Company: CDEX

C0009A Kumanonada, Offshore Kii Peninsula
MDT Single Probe Pressure Test
MDT Dual Packer Stress Test

Khong Chee Kin
DCS Schlumberger North Asia
27-September-2009
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1. MDT Single Probe Pressure Test

1.1 PDPlot

Pressure Depth Plot

<table>
<thead>
<tr>
<th>FORMATION (BQP1 psia)</th>
<th>NPOR LIM (v/v)</th>
<th>DRAWDOWN MOBILITY (BQP1 md/cp)</th>
<th>RHOZ (g/cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>6000 0.6</td>
<td>0</td>
<td>1.45</td>
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<tr>
<td></td>
<td>2000</td>
<td></td>
<td>2.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MUD AFTER (BQP1 psia)</th>
<th>NPOR LIM (v/v)</th>
<th>DRAWDOWN MOBILITY (BQP1 md/cp)</th>
<th>RHOZ (g/cc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td>6000 0.6</td>
<td>0</td>
<td>1.45</td>
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<table>
<thead>
<tr>
<th>SP (mv)</th>
<th>FLUID FRAC</th>
<th>RLA5 (ohmm)</th>
<th>RLA1 (ohmm)</th>
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<tr>
<td>-400</td>
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<td>0.2</td>
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<table>
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<tr>
<th>CAL (in)</th>
<th>tvd (m)</th>
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C0009A - Kumanonada, Offshore Kii Peninsula
# 1.2 MDT Single Probe Pressure Test Table

<table>
<thead>
<tr>
<th>File No.</th>
<th>Test No.</th>
<th>Test MD (m)</th>
<th>Test TVD (m)</th>
<th>Last Read Pressure (psia)</th>
<th>Buildup</th>
<th>Drawdown</th>
<th>Mobility</th>
<th>Mud Before (md/cp)</th>
<th>Mud After (md/cp)</th>
<th>Spherical Mobility</th>
<th>Horner Mobility</th>
<th>Temp</th>
<th>Pretest Volume</th>
<th>Pretest Time</th>
<th>Pretest Flowrate</th>
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</table>
1.3 MDT Single Probe Polaris Pretest Interpretation
Pressure Vs Time Plot: File 59 Test 2 2811.02 M (TVD)
C0099A

Test 2

Test 3

Test 4

Tool Type: MDT
Test Type: Normal Pretest
Packer: Large-Diameter Probe
Gauge: BOP1
Formation Pressure: 4102.21 PSIA
Last Read: 4102.21 PSIA
Drawdown Pressure: 89.99 md/cp (3.4 of 4.97 cc)
Mud Pressure Before: 4520.15 PSIA
Mud Pressure After: 4520.06 PSIA
Temperature Before/After: 17.83 DEGC / 17.65 DEGC
Pretest Rate/Volume: 0.97 c3/s / 4.97 cc

Pressure (PSIA)

Mud Before
Drawdown Start
Buildup Start
End Buildup
Mud After

Pressure (PSIA)

Time (sec)

100 120 140 160 180 200

Time (sec)

100 120 140 160 180 200
Flow Regime Identification Plot: File 59 Test 2  2811.02 M (TVD)
Pressure Vs Time Plot: File 59 Test 3  2811.02 M (TVD)
C0009A

Mud Before
Drawdown Start
Buildup Start
End Buildup
Mud After

Time (sec)

Pressure (PSIA)

Detail Pressure Plot

Tool Type: MDT
Test Type: Normal Pretest
Packer: Large-Diameter Probe
Gauge: BOP1
Formation Pressure: 4102.13 PSIA
Last Read: 4102.13 PSIA
Drawdown Mobility: 75.252 md/cp (4.67 cc)
Mud Pressure Before: 4520.15 PSIA
Mud Pressure After: 4520.66 PSIA
Temperature Before/After: 17.62 DEGC / 17.51 DEGC
Pretest Rate/Volume: 0.97 c3/s / 4.67 cc
Flow Regime Identification Plot: File 59 Test 3  2811.02 M (TVD)
Pressure Vs Time Plot: File 59 Test 4  2811.02 M (TVD)
C0009A

