

MAGNETEK ENGINEERED SYSTEMS

TDC Cranes



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It’s often said that good things come in small packages. However, when it comes to dredge cranes – size matters – a lot.

This simple fact was substantiated recently when Canada-based TDC Cranes Ltd. commenced construction on the first large AC diesel-electric powered dredge crane ever built in North America—and what was destined to become the largest dredge crane operating in North America.

Keep in mind that this daunting task was made even more challenging by the fact that the build requirements for this project specified:

- That the crane be powerful enough to handle a massive 60-yard clamshell bucket;
- That the dredge be powered by an environmentally friendly diesel-electric system that eliminated the traditional hydraulic systems;
- That the design achieves the highest levels of environmental design standards;
- That the clamshell bucket include advanced software options delivering industry-leading safety and performance features;
- And, that the crane controls must be simple to operate.





Project — Provide state-of-the-art adjustable frequency drive crane motor controls for the largest capacity, most technologically advanced, dredge crane operating in North America:

- Engineer custom drive and control systems necessary to operate the first AC all-electric dredge crane. The crane is powered by two synchronized Caterpillar C27 Tier 4 diesel generators producing 800 ekW each.
- Implement a state-of-the-art dual-joystick command system designed to provide advanced precision and control of the dredger.
- Deliver advanced crane control custom software to coordinate the winches with auto-close, auto-open, and cinch control features for the massive 60-yard clamshell bucket.

CHALLENGE

- Eliminate all hydraulic and mechanical control systems while utilizing an AC diesel-electric powered crane design that exceeds stringent environmental operating regulations.
- Deliver industry-leading precision and accuracy in a dredge vessel with the highest production rate.
- Provide state-of-the-art bucket software solutions that deliver enhanced performance and safety.
- Implement ergonomic operator crane controls that incorporate dual joystick functionality, eliminate foot pedals, and reduce operator fatigue allowing crane operators to work for prolonged periods of time.
- Increase reliability and improve dredge crane production rate.
- Extend the work-life of the crane and reduce downtime required for maintenance.
- Meet TDC's requirement that the project be constructed using North American sourced components.

"From very early in the process Magnetek was an essential part of our team for this project," said Rick Gillespie, president of TDC Cranes Ltd. "We weren't interested in people that were just selling components. We needed a company with the ability to provide complete systems — solutions that included both drives and the custom software required for a project of this scale."

Over the last two years, Magnetek Inc., a leading provider of digital power and motion control systems for the crane and hoist industry, worked closely with TDC Cranes to engineer the most technologically advanced — and highest producing — dredge crane currently operating in North America.

The dredge, which was commissioned in late 2013, clocked 3,500 hours of operation by the beginning of April, 2014.

The heart of the massive dredger's precision crane control system features multiple adjustable frequency drives developed by Magnetek, which eliminate the need for the more traditional hydraulic systems that have the potential to leak, creating environmental risks. In addition, the IMPULSE•G+ and VG+ Series 4 Adjustable Frequency Drives provide industry leading precision and control and extend the service life of the crane from 20,000 hours to more than 200,000 hours.

As you can imagine, it takes an enormous amount of power to operate the dredge's massive 60-yard bucket which has the ability fill a 5,000 cubic-yard scow in just over two hours—nearly three times faster than any other dredge crane in North America.

Power for the vessel is provided by twin Caterpillar diesel generators which produce an impressive 1,600 ekW of power.

The dredge crane features 200,000 pounds of line pull per hoist with a 250 feet-per-minute rating, and a 75-foot operating radius. In order to meet the demands of today's precision dredging projects, the crane can be equipped with either a 60-yard bucket for trimming or a 28-yard bucket for heavy digging.

Contractor — TDC Cranes

Products Used

- IMPULSE®•G+ Series 4 Drives
- IMPULSE®•VG+ Series 4 Drives
- Blue Max® Inverter Duty Motors
- Dynamic Braking Units and Resistors
- Custom AC Control Panels
- Patented Advanced Bucket Control Custom Software
- Patented Static Stepless Simulation Custom Software



With a crane of this size, the notion that it can be easy-to-operate may seem hard to imagine. However, that's where many of its high-tech features and advanced bucket control software options come into play. The precision crane is controlled by a single operator from the custom, dual-joystick command chair. The IMPULSE•VG+/G+ Series 4 control systems eliminate the need for foot pedals and mechanical levers meaning that operators can now work for extended periods of time without suffering from fatigue.

