Offshore heavy lift system substitutes for large derrick barges

In Lake Maracaibo, Venezuela, plans called for increasing production from an old field to 200,000 bpd from 10,000 bpd. A three-platform facility with secondary recovery equipment was designed. One platform contained water-flood equipment, a second platform was equipped with facilities to produce the low gravity oil, and the third was to hold compression equipment for reservoir pressure maintenance. However, a bridge with only 138 ft (42 m) of vertical clearance spans the entrance to the lake, preventing the mobilization of a derrick barge of sufficient size to set each platform deck in a single lift.

Fig. 1. The Versatruss lift system was used to install a large deck section in Lake Maracaibo, Venezuela. Capacity of the 6-boom system is 7,500 tons, but an 8-boom system on larger barges could lift about 10,000 tons.

Lift system solution. **To** substitute for a derrick barge, a unique lift system was devised by Versatruss of Belle Chasse, Louisiana. The system uses two barges, each fitted with three 70-ft, 48-in.-diameter A-frame booms, Fig. 1. The booms are connected to heel pins at the base, which enable them to rotate and to be raised and lowered. To eliminate boom tip motion caused by barge roll during system operation, the heel pins are positioned over the longitudinal centerline of the barge.

The booms have a specially designed connection at their tips, which mates to pins mounted in the platform deck structure. The six booms are operated by six 150-ton lifting winches, which are each paired with two 1,500-ton blocks, one 1,250-ton shackle and a 12-in.-diameter sling attached to a pad-eye on the deck leg.

The lift system is positioned by maneuvering the two lift barges alongside the cargo barge, which supports the deck section. The booms are stabbed into the boom tip receiving pins, and the 12-in. slings are connected to the deck leg pad-eyes. The lift winches are engaged, and the two lift barges are pulled toward the transport barge, Fig. 2. As they draw together, the booms rotate on their heel pins, while the boom tips rotate on the pins mounted on the platform, thereby increasing the angle of the booms and raising the deck.

The deck, now suspended between the lift barges, is pulled over the jacket with auxiliary positioning winches. When the deck is in position over the jacket, it is lowered by the lift winches. The weight of the deck on the boom tips forces the booms down and the barges apart. The stabbing guides enter the jacket legs and lowering continues until the deck rests entirely on its jacket. The rigging is then disconnected from the platform and the barges are pulled away from the deck.

Lift system details. The system was installed on two conventional 72-ft by 260-ft barges. Six A-frame boom sets were fabricated of readily available pipe sections, and the bottom of the booms were slipped into heel pin receiver cans. The specially designed tip was fitted onto the top of the booms, securing the A-frame. This

Fig. 2. When lift winches are engaged, the two lift barges are pulled toward the transport barge. As they draw together, the booms rotate on their heel pins, thereby increasing the angle of the booms and raising the deck. Once in position, the deck is lowered by releasing tension on the cables.

feature allows the boom lengths to be changed for decks of different heights. The hydraulic hoisting winches are rated at 300,000 lb of single-line pull. The lower rigging, including blocks, slings and connecting pieces, utilized existing technology designed for the maximum expected loads.

A sophisticated PLC control system synchronizes operation of the winches by implementing a control algorithm in real time, matching the operation of each winch. To produce the desired level of load control, each boom was instrumented with load-cell electronics, which transmits load readings to a central control console. The central control console was equipped with touch-screen MMI and other computerized monitoring of winch and engine functions. All lift data is transmitted via a data highway and, as a back up, data is simultaneously transmitted by radio. A single operator using one joystick performs the actual synchronized lift operation.

For the initial hook-up of the lift barges to the deck, each barge was positioned about 20 ft from the deck using winch-positioning lines connected to the transport barge. The boom tips were then guided into the deck lifting pins. Next, winch lines with their rigging components were connected to the pad-eyes at the bottom of the deck legs. These pad-eyes, along with a lower horizontal structural member connecting the deck legs, became the lower tension chord of the system during lift. When hook-up was complete, the winches were engaged and lifting commenced. About 30% of the deck's weight was shifted to the lift barges, leaving 70% of the weight on the transport barge. This load transfer produced a very stable "trimaran" configuration for towing to the installation site.

After arriving on site, the transport barge was moored to the jacket with 75-ft mooring lines. Lines from an 80-ton winch located on each lift barge were connected to the jacket for positioning. The 150-ton lift winches were engaged, and the deck was lifted clear of the transport barge. The suspended deck was pulled over the jacket with the 80-ton winches and was slowly lowered into its final position.

Technical and economic benefits. Transportation to the field may be arranged to coincide with the most favorable sea and weather conditions. Anchor systems are not required, and field installation—which includes positioning, ballasting (if required), setting and disconnecting of all devices—can be completed in six hours or less, minimizing offshore exposure.

Transporting the deck in a trimaran or catamaran configuration produces a very stable system, which can withstand significant seas and adverse weather conditions. This was predicted by computer modeling and confirmed by operating experience.

In areas such as the Caspian Sea, where access is restricted by water depth or limited clearances, the system is unequaled for its unique design and operational benefits. To reach such sites with large marine equipment requires shipping in small pieces and onsite assembly. The lift barges, with all equipment, can be moved through the narrow Volga canal system to the Caspian Sea.

The capacity of the 6-boom system used in Lake Maracaibo is 7,500 tons, but an 8-boom system, using the same size components assembled on larger barges, could lift approximately 10,000 tons. To exceed this limit, it is merely a matter of increasing the size of the barges and lift system components. This system allows the loads to be controlled at all lift points.

A test lift or pre-lift of a deck can be performed in protected waters to validate all lift clearances and to develop the optimum ballast plan for the quickest possible installation offshore. *W O*