Pressure (PSIA) vs Time (sec) plot showing the following:
- Mud Before
- Drawdown Start
- Buildup Start
- End Buildup
- Mud After

Test Details:
- Tool Type: MDT
- Test Type: Normal Pretest
- Packer: Large-Diameter Probe
- Gauge: BOP1
- Formation Pressure: 4102.14 PSIA
- Last Read: 4102.42 PSIA
- Drawdown Mobility: 38.546 md/cp (9.92 cc)
- Mud Pressure Before: 4520.15 PSIA
- Mud Pressure After: 4520.66 PSIA
- Temperature Before/After: 17.47 DEGC / 17.37 DEGC
- Pretest Rate/Volume: 0.92 c3/s / 9.92 cc
Flow Regime Identification Plot: File 59 Test 4  2811.02 M (TVD)

Spherical Derivative: 0.003
Radial Derivative: -0.480
Pressure Vs Time Plot: File 61 Test 9  2959.02 M (TVD)

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Pressure (PSIA)

Time (sec)

Mud Before
Drawdown Start
Buildup Start
End Buildup
Mud After

Test Type
Test Type
Packer
Gauge
Formation Pressure
Last Read
Drawdown Mobility
Mud Pressure Before
Mud Pressure After
Temperature Before/After
Pretest Rate/Volume

Normal Pretest
Large-Diameter Probe
BOP1
4585.61 PSIA
4508.72 PSIA
1.237 md/cp (4.22 of 4.97 cc)
4761.94 PSIA
4758.52 PSIA
19.79 DEGC / 19.99 DEGC
0.64 c3/s / 4.97 cc
Flow Regime Identification Plot: File 61 Test 9  2959.02 M (TVD)

Pressure Derivatives

Delta-Time (sec)

Slope on Spherical 0.422  Slope on Radial 0.022

Radial Time Function Plot

Last Buildup Pressure: 4588.72 PSIA
Extrapolated Pressure: 4585.61 PSIA
Horiz. Mobility Thickness: 0.026 md.M/Cp
Radial Slope: -649.34
Flow Regime Identification Plot: File 61 Test 10  2959.02 M (TVD)

Spherical Derivative
Radial Derivative

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Pressure Derivatives

Delta-Time (sec)

Slope on Spherical: 0.428
Slope on Radial: 0.016

Flow Regime Identification Plot: File 61 Test 10  2959.02 M (TVD)

Radial Time Function Plot

Last Buildup Pressure: 4502.66 PSIA
Extrapolated Pressure: 4232.93 PSIA
Horiz. Mobility Thickness: 0.019 md.M/Cp
Radial Slope: -566.64
Flow Regime Identification Plot: File 65 Test 12  3256.06 M (TVD)

Slope on Spherical 0.524  Slope on Radial -0.259
Pressure Vs Time Plot: File 67 Test 14  3416.99 M (TVD)

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QUARTZ PRES MDT - BQP1 (PSIA)  3000.0 6000.0
QUARTZ TEMP MDT - BQT1 (DEGC)  25.0 30.0
FLOW LINE RES. MDT - BFR1 (ohmm)  0.0 0.1
MOTOR SPEED MDT - HMS1 (rpm)  0.0 2100.0
MRPS 1 PRETEST VOLUME MDT - PTV1 (C3)  0.0 5.0
PUMP OUTPUT VOLUME MRPO - POPV (C3)  0.0 0.0

Test 14

Tool Type MDT Test Type Limited Drawdown Packer Large-Diameter Probe Gauge BQP1 Formation Pressure 5130.89 PSIA Last Read Pressure After 5493.57 PSIA Temperature Before/After 27.78 DEGC / 28.03 DEGC Pretest Rate/Volume 0.64 c3/s / 4.83 cc

Mud Pressure Before 5491.13 PSIA
Mud Pressure After 5493.57 PSIA
Temperature Before/After 27.78 DEGC / 28.03 DEGC
Pretest Rate/Volume 0.64 c3/s / 4.83 cc
Flow Regime Identification Plot: File 67 Test 15  3416.99 M (TVD)

Spherical Derivative: 0.508
Radial Derivative: 0.096
Pressure Vs Time Plot: File 75 Test 28  3545.98 M (TVD)
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Test 28

