Modernization and upgrade to the latest technology

ABB installed a complete and most modern control system at Jura Cement Fabriken in Switzerland

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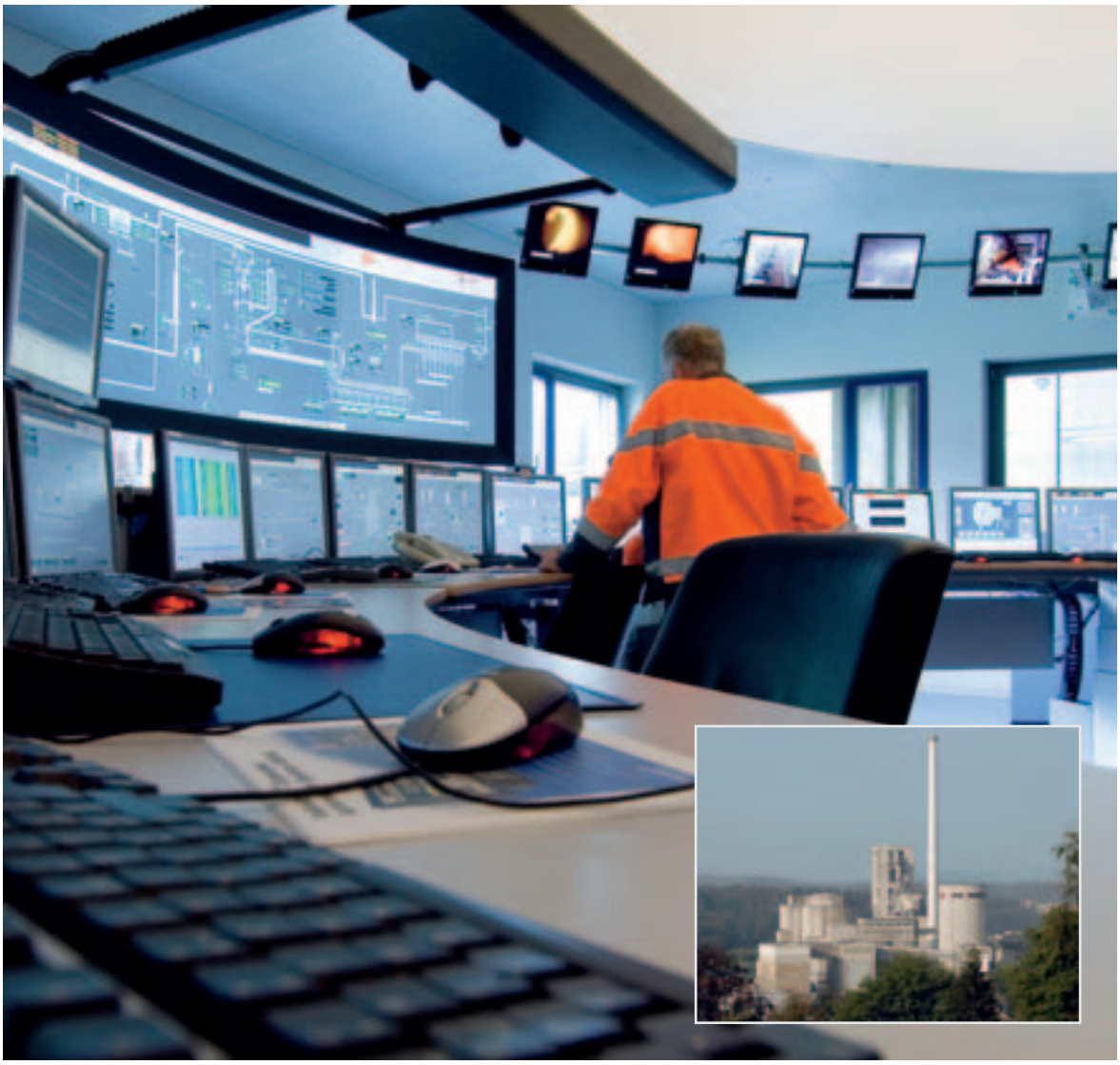

Jura Cement's hat-trick

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After Switzerland's and Austria's hosting of the Uefa Euro 2008 football championship last month, Jura Cement was motivated to write about the outcome of its own large project. Here, Jura Cement's Wildegg plant and ABB Switzerland Ltd reflect on their own hat-trick of success. And how three vital ingredients, the very latest technology supplied by ABB, the benefits of a customer who is open to trying brand new developments for the industry, and the close cooperation of the both parties' teams, has brought high scoring success and benefit for everyone involved.

