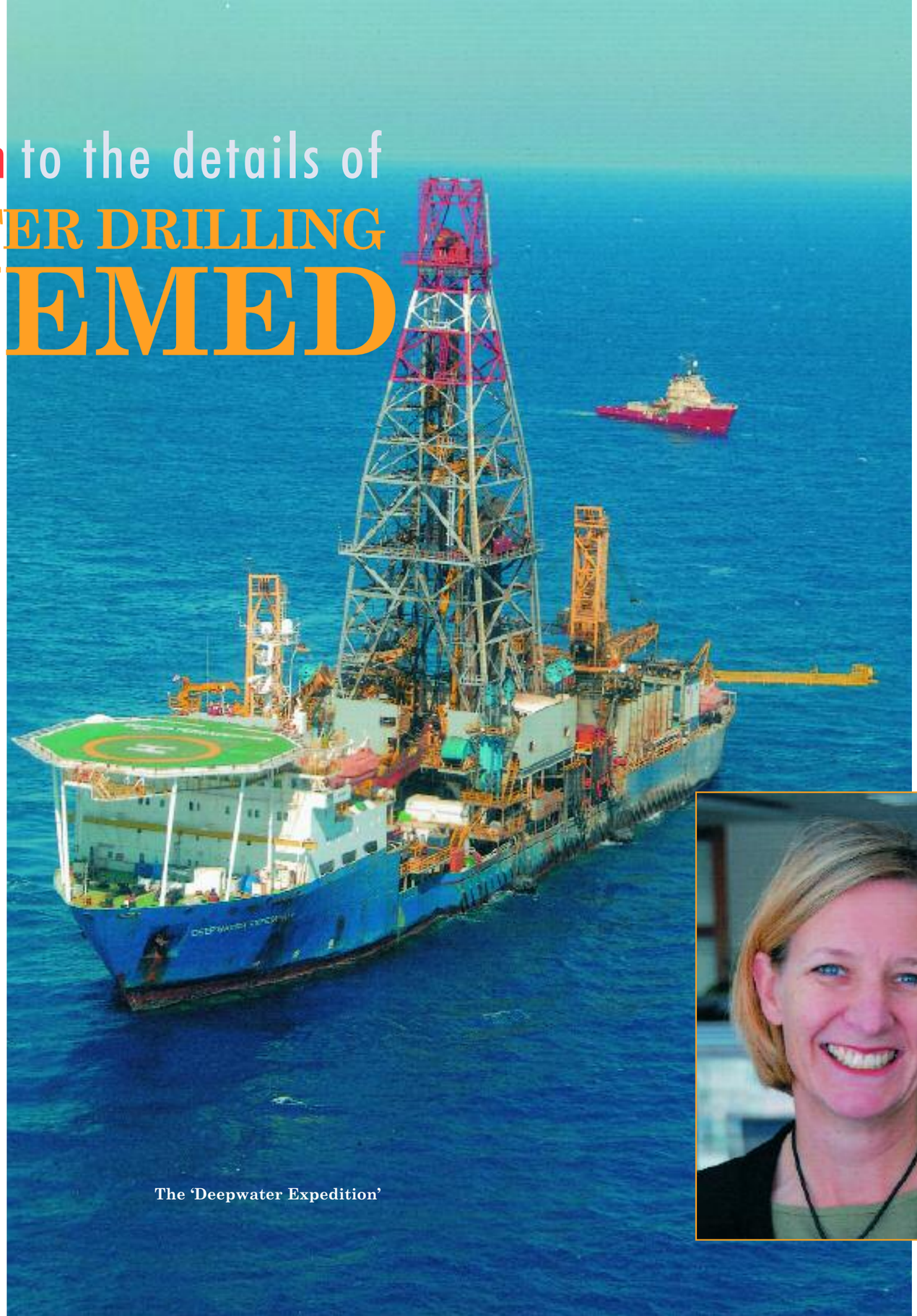
Getting down to the details of DEEPWATER DRILLING IN NEMED

