HEADING FOR THE FUTURE

An exclusive interview with Nicolcioiu Alexandru, Chairman, and other executives of Romania's Rompetrol Rafinare refinery and chemical complex, on process improvements and modernisation at the facility.

Six years ago, the Rompetrol Rafinare refinery and chemical complex (formerly Petromidia), located on the Black Sea in Navodari, Romania, could not produce quality products at a reasonable cost in competition with western Europe. Today the company, a unit of Rompetrol Group N.V., Amsterdam, is rapidly catching up and in the near future expects to cost effectively meet all EU product standards, becoming a force in the worldwide market. The complex includes the most sophisticated and modern refinery in Romania, processing 3.3 million t of crude in 2004.

FRESH START

Alexandru Nicolcioiu, Board Chairman, set the stage by summarising the success of a project to improve process operations, which began immediately after the Rompetrol Group took control of the refinery/petrochemical complex in January 2001. The effort automated and centralised all controls, replacing the facility's mid 1970s assemblage of panelboards, single loop controllers, pen chart recorders, rack mount equipment and six control rooms. He noted that attempting to improve output, quality and efficiency without automation would have been impossible.

'Rather than automate piecemeal, we decided to leapfrog intervening technologies and install a single modern platform,' said Nicolcioiu. 'What's more, we chose to upgrade the entire refinery and chemical plant as a single project, with all basic controls completed by the end of 2005.'

IMPROVED RELIABILITY

The Chairman was well aware of the difficulties he faced back in 2001. He began his career at the refinery in 1978 as a young engineer. 'Five years ago, we processed 1 million tpy of crude. Recently, we reached 3.3 million tpy and are slated to raise that to 4 million t by 2007 and 5 million t by 2008. Already, we serve 32 - 35% of the Romanian market. By 2007, our products will comply with the strictest western European 2007 norms, two years ahead of the date these norms are scheduled to apply to southeastern Europe.'

Furthermore, costs are now under control. The executive reported that in 2000, operational expenses of crude were US$ 45 - 50/t. Today, they are between US$ 18 - 20.

'Although I don't have the exact number in my head, I believe we had 10 days of unscheduled shutdowns in 2000 due to control equipment failures alone. In recent years we've had none.

Figure 1. Refinery operations have achieved dramatically improved uptime with digital refinery technology.

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Figure 2. DeltaV SIS logic solvers installed on Rompetrol's distillation fired heaters.

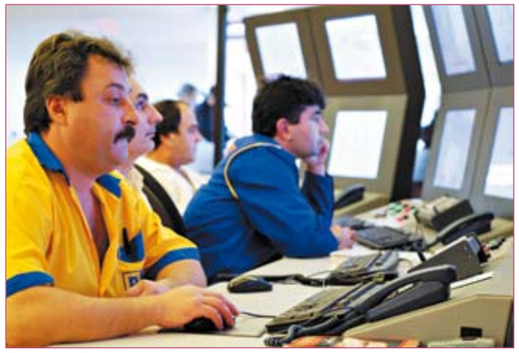

Figure 3. All plant refinery operations are controlled from one central control room.

With a daily product turn of approximately US$ 7 million, we're not losing US$ 70 million/y in production.'

2004 saw the first net profit in Rompetrol Rafinare's 30 year history. Also significant was a five fold increase in operational profit compared to 2003, with US$ 86.4 million on gross revenues of US$ 1.44 billion.

Rompetrol Petrochemicals, whose main product is polypropylene, also benefited. 'Before automating, we typically saw three or four unscheduled shutdowns per month, at a monthly cost as high as US$ 500 000,' reported Niculi Dumitru, Director of the chemical complex. We haven't had any since. Process stability has boosted output by 10% and reduced costs by 3%.'

Overall, Rompetrol Rafinare reports a more reliable and safer facility, a drastic reduction in operational errors, improved capacity utilisation, higher output, higher yields, higher quality, less waste to remanufacture, better compliance with industry standards and fewer employees. In terms of processes, the company sees greater stability, less downtime, less wear on process equipment, faster response times, tighter quality control, fewer instrument failures, longer instrument life and wide availability of accurate and detailed data.

ONGOING PARTNERSHIP

'In my opinion, the only way for a major controls upgrade project such as ours to succeed is to establish a partnership with a leading manufacturer of automation products and create with that manufacturer a long term strategy for implementation,' emphasised Nicolcioiu. 'This course provides the customer with knowledge as to where automation technology is headed and what techniques may be practical, and the automation manufacturer gains more intimate knowledge of customer plans and can advance ideas drawn from its wide knowledge of control solutions. It's synergistic. Both pull together in the same direction.'

