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The Way Forward for Deepwater and Ultra Deepwater Drilling in Trinidad and Tobago

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Abstract

Future deepwater drilling in Trinidad and Tobago will definitely present enormous challenges. During the period 1999 to 2003, eight deepwater wells were drilled in deepwater acreage. None of these wells found hydrocarbon in economic quantities although abundant reserves have been found in the shelf area (<1000 meters water depth).

The data from these wells would be useful for further deepwater and ultra deepwater drilling in Trinidad. To date, no wells have been drilled in our ultra deepwater acreage but seismic acquisition and processing has been undertaken. Thus lessons learned from the first deepwater campaign will definitely propel the way forward for further exploration works in deeper waters. We have to adapt our operations to accommodate the problems associated with our first phase of deepwater drilling in our area.This paper will look at the approaches we should adapt in the next phase of deepwater drilling. Some of these issues include rig selection, well location, well design and planning, environmental studies (wind, wave, climate etc.) and shallow hazard assessment. The key learnings from previous deepwater drilling events are useful in future operation in Trinidad and Tobago.

Key words: Deepwater drilling; Trinidad and Tobago

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Nomenclature

ADCP	=	Acoustic Doppler Current Profiler
BOP	=	Blow Out Preventer
BSR	=	Bottom Stimulating Reflector
DP	=	Dynamic Positioning
DPPS	=	Dynamic Positioning Safety Program
MEEA	=	Ministry of Energy and Energy Affairs
MWD	=	Measurement while Drilling
NBC	=	North Brazil Current
NE	=	North East
NECC	=	North Equatorial Counter Current
OSRO	=	Oil Spill Response Organization
Ppg	=	Pounds per gallon
PSC	=	Production Sharing Contract
PWD	=	Pressure While Drilling
ROV	=	Remote Operated Vehicle
SSE	=	South South East
SWF	=	Shallow Water Flows
TTDAA	=	Trinidad and Tobago Deepwater Area Acreage
VIV	=	Vortex Induced Vibrations

INTRODUCTION

Over the last decade exploring the deep waters beyond the shelf (>1000 meters) has been looked at with much anticipation. Figure 1 below shows the deepwater and ultra deepwater acreage offshore Trinidad. A water depth greater than 1000 m is considered deepwater while greater than 1500m is ultra deepwater drilling. The concession map shows the blocks in the deepwater and ultra deepwater acreage (TTDAA regions). Also shown in the map in the shaded region is the current block and licenses operating by oil and gas companies. Our first deepwater drilling ended in 2003 and since then no further drilling was done. Deepwater blocks were recently awarded (2011) and a new deepwater bid round has started. It is hoped that the next deepwater drilling campaign would commenced in the near future.

1. A LOOK BACK AT OUR FIRST DEEPWATER DRILLING CAMPAIGN

The government of Trinidad and Tobago uses Production Sharing Contracts (PSCs) as vehicles to achieve a comprehensive exploration program. The PSCs were awarded in 1998 for the deepwater blocks 25a, 25b, 26 and 27 (Rajnauth & Boodoo, 2004).

These contracts involved:

(1) Five year exploration phase work program.
(2) Exploration wells to minimum commitment depths.
(3) Acquisition and processing of seismic data.
(4) Signature bonuses.

The drilling phase of the exploration activities in the deepwater blocks produced many challenges. The eight (8) wells drilled in these blocks have not found hydrocarbons in commercial quantities. Results showed that some of the wells were unable to reach their technical objectives. As a result, the actual number of days and cost for some wells were less than originally planned. There were numerous drilling events that significantly impacted the operation and contributed to downtime. These include impacts from currents, shallow hazards, abnormal pressures, rig equipment failures and hole problems. The average non productive time (NPT) was between 18-20% of total well days for some wells. The total cost of the drilling campaign was estimated at $223 MMUSD and then NPT would be estimated at $40 MMUSD.

