

Playing the power game by new rules

Increasing the lifting capacity of cranes generally increases their power requirements. ZPMC, for example, says the cable demands for the mains power reel are starting to become a problem. Higher power requirements mean bigger cables at a given voltage and the larger cables are heavier and more difficult to reel.

Another factor is increased crane travel requirements. As berths get longer to match expected vessel dimensions and crane density increases, some ports want to increase their crane deployment options and this requires reeling more cable. ZPMC engineers say they have had to look at large level winding reels in some instances although this creates its own challenges.

According to electrification systems specialist Paul Vahle GmbH most of today's power requirements can still be met on a 7-8m diameter reel. However, Vahle thinks a cable diameter of 65-70mm is about the limit for a

Monospiral reels are still the preferred solution for the crane mains power reel, but some manufacturers say it is time to consider alternative solutions

mains power monospiral reel and it has seen a trend in the last few months where users have been specifying higher voltage, up from 6kV to 10kV and even 20kV to get smaller cable diameters and, therefore, smaller reeling systems.

Wampfler's Daniel Dörflinger, head of business unit cranes, points out that increasing the voltage is not always possible for standards or other reasons and in some cases the travel length is simply too long. At Aarhus, the port has decided to have a gantry travel length of roughly 1500m (centre feed).

The levellers

Wampfler argues that above 8-8.5m reel diameter is a problem from a crane design perspective and the reel body and gearbox requirements make a monospiral

solution "costly and inefficient." As well as accommodating more cable "these level winding reels offer a smaller surface for wind forces and, due to the parallel design have the advantage that the increase in weight is equally distributed between two bearings on both ends of the reel."

While they are still the exception today, Wampfler believes they will become more common on container cranes in the future. Dörflinger adds that it is important to understand that the reels "will have nothing in common with the traditional level winding reel apart from the shape. The requirements of today are far removed from what the design of the traditional type allowed."

Stemmann Technik says level winding reels become economic

when monospiral reels reach 8m diameter, which corresponds to a winding length of 600-650m and most applications are well within this. Another option is to use a second feed point on the quay by adding a terminal box at the cable-fix point and Stemmann offers these in 12 and 24kV options.

Delachaux has brought together its Delachaux, Insul-8, Comes and Han Fa companies under the Conductix brand name. Conductix's Australian managing director Mark Howlett says historically most port cranes in Australia have used level winding reels because the reel market in Australia is dominated by the mining industry where they are the only option for very long travels. This is changing, however, and all the mains power reels on a new series



of cranes ordered by the two main stevedores have monospiral reels.

Feeling the heat

The big disadvantage of level winding reels is they do not cool cable as well as a monospiral and, therefore, bigger and more expensive cable has to be used. Vahle thinks this issue will lead to a "renaissance" of fitting conductor bars inside underfloor trenches, "especially when upgrading or enlarging an existing trench, such as in Valencia."

Recently Conductix was asked to prepare a cost comparison for supplying long travel high voltage power to five new cranes on one berth covering approximately 700m. Howlett says conductor bar and cable reels were the preferred options and the costs were approximately the same. However, "cable reels were ultimately the preferred outcome because they provided complete redundancy in that a maintenance down time affected only one crane."

"Cable reels also place most of the construction responsibility with the crane builder as opposed to a conductor system that would be mainly constructed by the port's contractors, with only the collectors supplied by the crane builder. If there had been any more cranes on the system, it is likely the conductor bar system would have been preferred as each additional crane requires only the addition of a set of collectors."

This is an interesting observation as crane density is increasing as terminal operators use more cranes over post-panamax vessels to keep up productivity.

Despite the higher torque re-

Rima's Cobra cable channel cover belt installation at Grangemouth has been extended as new cranes from Liebherr are added by Forth Ports plc



Dimensions, speeds and installation heights all pose a challenge for long travel reeling systems

quirements as installation height has gone from 18-20m to ca. 26m, magnetic couplers remain the most common mains reel drive solution. Conductix and Cavotec in particular have supplied hundreds of these over the years and it is the solution offered by ZPMC.

Suppliers of frequency controlled systems say that increased height, torque and reel diameter make them a better solution but Conductix says magnetic couplers are still perfectly adequate and today's requirements can be met.

Larger motors are not as big a problem as is the cantilevered load on the main gearbox, especially when wind conditions on bigger reels are factored in. An over sized gearbox output shaft is needed but off-the-shelf gearboxes with such a shaft typically have a very high torque rating and are very heavy. Conductix designs and manufactures its own gearbox for the application to get the shaft size without these problems.

