

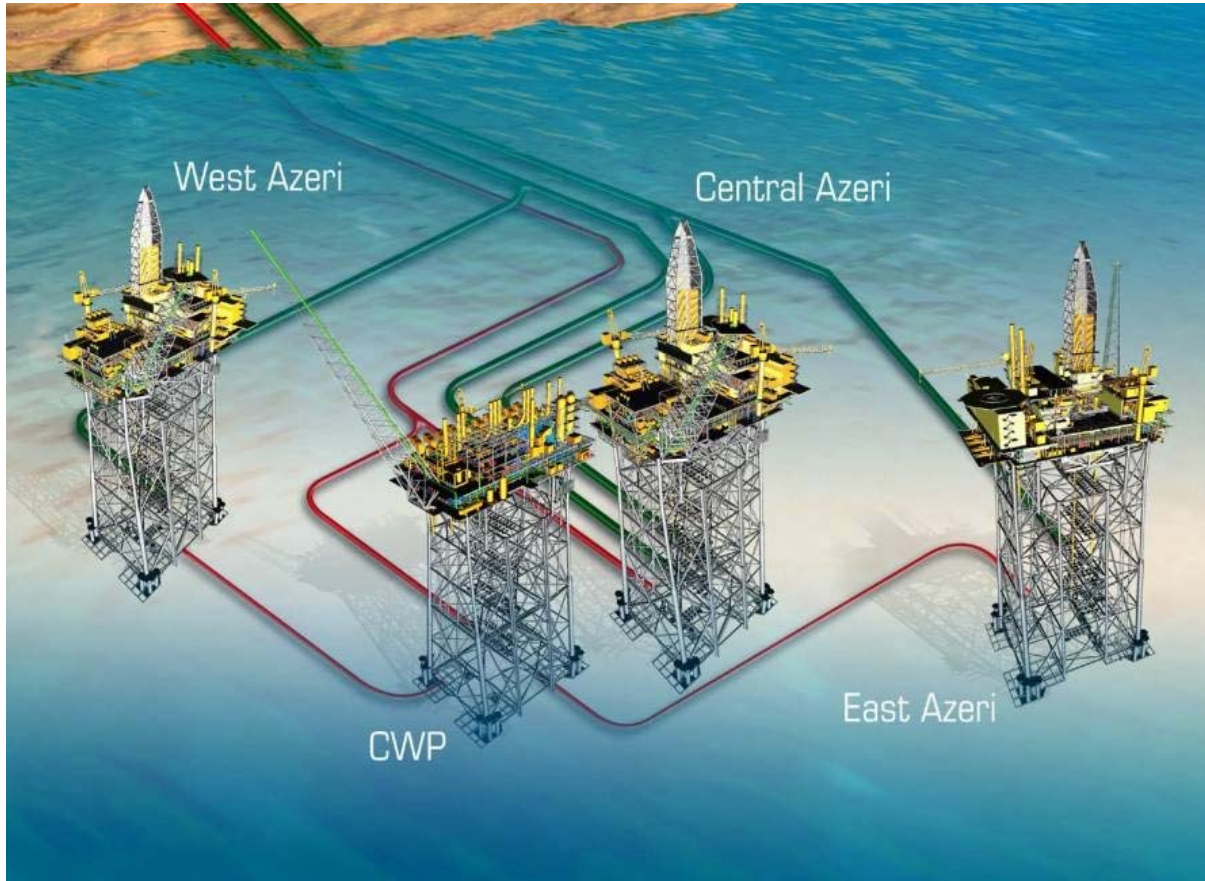
Riserless Mud Return Technology Solves Shallow Wellbore Instability Problem

A Case History

Presentation by Roger Stave
President & CTO
AGR Subsea, Inc, Houston



Background



- The Azeri oilfield is located in the Caspian Sea in water depths from 118 – 152m
- Phased development on Central, West and East Azeri
- Central Azeri pre-drill successfully completed in May 2003