Shell Egypt discovered gas in its 31,135 square kilometre NEMED (North East Mediterranean Deepwater) concession in 2004. In January 2007 Shell Egypt started Phase 3 of its drilling campaign in NEMED, using the TransOcean 'Deepwater Expedition' drilling ship. The vessel was positioned 185 kilometres offshore, to drill additional wells in water depths ranging from as shallow as 1,500 metres to as deep as 2,750 metres. Drilling deepwater wells is considered to be the most difficult operation in the oil and gas industry. 'Shell in the Middle East' visits the 'Deepwater Expedition' to talk to some of the people involved in the highly specialised activities which are required to conduct deepwater drilling operations…



The 'Deepwater Expedition'

"IT IS VERY EXCITING FOR ME to be appointed as Shell Egypt's Exploration Manager at this crucial time when Shell Egypt is carrying out extensive exploration activities in Egypt, both onshore and offshore," says Eileen Wilkinson.

"In the Western Desert Shell Egypt works closely with BAPETCO [Badr El-Din Petroleum Company], a 50-50 joint venture between EGPC [Egyptian General Petroleum Corporation] and Shell. BAPETCO is the operating company for Shell's activities in the Western Desert, and we have recently had a number of very notable exploration successes in the Western Desert.

"Shell Egypt is now progressing its offshore drilling campaign in ultra-deepwater in its NEMED [North East Mediterranean Deepwater] concession, during which Shell will be drilling the deepest ever deepwater wells both in the Middle East and in the Mediterranean. The deepwater drilling campaign in NEMED is being carried out using the TransOcean 'Deepwater Expedition' drilling ship.

Eileen Wilkinson, Exploration Manager, Shell Egypt

"Deepwater drilling is still one of the greatest challenges in the oil and gas industry and requires a great deal of technological know-how. Shell is today one of the world's leading companies in the deepwater drilling industry and Shell Egypt is fortunate to be able to draw on Shell's global experience in this industry.

"During the current drilling campaign in NEMED the Shell Egypt exploration team has been joined by experts from Shell's deepwater centre of excellence in Houston, in the USA. Shell Egypt's excellent exploration team is also being supported by internationally proven contractors and service providers, such as Schlumberger, Baker Hughes Inteq and MiSwaco.

"Good teamwork is the key to any drilling operation, and it is perhaps particularly critical when working some 200 miles offshore. In the eastern Mediterranean, where we are drilling, weather conditions can sometimes deteriorate to gale force conditions which can affect not only our drilling operations but our logistics and supply activities.

"We are using helicopters, based at Alexandria airport, to fly personnel to and from the 'Deepwater Expedition' to effect crew changes. Heavy equipment and other supplies are delivered to the 'Deepwater Expedition' from Shell's dedicated supply base at Abu Qir.

"Safety is always a major issue ▸

EILEEN WILKINSON CONTINUED

in the oil and gas business and, whilst working offshore presents its own particular safety challenges, our safety record during drilling operations in NEMED is something of which I am extremely proud.

"So," Eileen concludes, "Shell Egypt is hopeful that it will have success in NEMED, which will lead to the commercialisation of gas discoveries and the development of an onshore gas facility. This will benefit the people of Egypt by providing gas for the growing domestic market and by maximising valuable export opportunities in the form of LNG [Liquefied Natural Gas]."

Below: The DPS computer system

From the left: Captain Valerio de Rossi, Master of the 'Deepwater Expedition', Felipé Pacheco, Dynamic Position Operator, and Geoff Henstridge, Senior Dynamic Position Operator, of TransOcean

"THE 'DEEPWATER EXPEDITION' IS POSITIONED SOME 185 KILOMETRES from the shore in 2,420 metres of water, drilling the La 52-2 well," says Captain Valerio de Rossi, Master of the 'Deepwater Expedition'.

"Obviously, in such deep water we cannot drop an anchor so to maintain position of the vessel we use a DPS [dynamic positioning system]. This is an integrated system which uses a computerised DGPS [differential global positioning system] to control the vessel's electrical thrusters, or propellers, to maintain a fixed position to within about two metres.

"In addition we use a hydro-acoustic system of beacons, positioned on the sea bed using a ROV [remotely operated vehicle], which transmit acoustic signals picked up by hydrophones on the vessel.