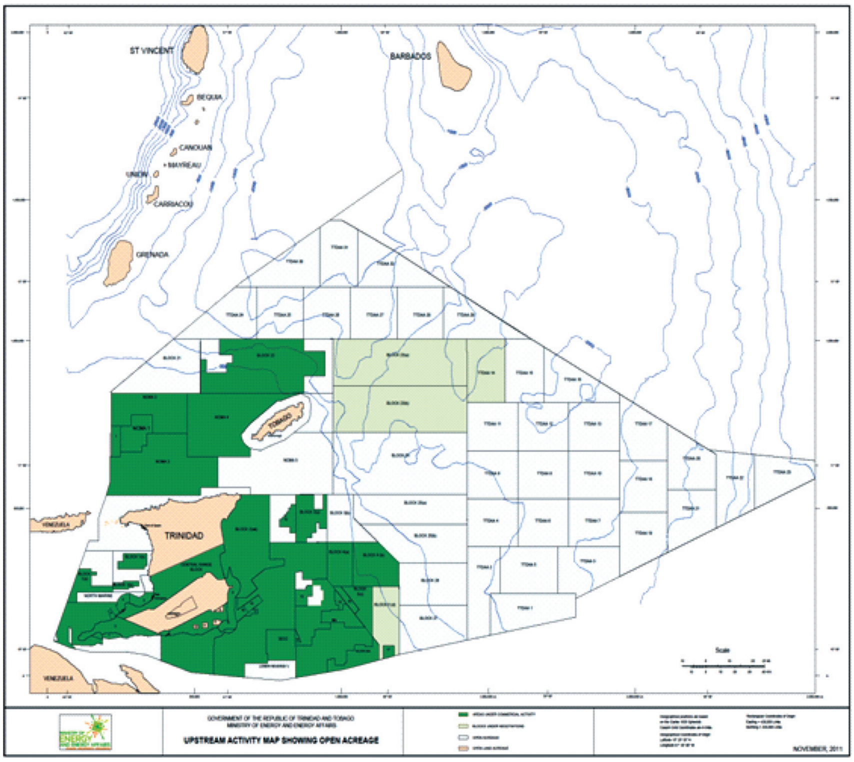

Figure 1
Concession Map of Trinidad and Tobago (MEEA, 2011)

2. IMPACTS ON DEEPWATER WATER DRILLING

Some of the issues that impacted our first deepwater drilling program are discussed below.

2.1 Meteorological and Oceanographic Impact

2.1.1 Weather and Met Ocean Conditions

The marine environment is characterized by wind driven waves predominately from easterly trade winds. Water swells are normally in the order of 2 m, increasing during periods of tropical storms. Wave regimes generally approach from the east, showing an annual shift towards the northeast during the period of January to February. The period between November to March coincides with winter storm activity in the North Atlantic Ocean, resulting in higher waves and rougher seas during this period and has impacted drilling operations.

2.1.2 Hurricanes

Trinidad and Tobago are generally considered to be slightly to the south of the hurricane belt. In the tropical region, the hurricane season normally extends from June to November. There have been over 25 hurricanes or storms affecting Trinidad and Tobago over the last century. One of the deepwater wells drilled in 1999 was suspended for an approaching hurricane; however, the storm deviated before crossing the location. While hurricanes have not severely impacted deepwater drilling operations in Trinidad, it is expected that tropical storms can have an impact on drilling operations in the future.

2.1.3 Currents

The drilling operations of several operators in deepwater blocks offshore Trinidad have been subjected to delays caused by high currents with current speeds in excess of 3 knots recorded. Currents had significant impact on several wells; on one well there were four (4) attempts at running riser with resulting downtime of 15.2 days (Table 1). It took about one week to run the Blow Out Preventer (BOP) and riser on another well. The drill ship actually went south in order to avoid strong currents. The highest recorded current during operations on another well was 3.3 knots, which occurred while running wireline logs. Additional casing running time was required due to severe problems experienced, stabbing and making up casing. There were major deflections of the casing joint in the slips caused by surface current deflecting the casing in the moon pool, however, conditions improved with depth/string weight. There was no evidence of vortex shedding, but the rig was able to maintainits position on location. Downtime from strong currents was estimated at about 23 days at a cost of $8 MMUSD for the eight deepwater wells drilled in Trinidad.

These currents are derived from North Brazil Current (NBC) that flows northwest along the coast of South America and turns north offshore Trinidad (Figure 3). Strong currents can have various effects on deepwater drilling operations, such as drilling downtime, riser installation delay and fatigue damage. Strong currents in deep water can produce vortex induced vibrations in moorings and risers. These vibrations can quickly cause fatigue damage and even loss of riser and well head. Delays to operations involving Remote Operated Vehicles (ROVs) because of currents throughout the water column are a common problem.