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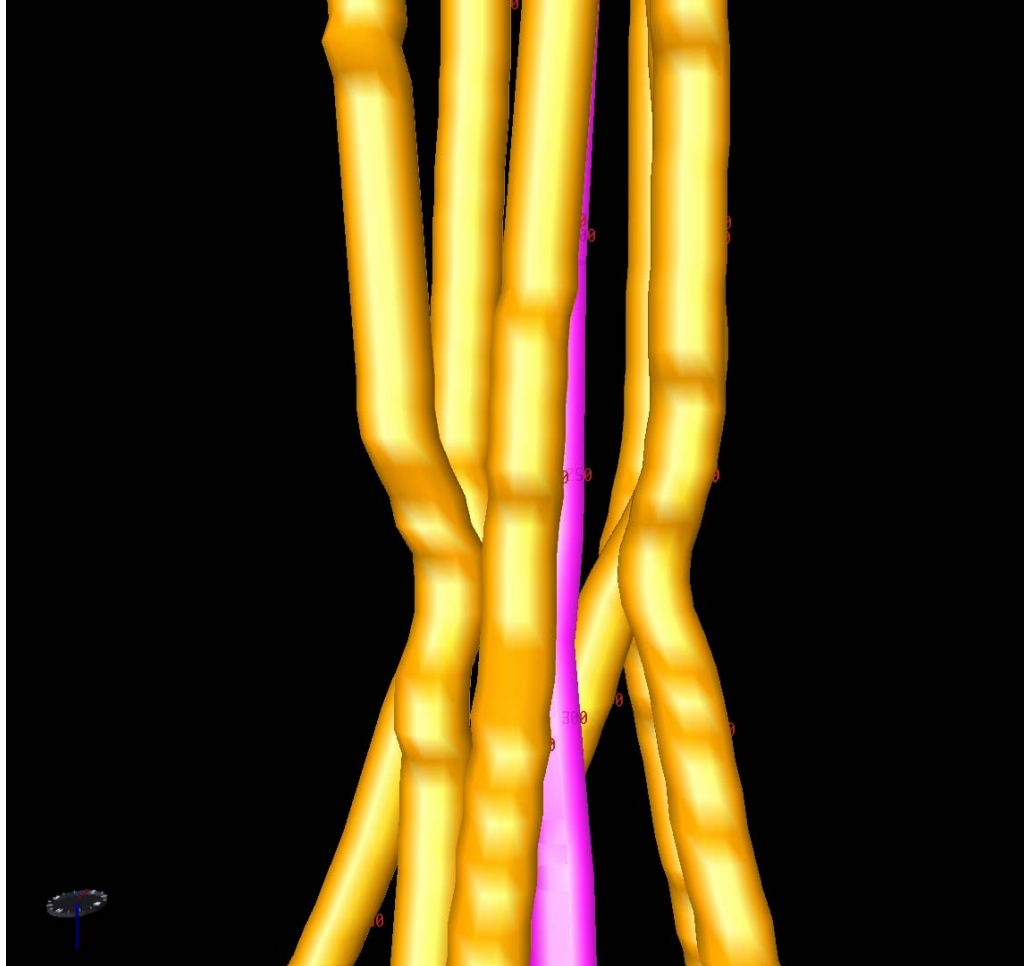


2003 West Azeri Template Pre-drill

Conductor / Surface Casing Issues;

- **Template installed** prior to drilling operations on C-01.
- West Azeri **Well C-01 drilled** and tested by Rig Dada Gorgud (May - July 2003).
- Started **Batch Drilling** operations July 2003.
- **Drilled 36” hole; ran and cemented 30” casing in Slots 24, 29, 22, 31, 21, 30, 28, 25, 27.**
- **Drilled 26” hole; ran and cemented 20” casing in Slots 27, 21, 29, 22, 24.**
Drilled 26” hole in Slot 31; unable to run 20” casing and suspended ops on slot.
Drilled 26” hole; ran and cemented 20” casing in Slot **25.**
- End Batch Drilling Operations involving circulation / pumping in August.
- Start Well Condition Assessment by cleaning out wells and running gyro surveys.
Detected damage to wells.

