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Sucess in Vietnam
Total plant solution for the Cam Pha cement plant

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Success in Vietnam

Introduction

Today, Vietnam is one of the fastest growing economies in the world. In 2008, it had an impressive industrial production growth rate of 17.1%, topped only by Sudan, Azerbaijan and Angola. Following a long history of war and widespread poverty, the last 20 years have seen major growth in all industries in Vietnam. This industrial growth and the ongoing development have unavoidably increased the demand for cement in the country. The total cement consumption in 2008 was 39.1 million t, an increase of 7.7% compared to 2007. It is forecast to rise to around 42 million t this year.

Vinaconex is a Hanoi-based corporation operating under Vietnam's Ministry of Construction. The cement plant was installed at Cam Pha town in the northern Quang Ninh province, which is located at the UNESCO World Heritage Site "Ha Long Bay". It is Vietnam's largest plant, with an output of 6000 tpd, and is part of the plan to meet the increasing demand for cement in the country.

It was Vietnam's first ever packaged project (a total of five packages) and ABB was awarded package number 5, which comprised the complete Industrial^{IT} Solution package with process control systems, Expert Optimizer system for kiln cooler plus mill optimisation, and an information management system. The electrification equipment included HV and MV switchgear, MV power factor compensation, emergency power distribution, motor control centre and uninterrupted power supply. Furthermore, ABB delivered MV fixed speed drives and all the variable speed drives plus LV motors. Services comprised the complete electrical engineering, engineering and design for infrastructure and installation, training, erection supervision and commissioning.

Cam Pha Cement plant.

High voltage distribution system.

Medium voltage distribution system.

Energy distribution

In cement plants, the electrical power received from the high-voltage or medium-voltage grid has to be distributed to the medium- and low-voltage loads. The energy requirement for a cement plant with a capacity of 6000 tpd is in the range of 35 – 40 MVA. This power has to be transformed to the medium-voltage level, mainly for large drives, and further by distribution transformers to the low-voltage level to smaller drives and auxiliary consumers. For operational and safety reasons, a cement plant is fed from the HV grid by at least two independent feeding lines.

High-voltage distribution system

The Cam Pha Cement plant is connected to the 110 kV switchyard overhead lines by means of two 25/30 MVA power transformers. The HV switchgear is air insulated (AIS) and designed for outdoor installation with increased rated voltage to compensate for the high humidity. The switchgear installation contains all the primary apparatuses, control, protection, metering and auxiliary equipment necessary to ensure reliable operation of the installation and a secure supply of electricity. Atmospheric over voltage is limited by means of lightning surge arrestors at the two 110 kV incomings. The switchyard itself is protected by lightning protection wire on top of the structures.

The installed HV components consist of reliable and well-introduced primary parts, such as disconnectors, SF6 circuit breakers, instrument transformers, surge arrestors and earthing facilities etc., which have been installed worldwide under all kinds of climatic and industrial conditions. The altitude of installation is taken into consideration when selecting components. The design of the steel structures, supports, insulators, overhead wires, clamps, strings etc. were also included in ABB's scope of supply.

The protection system for the high-voltage level was executed by programmable electronic multifunction protection and bay control units (REF 542+) of the very latest technology. They are designed for communication links via fibre-optic cables and provide the maximum safety, flexibility and comfort.

Medium-voltage distribution system

The voltage level of the MV distribution system in Cam Pha is 6.3 kV. The medium-voltage switchgear consists of metal-clad freestanding cubicles, designed for indoor installation. The cubicles are equipped with vacuum draw-out type circuit breakers, an air insulated copper busbar system, and subdivided into several compartments, e.g. circuit breaker compartment, busbar compartment, low-voltage compartment and cable compartment.

The circuit breakers are coded and only circuit breakers of identical current and voltage ratings are interchangeable.

The single busbar system of the main substation is designed for 3150 A, the fault level is 31.5 kA. From the MV distribution centre in the main substation, the power is transferred to the 13 local distribution centres, which are as follows:

- LS01: limestone crusher.
- LS02: limestone transport and storage.
- LS03: clay and gypsum receiving port.
- LS04: raw mill.
- LS05: kiln feeding and kiln.
- LS06: cooler.
- LS07: coal mill.
- LS08: cement mill.
- LS09: packing dispatch.
- LS10: dispatching port.
- LS11: transport conveyors.
- LS12: workshop and storage.
- LS13: stacker reclaimer.

