

Automated systems increase safety and efficiency

THE AUTOMATED DRILLER'S consoles and pipe handling capabilities that began appearing in the North Sea as a means to increase worker safety are now being used in virtually every area of the world, both offshore and onshore.

Now the equipment is increasing drilling efficiency as well as resulting in safer operations by removing much of the human interaction in many of the drilling operations. Equipment manufacturers have made great strides in just the past couple of years to expand the capability of the systems and increase reliability as well.



Automated Driller's consoles such as this one on GlobalSantaFe's drillship *Glomar Celtic Sea* enable the Driller to monitor all facets of the drilling operation

Many of the automation breakthroughs occurred in the past two years, however, the industry has made attempts at various levels of automation for nearly 20 years. It has been only relatively recently that the equipment has become more industry accepted.

Automated drilling equipment manufacturers can provide such differentiating services as monitoring their specific equipment from shore to help analyze and maintain it. One pipe handling system manufacturer claims its new system

can make up and break out stands of pipe during tripping at the rate of almost one stand per minute.

When automated and mechanized pipe handling capabilities were introduced, most of the rig automation was focused around getting manpower off the rig floor and away from the drilling operation. This was especially important when moving pipe and other tubulars from a horizontal position on the rig to a vertical position in the derrick when the tubulars are actually in use.

Most of that effort was pushed by the offshore market and primarily by operators working offshore Norway in response to specific safety and manning guidelines aimed at reducing the number of workers on the rig floor.

As the technology has proven itself and become less expensive, it has found its way to drilling operations in less costly drilling installations in other areas such as the Gulf of Mexico and on land rigs.

ARE AUTOMATED RIGS NECESSARY?

Atwood Oceanics has taken a plug and play approach to automated drilling operations in their jackup rig currently being built, the Atwood Beacon. The company has an automated Driller's cabin to be installed that is ready to accept pipehandling equipment. However, the company is not presently planning to install automated equipment until a client requests it.

"We have everything set up in the control system," said **Alan Quintero**, Atwood Oceanics' Manager of Engineering. "The derrick and foundation are designed for it, we have everything ready to go, but we have not purchased the equipment."

"We will not have anything automated on the rig floor to make up and break up pipe, it will be done manually," Mr Quintero continued. "We don't have a pipe racking machine and we don't have the (automated) equipment to bring the pipe from the pipe rack to the rig floor."

The primary reason for this is a direct comparison that Atwood was able to make several years ago between a rig with automated equipment and one that was completely manual. Two platform

rigs were operating in the Bass Strait offshore Australia. They were operating for the same client, drilled similar wells and were run out of the same operations base.

Rig 19 was a completely manual operation while Rig 200 included a then state-of-the-art star racker machine, iron roughneck and automated Driller's cabin.

"Rig 19 was doing as well or better in such things as time to trip pipe," Mr Quintero noted.

"Drilling itself is not where the advantages of the automated equipment come in," he continued. "You drill at whatever speed the formation and weight on bit and hydraulics allow you to drill."

"It is in the flat spots of the drilling curve that automated equipment is supposed to be more efficient, however, we were tripping pipe as efficiently or more efficiently with Rig 19 as we were with Rig 200."

While safety is a factor touted with automated equipment, Mr Quintero points out that both Rig 19 and Rig 200 had perfect safety records. "We find that what really impacts safety performance is safety systems, training and what we call a safety culture," Mr Quintero said. "That has a more direct impact on performance than automated equipment."

SAFETY FIRST

The focus on automated drilling systems as a means to increase safety has occurred only during the past half dozen or so years.

The Norwegian companies were driving safety rather than pure economics with automated pipe handling systems. When the first systems were installed on the North Sea rigs and platforms, contractors and operators rarely realized projected operational efficiencies.

Safety has become a high priority, especially in the past few years.

"I don't believe we would have seen a lot of these systems sold purely on safety until during the last year and a half," said **David Reid**, Vice President of Marketing and Business Development for **Varco**.

"Safety has become a large enough issue today that it is resulting in the use of the systems on middle range jackups and even land rigs."