Table 1
Current Readings During Riser Running Problems

Depth (ft)	Current reading (knots)
Surface	2.8
289	2.5
663	2.3
1686	1.3

2.2 Shallow Hazards

Shallow hazards have impacted drilling operations on several deepwater wells drilled in Trinidad. One well had a shallow gas flow issue which was regarded as minor, slightly overpressure, with just a stream of bubbles observed at the wellhead. The flow was observed while drilling the pilot hole. The well was controlled with eleven pounds per gallon (11ppg) mud and flow checked before continuing operations. While running the BOP on riser during operations on another well, a flow was observed at the sea floor. This gradually increased and plumed up to forty-eight feet (48ft) in height (Figure 2). A pilot hole was then drilled to five thousand two hundred feet (5200 ft) and traces of bubbles were seen.

Figure 2
Shallow Water Flow Deepwater Trinidad

During the drilling operations of another well, the cameras on the ROV underwater showed a plume of gases around the BOP stack caused by a buildup of hydrates.

2.3 Well Design and Planning

The design and planning of the drilling programs for deepwater wells did not consider the planning of relief wells in case of an environmental issue. In the past the oil and gas operators would normally possess equipment to handle their own spills at a Tier 1 level. They would not normally stockpile equipment to manage a Tier 2 or Tier 3 incident within Trinidad and Tobago but the government of Trinidad and Tobago under the National Oil Spill Contingency plan will soon require operators to stock Tier 2 equipment or have access to it.

3. THE WAY FORWARD

3.1 Currents

Offshore operations are affected by all types and scales of current, from short-lived high-frequency variations that last just minutes to longer time-scale and more predictable features, such as tidal currents. NORSOK, a Norwegian initiative to reduce development and operation cost for the offshore oil and gas industry, recommends evaluating the following current components for structural design (Baynes, 2002): wind induced current, tidal current, coast and ocean current, local eddy current, currents over steep slopes, currents caused by storm surge and internal waves.

This list provides an overview of the current regimes that affect both the design and operation of offshore structures and vessels. It is not only surface currents that are important. Currents throughout the water column are important and especially the profile and vertical shear. It is not necessarily the intensity of the current that is most important. Current features that cause abrupt changes in the current at a specific location tend to have a greater effect on marine operations. For example, variability of the current profile over a timescale of minutes can cause problems in structures due to Vortex Induced Vibrations (VIVs).

The impact of currents on deepwater drilling operations could be reduced if there was access to reliable current measurements and/or forecasts. Information on currents is obtained from the following sources, either in near real-time or from archives: specific in situ measurements (e.g. drifting buoys, ADCPs, Radar), numerical models and remote sensing. Also of value is the local knowledge accumulated by seafarers and mariners, and this is often the only source of current information available.

The likely benefits to the offshore industry from improved current information are: reduced drilling downtime, reduced downtime in installations, improved safety, reduced costs of current impacts due to improved modeling capability and verification of models, reduced damage and losses from improved design, reduced costs associated with over-design or specification due to lack of current information, and more effective deployment of resources for in situ current measurements.

A combination of data sources and numerical modeling should be used by deepwater operators in Trinidad to provide effective current advisory information for their deepwater campaign. The regulatory body in Trinidad and Tobago should require operators to have a current monitor on the rig and the results from monitoring can be compiled in a Meteorological and Oceanographic data set for the country.

3.1.1 Formation and Migration Pattern of NBC Rings

Data from other studies are also useful in obtaining relevant data on currents that impact deepwater drilling operations offshore Trinidad. A study was done by Horizontal Marine Inc. on operational analysis of the NBC for 8 years from 2001 to 2009, using drifting buoys, satellite imagery, and Acoustic Doppler Currents (ADC). In this study, 44 NBC rings were researched to determine seasonal trends and find interannual variations (if any) in the formation and migration patterns of these rings. Figure 3 shows the Equatorial Atlantic circulation system showing the NBC movement to the Caribbean region.

The results showed that the maximum transport of water mass across the Atlantic Ocean occurs during the period June to August and minimum transport occurs during the period December to February. Thus, the NBC is only beginning to exhibit an increase in transport and intensity during spring and early summer (Sharma *et al.*). Due to its reduced intensity (during April-June), the NBC becomes coastally trapped and flows continuously along the northern coast of the South American continent. The North Equatorial Counter Current (NECC) ceases its eastward flow during the late spring and early summer and is replaced by a weak westward flow that does not influence the formation or migration of NBC rings. Thus, a lack of kinetic energy either prevents the NBC retroflection from forming altogether or allows for only a weak retroflection. Previous studies indicate that no NBC rings typically form during this time of the year and a relatively moderate flow is observed all along the northern coast of the South American continent and into the Caribbean Sea. Only one of our deepwater wells was drilled between April and June and this well did not encounter any problems due to high currents. All of the other wells were drilled between October to December and January to March when the NBC averaged higher ring size.