Conductix offers a variable frequency drive, but believes it is not necessary for speeds of less than 120 m/min. A properly designed magnetic coupler can cope with the torque requirements of very large reels and has the advantages of cost, simplicity, reliability and low power consumption over a large speed range, says the company. In fact, Conductix has recently upgraded its range of parallel lay reels to include a magnetic coupler option.

50% share

One reel supplier reckons ZPMC now has more than a 50% share of the market for cable reels on container cranes. The company makes reels at ZPMC Ningbo Transmission Machinery (ZNTM) that operates from a facility in Dongqian Lake near Ningbo in Zhejiang Province. The company is also known as Ningbo Weilong Transmission Machinery and produces a range of couplings, circuit breakers and vacuum switches for the power industry. Its cable reels, however, are produced for and sold only through ZPMC.

JPC reels

ZPMC's design is called the "JPC" cable reel and uses a permanent magnetic coupler with a magnetic hysteresis coupling and a high voltage four-pole electrical coupler with a rated voltage of 6-12kV. If required an optical fibre cable coupler is sourced from Conductix. The coupler system itself is modular with between two and four couplings normally installed on each crane, each with a torque of 6-8Nm and is driven by a 1.1-1.5kW motor through a spur gear reducer. The advantage of the JPC reel, says ZNTM, is a simple robust design that is easy to repair. The design is limited, however, to a maximum speed of 140 m/min, cable mass of 13 kg/m and reel diameter of 8m.

ZPMC also makes spreader reels and its design is called the JPC Spider cable reel. The design uses a monospiral reel driven by frequency converter motors through magnetic couplings. The magnetic couplers are set to slip in an over torque situation and prevent excessive pull on the cable, while the frequency converter motors match the speed of the reel to that of the crane hoist drive.

A monospiral reel requires more room around the crane trol-



Wampfler: a level wind reel on a crane in the Port of Århus (left) and (right) the company's Cobra energy chain as installed on 15 Noell RTGs just delivered to DP World's Centerm, Vancouver, BC terminal

caution. The SMG was tried in Long Beach around 10 years ago to carry an Ethernet Protocol to several cranes but Vahle says the application was "too future minded."

Proven mix

Vahle says the Unipole plus SMG solution is now well proven in many rough environment applications such as steel mills. It does require an underfloor trench to keep the entire system traversable but the system is low maintenance and can support a travel speed up to 600m/min. The retrofit application on a container

crane in Hong Kong (for trolley power) has generated plenty of interest and port and crane OEM representatives have been to see it. Vahle has since quoted the system on several projects in Europe and Asia.

Stemmann has 15 years experience with reels on the ASCs at ECT (240 m/min top speed with fibre cores) and says one of the biggest challenges of automation is the high operating hours and long travel distances – up to 25,000 km a year. Its reels at ECT have direct drives with frequency converters that can be connected to the crane monitoring system with a Profibus connection.

Cable life is affected by whether diverting rollers have to be used but because cross sections are typically small, reinforced cable is normally required. For optimum control Stemmann has devel-



oped software called Automatic Speed Control and says it has already realised speed of 270 m/min with reel diameters up to 6.5m, with speed but to 120 m/min when passing the feeding point.

Stemmann is not convinced that trying any reel technology can mean cheaper

cable. The cable has to meet the technical parameters of the application with regard to winding speed, cable tension, wear and diverting via rollers. "Of course, reserves in designing cables increase service life."

Talking chain life

ASCs are also a more demanding application for the trolley power system. Wampfler points out that the application looks no different to an RTG, but the requirements are far higher. The cranes travel in three directions at once and operate for around 2500 hours per year. The lifetime of a power supply system on a ship-to-shore crane can be expected to be 8-12 years but, says Dörflinger, on ASCs this may go down to 5-8 years due to the high operating hours.

Despite this, he says, terminal opera-

ley but is preferred because it is easier to wind in high wind conditions.

The gear reducer and magnetic couplers are of ZPMC's own construction and the two drive motors are supplied by ABB and the slip ring by Conductix. The system can support a reeling speed of up to 220 m/min.

Reeling at speed

Automated stacking cranes (ASCs) are becoming more common and Wampfler says it expects between four and six projects for ASCs to come out this year and more will follow in the future. Automation offers the potential for faster crane travel speeds, much more intensive duty cycles and high travelling speeds. Dörflinger says crane manufacturers are designing ASCs with gantry speeds from 180 m/min up to as much as 300 m/min and accelerations of up to 0.5 m/sec².

