Kaut MK 832-4519096

⇒ Wirewrap — why no data for wirewrap itself?
⇒ ~~Sand~~ Gravel pack skins — QA/QC. Steve Tinker's input

ESP
⇒ oil well 10.
Gauge broken; estimate a pressure.
⇒ From VLP/IPR Quicklook: Choose data source.
⇒ First: work out pump wear factor so intake P on curve.

FracPack
⇒ In changing R unit from ft to in.
need to do it in all place

Feedback:
Smart well modeling: very high demand
Smart well — once well is in place, select it to VLP only (default VLP/IPR)
Smart well — model cross flow.

713-966-6831 missed call
Changxu Sun, DAP.
Tab "DL": Col "I" for "GOR", "J" for FVF, Viscosity of 255 to 300 column "C".
Pb = 1199 psia, T = 237°F

Ansari M. ~~Aleem~~ Aleem: BP Pakistan, BM Mgr.

Greater Mahogany
20 April 2010 Snorvette SAVA01 no composite rate last 7 days.
20% choke. Q = 120 mmscfd. Pwh = 3493, Pdn = 1019 psi.
SAV-A-02: If is still closed. Pwh = 1399.43 psi (above PMV — which is still closed)

bp1posap045 Amherstia: Amherstia + Cashima
Greater Mahogany: MA (none)
BP1posAP046 MB (MB01, MB03A) only
Sav.
BP1POSAP035 Greater Cassia: CA, CB, KA, MAG
bp1posap040 Also hosts Mango & Greater Cassia

Anna: X 3750

21 April 2010: History Match. Peter Clifford

A-13 watercut Hostein

⇒ Not rel. perm curve – should use the pseudo rel. perm curve (upscaling)

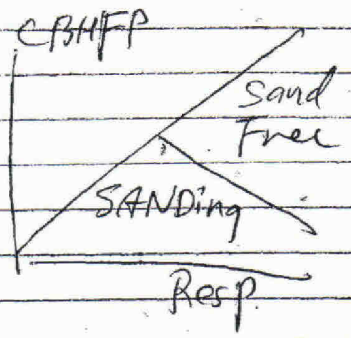
Hans Vaziri: 13.172B. X 3796.

21 April 2010. Hans, Aaron. Chaefer, Tony

Perm: effective perm.

Labde: Sand Free, Sanding zones

CBHFP: critical BHFP.



SS

PVT.

T=156, P=9365 psi.

8620.

CRP=5000

Water cut: Flux, solid transport. Pwh, Twh.

Gas – need an example.

Nakika is the gas

Shah Deniz is gas

⇒ Savonette.

Gas: Viscosity,

Solid transport, Flux. (velocity)

Tony & Aaron to work together

exchange files via ibackup (then delete it)

{Tony to check condensate PVT format
Gas pvt format} ⇒ Aaron

Timing: before June work in Trindad

Trevor's note on

03125

⇒ Walt 0801.

22 Apr 2010 Team Mtg.

Bryan, Simon, Angie, Tony.

Cachshare Vs. Hysys.

We should watch Pet6x health.

potential workshop

NAG workshop — compression, deliq.

Gas management under IAM cap.

ACG: Baku: workshop

Azbaijan

Australia IAM, TDRM

New tech development with Pet6x: { low rate VLP correlation. Bryan: need validation data

Bryan: Jordan has approved BP's plan { $1mm range for date.

Business plan. IAM played a big part to it — Success story

Simon: Andrew

Fiavan.

Pakstan peer review

N. Sea. multilateral.

Debbie ~~Kercho~~ Kevin

6853, ~~0312~~, 0312, 4873, 0801 Walt

Oil-Water

Mbal

SWI - connate water saturation

SWR - Residual Sw (Krw=0).

SWRO - water sat at residual Oil (Sw where Krofirst=0).

SWU-1

Gas-Oil

SGTR. Priority SI List.

Mach

Debbie Kercho: Relief well. X0312

1000 ft open hole. TD

900ft. 100ft neg.

8½" = 0.018

Brill's paper.

Caliper log: to estimate the roughness.

↑ hole diameter.

Q: $\Delta p = f(Q)^2$ multilateral option / older casing

2001 BPTT GAP
F3G40.
15Feb2
17Feb2: Dry gas: $\gamma_g = 0.6736$, Psep 700, CGR=6.6, no match
Reppam:

	Residual sat	End	Exp
Krw	0.226	0.265	2
Krg	0.203	1	2

18aFb2: Psep=500, SepGOR=84602 DewP=3915, T=153.
CGR: Reservoir CGR & Vaporized CGR.
Corey

	Resi.Sat	End pt.	Exp
Krw	0.359	0.265	2
Kro	0.2	1	2
Krg	0.203	1	2

2002. Flam
Darang:
Kapok (Sparrow, Renegade)
for condensate, match to Res. CGR & Vaporized CGR

can-tp65
GOR = ~~655~~ 640. WC = 6.

Work note before Macondo.

2001 BPTT GAP
F3G40
15Feb2
17Feb2: Dry gas: $\gamma_g = 0.6736$, Psep 700, CGR=6.6, no match

RelPerm:

	Residual Sat	End	Exp
Krw	0.226	0.265	2
Krg	0.203	1	2

18a Feb2: Psep=500, SepGOR=84602 DewP=3915, T=153.
CGR: Reservoir CGR & Vaporized CGR.
Corey

	Res. Sat	End pt.	Exp
Krw	0.359	0.265	2
Kro	0.2	1	2
Krg	0.203	1	2

2002 Flam
Parang:
Kapok (Sparrow, Renegade)
for condensate, match to Res. CGR & Vaporized CGR

can-tp65
660.
GOR = ~~653~~ WC = 6.

Centrilift mtg.:
5000 B/D pump (range 500 ~ ~~5000~~ 7500 B/D)
Non-Restrictive area on the ship?
Pump & gas left
about 4000ft.
Need: power info (availability)
PVT.
Friday:

27 April 2010

Start

5000 psi
noticable change in flow
operation experience in
4:30pm meeting daily

MW of N_2 = 28
MW of CH_4 = 16.
Specific gravity of N_2 = 0.9669 = 0.97

P_b = 6650. T = 240, GOR = 3000, Oil FVF = 2.77, μ_o = 0.17 cp

Problem with 9 5/8" X 3 1/2" 50% WC Quicklook
two curves don't overlay
sht1 D3-D26 E3-E26

13.813 OD → 12.687
Rob Coyle (Esp from Centrilift).

2.77

Thakur, Ludolph
⇒ Erosional Velocity

$$C = \frac{v}{\sqrt{\rho}}$$

62 = C

$$v_{max} = 100/\sqrt{\rho_m} \quad (\rho_m - lbm/ft^3)$$

Centrilift mtg:
5000 B/D pump (range 500 ~ ~~5000~~ 7500 B/D)
Non-Restrictive area on the ship?
Pump & gas left
about 4000ft.
Need power info (availability)
PVT
Friday:

~~27 April 2010~~
5000 psi
noticable change in flow
operation experience
4:30pm meeting daily

MW of N_2 = 28
MW of CH_4 = 16,
Specific gravity of N_2 = 0.9669 = 0.97

P_b=6650, T=240, GOR=3000, Oil FVF=2.77, μ_o=.17cp

Problem with 9 5/8" X 3 1/2" 50% WC Quicklook.
two curves don't overlay
slot D3-D26 E3-E26

13.5/13 OD → 12.687
Rob Cayle (Esp from Centrilift)

2.77

Thakur, Ludolph
Erosional Velocity

$C = \frac{V}{\sqrt{\rho}}$ $\boxed{\cdot 2 = C}$

$V_{max} = 100/\sqrt{\rho_m}$ (ρ_m — lbm/ft^3)

Printer in RP Room 306 AB 70 — Elizabeth

Hbpthouis023\houp2674

900 X 3000 = 2700000

6

8.7

48F

Hy.

No

Tubing	2" CT	2 3/8" CT	2 7/8" EUE	2 7/8" CT	3 1/2" EUE
ID	1.688"	2.063"	2.259"	2.563"	2.992

Les Owen

Choke 6"

400md 100ft 90ft 8 5/8"

~~11000~~ 12,000 psi

35° API, GOR = 3000. B_o = 2.77. μ_o = 0.17 cp

P_b = 6650.

5000 ft. ⇒ 2270 psi

100,000 BOPD ⇒ 277,000 BL

300,000M

100,000 / 50 = 2000

PI 55

10000 : 2270

Mike L X 281-366-5685

0.35 X 13,000 = 5000 psi = ΔP_f

2500

7500

2500 psi = ΔP_f

choke ~~0.016~~

⇒ 0.16 in Choke.

BOP partially closed.

μ_o = 0.168 cp, 6650 P_b, 3000, 2.77, 243°F

measured at res. pressure

k = 300 md. (0.85 convert air perm to oil perms)

h = ok

not perfed.

Debbie Kercho 713-471-4221 (C)

Drainage area = 900 acre. could be bigger

Typical: at least 400 acre

1400 ~ 1500 total

⇒ 400, 1800

S = 0, 5, 10.

1500 ↔ 5000 ft.:

	S=0,	5,	1000
With out line:	9470	9367	9267
	9480	9377	9277

Annulus Flow model.
As it is.
Thickness: 38, 47, 62.

⇒ Drill string. where it is?. Geometry check.
⇒ Does it flow in the drill string

P_{wh} = 2270.
K_y = 300, 200, 100
V ⇒ P_r = 11850. MDT sample, measured → confirmed
Temp. measured.
⇒ [Sample transferring. dead oil] Yun Wang
leak point.
⇒ Jim Walton (Group) Exp. Team

[GOR. 3 samples. 2800 → 3000, original. (single stage flash)
Today. would use 2900 → multi stage flash.

K = 354 measured. convert to oil perm.
over balanced.
log derived perm could be lower. (core data - limited core)
not data for all. random core.
Biased toward high side.
R ⇒ From log. Geo mean: 165 md from (air perm)
↳ 0.85 conversion.
⇒ MC216. 6 Darcy perm, but well test 1.3 Darcy.]
(Air perm)
⇒ TH. use 0.65 to convert air perm to oil perm.

⇒ Net pay: from log. (avg in fld is half)
drilled to the thick part of fld
⇒ Drainage. sensitivity based on the map
Lowside 100 acre, stratagraphical

⇒ $8\frac{1}{2}$" bit

⇒ Skin: could be very sweet now!
Formtn behind casing can

⇒ Cement pumped
Les Owens

[⇒ 1000 B/D. news report
Coast guard estimated. images.]

PVT: Rematched
live.
FVF: not confirmed yet no' measured yet, next week maybe.
⇒ Check Yuns EOS BO table.
Xover from $9\frac{7}{8}$ to 7" at (12485 ft MD)

Revised ⇒ Drill string: $5\frac{1}{2}$ work string OD from rig to ~~wke~~ wellhead.
800 ft $3\frac{1}{2}$" drill pipe below the $5\frac{1}{2}$" pipe

⇒ open ended

⇒ 2270 psi ⇒ hydrostatic of seawater

⇒ Riser is still connected
) map of the riser. ($21\frac{3}{4}$") ? 21".

Mike 2270

5½. 24.7#

Case
3½" drill string. Tool size 2 11/16" ID
└ ID = 2.764
5½" drill string: ID = 4.276. Tool size = 3½" ID

① Q = 23,340 B/D with 5½" drill pipe = 5000 ft & 800" 3½"
② With choke 0.5" ⇒ Q_e = 8709.
k = ~~100md~~ ~~200~~ 180md 300md
Q = ~~8580~~ 8388 ~~8638~~ 8624 ~~8709~~ 8695

4989
−1500
3489
100 md 6000 ~ 12,000

$\pi r^2 = 0.5$
$r = \sqrt{\frac{0.5}{3.14}}$
$= 0.399$

Les Owen. 713-870-3547
1" down to zero.
Julian.Austin@bp.com — Sunbury Doing Finite Element
+44 (1932) 739352 state mechanic Model.
⇒ Area of restriction: 0.5 in² ⇒ 0.399 in. R
D = 0.8 in.
(If A = 0.25 in² $a = \frac{\pi}{4}D^2$. $D^2 = \frac{4a}{\pi}$ $D = \sqrt{\frac{4a}{\pi}} = \sqrt{\frac{4 \times 0.25}{3.14}}$
= 0.564 in.

700 drill pipeflow

Restriction	D	0.5 in	0.564 in.	0.8 in
With 3½" Drill pipe.	Q	9045.	11397.5	19,905 B/D

Inside of clapsed riser
Drill pipe 4117ft x 6 5/8" + 3450ft x 5½" + 810ft x 3½"
Riser = 750 + 1500 + 1500 + 700 = 4450
Riser missing 550ft
Drill pipe in riser 5000ft
883ft of 5½" Drill pipe in riser
2567ft of 5½" Drill pipe in well
3½" x 800ft drill pipe in well
5½" Drill pipe ID = 4.78" Wall = 0.72/2" = 0.36"
Assume the drill pipe is completely crashed

No restriction in riser Q = 9653

0.25 chk 20 skin./10ft open
0.5 chk 20 skin/10 ft open

~~29 April 2010~~
Flow in annul ~~Tubing~~ drill pipe
about 2542ft 5½" in hole, & 821ft 3½" in hole
Assume the surface has only riser.
4989 + 2542 = 7531
4989 + 3363 = 8352
9⅝ csg 12360ft 8.605" ID
7 csg 18300ft 5.92" ID

½" choke on riser (seabed): Qe = 8900
½" choke on DP Qe = 8813
Without riser Qe = 8958

Assume.
$a = \frac{\pi}{4} D^2$ $D = \sqrt{\frac{4a}{\pi}} = 19.3$ in. without the wall of 6⅝" DP.

Key learning — With surface line, it is very important to specify first node P as sensitivity var in Sys Cal.

$A = \frac{\pi}{4} D^2$

3½ both 5½" & 3½" in 9⅝" casing.

$A_1 = \frac{\pi}{4}(8.6^2 - 5.5^2 + 4.78^2)$ $D_1 = 8.158"$ $D = \sqrt{\frac{4A}{\pi}}$

$A_2 = \frac{\pi}{4}(8.6^2 - 3.5^2 + 2.602^2)$ $D_2 = 8.275$

for 2.992 = 8.406"

Small csg due to Drill pipes

Case 2

12360 + 821 = 13181

2542 = 9818 ft

8.605) 8.605 ID" + 5½" DP

5.92" ID + 3½" DP

$A_1 = \frac{\pi}{4}(8.605^2 - 5.5^2 + 4.78^2) \Rightarrow D_1 = 8.16"$

$A_2 = \frac{\pi}{4}(5.92^2 - 3.5^2 + 2.602^2) \Rightarrow 8.16" \; D_2 = 5.43"$

⇒ check velocity calculations.

Norm McMullen 832-693-7031 (m)
832-772-1934 (o)
281-304-0548 (h)

model flow out of Annulas.
Assume no flow in casing strings ($9\frac{5}{8}$" x 7").
Pigtte Deynet 281-
S=0, 20, 50, 100

Any production log.

6, 11, 16

2000, 5000, 19000, 20000, 40,000, 80,000
WC: 10, ~~25%~~ ~~50%~~

Table.

