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upfront

MAINTENANCE

It pays to appraise

Early planning promises myriad benefits for BHP Billiton's Jansen project

by Ian Ewing

Courtesy of BHP Billiton

BHP Billiton's multi-billion-dollar Jansen potash project under construction in September 2012

BHP Billiton is not taking any chances with maintenance planning on what could become one of the world's premier potash mines. Tens of millions of dollars are at stake in potential unforeseen parts, labour costs and lost productivity over the life of the site. To minimize its maintenance risk, increase cost planning certainty and test processes and equipment before they become entrenched, BHP Billiton has engaged consulting firm ARMS Reliability to perform early asset reliability analyses for its Jansen project, situated 140 kilometres east of Saskatoon, Saskatchewan.

The goal of asset reliability analysis is to predict and then minimize lifetime maintenance costs and downtime, but by starting the process at the prefeasibility stage rather than at the execution stage, the results can be implemented with more ease and less impact on cost. The information provided will assist the BHP Billiton team in its plant design decision-making process.

"We were able to provide them with maintenance budget predictions, and also some production predictions," explains Jason Ballentine, engineering manager for North America at ARMS. "It's not so much what we're doing that's unique. It's the fact that they've applied it at very early stages of the project."

The methods that ARMS Reliability and BHP Billiton are using for the Jansen mine are becoming increasingly common across the rest of the mining industry but have been slow to be adopted in potash, partly because Jansen will be the first greenfield potash mine built in over 30 years.

Ballentine says companies fail to understand how asset reliability analyses can provide value early on in the process. "They're sort of focused on executing and getting the plant up and running, and they kind of forget about some of the long-term operability of the plant and the influence maintenance can have on the actual production and the design," he explains.

Detailed analysis

Once process flow sheets had been created in prefeasibility, ARMS began making reliability block diagrams (RBDs) using a powerful reliability simulation tool. Preliminary process flow diagrams were used to model the relationships between the major pieces of mechanical equipment in the process. In one section of the model, for example, material from a single wet sizing screen feed distributor is split into two paths, heading to another feed distributor and a secondary feed distributor. From those two points, the material is routed to one of four wet sizing screens, each of which sends output material into one of two secondary cage mills. Each component has a probability of failure associated with it. Simulations of the process

were performed using this detailed model; rough performance predictions could be made and capacity losses due to particular pieces of equipment quantified.

As the project progressed into the feasibility phase, process flow diagrams were revised, equipment selections were made, and equipment vendors were chosen. ARMS began identifying the individual failure modes of the main process equipment. By the time the initial feasibility stage was complete, nearly 6,000 failure modes – specific ways equipment could fail – were identified in the process plant, and nearly 4,000 more below ground. For each failure mode, a probability was assigned, based on a combination of manufacturer data, industry experience of the teams at BHP Billiton, as well as ARMS' library of data gathered over the last 10 years.

Planning and due diligence

The analyses informed the team about how much inventory they would need for spare parts, and will eventually let them know what their critical spares will be. They also included major scheduled maintenance and generic maintenance tasks, and considered storage and surge buffers, which allowed ARMS to predict the total availability of the plant and to verify that the plant would achieve its designed throughput capacity.

"Because we've considered all the possible maintenance failures, we've considered the maintenance outages, and we understand that it is possible to get what we're promising," says Ballentine.

The solid data behind such predictions affords BHP Billiton an envious level of certainty in cost planning – plus or minus 15 per cent for maintenance budgets and labour requirements at the feasibility stage. Ryan Posnikoff, BHP's principal mechanical engineer for the project, says it helps the company know what it is getting into: "It's part of the puzzle."

Influencing design

The benefits of early reliability studies extend beyond cost planning and productivity verification. They also allow reliability and maintenance planning to influence the plant design. By showing very early on what the major sources of downtime in a process are expected to be, the model can point to helpful design modifications when they can still be easily implemented.

One such modification on the Jansen project was with the baghouses, used for removing particulate from the air. During the initial process modelling, the baghouses unexpectedly stood out as one of the biggest causes of downtime. A baghouse shutdown, once the site reaches its full proposed capacity of eight million tonnes per year, could cost BHP Billiton as much as an estimated $100,000 per hour, depending on the facilities that are affected.

"We didn't want to have to stop the whole process just to go in and see if there was a bag blown because we have a pressure drop trip," explains Posnikoff. "Or, alternatively, shut the unit down and keep running, risking creating a really dusty environment in the plant."

With the problem identified, the BHP Billiton team consulted a potential vendor, who was able to take the large baghouses and subdivide them into four smaller compartmentalized units. It was then possible to isolate any one of the four, and still run on the remaining three with adequate capacity.

"We changed our baghouse strategy everywhere we had one, and basically took it right out of the picture in terms of maintenance," says Posnikoff.

The long game

The legacy of this reliability planning will be apparent in the Jansen project's future day-to-day operations, as data compiled now will propagate through the operating and maintenance plans. Equipment data sheets and procedures for routine inspection and maintenance will be available when work orders are created, and the software will be used to create schedules to plan the preventive maintenance program. As the real-world operational history increases over the life of the mine, more data will become available for each piece of machinery. Modifying the model with this observed data will further improve reliability predictions and maintenance planning. The model can also be easily modified to analyze what-if scenarios regarding process changes.

The ability to justify design decisions, make accurate cost and productivity predictions, and easily modify maintenance procedures throughout the life of the plant will place BHP Billiton's first-ever potash mine well against entrenched competitors. And it seems like a worthwhile investment. Ballentine notes that with the high cost of downtime, the eventual savings for BHP Billiton could well be 10 to 20 times the value of its contract with ARMS.

For his part, Posnikoff is proud that his company is ahead of the game. "My hope, and my full expectation, is that we're going to bring a step change in maintenance processes to Saskatchewan," he says. "That's part of our plan – to be a lower-cost producer – but it's also part of our plan to attract people." CIM