Newcastle Coal Infrastructure Group (NCIG) implements a condition based maintenance solution

The Integrated Condition Monitoring (ICM) solution by Rockwell Automation provides 24 hours a day, seven days a week coverage of the coal loading operation to minimise unplanned downtime and help improve overall productivity with minimal onsite personnel.

Solutions

Integrated Condition Monitoring (ICM)

- Allen-Bradley® accelerometers and temperature sensors were used to measure vibration and temperature.
- XM® series dynamic measurement module provided real time processing of critical parameters.
- ControlLogix® and Integrated Architecture platform.
- Ethernet communications.

Condition Monitoring software

- Emonitor® software was used to capture and store vibration information.

Results

Reduced downtime

- Significant savings annually in unplanned downtime by detecting approximately 10 impending failures per year at an average repair time of 10 hours per incident.
- Emonitor software is key to success of the system by providing both historical and real time data analysis allowing quick decisions to be made for preventative action.

Minimum support requirements

- Integrating the Condition Monitoring system into the control system provides automated alarming and analysis, which requires minimal support and helps keep engineering support costs to a minimum.

Overview of NCIG Terminal

Background

The Port of Newcastle is the largest bulk shipping port on the east coast of Australia and the world's leading coal export port. Newcastle Coal Infrastructure Group (NCIG) owns and operates one of Australia's major coal export terminals with proximate rail, storage and shiploading facilities and associated infrastructure.

NCIG's terminal has been operating since 2010 and services coal mines in the Newcastle, Hunter Valley, Gunnedah, Gloucester and Western Coalfields of New South Wales by providing access to port infrastructure to export mainly their thermal and sometimes metallurgical coal production to the world market.

To meet the requirements of growing exports from the Port of Newcastle, the Terminal was expanded to provide an overall export capacity of 66 million tonnes per annum (Mtpa) in June 2013.

A key focus of NCIG's operational strategy is to operate continuously, 24 hours a day, seven days a week, with the minimum number of staff. To achieve this, the latest integrated control systems were required to provide site wide access to condition monitoring data in a timely manner. The Integrated Architecture® platform from Rockwell Automation allows for the seamless integration of vibration and temperature monitoring sensors, providing the capability for NCIG to implement a preventative condition based maintenance strategy.

Predictive Monitoring perfection

There are three key components of the NCIG terminal; the inbound system, stockyards and outbound system. The inbound system unloads trains and feeds coal into the stockyard area, it incorporates rail sidings and rail balloon loop, dump stations and two inbound sampling stations. There are five stockyards in total with four combined stacker reclaimers. The stockyard provides for stacking coal, then storing the coal before reclaiming the coal to send to the wharf. The outbound system loads coal into vessels and incorporates two buffer bins, two outbound sample stations, two shiploaders and three wharves.

The key objective of the condition monitoring solution was to provide an automated system that can help predict system failures and prevent and minimise downtime. According to Scott Liddell, senior electrical engineer at NCIG, "We load coal into our ships at around 10,500 Tph so every minute that we are down from an unexpected incident results in the loss of approximately 175 tonnes of coal. Each hour of downtime costs a whole train full of coal so we needed a reliable system that could predict any failures before they occurred."

The Rockwell Automation XM® Series of Intelligent I/O modules were used to provide real time processing of critical measurements used in assessing the health and predicting the future health of the system.

"The Condition Monitoring system deployed on site uses around 2,200 field sensors to provide an advanced warning if something is about to go wrong, allowing scheduled maintenance to be performed to avoid the costly downtime associated with unplanned stoppages across the whole plant," said Gavin Black, Product Manager for CompactLogix, SLC, KNX and ICM at Rockwell Automation.

The Allen-Bradley accelerometers and temperature sensors are the two main types of field sensors used to measure vibration and temperature. These sensors were wired back into the XM series dynamic measurement module and connected via Ethernet to the ControlLogix® automation controller to rapidly transfer information from the field module.

The Rockwell Automation XM system provides vibration data to the control system in multiple parameters including overall vibration, spike energy and frequency bands. The overall vibration levels provide a general condition of asset health, whilst the spike energy and frequency bands are specific to fundamental frequencies, providing both process and maintenance intelligent advisories when changes occur.

Software saves downtime

Condition monitoring data is used by the plant SCADA (Supervisory Control And Data Acquisition) system to display in real time the vibration and temperature levels on all measuring points, as well as trends, and so alert the operator of any significant condition monitoring events that could potentially cause an unplanned stoppage of the plant.

Stacker/reclaimer machines in operation on coal stockpile.

Additionally, data of vibration levels is stored in the plant Historian and detailed spectral vibration information is captured and stored using the Rockwell Automation Emonitor® software which is analysed by Condition Monitoring technicians to detect equipment trending towards failure.

"The Emonitor software is a key to the success of the predictive monitoring system as it provides the capability for both historical trend analysis as well as real time data viewing. Anything that is picked up as 'out of the ordinary' with real time monitoring of the vibration levels is then referred to the Emonitor system for further investigation," said Liddell.

The terminal has already benefited from the early detection of faults that if ignored, could have resulted in catastrophic failures on numerous occasions. "The condition monitoring solution identifies at least 10 vibration abnormalities each year that if left unchecked, would cause significant unplanned downtime," explained Liddell.

Each hour of downtime costs a whole train full of coal so we needed a reliable system.

Gearbox coupling faults are a common example of a situation where an abnormal vibration frequency has been detected and further investigated. In the example below, a low frequency vibration was detected throughout the Boom Conveyer gearbox that was identified as an output shaft turning speed. The trends of the fault were retrieved and analysed using the Emonitor software, the couplings were removed and tested and the coupling fault detected (a hairline crack).

Coal train unloading in operation

The XM Series of Intelligent I/O modules from Rockwell Automation allows for the seamless integration of vibration and temperature monitoring sensors

In another example, excessive vibration at the frequency of input speed together with harmonics, was detected throughout the gearbox and indicated excessive clearances surrounding the input shaft bearing. This gearbox input shaft looseness fault was verified and repaired before it could result in any unplanned equipment downtime.

Securing the long term coal loading capacity at the Port of Newcastle

"The Integrated Control and Conditioning Monitoring is an important part of our everyday monitoring of the plant in real time, it shows us the failures we need to see to minimise any unplanned downtimes," said Liddell.

By integrating with the terminal's existing networks and controls systems, the condition monitoring system provides an open source of asset reliability and introduces the capability for automated recommendations and actions.

"The condition monitoring system identifies at least 10 pending failures per year and at an average repair time of 10 hours per incident, the downtime saved is very significant to the business", said Liddell.

As testament to the success of the system, NCIG is currently extending the condition monitoring capabilities across the remaining parts of the plant not yet covered by the system.

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