Power factor compensation and filtering

To improve the power factor cos ϕ of the entire plant, as well as to reduce the contribution of plant harmonic sources to the voltage harmonic distortion, a central power factor compensation and filtering system was installed at the 6.3 kV level of the plant.

The kiln at the Cam Pha Cement plant.

Low voltage distribution system and motor control centres.

Motors and drives.

The main goals of the PFC and HFS are:

- To improve the overall power factor of the new plant to a level of ≥ 0.95 at 6.3 kV main busbars measured as monthly average.
- To reduce the voltage harmonic distortions caused by harmonic sources within the new plant at the 6.3 kV MV busbars according to limits specified by IEC 61000-2-4 Class 2 electromagnetic environments.

Based on the electrical data of the plant, it was decided that, to achieve the target power factor of ≥ 0.95 lagging for the new plant at 6.3 kV voltage level, approximately 6.2 MVAr capacitive power is needed. In order to provide consistency and identical filter units on both 6.3 kV main bus sections, a total compensation power of 8.0 MVAr was installed.

There are two major characteristics of the PFC-Units, which determine their efficiency in fulfilling the two main goals (improving plant power factor and filtering of harmonics):

- Capacitive power
  - The total capacitive power of 8.0 MVAr has been divided into two equal MV-PFC-Units of 4.0 MVAr and connected to 6.3 kV left and right bus respectively.
- Tuning frequency
  - Proper tuning is essential to assure sufficient harmonic filtering and avoid building of risky parallel resonances. The MV-PFC-Units have been tuned for 150 Hz fulfilling both the above criteria.

These MV filter units are designed to be always connected to the network during normal operation of the plant. This ensures that both the maximum reactive power and reduction in harmonics are sufficiently and permanently achieved.

These can be operated by the central control system or manually controlled based on actual load and power factor conditions.

Low voltage distribution and motor control centres

After the transformation of the electrical energy to the low-voltage level, it is distributed by means of a combined low-voltage switchgear and motor control centre.

The switchgear installed at the Cam Pha plant is an ABB modular low-voltage switchgear type MNS, with intelligent motor controllers type UMC22.

Each withdrawable motor starter module, independent of DOL or reverse starter module, is fitted with a coordinated short-circuit breaker protection, contactor and a programmable microprocessor based motor control unit.

The motor control unit is a completely self-contained unit with a non-volatile memory. No battery back-up is required. The UMC22 detects the actual motor current information, utilising the built-in current transformer unit.

The communication with all other field units within the system is achieved via a fieldbus plug.

Motors and drives

HV motors

All constant speed motors with an output of more than 200 kW are connected to the medium-voltage system of 6.3 kV. Bigger motors, such as the motors for the raw and cement mill, are slip-ring motors and are equipped with over temperature sensors in the stator windings and bearings, vibration detectors and space heaters. The rotor starters are of liquid rheostat type.

Variable speed drives

In the last 20 years, variable speed drives (VSD) have been used more frequently in the cement industry. The main reason was to save energy in the production process. With its latest developments in power semiconductors for medium voltage applications, ABB can offer units with a capacity of up to 20 MVA to the cement industry.

A special challenge in this plant was the VSD system for the approximately 7.5 km long belt conveyor that runs from the limestone crusher to the storage site. The belt is driven by three drives, each of them having a drive power of 490 kVA. Two of these drives are installed at the belt head side, and one is installed at the belt tail side. Due to the various changes of directions

and slopes of this conveyor, it was necessary to develop drive application software, coordinating the three drives at the two ends of the belt, thereby reducing the oscillations of the conveyor belt to a minimum. This application is now significantly extending the lifetime of the conveyor belt, and saving electrical energy.

LV fixed speed motors

All fixed speed drives up to 200 kW are squirrel cage motors according to IEC standards, with insulation class F, enclosure IP 55 and are designed for an ambient temperature of 40 °C. Special explosion-proofed motors were installed in the coal mill area. A total of approximately 110 LV fixed speed motors were supplied for this plant.

Electrical infrastructure systems

The efficiency of an industrial plant is also defined by the appropriate infrastructure installed in the plant.

A reliable plant infrastructure consists of:

- Optimised substation and electrical room layouts.
- Cable engineering.
- Installation engineering.
- Earthing and lightning protection.
- Process and street lighting.
- Fire detection and protection.
- Air-conditioning and ventilation.