Pressure (PSIA)
2999.8
3813.6
5495.2
100 175 250 325 400 475

Time (sec)
100 200 300 400 500 600 700 800

Mud Before
Drawdown Start
Buildup Start
End Buildup
Mud After

Test 29

Pressure (PSIA)
2168
2999.8
4663.4
5495.2
100 175 250 325 400 475

Time (sec)
100 200 300 400 500 600 700 800

Tool Type
Test Type
Packer
Gauge
Formation Pressure
Last Read
Drawdown Mobility
Mud Pressure Before
Mud Pressure After
Temperature Before/After
Pretest Rate/Volume

MDT
Limited Drawdown
Large-Diameter Probe
BOP1
5428.09 PSIA
5428.09 PSIA
0.059 md/cp (3.9 of 4.91 cc)
5701.61 PSIA
5701.13 PSIA
33.23 DEGC / 33.35 DEGC
0.82 c³/s / 4.91 cc
Flow Regime Identification Plot: File 75 Test 28 3545.98 M (TVD)

Pressure Derivatives vs. Delta-Time (sec)

Spherical Derivative
Radial Derivative
Pressure Vs Time Plot : File 75 Test 29  3545.98 M (TVD)
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Test 28

Test 29

Detail Pressure Plot

Mud Before
Drawdown Start
Buildup Start
End Buildup
Mud After

Tool Type
Test Type
Packer
Gauge
Formation Pressure
Last Read
Drawdown Mobility
Mud Pressure Before
Mud Pressure After
Temperature Before/After
Pretest Rate/Volume

MDT
Limited Drawdown
Large-Diameter Probe
BQP1
4422.35 PSIA
5185.5 PSIA
0.098 md/cp (4.57 of 4.94 cc)
5701.61 PSIA
5701.13 PSIA
33.1 DEGC / 33.16 DEGC
0.42 c3/s / 4.94 cc
Flow Regime Identification Plot: File 75 Test 29  3545.98 M (TVD)

Slope on Spherical 0.364  Slope on Radial -0.044
Pressure Vs Time Plot: File 78 Test 30  3300.03 M (TVD)

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Test 30

Mud Pressure Before: 5304.4 PSIA
Mud Pressure After: 5307.88 PSIA
Temperature Before/After: 31.15 DEGC / 31.08 DEGC
Pretest Rate/Volume: 0.63 c3/s / 4.93 cc

Tool Type: MDT
Test Type: Normal Pretest
Gauge: BQP1
Formation Pressure: 4825.1 PSIA
Last Read: 4825.1 PSIA
Drawdown Mobility: 0.663 md/cp (4.12 of 4.93 cc)

Mud Pressure After: 5307.88 PSIA
Temperature Before/After: 31.15 DEGC / 31.08 DEGC
Pretest Rate/Volume: 0.63 c3/s / 4.93 cc

Mud Before
Drawdown Start
Buildup Start
End Buildup
Mud After

Pressure (PSIA)
Time (sec)

5568
5043.8
4519.6
4005.4
3471.2
2947
100 130 160 190 220 250

Detail Pressure Plot

Time (sec)
Flow Regime Identification Plot: File 78 Test 30  3300.03 M (TVD)

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Spherical Derivative
Radial Derivative

Pressure Derivatives vs Delta-Time (sec)
Flow Regime Identification Plot: File 78 Test 31 3300.03 M (TVD)

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Spherical Derivative: 0.571
Radial Derivative: -0.034

Pressure Derivatives

Delta-Time (sec)

Slope on Spherical: 0.571
Slope on Radial: -0.034
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MDT Dual Packer Stress Test and Mobility Test

MDT Single Probe Pretest
Dual Packer Stress Test and Mobility Test

• Stress test at 2958 m is reliable and minimum stress could be bracketed from fall-off response seen – it takes about 400 psi over-pressure to fracture the formation here

• Stress test at 3615 m is not valid – injection over-pressure is only about 250 psi – should have injected higher pressure

• Dual Packer Mobility Test will be very difficult to interpret – should have Pump Out once only and stop PO to Build Up as long as possible
2958 m – Dual Packer Stress Test