Nicolcioiu cautioned that bidding out every new project is inhibiting as each time the customer and the winning supplier start at ground zero, time and effort are wasted. Contentions tend to develop as people try to adapt to one another, which delay projects further.

Additional benefits were noted by Cornel Cirligeanu, director of Rominserv's Constanta Branch, the exclusive services provider to the refinery. 'The partnership between Rompetrol and its process automatives supplier is a good idea because it allows access to the most modern technologies in automation, the most reliable automation equipment, field and control, and provides the possibility of reducing maintenance costs,' said Cirligeanu.

Nicolcioiu concluded by commenting that process automation manufacturer Emerson Process Management and Rompetrol Rafinare have been working together very closely since 2001. Implementation of the basic automation from 2001 through 2005 took place without ever shutting down the refinery, quite an accomplishment, considering the size of the project and pressures not to degrade product quality, unbalance the units, or lose market share. He estimates that the refinery will operate 355 days in 2006, compared to 330 in 2000.

Emerson supplies the control hardware and software, which include field devices, controllers, PC workstations, PCs for specialised tasks, analysers and communications links. The topology follows the company's PlantWeb field based control architecture and DeltaV digital automation. The company, with assistance from refinery personnel, has also performed the engineering, configuration, testing, commissioning and startup for new projects.

Although the automation presently incorporates basic functions, eventually it will cover every aspect of every process; atmospheric distillation/vacuum distillation, catalytic reforming, naphta hydrotreating, saturated gas plant, fluid catalytic cracking, hydrogen plants, delayed coking, gas desulfurisation, sulfur recovery, MTBE and aromatics.

SAFETY SYSTEMS COMPLETED

Cristian Pariza, automation/systems engineer, managed the recent installation of SIL 3 rated, DeltaV SIS technology protecting gas fired burners for atmospheric distillation/vacuum distillation (AD/VD) heaters. In addition, SIL 3 rated SIS will be placed on polypropylene and pyrolysis units in the site's petrochemical plant. Configuration, startup and post startup activities are conducted by a team of refinery and Emerson engineers.

'Looking at the AD/VD project in particular, the safety system consists of three identical subsystems, one for each heater,' Pariza reported. 'Each heater subsystem is housed in a dedicated cabinet containing 18 non redundant logic solvers, some 270 I/O points, redundant power supplies, and redundant communications with the plant network.

'A great advantage of the Emerson SIS is its integration into the plant's existing DeltaV hardware, software, and global database. No additional operator, application, or engineering workstations were required. What's more, the safety system's operating style is the same, it uses the same configuration and diagnostic tools, and display screens are similar.'

Pariza indicated that integration is total; DeltaV SIS is not a standalone or add on. It is simply a natural extension of the plant's existing technology. Operators mastered the system quickly because they were already familiar with the interface to the AD/VD heaters.

DeltaV SIS is the world's first smart safety instrumented system. Its design reflects the fact that more than 85% of safety faults occur in field instruments or final control elements. The logic solver communicates with intelligent devices via the HART protocol to diagnose faults before they cause spurious trips. In other words, the system applies predictive intelligence to increase SIS availability.

The new technology takes into account SIS standards that insist upon separation of control and safety functions to eliminate failures that might affect both layers of protection, while answering end users' desire for integrated configuration, maintenance and operation. 'We have chosen DeltaV SIS for the safety systems for the critical units in the refinery because it is integrated with the DeltaV system already in place, [thus] we can use the same displays and the same engineering workstations and the same configuration and diagnostic tools,' said Cirligeanu.

'Each AD/VD logic solver features dual CPUs and 16 channels of I/O,' Pariza asserted. 'Scan rate and memory usage are constant and independent of system size. The system checks for new hardware every scan, which will permit us to add equipment without process shutdown.'

DeltaV SIS's function blocks have been certified for SIL 3, and they include all common safety functions. Risky, hard to verify ladder logic and cause and effect matrix translations into code are unnecessary.