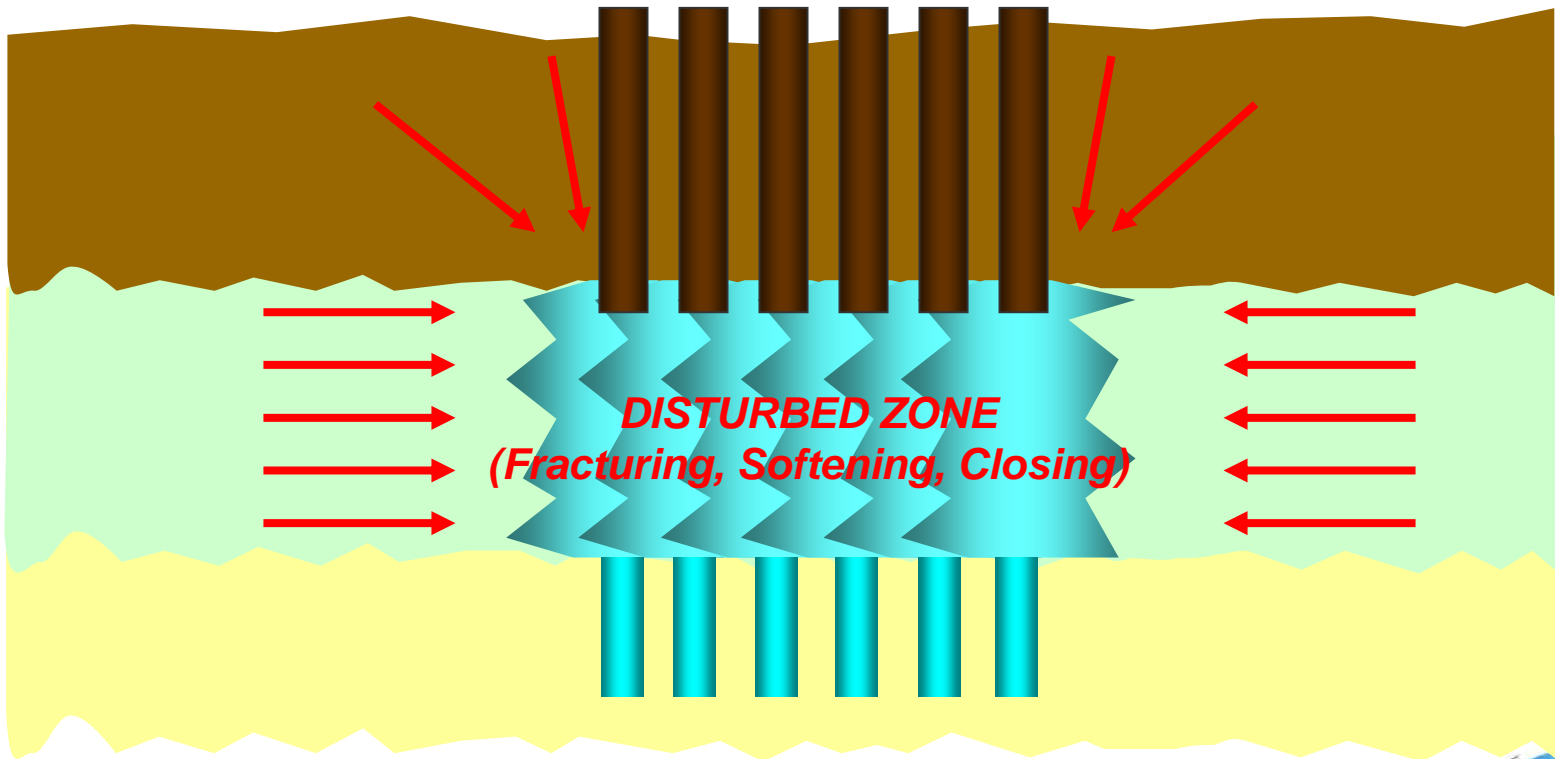
Casing Deformation



Exaggerated image of Conductors

West Azeri Predrills - the damage

Note: The Template and wells apparently did subside somewhere between 0.30m and 0.50m.

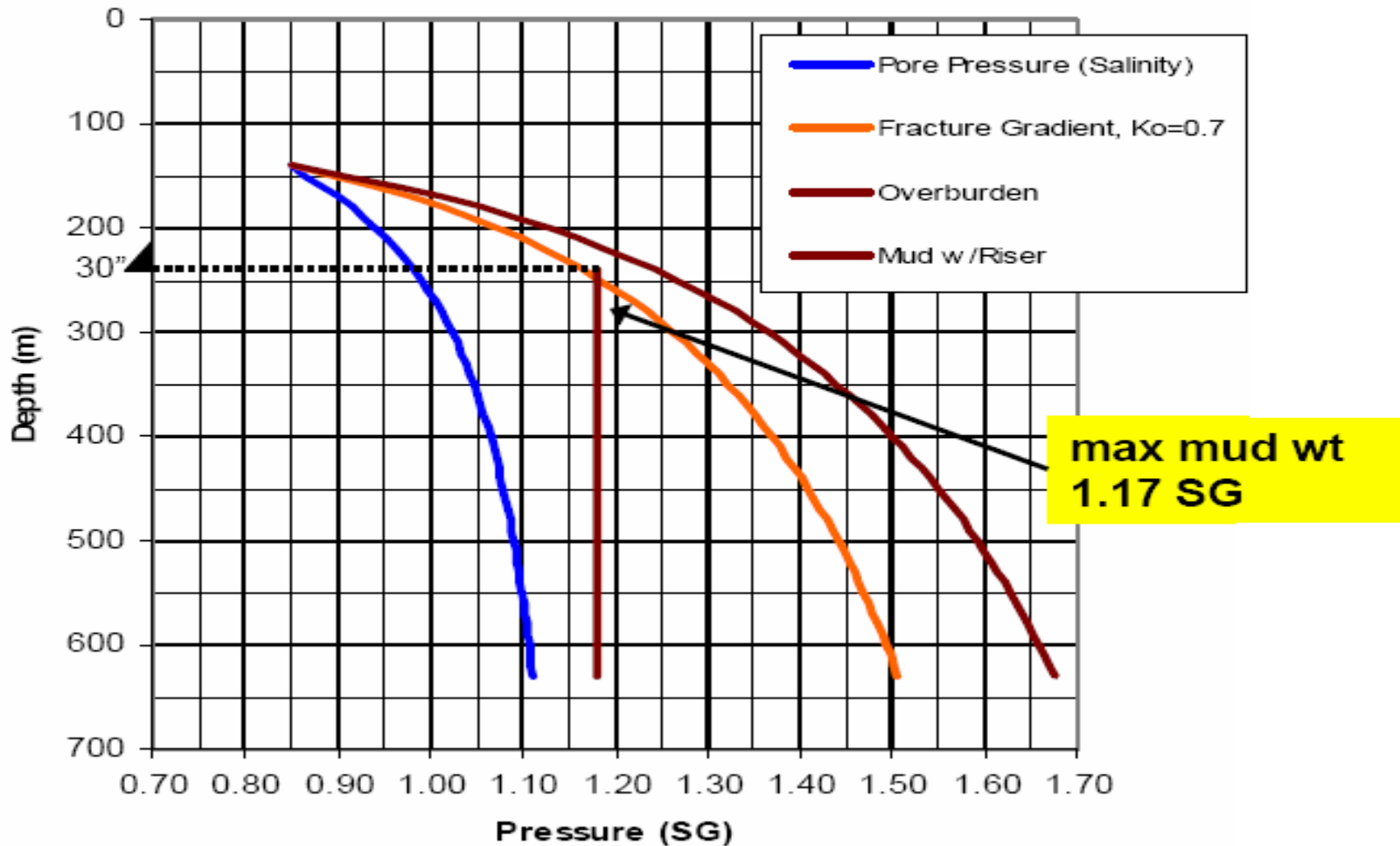


Shallow Soil Solution BOD

- Minimize shallow soils' exposure to sea water
 - Jet 30" to minimize time exposure (leave full of "inhibitive fluid") (W. Azeri)
 - Use "inhibitive fluid" (Silicate) for 26" hole.
- Minimize fluid or cement losses in shallow soils (Control Hydrostatic)
 - Plan to use RMR
- Drilling fluid designed to oppose hole pressures and salinity (Weighted, Silicate)

