Rogerio Martins, Schneider Electric, Brazil, discusses the advantages of modern distributed control systems in coal handling preparation plants.
The coal handling preparation plant (CHPP) plays a key role in the mine supply chain in terms of meeting customer orders, ensuring the quality of the coal and managing stockpiles. The control system used at CHPPs plays a key role in optimising the processing operations and maximising uptime. It also feeds data to the manufacturing operations management system to drive decision making at an enterprise level.

As the ROM coal passes through the various crushing, washing and separation processes in a CHPP, ensuring the finished product meets the right grade and size required by the customer, it requires an automation system to manage coal flow, density, levels, ash and moisture, etc. These systems were traditionally managed by a PLC/SCADA architecture.

However, mining companies are increasingly looking to distributed control system (DCS) technology for enhanced control system functionality and advanced data exchange. PLC/SCADA systems are typically very flexible, open and connect to third party components easily. They are also cost effective to run. On the other hand, however, there is a low level of integration, which means operations teams have to manage many different tools, often from different vendors.

DCS technology was initially focused only on control. However, it has evolved dramatically over recent years to become part of global IT. The DCS scope has been modified so the system receives instructions from enterprise resource planning (ERPs) and delivers data in return. The technology also integrates safety systems and fulfills an asset
management role. DCS not only performs the basic PID loops but also achieves complex advanced process control. The system serves as the operator interface and ensures operational efficiency. It alerts operators and is embedded with a sophisticated alarm management system.

CHPP lifecycles have been affected by the use of DCS. Several decades ago, plant evolution was not taken into consideration when planning control systems, but these days mining customers must adapt their production to meet customer requirements, which means plants must be expanded or modified frequently. As technology evolves quickly, mining companies want to protect their investment by having a clear migration path. There is also a need to consider the impact of emerging technologies, such as mobile access, as well as tighter integration into the supply chain. This increases pressure on control systems to continue to evolve to meet the market demands.

As with most mining applications, control systems in CHPPs must meet the challenges of system robustness for continuous use in harsh environments, near zero downtime and the need for powerful diagnostics for fast rectification of any issues. The additional challenge for CHPPs includes the special process engineering requirements needed for particular items of equipment, such as configuring faceplate commands for priority control.

Selecting a DCS
Global mining companies usually operate CHPPs all over the world. They all process coal, some using the same methods, while others use different machinery and procedures that result in varying throughput and quality. Mining companies like to standardise and gain synergies in terms of resources and maintenance. This enables an operator to move from one mine to another with minimal training or, alternatively, an engineer can be sent to another site to duplicate an innovation. Common services should be able to be operated or maintained remotely. DCS meets these requirements, as it provides a standardised environment from mine to mine and for remote operation centres.

Energy management is increasingly important for the mining sector, as it shifts from the mantra of “production at any cost”, to a quest for more efficient production. The focus is not purely on reducing consumption, so metrics such as overall equipment effectiveness and energy efficiency (OEE+E), rather than energy cost or consumption, are becoming mandatory indicators. A higher degree of focus on sustainability is also being driven by governments and stakeholders to control the environmental impact of operations.

Measuring the energy purchased and the energy used within the mining...
process (as water, air, gas, electricity and steam) can provide insight into the efficiency of a CHPP and identify opportunities where energy can be saved. By measuring energy using a DCS, it becomes a manageable input in the mining process (much like temperature, pressure, flow, levels, etc.).

CHPP managers are often required to do more with less. Operational efficiency is a consideration when planning the deployment of a new system, particularly as the CHPP forms part of the overall resource to market operation. This includes what can be delivered to an operator to obtain the right information at the right time to improve the decision making process.

**Design considerations**

Protection of investment is a major concern for CHPP owners. When designing a DCS, project teams must plan ahead and consider the following:

- The architecture requirements and constraints.
- Any potential modifications that are required.
- The project library.
- Operating data, such as interface with the ERP and other systems.

The lifecycle of a CHPP must be considered from the beginning. A design that does not take future modification into account is not a good one. CHPPs need flexibility to adapt production to new customer requests, so scalability is a key factor. The ability to easily implement a change request without revisiting the initial design will make a difference in the future.

A big differentiator of DCS over PLC/SCADA is the standardisation they provide. In the early stages of design, the first priority is to define the project library of objects, such as valves. Suppliers of valves usually offer different models of control valves and some even have an open model that can be modified to fit their customers’ habits or specification. Selecting the right model for all basic objects – and choosing whether to take a standard valve or build a new one – will effect not only the development itself but also the complete lifecycle of the CHPP.

In terms of hardware and the flexibility brought by fieldbusses, the architecture design is key and careful consideration of the I/O distribution will impact future maintenance. A good design will meet the topology constraints.

