Keeping the Largest Machines Moving

In addition to routine maintenance, planners should consider new motor and braking technology during upgrades

BY STEVE FISCOR, EDITOR

The 8200 above is one of the four draglines Flanders has converted from DC to AC power.

Draglines are not only some of the most efficient tools for moving material, they are likely the oldest continuously operating machines in the mining business. That's a testament to the original engineering and design and current maintenance programs.

Technology has evolved substantially as these machines have aged. Unfortunately, slack market conditions prevented mine operators from making all the changes they wanted to over the years. In many cases, maintenance programs were focused on simply keeping the machines running as well as possible for the least amount of money.

There are a couple of options available today as far as motors and braking systems that could reduce the downtime associated with maintenance at a relatively low cost. They also have side benefits of standardization, which speed maintenance processes and reduce the parts inventory at the warehouse.

Power System Considerations

As draglines age, there are some major concerns from an electrical perspective. "When you look at the age of the global walking dragline fleet, about 75% were built between 1968 and 1988, so the bulk of the world's fleet is around 40 years old," said Mike Casson, global mining manager for Flanders. "Most of these draglines are still operating with the original DC technology."

Flanders is one of the only service providers in the dragline industry to offer a complete, comprehensive range of options from basic repairs and troubleshooting to new controls and rotating equipment, upgraded DC performance options or a complete AC conversion.

At some point, considerations change from regular maintenance to rebuild. Maintenance planners use different inputs to balance those decisions. Casson reminded everyone that there is no "one-size-fits-all" solution. "We have converted four draglines from DC to AC power and have a fifth AC conversion in process," Casson said. "AC has proven to be by far the lowest cost of operation and the most productive option, but it can be expensive and it's not the right solution for every operation."

Life of mine is probably the most significant factor to consider, but it all boils down to the cost per bank cubic yard, Casson explained. "A mine with 15 years or more of life can significantly reduce their

cost per bank cubic yard with a variety of upgrade options, while a mine with only a few years left may never receive the return on investment," Casson said. "Almost every mine, however, can still reap some benefits from improved reliability and performance, even in the short term, with DC upgrade options."

With modern computerized maintenance management systems (CMMS), it is easier than ever to track direct costs of maintenance and repairs. Couple that with a study of historical data for the cause and duration of both planned and unplanned downtime, a planner can develop a very good picture of problem areas to focus on and begin to seek proper solutions, Casson explained. "The cost of unplanned downtime and lost production is almost always the real cost to focus on and far outweighs the direct costs from a maintenance standpoint," Casson said.

Depending on the actual upgrade performed, the downtime can vary from a few days to several weeks. "Almost all electrical upgrades, however, can be performed within a planned shutdown window established by mechanical maintenance requirements," Casson said. "The electrical portion of a dragline shutdown is almost never the critical path for the total duration."

A couple of years ago, Flanders developed a new, complete dragline control platform that can be used for both AC and DC machines. The company is currently partnering with a company that operates multiple draglines to develop adaptive control technology for various portions of the dig cycle. "We are very early in this development, but in cooperation with this end-user and taking a holistic approach to the dragline, we have already identified actionable opportunities to decrease cycle time significantly while still protecting the machine," Casson said.

Braking Technology Contributes to Efficiency

When Rick Kallenborn, North American regional sales manager for Hilliard's motor control division, thinks about aging draglines, his immediate concern is the loss in efficiency. The efficiency of the machine has a direct relationship with costs, Kallenborn explained, especially costs associated with downtime due to the older, antiquated equipment.

For draglines or other equipment, such as electric shovels and mills, Hilliard offers a line of caliper-style brakes. "These brakes are way more efficient than the original methods of braking, such as plate brakes, band brakes or shoe brakes," Kallenborn said. "Plus, finding replacement parts for those older systems is becoming more and more difficult as far as who is still supplying them if they are even available."

On a dragline, the brakes are responsible for managing the three motions: hoist, drag and swing. During one of his recent projects, one of Kallenborn's customers was experiencing serious issues with the dragline's swing brakes. "This operation walked their dragline a lot — like every other week — from one end of the pit to the other," Kallenborn said. "The swing brakes hold the boom in place. When they were walking the machine, the boom was moving more than it should because the brakes were unable to hold it. This was a serious concern. If they suspect the boom has been damaged, they would have to bring it down and have it inspected, which can be expensive."

Hilliard installed a new set of caliper brakes and the mine is no longer having issues. "They are still walking that dragline a lot, but now the boom is secure," Kallenborn said. This is a serious safety issue and an insurance concern. If the boom hits something, they have to bring it down and get it inspected, which is time consuming and expensive.

When it comes to replacing the braking systems on a dragline, maintenance planners face a similar set of considerations based on costs and the life of the mine. Parts availability could hasten that decision. "Once they see the advantages of the brake upgrades, the decision becomes much easier to justify," Kallenborn said. "One major advantage is in parts inventory."

