WorldCargo news

Drive monitoring and productivity

Crane monitoring systems can help improve productivity as well as crane maintenance

Quayside crane productivity is a key performance indicator for terminal operators, yet many have surprisingly little data on actual crane performance. Operations managers typically get productivity reports from the main Terminal Operating System but these are very limited from a crane productivity perspective, showing only number of cycles achieved over a defined period.

Although several software companies have recently launched a range of real-time monitoring applications, they do not break the crane cycle down into information that can be used to identify delays.

Crane management

ABB continues to develop its crane information management system (CIMS) and it now offers functionality that helps increase productivity and equipment utilisation as well monitoring and maintenance management. The CIMS concept uses a distributed PC-based client/server system for collecting diagnostic and operational data using crane and shore-based computers.

The CIMS network is divided into two segments for craneside and landside networks. A crane maintenance station with monitoring and maintenance software is normally located in the main electrical room and a cabin view station provides the driver with operational information and basic diagnostics. Additional outputs can be provided around the crane as required.

Detailed data

CIMS makes detailed information on crane and driver performance available through several applications. LandStation View provides information on the real-time status of all the cranes and a 3D view of the whole terminal from a standard office PC. Another application, called LandStation Data Central, is the access point for the CIMS network and manages individual PC access requirements.

An optional LandStation Database Server is available to store historical information from cranes. Using two configurable report generation tools information can be analysed by single or multiple cranes, shift or ship, container size, etc and day and load cycle reports generated.

Using a data logger to access drive position information, operations managers can get detailed information on productivity and see actual crane cycle graphics and time statistics. A crane cycle can be broken down to show, for example, the time spent in the cell guides, the load path and the hoisting and trolley speeds.

Armed with this information they can identify problem points and which parts of the cycle take longer and why. Crane cycle records are also invaluable for accident investigation.

In one recent case CIMS was used to identify driver error as the cause of a fatal accident, where a load was not hoisted clear of containers on deck and one was knocked off the vessel.

Customised

The CIMS software can also be customised for a particular terminal by integrating other software and systems related to crane operation. At YICT in Yantian, CIMS is integrated with the PowerLogic electricity management software from Schneider, while other terminals have integrated anemometers and wind speed logger software. Fault management software from other components such as spreaders can be integrated into the CIMS, so maintenance staff can access all equipment information through one application.

Connecting others

Cranes with non-ABB drives can be connected via a TCP/IP and OPC server and older versions of ABB drives can also be integrated. Currently the logger files must be played in the CIMS software but ABB is considering develop a tool that can read the logger files on thin client PCs. Apart from YICT, terminals using CIMS include PSA in Singapore, Pusan Newport, CTA Hamburg and, in future, Euromax Rotterdam.

Siemens also offers monitoring and evaluation tools within its CMS, SICMA. The company says information on cycle times, cycle tracing and fault diagnostics can be presented as a management tool but it also enables "terminals to optimise their specifications for new cranes, based on the historical data."

A key area in this respect is the sizing of the drive system and SICMA and other CMS systems can tell operators to what extent crane drivers are using the acceleration and maximum speed parameters of the drive system. Therefore, they can tell whether higher power would achieve an increase in productivity.

Adding value

The preference of some crane manufacturers, and ZPMC in particular, to integrate their own drive systems from components available from bespoke drive suppliers, highlights the fact that terminal operators need to be clear exactly what they are getting. ABB drive components are available through the global ABB network if a crane manufacturer wants to integrate a drive with them, but ABB Crane Systems itself does not sell components separately.

According to ABB Crane Systems, its advantage is its "vast experience of how the ABB components should be used (and sometimes adapted) for use in crane applications." This is particularly important in the areas of crane monitoring and management applications and automation systems.

Increasingly, however, it seems end users are electing to source the drive from the crane maker rather than the drive specialist. Axis Intermodal in the Port of Auckland, for example, specified Siemens drives supplied through Siemens Australia on its first ZPMC cranes ordered in 2000, but will have a Siemens drive integrated by ZPMC on three new cranes on order.

ZPMC has integrated hundreds of drives with Siemens and, more recently, Fuji components. Fuji is also supplying components to Paceco Corp for a project in Turkey (*Yilport* - *see p18*).

Modular approach

Control Techniques specialises in the development of modularised drives that allow crane manufacturers to integrate its components into their own drive systems. As an example, it furnished its Unidrive SPM inverters, together with associated components such as chokes and filters, to SPMP in China in connection with an order for six ship-to-shore cranes and six RTGs from XICT Xiamen. These cranes are about to be delvered.