Traceability is also a key parameter to consider. During the functional design phase, CHPP’s must clearly specify the data that needs to be tracked, how it will be stored, how it will be retrieved, and what kinds of parameters have to be accessed. In the big data era, the size of the files is no longer an issue: what is important is information and how easy it is to find it.

**Engineering with DCS**

One of the main benefits of engineering with DCS is the shorter timeframe to implement a sequential process engineering method. The design, implementation and verification stages can be consolidated because consistency is guaranteed by the object oriented programming, single data entry point and change propagation features. The enhanced diagnostics also make the job easier during system start up.

The consistency of a DCS enables a reduction up to 30% in engineering time when compared to the engineering time to install a conventional PLC/SCADA system.

Integration is key and engineering with DCS affects the configuration time, minimising tests so commissioning can occur quickly. As most engineers will know, in the automation world, almost anything is possible with a little effort. However, almost every engineer has experienced the issue of interfacing two devices using the same protocol, just because there was a parity difference somewhere along the line. Project managers often rank interface as one of the main reasons for a delay or overspend on a project. A DCS avoids these kinds of interface issues.

A DCS offers a database with a “configure once” philosophy; i.e., there are no databases to map. For every piece of data, such as a flow measurement,
there will be a unique identification throughout the system, both for the program in the controller, as well as the symbol on the operator interface. This tag could be linked to a physical address and then, no matter what modifications occur, it will be completely transparent regardless who uses the data.

Next generation systems go a step further, integrating the best of PLC/SCADA and DCS worlds with energy management capabilities. This means that the latest DCS are flexible, open and easy to use, and combine integration capabilities, single database and powerful diagnostics, alongside energy optimisation, load shedding and real-time dashboards.

**Operations and maintenance**

A CHPP is a continuous process and stoppages can significantly impact the coal processing in many ways, including non-conformance to out-load plans and poor process performance. Improved operational intelligence and simplified maintenance – and therefore greater uptime – can be achieved with a good DCS system: i.e., one that enables operators to quickly and easily navigate to root causes and rectify any issues.

Basic asset management is now included in any recent DCS. It gives operators the minimum information needed in case of process failure.

A DCS gives a CHPP operator the ability to navigate easily from one display to another. The faceplates are the primary tool. They give the operator a quick overview of any process element, allowing them to pilot the plant with all the process information needed.

A DCS is usually embedded with native diagnostics, which means that an operator can get accurate, real-time information about any malfunction in the system, such as why a feeder will not start. The object library enables the operator to quickly access manuals, trend information and understand the links to other equipment so they can resolve issues. The latest DCS allow configuration changes to be made online without stopping the plant.

Operational and maintenance efficiencies can be gained for a CHPP, as a result of greater embedded features and intelligent data available at an operator level.

**Case study**

QingHe coal washing plant is located in Green River Industrial park in Altay (in the Xinjiang Province of China) with an output of 1.5 million tpa of coal. The main processes in the plant are non-desliming and non-pressurised heavy medium cyclone separation technology, coarse coal slime recovery with high frequency sieve and fine coal slime flotation filter. There are also workshops for coal washing, filter press, flotation separation, slurry concentration and a conveyor belt corridor. The DCS selected for the plant was Schneider Electric’s PlantStruxure process expert system (PES), which gives the plant object modelling capabilities and increased flexibility.

**Resolving engineering challenges with DCS**

For this particular project, the challenge was in the special process requirements. One of these was the interlock status. The equipment can also be started or stopped manually using the popup faceplate. For any situation, the stop command on the faceplate should be given first priority.

Another challenge was the controls. In the CHPP, besides the group control (such as raw coal conveying), there were also some process controls, such as PID, to control the qualified medium density. There were also a lot of analogue variable control processes.

Libraries were the cornerstone of this project and they were developed to cater to the special process requirements, taking into account the control logic and the human/machine interface style. The open nature of PlantStruxure PES enabled third party libraries to be incorporated into the system. In the early stages of the project implementation, the third party library was modified to fit the requirements of the coal washing plant before being integrated into the PES.

**Ongoing benefits of DCS**

Ongoing maintenance of the plant will be simplified. This will require fewer specialised skills and less time, while the object library can be customised according to the customer’s standards.

**Conclusion**

Since they were first launched almost 40 years ago, DCS have evolved from simple control focused systems to become an integral part of the integrated planning and optimisation solution in a mining operation. The latest generation of DCS is based on field-proven hardware and open ethernet technologies that extend from device level, through control and supervisory levels and provide a way to share information with higher level operational systems, delivering intelligence that leads to operational efficiencies.