The Rovdrill Concept for Ultra Deep Water Geotechnical Investigations

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WHY ROVDRILL?

Typical Drill Ship Operation - But is it always the only solution?  
*Images: courtesy Nautilus Minerals*

A New Approach to Offshore Geotechnical Investigations...?

- Current Offshore Geotechnical Investigation market is dominated by drill ship based operations, however:
  - Operational window of drill ship can be limited by prevailing weather conditions / sea state.
  - The drillship solution can often be over-specified for some investigations – but still selected due to lack of viable alternatives.
  - For deepwater investigations – having long lengths of drill string in the water column during operations is inefficient and can contribute to increased risk of sample disturbance during recovery.

- What if we take the drilling / sampling operation directly to the seafloor...?
Results – Solwara 1

- 111 holes drilled
- Average core depth 9.8m
- Average water depth 1500m
- Max core depth 18.2m
- 40% of holes open at depth
- Large quantity of recovered cores
- Rovdrill® completed Solwara 1 drilling operations on September 19, 2007
Remote operated seafloor geotechnical drilling, sampling and in-situ testing rig.

Evolution of previous field-proven systems; Rovdrill 1 & 2.

Electrical and Hydraulic power provided by free-swimming work-class ROV via wet-mate hot stab interfaces.

Modular design with interchangeable foundation assemblies for all types of seabed terrains and gradients up to 35° from horizontal.

Suitable for shallow or deepwater geotechnical site investigation campaigns worldwide.

ROVDRILL 3: CONCEPT TO REALITY
Can operate from any locally available ROV equipped vessel of opportunity already in your project area.

- Working depth = depth rating of support ROV

Works in all seabed environments

- Multiple interchangeable foundation options are available to best handle project/seabed conditions

Provides rotary drilling with wireline push-sampling, CPT as standard.

- Maximum sampling depth >200m (continuous CPT).

Provides core diameters up to 3” (76.2mm), OD

Builds upon experience from Rovdrills 1 & 2.

Attractive option compared to drill vessel day-rates, operational performance, & weather envelope.
ROVDRILL 3: SAMPLING CAPABILITIES

Rovdrill Sampler & In-situ Tooling

3" EXN Assembly
3" /1.5m SHELBY
3" EXN with Liner

1.5m stroke CPT Assembly

PATENT PROTECTED
ROVDRILL® CONTROL SYSTEM

- Rovdrill® uses a subset of the ICE® Hardware and Software – the latest generation of ROV control system used on all Perry Slingsby Systems products.
- Intuitive HMI driven by touch screen controls
- Single Surface Computer
- Graphical User Interface (GUI) with User Configurable Pages
- Subsea Manifold w/ Local Valve Controller (LVC) – NO ELECTRONICS PRESSURE VESSEL
- Full mission simulation, personnel system training and custom scenarios can be offered through complete integration with Vmax Technologies

PATENT PROTECTED
ROVDRILL 3:
BASE REQUIREMENTS

ROVDRILL & VESSEL OF OPPORTUNITY

- **Rovdrill needs a 100-150 HP Workclass ROV Spread**
  - Subsea hydraulic power: 18 gpm at 3000 psig from the ROV auxiliary pump
  - Subsea electrical power: Single phase power 5 amps at 120V
  - Access to single mode fiber or twisted shield pair in the ROV umbilical
  - Access to the ROV’s telemetry system for data transfer

- **Deck crane: Nominal 50Te SWL x 10m under hook**

- **Fast deployment winch: 30-35m/min. or faster**

- **Modest deck space of 500 square feet to accommodate:**
  - Drilling module on flat rack footprint 20ft x 8ft (160 sf)
  - Skirted mud mat footprint 11.5ft x 8.5ft (100 sf)
  - Soils Test Lab footprint 20ft x 8ft (160 sf)
  - Spares container footprint 20ft x 8ft (160sf)
ROVDRILL 3: BASE REQUIREMENTS

Rovdrill 3 – Assembled Dimensions,
### Rovdrill 3 – Shipping Dimensions

#### Summary Table

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<td>6.0</td>
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ROVDRILL 3 CAPABILITIES SUMMARY

- Drilling/sampling operations are executed directly at the seafloor – no operations in the water column
- Deck operations/human intervention is minimized, increasing safety level for offshore operations
- Highly-reduced shut downs due to adverse weather/currents
- Optimal core quality “Low sample disturbance during retrieval”
- Short time to Mob & De-mob Rovdrill to any global location:
  - Rovdrill can airfreight worldwide in 24 to 72 hrs
- Lower vessel cost for ROV vessels in area
Results – Land Trials

- 6 holes drilled
- Maximum hole depth 15m (50ft)
- Longest continuous core recovery 2.4m (8ft)
- Downhole CPT sounding: 1.5m (5ft) stroke
- Currently preparing for sea trials in SEA
DESCRIPTION OF TESTS

1. Blind Borings (4” diameter); 1 x 15m boring, 1 x 13m boring, 2 x 12m borings

2. Shelby Push Samples; 2 x 1.5m down-hole pushes at 2m and 4m hole depths.

3. Extended Nose (EXN) ‘Push while Drilling’ Samples; 2 x 2.4m down-hole samples at 3m and 6m hole depths.

4. CPT Soundings; 2 x down-hole pushes, at 3m and 4.5m hole depths, CPT strokes at 1.5m.
ROVDRILL3: LAND TRIALS
DESCRIPTION OF TESTS

TEST SET-UP

Rovdrill Drill Module Assembly

50 HP Test HPU

Rovdrill Surface Controller

Cuttings Tray/Mud Pit

Rovdrill Drill Module mounted on Cuttings Tray/Mud Pit

...Bringing Out the Best
TEST RESULTS – CORE SAMPLES

- Shelby Samples; Push cycles successful, 0% recovery on 2 x samples due to incompatible ground conditions for sampler.

- EXN ‘Push While Drilling’ Samples;
  - 1 x 100% recovery at 3m - 6m hole depth – recovered sample length = 2.4m in single liner.
  - 1 x 70% recovery at 6m – 9m hole depth – recovered sample length = 1.8m in single liner.

- Core Composition; Observations on retrieved core samples revealed fine grained sand to stiffening clays with increasing depth.

- Subsequent drill-outs deeper than 9m encountered sandy seams which were drilled out using the non-coring bit and the addition of polymer.
TEST RESULTS – CPT SOUNDINGS; Soil Behavior Type Plots (Normalized – Corrected for Overburden Stress)

Project: Rovdrill Land Trials (May 2009)

CPT: - 01 (Rovdrill 3) - Total depth: 19.23 (ft)

Norm. cone resistance

Norm. friction ratio

Norm. pore pressure ratio

SBTn Index

Norm. Soil Behaviour Type

SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained
TEST RESULTS – CPT SOUNDINGS; Soil Behavior Type Plots (Normalized – Corrected for Overburden Stress)

Project: Rovdrill Land Trials (May 2009)

CPT: O1 (Rovdrill 3) - Total depth: 19.23 ft

SBT - Bq plots (normalized)

SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Increasing OCR
Increasing Sensivity
QUESTIONS?
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