WC = 10%

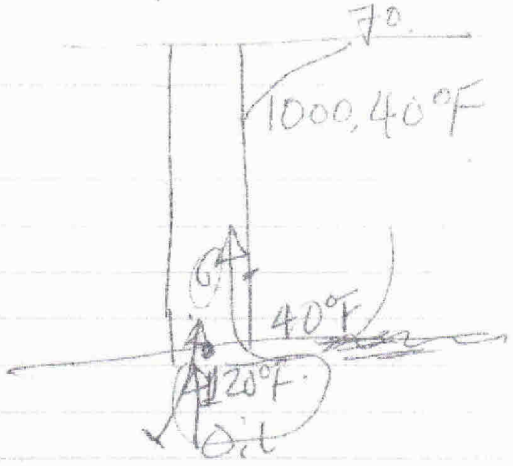
Qo	Pwh	Twh
~~2000~~	~~1418~~ X	86
5000	1427	99
10000	1397	1076
20000	1245	113
40000	532	116
60000	X	X
80000		
~~42~~000	394	116

WC = 25%

Qo	Pwh	Twh
2000	1348	86
5000	1365	100
10000	13405	108
20000	1212	114
40000	607	1166
45000	307	117

WC = 50%

Qo	Pwh	Twh
input ~~80~~ 2000	1189.7	88
5000	1214	101
10000	11995	109
20.000	1108	114
40000	671	117
45000	490	117
50000	205	117



New Table: updated temp with mixing oil & seawater

50% WC. $T_{bottom} = \frac{1}{2}(40+120) = 80°F$

50% WC Q	Pwh	Twh	New Q	Pwh	Twh	GOR 300
50000	~~8179~~ 179	77	String	281	77 ✓	~~337~~ 337
40,000	615	76		714	76	432
20,000	1016	73		1079	73	552
10,000	1094	67		1151	67	587
5000	1096	59		1151	59	589
2000	1056	51		1111	51	570

10% WC. $T_{bottom} = (0.1\times40 + 0.9\times120) = 112°F$, GOR 300

Q	Pwh	Twh	New String Q	Pwh	Twh	
2000	1308	53		1352	53	577 ✓
5000	1363	68		1409	67	597 62 ✓
10000	1356	84		1404	84	602 77 ✓
20000	1220	96		1281	96	582 91 ✓
40000	520	103		662	104	473 101
42000	397	104		558	104	458 101

25% WC: $T_{bottom} = (0.25\times40 + 0.75\times120) = 8+96 = 104°F$ GOR 300

~~45000~~	Pwh	Twh	New String Q	Pwh	Twh	
42000	399	93		631	94	388 92
40000	527	93		709	93	404 92
20000	1199	87		1226	88	514 85
10000	1334	77		1327	78	537 74
5000	1343	64	↓	1329	66	534 61
2000	1295	53	↓	1279	53	512 52

Grace Cooling
Stan Wan

2542 | 4989
831 | 7531
8362

50 mm
Call Terry @ 5:00pm 30 April 10

Prosper
9000 B/D $\Delta p = 8491 - 2479$ psi $\Delta T = 115 - 105 = 10°F$
4000 B/D $\Delta p = 3897 - 2479$ psi $\Delta T = 71°F - 66°F = 5°F$

~~Hysys:~~
Kyle.
Carlos Stewart: ~~29 T.T~~ 6 → 9

6 - 9
8

A2 12
A3 14
A12 6
A7
A4 2.7: ~~2300~~ (2300) Pr = 4700, Tr = 130

Use OHTC
4000 B/D: $\Delta p = 3989 - 248$, ΔT very small

$A = \frac{\pi}{4}(D_2^2 - D_1^2)$

1 May 2010 Richard Simpson called
case 10: all flow through DP only:
$Q_o = 4546$ $Q_g = 13.6$, An

~~Qg~~
Case 11: model annulus flow @ 8362 ft.

$T = \left(\frac{240-40}{18300-4989}\right) \simeq \frac{200}{13300} \Rightarrow$

$T_{at\,8362} = 40 + \frac{200}{13300} \times (3362) = 90.6°F$

$T_{avg} = (40 + 90)/2 = 130/2 = 65°F$

4989
2542
7531
831
8362

2542
+831
3373
4989
8362

Annulus $= \frac{\pi}{4}(14.85^2 - 9.875^2) =$ $D_1 = \sqrt{14.85^2 - 9.875^2}$
$= 11.09$

Annulus $(9\frac{7}{8}" - 5.5") = \frac{\pi}{4}(8.605^2 - 5.5^2)$
Ann @ $9\frac{7}{8}" - 3.5") = \frac{\pi}{4}(8.605^2 - 3.5^2)$

$D_2 = \sqrt{8.605^2 - 5.5^2} = 6.618$
$D_3 = \sqrt{8.605^2 - 3.5^2} = 7.86$

~~27764~~ 27808 bspd
83.4 mm
154F
11295 FBHP
2270 FWHP
No Choke
S = 0
h = 88'

For meeting Tomorrow & Monday
1. Case 1 – 11
2. Choke calculation: each cases

IP 164.63.65.130; 149.179.158.92; 10.199.61.174
Conf. code: 211-117-4375,
Pin: 215-0810
Live.
VBR: Variable Bore Ram: Rm 152 Tim Lockett
+44-1676-522-335-
Fluid: collection practice was OK.
Wang's EOS. only components data
Heat capacity data: random values.
⇒ PVTsim – BP has only one license (in Houston).
Tim –
PVTsim license: 27000 bp1xenap381 license server:
Temp. linear 40 & 248
⇒ Tony to verify reservoir temp
⇒ & Yun update.
⇒ Pipesim – can't unify system – not consistent model – left it
⇒ Use OLGA (Can integrating)

⇒ Q
PI=10. 10K~15K; T=200°F flat. Q max 35K

Lockett

⇒ OLGA Temp cap. Good.
done ⇒ Wellbore dia to Tim (Tony)
⇒ PI = 6, 10 Tim used.
⇒ OHTC=8 is about 4 times as OLGA
Tony ⇒ Equivalent PI. to Tim
Farah Saidi — GoM.

Peter 44-780-11-51-986 (UK) (M)
44-1932-7705-72 (h)
PI=29.67 (S=0).
Oil. Q_o=9191. Q_g=26.6 mm. T_{wh}=115°F
OHTC=8 Condensate Q_o=8854 Q_g=25.6 T_{wh}=132°F
OHTC=4 Condensate Q_o=9121, Q_g=26.5 T_{wh}=173°F
OHTC=2 Condensate Q_o=9456. Q_g=27.4 T_{wh}=203°F.

Farah MKD U=2.
TH U=1.2) Most Assets = 1~2. TH is the only one with low !

Behind casing ⇒ Annular and tubing Flow-42610 with half in restriction — behind casing

Pupstream choke — Case 10 (or B1) — ... — Drill String (Why it's different) — 2 May update.

Case B.3 ✓ Done

Node 15 : error casing ID 6.09852 is less than ~~casing~~ tubing OD (6.92)

✓ B2 — S=5q, h=30
⇒ B3 — check.
✓ A2 — Back of long string → up back side of DP → into DP

Not

A4, 50 S/cm

1/4 FWHP Upst of Choke

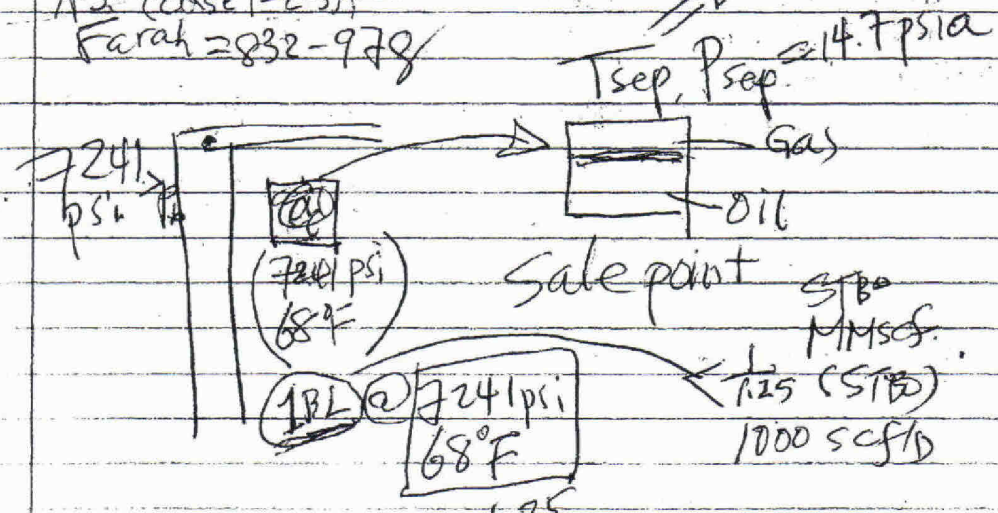
1/2 " " "

⇒ Chris Zamora (Yegor's TL).
Pvs Rate Qs.

A1 Chokes Qo S=50, h=18, Qo = 1914 (not 1194).

A2. pipesim not worked.

A3. (case 1-2-3)
Farah = 832-978



GOR = 1000 scf/STBO

1336 STBOD X 2832 = 3.87 mmscf/D

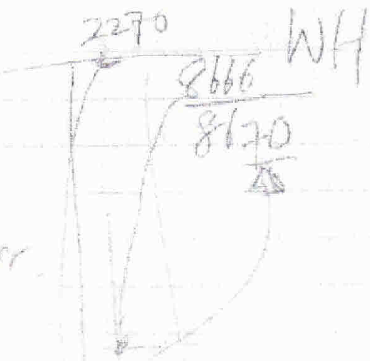
27808 BP ? Farah = 32,680 BPD ?

832-244-1336
Trevor 832-563-9801
Doug Wood

Rich Stoisits — Exxon

3 May 2010
Case management
A1 – no choke
A1 – half-in-chk.
A1 – qtr-in-chk.
A2 – can't be easily modeled – prosper
A3 – similar to A2
A4 – to be confirmed with Mike
Skin range 10 ~ 25

B1 (GOR changed to zero from 3000)



4 May 2010 Meeting with Richard Stoisits of Exxon
Rock type: Sand stone } moderately consolidated Rock, planned for frac pack. have some sand issue.
60312 Debbie
Kelly

what ΔP would clapse the 7" pipe (casing)
phil. S=10. (Frank Walter), S20, Dave Rich 25 [well not cleaned]
→ Hold off on T.
→ Sen on K.
→ Rich: Don't know flow. well test, use OLGAS 2P
→ PVT.
→ partial penetration. other range
→ Flow path in both. casing string & behind — the absolute worst

→ BP have done what EXN would
the approach was thorough,
the correlation selections were reasonable
— The good match between BO model & pipesim model Farah did gave him good assurance
If they ~~have~~ don't have well test data,
They would use OLGAS 2P
PE2 is very well widely used too.
→ OHTC of 8 too high would use 2 if they don't know any thing else

(For GAP to display results with mouse in place
(1) View → Label Only → Solver Results Rates)

4 May 2010
New cases.

Cases	A1	A1(1/2" chk)	A1(1/4" chk)	A2	A2(1/2" chk)	A2(1/4" chk)	A4	A4(1/2" chk)	A4(1/4" chk)
S=10,25	✓	✓	✓				✓	✓	✓
OHTC 2,8	✓	✓	✓				✓	✓	✓
File saved	✓	✓	✓				✓	✓	✓

cases	B1	B1(1/2" chk)	B1(1/4" chk)	B2	B2(1/2" chk)	B2(1/4" chk)	B3()	B3(1/2" chk)	B3(1/4" chk)
S=10,25	✓	✓	✓	✓	✓	✓	✓	✓	✓
OHTC=2,8	✓	✓	✓	✓	✓	✓	✓	✓	✓
File saved	✓	✓	✓	✓	✓	✓	✓	✓	✓

PI Data for Farah
Based A1B3.out model (
GOR=2900: Base model. AOF = 334846.0, equivalent PI = 49.59 for S=0

For S=10, AOF = ~~441063.9~~ 202,240.7
If PI = 22.75 (S=0), AOF = 202,353.2 (STB/D)

For S=50. AOF = ~~82858 (STB/D)~~ 63881.3
If PI = 7.18 S=0 AOF = 63864 STB/D

~~For S=20, AOF = 132064.7 (STB/D)~~

For S=25. AOF = 112334.8 (STB/D)
PI = 12.68 → AOF = 112287

87.687 mm

Situation no choke ~~Case A2 in red~~
Case A2: S=0, h=88 Q0=26939 (41083, 37284) Qg=80.8, T=154.6°F → 160.16F [BHFP=11307psi]
0.5" chk (BHFP=11664) Q0=9328, Qg=27.98, T=96 (102.3) Pchk up=8042.7 Δp=5772.5psi
0.25" chk (BHFP=11800) Q0=2495 (2448) Qg=7.5 (7.4), T=74 (73), Pchk up=8756 (8773) Δp=6486

PipeSim (without flow behind Drill pipe & long string
Q0 = 32680, 5035307 with 1/2" chk (T=128)
(T=202) 1366 with 1/4" chk (T=108)

✓ Situation A2: S=50, h=10
BHFP=4957psi no choke Q0=5511.6 Qg=16.5mm Twh=74.7F.
BHFP=6666. 0.5 inch choke Q0=4277. Qg=12.8mm Twh=64.5°F P choke up=3824.4psi
BHFP=9439 0.25" choke Q0=1989.4 Qg=5.97mm Twh=63.3 P choke up=6490.4psi

LMRP above Wellhead = 52.6 ft ~~5586~~ ~~4989.0~~ 4989.0 − 52.6 = 4936.4

Situation A3. Flow in the annulus between DP & Riser. ($5\frac{1}{2}$"OD) (19.5"ID)

Assumed: $T_{avg} = \frac{1}{2}(40+70) = 55°F$

Situation A2, S=50, h=10 (equivalent PI=5.7, AOF=7307)

✓ Situation A3 (S=50, h=10)

BHP = ~~11919~~ 4740psi no choke Q_L=5644.5 Q_g=16.91MM. T_{wh}=85.98F.

BHFP = ~~11658~~ 6618 0.5" choke Q_o=4316.6 Q_g=12.95mm T_{wh}=68.9F. P_{up}^{choke}=3871.psi.

BHFP = ~~11800~~ (9437.96) 0.25" choke Q_o=1990. Q_g=5.97. T_{wh}=62.06F. P_{up}^{choke}=6493psi

✓ Situation A3 (S=0, h=88)

BHFP=11919. no choke Q_o=4669.7 Q_g=140.0mm. T_{wh}=203.1F

✓ BHFP=11658 0.5" choke Q_o=9630. Q_g=28.89 mm, T_{wh}=128.6F, P_{up}^{choke}=8467.7psi

✓ BHFP=11800 0.25" choke Q_o=2499.7 Q_g=7.499mm, $Temp_{WH}$=75.78°F P_{up}^{choke}=8784.psi

A1

	S=10, h=88			S=25 h=10		
	No chk	½" chk	¼" chk	No chk	½" chk	¼" chk
Qo	47444	9016	2363.	9322	5704	2090
Qg	137.6	26.1	6.85	27.	16.5	6.9
Twh	216.6	148.	76	150	121	71.7
ΔPf	507.	184	14	216	77	11.
ΔPg	2408	2920	2976	2433	2888	2938
BHFP Tupchk	9763	11453	11746	4944	7849	10324
Pupchk	X	8243	8610	X	4892	7296

Simon's model	¼" chk
Qo 9297	2516
Qg 274	7.5
Twh 181	109
BHFP 11515	11821
Pchk Pup 8142	8945
½" chke	

Simon modeled it with default IPR & OHTC = 2. Rates compared only wells T+ as expected.

A2 & A3 modeled using GAP & Prosper

Prosper Models
A2 and A3 S=0 H=88 well modeled
A2 and A3 S=10 H=88 well modeled
A2 and A3 S=25 H=10 well modeled
A2 and A3 S=50 H=10 well modeled

nochoke

A2

S=10. h=88. | S=25 H=10

Simon		No chk	½" chk	¼" chk	No chk	½" chk	¼" chk
2711	Qo	13926	7241	2327 24830	9086	5939	2192
81.	Qg	41.8	21.7	7.0 7.5	27.3	17.8	6.6
215	Twh	114	80.5	70 74	94.8	71.3	67.
	ΔPf						
	ΔPg						
10872	BHFP	10727	11451	10459 11742			
	Pupchk	6516	7836	7446 8300	5430	7729	10329
		X	5836 7857.	(7446)	X	4722	7340

A3

	S=10 h=88			S=25 H=10		
	No chk	½" chk	¼" chk	No chk	½" chk	¼" chk
Qo	43358	9462	2487	9729.5	6049	2194
Qg	130.0	28.4	7.5	29.2	18.1	6.58
Twh	201.0	122.	74	121	85.3	66.6
ΔPf						
ΔPg						
BHFP	9964	11438	11742	4869	7654	10327
Pupchk	X	3251	8717.	X	4825	7348

Qo

A4 (S=10, h=88)

	no chk	½" chk	¼" chk
Qo	47051	9014	2363
Qg	136.4	26.1	6.9
Twh	2164	1484	76.
ΔPf	1120.	186	14.
ΔPg	5009	2920	2976
BHFP	9781.	11454	11746.
Pwfchk	X	8182	8613

A4 (S=25, h=10)

No chk	½" chk	¼" chk
9317	5703.	2090.
27.	16.5	6.1
150	121	72.
~~50278~~ 219.2	78	11.
24343	2807	2937
4949	7849	10384
X	4894	7297.