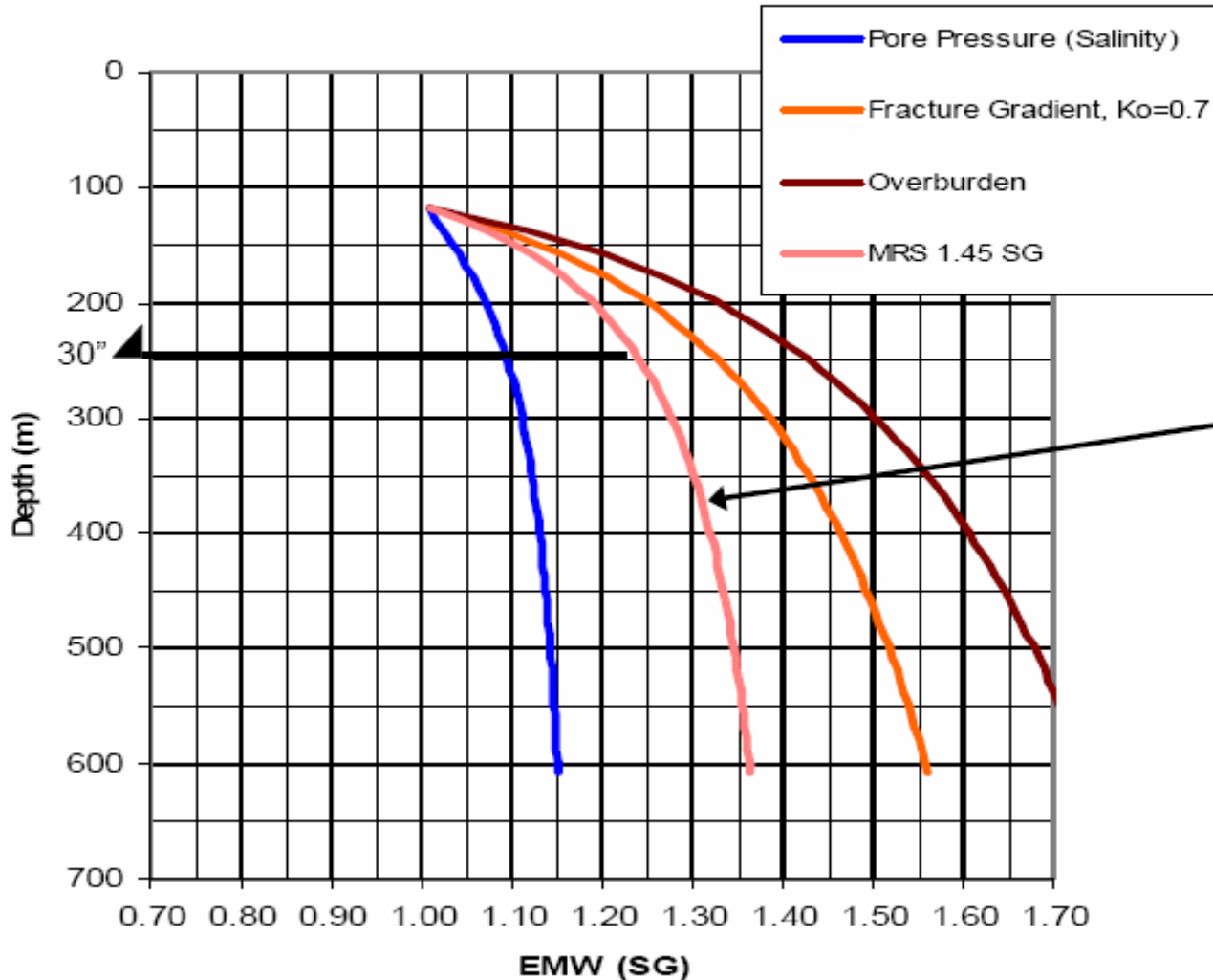
Mud Weight Limitations With Riser

West Azeri Model



Mud Weight Limitations With RMR

West Azeri Model
Ref SS

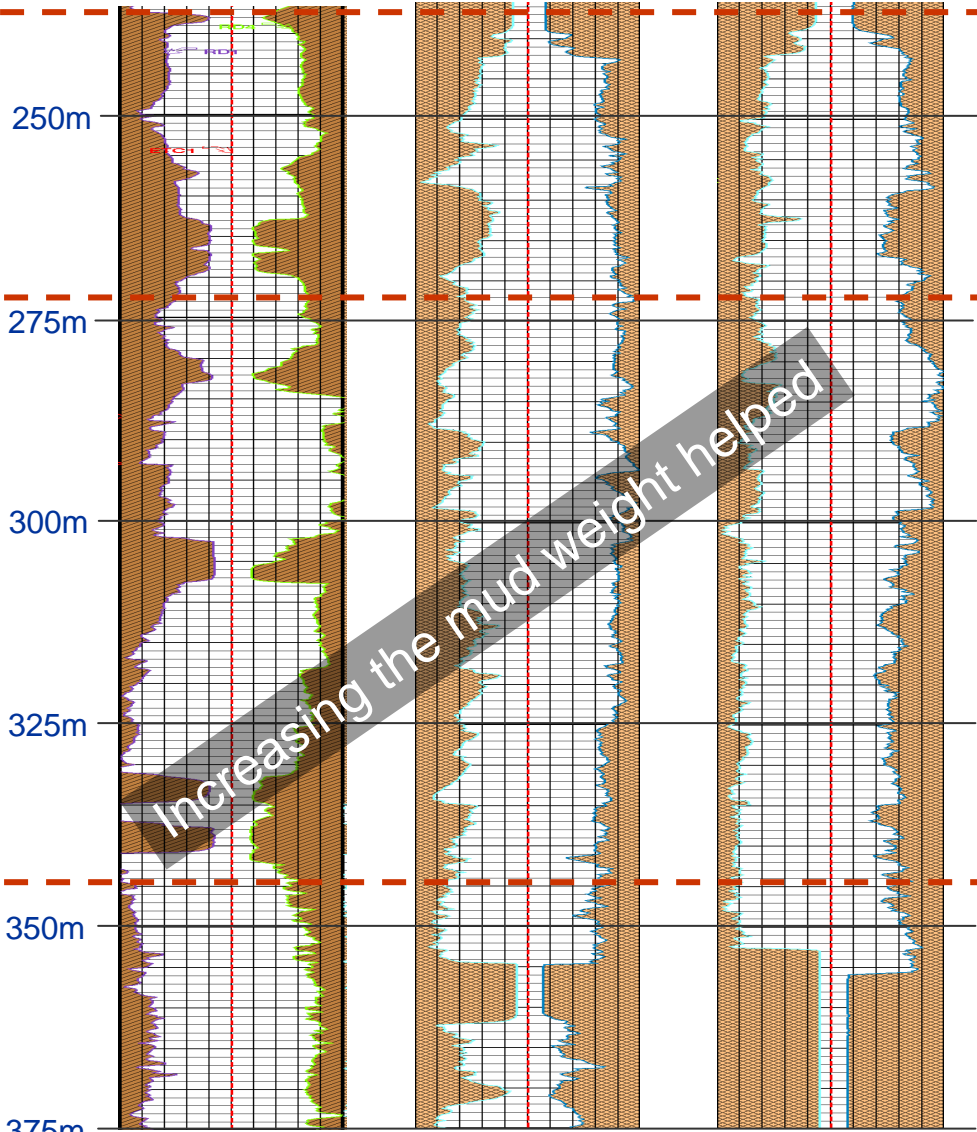


Mud weight profile now different - higher mud weights possible, e.g. 1.45 SG

Calliper summary for WAT1

1.25 SG Silicate mud,
40ppb KCl + MRS

30" Casing Shoe



Signs of instability at the shoe.
Worse with time?

Top Soil Unit 8

Base Soil Unit 8

Tool not reading correctly in Apsheron due to clays sticking calliper arms.
Time dependent?

