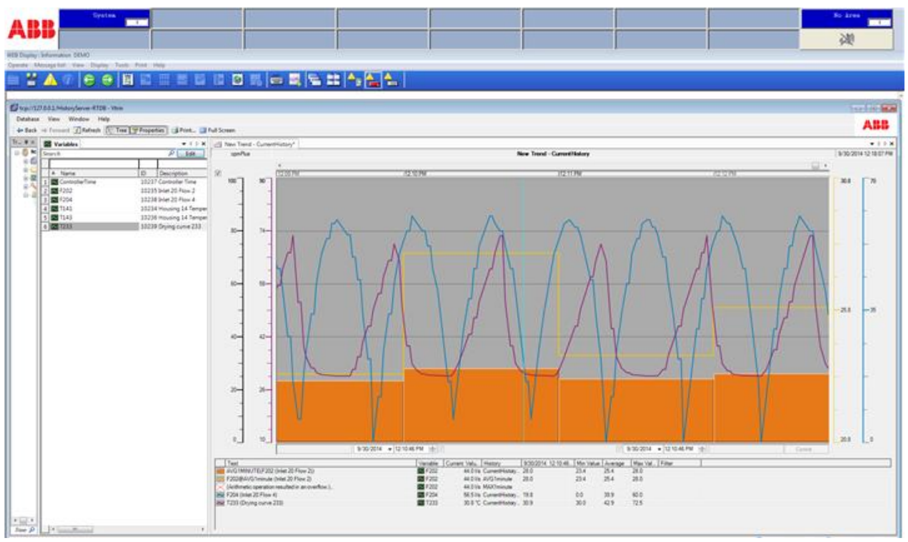

Figure 5. Trends analyze of collected data [6]

There are a couple of issues that can arise at an air segregation plant , related or not to DCS or human factor: inaccurate data value for set-points introduced in DCS's software, sensors crashes, partial or complete of an equipment failure, poor intervention of engineers at DCS alarms.

Nevertheless, one of the most critical issues with a greater impact upon production flow is given by electrical down-times which affect product quality in most situations and occasionally the complete shut-down of production.

By analyzing parametric value collected from the installation DCS is programmed to suppress functioning of a device if values received are not according to standards. Since devices are all connected and interdependent what follows is that all will be shut down one by one and product from installation expelled. All ensues to great losses for company but to the detriment of engaging a costly power supply backup, taking into account that these electrical issues are random and not recurrent. For sure there are situations when human factor presence is imposed and problems can be remediated.

4. Conclusion

There are several industries where automation is imposed and DCS technology has the greatest productivity in monitoring and controlling processes. The use of DCS architecture facilitates plant activity and maintenance and along with process automation shortens production times and risk failures. We have to keep in mind that an automatic process can't function without engineer intervention and, as well as human factor, automation is not infallible. However, with current trends of technology and industry development, the future of automation is, for sure, artificial inteligence. Automation has, indeed, led to a decrease in man-power necesity but this doesn't interfere with the efficiency of plant performances.

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