B1 (S=10, h=88)

	no chk	½" chk	¼" chk
Qo	32475	8843	2358
Qg	94.2	25.6	6.8
Twh	196	131	73
ΔPf	5274.	367	29
ΔPg	2751	2940	2990
BHFP	10422	11461	11746
Pwfchk	X	7999	8579

B1 (S=25, h=10)

No chk	½" chk	¼" chk
8832	5670	2085
25.6	16.4	6.0
131	108	70.
473	157.	23.
2628	2821	2953
5407	7872	10388
X	4810	7271

B2 (S=10, h=88)

	no chk	½" chk	¼" chk
Qo	78874	9110	23685
Qg	228.7	26.4	6.9
Twh	215.	115	61.
ΔPf	35~~40~~ (3540)	46	4
ΔPg	2513	2944	2994
BHFP	8381	~~11449~~	11746.
Pwfchk	X	8284	8604

B2 (S=25, h=10)

No chk	½" chk	¼" chk
9399	5803	2093
27.3	16.8	6.1
117	91	59.
65.6	20	3
2528	2822	2955
4870	7779	10382
X	4813.	7282

B3 (S=10, h=88)

	no chk	½" chk	¼" chk
Qo	68083	9055.	2359.
Qg	197.4	26.3	6.84
Twh	218.6	138.	80.
ΔPf	3774	67.	6.
ΔPg	2698	2940	2990
BHFP	8556	11452	11746
Pwfchk	X	8273	8603

B3 (S=25, h=10)

no chk	½" chk	¼" chk
9381	5735	2086
27.2	16.6	6.05
140.	114.	77
94	28	4
2516	2820	2952
4888	7827	10387
X	4873	7290

A1	P	Q	A4	P	Q
No Hk	2270	5488		2270	5488
0.5"	3877	4123		3877	4123
0.25"	6527	1914		6527	1914

Note on situation A2 and A3

① S=0 h=88, ② S=50 h=10 ③ S=10 h=88; ④ S=25 h=10

For each case above, there are Three cases

Ⓐ: No choke Ⓑ ½" choke, Ⓒ ¼" choke

All together, there are 4×3 cases.

each case has a GAP archive file "GAR".

These files are:

A2 S=0 H=88 Qtr-inch-choke.GAR — not seen

→ produced water; highly unlikely.

→ Test hydrate formation in riser.

→ Evidence of way?

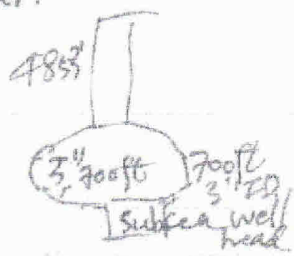
Need Worst B case.

B2

8May10 Revised A1.
no choke. 4 wells
A1 with riser 4853', 5.625" ID & 2 X 3" 700 ft below the riser.

$T = \frac{1}{2}(70+40) = \frac{1}{2}(110) = 55°F$

Avg overall heat transfer coefficient
Water to water. 60~70 = 65
→ Steam to water (mild steel) 185
→ Steam to water (stainless steel) 120
Use U = 120 for steam to water in stainless steel)



P_{wh} = 500, Q_o = 44423, Q_g = 133 T_{wh} = 755 °F, T
T at inlet of riser = 185.5°F, P = 2734

(1) U 120

P_{wh}	Q_o	Q_g	T_{wh}	P^{in}_{riser}	T^{in}_{riser}	ΔP_{riser}	ΔT_{riser}	P^{3in}_{in}	T^{3in}_{in}	ΔP_{3in}	ΔT_{3in}
500	44423	133	755	2734	185.5	2234 psi	110°F	3891	232.4	1162	47.9

Model. Situation A1 Riser 05 88ft OHTC_pipe water 120. gar

(2) Model Situation A1 Riser 105 88ft OHTC_pipe water 120 gar
(S=10) IPR - changed. VLP
1200 500 ~~40218~~ ~~24.4mm~~ 71.0 2557 p 181°F ΔP_{riser} 2058 ΔT_{riser} 109.7 (P^{3in}_{in} = 3501) T^{3in}_{in} = 233 ΔP_{3in} 892 ΔT_{3in} 52 F

✓ (3) Situation A1 Riser 25 S 10ft OHTC-pipe water 120 gar
500 (14827.8) 44.5mm 1353.27 P_{riser} 1381 T^{in}_{riser} 116.5; ΔP_{riser} 882 ΔT_{riser} (P^{3in}_{in} 1804) T^{3in}_{in} 234.1 ΔP_{3in} 173 ΔT_{3in}

(4) Situation - A1 Riser 50 S 10ft OHTC - 120 GAR
~~500 (4088) 114.1mm T_{wh}=55 P^{in}_{riser} 1147.8 T_{riser} 51. ΔP_{riser} 674, ΔT_{riser} 3.7 (P^{3in}_{in}) T^{3in}_{in} ΔP ΔT~~ P^{3in}_{inlet} = 1265

(5) S=0 h=88, choke=0.5"
Q_{oil} = 10182, T_{wh} = 55.01 °F $P^{3"}_{inlet}$ = 1305 psi

(6) S=10. h=88 Choke=0.25 $P^{3"}_{inlet}$ = 1292 psi
Q_{oil} = 9873, T_{wh} = 55.01

✓ (7) S=25, h=10. Choke=0.5"
Q_{oil} = 8869 T_{wh} = 55 $P^{3"}_{inlet}$ = 1240 psi

✓ 8. S=50, h=10, Choke=0.5"
Q_o = 5013. T_{wh} = 55, $P^{3"}$ = 1203

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BP-HZN-2179MDL07584219
BPD661-001692

TREX 011146.0027

\\bp1houis022\Houp5013 | WL4 4th floor

S=0, h=88

Pwh	~~100~~ 250	500	1000		1500				
Pinlet	3731	3788	3898	4148	4479	4785	5094	5405	
Qo	~~22557~~ 45115	~~22488~~ 44876	~~22211~~ 44423	~~21639~~ 43279	~~20955~~ 41910	✓ 40689	39005	~~[illegible]~~ 36804	

S=10, h=88

Pwh	100	250	500	750	1000	1500		
Pinlet	3192	3263	3381	3623	3749	4011	✓ 4725	5058
Qo	41357	41081	40616	39635	38922	36975	33453	31409

S=25 h=88

Pwh	100	250	500	750	1000	1500		
Pinlet	2639	2718	2849	3011	3234	3570 ✓	3976	4355, 4764
Qo	35401	35082	34470	33991	32747	31238	29403	27676, 25850

S=50 h=88

Pwh	100	250	500	750	1100	1500	✓	
Pinlet	2038	2122	2282	2467	2663	3139	3608	4089, 4494
Qo	28252	27931	27386	26749	26113	24636	22951	21485, 19922

9 May 2010

options, pump junk shot →
4 options

Remove LMRP
5 choke & kill

Top option: make — well shut in pressure at wellhead

Xin (shut in mudline pressure)

23 samples, methane — will it materially change fluid composition — thus change shut in P.

3 points

only Pb for lower lobe.

For all three bottom lobes → GOR & API for all the depths (slight variations in GOR & API)

→ 3 ft. Peter Carragher: P is higher k=10 md. 17704 TVDss, 12023 psi

70% methane from top section

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BP-HZN-2179MDL07584220

BPD661-001693

TREX 011146.0028

Wang Yun

~~tube~~
top: 17967 TVDss 11824psi (Smaller tube)
~~~6000 mm in place~~ (in place or recoverable)
→ 1st 2 days 50,000 B/D, then 5000 ~~for~~ then on (for 1m)

2 days 10600 (from 11800).
→ Recover to 11600 psi, then
decline to 11100 (by 500psi)
by month end
When the well is closed
P → 11300
(build up within 5 hrs) ± 70,000

LHRP
PA = 3800 psi
BHP
VBR
VBR
Gauge ± 400
Test

S = 0
S = 25 BHFP = 7800+
S = 50 BHFP = 4000+
during 50kB/D BHFP =

at 50,000 B/D

S=0 11200 = BHFP
25 = 11100
50 = 10600

Buildup a few hours - done.
Assume Q_o = 25,000 B/D
BHFP → 10158 psi
Build up - within 1st hours

Shut in wellhead FP
8900 (With dead oil) — from pipesim model (oLga)
8600 oLGA
with live data.
Range (8580 ~ 8900)
with the best est stand 8580 psi based on live oil properties calculated at res. pressure
10160 ← 11850 if Q_o = 25,000 B/D for 1 month
For pure gas 10040 psi

Cross flow. if ΔP is only 200 psi, not a big deal
if ΔP = 1000 psi, be careful about cross flow
~~~

Wang Yun - check reservoir pressures.
→ Can we get pressure data over time or continuously?

$\frac{11850-9900}{8} = \frac{1850}{8} \simeq 250psi$ 11850 / 9900 / 1850

TO 3" line ≈ 7,176,
17989

18091

10 May 2010
Pencore
→ FVF = 2.367
Casing ram
one DBR closed
good chance no DP in
Nothing in the kink (no DP) no

(1) → only AL now focus.
10-20% chance of A2.
Most choke in BOP.
to answer
How to prod. oil to Enterprise?

(2) → 0 psi, 300, 800,
→ 4000 at BOP
(3) → peer review: peter clifford, Richard Heddle, Tor
→ who can tell oil mix seawater? Lawrence Cowie

→ Final report
→ Time line of data

| S = 50 | 3850 psi

Effect of FVF: 2.367 vs 2.77
With FVF = 2.77 as it is now in model
S=0, h=88. A1 – Q_o = 53286.1 STB/D
With FVF = 2.367 a matched to PVT model
S=0, H=88, A1 – Q_o = 53963.5 STB/D
Conclusion not much effect, leave 2.77 alone for the time being.

→ For A1, S=50
h = f(Q) Q_o = 1500, 5000, 10,000, 15,000) at P_{wh} = 3850
Work with layer 3 Top MD 18030 Top TVD 18020
Top MD 18030 TVD 18020
Bot MD = 18101, TVD = 18091
(1) h = 71 Q_o = 21470
(2) Bot MD = 18050 TVD 18040. Q_o = 9082.3 B/D (h = 20 ft)
(3) h = 10 ft. Bot MD = 18040. Bot TVD = 18030 (calculated) (h = 10 ft)
Q_o = 6054.5 B/D.
(4) h = 15 ft Bot MD = 18045 Bot TVD = 18035 ft
~~Q_o~~ Q_o = 7587. STB/D
(5) h = 30 ft. BOT MD = 18060. BOT TVD = 18050
Q_o = 11932 B/D
(6) h = 50 ft (out of 71 ft).
Bot MD = 18080. Bot TVD = 18070
Q_o = 17014 B/D
(7) h = 40 ft. BOT MD = 18070, BOT TVD = 18060
Q_o = 14577 B/D.
(8) h = 5 ft BOT MD = 18035, BOT TVD = 18025
Q_o = 4470 B/D (mostly slug flow)
(9) h = 1 ft Q_o = 3157 B/D

For: Peer Review
Simulate the annulus damaged restriction.
What restriction would result in Q = 5000 B/D.

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BP-HZN-2179MDL07584223
BPD661-001696

TREX 011146.0031

Perm: 300~170. Net Pay 88 – 44

AD noDP

S	h	k	Q
0	88	300	51760 ✓
10	88	300	47281
25	88	300	41015
0	88	170	48768 ✓
10	88	170	41364
25	88	170	32883
0	44	300	47917
10	44	300	39693 ✓
25	44	300	30978
0	44	170	42477
10	44	170	31433
25	44	170	21404

AZ

Pwh=2270

S	H	R	Q		Pwh=3400
0	88	300	27229 ✓	24039 ✓	24907
10	88	300	25941 ✓	22754 ✓	23623
25	88	300	24143 ✓	21042 ✓	21895
0	88	170	26389	23193	
10	88	170	24245	21137	
25	88	170	21457	18329	
0	44	300	26134	22942	
10	44	300	23751	20674	
25	44	300	20766	17561	
0	44	170	24560 ✓	21433 ✓	22288
10	44	170	20923 ✓	17728 ✓	18593
25	44	170	16586 ✓	13573 ✓	14573

Pwh=3800 124 ways new eng.

Tor's Kragos Review
→ Model restriction in Riser

11 May 2010 A1/A2 case
k=170, h=10, S=25
A1 — done yesterday

A2 k=170, h=10, S=25 Vary h

h(ft)	2	10	20
Q_o (2270psia)	1058	5459	10062
Q_o (3800psia)	821	4257	7950

Friction loss 176
102

$$\frac{176-102}{5459-4257} = 102 + \frac{176-102}{5459-4257} \times (5000-4257)$$

= 148 psi ≈ 150 psi friction loss

12 May 2010

A2 k=170, h(~~variable~~) = 44, S=0, 10, 25,

S	h	k	Q_o (P_{wh}=2250)	Q_o (P_{wh}=3400)
0	44	170		
10	44	170		
25	44	170		

~~Q_o=16586 @ P_{wh}=2270~~
Q_o For S=10, h=88, k=300. without choke Q=25941 BPD
with choke 1.25" Q=21607 BPD
with choke 1.29" Q_o=21866 BPD
P_{chk}=1143 psi.

3700.

George King 303-408-1760

3574
4075 →

3892
3785 → 1450.

2500 3776 → 3871
3000 4254

Simon

5000 B/D.	$P_{DP} = 3700 \Rightarrow P_a = 3852$	$P_{DP} = 3680 \Rightarrow P_a = 3850$
10,000 B/D	$P_{DP} = 3275 \Rightarrow P_a = 3847$	$P_{DP} = 3240 \Rightarrow P_a = 3852$
15000 B/D	$P_{DP} = 2575 \Rightarrow P_a = 3848$	$P_{DP} = 2475 \Rightarrow P_A = 3958$
20,000 B/D	$P_{DP} = 1450 \Rightarrow P_a = 3857$	$P_{DP} = 1200$ psi $\Rightarrow P_a = 3852$

Commercial steel 150×10^{-6} ft $\Rightarrow 1800 \times 10^{-6}$ in
$= 0.0018$ in.

Cem Sarica 1-918-671-9498 (m)
6 Jan 2004 Mike [illegible] 918-631-5154 (O).

125 Min 125×10^{-6}
0.000125
$500 \times 10^{-6} = \underline{0.0005}$ in.

Kurt Mix 832-451-9096

60
48.

Crowthor David

13 May 2010
~~Insurance~~ National Lib Research Group
3 top
→ Flow path & flow rates.
one of the annulus was closed (12 May 10 5pm).
Most/acoustic reading shear sealing rams.
→ Junk plug Monday.

Catherine Hyde Barber
$1 ft^3 = 0.178107607$ Barrels (US, Oil)
$V = \pi r^2 h$ $(h=1)$.
$r^2 = \frac{V}{\pi h}$
$r = \sqrt{\frac{V}{\pi h}}$ $D = 2r = 2\sqrt{\frac{V}{\pi h}} = 2.992$ in.

Impact of Drill pipe ID:
~~Steve~~ Morey ~~281~~ 281-440-1435(c)
281-366-3151(o)
$3\frac{1}{2}$" 2.992
$5\frac{1}{2}$" 4.778
For 5000 B/D $6\frac{5}{8}$" 5.625
800 DP (ID=2.602) P_{wh}=2700. P^{DP}_{end}=3599 (ΔP=899 psi, ΔT=5.7 °F)
800 DP (ID=2.992) P_{wh}=2700. P^{DP}_{end}=3535 (ΔP=835 psi, ΔT=5.8 °F)
] difference of 64 psi
For ~~20~~ 12000 B/D: P_{wh}=2700, P^{DP}_{end}=4200. (ΔP=1500) [ID=2.602]
ID=2.992": P_{wh}=2700, P^{DP}_{end}=3855. ΔP=1150 psi.
] difference of 350 psi

Need: free
Pressure absolute or gauge.

No drill pipe above LMRP
Blind shear - Clo
~~Casing~~ Shear - Open
VBR - open
VBR - clo
VBR - cl.
Test RAM

Steve Morey BP Drilling
Nikolay

update A2 model with $\varepsilon = 0.0018$" & DP = 2.992" for 831 ft Drill pipe.