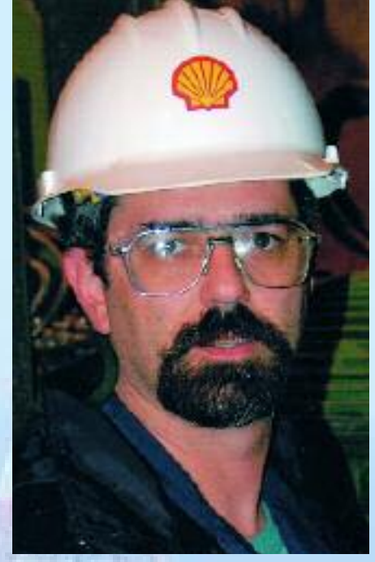
"We also use sensors to measure wind speed and direction, vertical motion sensors to monitor the pitch and roll of the vessel, and electronic gyro compasses to provide information on the ship's direction.

"All of this data is fed into a master computer which then sends signals to the ship's thrusters with commands which allow us to control the vessel's position to within a couple of metres.

"All of the systems have duplicate back-up systems, and in the event of complete failure the DPS can be controlled manually.

"Out in the eastern Mediterranean it can get very windy and the sea can get very choppy, so it is quite a job to hold the ship in one place," Captain de Rossi concludes.

Left and above: The 'Deepwater Expedition' stays in place using a DPS (dynamic positioning system). In the middle of the vessel is a big hole referred to as the 'moon pool' and it is through the moon pool that all drilling operations are carried out. A 21-inch diameter riser pipe is installed from the well head on the sea floor rising 2,420 metres to the surface of the sea and up through the moon pool to the vessel, where it is fixed to a telescopic slip joint with tensioners attached to the vessel. The 2,420 metres of riser must remain static so, as the boat pitches, rolls and heaves, the riser remains static whilst the boat moves up and down around it with the tensioners and slip joint tightening and slackening to permit this movement



Ron Rock, Drilling Fluid Specialist with Shell, based in Houston

"SHELL IS USING A SYNTHETIC BASED MUD [SBM], which is a low toxic mineral oil called Safarsol D 80, to drill the La 52-2 well, one of the wells in Phase 3 of Shell Egypt's NEMED drilling campaign," says Ron Rock, Drilling Fluid Specialist with Shell, based in Houston in the USA.

"As the drilling fluid - or mud as it is called in the drilling world - is oil based, we cannot discharge the formation cuttings into the sensitive environment of the Mediterranean as they are contaminated with this oil-based mud. So we are using a system designed by the mud contractor, MiSwaco, called 'Skip and Ship'. This enables us to collect and remove to shore all cuttings to protect the environment.

"The reason that Shell is using this type of mud to drill the La 52-2 well is because it is inhibitive and does not react with the formation. This means that it provides chemical and mechanical stability to the well bore during drilling, and provides the correct weight to maintain a positive hydrostatic balance in the well bore.

"The well design called for the completion of the well using an ESS [expandable sand screen] in the reservoir section. With current mud and new shaker technology we have attempted to screen the mud using Axiom shaker technology in parallel flow, using screens of a 250 mesh [50-55 microns] whilst drilling the 12.25-inch section.

"By using these fine screens to collect formation cuttings, whilst maintaining a mud flow rate of up to 1,350 gallons per minute and still managing to provide good hole cleaning, we have been successful in passing the production screen test through a 150 micron ESS provided by Weatherford with no mud losses.

"If we are also successful using SBM with the Axiom shakers in the 8.5-inch section then the integrated approach of drilling fluids, new shaker and centrifuge technology, Skip and Ship operations, as well as expandable sand screens, should help optimise the production data during the well test. Shell has utilised this specialised drilling fluid to act as a completion fluid in this remote location as an enabler to achieve success in the final production test," says Ron.

The shakers

Geoff Camm, Service Engineer, MiSwaco

GEOFF CAMM, SERVICE ENGINEER WITH MiSWACO, was awarded a Shell 'Hero' award for his services to the NEMED offshore drilling programme for his good work in developing, installing and operating the Skip and Ship system, also known as 'Clean Cut', to collect formation cuttings contaminated by the oil-based drilling fluid.

