EMERSON
Industrial Automation

applied

To cranes & hoists

Unidrives Feature in Floating Grab Crane Retrofit

Control Techniques' Drive Centre, the Netherlands has recently completed the retrofitting of four floating grab cranes. All four cranes, situated at Amsterdam, have the four-rope grab system and are mainly used for ship to quay bulk handling. Two of the cranes are rated at 16-tonnes and have been retrofitted with AC Unidrive variable speed drives, while the two larger 25-tonne cranes have a DC solution, with Mentor II DC drives.

The 16-tonnes floating grab crane, built by Figee, is a Lemniscate type and mounted on a barge. For the different movements standard AC-motors were used. The AC-motors for the hoist and close movement of the grab, as well as the motors for the luffing and slewing movement, are all equipped with Unidrive AC drives.

The data communication between the Unidrives in the control room is based on our high speed network, CTNet.

Control Techniques provided a turn-key service, including design, engineering, software and programming, the building of the panels and the final installation and on-site commissioning at IGMA Amsterdam.

The scheme comprised Unidrive AC drives on a DC-Bus system, with CTNet-communication between the grab hoist and the grab close drives.

Squirrel cage AC motors controlled the movements of the hoist/grab closing (2x160kW) driven by 2 double size 5 Unidrives, both the luffing (1x40kW) and the slewing (2x 39kW) are driven by a 55 kW Unidrive each. The configuration is a standard drive system with a single quadrant rectifier and brake choppers. Since the crane is powered by a diesel engine/ generator set, energy stored in the system cannot be regenerated as with many other dockside cranes. A diode bridge rectifier supplies the inverters for hoist, slewing and luffing via a common DC-bus giving high reliability. Large brake choppers are required to convert potential energy stored in the hoisting system, or kinetic energy stored in the moving masses, into heat, since no regeneration into the grid can take place. The brake resistors are mounted outside the control panel. The crane control system requirements include slewing control, grab hoisting and closing and load dependent speed control on the hoist movement. All this software functionality was achieved without a PLC, using the integrated software solution inside a plug-in programmable application module built-in to the drive.

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CONTROL TECHNIQUES

SLEWING CONTROL

On many conventional cranes, the slewing movement is undertaken with slip-ring motors. The slip-ring motor, in combination with rotor resistors, meets the crane driver's needs in most instances. There is good motor torque control for acceleration and deceleration and it is possible to coast when the controller is moved to zero. However, this method of control is very poor at low speeds, with sudden steps in torque between resistor steps, wasting a lot of energy, and the system requires very regular and intensive maintenance.

When replacing the slip-ring motors with a modern drive system, the results can be very disappointing. *Figure 1* shows the behaviour of a conventional speed controlled drive system that makes it almost impossible to control the swaying of the load.

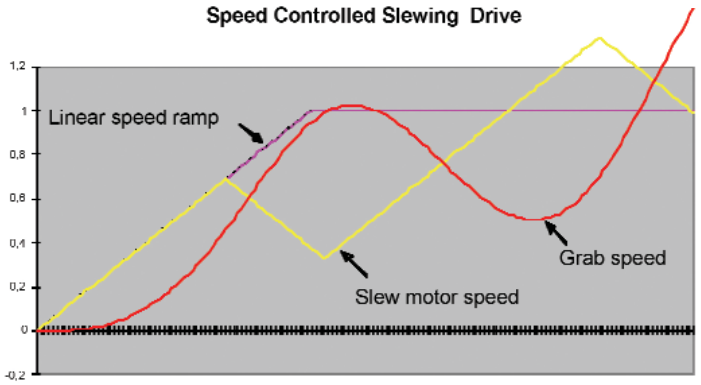

Figure 1 speed controlled slewing drive

To counter this effect, Control Techniques has developed a programme that gives the crane driver optimal control over the swaying load, without the need for a PLC.

The slewing control system provides the driver with control over both the speed and the motor torque. Speed control is important for accurate positioning at low speed. It also provides compensation for the wind forces on the load.

Torque control is crucial for controlling the sway. In this way, the driver is always able to anticipate the movement of the load and compensate for it. By bringing the controller back to zero, the movement is effectively coasting, which gives a major dampening effect on the sway of the load (Figure 2).

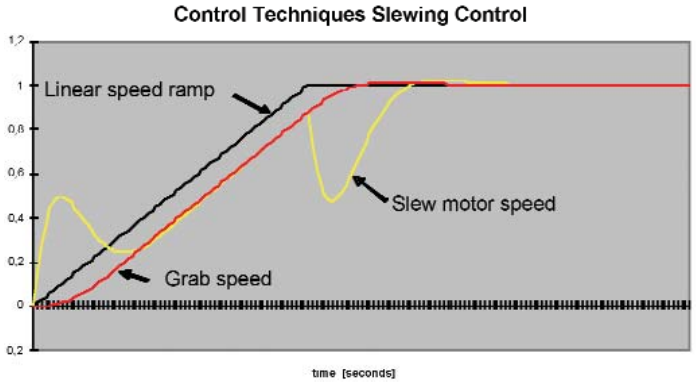

Figure 2 Control Techniques Slewing Control

Using Control Techniques drives, there is the dual option of using existing software for a refit, where it exists, and where this does not apply there is the further option of using software that is integrated into the drive itself. In either case, it is possible to fine-tune the system to meet the crane driver's needs, for an effective solution.

GRAB CONTROL

The hoist movement is controlled by two Unidrive AC drives, one driving the hoist and the other one driving the grab closing movement. Both drives operate in a closed loop control with standard incremental encoders and no additional sensors. With the grab control software all movements are possible between zero and maximum hoisting speed including hoist/closing and hoist/opening, lowering/closing and lowering/opening, grab sinking into bulk product and synchronisation between the hoist and close drives with standard incremental encoders. Additional features include high speed (in motor flux field weakening) with empty grab (1.5 time base motor speed), "teach" function for grab open position and grab closed position. (open and closed positions are stored in the non-volatile memory of the option module, UD70, inside the drive), load balancing with closed grab and hoisting heavy equipment into/out of the ship.

LUFFING CONTROL

Control of the luffing movement is done in a similar way as the slewing movement, but in this case, limit switches are taken into account.

The Unidrive modular drive – the latest incarnation is the advanced Unidrive SP - is well suited for floating grab crane applications, giving savings thanks to the elimination of the need for an additional PLC. The design meets all of the needs of both the crane builder (standard sizes, ease of programming and energy efficiency) and the user (exceptional reliability, flexibility in operation, ease of maintenance, safety and low spares requirement).

KEY BENEFITS

- IMPROVED CRANE PRODUCTIVITY
- COST SAVING AS PLC REQUIREMENT ELIMINATED
- EASY PROGRAMMING
- ENERGY EFFICIENT
- RELIABLE & FLEXIBLE

CONTROL TECHNIQUES

For further information please visit www.controltechniques.com

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