The list of state-of-the-art features doesn't end there. The crane's custom software components allow the operator to automatically coordinate the winches, auto-close, auto-open, and cinch control.

"This dredge is light years ahead of the competition from both a technological and environmental standpoint," said Gillespie. "There will be a need for even larger dredges in the future. This project gave us the knowledge that will be required to meet those needs."

The vessel took its maiden voyage in October 2013 to begin maintenance dredging in both Norwalk and New Haven, CT harbors for the U.S. Army Corps of Engineers. Once these projects were complete, the dredge set sail for Portland, ME where it began the first maintenance dredging on the Portland Harbor in nearly two decades. The work in Portland was completed ahead of schedule.

Based on the success of this project, TDC Cranes and Magnetek have recently partnered to build a smaller, pier mounted crane rated for 100,000 lbs. duty cycle at 100 ft. radius and featuring similar advanced control technology. According to Gillespie, the future of duty cycle cranes is AC electric.

"Magnetek is dedicated to bucket handling cranes in particular and have developed systems, hardware and software to give us fantastic control, power, reliability, backup, and life that we could never hope to achieve with hydraulics and is far superior to any other comparable VFD (Variable Frequency Drive) system," said Gillespie. "If we have a mission critical machine, we use Magnetek."



RESULTS

- Installing IMPULSE•VG+/G+ Series 4 Adjustable Frequency Drive Crane Controls resulted in a highly agile and reliable crane capable of completing dredging projects safely, and in record time.
- Diesel-electric drivetrain and durable IMPULSE•VG+/G+ Series 4 Adjustable Frequency Drive combination extends the service life of the crane from 20,000 hours to more than 200,000 hours.
- Diesel-electric powered dredge crane features 200,000 pounds of line pull per hoist, 250 feet-per-minute rating, and 75-foot operating radius.
- Elimination of hydraulic systems allows a single operator to control the crane from the dual-joystick control chair. Foot pedals were eliminated and crane operators are now able to work for longer periods of time without fatigue.
- Elimination of hydraulic systems from the dredge crane design provides increased reliability, longer service life, lower fuel consumption, increased production efficiency, and reduced environmental risks.

SOLUTIONS

■ Bucket Solutions

Two 700 HP IMPULSE®•VG+ Series 4 Adjustable Frequency Drives with state-of-the-art Bucket Control Custom Software controlling two Blue Max® Motors with advanced safety and control features for the dredging system. The control system featured:

- Custom Auto-Open/Auto-Close software designed to allow for semi-automated blind operation without requiring additional hardware.
- Slack Take-Up software was used to eliminate slack in the holding line, increasing performance and making the clamshell bucket easier for the operator to control.
- Custom software was implemented allowing for hoist operation above base speed to maximize speed and cycle times.
- Bucket Control software allowed the operator to quickly shift from bucket control method to standard hoist speed control method permitting the bucket motion to double as a standard hoist to machinery.
- 75 HP Adjustable Torque Control Tag Lines were used to prevent unwanted rotation of the bucket and improve safety by eliminating mechanical springs and counterweights.
- Bucket Position Indication provides the operator with open/close status when bucket is not in line of sight and while dredging underwater.
- One 100 HP IMPULSE•VG+ Series 4 Adjustable Frequency Drive was used to raise and lower the boom with speed control.

■ Crane Slew Solutions

Three 75 HP IMPULSE•VG+ Series 4 Adjustable Frequency Drives and Blue Max Motors were customized with Static Stepless Simulation Software to simulate traditional hydraulics while eliminating jerking motions and providing maximum performance and torque control.

■ Spud Solution

Three 100 HP IMPULSE®•G+ Series 4 Adjustable Frequency Drives and Blue Max Motors were implemented to raise and lower the spuds used to secure the vessel to the seabed while the dredge is operating.