Modern Controls

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look at issues to consider when modernising a plant's control system.

Introduction

Eastern Province Cement Company (EPCC) is one of the leading cement producers in the Middle East and one of the largest manufacturers of ordinary Portland and sulphate resisting Portland clinker and cement in Saudi Arabia. The 2 x 3500 tpd plant is located on the shores of the Arabian Gulf next to the Dammam – Kuwait highway, 135 km from Dammam and 65 km from Al Jubail (one of the largest commercial ports in Saudi Arabia). The ideal location of the plant site not only serves all the corners within the country, but also makes it economically viable for export to many countries. In the last decade EPCC's products were exported not only to the international neighbours Kuwait, Bahrain, and Qatar, but also to destinations in Europe.

The construction of the existing plant was begun in February 1982, and the first commercial clinker rolled out of the kilns in October 1984. This article provides an overview of the project scope, the decision making process and the technology to modernise EPCC's process control system facilities into a world class operation.

Existing plant

The original technical concept for the plant was formulated by EPCC management in early 1982, assisted by Prospective Engineering Gestion (PEG) of Geneva, Switzerland. All of the plant's machines were supplied by Krupp Polysius, Germany, and all electrical and control systems were from ABB/BBC, Switzerland. The plant production capabilities were increased in 1987 with the addition of two more Krupp Polysius cement grinding mills, as well as an automated control system from ABB/BBC. Further modernisation was carried out periodically to keep the plant operationally efficient. These included the extension and modernisation of electrostatic precipitators, rehabilitation of the bypass electro filters and the installation of an online bulk analyser.

Market conditions also contributed to the plant's necessity to modernise, as cement demand in the region has been rising since the beginning of 2001.

A key consideration in the plans was the flexibility and expandability of the new system for future modernisation. Programmes already being considered included converting the cement mills to closed circuit grinding, modernisation of the preheater and the cooler, new quarry development, installation of a third kiln line, online analysers for raw meal analysis and ERP solutions.

The decision process

Since 1984 EPCC has used the original ABB/BBC 'DP - 800 and DP - 1500' Procontic control systems to manage operations on a daily basis. Throughout the years a number of control system modernisation projects were discussed, but were never realised, due to the fact that the Procontic system fulfiled its duty perfectly with the highest reliability. However, a lack of available spare parts combined with efficiency and reliability needs have led to EPCC deciding to replace the control system for one with the latest technical features and ease of operation. Based on these considerations EPCC floated a global tender assisted by the consulting engineers WS Atkins plc, UK, and went in for a stage wise selection process.

Operate^{IT} process portal: a dualhead workplace.

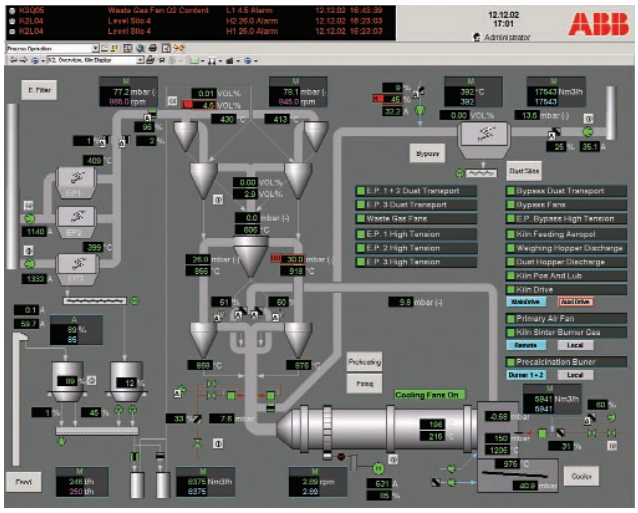
As one of the original designers and constructors of the plant, and being involved in the numerous changes, upgrades and modifications throughout the years, ABB were awarded the plant's control system modernisation project.

Scope of supply and dedicated solution

ABB Switzerland, with its local business unit in Saudi Arabia, formed the project team to address the issues surrounding 'Asset Management'. These include eliminating obsolescence, improving operational performance on all levels and integrating the information flow from the plant floor to the boardroom, helping to improve the overall decision making process.

EPCC's main targets of the project were to have an open solution and have all process controls integrated in one platform with industry standard communications. This would eliminate the need to develop custom interfaces for third party equipment. In addition, the maintenance of the equipment had to be optimised, providing the highest possible availability, easy updates and quick troubleshooting tools without excessive costs and downtimes.