$Q_0 = 5000$ → 3500 → 3676
4000 4173

$$\frac{\pi}{4} D_1^2 \times 26 + \frac{\pi}{4} D_2^2 \times 4$$

$$= \frac{\pi}{4} D^2 (30)$$

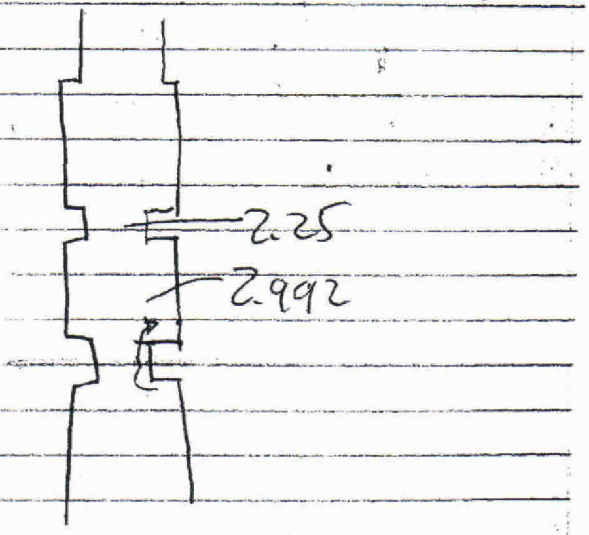
$$D_1^2 \times 26 + D_2^2 \times 4 = 30 D^2$$

$$D = \sqrt{\frac{26 \times D_1^2 + 4 \times D_2^2}{30}}$$

$$= \sqrt{\frac{26 \times 2.992^2 + 4 \times 2.25^2}{30}}$$

$$= 2.893$$

831
111 ft 2.25"
720 ft 2.992



$\Sigma = 0.0018$

(1) $Q_o = 5000$. $P_{wh} = 3675$, $P_a = 3852$. ($P_{end}^{DP} = 4573$, $\Delta P_{DP} = 923$ psi) (800' ID = 2.602)

If 831 = 111 ft X 2.25" + 720 X 2.992"

Lin2 : 831 — 8362 — 2.602 — 0.0018

Change to 2. 111 — 7642 — 2.25 — 0.0018

3. 720 — 8362 — 2.992 — 0.0018

Then $Q_o = 5000$. $P_{wh} = 3675$, $P_a = 3800$ psi

$Q_o = 5000$ $P_{wh} = 3725$. $P_a = 3850$ psi ($\Delta P_{DP} = 870$ psi)

$Q_o = 8000$ $P_{wh} = 3542$. $P_a = 3850$.

$Q_o = 10000$ $P_{wh} = 3375$, $P_a = 3852$

$Q_o = 12000$ $P_{wh} = 3115$ $P_a = 3848$

$Q_o = 15150$, $P_{wh} = 2670$ $P_a = 3851$.

Conclusion: Calculation we did yesterday was good.

The use of 2.602" ID for the 831 ft drill pipe is OK.

With 4'X2.25" coupling ID + 26' X 2.992" ID, the results are compatible with those of using 2.602" X 831'.

In addition, the new calculation was

Compare with 831 ft X 2.602" ID.

$Q_o = 5000$. $P_{wh} = 3750$, $P_a = 3853$.

$Q_o = 8000$ $P_{wh} = 3590$ $P_a = 3848$

$Q_o = 10000$ $P_{wh} = 3460$. $P = 3853$

$Q_o = 12000$ $P_{wh} = 3290$ $P_{wh} = 3851$

$Q_o = 17250$. $P_{wh} = 2670$. $P_{wh} = 3851$

3954
3818
136

3750
- 3675
75

8000. 3524
+ 75
3600

3375
75
3450

3115
75
3190

3954 18000
3818 17000

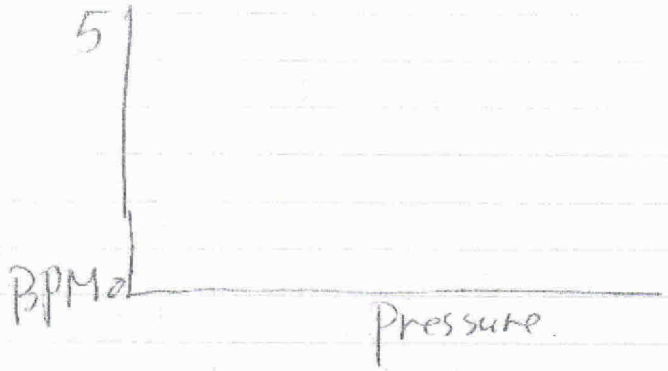
Injection

WL4. 0294

14 May 2010

Injection matrix

Qo	S	h	k	OLGA Buildup (mins)
5000	25	10	170	20
16500	25	40	170	—
25000	10	44	170	2
52000	0	88	300	—



S=25 h=10 k=170.

Pinj	9333	9467	9600	9733	9867	10000
Qinj	683	863	1043	1220	1396	1571
T2	687	863	1039	1215	1390	1565

Qo=1000 Sim

S=25 h=40 k=170

Pinj	8933	9067	9200	9333	9467	9600	9733	9867	100
Qinj	635	1426	2139	2813	3467	4108	4735	5346	595
T2	658	1395	2104	2789	3461	4106	4747	5372	597

→ Time for Pr. Buildup at normal WHSIP
— Ultimate SI pres. taking into account of oil & gas

					OLGA AOF
4	S=0, h=88, k=300.	AOF=44354.	PI=50.14	49463
1	S=25, h=10, k=170.	AOF=7233.	PI=0.815	6336
2	S=25. h=40 k=170	AOF=28933.	PI=3.27	22444
3	S=10 h=44 k=170	AOF=57677.	PI=6.5.	33339

Ted Bergoyne

11850
11650

Gas only SIWHP = 9741 psi for $\gamma_g = 0.78$
Oil SIWHP = 8852 psi
→ SIWHP = 10169 psi for $\gamma_g = 0.58$

9901 | 12038
SIWHP = 10339.5 $\gamma_g = 0.58$ for P_r = ~~12088~~
Simon 10332.1 psi → 10341

Depth ⇒ 17713 ft.

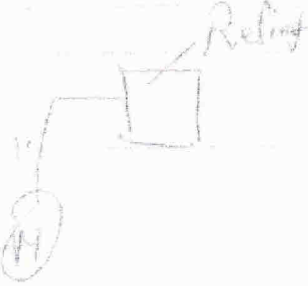
HORNBLOCK Y MASON 89

~~BERGOYNE~~ 80-82 Ted Bourgoyne

Friday 14 May 2010

[P_{wh} = 3850, Q_o = 5000) ⇒ P_{bhf} = 6697 psi] which model this was generated?

X 2900'
h = 20' + 8'
PV 1892e6 ft³
PV 4759.2e6 ft³) φ 30%



Tank sizes 47, 148
117 370
Injection rate 50,000 25,000 10,000 into 4.0 BCF tank.

Static Shut In wellhead pressure
(Using A1 model = 8820 psig = 8835 psia)

⇒ 8500 ± 8660
Simons calculation on 13 May 2010
Using correlation of Vazquez-Beggs ⇒ PSIWH [illegible]
density @ 10,000 psi ρ_o = 35.56 lb/ft³ = 0.5696 g/cc
ρ_o = 0.503 g/cc - [illegible]

Tony Liao use Lasater correlation (match better to available PVT data)
PWHSI = 8830 psia

-28+112 (?) Oil in place = 188 mm. Pr = 11850, Sw = 15%, Ct = 6 usips.
Cw = 4.5 usips. Corey exp 8 and for water / 2.0 0.6, 1.0 0.8 for oil, 1.5 0.4 for gas

15 May 2010: differential pressure off the mudline downstream of the junk. It is ~500 psi.
exactly where is it? Differential between what points?
pressure at bop 700 psi lower than it was measured on 8th.
possibilities: ① depletion — reservoir pressure decreased.
② reduced flow area or obstructed flowpath – sand/junk piled up downhole (in the annulus – resulting lower rates, & lower pressure at BOP
③ combination of ① & ②

cases: 5000 B/d → Pr = 11809 on 15 May 2010 ΔP = 11850 - 11809 = 41 psi
50000 B/d → Pr = 11441 on 15 May 2010 ΔP = 11850 - 11441 = 409 psi
93,000 B/d → Pr = 11123 on 15 May 2010
ΔP = 11850 - 11123 = 727 psi

→ 86,600 B/d Pr = 11141.6 = 11150 psi on 15 May 2010
ΔP = 11850 - 11150 = 700 psi
Also for 60000 B/d P = 11360, ΔP = 11850 - 11360 = 490 psi

Mbopd
Macondo 1
Expected Reservoir Depletion (Mbal Model)
X – Date
Y – Reservoir pres. Depletion (psi)

BOP BT raw data 2010.05.14 C.xls — excel plot
14May 2010 BOP Press", sheet2!$D$1:$D$8210, sheet1
(D1:D8210) (L1:L8210)
BT: B32091 MT: M32091
=TEXT(CB1+C1, "dd mm yy hh:mm:ss")
E&M (1:32091)

√ Category X axis
√ Auto
√ Value (Y) axis
Original 2010.05.08D.xls plot C vs K

Original (14May2010 BOP pressure)
C Format: Time 13:30:55
D Same format

Matt's format: 14 05 10 23:11:36) The same
Tony's format 08 05 10 02:12:24)

Matt: Line
Base sheet: 8May onto BOP pressure

13 May 10 Kurt MSK 832-451-9096

8May2010 data 2:24am → 7:03pm ⇒ 17 hours worth of data
14May2010 data 22:10 → 3:35 ⇒ 4 Hours worth of data

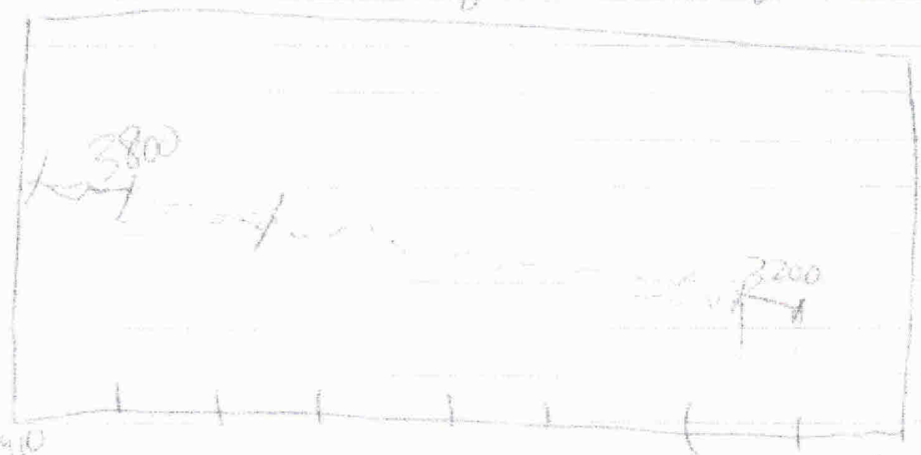
8May2010 00:00:00 start =
16May2010 00:00:00 End =

1/1/2008 = 39448. 8May2010 = 40305 days start at 4am
End + 7 days End at 40313 days

⇒ Yegor's packet to Chris

~~bouquet~~ bouquet

P



8May10 — 16May10

Mty — 868-623-2862 x 5476

17May10 — Chris Drysdale

1. MKD — SIAM — request to help Amber (before we move from ARE to Support)
2. Mad Dog — Similar coaching on SIAM (Brian, Sam)
3. ~~Mad Dog health check~~
3. Trinidad Dave was there last week met with Pete Jackson (~~Kim Hoose~~ Petroni — similar to Kim) — Mad Dog II (remote from Hou) ~~Det~~ health check, ~~Tony~~ help them ~~Hosein~~ Jose & Amit may go to POS; Tony may not need to go there
4. SIAM RPS support release
5. Issue with TH — revision (Amit will contact) mud well (June 15) — Amit has it under control
6. Atlantis well ddd — deferring

[John Stegink / Cathy Chafee 281-366-2086] Judy Jones TLiao323391 liao@stax

Computer Virus Hunting: Ticket #: 1639898

2009 contact: LaTanya Williams 713-356-5213
bpustaxteam@us.pwc.com
Fax 813-375-4086

IBM helpdesk (for BP people portal) 1-877-581-4922
IRAS problems (BP #) 1-800-660-3949
(May need to update IE to IE8) IE7 is OK
⇒ Adobe Reader 8 should update to 9 (9.2 or above)
⇒ popup blocker (disable it)

Myservicecenter.bpglobal.com
port: 80
iaccess.bp.com
164 0061 — Cloud
Cost Center number ~~1400-9500~~ 100063698 (Cecil)

Cost center 1000541888 (Tony)
@bp.com 907-351-8067 (m)
11:14C Jairo Corredor Karam Burn, Tony Liao Alaska
Point Thompson expect high rates
Simulator can get any rates
Check what rate we can realistic produce
Check with Arnold against system
Condensate 62~65 B/mm H&B Has PVT
Vertical 13000 TVD
PVT prop (use the same PVT) has EOS (not tuned yet) ...
Single well basis. erosion, sanding
Check with VIP simulation (using H&B)
Pans wells (reinjection of dry gas)
7" ID for injection, 11,000 ft
OH 9 1/4", Tubing ID = 5.82" 7" OD 13000 TVD
⇒ 30~40mm to whatever max
⇒ 10 TCF 1/3 or 1/4 of gas in Prudhoe
~~Week~~ Before next Thursday
Pr = 10,000 psi, K = (300~2D) (Karam: VIP avg) h = 500 (?)
ϕ = 0.2 (Top Stim ...?)
CGR = ~~400~~ 40 ~ 70 B/mmscf
Pdew = 10,000 psi, Tres = 130°F

713-683-7882

⇒ Time Line of data
Check National lab's BHP number.

How to calculate a rate / What is assumed for reservoir?

Kurt
(Cal1) Case 1 / (Cal2) Case 2

Case 1: Given FWHP, cal oil rate
Case 2: Given Oil rate, Cal FWHP
3100 psi/7495 bpd   3100psi/17,905 Bpd   3100psi/3680 bpd   3100 psi/37,505 bpd
5000 bpd/3637 psi   5000bpd/3605psi   5000bpd/3700psi   5000bpd/3908psi.

Tony
Q_o = 5000, P_{wh} = 3850 ⇒ P_{wfbh} = 6697 psi (19 May 2010) (AI model = 6744.82)
Q_o = 1000 P_{wh} = 3850 ⇒ P_{wfbh} = 6734 psi. ✓ (AI model ok)

6744.8
6697.0
47.8
48 psi too small

Ron
For Q = 5000bpd, cases 1, 2, 4 yield (
FBHP (assumed FWHP)
6560 psi (3800psi)
5740 psi (3100 psi)
) same answer
Case 3 yielded
6150 psi (3800psi).
xxx psi (3100psi)

) This team also calculated ΔP X DP
5000 BPD   @ 3800psi FWHP   @ 3100 psi FWHP
Case 1&3   4070 psi   3320 psi   @ DP inlet
3370 psi   2700 psi   @ Top of BOP stack
Vs. measured Value   2670   2770 psi.

CONFIDENTIAL

BP-HZN-2179MDL07584236
BPD661-001709

TREX 011146.0044

18 May 2010

check Kurt's calculation

Call this Calc 1 for calculation 1

~~Case 1~~ Calc 1: 3100 psi / B_o = 7495 bpd (Tony's A2 model, not checked.) | 3100 psi / 17,905 B/D (Tony A1 model S=25, h=44, k=170, Q_o = 18629.9 B/D) | 3100 psi / 38 bopd (Tony B1 model S=25, h=44, k=170, Q_o = 17874 bpd) | 3100 psi / 37,605 B/D (Tony's B2 model S=10 h=44, k=170 Q_o = 38769 B/D)

Without knowing what the assumptions for reservoirs, it is hard to see what situation was modeled?

Call this Calc 2 Calculation 2

Calc 2 Case 2: Given oil rate, calculate FWHP. — need to do trial & error.

Case 1 (use Tony's A2 model) — not checked

Case 2 (use Tony's A1 model): 5000 B/D & 3605 psi don't relate to each other.

Case 3 (use Tony's B1 model): 5000 B/D & 3706 psi don't relate to each other either.

Conclusion: for this second group calculations, we need to know this assumptions on reservoir. Otherwise,

Ron's calculations: checked better.