"An end is not in sight, but these demanding requirements ask for a new design of the mechanical components as well as the control mechanisms both for the cable reels and the cable guide and result in bigger drives and gearboxes. Only cable reels with frequency controlled drives offer the performance without overloading the cable."

Conductix says that, in general, a magnetic coupler is not suitable for speeds above 200m/min and it has developed its "Smart Drive" system for high speed applications. This is a VFD that uses a real-time calculator to generate the exact required torque for the reeling diameter and to minimise cable stress. The system comes in three different versions all with parameters pre-installed into the software for easy commissioning. Howlett stresses the importance of reel control to cable selection. "If the reel manages to generate a perfect tension, it is possible to use a more efficient and lighter cable. If the cable is lighter, the reel is smaller."

Even with frequency controlled drives cable manufacturers still have to cope with significantly higher stress and tension on the cables and Dörflinger says there were some problems in this area at the first automated yards. Cable manufacturers offer reinforced cables for high speed applications but they cost more, and the extra cost is ongoing every time the cable needs replacing.

Steel stiffeners

Draka has supplied cable with an integrated steel member for the ASCs at CTA Hamburg. Nexans' Rheyfirm RTS is a high-stress rubber cable in the 3-30kV range designed for reeling applications with a standard operating speed up to 190 m/min. However, with an integrated steel strength member it can handle up to 240 m/min. Gottwald has fitted Nexans Rheyfirm RTS to RMGs at intermodal rail terminals in Switzerland and Italy.

Vahle's view on the problem is that although higher speed and acceleration can be realised with a PLC-controlled motor driven reel, "reel technology may come to its limits in the near future." Over long travel distances with high speed, big reels become unattractive. Vahle is discussing alternatives with its customers.

It is promoting its Unipole conductor rail and slotted microwave guide (SMG) as suitable for mains power appli-

tors are not doing a thorough FMEA analysis of each component in the system. If they did, they might well discover that the ability to replace wearing parts means a festoon is actually cheaper to own in the trolley power application. Wherever Wampfler's view, chains now dominate the yard gantry trolley power application, but ASCs do have a far higher duty cycle and will wear friction bearing parts faster.

For applications with a high duty cycle Wampfler recommends a twin chain arrangement to reduce the weight per metre and increase the lifetime. An additional carriage in the chain system reduces friction wear even further.

Wampfler's Racer system, in use on two intermodal RMGs at CTA, features a linkless extruded side design where the pulling forces are carried on a steel rope inside the sideband causing less wear on the chain and generating less noise. However, lifetime data are still some years away as the system is relatively new.

Quiet chain

As previously reported, Igus is easily the biggest supplier of energy



Y-branch connector in Draka's JETnet cable system

chains on container cranes and is naturally always looking to maintain its edge.

It has launched a new energy chain series called "P4" specially designed to reduce noise. This has been achieved through a series of changes including: dividing the rollers into profiles in the centre, which allows them to roll on one level; equalising the pitch length of the chain links with and without rollers to give vibration free movement in the radius; and firmly integrating the rollers in the sides of the chain.

Igus has also launched a smaller version of its "5050 Heavy Duty" model, the 4040. This chain is suitable for high cable weights in crane applications but has a reduced interior height of 56mm (compared with 80mm for the 5050) and a smaller minimum groove height - 170mm compared to 200mm for the 5050.

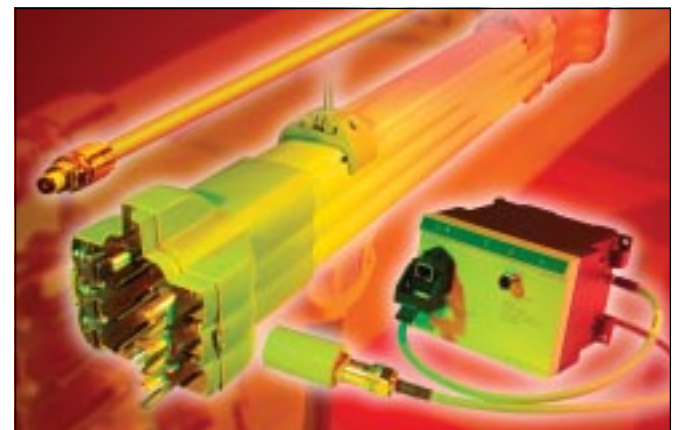
Within its smaller dimensions the 4040 has a comparable load-bearing capacity to the 5050 but takes less material to construct and is, therefore, a more economical option. The design will also ben-

efit crane builders looking to save space and is available both with and without rollers. Like all igus chains it can be delivered complete to the site and, in addition to the requirements on the crane manufacturer, igus offers to carry out an acceptance test itself before the crane is put into service at the terminal.

