

PdM Success with Azima DLI Methodology

Implementing Vibration Analysis to Protect Mines and Miners in New Mexico

Background

The San Juan Mine is a “longwall” coal mining facility located in northwest New Mexico and began production in 1973. San Juan Mine’s annual capacity is 6.4M tons and has about 100 pieces of equipment as part of their PdM program. San Juan has a team of maintenance engineers dedicated to ensuring the mining operations are running smoothly and safely at optimum capacity.



Working with Azima DLI to implement a predictive maintenance program, San Juan Mine was able to immediately spot

two potentially catastrophic conveyor issues. Either one of these issues, if left undetected, could have cost the mine more than \$100,000 in repair expenses and lost productivity.

Early detection allows San Juan Mine to research a solution and schedule the maintenance on their own time, allowing for minimal disruption of ongoing operations and lowering the cost of maintenance. In addition, by identifying machine imbalances before they reach the failure stage, San Juan Mine is protecting the health and safety of its mine workers, potentially saving lives, avoiding injuries, and saving millions in lost productivity.

Challenge

Longwall mining utilizes an underground section of earth roughly one-mile-long and a thousand-foot-wide. Shearing off individual “slices” about a meter thick, this mining facility processes each of these thin “long walls” of earth for coal, and then allows the leftover rock to collapse, eliminating the potential for aboveground cave-ins and erosions. Average longwall production rates of 3,500 tons per hour or higher can result in mine revenue of \$300,000 for a single eight-hour shift. A serious mechanical failure can cost the mine up to \$6 million for a one-week shutdown.

Prior to engaging with Azima DLI, San Juan Mine had hired a company to provide vibration analysis services, and the San Juan team felt the need to get certified in vibration analysis to be able to interpret the results.

“That was a red flag for me” said Paige Maile, sales engineer at Azima DLI. “Vibration analysis service providers should be able to provide clear diagnoses and recommendations that allow the customers to take action immediately.

Vibration analysis is Azima DLI’s key focus and competence, according to Maile. Helping customers quickly and proactively identify maintenance issues early on helps them avoid failures, and allows them to plan and schedule maintenance to reduce costs and minimize impact on plant productivity. Key to this ability to help customers is the expert analysis and interpretation of vibration data delivered by Azima DLI’s analysts.

“At Azima DLI, we focus on ease of understanding,” said Maile. “We help our customers find out what’s broken and how to fix it. We want our recommendations to be clear and easily actionable. Our analysts are the best out there – experts far beyond other service providers. To me, San Juan wasn’t getting that expert analysis from their previous service provider.”

Safety in a coal mining environment remains a paramount concern for miners and operators: the flammability of coal dust and the dangers of underground mining means that stringent care of machines and plant environment preserves the safety and lives of workers. To address safety concerns, San Juan Mine engaged with Azima DLI to conduct an onsite trial deploying a hybrid predictive maintenance program for vibration analysis on their machinery. This involved training San Juan Mine mechanics to collect the data and use the professional analysts at Azima DLI to remotely interpret the data collected and make recommendations.

Solution

Azima DLI analysts conducted a survey and analysis of the San Juan Mine’s facility machinery as a preliminary demonstration of Azima DLI’s root analysis and predictive maintenance techniques.

Normally during a first-day demo, analysts shy away from exploring complex machinery such as gearboxes and conveyors, but at San Juan Mine, the Azima DLI analysts recognized the crucial role of conveyors in this longwall mining facility and decided to tackle them anyway. Within a single day, Azima DLI analysts caught two severe faults that had not been previously detected. Left unchecked, these problems would have inflicted severe damage on the conveyor and shut down the plant for approximately a week during repairs.

Results

Quick Win #1: Drive Motor Gear Pulley

The first fault Azima DLI analysts caught during their demo analysis showed elevated harmonics on a drive motor gear pulley in the coal processing plant. The pulley also showed impacting at the head roll coupled-end bearing. The increased speed of the head roll indicated a serious to extreme bearing fault. The initial report presented by Azima DLI analysts after the first day “allowed us to plan the repair at a convenient time for the plant maintenance department,” said Steve Pierro, superintendent of the conveyance system at the facility.

