

Standing the environment

ABBs reliable electrical equipment for Collahuasi open-pit mine

Collahuasi is one of the world's highest, harshest job sites. The landscape is so desolate it is sometimes described as "moon like". Extreme climatic conditions and a low in oxygen environment put thoroughgoing challenges to men and equipment. Since 1995 ABB delivered and installed the automation system for the open-pit copper mine located in the middle of the Andes, in a historical mining area. The latest project, the automation system based on the Industrial IT System 800xA for a crusher including the delivery conveyor, intermediate bunker and a feeding conveyor to the Collahuasi copper processing facility seamlessly integrates with the already installed systems. The project demonstrated the products reliability the high value of customer relationship over time.

Stranded 4,200 to 4,700 meters above sea level in the Andes and surrounded by northern Chile's brutally barren Tarapacá Desert, the Collahuasi copper mine is subject to conditions that are unprecedented, and unrelenting. Breathing is a struggle in the thin air with barometric pressure of about 0.5 to 0.7 bar. Temperatures rarely top 11 degrees Celsius during the day and normally plunge below freezing at night. Ferocious blizzards, lightning storms, and active volcanoes batter the region. There are no

trees, signs of animal life are rare, and humans are almost unheard of—the nearest settlement is nearly 100 kilometers away.

The extreme temperatures and the low in oxygen air put the electrical equipment of the mining machinery to the test every day:

- Extreme high dust formation,
- Vibration, Earth quake,
- Electric storms and extreme thunder storms
- Reduced cooling power
- High range of temperature oscillation between day and night from -20 till + 25 °C

Extensions for new mine

The operating company of the mine, the Compañía Minera Doña Ines de Collahuasi SCM (CMDIC) bears those conditions in mind when placing the latest extension order for the electrical equipment of a crusher and a belt conveyor system: the company decided on an extremely rugged solution with the reliable Industrial IT Extended Automation System 800xA and ACS 6000 water-cooled medium-voltage frequency converters from ABB. A belt conveyor system to transport the mined material consisting of two rising and one downhill belt, an intermediate bunker and three feeder belts completes this order, which is now

successfully commissioned and in operation. The automation system controls and supervises the transport copper ore from a new mine to the existing processing plant.

"The order traces back to the excellent customer relationship over time," explains Horst Mücklich, head of Business Center Foreign Accounts, Center of Excellence Open Pit Mining Germany. "Since 1995 ABB has been successfully working with Compañía Minera Doña Inés de Collahuasi".

The company operates the copper mine in Chile, which is the fourth largest in the world.

The first order to monitor and control the mine's total production on-line Based on an Advant control system. In 2001, ABB received an order comprising drives and ring motors for one SAG mill and two ball mills. In the same year ABB also won a contract for electrical equipment for a large-scale conveyor system, consisting of rising and downhill belts and storage facilities, where supplied five 2 MW motors with ACS 6000 drives.

Latest technology

The heart of the new control system is ABB's Industrial IT Extended Automation System

800xA. For availability reasons the installation is designed redundant, thus including redundant aspect and connectivity servers as well as redundant AC 800M controllers (including redundant power supplies) and S800 I/O, which are connected using Profibus-DP protocol. The system handles approximately 1650 I/O signals and about 4500 alarms and events.

Two operator workplaces are installed in the crusher control room for operating tasks. Five additional workplaces installed in the control rooms serve maintenance and diagnostic purposes.

In addition to engineering, programming and configuration tasks, the experts prepared the complete documentation in English and partly in Spanish. The corporation also carried out the entire production, shipment, all the tests as well as the supervision of the installation, the commissioning and the quality assurance. An important point in this new installation was the integration of the existing Advant control system comprising controllers of type Advant Controller 450 (AC 450) and Advant Controller 110 (AC 110).

The plant was constructed according to the American NEMA standard and not to the DIN VDE standards – another



It is a moon-like atmosphere in an inhospitable environment, where copper is mined in Collahuasi in the middle of the Andes.

Spanning distances is key in Open-pit mining. If braking energy is returned to the power network on downhill belts using regenerative drives, the energy balance is positively influenced.





System 800xA Operations serves as interface to the process. It is available in different languages.

challenge for the German experts in the team, which they accomplished successfully.

Availability is key

"The plant dimensions as well as safety and security issues put several requirements on the control system features and its layout as well as to the installed drives technology," explains *Gilbert Lilienthal*, responsible engineer for the automation project.