This is a basin scale current system that is driven primarily by the trade winds. Typical surface currents within the NBC range from 1 to 3 knots. The NBC currents decrease with depth and extend down to 1000m. NBC rings propagate at speeds averaging between 8 and 20 km/day, remain intact for up to 150 days, and have diameters ranging from 100 to 500 km. Surface currents within these rings circulate anti-cyclonically (clockwise) and may at times exceed 3.0 knots. Significant subsurface ring currents can extend as deep as 400m.

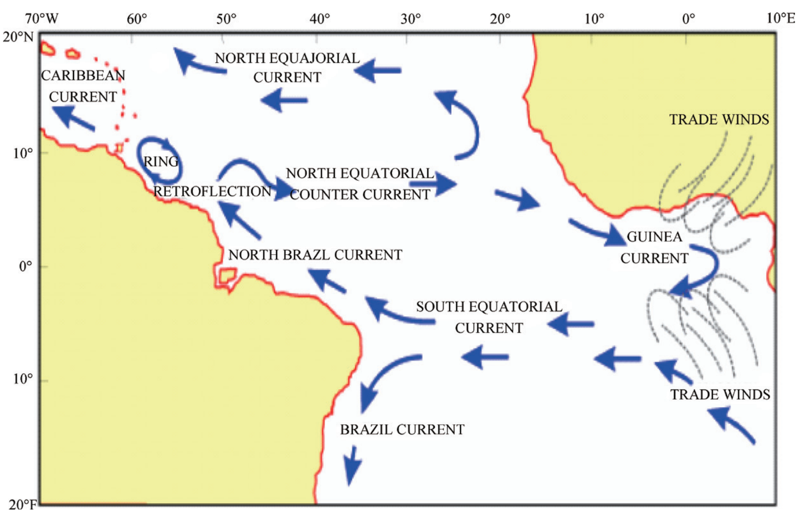

Figure 3
Equatorial Atlantic Circulation System (Sharma, *et al.*)

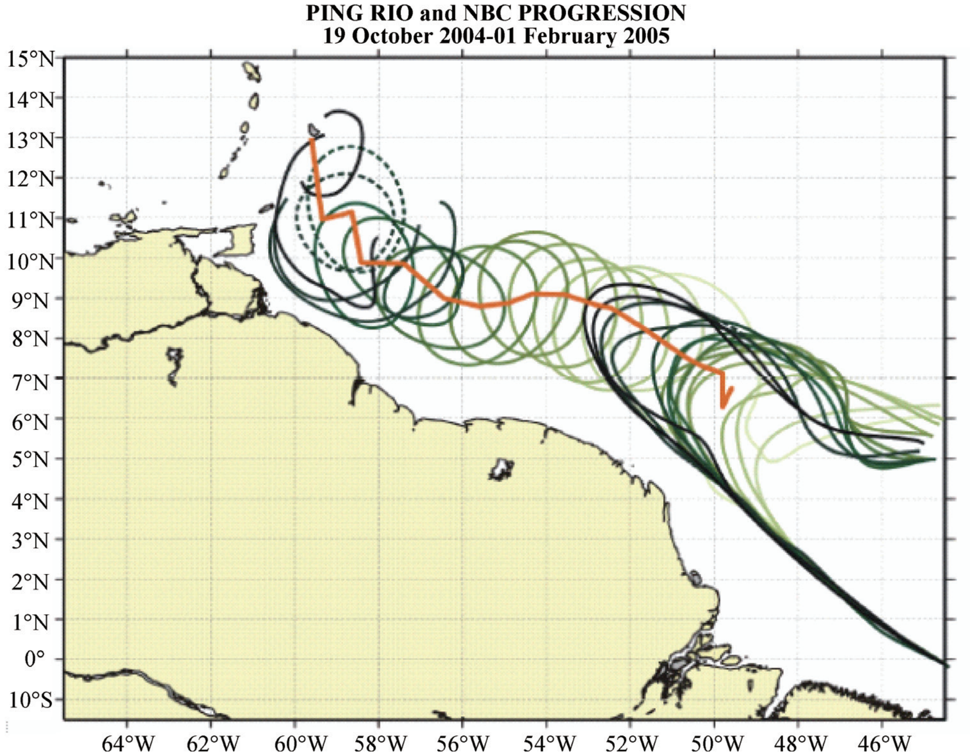

Figure 4
NBC Ring Progression over 3 Months (Sharma, *et al.*)