Increasing the mud weight helped

01:00
05.01.2004
1.25 SG

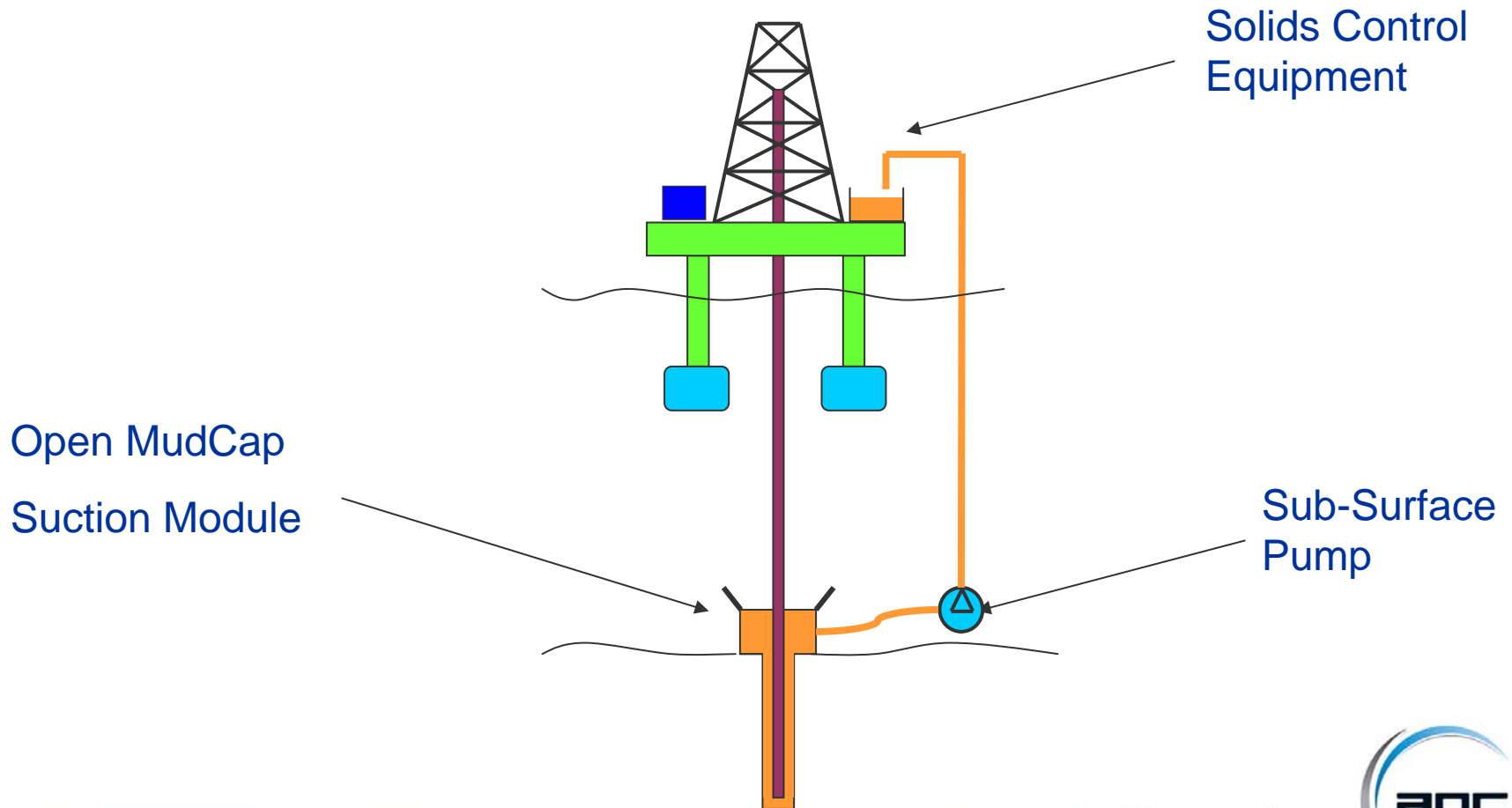
07:00
07.01.2004
1.45 SG

09:00
07.01.2004
1.45 SG

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The RMR System used



Open MudCap



1st Generation Suction Module (SMO)

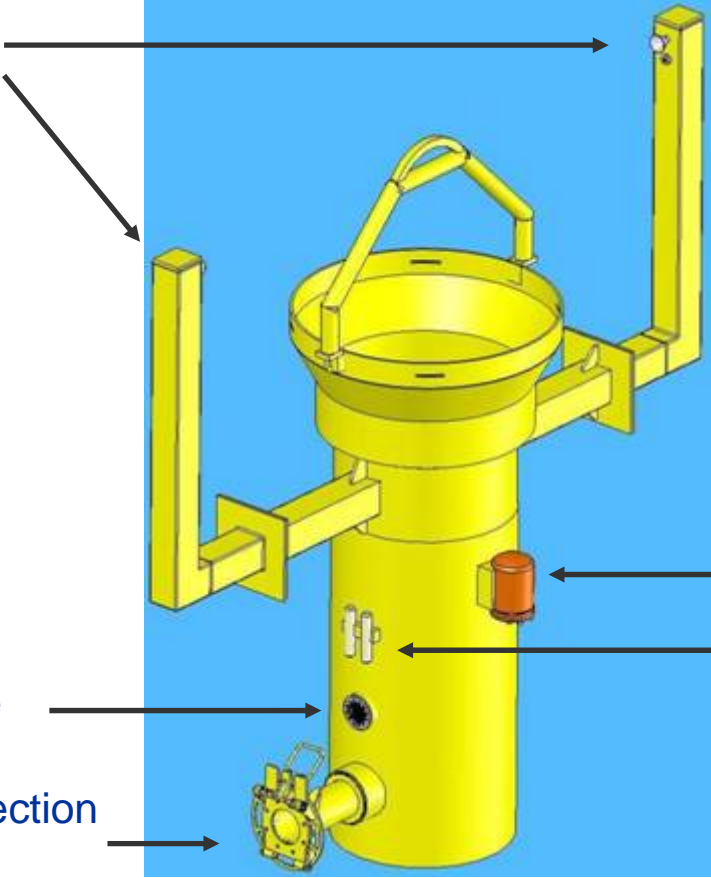


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2nd Generation Suction Module

