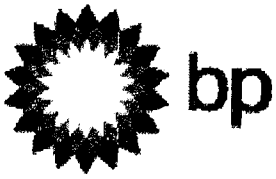
From: Mason, Mike C
Sent: Sat May 15 00:58:50 2010
To: Turnbull, Jon B
Cc: O'Bryan, Patrick L; Tooms, Paul J; Cecil, Chris; Kercho, Debbie A
Subject: Macondo SIWHP & Build-up Rate Final Report.doc
Importance: Normal
Attachments: Macondo SIWHP & Build-up Rate Final Report.doc

<<...>>

This is version A of the above referenced report it will be updated as version B after we get SIWHP conclusions from the National Laboratories and additional data from one of the contributors.

Mike Mason PE
Vice President, Base Management
BP Exploration & Production Technology
Contact Details
Office - 281 504 2227
Cell - 713 301 3745

6194
Exhibit No. _____
Worldwide Court Reporters, Inc.



Technical Note

Title:	Macondo SIWHP and Build-up Times
Prepared by:	Mike Levitan, Debbie Kercho, Farah Saidi, Simon Bishop, Tony Liao, Thomas von Schroeter, Kelly McAughan, Chris Cecil
Reviewed by:	Debbie Kercho and Chris Cecil
Approved by:	Mike Mason
Date:	May 14, 2010
Revision:	A

Question Addressed in this Technical Note

As BP is currently evaluating kill options for the Macondo well, this technical report addresses the following question:

What is the estimated shut in pressure character for the well addressing:

a) time for Pressure Build Up at normal SIWHP

b) ultimate shut-in pressure taking into account both the oil bearing and gas bearing sands?

Key Conclusions

1) The SIWHP is expected to be between 8,400 psia and 8,900 psia for the oil sands between depths 18,060' and 18,200' (MD-RKB). This assumes no reservoir depletion.

2) The average SIWHP is 0 – 10 psi higher than those listed above in item 1) when flow from the gas sand is included in the calculation.

3) The maximum SIWHP could be as high as ~10,340 psia for the gas sand at a top depth of 17,802' (MD-RKB) assuming the oil sands do not contribute to flow. This would necessitate a sealing-off of the oil sands not yet observed and therefore is considered highly unlikely. Dry gas and no reservoir depletion were assumed.

4) The time required for oil sands between depths 18,060' and 18,200' (MD) to build-up to a static SIWHP depends on the assumed location of the flow restriction.

   a. for a case in which there is a flow restriction at a shallow location in the well the time to build-up to a nearly-static SIWHP is on the order of 5 minutes.

   b. for a case in which there is a flow restriction located deep in the well the time to build-up to a nearly-static SIWHP is on the order of 30 minutes.

5) When both the gas sand at a top depth of 17,802' (MD) and the oil sands between depths 18,060' and 18,200' (MD) contribute to flow, the time required to build-up to a static SIWHP is essentially the same as the cases listed above in items 4) a. and 4) b.

6) The expected reservoir pressure depletion ranges from 40 psia (assuming a production rate of 5,000 bopd) to 400 psia (assuming a production rate of 60,000 bopd) from April 20 to May 14, 2010. This depletion would reduce the SIWHP by an equivalent amount.

Discussion

Shut-In Wellhead Pressure (SIWHP)

All SIWHP calculations are based on a static formation pressure measured by MDT (11,850 psia at 18,124' MDRKB) and PVT lab analyses from Pencor and Schlumberger. The PVT lab analyses were conducted on MDT samples taken at 18,142' MDRKB. We have conducted QA/QC on the samples and are satisfied that they represent the reservoir fluid. The two vendors' results are consistent with each other with respect to a single phase fluid. Tests are ongoing as of May 14, 2010 on two additional samples taken at depths: 18,086' MDRKB and 18,142' MDRKB.

A summary of SIWHP calculation methods and results follows:

- 8,900 psia (PIPESIM) steady-state model (Farah Saidi, April 29th, 2010).
- 8,835 psia (PROSPER) Lasater correlation steady-state model (Tony Liao, May 14, 2010).
- 8,600 psia (OLGA v5.3.2) transient model (Farah Saidi, ~April 29th, 2010) considered accurate to within +/- 200 psia.
- 8,550 psia (PROSPER) Vasquez-Beggs correlation steady-state model (Simon Bishop, May 13, 2010)
- 8,400 psia (OLGA v5.3) compositional, transient model (Ole Rygg, add energy, May 13, 2010)

Black-Oil PVT tables were generated in PROSPER software using reference values of Oil Gravity (35 °API,) GOR (2,900 scf/stb,) Pbp (6,650 psig,) Reservoir Temperature (240 °F) and initial Reservoir Pressure (11,850 psig.)