Figure 4 shows the weekly progression of a typical ring over a 3-month period during the NBC seasonal peak export in boreal fall and winter. Upon encountering the islands of Trinidad and Tobago, the ring changes its course of migration to move northward. From the concession map (Figure 1) it can be seen that most of the deepwater and ultra-deepwater blocks are in the region of 10 N to 12 N latitudes and 58 W to 60 W longitudes. Therefore the NBC can have tremendous impact on operations in deep acreages. The study also showed the general decrease in ring activity during late spring and early summer and increased activity in the second half of the year. The rings that do form in this season tend to have shorter life spans. Deepwater Operators may want to consider drilling wells during the April to June period to minimize impact on drilling operations from high currents.

Some of the possible mitigations include:

Monitoring of the weather and currents at and around the deepwater drilling location should commence as early as possible in the well planning phase. Historical met-ocean data and daily updates with weekly (and longer) forecasts are available from numerous commercial sources including ocean routes and storm data. Using the latest generation current meters would be extremely useful.

Historical and actual eddy current data are available from Eddy Watch groups. This data can provide the basis for contingency planning, as well as a guide to the likely occurrence of a high current event at a particular deepwater drilling location. Caribbean Met Ocean Statistics (CARIMOS) consists of a set of wind and wave hind cast data and extra-tropical storm data, with a description of regional climatology. It is one of the most comprehensive meteorological and oceanographic set of data for the Caribbean that meets offshore engineering requirements. This was developed by both Fugro GEOS and OceanweatherInc, who has drawn on 20 years' experience in pioneering state-of-the-art, met ocean studies to produce engineering descriptions of the environment (GEOS, 2012).

A detailed riser analysis is recommended prior to commencing any deepwater operations. An important objective of the analysis should be to identify what approaching current conditions would require the well to be secured and the riser pulled.

A disconnect criteria should be established such that the operations personnel clearly understand under what conditions the riser should, and should not, be disconnected. A disconnect decision matrix would be one approach to assist operations personnel in their understanding of the numerous and varied issues surrounding the disconnect decision and the establishment of the disconnect criteria (IADC, 2002).

The best period to drill deepwater wells in Trinidad is April to June from Horizontal Marine Inc. study. However, it is recommended that any operator planning to drill offshore Trinidad through the loop current season should have an alternative work location ready for the rig prior to the startup of a deepwater campaign. Eddy and loop current events generally tend to be of longer duration than hurricanes, affecting drilling locations for up to several weeks. For these reasons the risk mitigation of having an alternative location available during the loop current season can pay significant dividends.

The key is to select a vessel capable of handling currents up to and above 4 knots. The wells drilled in Trinidad experienced currents as high as 3.7 knots. Evaluating available technology such as non rotating drill pipe protectors; flex joint wear bushing, and fairings is important. Installing fairings on the riser help reduce VIV and are very useful in the high current portion of the water current.

3.2 Shallow Hazards

Shallow Water Flows (SWFs) were encountered at some of the wells drilled in the deepwater blocks. Figure 5 below is a picture showing a plume from the shallow flow experienced during drilling operation.

