

CASE STUDY

MINING INDUSTRY

SOLUTIONS

- Solution provider
Rockwell Automation for *VFD and control and BEA for installation, control house, mechanical retrofit
- Variable Frequency AC Drive
 - PowerFlex® 7000 medium voltage drive for 6.6kV with very low harmonic distortion.
 - The PWM rectifier does not require individual isolation transformer, thus saving space, installation effort and fifteen tons of weight.
 - Optimizes conveyor loading by material tracking over several conveyors and speed regulation, dependent on excavator output.

RESULTS

- Operations impact
 - Coordinated start/stop sequences independent of load and without time limits
 - Less stress and wear on the motor, gearbox and belts
- Financial impact
 - VFDs require less installed power (6MW) than fixed speed drives (9MW)
 - Optimized conveyor load and high efficiency drive system reduces energy consumption
 - Reduces stress and wear of mechanical equipment increases availability and cuts maintenance costs

*VFD: Variable Frequency Drive

Vattenfall Europe Mining AG modernizes conveyor with variable frequency drive

VARIABLE SPEED CAPABILITY, COMPACT STRUCTURE AND SUPERIOR LOW HARMONIC DISTORTION MAKE POWERFLEX 7000 AC DRIVE THE RIGHT SOLUTION FOR CONVEYOR MINING MODERNIZATION PROJECT



Conveyors are the most energy efficient means to move millions of cubic meters of overburden over several kilometers at Vattenfall Europe Mining AG's open pit mine, in Germany.

BACKGROUND

When Vattenfall Europe Mining AG (formerly LAUBAG), in Welzow Sud, Germany, decided to modernize the overburden conveyor systems of its open pit coal mine, the main goals were to minimize wear

and to optimize the installed power of variable speed drives.

To reach the brown coal, an excavator removes 60 to 120 meters of surface overburden onto a chain of conveyors that move out of the pit area to a



The mobile conveyor head station with limited footprint and acceptable weight for the complete drive system of up to four 2MW variable speed drives including transformer and switchgear.

stacker. The conveyor is the most energy efficient means of moving the 115 to 119 million cubic meters per year over several kilometers. The conveyor follows the excavator as it moves with the expanding mining area, making the size and total weight of the complete drive system on the conveyor head station crucial to its operation. Excess weight would require significant investment to reinforce the mechanical structure.

CHALLENGE

The traditional slip ring (or wound rotor) motor solution was characterized by high maintenance, a load dependent acceleration with some limitations and no continuous conveyor speed control. The new, variable speed solution had to start and accelerate smoothly independent of load without slipping the belt on the drums, even with overload. The load has to be equally shared on all attached motors at all times, but particularly during acceleration and deceleration.

As weight and cost are key issues, re-use of existing components and lightweight new equipment is essential.

Line side harmonic standards EN 6100-2-4 and power factor (cos (phi)) greater than 0.9 for the operating speed range of 50 to 120 per cent of nominal speed had to be met.

SOLUTION

To meet these challenges, Vattenfall Europe Mining AG turned to technology leader Rockwell Automation and installation experts BEA for the medium voltage drive solution that is lightweight and allows the use of either standard motors or retrofitting existing wound rotor motors at 6.6 kV.

Rockwell Automation leads the trend toward reduced size and weight of drives with its compact Allen-Bradley® PowerFlex® 7000 medium voltage AC drive. The cabinet size on a 1.5 to 2.5 MW

drive is 3.5 to 4 meters and has a weight of 3.5 to 4 tons. The innovative technology of the pulse width modulation (PWM) rectifier impressed Vattenfall Europe Mining representatives. The PWM rectifier does not require an individual rectifier duty transformer. Instead, it operates direct on the 6.3 kV line with a built-in AC line reactor, making the complete PowerFlex 7000 drive system the most compact, the most efficient and lightweight solution that saves approximately fifteen tons compared to previous liquid starters.

The PWM rectifier also provides superior low-line harmonic distortion well within the EN 6100-2-4 and IEEE 519 guidelines, approved by on-site third-party line harmonics. These low line harmonics avoid extra thermal stress in other transformers and motors, and issues with harmonic sensitive equipment.

A unique feature of the PowerFlex 7000 is the innovative PowerCage™, which reduces repair and shutdown time. The PowerCage houses all the main power components in a compact modular package and allows components to be replaced in under five minutes.

RESULTS

Rockwell Automation's drive solution offers significant benefits to the accelerating and decelerating conditions, as well as during continuous operation of the material transportation process. Rocks, water or technical problems can cause the whole conveyor chain to stop up to 20 times per day. The regenerating capability allows a fast and coordinated deceleration without

heating up any braking components and without wasting energy. The coordinated deceleration avoids overloading at conveyor transfer points. Under all conditions, the overhead control ensures balanced load sharing between the two drives operating on a single drum and between separate drums. The ability of controlled and balanced torque, means less stress, wear, and therefore less maintenance on the motor, gearbox and belts. "S" curve speed control during acceleration and deceleration also minimize belt dynamic interaction.

The squirrel cage motors, tuned for VFD operation, have been factory tested at 97 per cent efficiency at nominal speed and load. The PowerFlex 7000 AC drive with PWM rectifier operates at nominal load with greater than 98 per cent efficiency, with the auxiliary power supply and fan included.

The ControlLogix-based "optimized conveyor loading" (OCL) ensures high system efficiency by using a material tracking system across the chain of

conveyors, to continuously adjust speeds so that the conveyor belts are fully and uniformly loaded. A partly loaded conveyor with a higher speed than necessary, wastes energy and causes unnecessary wear. As a result of high efficiency components and OCL, the overall operating and maintenance costs are heavily reduced.

The most important benefit with respect to the overall project costs is the reduced amount of installed drive power. The same conveyor before modernization with conventional fixed speed drives required six units of 1.5 MW each, totaling 9 MW. After modernization, this conveyor with a variable speed solution and a 120 per cent overload / overspeed capability moves at least the same amount of material with only 3 units of 2 MW each, for a total of 6 MW. Additionally, capital investment was reduced by re-using some existing equipment like the 10 MVA transformer.

Reliability and serviceability are key issues for a mining business operating

three shifts, six days per week, where a conveyor breakdown will stop the entire process. On-site medium voltage trained BEA service engineers guaranteed a 4-hour response time and Rockwell Automation provided backup with a Global Manufacturing Solutions engineer, and dial-in access for additional diagnostics capability. Vattenfall Europe Mining AG demonstrates its confidence in the strategic decision to use MV VFD drives for mobile conveyors by the award of two more conveyor upgrade orders to the Rockwell Automation/ BEA consortium.

The results mentioned above are specific to Vattenfall Europe Mining AG's use of Rockwell Automation products in conjunction with other products. Specific results may vary for other customers.

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