Pressure Build-up Time

The reservoir pressure transient calculations were performed using the PIE pressure transient analysis software. Two reservoir models were used:

1) a single oil layer (k_o= 300mD, h= 88ft, A= 3,500' x 8,000', ϕ= 21%, S_w= 12.3%, c_o= 14.6 μsips, μ_o= 0.168 cP, B_o= 2.77rb/stb, P_{ri}= 11,850 psia)

2) two layers, the first identical to the previously described oil layer and the 2nd mimicking a gas layer which has the same areal extent, water saturation and porosity, h= 3ft, k_g= 15 mD (equiv. k_o= 72mD) and P_{ri}= 12,028 psia. Model 2 incorporates cross-flow between the two layers in the wellbore. Initial model date was May 3, 2010.

The wellbore portion of the pressure calculations were performed using OLGA software with the bottom-hole pressure calculations from PIE as a boundary condition.

Reservoir Depletion

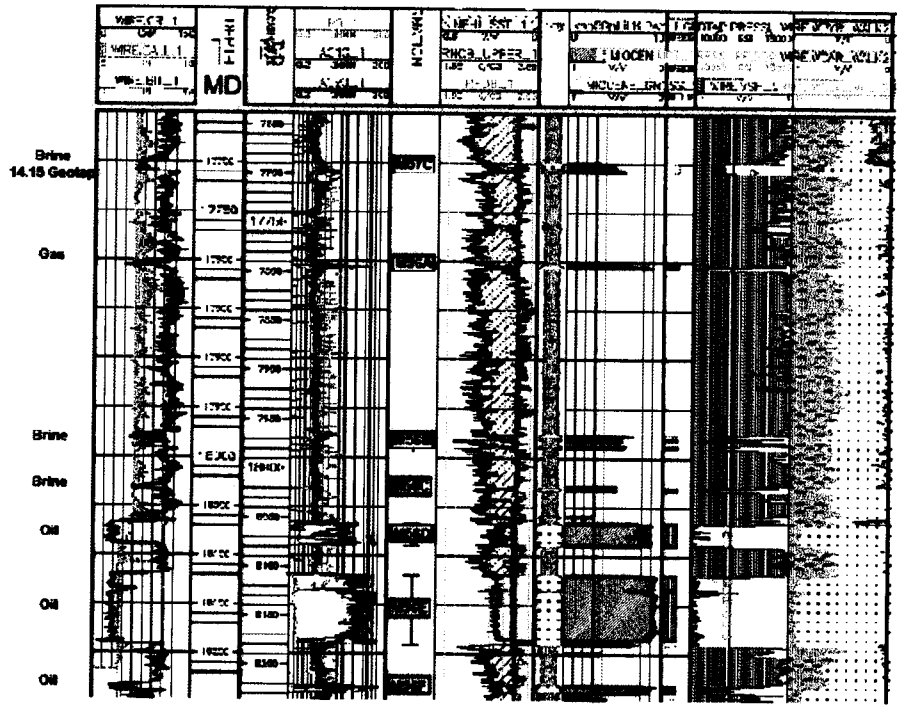
Reservoir pressure depletion due to production was evaluated using the MBal software. Model inputs included: 11850 psi initial reservoir pressure, 188 mmstb original oil in place (based on volumetric calculations,) no aquifer, no gas cap, S_w=15%, c_f= 6 μsips c_w= 4.5 μsips; Corey exponents and endpoints of 1.2 and 0.63 for water, 2 and 0.8 for oil, 1.5 and 0.9 for gas.

Three constant production rate scenarios at 5, 20 and 60 mbopd were evaluated. For the time period from April 20 – May 14, 2010, the expected depletion is 40 psi for the 5 mbopd case and 400 psi for the 60 mbopd case.