"There are various stages of pipe handling throughout the drilling operations that are very human intensive," said **Jason Whyte**, New Product Implementation Manger for **National Oilwell**.

"That is where a lot of the accidents occur and that's where we have focused a lot of our development in the past few years."

Mr Whyte said that drilling efficiency is also a factor in pipe handling with the ability to trip in and out of the well and drill faster with an automated system compared with a manual system.

However, once the manual tasks of pipe handling are eliminated and a machine is allowed to perform those tasks, then an element of risk is removed.

"Safety is the reason why contractors buy pipe handling equipment," said **Danny McNease**, President and COO for **Rowan Companies**.

"That's the reason Rowan buys it, and I think if you really get down to it that would be the reason why other contractors buy the equipment."

"With this equipment you don't have workers coming into contact with slips and tongs," Mr McNease continued. "I think about 54% of our accidents happen around the drill floor, so if you can eliminate one accident, that has a big effect on your accident rate."

Still, Mr McNease doesn't forget the efficiency resulting from pipe handling equipment. The company drilled 33 wells deeper than 15,000 ft since April 2001, according to Mr McNease.

"That efficiency has improved as we learn how to drill deep wells and (pipe handling equipment) has made it cost effective to drill. That's the only way some operators can drill these wells."

Mr McNease noted that a deep well could cost \$12 million to drill a few years ago but the cost is now around half that amount due to greater operational efficiency resulting from automated pipe handling equipment.

REDUCING NUMBER OF PEOPLE

Automated drilling operations increase safety since it reduces the number of workers on the rig floor. That doesn't necessarily mean the total crew complement will be lower because of these machines, however.

On the contrary, some contractors have found that while most or all of the rig floor hands are eliminated, they sometimes end up with more workers, or more expensive workers.

"One thing I have learned with these things," said **John Vecchio**, Senior Vice President of Technical Services for **Diamond Offshore**, "is I never have seen us use fewer people on the rig with the automated systems."

"Even if you eliminate four floor hands, you need an assistant driller, another

person that is a computer operator, an electronics technician and others.”

“You end up with the same number of people,” Mr Vecchio added, “but now they are more expensive people.”

GlobalSantaFe has automated Driller’s cabins and pipehandling equipment on a number of its rigs, including a couple of jackups under construction in Singa-

pore that were inherited with the merger of Santa Fe Drilling. These will have horizontal piperacking systems.

But in Global SantaFe’s situation, that doesn’t mean fewer people on the rig floor.

“The automated equipment doesn’t necessarily reduce the number of hands on the rig floor,” said **Marion Woolie**,

Senior Vice President of Operations for GlobalSantaFe, and IADC Secretary-Treasurer.

“It reduces where the hands put their hands on the rig floor.”

INCREASED RELIABILITY?

Reliability of the automated Driller’s console and the pipe handling equipment has increased significantly since serial number 001, but which segment of the technology is more reliable is up to debate.

Rowan Companies’ experience is that the automated Driller’s console is reliable and if anything is going to cause problems it is the pipe handling equipment.

Diamond Offshore, on the other hand, apparently has experienced more problems with the computer equipment than with the mechanical equipment.

“Pipe handlers, rackers and skates are more of an extension of existing technology,” Mr Vecchio said. “There were some headaches (with the equipment) but they were not as major as in the controlling system in the Driller’s console.”

“It was a quantum leap in technology,” Mr Vecchio continued, “and the computer aided controls have not had a long time to develop.”

Mr Vecchio says the problem was a combination of the long drought of activity in the industry that led to a hiatus in research and manufacturing coupled with the extreme upswing in demand to drill more deepwater and deep, more complex wells.

“The equipment became larger and more difficult for people to manage plus there was an increased awareness in safety at all levels,” Mr Vecchio said.

“Basically, there was a demand for equipment to be delivered in an extremely short time and an obliging vendor core. It went from concept to sales without development.”

“The testing was the first units deployed to the field,” Mr Vecchio said.

Still, Mr Vecchio is not completely against automation. “There are benefits, and the equipment is getting better,” he said. “The last installation we did had a pretty easy startup.”

