# Q&A

# RIG DESIGN

*OILFIELD TECHNOLOGY* INVITED EXPERTS FROM NABORS AND NOV TO SHARE THEIR KNOWLEDGE ON A VARIETY OF RIG DESIGN TOPICS. READ ON FOR INSIGHTS FROM:

## NABORS

RANDY PYRCH joined Canrig as an engineer in 1985. He has served in various roles including operations manager, technical services manager and top drive product line manager.

LARS RAUNHOLT is the founder and CEO of Robotic Drilling Systems AS (now Canrig Robotic Technologies AS). Lars has been CEO of the company for a total of nine years.

SUBODH SAXENA began his career as a field engineer with Schlumberger and subsequently worked in different management positions. In 2013, Subodh joined Nabors as senior vice president.

## NOV

ROBERT GOODWIN is the product line manager for top drive drilling systems at NOV, overseeing both land and offshore top drives. Robert graduated from the College of Engineering at Texas A&M in 2001.

RICHARD VERHOEF is the product line director for pipe handling, hoisting, motion compensation, and fluid systems at NOV. Richard has been with NOV for more than 20 years and has held various positions with the company in sales, engineering, and quality assurance.

VINESH RAMBALLY is currently a business development manager at NOV, where he is responsible for the integration of applications onto the NOVOS system. He completed the NOV Ventures – Technology Commercialization programme at the University of Texas in 2012.

OLAV FIVELSTAD is the senior product line manager for land and offshore drawworks at NOV. During his 12 years of service with the company, he has also worked in several other positions in engineering and product line management.

## TOP DRIVES

### RANDY PYRCH – NABORS

Over the past 30 years, top drive drilling systems have been proven to reduce risk and increase safety while drilling by reducing manual operations. Drilling with triples and being able to rotate pipe while tripping have revolutionised horizontal drilling. With the acquisition of Tesco Corporation in December 2017, Canrig has been able to double the amount of top drive systems in their portfolio, which now includes both hydraulic and electric-powered units, with the highest performance of torque and speed in the industry. Electric top drives use the power of the existing rig generator to perform necessary tasks required for drilling applications. Some advantages of using an electric top drive include: low maintenance, improved performance efficiency, higher torque capacity and improved environmental credentials. Hydraulic top drives have a smaller footprint in the mast and are well suited for smaller rigs. Canrig's commitment to drilling automation and efficiency has resulted in the development of intelligent top drive accessories including an advanced diagnostics system, zone management system, remote equipment condition monitoring, ROCKit® (pipe oscillation while sliding) software, REVit® (stick slip mitigation) software, and Navigator™ directional platform. The top drives are equipped with the CRT-READY™ drilling package, which fully integrates casing running tools with the drilling rig. Each accessory allows Canrig to provide efficient service and support of their top drive systems located around the world.

### ROBERT GOODWIN – NOV

The drilling landscape is changing. Horizontal wells are being drilled to exceedingly long lengths, with land rigs often drilling wells exceeding 4.5 miles in length and offshore rigs drilling wells over 7 miles long. Despite the recovery in oil pricing, the market remains tight, with many contractors being challenged to push the limits of their existing equipment and fleet rather than allot capital to expensive newbuild capital equipment. This issue is

compounded by the fact that new equipment often has long lead times, leading to even more costly downtime.

Arguably no piece of rig floor equipment is subject to this changing market dynamic more than the top drive. Increased power and torque are becoming more critical to drill in these horizontal extended-reach drilling (ERD) programmes, but the limiting factor is often that the top drive does not have enough horsepower to reach the formation. To address this, NOV has developed a way to take an existing top drive and upgrade the unit so that it can handle these demanding drilling conditions. The TDS-11SAE is the result.

The TDS-11SAE builds upon the wide field implementation of the original TDS-11SA top drive, which currently has more than 2000 units in use. The TDS-11SAE represents an enhancement to the original top drive that meets the land drilling market's need for more power, achieving 32 120 ft/lb of torque at 180 RPM at the drill stem, while also extending the life of the existing top drive. The upgrade consists of two new 600 hp induction motors and gearbox internals that are retrofitted to a customer-owned TDS-11SA top drive.