Finally, the turnkey solution had to be simple to use and provide the necessary information to those who



Kiln control screen shot.

need it, when and where they need it, at all levels in the company.

The main scope of supply of the turnkey contract included the following:

- Equipment for local and remote control.
- Control system for cement production lines 1 and 2.
- Control system for seven stacker/reclaimers.
- Modernised management information system capable of e-business solutions with a client server architecture.
- Remote and self-diagnostics.
- Hot backup and mirrored servers.
- Large video and industrial TV system (including plant supervision).
- Plasma screens and digital video technology.
- Four road weigh bridges (including civil work).
- Revamp of the four bulk weighing systems for silos and despatch system.
- Instrumentation.
- Operator workplace replacing the existing control room equipment.
- Cables and installation materials .
- Services, such as training, engineering, integration, erection, installation and commissioning, supervision and project management.

The original 12 control rooms were reduced to five smaller subordinated ones plus the existing but new assembled Central Control Room (CCR). The CCR is now equipped for monitoring and control of the raw mills and raw material transport systems, kiln, clinker storage, cement milling up to the feed of the cement silos, gypsum crushing, storage and transport and plant auxiliaries. This provides the possibility for controlling the whole plant from this central location. The new crusher control system is installed for the control and monitoring of the crushers, new online analysers, stackers and sampling stations.

The planning of the project played a critical role in its success, as the changeover was a complex task which had to be completed in a limited time. The modernisation was phased to allow for minimum disruptions to production and to quick changeover to the new system in an efficient and controlled manner. The project began with an onsite field survey, ensuring the status of the systems installed, and confirming that the existing drawings, wiring diagrams and general plant documentation were up to date. They then proceeded with the definition of loop diagrams and I/O lists, confirming what instrumentation could be kept and what had to be replaced, as well as their connection planning, reusing as much of the installed infrastructure, cabling and Motor Control Centers (MCCs) as possible. Integration to third party systems as well as another ABB system, Cement Information Management System (CIMS), delivered in 1999, was planned and defined using standard networks such as Ethernet (TCP/IP, IEEE 802.3) and Fieldbus technologies (Profibus) for a cost optimised solution.

During a 10 day production stop, ABB installed Control^{IT}-AC800M distributed control systems with S800 I/O modules, replacing the control system of the first cement kiln and for one raw mill. This first step included the conversion of approximately 5000 I/Os of the 15 000 to be done throughout the project, after which the plant was operating with 8 dual screen workplaces, 5 AC800M controllers, 1 redundant connectivity server and 1 redundant aspect server. The second step in the modernisation included 15 more AC800M controllers, 15 workplaces and 3 connectivity servers.

Redundancy is provided at network level, dedicated controllers and power supplies. Fibre optics are used to ensure trouble free operation. Special attention was given to the possibility for simple upgrades and expansion in the future.

ABB paid particular attention to the Human Machine Interface (HMI) aspects. The delivered system ensures the best information possible is available at all user levels. The display updates on the operator stations (approximately 1 sec) are exceptionally good, considering some heavily loaded displays can have 2500 OPC items/250 dynamic objects. The new digital controllers on the system provide for quick and easy tuning of the control loops. The connectivity server(s) manage over 17 000 items for trend logging and works with the Aspect server(s) in load sharing mode. This provides the operators with a variety of trends, making the dynamics of the process visible and allowing them to initiate corrective actions on the process. The engineering tools provided, (Control Builder M), enable online editing of the control programmes in a multi-user environment. Enhancements in the control philosophies are made online, without interrupting the production, while safety is ensured through planned interlockings and alarm messaging. Maintenance and especially preventive maintenance is improved, as the new system provides staff with real time information such as operating hours, number of motor starts and more.

Due to the added simplicity in operation and the availability of information, the operators switched from the old system to the new one in a short, on the job, training session. ABB's University (Switzerland) included in the scope of the project a deeper training at the EPCC plant's training centre, for the operators, engineering and maintenance staff, helping them gain further insight into the new technologies' functionality.

Technology

ABB's Industrial^{IT} (IIT), was the platform chosen by EPCC. It was also approved by WS Atkins. The platform combines traditional 'pure' control, interlocking and safety functions in a real time environment with MES or ERP systems, that have a non-time critical business background. It merges real time functionality with transactional business functionality.

