

Hydraulic rigs lower cost, reduce environmental impact

Fully hydraulic rigs lower field development costs, improve safety, and reduce the environmental impact of drilling operations.

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Automation in the land rig industry has been a target for quite some time. Due to the innovations in hydraulic capability within the past two decades, fully hydraulic drilling systems are becoming a reality.

In fact, DrillMec Drilling Technology's Hydraulic-Hoist (HH) Series rigs have been in operation since 1996. The company, formerly a division of Soilmec, developed its HH Series through a joint venture with ENI (formerly known as Agip) and Saipem. The project focus was to design a low impact, low noise drilling rig with increased mobility to operate in marginal fields, primarily in Italy (northern Italy, Po Valley, Sicily).



According to DrillMec, the HH Series was the first rig on the market to offer joystick controls. Today, about 80% of the routine work is done with an unmanned rig floor. (Images courtesy of DrillMec Inc.)

According to Brando Ballerini, president of Drillmec Inc. Houston, the decision brought significant benefits. "This was a big advantage for us because, as a conventional drilling rig manufacturer, knowledge of hydraulics was fairly limited. With Soilmec experience in automation and hydraulics, we could focus on developing this specialized type of rig."

The company has developed six classes of the HH Series ranging from the 100-ton HH102 to its largest rig, the HH350. A prototype of a new design with 600-ton static hook load capacity is scheduled to run its first test in September.

Designed for purpose

"This first rig was designed for small marginal fields in Italy," Ballerini said. The Po Valley is a flat area that is home to a number of small wells producing marginal volumes of natural gas from shallow depths. The goal was to design a rig that could match the power of a conventional rig while reducing the impact on the environment. In addition to reduced noise and visual impact, the rigs needed to be fast moving and provide a safe working environment.

"In Italy, you have a house every 100 m [328 ft]. Unlike in the US where you can drill on land kilometers away from a residence, reduced sound was an important part of this specialized design," Ballerini said. The HH Series reduces sound to a maximum of 60 decibels at the location limit, compared to conventional rigs where sound averages up to 120 decibels.

The size of the rig also had to be reduced to fit a small footprint in a region where land costs are very high. The HH Series footprint ranges from 131 ft by 164 ft (40 m by 50 m) up to 197 ft by 262 ft (60 m by 80 m). The conventional rig's footprint is about 328 ft by 328 ft (100 m by 100 m).

To date, DrillMec has more than 100 HH Series rigs working globally. While the company remains active in the conventional rig market, Ballerini said, "We push this rig because we think it's the future of drilling."

From concept to reality

Designed primarily for shallow- to medium-depth drilling, the HH Series has been used around the world, from Libya and Egypt to Iceland and the shale plays in the US, as well as oil operations in South America.

With the goal of providing sound drilling cost with minimal environmental impact and a high level of safety, the company designed its HH Series to achieve the following:

- Reduced footprint;
- High level of automation;
- Fast moving and rigup;
- Reduced personnel requirement;
- Minimal noise;
- Minimal waste production; and
- High-capacity snubbing.

The rig operates on a total hydraulic system capable of driving all of the rig components in a self-contained configuration

on a semi trailer that is never disassembled for moving. This design eliminates racking board and drawworks, massive mast structures with crown block, and traveling equipment. The use of a single hydraulic cylinder allows for the mast height reduction. The HH300 has a mast height of 101 ft (31 m) compared to 165 ft (50 m) for a comparable 1,500-hp conventional rig.

According to Ballerini, the HH Series is designed around the top drive. This is also unique to the hydraulic rig. For conventional rigs, top drives are usually reserved for rigs 200 tons and above. For the HH Series, top drives are featured in every size including the HH100, which has been favored in mountainous regions of South America. The rig's top drive capacity, combined with ease of mobility, delivers the highest capacity equipment.

The top drive is suspended from two to four cables that engage the sheaves on the top of the cylinder and are fixed to the trailer frame. This configuration allows the hook to double the cylinder's speed. It also allows a pull-down controlled weight on bit up to 66,000 lb (30 metric tons) – particularly useful at shallow depths – and avoids sudden jumping of the traveling assembly in overpull operations for stuck pipe.

The vertical container system for drillpipes and drill collars makes tubular transport during rig movements, as well as pipe connections and string running, easy and fairly quick. The HH rigs are designed to work with 45-ft (14-m) super-single pipes. The system is designed to use the mousehole as a parking system. Because of the automatic hydraulic pipe handler, the driller's activity is limited to only a few actions. The average trip speed is consistently about 42 joints/hr. "For a super-single, that's a big achievement," Ballerini said. "The average is still a little bit less compared to a triple, but the advantage for the automatic system is that the speed is consistent, regardless of weather conditions or the behavior of the workers." While conventional rigs can sometimes trip out of hole much faster, the presence of additional crew can increase the risk of injury, which could shut down the operation completely for several hours.

Challenges

An early challenge for the HH rig's pipe handler was resetting pipe after a rig move. Because of the automated system, efficiency was based on precision. When the first pipe handler entered into use in 2001, crews could spend several hours resetting pipe racks. Today, the system is in its sixth generation. "The base is now independent, and the handling system is redesigned. Resetting takes minutes as opposed to hours," Ballerini said.

Another challenge for the fully hydraulic rig is its high-tech drilling console, which operates with joysticks and touch screens. According to Ballerini, the HH Series was the first rig on the market to offer joystick controls. Drillers used to working on conventional land rigs are sometimes reluctant to make the transition to the automated console.

According to Ballerini, "The advantage of the drilling console is that it reduces the amount of work for the driller. Basically, today a young engineer with some knowledge of well control can easily be trained to drill because the console is designed to automate most of the work usually done by drillers."

To provide a full-service model to potential clients, DrillMec has installed a training simulator in its US plant in Houston. Training typically takes two to three weeks, while an average learning curve in the field is around four months.



The HH Series was designed to deliver low noise, decreased environmental impact, and increased mobility for marginal field operations.