Tony's model check Q_o = 5000 B/D

Model	A1 (for Case 2)		B1 for Case 3		B2 for Case 4	
~~FBHP~~ FWHP	3800	3100	3800	3100	3800	3100
FBHP	6696	5954	6775	6074	6670	5965
ΔP	(59+2837)	(59+2775)	(135+2842)	(138+2893)	(154+2854)	(184+2842)
Pat DP model	~~4477~~ not calculated		4669	3950	4556	3841 (not relevant)
→ Ron's FBHP	6560	5740	6150	N/A	6560	5740

~~Conclusion~~ Observation:

Ron's calculations for FBHP and Tony's agree pretty well.

i) Annulus flow and long string (without drill pipe)

more discrepancy with Drill pipe

update PVT data
Pb=6406. GOR=2920 FVF=2.564. Mu=0.12

8 May 3800 — 7000
14 3100 — 50
18 3050

Neon gas oil at 17468' → 11782 psi
SIWHP=10132405

Changed TD depth of 17713 to 17892'
& switched gas to oil (Pr=12038) → SIWHP=9181 psi

Steve CarMichael 281-610-4500
Debbie Kercho (m) 713-471-4221

19 May 2010
Geophysics model update.
4pm. mid day check in.
SIWHP update
Anything >10,000 big concern
for 8600~9xxx?
If there is a brine sand, in the shallow horizon.
Time to reach static — still need to know
Assume original fluid properties
GOR bouncing all over the place. Consider average
3050 last data point, reading min volt. but have trouble
to convert to pressure at the moment
MD RKB as the base
75 ft.
New lab work This weekend — not to worry about it now.
Which sand has the potential to sustain flow?

Cecil, McAughan

Major change 19May2010

(1) rel. description

(2) PVT update

8000	25	15
8500	50	55
9000	25	15
9500		10
10000		5

20,000

1000,000/20,000

= 50

multilayer model: Pwh = 227 psi → Qo = 278 B/D

GOR = 200000 scf/STBO

→ GOR = 1000000/200000 = 5 STB/MSCF = Try to trick Prosper to simulate gas in oil model

Layer production looks fine

Try GOR = 25,000 in 2 top layers

4989 8891 ft T = 111.3 °F

3902'

8891

For oil Model Pwh ≥ 4206 psig Broach will continue

For gas, Pwh ≥ 4652 psig Broach will continue

Model avoiding broach at 3902' below mudline.

Macondo\19May2010-New_Res_PVT_Case

\1.1 Avoiding Broach

5000, 20000 B/D

700 psep 5.375" riser

17467 ft $\bar{T} = \frac{1}{2}(78+40) = 55°F$

Tsep 55°F Q = 5000 B/D, Pwh = 1247 psi, Δp over 1000 ft flowing $\Delta p_f = 0.6$, $\Delta p_g = 87$, T_{wh} =

Tsep 58°F Q_L = 20000 B/D, Pwh = 1821 psi, Δp over 1000 ft: $\Delta p_f = 8$, $\Delta p_g = 92$, T_{wh} = 222

Decrease = 60, Tsep = 77°F, Pwh = 1878 psi, T_{wh} = 222

Steve Wilson
Mgo 281-366-5105 IT
20 Hours with GOR 200,000 for top 2 layers for gas.
SIWHP = 9446 OK
Qo for Rsh = 3050,

Assume other
Pf = 43 psi, ΔP_f = 166. psi for 20,000 BPD over 1000 ft
below mud line
for 5000 BPD case ΔP_f = 0.3 psi, ΔP_f = 168 psi

⇒ Aquifer may not well connected.
⇒ only oil sand, SIWHP = 8575 psi, very close to 8312 we had before.

7500	8000	8500	9000	9500	10000	10500	1850
100%	100%	~~85%~~	30	20	10	5	0

⇒ Hot water injection. 880 GPM @ 120°F surface pressure

~~20 Hours~~ Mtg with Nat and Labs
3 pressure pressure, bhp & Q
bhp 12 psia @ 18300 ft.
Bill
10, 20, 30
h = 44, k = 170
D 0 10 20 30 40 50
Q 33509 23418 17417 13611 11176 9435

28th May 2010

Top cement 17300 ft.

Objective: estimate what increases (changes) there will be for different options to stop the leak

24th May 2010

With Pwh=3700 A case Annulus flow no drilling

30,000 { k=300 { h=44, S=17 (29,933 B/D) ✓
h=88, S=43 (29,773 B/D) ✓
k=170 { h=44, S=7 (28869) ✓
h=88, S=20 (30145) ✓

For Pwh=8000 psi, the combinations above would result.

k=300 { h=44, S=17 ⇒ Qo=6733 B/D
h=88, S=43 ⇒ Qo=6674 B/D

k=170 { h=44, S=7 ⇒ Qo=6347 B/D
h=88, S=20 ⇒ Qo=6812 B/D

For Pwh=8500 psi, Qo ≅ 3000 B/D for the cases above

For Pwh=9000 psi, Qo=0!

Pwh=8750, Qo=659 B/D ~ 700 B/D

Pwh=8850 psi, Sure kill, Qo=0!

Pwh=8800 psi, Sure kill too.

Al-Marhoun for Pb, Rs & Bo, Begg for Oil Vis

Kurt
mtg

26
~~27~~ May, 10
Simons plots
Annulus with DP.
2270. →
Within DP: $\Delta p = 1842$ ($\Rightarrow \Delta P_f = 1096 + \Delta P_g = 737$ psi

P = 4258 at the annulus (behind casing) at 8362 ft.
From Prosper, $Q_o = 42147$ for $P_{wh} = 4258$ at 8362 ft.
Why is GAP giving ~~15,000~~ Bbl

2270 C,D → G,H
2600
2670
3000
4000
5000
6000
7000

Based on the model with $\varepsilon = 0.0018$.

C,D → G,H
C,D → L,M

$\varepsilon = 0.0018$ (from 0.0006)

	$G_g = 1.5$ (low) ΔP_f	6000 ΔP_f	16.5 PPG ΔP_f	14.2 PPG ΔP_f
28800	1823	1827	2406	2080
57600	7199	7176	can't go down	8170
86400	9447	9093		
100806				

5000
6000

70 Bbl/min.
20 Bbl/min.
40
60
70

2

Mud report

16.5 PPG X 0.052 = 0.858 psi/ft
→ Sp. Gr = 1.98 = 2.

Water 8.33 ppg.
Typical mud 16.4 or 14.2 PPG.
16.4/8.33 = Sp Gr = 1.96
14.2/8.33 = Sp. Gr = 1.7.

Q	28800 Bbl	57600 Bbl	86400 Bbl
ΔP_f	2406 psi	can't go	
Q	28800 Bbl	57600	
ΔP_f	2080	8170 psi	can't go

27 May 2010.

Casing flow with drill pipe

Pmud line = 2270	2600	2670	3000	4000	5000	6000	7000	— L
Pbop ≅ 4164	4379.8	4425	4453	5411	6162	6986	7863	
Pbop 3699	3906	3949	4169	4902	5637	6443	7304	— N

Pmudline / Pbop

water flood: MP, jointly with Laurance
Lynda Hutchin (maybe?)
PTL planned in July
Agb: Angie, Saul management for Mbal model — big area
old Mbal model
Freedom —
GAPS in Macondo — capability GAP,
weakness/strengths of different tools, Approaches
Game change technology: North American Gas
NAG, —
Challenger come in September/October.
⇒ Trevor's email to Simon.

Rupture Disk locations:
Pmr
9560'
8304'
6047'

3500psi, 4800psi at BOP. 15,000BPD Before pumping drilling mud
Pump beside drill pipe
Gene Robert

Pressure 100psi above breach pressure
Leakout into sand is small (drilling fluid — mud cake)
Rich Miller
Burst 6000 ~ 7000 psi
.433" 20 of them: Burst Disk
→ Net pressure. 50psi, breach would occur (for mud)
→ Net pressure. 100psi breach would occur for oil)

PetEx
44-131-474-7030
T.
ρ, ρ_w, μ.

Model mud: Specify it as oil, 100% water in PVT, specify table. ρ, ρ_w, μ_w.

P_{wh}=2670, P_{bot}
6 ~~29~~ X ~~6~~ X 0.44" ID
5100~5900 psi, 150°F
$6 \times \frac{\pi}{4} D^2 = \frac{\pi}{4} d^2$ $d^2 = 6 \times D^2 = (6 \times 0.44^2)$
d=1.0778 in.

Oil
gas
mud (16# PPG). & 14.2 PPG.

PVT 2920. 243°F, P_b=6500~ B_o=2.56 RB. at P_i=11850
8362 ft = 104°F
GOR
Use Lasater (others) & Bergman-Sutton (μ_o)

Everything is updated for A2 case, S=20, h=30', k=300.

For annulus flow case (A1):
If drilling mud is 14.2PPG, P_{inj}=5000psi, T_{inj}=50°F.
For Q=14400 B/D. D 6047 8304 9560
P 5790 7484 8272 psi
→ P_f loss is minimum.
P_{wh} 2670 P_{BOP}=4800 psi, Q_L=2048 BL.
P_{wh}=5025 for Q_L=2048 BL.

A2 — test drill pipe (coupling). — Do not use it
Original drill pipe ID ($4\frac{1}{2}$" = 2.602").

A1: S=30, h=32, Pwh=480? Qg=15000

: Pmud Casing flow with Drill Pipe

Pmudline	2270	2600	2620	3000	4000	5000	6000	7000
Pbot drillpipe	4993	5158	5196	5365	5906	6536	7204	7960
PBOP	4458 4506	4666	4703	4867	5393	6009	6663	7406

→ steps: (1) System cal Qg with Pmudline — syst cal.
(2) For each rate, calculate pressure at end of drill pipe (5362ft) — Gradient
(3) Change Fluid to Gas, then calculate PBOP
↳ specify Qg=a1mm. GGR=0, WGR=0, Pbot Drillpipe (ex. 4993psi)
calculate → Pat Tree (4959ft) → (ex 4506psi)
This is the BOP pressure
(4) Switch fluids back to Oil
(5) Save model.

28May31 Test if 3½" Drill pipe is not there.
UK- Upper kill
LK- Lower kill

✓ Annular- no DP
✓ Csg- no DP
End of DP (5.½") 7531'

Casing Flow w\ DP

Pmudline	2270	2600	2670	3000	4000	5000	6000	7000
P bottom Drillpipe	2945	3281	3351	3671	4641	5613	6573	7565
PBOP	2644	2963	3030	3336	4276	5226	6169	7147

Annular Flow w\ Drill Pipe Twh (@ 7531) 88.2°F)

P

Casing with DP
P: D6-13
Q E6-13. Pbob=F6-13

Claremont { Harvey Mudd, Scripps, Pomona, Pitzer

BOP pressure drop.
choke sizes.
44-7879-486-974
2600~2900 psi

6"
16# 5.5"
17# 5.45"
18# 5.424
20# 5.352
23# 5.240
26# 5.162

12345

June 6 10
Put the 3½" drill pipe back into the models ... all the models are upto date, with good PVT, Geothermal information.

9362 ft.
With k=3 and, h=32ft, S=25
Q=17338 B/D under Pwh=2600 psi
At this time, PbotP = 4316 psi
This matches reasonably well with the measurement taken prekill. (Pwh = 2560 psi), & Pbop = 4400 psi.

Casing flow w/ DP → 2nd pipe segment.
8.275" Tubing ID

Ann - no DP.
Csg-DP: Pwh 2270 2600 2676 3000 4000 5000 6000 7000
$P_{bot\ DP}$ 5429 5553 5582 5740 6201 6766 7360 8044
Pbop 4929 5049 5078 5232 5687 6234 6816 7488

Csg flowing DP.

Steve Wilson
X65842
713-859-7172 13.114B

Thomas Selbekk (47) 916-32-267 (Norway #)

12345

6" 16# 5.5"; 17# 5.45", 18# 5.424, 20# 5.352
23# 5.240, 26# 5.162

Claremont { Harvey Mudd, Scripps, Pomona, Pitzer

BOP pressure drop.
choke sizes.
44-7879-486-974
2600 ~ 2900 psi

1 June 2010

Put the 3½" drill pipe back into the models so that all the models are upto date, with good PVT, Geothermal information.

3362 ft.

With k=300md, h=32ft, S=25
Q = 17338 Bbl under Pwh = 2600 psi.
At this time Pbsp = 4316 psi
This matches reasonably well with the measurement taken prekill. (Pwh = 2560 psi) & Pbsp = 4400 psi.

Casing flow w/o DP — 2nd pipe segment, 8.275" Tubing I.D.

Ann - no DP.

→ Csg - DP:

Pwh	2270	2600	2670	3000	4000	5000	6000	7000
$P_{bot\ DP}$	5429.5525		5582	5740	6201	6766	7360	8044
Pbsp	4929	5045	5078	5232	5687	6234	6816	7488

Csg flow no DP.

Steve Wilson
X65842
713-859-7872 13 114B

Thomas Selbekk (47) 916-32-267 (Norway #)

12345

6" 16# 5.5", 17# 5.45", 18# 5.424, 20# 5.352
23# 5.240, 26# 5.162

X11440 = 73440 B/D

BJ rate = 51.5 BPM, BJ pressure = 10,000 psi above bleed

HES rate = 27.5 BPM

X11440 = 40032 B/D

3 June 10

Tech report

List of all tech work. ← Report to ...

Mike, Bob & Adam — Hydrate

Tony's work on ...

Chris on SIWHP

→ Shelia Hughes / PWS

9 June 2010

1. 6PU2, 67122 Isak

Prosper to GAP

2. pressure constraints on sep only, not other nodes

no rate control anywhere else.

Latest news

8 June 12 hrs on June 8. 7,850 Barrels of oil were collected & 15.2 mmscf gas flared

7 June 2010. 14,800 Barrels oil collected. 30.6 mmscf flared

Assume → Rate for 8 June = twice as much as

$Q_o = 2 \times 7{,}850 = 15{,}700$ B/D

$Q_g = 2 \times 15.2 = 30.4$ mmscf/D → $GOR = \frac{30{,}400{,}000}{15{,}700} = 1936.3$ SCF/STBO

For 7 June 2010 data $GOR = \frac{30.6 \text{ mm}}{14{,}800} = 2067$ SCF/STBO

(1) separator path

(2) Miller fluids

(3) Gas being easy to escape to plume → more mobile

Roughness

node 15 Casig ID 6.09852 6.93 18300

17168'
Steve W. ~~X5807~~ 69842
~~203-482-4299~~ 713-859-7172
⇒ 14.85" ~~14.8394~~ 14.8394

123731
⇒ 6.09852"
IPR = 4.9375

10 June 2010: Revise Enthalpy Model
8 June 2010. 15,000 Bbl 29.4mmscf.
9 June 2010 1st 12 hrs 7920 BO 15.7mmscf flared.
→ last segment: make the hole diameter bigger than 9.875"
Actually, the hole size is actually 12¼"
⇒ PetroX on Enthalpy Balance
widely used — to calculate V. ⇒
⇒ 4.41766 from V value match.
Q = 23622, T = 219.5

Prosper solves the general energy equation by considering the enthalpy balance across an incremental length of pipe. It solves the energy equation simultaneously for both temp & pressure. The OLGA takes into account forced convection inside the pipe and free convection outside the pipe plus radiation and conduction.

2000 GOR + 300 +

36126-53 Wellstream (comps)] Pencore
-53 MSF

Compare fluid data (model)

Black oil model vs. EOS parameter

23608. EOS — 23608.0

BO — 23563.5 — 23563.5 — 17,000

Δ = 44.5 — 7000

3 June

EB model Q_o = 22208.2 B/D (with BO data) $T_{mudline}$ = 218.57°F

Q_o = 22279.0 With EOS T = 219.76°F

13 May EOS

14 May — PVT table 240 (

3 June —

BO { Annular Flow without Drill Pipes Q_o = 23563.5 T = 202.57°F

U=8 { Al-Marhun Q_o = 25847.7 T = 205.99°F

			Matching
U=4.5 Lasater	Q_o = 23,622.2 B/D,	T = 219.53°F.	1.03/1/1
Al-Marhoun	Q_o = 25914.9	T = 221.77°F	0.85/1.6/1
Glaso	Q_o = 24955.3	T = 220.84°F	0.88/1.58/0.99
Standing	Q_o = 23455.9	T = 219.38°F	0.82/1.7/0.99
Vazquez-Beggs	Q_o = 25,368.9	T = 221.25°F	0.76/2.13/1
Petrosky	Q_o = 25,948.9	T = 221.76°F	0.85/1.63/1.
EOS	Q_o = 23,679.9	T = 219.34°F	

11 June 2010.

10 June 10. 12 hrs — 7,630 BO 15.3 mmscf.

9 June 10. 15,800 BOPD + 31 mmscf/D.

EB model add 66ft. 21" riser with 19.25" ID

(didn't get a place to change OHTC) — How to handle this?