The quick catch allowed mine personnel to repair the fault without any risk of fire or safety. If this fault had been allowed to progress, mine personnel would have had to shut down the conveyor for up to a week, causing a considerable loss in productivity and revenue.

Quick Win # 2: Underground Conveyor

The second critical fault Azima DLI analysts uncovered involved the pulley frame on the one of the underground conveyors. Pre-shift inspections revealed a slight vibration at the location of the head pulley and snub pulley mountings. At first, it was unclear whether the A-frame foundation had loosened, or if the vibration was due to an issue with another bearing. The analysts collected data from all four bearings mounted on the A-frame. They pinpointed the source of high energy impact and short high frequency events: rolling element bearing wear on the snub pulley. The rolling element bearing suffered water and coal damage, developing pitting and spalling. The damage was concentrated on one side of the bearing, which proved to be a crucial detail when analyzing the root causes of the problem.

A group of subject matter experts met to perform a root cause analysis on both bearing failures. Both bearings showed signs of coal fines contamination and water infiltration around the seals. After thorough investigation it was decided to change to a heavy-duty aluminum complex grease specifically formulated for construction and heavy industrial equipment designed to handle the harsh environments within the underground coal mine.

Protecting the health and safety of miners

Predictive maintenance through vibration analysis can do more than reduce maintenance costs and safeguard plant productivity. When it comes to underground mining, as well as many other industries that are reliant on heavy equipment and large-scale mechanical processes, machine failures can create dangerous, even fatal conditions.

At the San Juan coal mine, faults in mining equipment and conveyors can potentially result in catastrophic fire and explosion, risking lives and harming production. The damage would also expose the above-ground plant and its workers to the risk of fire or explosion.

By catching these faults through vibration analysis, San Juan Mine averted a potential safety hazard and ensured continued production and distribution of coal.

The predictive maintenance team at San Juan Mine is tasked with maintaining its high standards of safety in its underground mining operations, and in its aboveground coal processing facilities, as well. Coal processing and production carries an inherent risk, since coal dust can be explosive, and processing facilities handle mountains of coal alongside a system of conveyors that transport the coal to transfer towers.

Mechanical failure, whether under- or above-ground, can be catastrophic to production, as well as to human life and safety. The San Juan team determined that a maintenance program using predictive vibration analysis would be the best fit for the site's application and needs.

“In an underground coal mine environment, predictive tools help protect the health and safety of miners by providing early warning of potentially catastrophic events, involving fire and explosions,” said Steve Pierro, superintendent of the conveyance system at the facility. “The most important outcome of this project is prevention of mine fires that ultimately protects human life.”

Benefits of Predictive Maintenance Programs

Maintenance strategies built on root-cause analysis minimize the risk of the reoccurrence of similar faults in mine machinery. After the initial analysis, Azima DLI analysts returned to the mine to place over 215 strategic vibration collection measuring point fixed pads, junction boxes, and remote sensor lines in order to maintain stringent machinery monitoring.

Azima DLI analysts also trained personnel to operate their TRIO™ data collectors, ensuring personnel independence and another level of vigilance safeguarding secure and efficient mine production. Azima DLI continues to monitor, analyze, and recommend actions regarding the information mine personnel upload to the Azima DLI cloud database and the WATCHMAN™ Reliability Portal.

By early detection of faults, even before being noticeable by the human senses, the vibration data can give facilities the time to plan and schedule repairs well before production is lost and expensive secondary damage occurs. For example, when the vibration data indicates a problem, maintenance staff will now have time to investigate and answer questions, such as: “How do we change this bearing in place, instead of replacing the whole rotor?” “This bearing is no longer available from the manufacturer, where do we find a compatible replacement?” Predictive maintenance gives teams time to answer these questions and make cost-efficient repair decisions, rather than scrambling and making rushed decisions due to the emergency of a breakdown.



