Secondary-controlled drives compensate for sea swells

**MOTION CONTROL** Wind and waves cause vessels to move around, making it more difficult to place loads on the ocean floor. Active heave compensation from Bosch Rexroth detects the crane and vessel motion, integrates it into the control process and compensates for up to 95% of the motion through secondary-controlled drives, writes Michael Teuteberg from Bosch Rexroth AG.

High oil prices promote development of new offshore oil fields. Carrier companies are pushing forward to increasing depths. Crane and winch drives position loads of more than 250 tonnes on the ocean floor. A vessel’s movements caused by wind and waves present a challenge to every crane operator when it comes to setting loads down. The crane follows the movements of the vessel, continuously changing the distance of the load from the ocean floor. Demand for active heave compensation systems has therefore increased constantly in recent years.

**Stability in high seas**
Active heave compensation detects the vessel's heave, roll and pitch and integrates them into the control process. The correction values that are calculated from the motions are taken into account in the crane winch. Vessel motion transferred to the load can thus be reduced to a minimum. Hydraulic secondary-controlled drives from Bosch Rexroth have been a tried-and-tested solution for years in numerous systems for active heave compensation, achieving a high compensation result of up to 95% of heave movements. This allows crane drivers to securely place larger loads on the ocean floor. The hydraulics offer the necessary high level of dynamics and controllability in combination with energy recovery and energy storage. The secondary-controlled drive system works on a constant pressure system. It is virtually non-dependent on pipeline lengths.

When the active heave compensation is activated, the motion reference unit measures the accelerations of the ship. Based on the recorded acceleration values, the Rexroth control electronics calculate the compensation values and output the required rotation speed correction value to the crane winch drive units. A slow display of the active heave compensation after activation prevents overloading of the winch system or the steel rope. After just a few seconds, the active heave compensation almost completely compensates for the vessel’s movements. The winch can now set the load down with full control.

**Energy recovery**
Secondary-controlled drives work both as a pump and a motor in active heave compensation operations. When the vessel experiences downward motion, the drives wind up the winch to keep the load in position. The drive units work as a motor and require energy. When the vessel experiences upward motion, they unwind the winch to keep the load in position. The load drives the secondary units. It now works as a pump in generator operations, thereby feeding the generated energy back into the hydraulic system. The hydraulic accumulator then makes the energy available for the vessel’s next downward motion. Through this process, the drive system recovers up to 70% of the energy, significantly reducing the necessary installed power for the power unit.

**Interference-free measurements**
Rexroth’s latest development now makes it possible to position the sensor to detect vessel movements independent of...
location. One motion unit measures the vessel's movements and calculates the correction value on a compensation point – generally the last sheave on which the rope is fed into the ocean. The placement of the compensation point must be entered into the motion unit. But because cranes change their slewing position as well as the position of the knuckle boom, the only remaining options are to correct the position on the sensor, the installation of the motion unit on the tip of the knuckle boom, or to define a fixed working position for each crane. This issue was considerably simplified in collaboration with the company Ship Motion Control (SMC). After arriving at the new working position for the crane, both the position of the rotating mechanism and the angles of the knuckle boom are transmitted from the crane PLC via bus to the Bosch Rexroth control electronics, which transmits the position correction to the SMC Motion Sensor. This eliminates fixed crane working positions and mounting the sensor on the knuckle boom tip. Boom perturbations for RAHC (rotary active heave compensation) operations are significantly reduced.

Secondary-controlled drive units from Bosch Rexroth have been put to the test for years in numerous systems for active heave compensation, achieving a compensation result of up to 95%

Photo: National Oilwell Norway AS

Summary
Active heave compensation with secondary-controlled winch drives from Bosch Rexroth has been developed to facilitate load placement on the ocean floor in all weather conditions. Dynamic, powerful drive systems play the decisive role in a good compensation factor. With secondary-controlled drives it is possible to compensate for up to 95% percent of the movements. The energy generated by the upward motion of the vessel is then fed back into the hydraulic system. Thus up to 70% of the energy can be recovered.

The control electronics (shown here: the HNC100 from Bosch Rexroth) calculate the vessel motion compensation values and give the required rotation speed value to the crane winch transmission units.