Control Techniques, part of US-based Emerson Industrial Automation, is also active in crane upgrade projects, for example in Italy, through the Control Techniques Italia drive centre in Milan. The drive centre has also worked with OEMs such as OMG to furnish drives for new cranes. It has also co-operated with crane cab specialist Brieda, whose latest design, aimed at US as well as European port operators, features new SCADA screens and controls (supervisory control and data acquisition system).

Retrofit options

Two terminals in North America have taken a different approach to crane drive refurbishment. TMGE is currently upgrading two 1988 cranes at P&O Ports Canada's terminal in Vancouver that were delivered with GE DC300 drives for the hoist/gantry and trolley/boom control and Series six PLCs with genius I/O blocks.

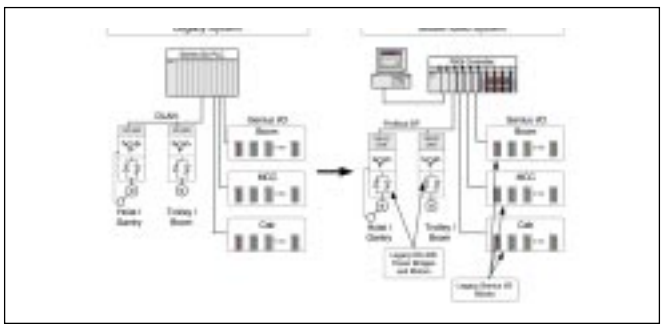
The cranes have a text operator interface and a DLAN between the PLC and the drives. The DC300 drives will be retained but are being retrofitted with TM-DC Digital Front Ends and the PLCs are being replaced with an RX3i controller. A colour graphic Local Crane Management System is being installed for engineering, diagnostic and operations support.

This upgrade gives the crane a digital front end and maintains the power bridge, cabling and motors. The RXi controller can be installed while keeping all of the existing I/O wiring intact. The cranes are scheduled to be commissioned this August.

Miami twice

On the US east coast, Port of Miami Crane Management Inc, a subsidiary of the Port of Miami, is currently refurbishing three Kocks cranes (Nos 4, 5 and 6) delivered in the late 1980s. The cranes were originally diesel-electric but were converted to shore power last year. Crane Management is now overseeing a drive refit including replacing the hoist motors and gantry motors, and upgrading the analog drives from ABB Tyrak L to DC 600 and DCR 600 and the control system from MP200 to Advant AC410 and CMS.

Miami had previously upgraded cranes 1, 2 and 3 with new ABB drives and CMS and is very happy with their performance. In contrast cranes 4, 5 and 6 are less reliable and faults take longer to find and repair. Trouble shooting



Schematic of dc digital front end (DFE) conversion of two cranes at P&O Ports' Centerm, Vancouver, VC facility by TMGE. The DFE upgrade consists of a straightforward swapping of control cards, maintaining the existing power bridge, motor cabling and motors. Using the RX3i Genius bus controllers, all the existing I/O wiring could remain intact. TMGE is undertaking turnkey responsibility for this upgrade and commissioning is scheduled for this August

control system faults, for example, requires metering out to identify faulty cards. A modern CMS with better diagnostic is expected to be much faster.

ABB engineered the upgrade to use many of the existing panels that were fitted with new control cards for the new AC410 controls. The new operator's consoles required the I/O wiring on the trolley and in the cab to be completely replaced with new cabling including fibre optics. Other upgrades included a new festoon system from Wampfler, new gantry motors and storm brakes from Hilmar.

Staying with dc

Crane Management CEO Ed Bello says switching to ac drives was considered but, although not an easy decision to make, the port could see only the potential for more problems with ac systems for the sake of eliminating brushes on dc drives. The need to convert power from ac to dc and then back to ac means that ac drives have more panels and cards and, therefore, more things to go wrong, says Bello. Furthermore, the port has stayed with dc drives on its latest ZPMC cranes and port maintenance staff have no experience with ac technology.

Having opted to stay with dc drives, the port still had to decide whether to retain the old dc motors or buy new ones. Although still serviceable, most of the motors will be replaced as this is more cost-effective than ongoing refurbishment in the long run. They will be changed out gradually as operational requirements allow, and some will be kept as spares.

Crane Management considered fitting larger motors to increase crane speeds, but decided there was little to be gained as the real limitation on productivity is the quay/yard interface. According to Bello, the terminal area leased to APMT is already supporting up to 40 moves per hour on the larger vessels and had the fourth highest productivity of all APMT terminals last year.

Sensing a market

Increasingly, automation systems are developed using off-the-shelf sensors from specialist manufacturers such as Sick, Arck and Micas. TMGE, for example, uses a Sick Lidar (Laser Radar) scanner in its Maxview crane guidance and positioning system.

Three sensors are mounted on the crane trolley for detecting and defining the position of the front edge and both sides of the spreader and container. Laser scanners also form the basis of TMGE's automatic landing system for landing a container on a chassis and its chassis guidance system for positioning a chassis correctly under a crane.