"MiSwaco has an in-house system for the collection and safe disposal of contaminated formation cuttings which is called Clean Cut, or Skip and Ship," explains Geoff.

"Cuttings produced whilst drilling through the formations arrive with the recirculated drilling fluids, or mud, on to the shaker screens from which they are delivered into an auger. From the auger a blower pneumatically conveys the cuttings to a loading station where they are contained in skips.

"These skips are then back-loaded on to supply vessels for shipping to Shell's Abu Qir logistics base, where they are delivered for treatment to a thermal de-sulphurisation unit to separate the oil from the formation rock. The rock can then be used as land fill whilst the oil is recovered for further use.

"MiSwaco also provides a centralised vacuum system which provides Shell with an emergency cleaning system should there be any spills of drilling

GEOFF CAMM CONTINUED

fluid on the 'Deepwater Expedition' to prevent contamination of the sea.

"This service is available on the drill floor, in the shaker house, the mud pit and pump rooms and also in the sack store.

"MiSwaco is also the supplier for the SBM [synthetic based mud]," concludes Geoff.

**Dominic Sankey,
Driller for TransOcean**

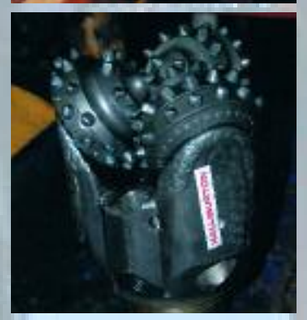
"THE 'DEEPWATER EXPEDITION' USES A REMOTELY OPERATED DRILLING SYSTEM which is controlled from two cyber chairs in the 'doghouse', where the drillers sit and remotely operate most of the drilling operations," says Dominic Sankey, Driller for TransOcean.

"The drilling system which we are using on the 'Deepwater Expedition' allows us to considerably reduce, but not completely eliminate, the manual handling of tools, equipment and drill string components, such as the BHA [bottom hole assembly], drill pipe and other drilling tools.

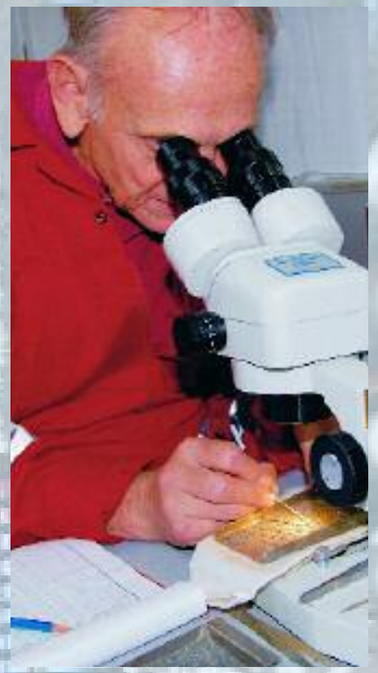
"The driller sits in one chair and operates the top drive, controlling the drill string, whilst the assistant driller sits in the second chair and operates the PRS [pipe racking system], feeding the driller with stands of pipe as required.

"The automated PRS allows us to handle three joints of drilling pipe of 9 metres, or 30 feet, each in what is called a stand of almost 100 feet. This obviously allows for faster tripping of the drill string as we only have to disconnect every three joints of drill pipe. In addition there is no need for a derrick man at the top of the pipe rack as it can be fully controlled from a cyber chair.

"The drilling system is equipped with several closed circuit TV cameras which transmit live pictures of the operations to screens situated at the cyber chair stations, which allows us to monitor different operations taking place on the drill floor. In addition, there are other touch screens which provide us with real time information of important drilling data, such as the WOB [weight on bit], the RPM [revolutions per minute] of the drill string and information on the mud system which is used to maintain hydrostatic pressure in the well bore, lubricate the drill bit and bring the cuttings from the formation to the surface," Dominic concludes.