He said while it still is expensive, the hands-free type of equipment is safer, and it doesn't take eliminating many accidents to make up an expense when viewed from an economic standpoint.

Rowan Companies' experience has been that if there are going to be problems it will more likely be with the mechanized pipe handling equipment.

"The controls have been pretty reliable," said **A J Ortiz**, Project Engineer for the Tarzan Class rigs for Rowan Companies. "It's been the mechanical equipment that is subject to breakdown."

"If it's a piece of equipment that's lifting heavy pipe and it has to grab the pipe and move it around, that wears on pins and clamps," Mr Ortiz said. "You get enough wear on it and it takes only one piece to break and the entire system is down."

Mr Ortiz also noted that an advantage of the pipe handling system being separate from the drilling system is that if the pipe handling equipment malfunctions, it can be shut down and those operations can be performed in the traditional fashion, i.e., manually.

While Rowan says it has had little problem with the Driller's console, the company does include a familiar piece of equipment should problems occur that shuts down the automated drilling system.

"We have the traditional brake handle in case something does happen," said **Eddie Robertson**, Operations Engineer for Rowan Companies. "This covers us so we can at least get out of the hole."

"A lot of the contractors don't include the brake handle," Mr Robertson said. "From what I understand, we are the only contractor that wanted the old reliable brake."

"Most of the other contractors wanted to get away from (the brake) so they can say they have an automated state-of-the-art drilling system," Mr Robertson continued.

"We wanted to say that, too, but in case something happens we want to be able to (drill) the old fashioned way."

Rowan says, however, that reliability has improved, and Mr McNease pin-

points increased reliability primarily on better software.

"Reliability has improved because there have been major advances in the software," Mr McNease said. "There were problems with the software and during the past two years the software has been re-written for the pipe racking system."

Previously, Mr McNease said, software was designed to interface the three motors that operated the pipe racking system.

This meant that if there was interference or noise in the system, it could affect all three motors. The equipment manufacturers re-designed the system so one set of software operates one motor, eliminating interference from the other motors.

"That solved basically all of the electrical problems," Mr McNease said.

The other issue the manufacturers improved was with service loops,

according to Mc McNease. These electrical loops were re-designed, resulting in longer life.

DEVELOPMENTS IN AUTOMATED SYSTEMS

There have been several new developments in increasing the efficiency and safety of automated pipe handling equipment and the monitoring and maintenance of that equipment.

Maritime Hydraulics now offers a pipe handling system that is so automated that it can be preprogrammed to perform sequential operations.

The Driller needs only to confirm that the operations have been performed. Rowan Companies is considering the use of such a system on its newbuild Tarzan Class jackups targeted for shallow water deep drilling in the Gulf of Mexico.

Varco recently introduced a land-based remote equipment monitoring and diagnostic system that provides its product experts on a 24/7 basis worldwide. And

National Oilwell's newly launched HAWK suite of applications access and distribute information to and from drilling facilities and transfers it to the appropriate location via the Internet.

The first Maritime Hydraulics' automated programmable pipe handling system will be installed this year on BP's Valhall field platform offshore Norway.



The Assistant Driller aboard GlobalSantaFe's drillship C R Luigs operates the pipe racking machine.

To operate the system, the Driller would choose the trip in sequence, for example. Instead of running the drawworks, top drive, pipe handling and slips in separate operations, it is all preprogrammed.

The Driller merely confirms everything visually and indicates that the sequence has been performed. Even the optimal weight on bit is preprogrammed.

"There will be people in the Driller's cabin but there will be absolutely nobody on the drill floor," said **Arnt Lauen**, Technical Sales Manager for Maritime Hydraulics in Houston.

"It will be completely hands off for strict North Sea and BP requirements."

"BP has tried to lift the standards," Mr Lauen said. "The hands-off portion of the system comes from Norwegian safety requirements, but BP has tried to raise the bar on control systems and automation."

The system is dubbed the Configurable Automatic Drilling System (CADS). Maritime Hydraulics programs the various sequential operations working with the contractor and operator.