Chains are a very competitive sector. For example, the 16 RTGs recently delivered by Noell to P&O Ports' Canada in Vancouver are fitted with Wampfler Cobra 58M chains. The cross-travel range is 21.47m and the chain length is 13.3m, with a travel speed of 70 m/min. The connector is aluminium C-profile. The cable package includes two f/o cables and three separate data cables.

Cover with a Cobra

Rima, perhaps best-known for its range of crane brake and crane hydraulic systems such as trim, list and skew control, also offers its Cobra cover for cable channels that features a 120 x 12mm continuous rubber cover plate containing textile fibres for added strength. The rubber plate rests on two steel beams inside the cable



Components in Stemann Technik's new IWLAN system

channel around 20mm below the surface and is tensioned to keep it in position. The cable is lifted by the "lodging device" attached to the crane.

Rima says the system requires less maintenance as there are no hinges and any dirt or other debris on the channel cover are discharged when the lodging device lifts the cable. Furthermore, as the channel cover is contained below ground level, it is not stressed by vehicles crossing the channel and assembly is straightforward.

Installations of the Cobra system include the Port of Trieste where a stainless steel solution is in service covering a 700m channel that services both ship-to-shore and RMG cranes. Another system is at the Port of Grangemouth in Scotland. This is undergoing an extension.

The cable channel was fitted with the original Cobra rubber cover solution to cover a 320m channel. This is being extended to 520m as the berth is being extended. The cable diameter is 60mm and the crane travel speed is 60 m/min.

Rima's sales director Vincenzo Marmorato says the patented Cobra solution is ideal for container crane applications as it performs well and is cost-effective. As well as being cheaper to purchase than other systems on the market, any accidental damage is simple to fix as the rubber cover can be repaired or replaced independently.

Rima sees no problems with the Cobra design in high speed applications as the design is compact (trench cover dimension is within 130mm) and the positioning of the rollers on the guiding trolley minimises wear of the rubber. At Trieste the system supports RMGs with a top speed of 160m/min.

New developments

Among new developments in the sector, Stemann Technik has launched an industrial wireless LAN for mobile electrification systems, the IWLAN. It is based on Siemens RCoax industrial wireless technology, using an RCoax cable with slots in the outer conductor (known as a 'leaky feeder') as an antenna that gives a very controlled radio range within a small distance of the cable. Using the RCoax system Stemann has engineered a non-contact data solution that can be

used with conductor rail in applications such as crane trolley power.

Draka has developed a flexible ducted cable management system called JETnet that uses internal microtubes to house and protect f/o cables within the main conduit. Internal subdivisions allow versatility during installation, while also allowing for expansion and adaptation in the future.

No more splicing

The JETnet architecture enables customers to eliminate splicing, expand existing systems with minimal civil work and to customise their fibre optic infrastructure to meet current and future needs.

"Installing the micro-ducts on site allows maximum flexibility especially if the installation requires a lot of branching, as the conduit can be cut and branched with a simple Y-branch connector and standard couplings," explains Draka's Dennis Anweiler.

"Micro ducts are then jetted in followed by the cable. Fibre can be blown up to five miles with an inexpensive system that is carried in a briefcase."

Data requirements at ports have grown rapidly over the last five years and experience shows the benefit of being able to add cable after the major civil works are completed, says Anweiler.

Network manager

JETnet is an ideal way of putting an infrastructure in place that will support the cable networks for data management, CCTV, gate OCR as well as lighting and low voltage management. "It allows ports to choose what they need, where they need it and pay for only what they need as they go," adds Anweiler.

"Simple branching and expansion possibilities and the reduction of predetermined splice sites and more effective use of duct space all streamline the access process. JETnet eliminates the need for stored cable loops or parallel ducts along the feeder duct from multiple splice points to the customer, saving material costs and installation time."

Draka is currently introducing the system to ports in the United States and says its use of compressed air instead of nitrogen for jetting, as well as its Y-branch connector feature, gives it an advantage over competing products. □

The new P4 "quiet" chain from Igus