**Top to bottom, left to right:
The pipe racking system, the MiSwaco Skip and Ship system, the vacuum system, the 'doghouse' and a drill bit**



**Derek Moss,
Operations Well Site Geologist**

DEREK MOSS IS SHELL'S OPERATIONS WELL SITE GEOLOGIST, responsible to Shell's Asset and Development Team in Houston. He says, "My main job is to liaise between the 'Deepwater Expedition' drilling rig and the Houston sub-surface team on the progress of drilling activities and on the formations encountered on the well, La 52-2, in the offshore ultra-deepwater Nile Delta NEMED concession.

"The first well is classified as an appraisal well because it is a follow-up to the La 52-1 discovery well drilled three years ago in the La 52 prospect during Phase 2 of Shell Egypt's NEMED drilling campaign.

"After coring the La 52-2 reservoir section and subsequently drilling to a planned total depth, the section will be evaluated by running a suite of wireline logs. Wireline logs will confirm the presence of the reservoir section, over which it is planned to conduct a well test by flowing the gas to establish its productivity. The well test involves flowing gas from the well to achieve a minimum flow rate and volume in a set time, which will hopefully confirm the success of the well.

"There have not been any surprises with regard to the geology we have encountered so far and we don't expect this to change. We have excellent seismic data, good well-to-seismic ties, as well as formation data from drilling the La 52-1 well.

"The formations have been predominantly shale, with inter-bedded layers of sandstone, and have presented no problems to date. We are just above the first reservoir, from which we will take a core sample, then we will drill deeper to a lower second reservoir, which we will also core.

"There is a specialist coring team from Baker Hughes Inteq onboard, which will cut and retrieve the cores, as well as experts from Omni Laboratories in Houston, who are responsible for the preservation and stabilisation of the cores in dry ice once they have been recovered and are on the surface.

"The first core, of four inches in diameter, will be recovered in an aluminium sleeve of some 18 metres in length. This aluminium sleeve will then be cut into two nine-metre lengths, placed into special metal containers and packed in dry ice to freeze and stabilise it. It is recommended that the core be frozen immediately because the sandstone formation is very poorly consolidated and, by freezing, the core can be stabilised to preserve its integrity. Once frozen, the core will be cut into one-metre lengths and packed into specially insulated shipping crates of dry ice for shipment by air to Omni Laboratories. Once in Houston, the core will be described and analysed to determine porosity and permeability and other reservoir rock properties and characteristics," concludes Derek.

Ahmed Kawanna, MWD/LWD Engineer, and Rami Fakhry, General Field Engineer, both of the Drilling and Measurements Division, Schlumberger

"SCHLUMBERGER IS PROVIDING LWD [LOGGING WHILE DRILLING], MWD [measurements while drilling] and DD [directional drilling] tools and services to Shell Egypt in its drilling operations from the 'Deepwater Expedition," says Rami Fakhry, General Field Engineer, Drilling and Measurements Division, Schlumberger.

"LWD is a tool which is a part of the drill string and goes down the well bore just above the drill bit. This tool provides real time formation evaluation of a range of data. The data collected by the LWD tool includes naturally occurring gamma rays and electrical resistivity in the formation, the density, porosity and pressures of the formation.

"These measurements are then used by Shell's on-board petro-physicist and drilling team to identify zones of interest which may contain hydrocarbons. The LWD tool also provides real time data to the driller to enable him to optimise drilling performance.

"MWD is normally the second tool in the drill string and positioned

RAMI FAKHRY CONTINUED

in the drill string above the LWD tool. This tool measures the inclination and direction of the drill bit by measuring the orientation of the drill string in relation to the earth's magnetic and gravitational fields.

"When drilling of the well nears the final TD [total depth], a combination of LWD, MWD and DD services will be used to ensure that Shell hits the 'sweet spot', or the final target of the reservoir," concludes Rami.

From the left: Mohamed Hilaly, Data Engineer, Mohamed Fathy, Sample Catcher, Ashraf Ghazy, Data Engineer, and Eslam Kamal, Mud Logger, from Baker Hughes Inteq

"BAKER HUGHES INTEQ IS PROVIDING MUD LOGGING SERVICES for Shell during its operations here on the 'Deepwater Expedition'," says Ashraf Ghazy, Data Engineer for Baker Hughes Inteq.