Figure 1: Jura Cement, Wildegg plant

In 1882 Friedrich Rudolf Zurlinden launched the company Zurlinden & Co and built a cement plant comprising five shaft kilns in the city of Aarau. Due to rising cement consumption in the last two decades of the 19th century a second cement plant was built in Wildegg. Both locations were attractive due to their proximity to nearby electrical energy available from local hydro power stations. The Wildegg plant was ready to start operation after a construction period of two years. In 1897 the two plants of Aarau and Wildegg were joined as the incorporated company Jura-Cement-Fabriken. From 1896 to 1983 four different cement production lines, with different process technology, were in use.

By putting in operation kiln number five between 1984-1986, a dry treatment process with heat exchanger and a capacity of 600,000t of cement was introduced. ABB Switzerland, formerly called BBC (Brown Boveri Corporation), was selected to supply the entire electrical equipment and plant control system.

Since November 2000 Jura-Holdings has been owned by Irish-based CRH, which has over 80,000 employees in more than 3300 locations in 31 countries. It is listed in the stock markets of Dublin, London and New York.

Alternative fuels and Expert Optimizer

The use of old tyres as an alternative fuel was increased considerably by Jura Cement in 2000 by putting a pilot plant into operation in which the combustion chamber is used to burn complete tyres.

Further alternative fuels such as, waste oil, dry sludge, meat and bone meal, and plastics were also added, bringing the use of alternative fuels to around 60 per cent of the total fuel used.

To enable Jura Cement to use these various fuels to their full extent, ABB's Expert Optimizer version 4.0 was installed in 2001. This was installed to optimise the kiln, cooler and tyre burning. The Expert Optimizer, built on the excellence of its predecessor LINKman and part of ABB's suite of Collaborative Production Management (CPM) solutions. It achieves stable and optimal kiln operation at a level that even the best operators are not able to match, 24/7. The Expert Optimizer solution installed in 2001 comprises both rule based control with other modern tools like neural networks and fuzzy control which optimised the kiln and cooler while complying with the process constraints.

Expert Optimizer learns the process behaviours and, by then sending frequent but small set point changes to the controller, the process becomes more stable. This stability allows the process to be operated with smaller tolerances. Being able to run closer to operating constraints allowed Expert Optimizer to increase the amount of product produced while handling Jura Cement's alternative fuels with no reduction in quality.

Packing plant and integration of Siemens

In 2005 the resolution was adopted to revamp the automation of the existing packing department. With this decision the latest and most efficient plant in Switzerland came into existence. The packing plant section of Jura Cement's Wildegg plant was automated in 2005

Figure 2: the old plant mimic versus the new extended workplace of ABB and CCR layout (pictures below)

by a local Swiss automation company. Jura used Siemens S7 with Siemens Cemat library.

For the main plant Jura selected ABB's System 800xA as the control system, but it wanted to integrate Cemat into the 800xA. The 800xA system can handle this by accessing data via Siemens OPC servers and a special 'ABB Cemat Connect' library. A big advantage of this arrangement is that the operator at the station benefits from seeing no difference between working on an S7 or AC800M controller.

Mill optimisation

In 2005, Jura Cement partnered ABB Switzerland in an exciting new development. Model Predictive Control (MPC) technology had been integrated into the latest version of Expert Optimizer and had been extended to include Mixed Logical Dynamic (MLD) systems but at Jura Cement, this was applied for the first time to a cement mill.