Camera and Light



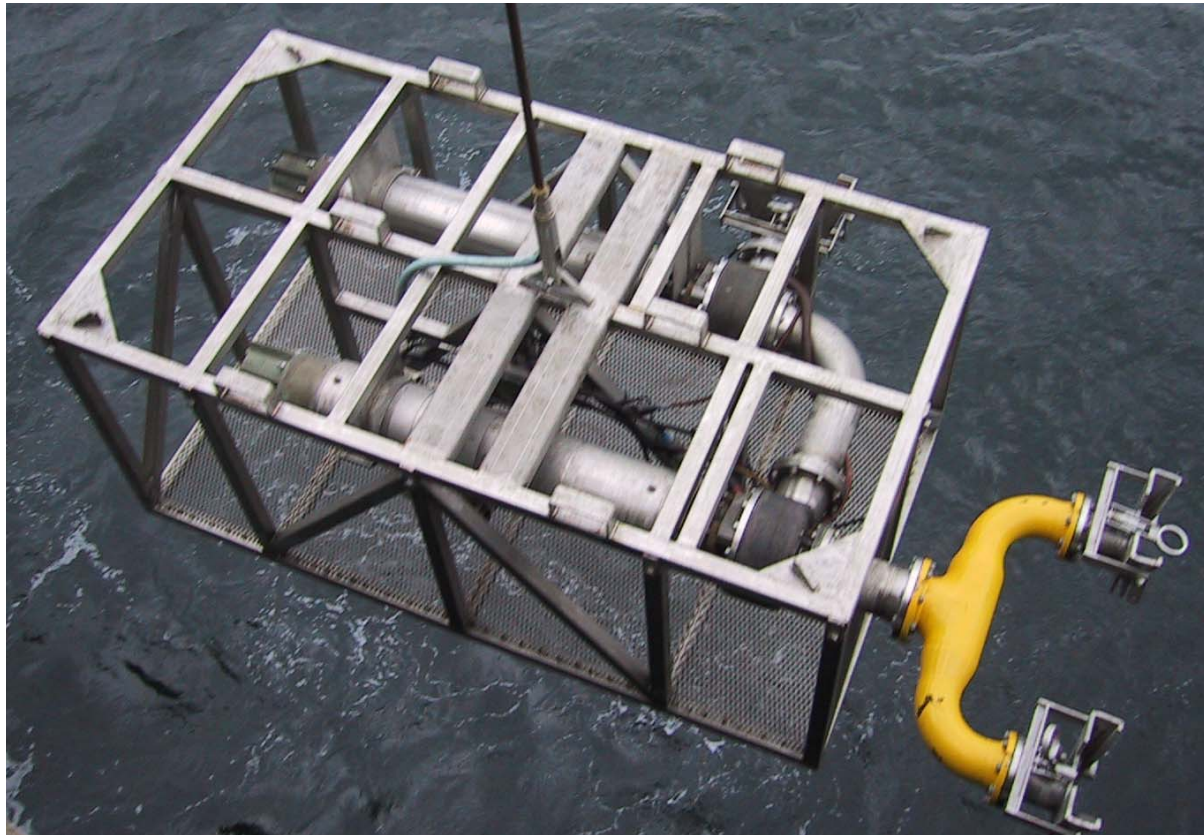
SMO Control Pod

Pressure Transmitters

Pressure Membrane

ROV Friendly Connection
for Suction Hose

1st Generation Pump Module



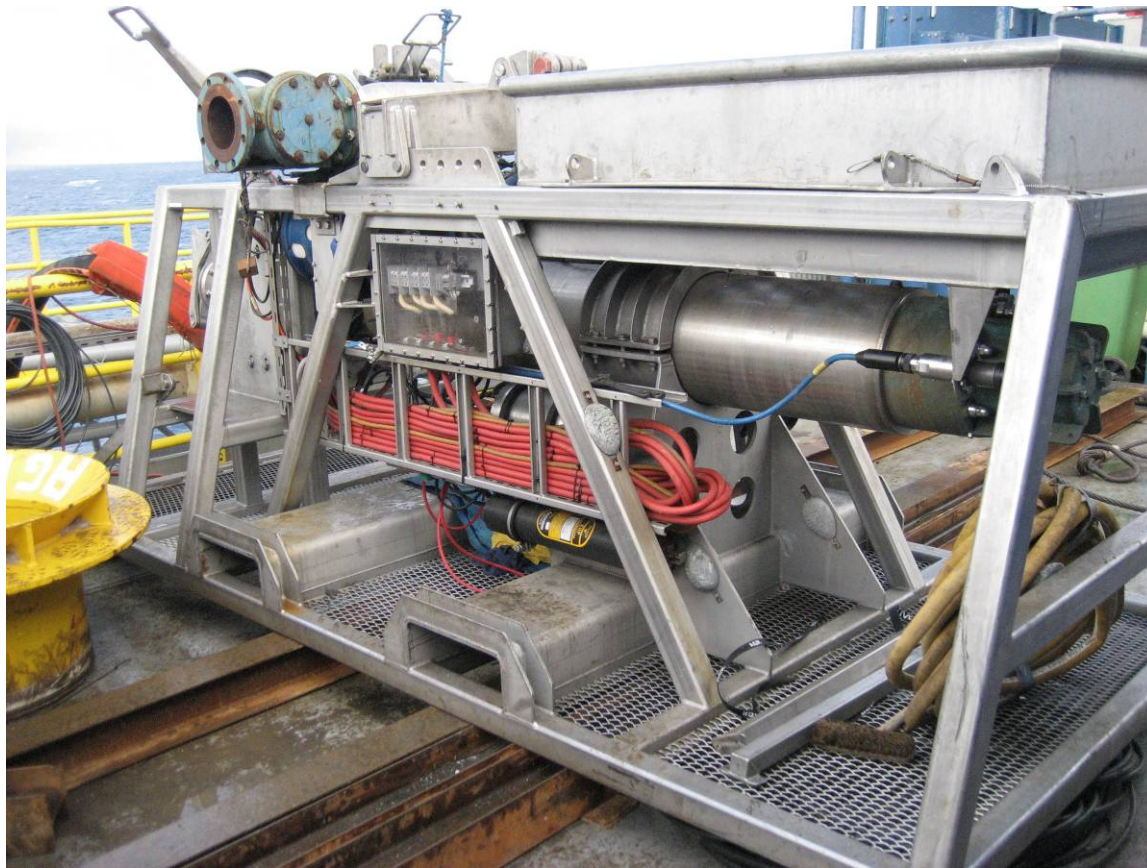
2nd Generation Pump Module



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3rd Generation Pump Module



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Umbilical Winch & Hose Platform



Control Container



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Umbilical Winch & Hose Platform



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RMR Spread



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Caspian Sea Status



- Used on 15 Azeri wells (including two test wells)
- Used on SDX-4 well on Shah Deniz (392m - Istiglal)
- Being used on Deep Water Gunashli (275m – Dada Gorgud)
 - 12 of 16 wells are currently completed
- Will be used on Inam INX-2 well

