

# ENGINEERING DOWNTIME ANALYSIS OFFSHORE IRELAND POINTS THE WAY TO COST EFFECTIVE DRILLING

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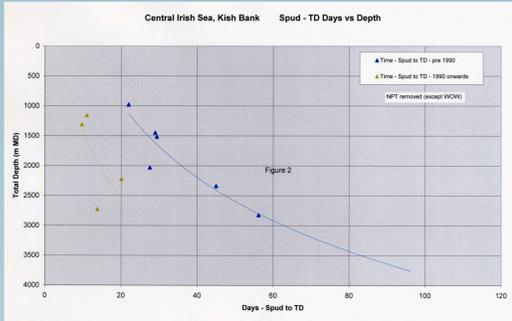
## Introduction

Engineering downtime analysis of all Irish exploration wells drilled to date provides indicative drilling time-depth curves that could be used as a reference for estimating budgets for summer drilling in different sectors offshore Ireland. The downtime analysis allows recommendations to be made to improve drilling performance offshore Ireland.

## Methodology

Wells were grouped for analysis into 5 areas with similar metocean and subsurface conditions: 1. Central Irish Sea and Kish Bank Basins; 2. North and South Celtic Sea and Fastnet Basins; 3. Erris, Slyne and Donegal Basins; 4. Porcupine and Goban Spur Basins and 5. Rockall Basin. Well data was tabulated and charts produced for each area in order to examine historical drilling activity, establish time vs depth curves for each area, determine most significant areas for drilling downtime and identify where improvements have been made over 30 years of offshore drilling in Ireland

## Central Irish Sea and Kish Bank Basins



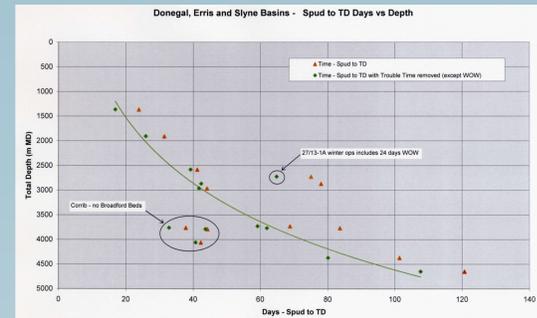
### Conclusions

- Winter drilling is feasible at the expense of increased potential for weather related downtime.
- The water depths in the area range from too shallow for a semi-submersible to too deep for a standard jack-up. Water depth over much of the area is suitable for both types of drilling unit.
- The greatest single source of downtime has been associated with top hole drilling.
- Below the troublesome sediments just below seabed, formations are competent and generally stable.
- There is no evidence of any significant overpressure.
- Vertical wells can be drilled with Water Base Mud without problems.
- There is scope to further slim down wells and drill Finder Wells with minimal casing and wellhead requirements.
- Strong currents need to be considered in selection of equipment (ROV, surface casing etc).
- One bit per hole section is a realistic objective.
- Wells can be drilled with very minimal casing designs, due to the development of high formation strength at relatively shallow depths.
- Hole conditions in CIS and Kish Bank wells have been relatively good, in all formations drilled.
- The latest advances in PDC technology are likely to extend the use of fixed cutter bits, particularly in Triassic Sandstone.
- There is scope for applying lessons learnt from other drilling areas, such as the Morecombe Bay Gas Fields.

