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ABB

Expertly Controlled

D. Clark, Project Engineer (MES), ABB, Switzerland, describes the implementation and operating results of a new LINKman expert control system at the Deuna cement plant, Germany.

Introduction

The Deuna cement plant is located in the northwest of Thuringia in what used to be East Germany. It has two pre-heater kiln lines, three raw mills and four cement mills. The kilns are fired with a combination of coal, oil, whole tyres and alternative fuels. In 1991 the plant became part of the Dyckerhoff Group and since then has upgraded and improved the whole plant including the electrical equipment.

After studying the production process, Deuna believed that it should be possible to improve the control system. The expected benefits of this were as follows:

- Reduced kiln fuel consumption.
- Improved kiln stability, particularly when burning waste fuels.
- Better control of waste fuels.
- Increased output from the cement mills and the raw mills.
- Reduced power consumption from the cement and raw mills.
- More consistent cement quality.
- Better changeovers between the 16 different cement types.

The chosen method of improvement was an expert system. This is a well-established technology that has been in use for more than 15 yrs in the cement industry. An expert system is a way of combining the process knowledge of the operators and engineers, in a consistent way, to produce a 'best' operator. This operator is then on duty 24 hours per day, 365 days per year.

In selecting an expert system the following factors were considered to be important:

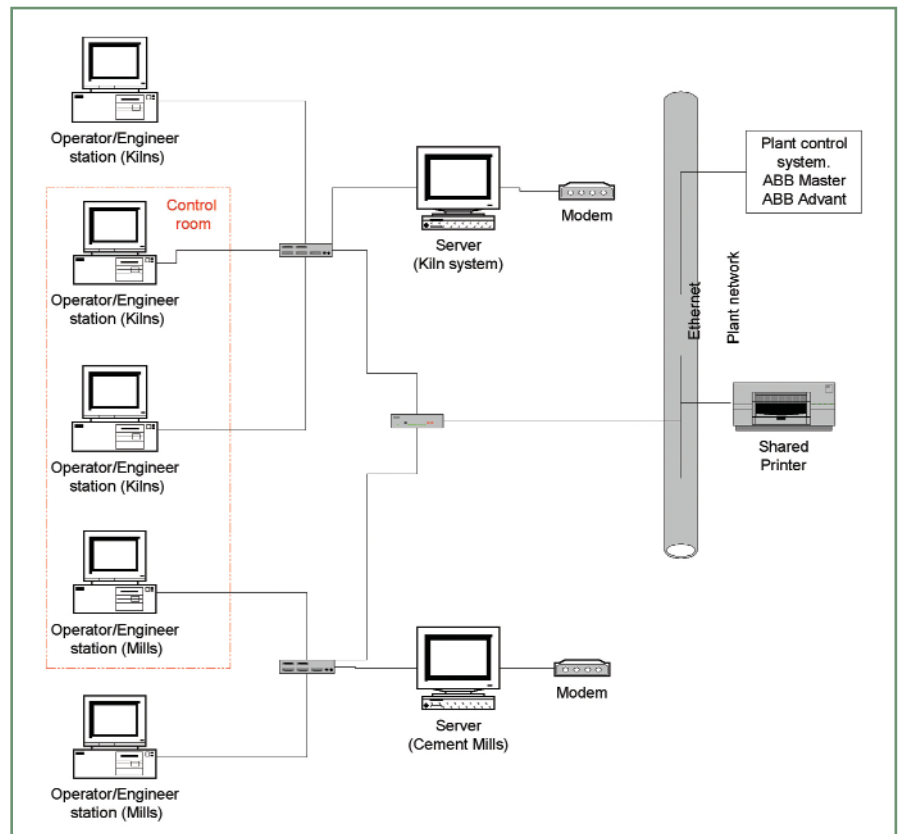


Figure 1. The LINKman system at Deuna.

- Proven record of success in the cement industry.
- Easy to use technology that could be supported by the factory engineers.
- Easy for the operators to use.
- Modern technology (PCs, WindowsNT, etc.).
- Easy to integrate with the existing system.

As a result of considering these factors, the LINKman expert system from ABB was selected. This system has in excess of 4 million hrs of track record in closed loop control for the cement industry and has more than 80 million tpa of capacity under control.

The LINKman project

System installation

The LINKman system at Deuna was installed in two phases. Firstly, the system for the cement mills was

installed in November 1998: this consists of a server and two operator/engineer stations (OES). One OES is located in the control room to be used by the operators and the other is located in the computer room for use by the engineer. The second LINKman system was installed in May 1999, and consists of a server and three OES machines. One OES is located in the computer room and the other two are in the control room. The configuration of the finished LINKman system is shown in Figure 1.

