

Global Leaders in Underground Chute Systems



Taking Intelligence Underground

First-of-its-kind ore handling solution puts safety first at one of the world's largest copper and gold mines

Mining companies are digging deeper than ever. And to maximize output, what starts as a pit mine often extends underground.

"As mines get deeper, extraction of valuable ore becomes more costly," said Derek Meloche, manager of business development, Variant Mining Technologies. "In addition, safeguarding personnel from underground hazards is a critical concern."

Located in the Sudbury basin in Ontario, Canada, Variant Mining Technologies specializes in solutions for underground hard rock mining. The company works to solve one of the industry's biggest challenges – moving material underground safely and efficiently. Opportunity at Massive Mongolian Mine

Recently, a leading global mining company engaged Variant Mining to solve an ore transport challenge for a copper and gold mine in Mongolia. The mining company began open pit mining at the site in 2011 and recognized the value that lay deep underground.

"In fact, this site boasts one of the largest known copper and gold deposits in the world," Meloche said. "Specifically, the company approached us to design an ore-pass loading system for underground operations slated to begin in a few years."

Upon completion, the underground mine is expected to produce 95,000 tonnes of ore per day, tripling the current production at the site.

Block Caving Challenges

Transporting ore underground presents significant challenges, depending on the excavation method used. Underground operations at the Mongolian mine will use the "block caving" method. In block caving, a large section of rock is undercut. The ore then collapses – or "caves" – gradually under its own weight.

The resulting rubble funnels through a series of vertical ore passes at various levels in the mine. A chute system is located at the bottom of each ore pass.

"The chute is a device that allows ore to be transferred safely to the haulage vehicles," Meloche explained. "It controls the flow so haulage equipment can be loaded quickly and safely."

Trucks collect the material from a chute at the haulage level and transport it to conveyance systems, which bring the ore to the surface.

Safety First

"Safety is the number one priority for this customer," said Meloche. "They are focused on creating a productive mining environment that mitigates safety risk – and is an attractive place to work."

The project is well aligned with Variant's niche in the marketplace. Traditionally, underground ore chute systems have been viewed as steel fabrications, with very limited control. However, Variant brings control technology to the forefront to help make equipment safer, more efficient and more reliable.

A Two-Fold Control Solution

Successful operation of the ore loading system depends on the coordinated control of the ore chutes and haulage vehicles.

Variant is charged with supplying the ore chutes – and a safety control system that meets functional safety requirements. To achieve a functionally safe system, in this case a system that meets SIL 3 ratings, the design considered the process that encompasses the bin, chutes and trucks.

The control system is built on a Rockwell Automation® platform featuring Allen-Bradley® Compact GuardLogix® safety controllers, Allen-Bradley POINT Guard I/O™ modules, and HMI based on Allen-Bradley PanelView™ graphic terminals.

The system is designed with a GuardLogix controller and HMI in each chute and aboard each truck. For fail-safe communication, the integrated system uses the CIP Safety™ protocol running on an EtherNet/IP™ wireless network.

“We have a history of working with Rockwell Automation during our design process,” Meloche said. “We’re a relatively small company developing state-of-the-art solutions, so we rely on the core competence of our larger group of companies and supply chain to support the development our solutions.”

Enabling Smart Technology

To optimize the system, Variant incorporated several technologies that are not new in other industries but new to underground mining. For example, the vehicle detection system in the chute loading area detects a truck’s presence and position – while RFID technology determines the vehicle model and type.

“This technology – and CIP Safety over wireless – allow operators in the truck cabs to control the chutes in a safer manner,” Meloche said. “The chute will not operate unless a haulage truck is present and in the correct position. Jeeps or other vehicle types cannot trigger operation.”

The system also includes fallen object protection. A gate at the end of the chute contains any loose rocks from the previous load to help safeguard approaching vehicles and personnel.

“And our system monitors the ore bins associated with each chute

to make sure they don’t run empty,” Meloche said. “We keep material in the bins at all times to serve as a buffer – so ore falling 150 feet doesn’t come out of the chute like a rocket.”

On the mechanical side, Variant designed the chute with a large, 5’ X 10’ (1525 mm X 3050 mm) opening to improve throughput and minimize the risk for hang-ups.

Exceeding Expectations

Variant’s initial contract includes five systems. The final mine plan will have as many as 30 chutes distributed underground – and up to 40 surface and underground haulage trucks for loading.

“We tested the first system onsite here in Canada,” Meloche said. “We fully assembled the system and ran it for a month. The customer was very pleased with the results they saw at our facility.”

The initial system has shipped to Mongolia and is awaiting underground installation.

In addition to enhancing operator safety, the ore handling system is designed to optimize mine throughput. When installed, each chute is expected to achieve a maximum instantaneous flow rate of 10,000 tonnes per hour (tph). Variant anticipates the system will enable significantly better traffic control and equipment utilization than other systems on the market.

“Overall, mining companies are most concerned about safety – and productivity,” said Meloche. “Our safety-rated SIL 3 system is designed to improve both.”

This truck loading control system is currently patent pending.