## SUMMARY RESULTS

	Central Irish Sea and Kish Bank	North/South Celtic Sea and Fastnet	Donegal, Erris and Slyne	Porcupine and Goban Spur	Rockall	All Wells
Weather Downtime	5.00%	6.10%	5.10%	3.70%	2.80%	5.20%
Top Hole (open water)	6.00%	1.80%	1.20%	3.30%	1.10%	2.30%
BOP running/testing problems	2.60%	3.30%	3.90%	6.40%	7.60%	4.30%
Other rig equipment downtime	0.30%	1.30%	1.30%	1.90%	1.70%	1.40%
Stuck pipe, twist off, fishing	3.60%	2.90%	1.70%	3.10%	1.50%	2.80%
Hole condition	0.10%	1.20%	1.30%	1.10%	3.30%	1.20%
Casing and cementing problems	0.40%	0.90%	2.30%	1.10%	1.20%	1.10%
Coring/Logging/Testing/Completion Problems	0.30%	0.80%	3.90%	1.80%	2.10%	1.40%
Well Control	0.00%	0.10%	0.20%	0.30%	0.50%	0.20%
<b>Total Downtime</b>	<b>18.40%</b>	<b>18.50%</b>	<b>21.00%</b>	<b>22.60%</b>	<b>21.80%</b>	<b>19.90%</b>

## Donegal, Erris and Slyne Basins

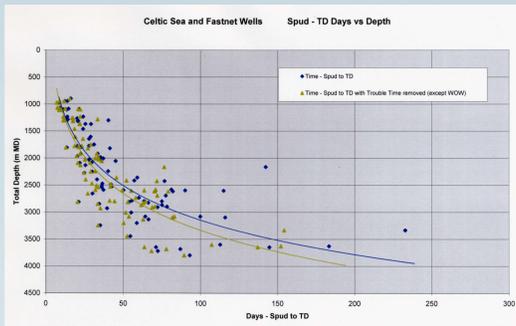


### Conclusions

- Weather has been the greatest single source of downtime.
- Winter drilling is unlikely to be economic given the likelihood of prolonged downtime.
- Winter weather conditions may exceed the design criteria for some rigs.
- Many standard semi-submersible rigs are suitable for summer operations in this area.
- Close attention must be paid to BOP and mooring equipment specifications and operational history.
- Well design must take into account the shallow sediments, in particular the presence of basalt near seabed.
- Where thick Jurassic Broadford Beds formation is present, overall well duration is likely to be significantly increased. The Triassic Sherwood Sandstone reservoir can also prove difficult to drill.
- PDC bits are widely applicable, although to date have not been successful in Broadford Beds or Sherwood Sandstone.
- Well testing in moderately deepwater can be problematic.
- There is a risk of encountering minor overpressure which could result in a well control incident. Past well control incidents have been handled relatively easily.
- Wells can be drilled successfully using "standard" 2nd or 3rd generation rigs of good specification.
- Hole conditions which can be difficult with water based mud, are greatly improved by the use of oil based mud. It has been demonstrated that zero discharge oilbased mud operations are possible West of Ireland.
- Deviated wells have been drilled successfully.