Q_o = 22225 B/D (compared to 22279 B/D)

$T_{mudline}$ = 219.76, $T_{top\ of\ BOP}$ = 196.17°F. 219 − 196 = 23.

Casing conductivity BTU/hr ft °F.

Overall heat transfer coefficient.

@ T = 81°F at Enterprise, P = 1050 psi.

If BOP Bank assumed Outside Diameter = 50 in.
T = 214.7°F
BOP bank weight 750,000 lb. 18 3/4" bore

$V = \pi(R^2 - r^2)h$ $\rho = 7850 kg/m^3$
$W = V\rho$ $1m = 39.37 in.$

$V = \pi(R^2 - r^2)h$

$\frac{V}{\pi h}(R^2 - r^2)$ $R^2 = \frac{V}{\pi h} + r^2$

$= 39.77"$.

$R = 40"$ $T = 212°F$.
$\Rightarrow D" = 2 \times 40" = 80"$ Equivalent Out Diameter of BOP

Used R=40" should use D=80"

Q	222257	30699	40,590
Tmudline	219.76	231.3	246.
Tbop	212.4	225.55	241.3.

For D=80": 215.4 227.9 243.2

~~40~~ 80 120 160 200 240

14 June 2010 on 13 $Q_o = 13,200$ (15,200). $D_g = 33.4$ m.
Chris' report: On 6 June 2010: Reported GOR = 1912.
$P_{wh} = 1200$ psi. $T_{wh} = 94°F$. ⇒ Rough estimate GOR = 568 for 92°F temp
⇒ Total GOR = 1912 + 568 = 2480.
(Calculate table PVT. 40~240, 6 step. P = 500~1850, 20 step)

Drill pipe: 6.625" OD, 5.375" ID, 500ft
Marine Riser, 21.00" OD, 19.375" ID, 500ft long with 300ft insulated. Insulation 18.75 in. $K = 0.765 W/mK$.
Zander Bruce
Richard Lynch

Add drill pipe to the entire system.
Q_o = 22246.6 B/D, Q_g =
$P_{mudline}$ = 2615 psig at 5067 ft. T = 219.67°F
$P_{top\ of\ BOP}$ = 2597 psig, T = 215.55°F at 5001 ft.
At surface: T = 61°F, P = 1050 psig (Specified)

If pipe diameter is changed.
OD = 12.25" ID = 11".
Q_o = 24196.7 B/D, not much change (use Beggs & Brill for top pipe).
Use PEA for top pipe: Q = 24854 B/D, not much a diferae.
⇒ The difference is small with a larger pipe.
ΔP's over suction pipe. ΔP_g = 3422 − 2620 = 802 psi.
ΔP_f = 2462 − 1798 = 664 psi.
P_{wf} = 7008 psi. (total ΔP_f = 2466 psi, ΔP_g = 3419 psi).

6⅝" pipe (ID = 5.375")
Q_o = 22505.3 B/D

For 12¼" pipe, (ID = 11"); $P_{mudline}$ = 1741 psi, T = 216.38°F
Q_o = 24843. ΔP_f = 2381, ΔP_g = 2922, not a very big change.
over the suction pipe
ΔP_f = 2373.9 − 2340 = 34 psi.
ΔP_g = 2925.9 / 22760 = 650 psi.
P_{wf} = 6547 psi. (difference of 7008 − 6547 = 561 psi.

2381
2922
5303
1850
6547

PI ≅ 18.62 B/D/psi.
19 × 561 = 10,000 B/D.
Why only 2000+ B/D shows up? Skin = 25?

R = 0.41146.

Start from mudline, assume P_{wf} = 2600, Q_o = 22279.
Absolute max (h = 88, S = 0), Q = 41600 B/D. with P_{wh} = 2600
if P_{wh} = 2270, Q_o = 42773 B/D, not a big change!

Ipconfig cmd http://planetbp.bpweb.bp.com

gpupdate /force — refreshing policy

~~50,000~~ by the middle of July.

After Q4000 rig, bp hopes to put in place additional handling capacity of 40,000 to 50,000 bbl by the end of June, with either the Helix Producer or the Toisa Pisces vessels. BP currently is using the drill ship Discoverer Enterprise to handle the oil at ~15,000 BBL

New BOP data:
current BOP pressure at 4100 psi.
What does 4100 psi means?
Program files 11.2GB
Programs — 11.4mb, nothing
Doc = 102GB
LPRA = 57.7GB
Yacheng = 10GB
CBM-Resolve 6GB
Explorer view
Atl BP World Comparison.dll

1700448

Ticket for PDF writer

BP Side Bar
Ticket # 1674006, HT 1677299
www.bppassport.com — IT 1681670 = Infi.
I-68

15 June 2010: 14 June 10 1st 12 hrs. Oil = 7620 B, 16.4mm.
13 June 10: 15,200 BOPD. 33.4mmscf.
Working in Houma June — Sept. Time not able to go

Add on still not working.
ATL
Manage Add-ons in IE
To enable add-ons from Adobe
IE — Tools → Programs — Manage Add-ons

Metin Gokdemir

Reference depth: 5067 mudline
+ 2542
7609 ft
+ 83.1
8440 ft

"Situation A2 - 15 June 210 with 6 and 5-8th Drill Pipe to Ship. gap"
→ It didn't work.

May 10 model

750~1200
Enterprise [600~1300]

Model is very sensitive to skin (or any change in well) — it could become unstable.
for example, S=26.4 model is stable.
S=25 model stable, but S=26.5 unstable
S=27 unstable
S=10 model is stable (Pbop too high)
S=20 model is not stable

When riser become 11" ID, model became unstable. — why?

16 June 2010
For 1st 12hrs on 15 June, 5,610 BO collected.

Mudline 4989
4853
136 ft. — where did this depth come from? 4989 − 66 (BOP) = 4923 above mudline

Update timeline:
— turbulent w/R
→ need to fill in GAPS in May

17 May 2010.
Bob Merrill
Frank 01932-760-620
John Bauldaugh — end of year.
New Director of PE by end of year too.
Challenger in ~~new year~~ next half year.
16 June 2010. 14,750 BOPD collected > Total 18,600 B/D.
3,850 BO flared.
18,600
40 mmscf flared: GOR = 2150.5 scf/STBO.
With 81°F & 1050 psi top side. GOR =

21 June 2010
1. verified flow calculation for Casing ~~flow~~ with Drill-Pipe Flow
(a) mean previous models — all correct
(b) For Casing & Drill-Pipe case, adding EOS & detailed Geothermal
very similar results as before.
[1-888-343-9862] Stay well advisor.
Need some help for nutrition.
Hewitt Page — Stay well.
1 min = 3 miles. Route 66
Dental: 1-888-638-3279
20 June 2010. collected & burned 23,290 B/D
(14,570 collected & 8720 B burned)
五律

For 1000 B/D FWHP = 3850 psi. FBHP = 6734 psig

20 June 2010

National Labs Discussion

Phil Nelson, USGS

Charles Mankin

Heat Mass transfer, Gas, Porous media

Revisit: SI pressure, burst disk pressure – Next week

20 yrs with BP Alaska. Mech. process engineer. design facility

P-R EOS, now with Sandia,

Nuclear Safety depart.

Need → Where are we going (from Kate)

Geo/Petrophysicist, Scale, hydrogeologic,

Scoping what to do when ship leaves. Subsurface/Geologic info

Tie with Engineering aspect

PVT: ~~no~~ low contamination, good samples.

Not seen gas from lower formation

Sandia:

BP #: Q1000: FBHP = 6734 (Pwh = 3850)] For case 2

Q5000 FBHP = 6697

Los Alamos: calculated rates for each case.

→ We did not provide rates.

Sandia: For case 2: For 5000 BLD. BHP = 6560 psi

(in Sandia's document).

PBH ≈ ~~6900~~ 5746 psi in Tri-lab report.

In Tri-lab report: LANL Case 2 PBH ≈ 6900.

LLNL: no data.

→ equivalent PI

New containment. Goal. 50k BOPD

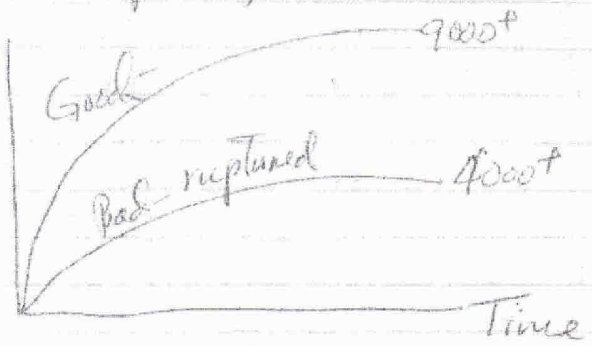
Will the fracture disc open?

3 sets of burst discs:

8304' for 16" 5647' for 16".] are we put these rupture disk at risk?

9567' for 16".

Two objectives
(1) SI protocol: valving enj. process/procedure ——— impact of burst discs.
(2) Pressure responses.



SI procedure:
Assume Q 4850 diff I have 9000 BOPD integrity,
Quick to manipulate Subsea chokes,
→ choke down slowly.

BOP ⇒ 4450 psi now ——— 1800psi drop across the rams.
⇒ ~~Wrap down~~ Ramp down procedure for 30K, 40K, 50K (30% step)
⇒ Back pressure upstream of choke. 2250.

Sbrg 8" long. 30K 40K 50K.

For 30K. ΔP across 3" choke = 2345 − 2270 = 72psi. Pressure GAP = 72psi.

40K ΔP across 3" choke = 2405 − 2270 = 135psi. ΔP GAP = 126psi

50K ΔP across 3" choke = 2482 − 2270 = 221psi. ΔP GAP = 207psi

Note: use BO from EOS, SIWHP = 8171psi. lower than 8500 psi for oil
SIWHP = 9668.8psi for gas

23 June 2010:
Last 12 hrs of 22 June, 84 70bbl were collected, 5,180 BO flared with 27.2 mmscf gas
estimate: Rate collected 16,940 BOPD on 22 June collected
Flared: 10360 BOPD flared
27,000 BOPD collected & flared.
Gas = 27.2 mmX2 = 54.2 mm scf/d on 22 June ole
GOR = 2007.4 ~~BOPD~~ BO.

For annulus for h=88, S=0, Pwh=2270. ⇒ Q=42,776 BBD.
Twh=247.77°F.
Available Fluid T:
- Average Surrounding T.
- Casing Inside T.
- Avg annulus T.

Using E&S and higher rate of pipe weight OHTC avg OHTC = 4.39 ⇒ about the same as before (4.5) for annulus flow.

Pressure drop across the 3" choke on the Vent line.
assume 5' upstream & 5' downstream of the choke.

Q_o (BD)	Pvent	Pupstream	ΔP_{total}	ΔP_{choke}
30,000	2270	2380	110	69
40000	2270	2469	201	124
50000	2270	2576	294	195

Free standing Riser #1: HP (20-25 mbopd)
Current Riser to DE (Discoverer Enterprise) 15-18 mbopd
@4000: 5~10 mbopd
max = 25+18+10 = 53 mbopd. (40~53)

Mid of July 60~80 mbopd
281-493-1857: Laura Lopez
Surf. Q_o = 6006, P=408. | 7084. @3843. (4915 / 4084)
Well. Q_o = 5838. | 6179 3843

Mike's model (Leveled)
2 months 9800psi @ sandface (assume 60k for 2 months)
8500 psi for S=10
2nd layer: 4685.0 psi @ 8900ft. ΔP from wellbore to reservoir ~5000psi

Aquifer: 7x res. size.

C:\Temp 1124 1127 grpcomp
2111 2932

23 June 10
GOR = 2938
API = 34.9
γ_g =
B_o = 2.538

acrstb90.exe

24 June 2010
GOR = 2600.2 API = 37.877 P_{BH} = D33
Stock oil 37.87 API, γ_g = 0.7515 ~~P_{wh}~~ P_{sep} = D79
Friction Gravity Liq 9 = B16. P_{wh} = D102

33.
79 M79 N79
102 M102 N102

Pr = 9854 now. P_{bhf} = 8506 for 50,000
= 8754 for 40,000
From Prosper Pr would be very similar to Mikes.

40,000 P_{bhf} = 8754
30,000 P_{bhf} = 9020
20,000 P_{bhf} = 9292
0 P_{bhf} = 9837

2nd set 40,000 9173
30,000 9431
20,000 9696
10,000 9970
0, 10256.

24 June 2010 Chris, Ashish, Metin, Mani, Tony on Window Clusters
- Use simple GAP model to test Resolve GAP-GAP linkage
- If successful use Nakiska for testing.
- Once working, go to Trinidad model.

25 June 2010 Install Adobe Acrobat 9
Adobe serial #: 1616-1318-3731-6931-3755-9001
layer flowing Radius 2.96" (7" casing) layer Roughness = 0.02in.
[Model: k, layer Drainage 900 acres = ft
Shapefactor 30.9972.
layer wellbore Radius 4.25" = ft

Oil
layer PVT.
① 8969 → 8969
② 8969 + 15 = 8984 → 8984
③ 18000 → 17990
④ 18300 → 18290

18300 − 12487.6 = 5812
18300 − 12488 = 5812
Temp = 12488 + 8969 = 35187 or 12360

Top layer: Flow Radius = 8.605/2/12 = 0.3585 ft
Top layer: Wellbore Radius = 22"/24 = 0.9167 ft

Lower layer Flow radius = 2.96"/12 = 0.2467 ft
Lower layer Wellbore R = 9⅞/24 = 0.3405 ft

Gas
[Top layer. γg = 0.58, k = 1000 md, 15 ft, 120 Ac
(kh = 15000)
Top layer k = 1000: lower layer dumps a lot to top layer
Top layer k = 500: lower layer dumps half to top layer.
Top layer k = 300: lower layer dumps 20,000 bl into top layer.

Rates ⇒ 24 June 2010. 21580 collected. 4040 BO flared with 27.2 mm on 23 Total 16,830 Bopd, 36.7 mm.

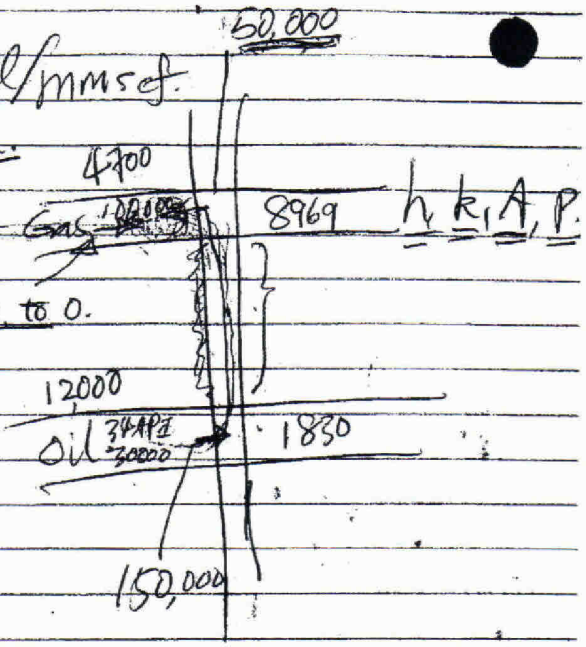
$P_{avg} = 9854$

$\Rightarrow$ 200,000 GOR $\Rightarrow$ 5bl/mmscf.

$P_m = P_g(H_g) + (H_e) P_e$ GOR.

50,000 for ~~2.5~~ 2000 hrs.

$\rightarrow$ 10,000 BD drop for 24hrs. to 0.