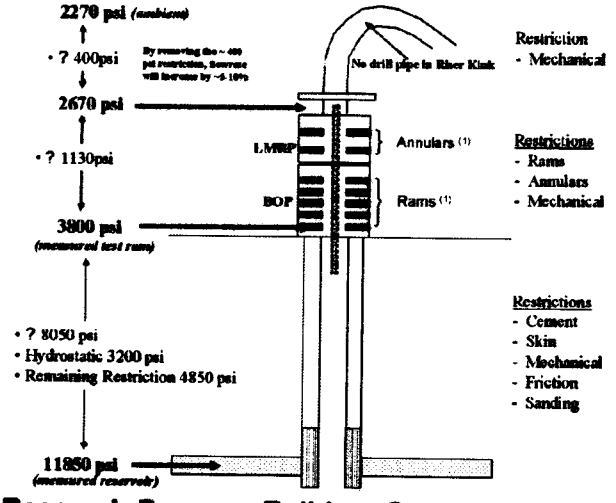
Appendix

Reservoir Description

Macondo Sand Identification

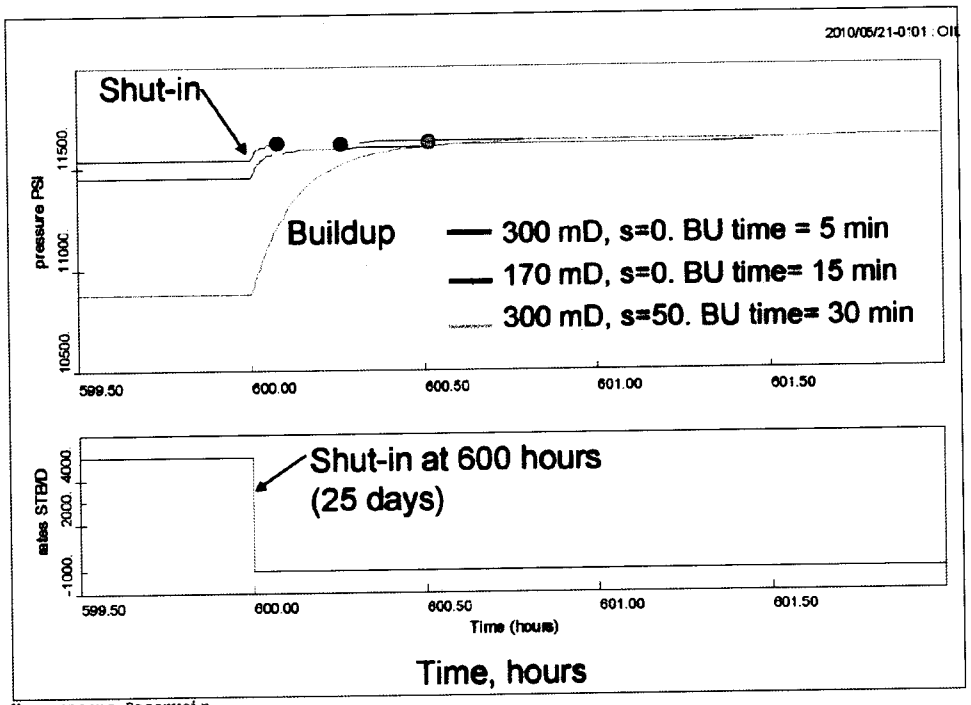


Current Available Pressure Measurements and Well Conditions



Single layer oil Reservoir Pressure Build-up Cases

(1) All Rams and Annulars Closed



Homogeneous Reservoir

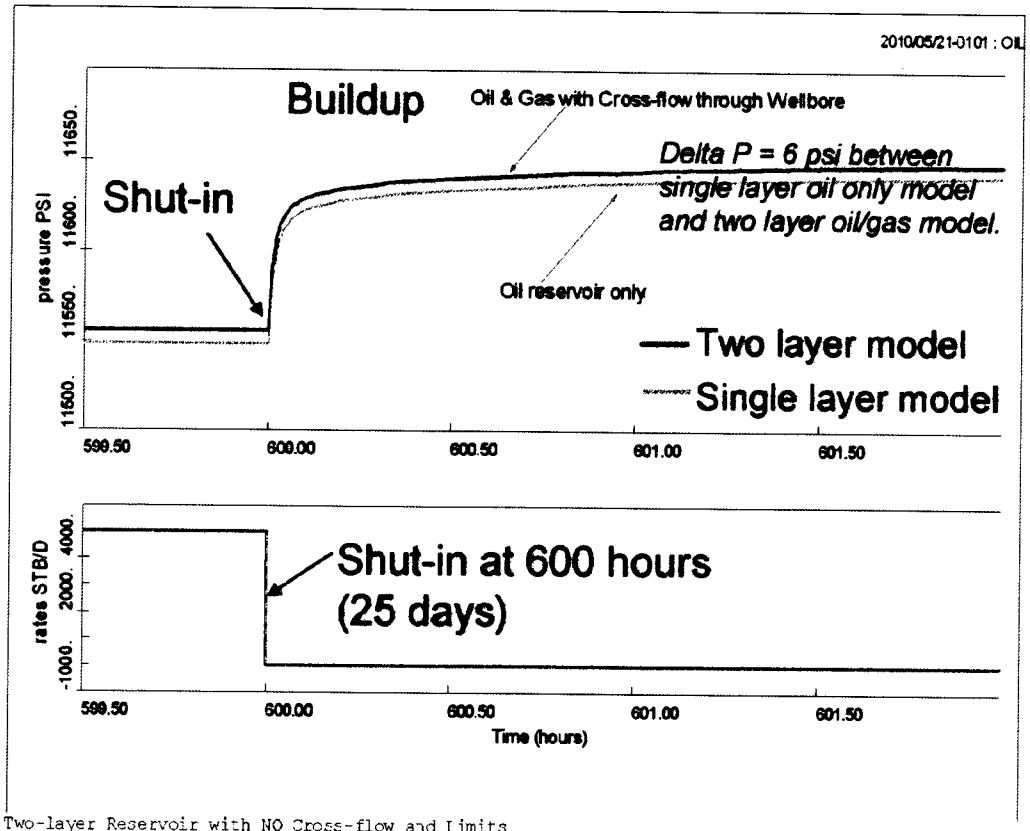
** Simulation Data **

well. storage	= 0.10000			BBLS/PSI
skin	= 0.	50.000		()
permeability	= 300.00 170.00			MD
Areal Ky/Kx	= 1.0000			()
Perm-Thickness	= 26400. 14960.			MD-FEET
x boundary	= 1750.			FEET
-x boundary	= 1.00			FOG-FACTOR
-x boundary	= 1750.			FEET
-x boundary	= 1.00			FOG-FACTOR
y boundary	= 4000.			FEET
-y boundary	= 1.00			FOG-FACTOR
-y boundary	= 4000.			FEET
-y boundary	= 1.00			FOG-FACTOR
Initial Press.	= 11850.0			PSI
Average Press.	= 11651.0			PSI

Static-Data and Constants

Volume-Factor	= 2.770 vol/vol
Thickness	= 88.00 FEET
Viscosity	= 0.1780 CP
Total Compress	= .1917E-04 1/PSI
Rate	= 5000. STB/D
Storivity	= 0.0003543 FEET/PSI
Diffusivity	= 110400. FEET^2/HR
Gauge Depth	= N/A FEET
Perf. Depth	= N/A FEET
Datum Depth	= N/A FEET
Analysis-Data	ID: DATA
PFA Starts:	2010-04-26 01:01:01
PFA Ends :	2010-06-10 21:01:01

Comparison of Single Layer Oil and Two Layer Oil & Gas Reservoir Pressure Build-up Cases