Taking a Hybrid Approach to Collecting and Analyzing Vibration Data

Depending on the needs and capabilities of each client, Azima DLI offers three basic programs to manage the collection and analysis of vibration data: fully in-house, fully outsourced, or a hybrid program utilizing both in-house and outsourced resources. The in-house program includes a fully insourced program that requires data collecting personnel, vibration analyst specialists and the equipment to collect and analyze the data. The fully outsourced contracted program requires contractor travel expenses, contractor access to the plant and there would not be anyone on-site in the event spot check data would need to be collected.

San Juan Mine chose the hybrid approach because it allowed them to train their own mechanics to collect the data, while using trained professional analysts to remotely interpret the data collected. Vibration surveys are scheduled and collected with expert analysts interpreting the data and maintenance personnel can access the reports through a web based portal.

Significant Return on Investment

It was expected that the San Juan Mine's program would pay for itself in the first year due to maintenance cost avoidance alone. Having sufficient time to plan changes of major roller element bearings that show signs of imminent failure through the vibration analysis on conveyance equipment can result in monetary savings of \$300,000 for a single 8 hour shift.

So far, according to Azima DLI's Maile, San Juan has been able to achieve a nearly 7 to 1 Return on Investment (ROI) ratio, meaning that for every dollar they have spent on the vibration analysis program, they have been able to save or recoup eight dollars, through lowering the cost of maintenance and avoiding costly machine breakdowns.

"Being able to be proactive allows us to prevent unexpected and premature failures," said Pierro. "Through the use of the vibration analysis program, the life of machinery can be extended reducing costs and warehouse inventory. Initiating a comprehensive vibration analysis program in an underground environment can be extremely advantageous by improving safety for underground miners and profitability for the company."

San Juan Mine has done more with its vibration analysis program than just "checking the box," said Maile. "They have made it a point act on every recommendation their Azima DLI analysts make. This has allowed them to make necessary adjustments and avoid costly unexpected failures. They trust predictive maintenance, and they're benefiting from it."

Azima DLI Methodology: Vibration Condition Monitoring

After reviewing available vibration monitoring solutions, San Juan Mine selected to work with Azima DLI based on the expertise of the vibration analysts. The solution incorporated a number of features which would help the team be successful including:

Rapid data collection: Triaxial simultaneous data acquisition allows vibration data to be collected in three directions in less than 20 seconds per test location (for a typical 3,600 rpm machine).

Accurate and repeatable results: Test location attachment pads with a screw-mounted connection is the most accurate means of collecting repeatable vibration data, especially in the higher frequencies. The bronze pads have an alignment notch to orientate the triaxial transducer and threaded captive screw for fast connection.

Automated diagnostics to identify pending problems: All vibration monitoring programs utilize some sort of data screening technique, either enveloping or mask alarms. Azima DLI uses its vibration analysis software called ExpertALERT™ that uses statistical analysis to compare accumulated average baseline signature against the test data and a diagnosis is rendered.

Expanded visibility across teams: With the WATCHMAN™ Reliability Portal, maintenance staff can access machine tests, results and maintenance recommendations 24/7/365 through a simple web-based interface. The Portal delivers high level performance analytics and executive summaries as well as allowing users to drill down to machine specific data.

About Azima

Azima is the leader and premier provider of predictive machine condition monitoring and analysis services that align with customers' high standards for reliability, availability and uptime. Azima's WATCHMAN Reliability Services utilize flexible deployment models, proven diagnostic software and unmatched analytical expertise to deliver sustainable, scalable and cost-effective condition-based maintenance programs. The company's bundled solutions enable customers to choose comprehensive, proven programs that ensure asset availability and maximize productivity. Azima is headquartered in Woburn, Massachusetts with offices across the U.S. and international representation in Asia-Pacific, Central America, Europe, Middle East and South America.