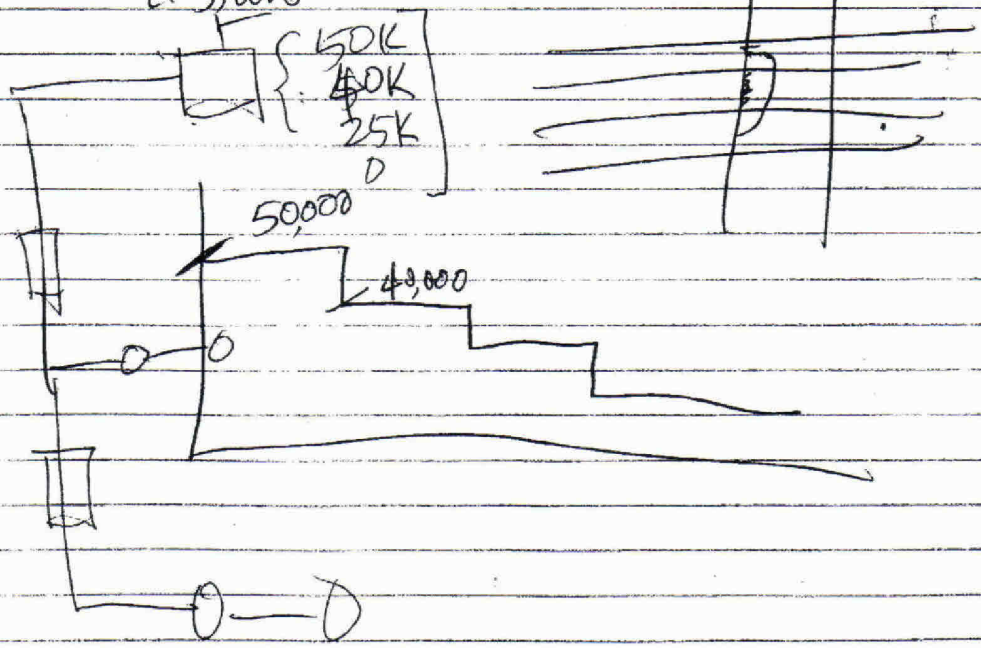
Skins. (0, 0), (5, 50) (10, 100).

50,000

avg. 137,000 B. lower

avg $\rightarrow$ 87,0000 B up layer

40,000 {+35,000 / +5,000}



Shut in Protocol:

obj Determine the integrity of the well & whether it can remain SI.

→ What rate change do we need in SI?

→ How accurate, how frequent do we need data?

→ Multirate tests — will it provide enough guidance for what we do

Charlie: if there is a 5% leak — small range

Question #9. What procedure to determine whether we have a high or low choke

→ Mike's assumption: 50K for 2 months

→ Depletion

→ Skin: 0 ~ 20 (typical range)

⇒ Do we need to know the rate before we know the well

⇒ SIP < Pb: check if it is gas case (gas at top near BOP)

⇒ Phil:

everything will survive 8900 psi at wellhead (annulus flow); even the burst disc

⇒ flow inside casing, annulus, or combine: will not

⇒ Casing/Annulus flow: may rupture invert acting disc

9 7/8" liner shoe: weak spot.. "8000 ~ 9000 Psi will cause it to fail.

⇒ 5000 Psi: fractured casing shoe? (14 PPG down annulus)

⇒ 13 5/8" hang failed at much higher value

Well cap good for 8900 psi

⇒ Flow past hanger for 13 5/8" casing & going back to the next casing — not likely

⇒ Will be able to measure pressured BOP

26 June 10 model Rupture disk

P=5200 @ 8969 ft.

12488 — 9560 — 2928

MD	18300	12488	9560	8304	6047	4989
Seg length	<	5812	2928	1256	2257	1058
T (°F)	245					40

disk1 2636
disk2 3426
disk3 3866.

For a case where

Location	Formation	9560ft disk	disk 8304'	disk 6047'	Mullin
~~Qo~~	~~57081~~	~~13277~~	~~1782~~	~~2971~~	~~51020~~
Qo	57329	3828	3305	3176	47018

4989 − 3450 − 831 → 3450 − 831 − 4281

4989 − 3450 − 831 → (8439) → 105°F

8439 − 831 → (9270) → 118°F

40 + 118 = 158

error msg while generating VLP

27 June 2010

Revise models:

CIS Bursted Rupture Disk Annulus

All relevant depths:

4989 (Mllin) — 6047 (1st Disk) — 8304 (2nd Disk) — 8439 (5½" DP end) — 9270 (3½" DP end) — 9560 (3rd Disk) — 12487 — 18300

Annulus annulus annulus Annulus Casing flow

9560 − 8969 = 591

8969 − 8304 = 665

8439 − 8304 = 135

8969 − 8439 = 530

8969

9560 − 9270 = 290

Behind Casing side (annulus flow)

Key Points: 18300 12488 9560 9270 8969 8439 8304 6047 4989

Seg: 5813 2928 301 530 135 2257 1058

T: 243 199 133 108 103 97 92 73 48 40

$Y = 0.776X^2 + 43.078X + 1950$

Drill pipe key points

4989 ft 8439 ft 9270 ft

3450 831 ft

T(F): 105 92 40

Avg(F): 99 66.F

In a test run:

Q Drill Pipe = 24869 BOPD

Annulus = 21049 BOPD

Burst Disk1 = 3239 BOPD @ 6047

Disk2 @ 8304 ft = 3461. B/D

Disk3 @ 9560 ft = 3464. B/D

47

With all disk OK, all oil goes to annulus = 62,172 B/D

Mud 80 BPM = 115,200 B/D

7"

½" & ⅝" 0.41"

For ½" rupture disk: Disk1 Disk2 Disk3

305 334 335 B/D

Annulus = 28,396, Drill pipe = 25,575

Assume top disk ruptured: $Q_{ann} = 26041$, $Q_{DP} = 25534$

$Q_{disk1} = 3267$ B/D

Problem 2 use Top kill calculator
(leave rupture disk in place — very small openings, they allow model converge)

For P_{inj} = 5407, Q_{inj} = 115000 B/D

~~Q_{BOP}~~ $Q_{csg-DP\ Coupling}$ = 77,927 B/D

Q_{DP} = 36748 BWD

No burst disks: Q_{BOP} = 26316 B/D
Q_{DP} = 26620 B/D

With top disk burst. Q_{disk1} = 3442 B/D
0.41" ID Q_{BOP} = 23744 B/D
Q_{DP} = 26330, B/D

0.125" ID Q_{disk4} = ~~325~~ 325 B/D
Q_{BOP} = 26159, Q_{DP} = 26588

With 0.41 all disk ruptured.

Q_{disk1}	Q_{disk2}	Q_{disk3}	Q_{BOP}	Q_{DP}
3354	3572	3579	19295	25416

28 June 2010

24 June Q_{total} = 23725 B/D (~~15780~~ 15,785 collected, 3440 flared)
547 mmscf/D flared

Bob 11.192C

P_{res} = 2636 psi, Q = 3400, P_{re}^{casing} = 4815

ΔP = 4815 − 2636

SIWHP = 6500 psi for Q_o = 59000 B/D
6900 psi for Q_o = 40,000 B/D
} no cross flow.

With cross flow 6400 psi

28 June 2010. Big Tele/conference.
Obj: understanding the important issue on well integrity after shut in.
How much fluid fmtn can take before broad to surface?
P. response after well shut in?
Pressure response that can lead us to know if there is an integrity issue
Rupture disc calculation: downstream pressure — should use fluid pressure.
Frac P 18" shoe = ~~5325~~ 5235 psi.)
⇒ very difficult to tell which injection case it is from watching surface P
assuming 30,000 bodp injection rate — will fmtn fracture?
⇒ Other sands other than M110? (M57?).
⇒ Sensitivity on leak rate 0.15m, 830mbd
⇒ A plot of ΔQ vs. ΔP at ~~wellhead~~ wellhead: can be very useful.
⇒ Timing of event of cross-flow.
⇒ pressure drop across the hanger?
⇒ BOP pressure fluctuates around 4200 ~ 4400 psi.
⇒ Status of the discs — unknown. (6 may burst?).
⇒ Band of rate: 3000 B/D, 30,000 B/D? → Time needed to fill M110,
⇒ Flow in csg as starting point (Trevor Hill)
⇒ Disc burst
☆ ⇒ Compression Disks: 4 = 2 inward acting, 2 outward acting] Phil P to clarify.
⇒ — Rupture disks: 10,000 psi — never have P > 10000 in the system — Rupture discs will not be burst.
⇒ Compression discs: most likely burst.

Call in: Cathy Enomoto, Curtt Ammerman, Paul Hsieh, Phil Nelson
Steve Hickman.
⇒ Phil Nelson analog for injection into shallow res.

CONFIDENTIAL

BP-HZN-2179MDL07584266
BPD661-001739

TREX 011146.0074

→ Compression discs failed inwards. (Some rupture disks burst, but not both)
→ Casing hanger: casing stay lifted
→ Δp across hanger = 1600 for casing to stay lifted (a few feet)
→ 3800psi before top kill
→ Top kill: 3800 + 966 = 4800 psi.
→ 4200 psi.
→ acoustic transmission:
Day before top kill → 4700 psi
Top kill → 6300 psi. (as low 3200 psi)
Post back test ram: bopf → 4200 ~ 4300 psi again.
30 May P_{bop} = 4300 psi

early day 4200 cycles ?

→ burst disks on 16" casing.
→ Bord of what's happening
→ Disc sizes? 1/8" or anything else? erosion [the only hole there is 1/8" [0.125 ~ 0.41]
→ # of discs: 6 max
→ Rate: 30 ~ 60. range
→ Max: 6 disks,
→ Tomorrow. 2pm Flow group: group check in.

→ Bob.
(1) Casing flow only (alone)
Q_p = 26,000 (DP) + 28,243 (csg) = 54,243 BOPD ✓
(2) All 3 flow paths:
Q = 26,000 (DP) + 21412 (csg) + 27218 (annn) = 75,186 BD
(3) Annulus only Q_o = 34,393 (BD)

30 - 60.
For 1/2" rupture disk, ~300 BOPD each
For 0.41" ruptwedisk, ~3400 BOPD each

Amazing model: can be used for top kill too.

3250 psi for it (±50 psi. after changing gauges.
5250 for mud) 50. mo'
2600 psi DP)

Top kill 3: ±4% in rate

29 June 2010 Top Kill model
Henry, Ashish, Metin, Mike M, Tony

1. Flow path
2. Rate estimate < (Pri post-Kill)
Top kill same damage for seals (around rams) eroded
Key ass: csg flow preferred case
Always flow around rams
3. Olga model (for 1st Kill period)
Olga: work in progress
BOP: pre mud: 4400
current 4300 ±50psi before top kill (guage change)
RAM Leaks (all RAMs).
3250 psi used to adjust PI.
Mud
All casing flow (in long string).
1. Casing hanger leak, burst disks open. 26.4
2. Hanger leak, disk intact 9.9
3. Hanger sealed (with 1/8" disk) 50.8

P = 7750 psi (SI) 0.41" disk
Psi = 6925 with 6X
Pcsgbot = 10812 psi
$\frac{\Delta P}{\Delta L} = \frac{10812 - 7750}{(18300 - 4989)} = -0.23 \frac{psi}{ft}$

(6 Dak 5700 B/D each choke ⇒ Total = 33,562 B/D (0.41")
0.125" choke ~600 B/D each, Total = 3517 B/D

PVT Sim model for Henry

Agenda: move problem statement to #1:
9 7/8" casing — casing string (9 7/8" x 7")
BP - Amoco

Choke line & Kill line (4 1/2" ID).

(Ram Choke(s) in oil prod. ——— Dts there
add Pbopbot on plot (along with Pbopt = 2600 psi, Psep = 250)

Total Flow to Se

18"

Need: Volume ① what is flowing into fmn above.
② comfort level.
Storage capacity.
Thursday afternoon: Slide package (US $ BP in agreement)
Next week: Shut in, are we in the position

Ed ② Mark:
Assumptions: too conservative
Red curve: Roni model.
Blue curve: Mark's
Prop 4115 today

→ No leak shut in.
→ 11350 — no depletion (depletion 35000 BOPD)
3.99 X aquifer.
— Oil, gas separation
(— D 9100 psi for gas

Pr = 11209 @ 30 June 2010: with 35000 depletion
Pr = ~~11115~~ psi @ 30 June 10 with 35,000 depletion (110 mmbo in place)
~~10922~~ 10756

on 28 May 2010
Pr = 11446.7 ≈ 11450 psi

With aquifer Pr = 11148 psi ~~with aquifer~~ 30 June 2010

30 June 2010 29 12hrs collected 8.475 bbl, flared 4150 BBL. 28.7mm.
28 June total 23,395 (15,310 collected, 8085 flared. 54.1 mm flared)
Neveu
Erte, James
Comments, deployed city/State/Role/Function/Title
812-9492
2nd floor HIVE

172
18
154 of shut in.

USGS Remot. Predict geologic hazards association

⇒ 18" shoe @ 8894 ft TVD.SS 5ft only
Pore pressure 4711 psig. Sand fracture P = 5211 psi

⇒ High injection case. 30,000 B/D ——— Question: would fluids be injected in to sands before injection in sand

⇒ Shut in scenarios. What SI pressure(s) were used?

⇒ M10 Gas Sand: (need to model it as gas injector?)

⇒ Sheldon: no evidence has suggested burst discs have burst.

⇒ 4 sets of new calc.
(1) discharge to liq
(2) discharge to form. pressure > underflowing condition
Undershut in condition

⇒ Flow only in annulus [Kaster case? need to ask]

12 July. Need SI procedure written

Helix 35K, with Ent. @ 4000 → all SAK

Cap. can seal.
Hat. can 4 seal.
Do we need to do test for well integrity (by step tests)?
(Fracture pressure, above & below.
Original SI = 8081. Qtotal was = 24.2 MOBD

With rupture disks: Casing flow (0.44")
SIWHP = 7532, Qtotal = 22.2 mobd

	Pup	Q	Pdn.
Disk 1	7726	7207	5801
disk 2	8246	~~3372~~ 7467	6176
disk 3	8492	7542	6488

Casing flow 0.125" disk | PSIWH = 8193, Qo total = 3044 BOPD

	Pup	Qo	Pdown
~~disk 1~~ disk 1	8435	1014	4262
2	8954	1017	4765
3	9244	1016	5036.

Pinj to MIO = 4901 psi

Annu Flow 0.125" disk | PSIWH = 8403 | Qo total = 3000.

	Pup	Qo	Pdown
disk 1	8403	1005	4257
disk 2	8911	997	4762
disk 3	9192	999	5033.

Pinj to MIO = 4899

~~No~~ Rupture Disks ~~Intact~~ Intact
~~Ann~~ Casing Flow case | PSIWH = 8214 | Qo total = 523.

	Pup	Q	Pdn
disk 1	8460	175	4~~0~~4
disk 2	8983	175	4616
disk 3	9272	174	4891.

Rupture Disk Intact

Annu. [PSIWH = 8428 psi] (Q_o^{total} = 518)

	Pup	Q	Pdown
Disk 1	8428	173	4100
2	8444	173	4613
3	8229	173	4891

Discharge to 22" casing [Q_o^{total} = 606 mbod]

Disk 1	~~P = 4658~~	Pmud = 2759
disk 2	~~P = 5154~~	Pmud = 3932
disk 3	~~P = 5284~~	Pmud = 4585

[Casing flow case — failed to solve]

[Annulus flow case] PSIWH = 7958 psi. Q_o^{total} = ~~3391~~ 3390. Rb

0.125" disk. Pup Qo Pdo

disk 1	7958	1206	2759
disk 2	8470	1116	3932
disk 3	8755	1069	4585

("No disk — very very small disks") (0.0625").

[PSIWH = 8009.]

disk 1	Pup = 8009.
disk 2	Pup = 8531
disk 3	Pup = 8820

5 July 2010

Fluid Flow

Key points. If disk ruptured, they'd be ruptured in days.

all failed if they'd fail.

Compression or burst

~~Not~~ Haven't seen pressure

Steps for adding collection capacity & for measurement.
Be able to measure upto 50 mbod.
50 → 35 → 25 (HP) → decisions stay at this condition, or SI, or reopen.

Quick SI: decide to SI with collection or discharge.
— Monitor BOP pressure during choke closure.
★ HP ramppng up toward end of next week
Capping stack — saturday
⇒ Don't want to flow mud in the collecting system.
⇒ Consequence of Broach to Seabed
⇒ After SI, PP. initial fracture.
⇒ Fracture pressure: leak off test.
⇒ 4800 ~ 5300 at BOP: Steve H.'s estimate
Disk failure, segence.
→ Top kill. Some mud — don't know where it went.
Guest [Steve Hickman, Paul Hsieh, Davy Blackenship, Art Ratzel, Phil Nelson]:
⇒ Sea water back pressure.
⇒ Oil pressure.
⇒ Kate: from 18300 to 18" shoe, used 14.1ppg mud = 10120 psi
⇒ Reservoir storage; Sand near 18" shoe is very small. (6')
(Net defined as VSH < 0.25. — is it too conservative)
→ Bob. cross flow: Δp = 600 psi depletion.