A total of 28 Caspian Sea wells drilled to date

Wells Completed

No	Client	Geo Area	Field	Well	Water Depth (meter)	Rationale for using RMR
1	BP	Caspian	West Azeri	WAT1	118	Shallow geohazards
2	BP	Caspian	West Azeri	WAT2	118	Shallow geohazards
3	BP	Caspian	East Azeri	D-01	152	Shallow geohazards
4	BP	Caspian	East Azeri	D-04	152	Shallow geohazards
5	BP	Caspian	East Azeri	D-03	152	Shallow geohazards
6	BP	Caspian	East Azeri	D-02	152	Shallow geohazards
7	BP	Caspian	West Azeri	C-01	128	Shallow geohazards
8	BP	Caspian	West Azeri	C-02	128	Shallow geohazards
9	BP	Caspian	West Azeri	C-03	128	Shallow geohazards
10	BP	Caspian	West Azeri	C-04	128	Shallow geohazards
11	Hydro	North Sea	Troll 31/2	L23H	330	Demostration and qualification of RMR at 450 m WD
12	BP	Caspian	West Azeri	C-05	128	Shallow geohazards
13	BP	Caspian	East Azeri	D-05	152	Shallow geohazards
14	BP	Caspian	East Azeri	D-06	152	Shallow geohazards
15	BP	Caspian	East Azeri	D-07	152	Shallow geohazards
16	BP	Caspian	East Azeri	D-08	152	Shallow geohazards
17	BP	Caspian	Deep Water Gunashli	E-01	176	Shallow geohazards
18	BP	Caspian	Shah Deniz	SDX-4	392	Extended casing depth (Elim. 2 casing sections)
19	BP	Caspian	Deep Water Gunashli	F-01	180	Shallow geohazards
20	BP	Caspian	Deep Water Gunashli	G-01	270	Shallow geohazards

Wells Completed

No	Client	Geo Area	Field	Well	Water Depth (meter)	Rationale for using RMR
21	BP	Russia	Sakhalin	# 1	190	Avoiding pilot hole and save time comp. To use RPC
22	BP	Russia	Sakhalin	#2	190	Avoiding pilot hole and save time comp. To use RPC
23	Hydro	Barents	Shtokman	# 7	350	Zero discharge
24	Total	North Sea	Jura West	3/15-10	113	Avoiding pilot hole and save time comp. To use RPC
25	BP	Caspian	Deep Water Gunashli	E-02	176	Shallow geohazards
26	BP	Caspian	Deep Water Gunashli	E-03	176	Shallow geohazards
27	BP	Caspian	Deep Water Gunashli	E-04	176	Shallow geohazards
28	Shell	Australia	Prelude	1	237	Shallow geohazards
29	Total	North Sea	Kessog	1	85	Avoiding pilot hole and save time comp. To use RPC
30	Shell	Australia	Prelude 1 A	1	254	Shallow geohazards
31	BP	Caspian	Deep Water Gunashli	E-05	176	Shallow geohazards
32	Nexus	Australia	Nexus	1	170	Shallow geohazards
33	BP	Caspian	Deep Water Gunashli	E-06	176	Shallow geohazards
34	BP	Caspian	Deep Water Gunashli	E-07	175	Shallow geohazards
35	CNR	North Sea	Columba	1	150	Avoiding pilot hole and save time comp. To use RPC
36	BP	Caspian	Deep Water Gunashli	E-08	176	Shallow geohazards
37	BP	Caspian	Deep Water Gunashli	E-09	175	Shallow geohazards
38	Shell	Australia	Gigue 1	1	240	Shallow geohazards
39	Shell	Australia	Rigaudon1	1	240	Shallow geohazards
40	BP	Caspian	Deep Water Gunashli	E-10	175	Shallow geohazards
41	Shell	Australia	Rigaudon1A	1	240	Shallow geohazards
42	Inpex	Australia	Ichts	1	240	Shallow geohazards
43	Statoil	North Sea	Tordis 34/7-L1H	1	200	Mitigate shallow gas

Operational Experience

- All wells to date have been delivered
- The systems have worked very well with few operational problems
- Good hole quality obtained, no casing running or cementing problems
- Experience has been gained resulting in system upgrades and modifications

Operational Experience

- 26 wells drilled on Azeri and Deep Water Guneshli
- Total hours spent drilling the surface sections; 3121.5 hrs
- NPT = 70 hrs (2.2%)

Main Lessons Learned

- Inhibitive drilling fluid must be used
- Motor Thrust Bearing failure on SDX-4 Caspian Sea
 - Motor bearings upgraded
 - Pump rotor modified
- Hose Failures
 - Hoses upgraded / procedure modification
- Pump blockage on the Kessog well
 - Mud inhibition / procedure modification
- Gumbo lifting Suction Module (DWG Caspian Sea)
 - Locking SMO to wellhead being evaluated

RMR Demo 2000 Deepwater JIP

JIP Purpose

- Develop, manufacture and perform a field trial of an RMR system for use in 5000 ft of water depth in the GOM.

Current JIP Members

- Demo2000
- AGR Subsea
- Shell International Exploration and Production Inc.
- BP America Production Company

Field Trial Target Date

- Q1 2008

GOM

- AGR Subsea Inc established in 05
- Organisation is up and running
- Plan to recruit 15 more engineers this year

- RMR Spread for 2 - 2,500ft being manufactured
 - Actively working with GOM + Mexico Candidates

References

- SPE / IADC Drilling Conference Amsterdam, February 2005;
Paper no; SPE/IADC 92769
“Silicate-Based Fluid, Mud Recovery System Combine to Stabilize Surface Formations on Azeri Wells”
- Offshore Mediterranean Conference Ravenna, March 2005;
Paper no; OMC 038
”Riserless Mud Recovery System and High Performance Inhibitive Fluid Successfully Stabilize West Azeri Surface Formation”
- SPE / IADC Drilling Conference Amsterdam, February 2007;
Paper no; SPE/IADC 105212
“Deployment of a Riserless mud Recovery System Offshore Sakhalin Island”



Thank you for your attention!