MLD systems had been applied elsewhere in the cement industry, to control kilns and raw mix for example, but this was the first known application of this technology on a cement mill.

MLD systems were recently developed at the Automatic Control Laboratory at the Swiss Federal Institute of Technology, ETH Zürich, with whom ABB launched a strategic collaboration at the beginning of this decade. The advantage of MLD modelling, when combined with an MPC system, as was the case at Jura Cement, is that the solution can make predictions about the process evolution in the near future. It can evaluate the merits of control decisions and it selects and implements the best series of control decisions into the future. This is achieved by the model giving a prediction of the quality after the mill.

Furthermore, the MLD mill model is not a black box like in 'standard MPC tools' but, constructed in the Expert Optimizer graphical model building toolkit, it is a clear representation of the real system relationships with components that have clear interpretation for versed process engineers. This increases the understanding and makes maintenance easier. The mathematical complexity is hidden, and only relevant process knowledge is presented. Expert Optimizer version 5.0 was installed on one of Jura Cement's mills in 2005. Despite this being a new application of the technology, a striking fact about the installation was the short time needed for the commissioning. Indeed, in a matter of a few days the system was up and running. This was a consequence of both the online adaptive features introduced in the system, which made the most out of both Jura Cement's and ABB's deep process knowledge, and the close cooperation between Jura Cement and ABB.

Phased out control technology

The BBC Procontic control system had been running at the plant since 1984 and, after 21 years of good service, by 2005 had reached the end of its life cycle and the availability of spare parts had become critical. Additionally, the central control room no longer met any of today's ergonomic and environmental standards. It was thus time for huge revamping of the plant. Therefore, Jura Cement decided to exchange the control system for the latest state-of-the-art technology and to totally renovate and update the central control room.

Essential elements of awarding this contract to ABB were:

- longstanding and successful collaboration of both companies
- already installed sub systems ABB Industrial^{IT}, Process Portal A SV2.1
- ABB's specific cement process know-how
- very flexible and cement specific application software ABB Switzerland offers
- the capability of ABB to show its flexibility and meet already in the sales phase specific customer requests, which are presented in more detail in the following chapter
- the Jura Cement engineers and operators were already familiar with the new system and the philosophy of how to operate. They where invited to participate in the execution of the project.

Concept and design

ABB adapted the ABB Industrial^{IT} system version 4.1 together with the Minerals library 5.0 and upgraded it to the latest version SV5.0. The system is based on a server-client-architecture with redundant servers. As Jura Cement has only one operator on duty at any shift, they requested a high number of operator stations (11 pieces) to reflect all plant sections at the same time. The old large plant mimic wall; where each drive on the wall was represented by a green LED has been replaced with a state-of-the-art ABB

extended operator workplace (EOW) with the three beamer technology.

Today, this allows Jura Cement to show the actual plant status on one screen in a detailed way. Furthermore, it has turned out to be very useful in critical situations, for example at the start up of the kiln, when many process experts need to see detailed process data all at the same time. To avoid quality losses on the PC screens, a professional Matrox graphic card is used. This graphic card consists of a receiving box, which is placed at the monitors and an optical transmitting PCI card at the PC end. The receiver has ports for four USB connections, keyboard, mouse, audio and four DVI monitors. So on one operator station PC up to four monitors are connected.

To provide a good working environment, with comfortable heat and low noise emission, all of the PC's have been placed in a server room located under the CCR. And to further improve the working conditions for the operators, all desks are height-adjustable by motor drive. The project ran from 2006 to 2008 and the outcome has been that ABB has implemented the most modern control system in Switzerland.

Field installation

Jura Cement decided to replace the complete control system including the IO boards. Since the old BBC IO cabinets were still in a very good condition, it was decided that they would be kept and reused. To exchange the IO boards in an efficient way, the new S800 IO boards were installed on pre-manufactured aluminium frames. The field signal cables were disconnected from the old Procontic boards. The installation of the S800 IO boards and the reconnections of the field cables was all done according to ABB designs. All IO boards are equipped with cage clamps instead of terminal screws to facilitate quick and reliable connections.

