What is Riserless Mud Recovery (RMR®)

- Return of drilling fluid to drill ship from mud line in “Top-hole” drilling
- Subsea pumps provide lift
- Permits use of improved mud
- Developed for “Top-hole” drilling
Suction Module

- Camera and Light
- SMO Control Pod
- Pressure Transmitters
- Pressure Membrane
- ROV Friendly Connection for Suction Hose
AGR Pump Technology

• Similar to a centrifugal pump
• Utilize smooth discs in place of vaned impeller
• Pumps impart energy to fluid through viscous drag
• Very good for pumping viscous fluids
• Very good for Pumping solids
• Reliable for pumping abrasive slurries
Single Gradient vs Dual Gradient

Single Gradient Drilling; \( \text{BHP} = H \times sgm \)

Dual Gradient Drilling; \( \text{BHP} = H_1 \times sg_1 + H_m \times sg_m \)

\[ P(\text{psi}) = Mw \text{ (ppg)} \times 0.052 \times H \text{ (ft)} \]

= BHP =
Tophole is also Dual Gradient Drilling

\[ \text{Dual Gradient Drilling; BHP} = H_1 \times \text{sg}_1 + H_m \times \text{sg}_m \]

\[ P(\text{psi}) = M_w \text{ (ppg)} \times 0.052 \times H \text{ (ft)} \]
RMR with Rotating Control Device (RCD)

Benefits:

• Allows pressurized returns / MPD System
• Allows use of fluids that are incompatible with seawater
• Enables a back-pressure on the well to control a flow until mud weight has been increased
• Reduces risk of suction hose collapse
AGR RCD on Eirik Raude

5 ½” to 8 ¼” OD tubular

Industry’s first and only deployment of a subsea RCD to date

Size; 1.15m dia x 0.80m
Weight; 2.3 tons
Going Deeper With RMR
Deepwater RMR

Demo 2000 Project. Technology qualified for 5000ft (1500m)
Deep Water Pumps
RDS System
RDS – Riserless Drilling System
Post BOP Riserless Drilling

- Riserless Drilling with a BOP and RCD
- Aim at eliminating Marine Drilling Riser
- Intermediate step may be riserless drilling through salt with a simple isolation device on seafloor
- Currently conducting Feasibility Study
Pump Technology
Subsea RamPump

- Weatherford IP – licensed to AGR
- Positive displacement type of pump
- Energy transfer is accomplished with pressurized sea water
- Subsea efficiency more than 90% (Discpump 50%)
- Can be designed to API / full well control pressure rating
- One size (standardization) independent of water depth

- Study currently ongoing in Houston. Outside participation would be highly beneficial
Subsea RamPump

- Based on proven pump technology
- 1200 GPM, 12,000 psig, Approx. 5000 DP
- Dual 16” Plungers
- 120 inch Stroke, 3 CPM
- Check Valve Intakes
- Powered by sea water pumped from surface
- Surge Vessel to limit back pressure fluctuations
- Retrievable Module with Check and Control Valves
Subsea RamPump vs Discpump

![Graph showing comparison between RamPump and DiscPump size/weight vs water depth.](image-url)
Operating Parameters

- Hole size 26 in.
- Drilling rate 20 m/hr
- Flow rate 1200 gpm
- Mud Weight 10 ppg
- MRL size 6 in.
- Suction hose length 50 m
- Discharge hose 30 m
- RKB 20 m
- Mud Plastic Viscosity 15 cp
- Mud yield point 15
- Pump two 6 stage pumps
The End