Two-layer Reservoir with NO Cross-flow and Limits

** Simulation Data **

well. storage	= 0.10000 BBLS/PSI
Skin(1)	= 0.
Skin(2)	= 0.
permeability-1	= 72.000 MD
permeability-2	= 300.00 MD
omega	= 0.032967
Layer(P2-P1)	= -178.00 PSI
Perm-Thickness	= 26616. MD-FEET
+x boundary(1)	= 1750. FEET (1.00)
-x boundary(1)	= 1750. FEET (1.00)
+y boundary(1)	= 4000. FEET (1.00)
-y boundary(1)	= 4000. FEET (1.00)
+x boundary(2)	= 1750. FEET (1.00)
-x boundary(2)	= 1750. FEET (1.00)
+y boundary(2)	= 4000. FEET (1.00)
-y boundary(2)	= 4000. FEET (1.00)
Initial Press.	= 12028.0 PSI
Average Press.	= 11666.4 PSI
Pore-Volume	= .5351E+09 FEET^3

Type-Curve Model Static-Data

'Wall' Thick.	= 0. FEET
Layer-1 Thick.	= 3.00 FEET
Layer-2 Thick.	= 88.0 FEET

Static-Data and Constants

Volume-Factor	= 2.770 vol/vol
Thickness	= 91.00 FEET
Viscosity	= 0.1680 CP
Total Compress	= .1917E-04 1/PSI
Rate	= 5000. STB/D
Storivity	= 0.0003664 FEET/PSI
Diffusivity	= 114000. FEET^2/HR
Gauge Depth	= N/A FEET
Perf. Depth	= N/A FEET
Datum Depth	= N/A FEET
Analysis-Data	ID: DATA
PFA Starts:	2010-04-26 01:01:01
PFA Ends	: 2010-05-25 05:01:01

Wellhead Pressure Build-up Cases

Shut-in with 5000 bpd choked back (annulus)

Page { Shallow choke Confidential Deep choke DATE \@ "M/d/yyyy" }

(Source: Ole Rygg, add energy)

Summary of Pressure Depletion Calculations