Figure 5
Shallow Water Flow Block 26 Deepwater Trinidad

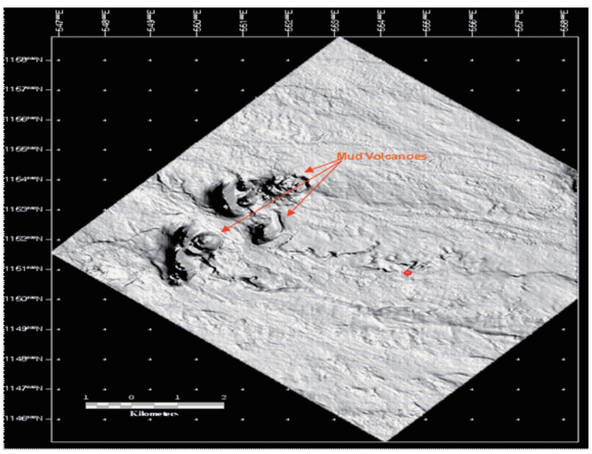

Figure 6
Sea Floor in Block 26 Deepwater Trinidad

The deepwater sea floor is typical of mud volcanoes and seeps (Figure 6). Mud volcanoes are frequently high relief and conical in nature and can range from 165 ft to 7500 ft in diameter and height from 130 ft to 400 ft. Seeps are common on the seafloor and therefore fluid migration pathways are prominent that communicate seeps around the base of some mud volcanoes. These increase the risk of shallow water flows in the deepwater operations. There is also the possibility of gas hydrates in the shallow sediments. This is indicated by a Bottom Stimulating Reflector (BSR). A BSR is a boundary that marks the phase change of water and gas to a solid gas hydrate. A high flux of gas and water through the upper sediments is required to produce a BSR and to produce a concentration of trap gas to pose potential drilling hazards. These conditions are met in deepwater acreages and must be evaluated before drilling. The presence of BSR also suggests that there are sufficient permeabilities in the sediments to be conducive for creating overpressure sands.

Some of the possible mitigations include:

Use shallow seismic surveys and all available offset data to select a location that minimizes shallow sandcontent. Geohazard surveys used to avoid shallow gas (or gas hydrates), can also help select casing setting depths to limit exposure to potential SWF reservoirs in the conductor and surface hole sections.

Well designs should consider that overpressure sands, gassy sediments, and gas hydrates could be encountered when drilling in deepwater Trinidad. Kill weight design should be considered together with mix on the fly capabilities.

Selecting a drill site away from known shallow gas sands increases the chance of drilling success. Learnings from past successes and failures in handling shallow water flows led to the successful installation of 11 slots at one of the most severe shallow water flow problems in the world (Eaton, 1999).

A contingency plan is required for handling gas hydrate formation. Gas hydrates build up were seen in some deepwater wells in Trinidad and therefore a detailed inhibition program should be designed which includes primary and secondary inhibition.

Using an ROV video monitoring of the sea floor around the well head should be a must during drilling. Early detection of shallow water flows that may be encountered could allow sufficient time to initiate corrective action that may prevent damage to, or loss of the well. The rig selected should be equipped with a hot stab glycol line to the connector and the ROV also equipped with glycol pumping capabilities. The ROV is to monitor and report any hydrates build up around the connector. If there are visual indications of ice forming around the connector, the ROV will commence glycol pumping operations. In respect to hydrates, prevention is easier than cure and the possibility of hydrates forming and their implications should be considered during any well control incident.

If feasible, Measurement While Drilling (MWD) logging could be considered for the top hole portion of the well. These logs can be useful in detecting sand units and hence potential SWFs. Also Pressure While Drilling (PWD) tools are capable of measuring annular pressures and detect evidence for shallow water flows while drilling.

3.3 Rig Selection

Rig selection is an important aspect of planning for deepwater and ultra-deepwater drilling. There are several concerns for selection of rigs for deepwater operations in Trinidad. These include high current environment, emergency disconnect capabilities and loop current response time. The rigs used were a semi sub and drill ships. Therefore knowledge of rig motions, station keeping system, riser tensioner system, drift off analysis and ROV deployments are some of the main parameters required for evaluation.

3.3.1 Rig Motion

Knowledge of rig motions is critical when selecting a rig heading in order to minimize weather related downtime. Selection of rig heading depends on the predominant direction of the weather (primary waves and currents) and the resulting rig motions. Typically for offshore Trinidad, the wind and waves come from NE to E direction most of the time. As seen with the movement of the NBC to Trinidad, it is expected that the currents come from SSE to SE direction. This is shown in Figure 7. The wind and wave direction can affect the rig positioning.

For e.g. the normal practice is to head a drill ship into the predominant direction of the current, however this direction can place the waves on the beam and this would not be a desirable position (Figure 7). However, operations might have to be suspended if waves exceeding 8 ft approached the rig on the beam (depending on rig motion operating limit).