Correct dimensioning, smart positioning and adequate technology helps to save money not only in the initial investment but also in the operating costs.

Cabling

In the vast area covered by the new cement line, the energy distribution from the 6.3 kV and 380 V feeders down to the corresponding consumers, including the related process control, earthing and lighting, required an extensive cable network in this plant.

The overall length of installed power and control cables has reached the following approximate amounts:

- MV power cables: 29 000 m.
- LV power cables: 227 000 m.
- Control cables: 433 000 m.
- Special cables: 73 000 m.

For the selection of the appropriate cable type and cross-sections, many factors had to be considered, including ambient temperature, cable laying method, permissible voltage drop, nominal current, cable length, short circuit current, tripping times of protective devices, load flow calculations, harmonic distortion and network grounding. The use of state-of–the-art cable and installation engineering software by ABB has enabled the optimisation of the design.

Process control system

ABB Industrial^{IT} is the industry's first comprehensive and integrated enterprise management and control system. The system offers enterprises such as the means to seamlessly link plant automation, asset optimisation and collaborative business processes in real time. It is designed as a world-class system that scales in both price and performance from small, low-level unit and area automation solutions to extremely large, vertically integrated plant-wide and multi-plant management and control applications. It addresses requirements of both multi-plant economic and production control, as well as the more traditional process plant regulatory control and safety-related applications.

7.5 km long belt conveyor from the crusher to the storage area.

Long belt conveyor to ship loader and unloader.

Central control room at Cam Pha.

The architecture of the control system is organised into four functional groups, from field-oriented controls and supervision towards fully integrated engineering tools:

- Area management and control.
  - Providing a comprehensive set of traditional process, regulatory and sequence control services and I/O interfaces.
- Plant management and control.
  - Providing a powerful suite of products and services for plant management and control, communication networking and network management.
- Human system interface.
  - Providing in a multiple operating environment, a range of products for viewing and accessing data from process control up to plant and enterprise information.
- System engineering and maintenance tools.

- Providing an integrated set of engineering, implementation and maintenance tools designed to support the total automation project, including planning, configuration management, commissioning and system documentation.

The Hardware structure of the process control system can be divided into three autonomous control areas, hierarchically organised in the following levels:

- Level I: process control.
- Level II: operator workstations.
- Level III: management and optimisation.

Control system configuration

The process control system has been configured in such a way that the entire plant can be operated from the central control room. For the crusher, port and packing plant, additional local control rooms with fast Ethernet links over a fibre optic connection were installed to also have local process control functionalities available.

The 19 Control^{IT} AC 800M process controllers are located in cabinets in a room beside the central control room. In this way, the most critical equipment is well protected against dust and high temperatures. As this equipment is located in the same building, they are also well protected against electrical noise. Each controller is connected over a PROFIBUS-DP fibre optic link with the respective remote I/O panels in the different electrical rooms, which are close to the process.

The platform communications are based on two independent networks for optimised availability. The control network connects all the controllers and the connectivity server. The plant network connects all the operator stations, the connectivity and the aspect server. The data transfer between the control network and the plant network is done through the connectivity servers.

For the operator workplaces, the Operate^{IT} Human Interface Portal for Windows 2000 is installed.

Operate^{IT}, the product to supervise and control the process and embedded in the client–server environment of Industrial^{IT}, consists of different packages for workplace management, graphical presentation, alarm and event handling, trend presentation, system status and reporting.

The Aspect Object technology from Industrial^{IT} allows the user to connect different kinds of information to every type of object in the production process, be it a sensor, control loop, motor, drive, transformer or substation. With this concept, access to information for maintenance, system status, logical diagrams and more are made available extremely quickly and easily.

Conclusion

ABB started focusing on Vietnam in the early 1990s, and began to build local contacts and credible relationships within the Vietnamese market. This long-term presence and performance in Vietnam, as well as the proven ability to supply almost the complete scope with its own equipment including related engineering, was key to this success story.

This successful cooperation with Cam Pha Cement has contributed to the upcoming orders for ABB products and know-how to be supplied to the ongoing cement projects of Thai Nguyen, Phu Huu and Binh Phuoc. Today, the brand name of Cam Pha Cement has become popular not only in the domestic Vietnamese market but also in foreign markets in Africa, the Middle East and South America.

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