Figure 3: top level, plant overview

All signals of IO cabinets and other Profibus consumers are connected to the central server room by fibre optic Profibus transmission. During the project Jura Cement consequently took the opportunity to connect all the variable speed drives and other sub-controlled systems, eg weighfeeders etc, with serial Profibus interfaces in order to get detailed information about these devices.

Reprogramming of Procontic code

The whole programming code had to be replaced. There is no conversion tool or anything like that convert Procontic code in any other Industrial^{IT} supported programming language.

After reporting all IO signals in a Microsoft Excel list, the collected data was filled in the minerals bulk data handling tool PDA5.0. This tool helps to efficiently create all consumer objects in a group oriented structure allowing data to be available to download for the controllers. Also the IO signal list and electrical diagrams can be handled with the same tool.

Once the object structure was in place, the real programming could start. For this task Jura Cement delegated the electrical engineer Ueli Burger full time for one year to the ABB offices to support the ABB programming team. Furthermore, two experienced Jura Cement software engineers each supported the programmer for one day a week. The integration of the customer's engineers was invaluable for learning how and where everything is programmed. In Jura Cement, 12,000 IO's in 15 AC800M controllers are installed.

For maintenance reasons it's very important for Jura Cement to know exactly the program code. Additionally, ABB also benefited from gaining a further year of experienced process know-how.

Because there was no actual interlocking diagram of the Wildegg plant, the well proven Procontic programming code was used as the model for the new code. Because of the close relationship between the Jura Cement engineers and the ABB engineers it was even possible to improve the existing code. The biggest challenge was to arrange the old and new program pieces to get a completely seamless piece of work, where an operator will not notice if the technology behind a device is 20 years old or brand-new.

Technical meetings between the Jura Cement project leader Jürg Hitz, and the ABB project leader Sven Wagner took place weekly. This close relationship enabled fast and exact decisions to be made for the project. ABB were able to hear the customer's wishes quickly and directly and was therefore able to propose the best solutions based on its wealth of cement experience.

Jürg Hitz, head of process, Jura Cement

Jürg Hitz, Jura Cement's head of process at the Wildegg plant said, "I'm very satisfied with the timely commissioning of all parts exactly as per the agreed time schedule and with the new working quality for the operators. They have now diverse information tools with clearly interpretable signals. The new control systems manage 12,000 signals over the whole process. We profit from a much more explicit overview and this gives us potential for more and better optimisation opportunities. With the control and optimisation systems Jura Cement will be able to improve productivity, due to fewer and shorter kiln stops."

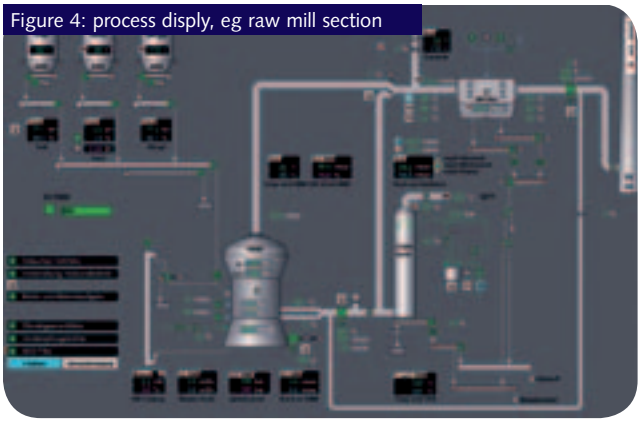
Figure 4: process disply, eg raw mill section