Initially the servers were UNIX machines but these were subsequently replaced with WindowsNT machines so that the whole LINKman network now uses NT.

Interfacing to the process is via the Masterbus network of the control system; this allows LINKman to access data from any of the Masterpiece or Advant controllers that are on the network. For safety reasons the control network is the master in the system; it automatically takes control from LINKman and returns it to the operator if any of the following situations should occur:

- Any problems are detected with communications between LINKman and the control network.
- Any of the setpoints are out of range.
- Any of the controllers used by LINKman are switched to manual.
- A problem is detected on the process, for example if the ID fan stops.

In each system a modem is installed to allow ABB to perform remote diagnostics on the system, and these are also used by the site engineers to work on the control strategies from their office without having to go to the computer room. A printer is shared by both LINKman systems and by the control net.

Control strategy implementation

Building the initial strategy

An ABB engineer conducted a pre-project survey in order to gain the knowledge required to build the initial control strategies. The purpose of the survey was to determine the following:

- What should be the basic control rules for the process.
- What process data was available.
- Which setpoints need to be controlled.
- What special situations need to be handled by the control strategies.

This information was sourced from the operators, the factory engineers and the factory operating procedures. Since ABB has considerable experience of applying expert systems to the cement process, the time required for this survey and to write the initial strategies was only a few days. By use of the survey and an extensive library of strategies that have been built up over the years, it was possible to produce a set of pre-configured control strategies that were approximately 85% complete, these strategies were installed on site at the time of the hardware installation.

Whilst the preparation of the strategies was in progress the factory engineers were receiving training in the use of the expert system toolkit so that when the commissioning started on site they were able to work in partnership with the commissioning engineers.

Primary commissioning

The purpose of primary commissioning is to take the pre-configured control strategies and to tailor them to the exact requirements of the process. For the cement mills this was carried out in December 1998 and for the kilns in June 1999. During this phase, the control strategies were turned on line and the response of the process to the setpoint changes was observed. Following extensive discussions between the operators, the factory engineers and the LINKman engineers the control rules and gain factors were then adjusted to tailor the responses of the strategies to the dynamics of the plant. The observe-discuss-change cycle was passed through several times in order to achieve the best control possible. Also at this time rules were added to control special situations that had not been identified by the pre-project survey. For the cement mills the primary commissioning phase lasted 2 weeks, whilst for the kilns it lasted 5 weeks.

At the end of the primary commissioning phase the strategies were able to control the process for at least 85% of the time but they were not expected to be perfectly correct. Also, the optimisation strategies were normally completed during primary commissioning as it was necessary to have stable control before trying to optimise production.

Further commissioning

During the primary commissioning periods, the strategies were tuned for the conditions prevailing at the time. However, not all possible conditions



The central control room at Deuna.

Table 1. Raw mill production rates and specific power consumption compared with 1998

Mill	Relative production rate (%)		Relative specific power consumption (%)	
	1999	2000	1999	2000
RM1	102.9	103.4	94.6	89.5
RM2	103.1	103.5	94.6	89.6
RM4	102.2	103.0	87.8	84.5

Table 2. Cement mill production rates and specific power consumption compared with 1998

Cement type	Relative production rate in 1999 (%)		Relative specific power consumption in 1999 (%)	
PZ-N	102.9		94.6	
PZ-D	103.1		94.6	
C-DO	102.2		87.8	

were experienced during this period and changed conditions may require the strategy to be tuned slightly differently. It would not have been cost effective for the ABB engineer to remain on site waiting for these conditions to occur and so a secondary commissioning period was scheduled some months later. The secondary commissioning had three purposes, as follows:

- Where necessary, to modify the control strategy in the light of several months of operating experience.
- Tune the optimising strategies to get the most effective operation of the factory.

- Provide additional training to the plant personnel to assist them in becoming self supporting.

Long term maintenance

At the end of the secondary commissioning the long term maintenance of the control strategies was handed over to the factory engineers. In order to assist with this a detailed report on the design of the strategy was produced by ABB. Since that time the strategies have been developed by the engineers at Deuna who have continued to optimise the process and achieve further savings. For example, there are plans to bring the control of the cement mill airflow into LINKman: currently this is under manual control. Airflow control is particularly important when making fine cement.

The benefits

The installation of LINKman showed benefits that exceeded expectations in all areas. Tables 1 and 2 show the power savings and the production increases for the milling systems.

Conclusion

In relationship to the mills, Mr Haufschild of Dyckerhoff stated that "the guarantee parameters were definitely achieved". In relation to the kilns he stated that LINKman provides "improved fuel handling" and "improved quality".

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