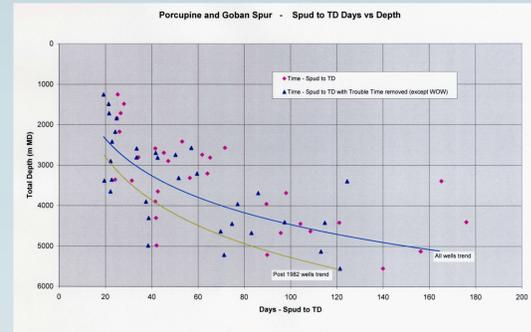
## Celtic Sea and Fastnet Wells



### Conclusions

- Historically, weather has been the greatest source of downtime.
- Winter drilling is feasible but will greatly increase the likelihood of severe disruption to operations
- All recent wells in the area have been drilled using standard semi-submersibles.
- The water depth is such that heavy duty jack-up rigs could operate although cost of this type of rig and mobilisation issues would make it uneconomic for single well drilling.
- Top hole drilling is a persistent problem. Improvements could be made in equipment and techniques to improve efficiency of conductor installation.
- Wells targeting the Cretaceous reservoir formations can be drilled with very simple and low cost casing design.
- The shallow depth and ability to drill with minimal casing strings permits the installation of very efficient production well completions using horizontal tree technology.
- A number of subsea development wells have now been successfully completed in the Celtic Sea.
- Cretaceous formations in the area are generally stable, normally pressured and apart from some hard surface drilling conditions, do not present major difficulties.
- Once into the Jurassic, shale stability can become a problem and overpressure can occur, especially in deeper wells in this area.
- Problems mooring semi-submersibles in the very hard seabed conditions have been overcome by planning for piggy-back anchors from the outset.
- Recent wells have been designed very efficiently with minimal casing. Good geological control and competent formations allow setting of surface casing relatively deep with a single hole section through the objective formations.
- All the vertical wells drilled in the area and many of the more recent deviated wells have used Water Based Mud successfully.
- It has been demonstrated that with oil based mud, long horizontal sections can be drilled in this area with minimal problems.
- Further advances in PDC technology are likely to further improve performance, especially in wells drilled into Jurassic formations.
- Recent small field developments have demonstrated that fast and low cost production wells can be drilled in the Celtic Sea area. A number of wells have been drilled and completed, ready for subsea hook up within 25 days.
- The slim hole casing design which can be used in the Celtic Sea (9 5/8" surface casing) is ideal for the horizontal tree completions.

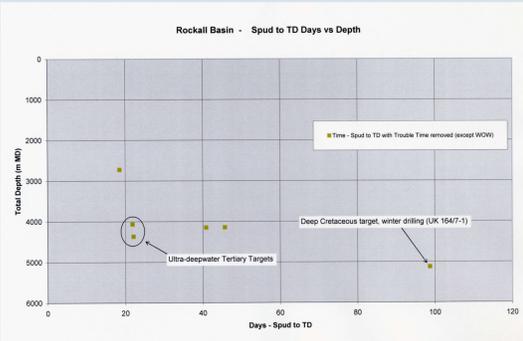
## Porcupine and Goban Spur



### Conclusions

- Operations are limited to an April-September drilling season.
- The ideal drilling unit is a large semisubmersible (DP or moored). Smaller 3rd generation semi-submersibles are also capable of operating successfully in the Porcupine albeit with a greater risk of weather related downtime.
- There can be some moderate hole problems, often associated with overpressure.
- No major problems in drilling vertical wells with water based mud.
- Historically, wells in the Goban Spur and Porcupine Basins have been of long duration. Early wells have tended to exaggerate this perception due to the additional time required by use of dual stack systems, pin connector, top hole drilling and lack of suitable drilling bits.
- Improvements can be expected to continue mainly due to advances in PDC bit design.
- Drilling performance on the highly directional Connemara wells was relatively good when using non water based mud (ester mud).
- The main single source of downtime has been BOP related failures.
- The formations in the Goban Spur and Porcupine, with the possible exception of pre-Jurassic are predominantly PDC drillable, and the latest advances in PDC technology will further increase ROP and bit life thus reducing well duration and cost.
- While some wells in the Porcupine have encountered significant overpressure, this overpressure has not created serious drilling problems and it has been possible to increase mud weight as required without inducing losses.

## Rockall Basin



### Conclusions

- The single greatest risk of downtime in ultra deepwater conditions of the Rockall Basin is BOP equipment related failures.
- Heavy duty, dynamically positioned rigs are likely to be the preferred choice for exploration drilling, particularly for water depths beyond 1500 metres.
- Weather downtime has not resulted in extended downtime during summer operations.
- Fast drilling is possible, especially in the Tertiary sections.
- Overall, formations in the Rockall Basin are more drillable than other areas of the Irish Shelf, and there is a wide application for PDC bits. High ROP and long bit runs have been achieved on the Irish Rockall Shelf wells in all formations.
- Water Based Mud is a suitable drilling fluid for vertical wells.
- The preferred and most successful method of conductor installation has been to drill and cement.
- There is a risk of encountering significant overpressure in the Cretaceous and Jurassic.
- Record breaking water depths have been drilled in the Rockall Basin, in both Irish and UK sectors.
- Both moored and DP drilling rigs have been used successfully.