Trick cameras

Kalmar is developing the container position system for the ASCs at HHLA's CTB Hamburg terminal using a camera and laser system that utilises reference points on the ground. The ASC spreader will be equipped with four cameras for finding the corner castings of containers and a 3D laser scanner for stack profiling. Other systems have been developed using a 2D laser but Jorma Tirkkonen, president of Kalmar Intelligence and Automation, says

Port of Miami: the picture above shows the E-house drive module with ABB Tyrak L drive; the picture below shows it after upgrade to ABB DCR 600

that a 3D long range scanner is needed to find accurately the sides and height of containers within deep stacks.

The Spica of life

Arck of France has developed several systems based on infra-red technology including its new Spica system for giving the position of a container in relation to the headblock or spreader. Arck sells Spica as an integrated system with sensors and calculator and does not sell the individual components separately.

Spica comes in three- and six-sensor configurations depending on the application. Three sensors will detect a container's position below an empty spreader and six are required to align a container locked to a spreader over another container for automated stacking.

In a six-sensor system, one sensor is installed on each end beam of the spreader and two on each side of the spreader. The sensors measure *x* and *y* positions by calculating offset angle in both directions and load rotation by measuring offset angle around the vertical axis.

Arck's president Marc Brouant says the advantage of infrared technology over laser systems is that there are no moving parts – laser radar uses spinning mirrors and other sensitive components and cannot, says Brouant, be mounted on a spreader. Spica has been tested at Arck's development facility and one system has been installed at a port for evaluation.

Collision avoidance

Another sensor option is frequency-modulated continuous wave (FMCW) radar and Germany-based supplier Micas is using this technology for collision avoidance in port applications. FMCW transmits a frequency sweep that is reflected from objects and then compared against the transmitted signal to determine the range of the target.

Micas has developed its RAS 400 sensor family for collision avoidance in difficult applications involving expensive

Micas frequency modulated continuous wave radar sensor in a collision avoidance application on a straddle carrier

equipment. RAS 400 uses 24GHz FMCW radar to detect static or moving objects within a range up to 20m. Micas says that compared to competing optical/laser-based systems, FMCW radar is not affected by fog, dirt, smoke or snow and is a more cost-effective solution.

The sensors are available with different detection fields including 7, 28, 38 and 45 deg and with SIL 1 certification under the IEC 61508 safety integrity level standards. The sensors can be factory- or field-programmed and are available with warning options including a TFT screen and siren. They are currently used for collision avoidance on straddle carriers in Hamburg and in anti-collision systems on ship-to-shore cranes.

Fuel costs fire change

Rising fuel costs and the increasing use of low-sulphur diesel fuel are driving RTG operators and designers to look at ways of achieving better utilisation of the diesel gen-set and drive package. The main opportunity is to develop ways of "storing" electrical power generated over a relatively short cycle instead of dumping it in a heat sink, in order to increase drive efficiency and reduce overall fuel consumption.

ZPMC has already fitted a drive system incorporating capacitor energy storage on several RTGs but some manufacturers worry that this may not be a breakthrough as high energy capacitors are still at an early stage of development.

Continual improvements are being made in energy density, driven particularly by the demand for hybrid cars that have considerable funding for R & D available, but even in this high profile sector there is still some way to go.

Control Techniques forecasts that capacitor-based energy bank systems will find a place in RTG drives, but thinks it is still "several years off" before a reliable, long life system will be commercially available. Currently, large capacitors have a life of around five years, but even if only one unit fails in the energy bank, the complete unit should be replaced to obtain even matching.

Control Techniques is planning to develop a 5 MJ capacitor bank for RTG drives as capacitor energy density improves, which it considers will have sufficient short term energy capacity storage for next generation RTG power demands.

An advantage of this solution is the ability to design the capacitor bank around the drive system and diesel gen-set control. Thus it is possible for the drive control to sense the re-gen energy available and automatically drop output frequency from 50 Hz to 25 Hz, thereby lowering fuel demand.

Flywheel energy store

US-based Vycon now has its flywheel energy storage system called 'Regen' on the market. As previously reported (*WorldCargo News*, March 2006, p24), Vecon originally developed its flywheel system for the uninterrupted power supply market but the technology can be applied to cranes.

Regen consists of a flywheel floating on magnetic bearings and operating in a vacuum to reduce rotational losses powered by an AC motor. The flywheel is powered over the RTG power bus when starting from cold, or when the RTG is standing idle if no re-gen power is available. Once the RTG starts to generate return power from spreader lowering, this is fed to the motor through a bi-directional convertor, which in turn drives the flywheel.