"During drilling operations, mud is circulated down the well bore through the drill string to the drill bit, where it is used to lubricate the drill bit and to bring the cuttings from the bottom of the well back to the surface to clean the hole.

"The drill bit may be 3,500 metres below the shaker screens, where the cuttings will eventually arrive at the surface, so we have to calculate, very accurately, the time it takes for each sample of cuttings to get to the surface and the depth from which the cuttings came. This is the most important part of our job and the calculations have to be exact.

"At the surface the mud is passed over a shaker screen where the cuttings are separated from the mud. Having had most of the cuttings removed, the mud is then sent to a centrifuge, where any remaining fine particles are removed before the mud is sent to the mud tanks for recirculation down the well bore.

"Our job is to collect the cuttings, identify the depth from which they were collected, prepare a selection of samples for different purposes and describe the cuttings, which we do in close co-operation with Shell's on-site geologist, Derek Moss.

"We collect sets of cuttings samples at five or ten metre intervals. Unwashed cuttings [wet samples] are collected for bio-stratigraphic analysis to determine the age of the rock from the micro-fossils present in the rock cuttings. Washed and dried samples are used for sample description. Isojar samples are collected for geo-chemical analysis to determine hydrocarbon source rock potential.

"We are also responsible for monitoring any gases that come out of the well bore in the cuttings. To do this we have several gas detectors and measuring devices in various locations, such as in the mud tanks and the shaker screens. These devices allow us to measure and analyse any gas emissions from the mud. By monitoring for natural hydrocarbon gases we can alert the drilling and sub-surface teams whenever we may be drilling through a potential hydrocarbon bearing formation.

"Our team also monitors the volume of mud in the circulating system because if there is a sudden drop in volumes it may indicate a drilling problem, such as drilling through a fractured formation or a very porous and permeable formation, causing mud losses in the well bore.

"Finally, we monitor a whole range of drilling parameters, such as ROP [rate of penetration] or the speed at which the drill bit is drilling through the rock formation. We monitor RPM [revolutions per minute], which is the speed at which the drill string turns. We monitor WOB [weight on bit], which is the actual weight of the drill string bearing down on the drill bit. We also record the temperature and weight of mud in and out of the well bore and the flow rate of the mud, and many other parameters during drilling operations.

"So, it is a very demanding job which covers a wide range of criteria, all of which are very important to any drilling activity," concludes Ashraf.

Left and below: The LWD tool, a gas monitor and the ROV operating arm

Martin Baker, On Site Operations Manager, ITECH, on right, with members of his team

"ITECH HAS BEEN CONTRACTED BY SHELL TO PROVIDE ROV [remotely operated vehicle] operations and services, which are based on the 'Deepwater Expedition', to support Phase 3 of Shell Egypt's deepwater drilling campaign in NEMED," says Martin Baker, On Site Operations Manager for ITECH.

"We are using an Olympian work-class submersible ROV which weighs in at some two and a half tonnes and has an operational depth of around 3,500 metres. The ROV is a very versatile piece of equipment and can do any job that a diver can do, with the added value that it can do it at depths at which a diver cannot operate.

"It would be impossible to drill in water depths such as those in which we are operating here in the Mediterranean, which today are 2,420 metres, without the services of a ROV. It is used for so many purposes, but mostly the ROV is used as 'the eyes' of the drilling team.

"Through on-board cameras the ROV is able to transmit real time images of the progress of certain drilling operations and to enable visual checks to be made of the sub-surface equipment, such as the well head and BOP [blow out preventor].

"Not only does the ROV act as the eyes of the drilling team, it is often used as 'the hands' of the team. Today, for example, the ROV has been used to remove hydrates, which had formed on the sub-surface well head and BOP, by using a high pressure water jet.

"So this is an essential tool for deepwater drilling and we are pleased to be here as part of the team working with Shell," concludes Martin. s

Ahmed Zaghloul, TransOcean's HSE Advisor (with green hard hat), taking new crew members on an HSE induction tour of the 'Deepwater Expedition'