Kallenborn sells one braking system that can be used for all three motions. The mines only keep one or two calipers in inventory and they only need to stock one type of pad. Previously, the warehouse would stock different size brakes for every motion. "Mines are very conscious of inventory these days," Kallenborn said. "Now they only have to carry one or two brakes to service the dragline."

The Hilliard brakes are spring-applied and pneumatically released. Acknowledging that the braking technology for the drag motion differs from the swing motion, Kallenborn explained that they adjust on the dump side to allow the brake to function as it should with the proper torque. "For the drag motion as an example, when the brake needs to be applied, the system dumps all of the air right away. The brake comes on at full force and holds what it needs to hold," Kallenborn said. "For a swing motion, we restrict the passage of air and dump the pressure slowly."

The initial cost for a caliper system is more than a regular brake replacement,

The same type of Hilliard brake, a caliper that is spring-applied and pneumatically released, can be used for all three motions.

but the longevity and stocking fewer replacement parts amounts to less money. The pads are the only replacement parts. "The time invested to make this change is minimal," Kallenborn said. "Maintaining several different types of brakes could take hours, where calipers are very quick."

Ideally, Kallenborn would like to replace the brakes on all the motions at once during the next planned maintenance event, but most mining companies opt to solve the glaring problems first. In the case of the mine that couldn't hold the swing motion, they were also having problems sourcing parts, Kallenborn explained. "They decided to take care of the swing motion first," Kallenborn said. "Now, they have budgeted brakes for the next time they service the drag and hoist motors. This rationale also applies to electric shovels."

Another important fact to consider: There is no need to rebuild a Hilliard braking system. "On some systems, there may be an occasional thruster issue and we just replace them," Kallenborn said. "With the calipers, it's routine pad wear. As long as the air gaps are checked routinely, there are no issues. Some mines assign that task to the electricians because they are already looking at the motors regularly."

"We have customers who haven't had to do anything on their brakes for five to seven years," Kallenborn said. "They installed them and haven't given them a second thought."

Kallenborn is passionate about the new Hilliard design. "We listened to our customers at the mines and incorporated those changes into certain aspects of the caliper design to make them more user friendly," Kallenborn said.

Downtime on a dragline is very expensive. Now that markets have improved a little, maintenance planners are looking for efficiency upgrades to dig faster and move more overburden. Taking brake and motor maintenance off the table, they can focus their attention on other areas.

Cloud Peak Generates Compelling ROI with Synthetic Main Dragline Pendants

Cloud Peak Energy installed the first set of synthetic fiber main boom pendants on its Marion 8200 dragline two years ago — with numerous benefits demonstrating a compelling return on investment (ROI), according to Applied Fiber. The first system recently completed the second annual inspection and shows that it is on track to far outpace the life of steel wire in this rigorous application. With both an increase in production and substantial reduction in boom cracking, Cloud Peak Energy has since converted two additional draglines to Applied Fiber pendants.

These synthetic main boom pendants provide better dampening to system movement.

The main pendants support the massive boom and loading bucket on dragline. The conversion from steel wire pendants to synthetic fiber pendants has provided numerous financial and operational benefits — attributed to the dramatic weight advantage and dampening characteristics of synthetic fiber. These synthetic main boom pendants are made with Dyneema DM20 fiber, which is seven times stronger than steel wire rope at the same weight, providing exceptional dampening to system movement. The highly analyzed and engineered offering nearly mutes normal pendant and boom bouncing, addressing many historical issues with dragline boom fatigue.

"This is not just a change of material, from steel wire to synthetic rope. These pendants are a productivity tool and have provided advantages from day one. They have increased capacity of the dragline, reduced the stresses on the overall system, and provided numerous operational and financial returns that were not expected" said Jim Pumphrey, vice president of industrial products for Applied Fiber.

Cloud Peak has wasted no time taking advantage of the benefits as they have recently outfitted two more draglines in their fleet with fiber main pendants. In fact, they retired a set of steel pendants two years early to realize the gains generated from Applied Fiber pendants.

"Cloud Peak predicted and now has validated through actual performance an ROI in less than two years," Pumphrey said. "While no two mines or pieces of equipment are exactly the same, the returns and benefits are quantifiable. We have worked with our customers and industry experts to define the benefits of a conversion to synthetic pendants and developed an ROI calculator for our clients." In addition to reduced maintenance, elements such as increased payload, extended pendant life, deferred boom laydown, etc., are all considerations for the ROI calculator and help mine owners, maintenance and production managers make informed decisions."

Applied Fiber manufactures the fiber pendants from a specialized production facility, integrating the termination/end-fitting technology with a production-testing process to ensure the pendant ropes are perfectly matched in length and tension to carry out this high load, high-cycle application. The test bed is 183 m (600 ft) long and has capability to tension and pre-stress pendants to nearly 950 metric tons or 2-million-lb tension.