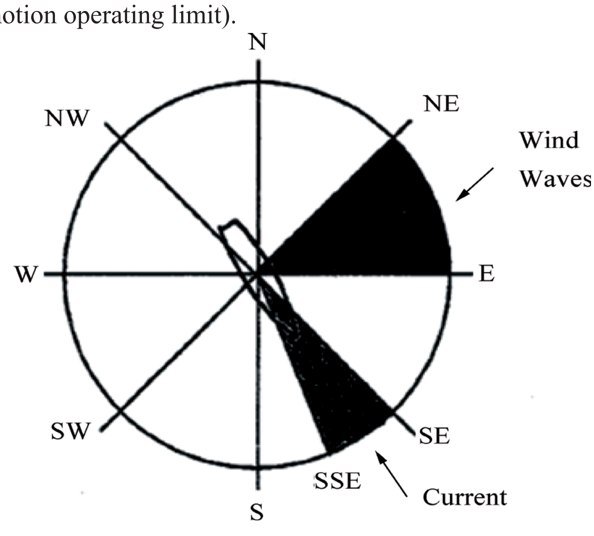

Figure 7
Rig Heading into Current

The estimated weather related downtime for a particular rig can be predicted using typical waves data. For e.g. if a particular month the waves are expected to exceed eight feet 30% of the time then it would be expected to have weather related downtime of 30%. In the example therefore, it is recommended to have the rig heading direction between current and the wind direction (Figure 8). This places the current on the starboard quarter and the wind on the port quarter.

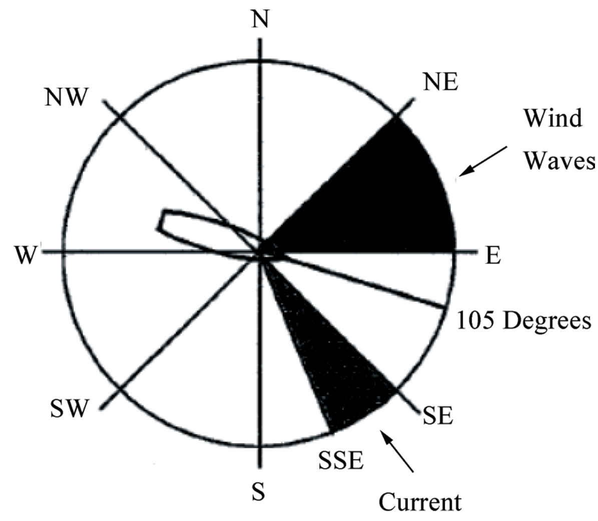

Figure 8
Preferred Rig Heading Based on Rig Motions

3.3.2 Station Keeping Analysis

A station keeping analysis should be done to determine the vessel's capability to maintain station during the operation period, during high winds, waves and currents.

The Dynamic Positioning system should be capable of automatically maintaining position and heading of the vessel within a specified envelope under maximum environmental conditions. The percentage of available thrust required for maintaining station with current and wind/wave approaching from various compass point directions should be evaluated. If the rig does not have sufficient thrust to maintain station in high currents (>3 knots), it may be necessary to suspend operation and rotate the rig to minimize drag on the vessel. Therefore if the thruster is down for repairs or maintenance, key rig personnel should monitor weather conditions and station keeping ability and determine when to suspend operations. It is therefore recommended that a suitable rig be selected with adequate station maintaining capabilities.

3.3.3 Drift off Analysis

During the drilling of one of the deepwater wells, there was an emergency disconnect that caused the detachment of the drilling riser from the wellhead resulting in the discharge of several hundred barrels of synthetic oil based mud on to the seabed near the base of the drillsite. Dynamically positioned vessels occasionally experience unexpected "drift-offs" which occurs if power to the thrusters is lost. As a result the vessel is forced off station by the environment. In order to cope with this unexpected emergency in a systematic manner and prevent damage or loss of the well, watch circles can be established so that key personnel know how to react. For e.g. a yellow watch circle can be established to signal suspension of drilling operations while a red watch circle is a signal to disconnect the drill string and riser from the well. The emergency disconnect sequence is activated. The decision point to initiate the emergency disconnect sequence should be based on the rig's riser tensioner stroke, connector integrity, conductor stress, riser stress, upper and lower flex joint angle and slip joint stroke. The power management system must effectively identify available power and measure consumed power, always maintaining a suitable margin of available power to keep the rig on location. The system must be able to adapt to abrupt changes in power demand such as a sudden storm, an engine drop off line, or the start up of a drilling motor (Shaughnessy, *et al*., 1999).

Selection of fit for purpose deepwater drilling rigs which are especially capable of handling high currents with good positioning capabilities are essential. Having drag reducing riser sleeves and increased riser tensioning capabilities is also important.

3.4 Well Design and Planning

The following are some of the well design and planning issues that need focus:

In the previous deepwater drilling campaign, major drilling problems include well control, lost circulation, stuck pipe and well stability and therefore require substantial pre-drill studies, modeling, and real time adjustments to help mitigate these events.