Total integration with IIT means having access and control of any kind of equipment that is implemented in the process, such as:

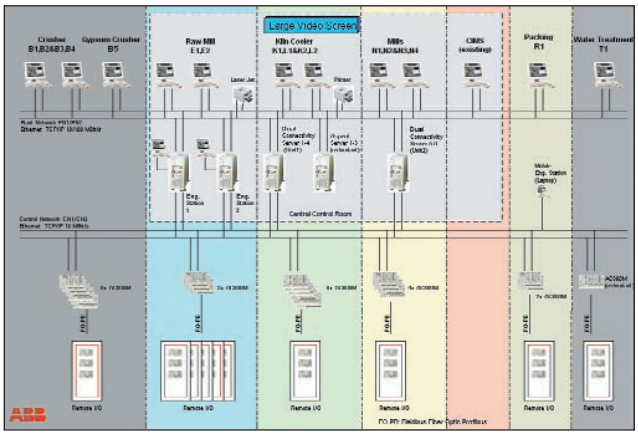
- Substations.
- Power distribution.
- MCCs.
- Generators.
- Drive systems.
- Communication systems.
- Monitoring systems.
- Third party subsystems.
- Quality systems.
- Collaborative production management systems.
- Expert systems.
- Optimisation systems.
- Enterprise and business systems.

It also means supporting and seamlessly integrating industry standard technologies such as TCP/IP, OPC and Profibus.

The EPCC automation platform is based on a redundant TCP/IP control network as well as a redundant TCP/IP plant network (Client Server Network), using ControlIT-AC800M controllers and S800 I/O system. I/O units located in the remote periphery centres are connected via electrical or optical Profibus connections. The redundant plant network connected to the existing ABB CIMS (Cement Information Management System), to the dual connectivity servers as well as the redundant Aspect servers. The complete network topology was designed by ABB, using redundant fast Ethernet switches with FX fibre uplinks, to fit securely into EPCC's existing architecture.

With the new installed distributed control system the plant now is equipped with a platform that provides the operating company with the possibility to install a wide range of progressive software tools. For example, if there is an equipment malfunction then plant documentation would need to be consulted. If this is filed in the technical office, valuable time and production down time can be spent gathering the information required to fix the problem. In the worst case scenario this could happen during the night or holidays.

ABB's commitment with IIT is to provide a complete set of Aspects with every Object in the plant, be it a sensor, control loop, motor, drive, transformer or substation. Every object in the plant is mirrored to a distributed redundant databank and defined with a virtual object, which can be accessed from various virtual aspects. This means that by clicking a button, the user can control aspects such as process graphics, control programmes, simulation data and loop diagrams. Other aspects that can be embedded in the object include manuals, system specifications, maintenance



Hardware architecture.

records, internet sites, parts lists and supplier data and specifications. There are endless possibilities.

The system makes it simpler and faster for the operator and maintenance team to trace any fault, get the relevant details and as-built drawings, as well as getting connected to the manufacturers maintenance manuals and online parts ordering.

When there are large amounts of data to be used and presented to the user, navigation becomes an important issue. Clear and clean navigation throughout the system and the plant is provided with the IIT Plant Explorer. Very much like the Microsoft Windows Explorer™, this powerful utility presents to the user the various objects and aspects in a tree structure. The tree structure can be presented in various hierarchies such as aspects for the functional structure, following process functions, or another aspect tree for the location structure, grouping the objects by physical location as well as an aspect tree for the control structure, following the sequence of the application programme.

Conclusion

With the commissioning of the first phase of the control system for one of the lines, the operating staff learned the control philosophy without any major hurdles and within a day. Also with the possibility of several trending of process parameters, the control of the process has become efficient and easier. As well for the maintenance staff the fine-tuning of the various process PID controllers became much easier and more effective. Further the usage of consumables like recorder sheets, inkpots for the recorders and associated maintenance on these parts has stopped completely. By the end of this project, all control from the raw materials handling through to the cement grinding will be carried out in a single control room. EPCC aim to have eliminated all the decentralised control centers. In turn this helps to curtail operating staff, as well as training individual operators to run either the mills or the kilns or both, therefore making them multi skilled.

For EPCC, the choice of selecting ABB with proven technology has been a success. Minimal down times of less than 10 days were achieved for the various phased upgrades, resulting in a world class installation, providing EPCC with a solid foundation for a modern plant today and in the future.