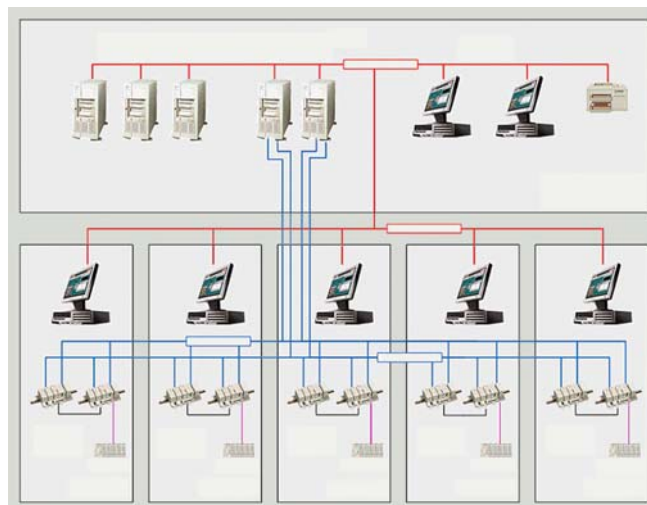
"For availability reasons we designed the control network including the process controllers in a redundant way, due the heavy weight of transported crushed material holds unpredictable risks for accidents."

A redundant switched network as control network and a single switched Client / Server network uses more than 13 km cable to enable information

transfer. In this installation fiber optic technology is the first choice: On one hand the need for repeaters to keep signal levels is drastically reduced and on the other hand fiber optic cable is resistant to EMC influences, e.g. caused by lightning strokes.

The Window to Access

System 800xA Operations user interface enable operators to supervise and maintain the process. Several detailed process displays provide a graphical overview, indicating basic information about equipment status and conditions in configurable colors. Operators may take actions through faceplates, which deliver compressed information about drives, sensors and other devices. User rights prevent non-authorized users access to restricted settings like for example



Redundancy is key to ensure availability of the control system. In this project the control system is designed redundant.

changing tuning parameters, thus keeping the system in a solid state.

National language support is another key feature, due people of different nationalities and therefore with different mother tongues work in the copper mine. Determining through Microsoft Windows language settings pictures and dialogues are available either in English, German or Spanish language.

System 800xA is open to connect to various controllers and control system families like Advant, Melody, Freelance or Harmony using so called Connection Packages. So integration of the existing proven controllers (i.e. AC 450 and AC 110), which were installed in previous steps, become child's play.

Drives integrated

Redundant controllers of type AC 800M execute the application programs to control the application for the crusher and the conveyor belts.

Because of the high power requirement and the altitude of the mine, medium voltage frequency converters of the type ACS 6000 with new low-power modules are first choice. They are interfaced and controlled by controllers of type AC 80. This controller manages access to drive information using fast built-in communication possibilities and fairly eases their integration into the overall control system.

ACS 6000 MD is designed for use under extreme environmental conditions. A total of five 2 MW motors with ACS 6000 medium voltage frequency converters are used in the two rising belts with a length of 234m and 2800m surmounting an altitude difference of 52 and 223 meters, respectively.

Huge energy savings

Three ACS 6000s power another belt conveying the material down an altitude difference of app. 340 meters. The regenerative drives of this belt, which spans a distance of about 5400 m, return braking energy back to the power network resulting in substantial energy saving because it does not waste the energy as heat.

The four-quadrant drive ACS 6000 MultiDrive W provides with direct water-cooling, which makes the converter extremely compact and silent. The enclosing cabinets meet up to protection class IP 54, thus providing the robust design needed for those harsh environmental conditions. Direct water-cooling provides for a much smaller design, saving up to 50% of space. It delivers an extremely low audible noise level and avoids excessive ambient temperature variations. Additionally it reduces the need for high-power filtered air-cooling in the installation rooms. Along with the high efficiency, direct water-cooling offers effective



S800 I/O modules serve as interface to the project. (all figures: ABB)

and easy heat transfer without air filtering problems.

Conclusion

Copper mining in Collahuasi traces back to the Incas; their tools and crucible were found in the area of the mine. Certainly, the amount of copper extracted from the mine is in no way comparable to the figures today, since latest technical equipment (crushers and conveyor belts) and control systems support men to mine the material. ABBs automation technology - including the Industrial IT Extended Automation System 800xA as well as

the robust ACS 6000 MD drives - plays an important role in the Collahuasi mine, due to its reliability in a difficult climatic environment. Since the mine extends over time, the equipment continuously needs to be updated and extended. Solving the later requirement is a highlight of System 800xA, which is open to integrate ABBs proven automation technology released in prior systems as well as third party vendors systems.

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