Well designs and planning should use knowledge based analysis of offset deepwater well data to reduce or eliminate past problems. This can tremendously reduce well cost and therefore encourage more deepwater drilling.

The design of the well should include the drilling of a pilot hole.

The objectives of the pilot hole are:

(1) To identify shallow water flow potential.

(2) To establish hole conditions (pore pressure/hole stability) until the 20" casing depth and beyond if possible.

(3) To optimize 20" casing setting depth with the objective to optimize casing program.

(4) To optimize jetting program (36" structural pile length and jetting parameters).

Most drilling programs should have detailed contingency plans and ability to mobilize any necessary equipment to minimize expensive rig downtime (Shaughnessy, *et al*., 2007). The contingency may involve the following: expandable casing, fishing tools, lost circulation material, extra casing for liners, and storm packers and bridge plugs.

The planning for a relief well must become compulsory and should include rig positioning and surveying. The operator should be responsible for informing the regulatory bodies on the accessibility and availability of drilling rigs to drill relief wells if required.

Rig capabilities should be taken into account when designing a well. Casing size, weight and setting depths are balanced to ensure the rig's capabilities to handle the load (Watson, *et al*.).

According to Rocha *et al*. (2003), a Dynamic Positioning Safety Program (DPPS) is an important program that encouraged drilling contractors as partners in an effort to reduce or eliminate Dynamic Positioning incidents and minimize their effects. Such a program can be looked at, since safety in deepwater drilling must be a priority.

3.4.1 National Oil Spill Contingency Plan

In the past, the oil and gas operators normally stored equipment to handle their own spills at a Tier 1 level. However they will not normally stockpile equipment to manage a Tier 2 or Tier 3 incident within Trinidad and Tobago. Tier One is a discharge occurring at or near a facility as a result of routine operations. Impacts are low and in-house response capability is adequate. Tier Two are medium-sized spills occurring in the vicinity of a facility as a result of a non-routine event. Significant impacts are possible and external (area) support for adequate spill response is required. Tier 3 are large spills occurring either near or remote from a facility as a result of a non-routine event, and requiring substantial resources and support from national or world-wide spill co-operatives to mitigate effects perceived to be wide-reaching, i.e., of national or international significance. There is need for an Oil Spill Response Organization (OSRO) for a spill of a specified quantity of oil within its geographic area. Presently, there are plans for a certified Tier 2 OSRO which is needed before the next phase of deepwater drilling.

Seabed monitoring surveys should be conducted on all wells drilled in the deepwater acreage. Generally, three surveys should be conducted: a pre-drill video survey, post riser and post drill sediment collection surveys. The monitoring surveys should include video observations of the sea floor conditions and a sediment sample collection through the use of an ROV. The purpose of the monitoring surveys is to assess the fate and effects of discharged cuttings at the drillsite location.

In ensuring the effective and efficient execution of deepwater drilling in Trinidad's environment, people management is important. This requires cooperation amongst personnel with diverse technical and cultural backgrounds. Collaborative teams are critical towards success of highly challenging well planning and construction in deepwater and ultra deepwater (Watson, *et al*.).

Proper planning using previous experiences in deepwater will ensure better capabilities for the next period of deepwater drilling in Trinidad.

CONCLUSIONS

Hurricane, waves and currents can have a tremendous impact on deepwater and ultra-deepwater drilling in Trinidad. However the impacts can be minimal if the operator gets access to reliable current measurements and/or forecasts. Historical met-ocean data and daily updates with weekly (and longer) forecasts are available from numerous commercial sources including Ocean Routes and Storm Data. According to the Horizontal Marine Inc. study, the best period to drill deepwater wells in Trinidad is April to June.

Selection of fit for purpose deepwater drilling rigs which are especially capable of handling high currents with good positioning capabilities are essential. Knowledge of rig motions is critical when selecting a rig heading in order to minimize weather related downtime. Selection of rig heading depends on the predominant direction of the waves and currents and the resulting rig motions.

Drilling a pilot hole should be considered before spudding the exploration well. In addition to objectives of the pilot hole mentioned earlier, this hole could be very useful in direct measurements of formation pore pressure and fracture gradients. Also it can give useful data on naturally occurring gas hydrates which are potential future source of natural gas.

Good well design and planning is the key to success in deepwater and ultra deepwater drilling in Trinidad. Analysis of offset deepwater well data and identifying solutions to potential problems must be done in pre-drill planning.

There is need to have a Tier 2 OSRO set up before the next phase of deepwater drilling in Trinidad and Tobago.

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