NOV collaborated with major drilling and engineering partners to create a cost-effective upgrade kit that increases drilling torque while maintaining the compact size of the original top drive. The increase in horsepower enables drilling of ERD wells beyond the technical limits of standard top drives, while a 500 t main thrust bearing ensures the hoisting capacity to handle heavy pipe. The advantage of working with the company is that customers receive the quality and experience of the OEM when upgrading a piece of drilling equipment that is critical to their operation.

## PIPE HANDLING SYSTEMS

### LARS RAUNHOLT – NABORS

In the drilling industry, dropped objects and pipe handling are two of the most common causes of incidents in pipe handling, typically resulting in more serious injuries. Canrig offers a robotic drill floor system consisting of an electric drill floor robot, robotic pipe handler, electric robotic roughneck, multi-size elevator and an overall robotic control system. The robotic drill floor system will handle drill pipe, tubing, casing, subs, stabilisers as well as speciality tools for hands-free pipe handling of e.g. safety clamp, manual slips and pipe guide. Another similar tool to the robotic pipe handler offered is the iRacker® autonomous tubular handling system. The system enables completely hands-free pipe handling, allowing for offline stand building and handling; it is offered in electric and hydraulic-powered units. After testing the drill floor system, results indicate a substantial potential savings of rig days including several hours of manual operations on the rig site that will be avoided when implementing robotic technology on the rig floor. In addition to saved rig time, improved HSE and cost savings, a full electric robotic system will give other benefits, such as less downtime, faster installation, reduced noise levels, less energy consumption and reduced $CO_2$ emissions. In the last decade, the development and implementation of electric, robotic equipment for the rig floor has become more attainable as contractors and operators want to provide safer and more efficient operations while handling pipe.

***Figure 1.*** *The electrical robotic pipe handler during field testing. Image provided by Nabors.*

## POWER SYSTEMS

### RICHARD VERHOEF – NOV

Operators are slowly adapting to the shifting energy environment, making it a priority to reduce their carbon footprint. NOV continues to develop power systems equipment design in order to help operators achieve their goals in this area. To achieve optimum systems design, the company had to consider power generation and storage, how to use power more efficiently, and how to integrate the system to better use and redistribute available power.

The primary concerns for power generation and storage on offshore installations are typically as follows:

- Where and how is the power generated on these installations?
- What can be stored and re-used?
- How can it be stored, and for how long?
- What storage device is best suited for the application?

When it comes to using and reducing power needs, NOV explored how power-efficient the equipment used is, and if there were opportunities to make it more efficient. The most important issue, however, was what system integration possibilities existed to better (re)distribute available power. The company determined that more integrated systems, which work together on the power generation and usage cycle and use smart control and software solutions to achieve the best results, must be developed – and that the outcome of their implementation would be a reduction in a drilling installation's $CO_2$ emissions, lower maintenance and fuel costs, and increased reliability.

NOV has developed and tested a flywheel storage system, the PowerBlade kinetic energy recovery system, and is currently working on a Norwegian government-funded field trial on a semisubmersible with a hybrid system, whereby the flywheel system works in conjunction with a battery system to optimise the energy recovery and release system. The PowerBlade system captures regenerated electrical energy when the drawworks, crane, or winch slows and stops the load on the hook. This is stored as kinetic energy using a flywheel that accelerates and gathers speed, capturing energy from vessel rising and block lowering during active heave compensation. This energy is then recycled and utilised to put power back onto the power grid when needed.

## DIRECTIONAL DRILLING

### SUBODH SAXENA – NABORS

Accurate wellbore placement is critical for operators drilling horizontal wells in unconventional formations, every foot of hole drilled outside the target zone represents lost production potential. In traditional operations, success depends on the skills and experience of the directional driller and the quality of directional decisions made as each stand is drilled. The results of this process can be inconsistent, with incomplete documentation of decisions, making it difficult to analyse performance on a given well and nearly impossible to identify improvement opportunities. Additionally, using the traditional process, operators can recommend rules or best practices, but have no means to enforce or confirm compliance. The Navigator™ directional platform is an automated directional drilling workflow that serves as a digital advisor, a documenter and a performance tracker. It calculates directional drilling instructions to keep the well within the target window, documents all decisions and actions taken and rates performance at each stand against quantifiable KPIs. The operator can also set best practices and rules for each well that are programmed into the platform so that its recommendations will always comply with the operator's set parameters. Specifying the acceptable drilling window avoids unnecessary sliding and doglegs that would result from adhering strictly to the well plan. Nabors has also developed the ROCKit® Pilot software to automatically execute the platform's instructions, including target toolface and slide distance for the stand drill down by controlling the top drive quill, using toolface results and delta pressure data. Early tests demonstrate the potential of fully automating the process of drilling with steerable motors, precisely implementing calculated instructions, and reducing the reliance on individual directional drillers.