AUTOMATION QUICKLY ACCEPTED

Referring back to the basic automation, Alexandru mentioned that only four PCs could be found at the site in 2000. Now they are everywhere, 1100 in total. At first, many employees thought automation could not succeed. Most operators had never used a computer and had to be taught how to operate a keyboard and how to manipulate a mouse, but they learnt quickly. According to Cirligeanu, the systems implementation was relatively easy. 'Both Rominserv and our customer, the refinery, were pleasantly surprised because the operator interface is very friendly and our operators managed to adapt very fast to the new control and automation system.

'The company is now overflowing with information and needs to find ways to use it more effectively. We've decided to set up a group to programme the automation to push vital data to users rather than require them to ask for it,' the Board Chairman stated. 'And not just raw data, but data formatted to particular needs with instructions on how to apply it. For example, the Plant Manager will be given data correlated with customer orders and requirements generated by the commercial department. This will help him respond better to the market.'

Figure 4. Rompetrol refinery and chemical operations facility located on the Black Sea in Navodari, Romania.

Figure 5. Refinery and chemical operations at the Petromedia refinery have achieved improved reliability by using field devices with digital instrumentation.

According to Nicolcioiu, real time and historic information were non existent or difficult to obtain in the past. Today, automation gives operators everything they need to run the entire site in real time while still being able to look at the past, all from a single control room and console. However, operators are not the only beneficiaries. Supervisors have a clearer picture of refinery operations, engineers readily analyse processes to make improvements, and maintenance can plan for equipment repairs and replacement.

'All information is within the system, and it's at their desks. Less need exists for meetings to bring people together, or to phone or walk or drive around the site to gather bits of information from here and there,' the Board Chairman concluded.

ADVANTAGES FOR BOTH PRODUCTION AND ENGINEERING

'Key for me as Chief Engineer in charge of production is the automations giving a view of process equipment status,' reported Gheorghe Oprea. 'I can see if equipment is operating close to its operational limits by looking at electrical currents, flow rates, and other parameters.

'The technology also allows us to easily set alarms, which increases my confidence in running the plant at the limit without causing upsets, shutdowns, or damage. The entire control system is proving to be stiff and stable, which helps us avoid critical situations. Communications between units is excellent, so supervisors are happier.'

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Oprea measures his performance in two ways: product quality, such as how well it conforms to Euro standards; and how much energy is consumed in making product, which is a measure of the plant's production efficiency.

A few years ago, quality was at lower levels, with diesel fuel sulfur content at 0.2%. Today, diesel is at 10 ppm and meets the Euro 4 or Euro 5 standard. Gasoline is also of higher quality, with most being exported and rated at Euro 3 or Euro 4. 'To improve quality, we had invested heavily in catalysts, reactors and other equipments,' Oprea reported. 'Additionally, we had to automate to achieve strict control so we could run closer to maximum output while still holding tolerances. The investments have resulted in operating costs falling significantly because units run continuously with little variation.

'An example is the atmospheric distillation/vacuum distillation, where variability was reduced through more advanced closed loop control. We flattened the spikes, allowing downstream units to make better product.'

Availability of historic data

As Oprea pointed out, the process and other information is available throughout the site via a plant information network. Especially useful to him are trend graphs and other historic data. Previously, written logs were the only trend data, as data within electronic equipment could not be saved.

'Historic information helps me analyse our processes, especially relationships between parameters and between operating units,' Oprea continued. 'I can determine optimal setpoints and take actions to maximise output. Business software allows me to find data without having to dig for it, and also to make calculations automatically.'

In the past communication between units by telephone meant the units essentially operated as stand alones. Today, electronic data from everywhere funnels into the control room. Operators can see what others are doing, what problems they are having and how they can be helped. Teamwork has been markedly enhanced.

Asset management preventing problems

Paduraru Dumitru, predictive maintenance engineer, finds PlantWeb AMS asset management software ideal for field device configuration, reranging, diagnosing and comparing performance over time and also for planning repairs and replacements.

The engineer uses a vibration analyser, in concert with AMS machinery health manager (a predictive maintenance software application), to evaluate rotating machinery at planned intervals for signs of rotor unbalance, misalignment, bearing failure and other problems. The stored data helps him predict impending failures, locations and suggests when spare parts should be ordered.

'A perfect example of the benefits of these measurements was the early detection of cracking in a pump rotor safety bolt,' Dumitru asserted. 'Had it broken, the process unit would have shut down.'

The engineer works with a lubricating oil analyser and AMS to check for signs of oil degradation to better determine oil change intervals and equipment repairs. The refinery is considering offering PM services to other Romanian companies. ■