File 80

Probe Depth (PAQP) 2988.0 M
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File 80

Pressure, PSIA

Motor Speed, RPM

Time, seconds
2955.8 m – Probe Pretest

Moisture Based Flow Volume: 2.4 cc
Total Pressure Volume: 4.7 cc
MRPS: -
BGP1 Resolution: 0.01 psi
3615 m – Dual Packer Stress Test
File 74

File 74  Probe Depth (PAQP)  3615.0 M
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Pressure, PSIA  Motor Speed, RPM

Time, seconds
3613 m – Probe Pretest

File 74
Depth: 3613.00

14-Jul-2009
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Volumetric Pretest - Large Diameter probe

Mud Pressure before test, PSIA: 5801.44
Mud Pressure after test, PSIA: 5801.79
Last build-up pressure, PSIA: 4708.43
Draw-down mobility, mdcp: 0.6

Pressure, PSIA vs. Time, sec

Mobility Based Flow Volume: 2.9 cc
Total Pretest Volume: 5.0 cc - MRPS 1 - BOP1 Resolution: 0.01 psi
3622 m – Dual Packer Mobility Test
File 73

File 73  Probe Depth (PAQP)  3622.0 M
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Kumanonada, Offshore Kii peninsula

Pressure, PSIA

Time, seconds
Single Probe Pretest

- Identify supercharged pressure measurement by comparing with pressure from pretest of high mobility
- For supercharged point, last read pressure higher than estimated reservoir pressure (based on pressure trend) while pressure extrapolated at derivative plot with zero gradient (seemingly radial flow regime) is also incorrect
- Reliable probe pressure could only be obtained by referring to pretest points with high mobility
2811.02 m – Probe Pretest

Volumetric Pretest - Large-Diameter probe

- Mud Pressure before test, PSIA: 4620.08
- Mud Pressure after test, PSIA: 4621.88
- Last build-up pressure, PSIA: 4102.12
- Draw-down mobility, mDcp: 42.3

Mobility Based Flow Volume: 9.9 cc
Total Pretest Volume: 9.9 cc - Mrps: - Bop: Resolution: 0.01 psi
2959.02 m – Probe Pretest
3256.06 m – Probe Pretest
3300.03 m – Probe Pretest

Depth: M: 3300.03

14-Jul-2009

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Volumetric Pretest - Large-Diameter probe

Mud Pressure before test, PSIA: 5304.5
Mud Pressure after test, PSIA: 5303.44
Last build-up pressure, PSIA: 4923.51
Draw-down mobility, mdcp: 0.7
3416.99 m – Probe Pretest

File 67
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Depth, M: 3416.99

Volumetric Pretest - Large-Diameter probe
Mud Pressure before test, PSIA: 5464.53
Mud Pressure after test, PSIA: 5464.1
Last build-up pressure, PSIA: 4960.61
Draw-down mobility, mdcp: 0.3

Pressure, PSIA

Time, sec

Mobility Based Flow Volume: 4.5 cc
Total Pretest Volume: 4.8 cc - MRPS 1.1 - BDP1 Resolution: 0.01 psi
3545.98 m – Probe Pretest

File 75  Depth, M: 3545.98
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Volumetric Pretest - Large-Diameter probe
Mud Pressure before test, psia: 5599.61
Mud Pressure after test, psia: 5700.34
Last build-up pressure, psia: 5182.79
Draw-down mobility, mdcp: 0.1

Mobility Based Flow Volume: 4.5 cc
Total Pretest Volume: 4.3 cc - NRS_1- BOP1 Resolution: 2.010 psi
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MDT Dual Packer Stress Test @ 3615 m
C0009A Kumanonada, Offshore Kii Peninsula 3615 m Stress Test (Minimum Stress 5040-5060 psia)

Square Root Delta T (sec)^0.5

Pressure (psia)

~ 5047 psia
C0009A Kumanonada, Offshore Kii Peninsula 3615 m Stress Test (Minimum Stress 5040-5060 psia)

~ 5050 psia
C0009A Kumanonada, Offshore Kii Peninsula 3615 m Stress Test (Minimum Stress 5040-5060 psia)

Approximately 5046 psia