The system also includes offline stand building with an advanced collision avoidance system to prevent interference with other operations. The Iron Roughneck is on a turntable to serve both the mousehole and well center.

Another new feature is the automatic E-Tally®. This is a measuring and recording system keeping track of all tubulars going in and out through the V-door and down-hole. The system measures and records the type of tubular, size and length, position in set-back or drillstring and even how many times and at which torque the tool joints have been made up.

Redundancies in the CADS abound. The Driller's and Assistant Driller's chairs are identical so if one chair malfunctions, the other chair and computer can take over the drilling operations.

Pushbuttons and switches typically seen in an automated Driller's cabin are eliminated and replaced with touch screens that can be configured in any manner.

There is a manual fallback with the pipe handling system.

"BP wanted to have a manual fallback so the fingerboards and racking system are set up to allow the monkey board to be folded down to manual operation should that be required," Mr Lauen said.

"Additionally, all of the computer and control systems can be bypassed and the floor hands can go back to manually

operating the drawworks, top drive and pipe handling separately."

Because everything is optimized, and the operation does not depend upon the Driller to choose when to perform different functions, tripping time on the rig is extremely quick, up to 55 stands per hour. That's a much higher rate than proven available in the industry today, according to Mr Lauen.

"We have taken the operation another step with sequencing and have been able to greatly improve upon tripping times as a result," Mr Lauen said.

Varco's e-drill service is the industry's first system for remotely monitoring and diagnosing their equipment on rigs anywhere in the world. It is available 24/7 and Varco in fact guarantees that it can put rig personnel in touch with a Varco technician in less than an hour from initial contact.

Data is accessed directly from intelligent systems built into Varco equipment to maximize the performance of the equipment such as top drives, pipe racking systems and V-ICIS controls.

With the monitoring system, rig personnel have access to a database of archived solution information, trend reports, event records, rig activity surveys, training aids and call logs. Information can be shared among rigs.

The goal is to achieve optimal drilling performance while preventing minor difficulties growing into downtime events. Should a problem be identified, a Varco e-drill technician will contact the rig to analyze, troubleshoot or advise a maintenance operation.

Transocean's drillship Discoverer Deep Seas was the first offshore rig to use Varco's e-drill to monitor, analyze and help maintain drilling equipment.

A four-month pilot program saved the rig several hours of downtime, according to Transocean. As a result of the pilot program Transocean has added seven more of its ultra-deepwater rigs to the service.

The rigs to be connected with e-drill are Discoverer Spirit, Discoverer Enterprise, Cajun Express, Deepwater Nautilus, Deepwater Horizon, Deepwater Pathfinder and Deepwater Millennium.

Helmerich & Payne drove the concept originally for their new fast moving land rigs and have a number of their rigs monitored by Varco's e-drill system, according to Mr Reid, including one of H&P's rigs in Argentina.

"We have a dedicated facility in our M/D Totco facility in Cedar Park, Texas, to monitor and support the H&P land rigs," Mr Reid said.

Varco originally planned to open e-drill centers in Singapore and Aberdeen as well as Houston but decided to utilize only the Houston location since it is manned around the clock.

National Oilwell's HAWK suite of monitoring applications is designed to simplify the way the Driller monitors the drilling operation.

"HAWK monitors the entire drilling operation," Mr Whyte said.

"That includes monitoring everything, from how your mud pumps are operat-



Maritime Hydraulics' Configurable Automatic Drilling System (CADS) will be installed on BP's Valhall platform in the North Sea. The bridge crane and fingerboard are pictured above.

ing to knowing in which direction your downhole drilling tool is drilling."

The applications include HAWK On-Line Support, WebDriller and Support Center. The On-Line support is a 24-hour service center while the support center is how the user chooses to utilize the information. With the software, the Driller will have the capability of asking for advice from National Oilwell technicians around the world.

Following the monitoring and measurement of any operation on the rig, the information can be distributed to expert teams and support centers offsite via telephone and/or computer. After transferring the information it can be stored and used for training.

With the software, wells could be designed offsite and transferred to the rig to be loaded into National Oilwell's Cyberbase Driller's console as graphs and 3D models for the Driller to follow.