## AUTOMATION TECHNOLOGIES

### VINESH RAMBALLY – NOV

The NOVOS™ reflexive drilling system is a process-automation platform designed to perform a series of actions when prompted, just as human reflexes respond when acted upon by a specific stimulus. NOVOS manages rig equipment to execute drilling programmes, allowing the driller to step back from the repetitive complexities of machine and process control.

Drillers can be overwhelmed by the huge amount of data needed to manage the operation, tasks in need of constant attention, and the high skill levels necessary to achieve both performance and consistency. These issues are compounded by the fact that unconventional shale wells are increasing in complexity, and drillers must try to maintain a wellbore's straight trajectory to maximise efficiency. The system provides users with a platform for the control, monitoring, scheduling, and optimisation of drilling operations to address these concerns.

***Figure 2.*** *The TDS-11SAE is powered by two new 600 hp induction motors, increasing power for use in ERD wells. Image provided by NOV.*

Using an imported well plan that describes desired drilling parameter ranges, the system performs the planned operation until total depth is reached. The system also structures data and defines activities through process automation, enabling engineers to develop lessons learned and scale best practices across regions and rig fleets, regardless of specification. By using NOVOS, drilling process cycles become more consistent while allowing the driller to focus on safety and execution, instead of being preoccupied with repetitive tasks. The system's open coding infrastructure allows developers to create and deploy unique optimisation applications – with some already developed by drilling contractors, operators, and universities – that improve performance and consistency.

NOVOS is now the most widely deployed automation system in the industry, operating on dozens of land rigs across North America, and being installed on multiple offshore platforms and drillships this year. Every driller, regardless of individual experience level, can use the system to achieve improved performance, thereby optimising standard processes – like ramping flow or lowering the string – and, as a result, reducing unnecessary wear on drill bits, drill pipe, and equipment.

## SEMISUBMERSIBLE AND DRILLSHIP EQUIPMENT

### DESIGN/UPGRADES

### OLAV FIVELSTAD – NOV

As the floater market has gotten increasingly competitive during the downturn, the focus has shifted to having higher hookload capacities that are necessary to drill deeper wells. There is a limited amount of drilling rigs that can handle the heavy strings, with casing loads over 1250 short tons, required on some of these deepwater wells. For drilling contractors with assets that do not have this capability, the solution is either to buy new rigs or to upgrade their existing fleet.

In a classic drawworks hoisting system the operator can increase hookload for the hoist by adding lines into the system, which decreases hookload speed. This is a time-consuming operation since the operator will have to hang off the top drive and the travelling block before adding wire into the system. Another critical factor is the safety aspect. On offshore drilling rigs today, the wire is normally 2 in. or greater. Large wire sizes mean that the operator will have a heavy weight to move around when stringing the hoisting system.

A new solution to solve the industry's offshore hookload and speed problem is to install an NOV multi-speed travelling block. The multi-speed block introduces a variable transmission ratio to the hoisting system, which is accomplished by changing out the number of sheaves that are moving with the travelling assembly. By disconnecting the sheaves from the multi-speed block the gear ratio will decrease, thereby reducing weight capacity and increasing maximum speed. Disconnected sheaves will be locked – either to the top assembly that is fixed to the top of the derrick or to the travelling assembly – and the locking and unlocking sequence will be completed by a simple automated sequence.

Using the multi-speed block means that less wire needs to be pulled/slacked when the gear ratio is changed without reducing heavy lifting capabilities. In addition, the variable transmission extends the product's lifecycle, making the multi-speed block an efficient and less complex device for performing hoisting transmission. This solution will decrease the cost of delivering hoisting