ABB Mine Hoist System at Mosaic Potash Esterhazy, K2 Mine

ABB has supplied to Mosaic Potash Esterhazy, K2 Mine, one of the worlds largest, most modern and sophisticated mine hoist systems. With a payload of 45 Tonnes, hoisted at 18.3m/s from 1000m, the new production hoisting system employs the worlds largest single motor drive used on a friction hoist. ABB supplied the mine hoist system on a turn key basis to Mosaic, including all of the electrical, mechanical and control system equipment as well as installation, commissioning, and long term service and support. Follows is a brief description of the ABB systems and equipment used for the Mosaic Project.

Electrical Equipment

AC Synchronous Motor

The electrical powertrain used on the Mosaic K2 mine hoist employs the worlds largest single motor drive used on a friction hoist.

The AC motor is a 16 pole, 8600kW AC synchronous machine. Motor torque is transmitted to the hoist drumshaft through an overhung salient pole rotor. Maximum hoist duty motor speed is 58.71 RPM. The AC motor is 6m high, 5.3m wide, 2m deep and weighs over 107000kg. It was manufactured in Helsinki, Finland and transported to Esterhazy, Sask. via ocean carrier and rail transport.

Direct Torque Control AC Drive

The ACS6000 Direct Torque Control, AC drive system is the most advanced and widely used drive system available worldwide. It is used on mine hoists in every major mining district in the world including Canada, South Africa, Australia, China and Europe. Of special importance to Mosaic is it's low impact on the electric utility network. The electrical network feeding the K2 mine is not so strong. Older style hoist drive systems can cause severe voltage flicker/voltage drops and harmonics on the network and adjacent clients. Dynamic VAR compensation systems such as Statcoms and SVCs are often required to mitigate voltage flicker and harmonics. These systems require a large footprint, are expensive and can be very complex.

The ABB ACS6000 DTC drive system supplied to Mosaic consumes no reactive power maintaining a 1.0 power factor. Additionally, it complies with IEEE Std 519-1992, Recommended Practises for harmonic control.

This means that SVCs, Statcoms and harmonic filters are not required, allowing Mosaic to operate North America's largest mine hoist system in compliance with the electrical utilitie's flicker guidelines as well as IEEE 519 without any Statcoms, SVCs or harmonic filters. This is of great significance for large mine hoist installations such as the K2 project.

Automatic Hoist Control System

The mine hoist and auxiliary systems are controlled by one of the most advanced mine hoist process control systems available. The ABB Hoist Control system consists of local and remote hoist operator stations (PA1/PB1) the main hoist and brake control system (KA1/KA2) as well as an independent hoist safety monitor (UHM). The hoisting process is fully automatic with the primary monitoring station located in the main dispatch building, approximately 200m away. A second station is located within viewing distance from the mine hoist.

Auxiliary Electrical Equipment

The entire hoist electrical system is supplied by a single circuit breaker within the surface powerhouse. From here a single, 15kV armoured feeder cable transports power up the headframe into a 15kV switchgear cell on the hoistroom floor. Contained within this cell are protective relaying and feeders for the drive transformers.

Premium class, ABB Resibloc dry type transformers are used for both main and excitation converters. Pure epoxy resin and glass fiber rovings reinforce the transformer windings, providing an extremely durable winding system. A three winding, 7.5MVA, transformer is used for the main converter.

A low voltage MCC and feeder transformer was also included for auxiliary loads such as oil pumps, cooling fans, etc. Control of this equipment is handled by the ABB hoist control system.

Mechanical Equipment

Friction Hoist

All mechanical components for the hoist were designed using ABB's standard friction hoist design system. The 5.94m friction pulley is a split design and is bolted directly to drumshaft mounting flanges. This highly successful design has proved itself over hundreds of hoist installations worldwide in addition to modern and advanced finite element analysis methods (FEM). The design allows for lowered masses and inertias resulting in lowered peak and RMS motor power requirements as well as corresponding reductions in size and weights of supporting civil structures and foundations.

The drumshaft includes two flanges to fasten the pulley halves as well as three tapered surfaces for mounting (interference fit) of the rotor and two bearings.

The bearings, following ABB's standard design philosophy, are tapered roller bearings designed for an expected lifetime of over 200000 hours (L10). The intermediate bearing is 817mm in diameter and the non drive end bearing is 681mm in diameter. Bearings are oil lubricated and were manufactured by SKF in Sweden.

The bearings and motor rotor are mounted on the hoist drumshaft with an interference fit using oil injection mounting methods.

An advanced bearing vibration monitoring system by DLI Engineering (an ABB subsidiary) was included in the delivery. This system uses triaxial accelerometers and automated bearing wear detection algorithms to determine, very early on, if there is any abnormal wear in the hoist bearings. This on line system is integrated to a remote support and diagnostics system.

Hydraulic Disc Brake System

The brake system consists of two brake discs mounted on the pulley and four brake stands, each of which carries six hydraulic calliper units that act on the brake discs. Control of the brake system is performed by two completely independent electrical and hydraulic control systems. Both systems act to ensure safe and reliable operation under all normal and emergency conditions. These independent control systems each control ½ of the brake system (6 brake calliper units against each brake disc). Control of all hydraulic brake callipers may be transferred to one or the other control system during maintenance. High resolution, redundant pulse encoders mounted on the shaft provide highly accurate speed feedback to the control system to ensure regulated deceleration under all normal and abnormal hoisting conditions.

Remote Support & Diagnostics

A remote support and diagnostics system was installed by ABB Service at the K2 site. The system allows ABB engineers and specialists safe, secure and controlled access to the AC drive system and all hoist control processors within the hoist system. The remote access system allows ABB specialists to run software tools and diagnostic programs in real time, as though they were on site, next to the equipment. Additionally, the system allows the ABB/DLI bearing condition monitoring system to transmit machine bearing condition data to servers at DLI Engineering headquarters for analysis by vibration experts. A combination of regular predictive remote diagnostics and monthly bearing condition analysis, allows ABB to assume a proactive role in the Condition Based Maintenance strategy for the Mine Hoist equipment.

Delivery and Installation

The mechanical equipment as well as the motor and transformers were shipped from a number of European production facilities by sea to Halifax, Nova Scotia, where they were offloaded and shipped by rail to the K2 site. Once at the site, the hoisthouse 50 Tonne overhead crane was used to lift the heavy hoist components from the surface to their final position on the hoisthouse floor.

ABB provided all mechanical and electrical installation services. Installation began with the bearing housings and drumshaft and took approximately two months to complete. Once the mechanical and electrical equipment was installed, pre-commissioning began and took about three weeks, resulting in an operational (with no ropes) hoisting system.

The main changeover from the old hoisting system to the new hoisting system began in middle October 2006 and took about four weeks.

During the main changeover, potash production from K2 mine stopped and a number of significant activities took place, some of which include:

- Shutdown and removal of the existing system: Skips, ropes, drums, motors, shaft, brakes, etc.
- Electrical tie in. Power, control, communications, etc
- Install new deflection sheaves on hoistroom floor.
- Install new headropes and tailropes
- Install conveyances
- Final commissioning.

Production resumed Nov 13, 2006

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