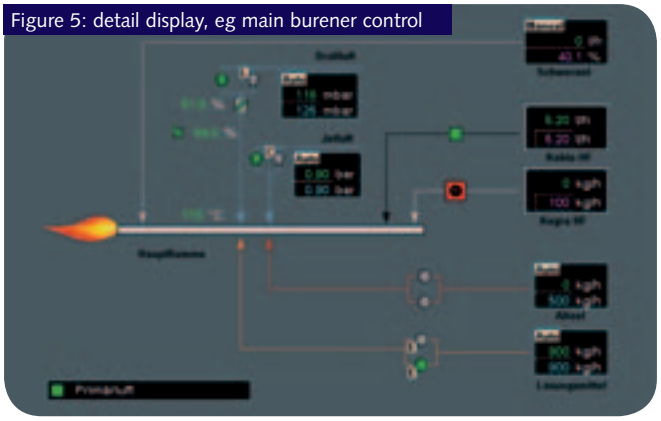
Figure 5: detail display, eg main burener control

Ergonomically and efficient displays

It's a known strength of ABB to make efficient and clear process displays which help the operator to keep the process running smoothly. The displays are structured in only three levels. The top level is a plant overview which can be accessed for each single process display.

The plant overview display individually links to anyone of the 20 process display. These displays are usually on the operator's screen. To have more single details, for example for large motor drives, detailed overlap displays are very helpful to the operator. As a last challenge, there was the large overview screen (EOW) that was needed, because of its large resolution for special displays.

Furthermore, the operator or the maintenance engineers are also supported by the normal features like trend displays, operator notes, event lists and alarm list. All plant sections announce their alarms in four different alarm sounds, so the operator knows exactly from where the alarm is coming from.

Commissioning during maintenance stops

To avoid production losses as far as possible, the commissioning of the complete plant (12,000 IO's) was split into the two normal maintenance stops, they take place each year in January. The first part was in January 2007, during approximately three weeks for raw material transport, raw mill, dust transport, homogenisation silo and the gas ways.

The challenge here was that before kiln stop the homogenisation silo was completely emptied, because of replacement works on homo silo aeration. That meant the kiln had to be restarted with a brand-new programmed raw mill and with no raw meal in storage.

During 2007 all other plant sections, that can work independently of the others, like three cement mills, the steam house, main station and the system upgrade of the all alternative fuel sections, were commissioned one after the other.

The second large part was in January 2008 again for approximately three weeks for the preheater, kiln, cooler, clinker transport, roller crusher and additive transport. The task here was that the CCR was completely dismounted to reinstall all the new CCR equipment, but the system had to continue running for the cement mills. That happened in a provisional CCR under the new CCR.

Also here the pressure to restart the kiln was huge; the 60,000t clinker capacity was emptied to about 5000t yet, which equates to not even two days of cement production for Jura Cement.

Mills go MPC

After the success of the first mill operating with Expert Optimizer's MPC and MLD control it was decided to extend the technology to the rest of Jura Cement's mills. In May 2008, commissioning of ABB's CPM optimisation solution was completed, meaning that MLD systems are now installed on the raw mill and all of the cement mills. ABB's Juliano Arantes, the commissioning engineer for Expert Optimizer at Wildegg, said "The cement mill is quite unusual as it's a central discharge mill with three chambers, but Expert Optimizer's graphical modelling capabilities allowed us to nicely represent this new configuration. The solution is bringing good results and high run times." This is also the first application of an MPC/MLD solution on a vertical raw mill.

Conclusion

The whole project has been a long collaboration, which started in 2000 and has only just concluded, and yet it has been hugely successful and mutually beneficial for both teams. Jura Cement is benefiting from the very latest technology and ABB Switzerland has benefited from working with a partner who is open to trying brand new developments for the industry. Over the years, the close communication and collaboration has been an outstanding feature of the project and was a key ingredient in the project's success. ABB kept every milestone in the project schedule and all of the work was carried out during the normal yearly maintenance stops. This has meant that due to very good interrelated time planning between Jura Cement and ABB, the entire upgrade project has been successfully carried out without any production losses. Switzerland may not have won Uefa Euro 2008, but two Swiss businesses are winning the challenge to champion the very latest application of plant technology and know-how. There may be no silver cup, but with increased production and alternative fuel use, as far as Jura Cement and ABB are concerned, they are both joint winners.


Figure 6: large overview, eg gas routes of complete plant

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