Once a current sensor detects a power demand, the flywheel motor becomes an alternator to return energy back to the main bus. Vycon calculates that a 120–150 kW re-gen flywheel installation will deliver at a rate of 0.58 kWh over 15 sec, sufficient to power a loaded cycle hoist. This, Vycon estimates, represents a fuel saving of between 20-30% depending upon the variable load cycle duties.

Eco-friendly

In several cases now, ZPMC RTGs have been specified with the Siemens' Eco-RTG system that is claimed to provide fuel savings of up to 50%. According to Siemens, Eco-RTG builds on the rugged drive that it has been developing for use in hybrid vehicles since 1995. This proven concept, says the company, has been used in hybrid traction systems for buses and propulsion systems for ships and relies on Duo inverters.

"Field tests of these hybrid drives during real operations on the Eco-RTG prototype at APM Terminals Algeciras, Spain show substantial fuel consumption savings," says Siemens. Importantly, fuel savings are achieved without cutting the size of the diesel in the genset, as is the case with ZPMC's super capacitor system.

Siemensadds that the "performance of the Eco-RTG system can be improved through installing energy storage such as an ultracapacitor pack for the storage of regenerative energy. In that case it might also be possible to install a smaller sized engine. But for now we prefer to have a diesel engine capable of operating the RTG without ultracapacitors." ❑

New name for old masters

Converteam is the new name for Alstom Power Conversion (APC), itself originally the merged Alsthom and AEG drive and converter business units. Converteam is owned by Barclays Private Equity in Paris, but there are three "home" markets - Germany (AEG), France (Alstom) and the UK (GEC) - as well as a worldwide presence.

The story behind the new name and the change of ownership goes back to the 1990s, when Alstom got into difficulties after buying ABB's gas turbines business. The French government stepped in with a support package, but a condition of EU approval was that APC and some other affiliates had to be sold out of the main company.

Converteam retains a 3300 worldwide workforce and remains active in crane drives (Alspa Procrane inverters up to 6.4 MW), for newbuilds and refurbishments and other materials handling applications, metal process industries, power generation, oil and gas, wind turbines, test benches, mining, etc. Its service offer includes remote diagnostics and trobuleshooting via a satellite link-up.

Worldwide turnover exceeds €700M. A new daugher company is being set up in Chennai, to cover the Indian market directly, as well as a new operating centre in Shanghai. ❑

Towards lower emissions

Cargo handling equipment with Tier 3/Stage IIIa engines in the ≥ 130 kW range are now in widespread operation and performance levels are reported to be good and even better than the equivalent Tier 2/Stage II engines, although emissions limits have been met in different ways.

Scania and Cummins, for example, have gone for in-cylinder combustion solutions without any after-treatment or additives. Scania came up with a new combustion chamber, refined the angle of the unit injectors and improved the camshaft. Having a modular engine range made the work easier, says Scania. The engines use many of the same components, so it was able to concentrate on one cylinder and one camshaft.

After problems

EGR (exhaust gas re-circulation) has disadvantages for off-highway use, states Cummins. It requires more frequent oil changes and may also oblige use of low sulphur fuel. However, off-road engines have to be designed for use anywhere in the world, irrespective of the quality of fuel available.

In addition, larger fans have to be fitted as ram air (cool air induction) is not available in off-highway plant, and that leads to parasitic power loss - the larger the fan, the more power is taken from the engine for cooling and less is available for performance.

Cummins' latest engine is the QSB3.3 in the 60-82 kW (80-110 hp) range, unveiled at Intermat in Paris in April. This allows OEMs to assess it in good time for the Tier 3/Stage IIIa limits for engines in the < 130 kW class kick in next January.

Cummins claims it is the first off-highway engine of its size to incorporate full-authority electronics ("Quantum") and HPCR (high pressure common rail) injection. At the top end of the range, (110 hp) the engine offers equivalent performance to that of larger 4-4.5 litre engines, claims Cummins, but with the compactness and economy of a 3.3 litre engine.

Power is increased by around 30% and peak torque by 40% (to 412 Nm @ 1400 rpm) without impacting fuel consumption. The top-rated 110 hp QSB3.3 reportedly achieves the same fuel efficiency as the lower-rated 85 hp (63 kW) mechanical B3.3 Stage 2 engine.

More torque

Volvo Penta is also reporting higher power and peak torque values with its Stage IIIa/Tier 3 engines. All the new V-ACT (Volvo advanced combustion technology) engines produce more torque at low speed than their equivalent Tier 2/Stage II engines. This is a crucial "plus" for heavy container handling plant, the company points out.

While external EGR (E-EGR) is sometimes specified for on-highway use, the V-ACT engines are available with internal exhaust gas recirculation (I-EGR). A second opening of the exhaust valve allows a controlled amount of exhaust gas to