Henry Needs: Frac pressure at 9 7/8" liner shoe.
Bob 8018 SIWHP. (7650 ~ 9,200') Rage

6 July 10: Team Mtg (Telecon)
HSE —
Peter & Simon: multilateral model (not good-Rawling near junction)
5 July 2010: 24,980 BOPD (16,760 collected, 8,220 BO flared along with 57.1 mmscf/d)

3 July 2010 1 of 3

Revisit disc calculation (using 2 July 2010 model).

OK

1. Annulus flow case confirmed (0.41" disks).

✓ (a) With Top side closed.

	Pup	Q	Pdn
Diskset1	7282	6635	5636
Diskset2	7719	6823	6023
Diskset3	8041	6891	6264

$P_{Bot\ of\ Bop} = 7282 + (\text{head from } 4989\text{ft to } 6047\text{ft})$ (15# at 4 disks)

$P_{inj\ to\ M110} = 5879$ psi.

Annflow (b) With topside open (at $P_{Bop}^{Bot} = 4350$ psi) 0.41" disk — Given (only This is open top of Bop is assumed closed.) (known) — 0.41" Disk ID

	Pup	Q	Pdn
Diskset1	4575	1873	4432
Diskset2	5066	1850	4930
Diskset3	5344	1936	5196

$P_{inj\ to\ M110} = 5049$ psi.

2 ~~Casing flow~~.

✓ (c) Annulus Flow with top side closed (0.125" disk size)

	Pup	Q	Pdn
diskset1	8505	1017	4259
set2	9014	1009	4764
set3	9245	1010	5035

$P_{Bot\ of\ Bop} = 8505 \pm (\text{head from } 4989\text{ to } 6047\text{ft})$

$P_{inj\ to\ M110} = 4902$ psi.

(d) Annulus Flow with top side Open (0.125" disk size).

	Pup.	Q	Pdn
diskset1	4578	308	4109
set2	5074	305	4636
set3	5353	309	4910

$P_{Bot\ of\ Bop} = 4350$ (known)

$P_{inj\ to\ M110} = 4782$ psi.

3 July 010 2 of 3

2. Casing flow.

(a) 0.125" disk ID, top open (with known P^{Bop}_{bot} = 4350psi)
$P_{DP\,Top}$ = 2600psi.
Top kill model failed to solve.
Need Tony's GAP model.

This system doesn't have a solution because the pressure at 18" casing shoe would be lower than M11O pressure (4730psi). (~4400 ~ 4500psi)
By iteratively ~~setting~~ testing a lower pressure at M11O (to allow minimum leak rates) it is possible to solve the system to ~~know~~ estimate pressure at 18" casing shoe. ~~The pressure at M11O that~~ 4370psi at M11O would allow the system to be solved with a minimum leak rate (total about 1200 B/D).

(b) 0.125" disk ID, ~~top~~ side closed — problem ~~can't~~ has a solution

✓ csgflow

	Pup	Q	Pdn
diskset1	8526	1011	4257
diskset2	9037	1020	4767
diskset3	9324	1022	5037

Pinj to M11O at 18" casing shoe = 4902 psi.
P^{Bot}_{Bop} = 8290 psi

csgflow (c) 0.41" disk ID, ~~top~~ side open. With known P^{Bot}_{Bop} = 4350psi
P^{Top}_{DP} = 2600 psi.

	Pup	Q	Pdn
diskset1	4569	1840	4434
diskset2	5085	1894	4930
diskset3	5337	1913	5197

Why did this case ~~have~~ a solution but 0.125" disk doesn't? Does it make sense?
Pinj to M11O at 18" casing shoe = 5049. psi.

✓ csgflow (d) 0.41" disk ID with ~~top~~ side closed.

	Pup	Q	Pdn
diskset1	7810	~~4511~~	5831
diskset2	82999	7565	6204
diskset3	8576	7650	6444

P^{Bot}_{Bop} = ~~7587~~ 7585psi

Pinj to M11O at 18" casing shoe = 6002psi.

3. 3 July 2010 2 of 3

Summary.

For the case with top side closed, results provided — OK.

For the case with top side open,

0.125" disk. casing flow.
no solution, as P_{inj} to M110 at 18" casing shoe is ~~close but~~ lower than P_{M110} (=4730) but very close to P_{M110}.

annulus flow:
$\bar{Q}_{oil}$ = 150 B/D. P_{inj} to M110 = 4800 psi.

0.41" disk (with top side open).

Casing flow:
Q_{oil} ~ 900 B/D (average), P_{inj} to M110 = 5049 psi

Annulus Flow
Q_{oil} ~ 900 B/D. P_{inj} to M110 = 5049 psi

→ very similar. in both cases.

8:30 OLGA Mtg 1-866-616-1740)
Code: 548-438-8484) Trevor Hill, Henry Nickens.
Tim Lockett, Farah Saidi, Ian Stilwell.

~~2350~~ SIWHP ~ f(step down rate),
depletion — to nearest res. pressure.
BOP — still 4100 psi. can go as high as 4500~4600 psi, then goes quickly back to 4100 psi.
→ Tim looks for diagram showing shut in physics.
Base of BOP pressure: 4300 up & down.
Case 1: Intact
Case 2: 1 of 1/8" (top).
Case 3: 6 of 1/8"
Case 4: 6 of erosion (moving away 0.41") — half inch. hole (2000 psi ΔP during top kill)
→ Rerun cases with depleted reservoir pressure.
Red zone:
Yellow zone:
Green Zone: 7500± psi.
6000~8000 psi, can shut in briefly, then, we need to reopen again.
~~Fastest~~ rate of valve closure — what is pressure response?
Slow/step rate of valve closure — what is the pressure respose?
→ Choke valve — (Farah has curve).
mini-mum closure.
Valve above 3 RAMS.
→ Sensitivity of 9 7/8" & 18" shoe (not both).
Drill pipe at casing shoe ⇒ flow area.
⇒ 2350 top of BOP.
4300 at BOP stack (with Test RAM closed)
→ lowest bop pressure 3250 psi after top kills. then it came back quickly.
⇒ Q: 35~60 range ⇐ (one outliner 70,000 BOPD
⇒ Pressure (as a function)
Kill mud — a different model
3 hr/case. steady state. 36 hrs.
olga 5.3.4. (6.2

Tools/options/Content/Auto Complete/settings

41 Tools/options/General/Delete

11 7 Firefox. Tools/option/Security

59 = 18,966. + 2289 =

= 19,000 + 2289

QP. [Q.P] . [R].

Hour Cost Travel Cost — charge out to BP China

6310

sturdock.com

53.

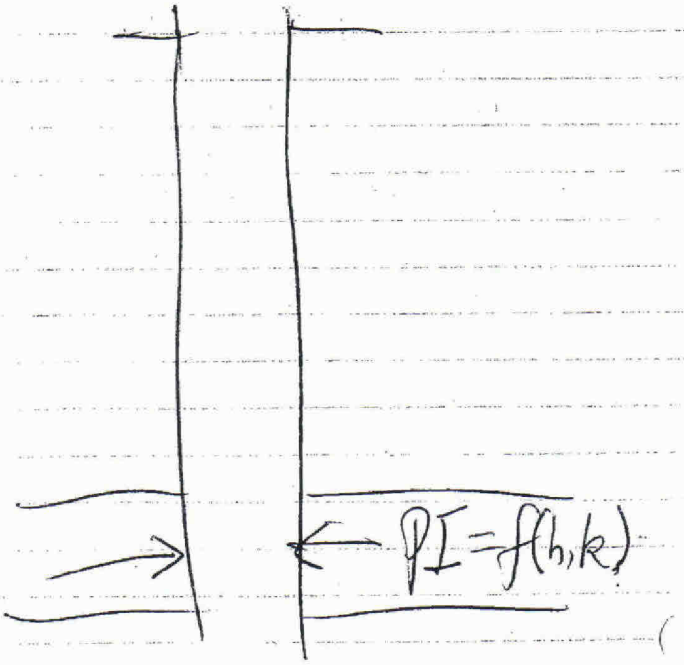
Robert Irvin

13740 psi, II = 100 For bottom fracture.

GAP model indicated bottom fracture would never be opened during oil flow and shut in.

Thus the bottom fracture can be disabled from OLGA mod.

Lo Xflo =



10 July 2010

1. Henry will be back to Katy Monday. He can be in office on Tuesday.

Zufei Shi Hua 281-249-~~4307~~ 1495, (713)-392-1613(m)

Farah Saidi: 832-978-4121(m), 713-461-5282(h)

Prosper & GAP

Bigleak ~~A~~ Tim Lockett +44-7825-273635(m)
+44-1932-771885(O)

Using established Temp profile – Shut in well → SIWHP,
27,340 B/D Pwh = 7142.6 psi, T_{wh} = 226°F, BHP = 10936 psi

Using Hot Geothermal Gradient (226°F surface → 245°F Bot hole)
~~SIP~~ SIWHP = 7781.6 psi

Compared to Original gradient, SIWHP = 7297.8 psi. ($T_{surface}$ → 40°F)

Small leak

BHP 10709 SIWHP = 7253

24 hr, 10977 SIWHP = 7485. (T_{avg} = 189°F, T_{BH} = 245°F)
with hot fluid Temp gradient. T = 7521 psi !

check case 10656 P_{WHSI} = 6879. (original Geothermal).
New Geothermal: P_{SIWH} = 7220 psi.

No integrity case

24 hrs 7220 vs 6879 for 0.4" disk leak

7521 vs 7485 for small disk leak

Slide #4

Robert Clark 214-679-1205
832-244-1336

7220
6879
341

Casing — no integrity (0.44" disk)

9 July 2010 Annulus Flow SIWHP

2 slides on
40m & 60 mbod friction
Range of Q across
EOS in SIWHP
2600.2, 37.8 0.7515
Low Xflow 7685 BOPD
27,340 BOPD

5½ [16.2 < 4989 8.158"
33.6 > 5151
80.0 < 8967 > 8.275"
9267

Small leak [31. 3463
0. 3461.
no leck 3647

→ Rich Miller
→ Cement: Eric Cirringhan

11 July 2010 Sunday. Heat Transfer Revisited
35MBOD & 60 mbod.
Compared the case of 27,340 BOPD case, 35,000 BOPD case will be ~~the~~ very similar.

For 35000 BOPD case. PBH = 10,858. psi.
Using Fluid temp as gradient, → P:SIWHP = 7435 psi.
Vs 7223 psi.

For max depletion case, SIWHP = 6802 psi Vs. 6577 psi for using original Geothermal gradient.

Confirmed with Tim Lockett: (1) EOS Table (latest) used in model
(2) BHP's from Bob used in model (3) OHTC.

outside formation OHTC — high (not very)
inside: modeled in OLGA.
AnnuA: between drillpipe & casing.
T: 214 °F - T=0.
(T=6 hrs: ~~3 hrs:~~) T = 173 °F 61 °F at top of A.
at 300ft below.

[48 hr. top = 61°F, 300ft 115. °F]

12 hrs: top = 65°F 300ft 150°F
24 hrs. top = 69°F 300ft 130 °F

⇒ Very unusual fluids, some phase behavior very difficult to model.
→ Discoverer Enterprise.

13 July 2010: 7978,
20" casing, at what what pressure does it rupture.
Phil ~ 7900 psi, but not sure, Rich.
Rich: David
yielding 6300 6400 ±15%: mudweight 8.5 ~~ppg~~ sea water

Well integrity tests are to determine whether we can use the new cap to simply shut in the well or will have to go to a fallback spill collection plan pending completion of relief wells.

(0.65)(8.5)

Check difference in OLGA & Prosper

P 5800 psi
T 40 °F
OLGA ρ_{liq} 38.7 lbs/ft^3
Prosper ρ_{liq} 40.6 lbs/ft^3
→ $\Delta P = 1.9$ → dP due to diff in density = 171 psi

14 July 2010:
Further analyses to be carried out before commencing integrity test on MC252 well. Consequently, the well integrity test did not start on 13 July
"The higher pressure we build to indicates the integrity of the system and if we don't get a significant build up in pressure then it would put in question the integrity of the system"
So just everybody hopes & prays that we see high pressure here."

14 July 2010: SLAM/ISIS: TH, 2 new wells
[281-366-7592 Chris Kurt Mix
281-366-6488

→ Rock license $60k/yr

15 July 2010: updated Reservoir simulation results.
TH: DC41 — names of the two new wells.
[TF002Q42 — TA002Q02
TG002Q39 — TA005Q04

Paul: What needs to be true for 6900 ish psi WHP after buildup?
Flow rate
Cw, Cr,
Compartmentalization
Aquifers
Skin

281-504-6577

88.16.

7826.

7335.

→ 2 Seismic by 2:00 pm → 1 Seismic run

→ open containment. Can we open the well

16 July 2010

[PVT before any change GOR = 2991.
API = 35.3[illegible]6, γ_g = 0.7748.]

20mbd leak. $\Delta p \cong 3400$

6mbd leak $\Delta p \cong 3200$

Yesterday base case $\Delta p \cong 3280$.

max depl. (60mbd) $\Delta p \cong 3200 \sim 3300$

19 ~~18~~ July 2010

[Do we need to have the original file that produce the restart file to be in the same working directory?]

→ Get it from Henry.

20 July 2010

			~~Pwh~~		
BO data	Annular	No Drill pipe	~~2270~~	~~3800~~	~~4250~~
			47162	41203	39202
EOS	Annular	No Drill pipe	~~47123~~	~~42587~~	~~40565~~

Properties: 2990.74, 334.366, 35.38 API, γ_g = 0.77479.

Update 2600.2 384.586 37.8 0.7515

Annular No Drill pipe Q 48990 42502 40492

92.70
− 4989
4281

Annulus flows. If flows only out of DP. Q = 24925

If flow is allowed to go out from DP & BOP

Q_{dp} = ~~16140~~ 16137 BOPD

$Q_{annulus\ (behind\ csg)}$ = ~~20358~~ 20231

total ~~36495~~ 36.17286

BP (with 4 aquifer): $P_r = 11148$ (for 35,000 BBL to 30 June 2010 / 15 July 2010)
EOS (no aquifer): $P_r = 10557$ for 35,000 BBL to 30 June 2010
$P_r = 10528$ for 35,000 BBL to 15 July 2010
$P_r = 10168$ for 45,000 BBL to 15 July 2010

With $P_r = 10168$ psia,
Annulus flow no Drill Pipe:

P_{wh}	2270	3800	4250
Q_o	42584	34265	31441

21 July 2010 SIWHP = 6834 psi. → now 6844 psi.
planning static kill, equipment lined up.
2 seismic lines/day. Takes 24 hrs to analyze the data
— static kill — need very low flow rate, low pressure (just slightly higher than SIWHP). — as soon as it starts, WHP will drop.
— Relief well: if annulus is flowing, need to kill it first.
then drill to casing, if it is flowing, kill it then
= "pumping mud & cement into the well through a hose connected to a failed blowout preventer at the seabed."

Bob needs:
- Table of temp. vs. depth.
- density vs. depth
- Pressure vs. depth.
- OLGA Temp Profiles

22 July 2010: SIWHP = 6867 psi.

23 July 2010: Tropical storm Bonnie — Relief well activities paused
SIWHP = 6881 psi — still rises slowly. Good news
Monitoring: visual monitoring, Sonar, seismic, hydrophones, Geophones. — there is no evidence that says the well will have integrity in the wellbore.
May not be able to monitor for a period of time — maybe able to obs

26 July 2010. SIWHP = 6918.75 psi now.
Kent Wells presentation on static kill
1. ? mud in static kill
→ Do we need to pump a "spacer" ahead of mud so that the mud will not simply penetrate the oil (so that mud can pull all the oil back to formation first)?
2. Cement — It shows a small/short" slug of cement — is that enough to seal
Relief well: 3. During the time when we pump mud, we do we allow (direct) the oil go in the annulus, then later in casing

27 July 2010
CNN news
BP COO Doug Suttles estimated the flow from the well at 53,000 BOPD in a June 6 CNN interview.
BP plans to sell off $30 Billion worth of assets.
— $7 billions to Apache in Egypt, Canada & New Mexico/Wyoming in the pipeline Δ Pakistan & Vietnam. $2 Billion.
Δ Pan American Energy (60% interests)
Δ Alaska — it's a source of free cash flow.

2 Aug 2010. SIWHP = 6989.25 psi ⇒ BHP = 10355 psi.
M56 18083 MD → 18,206 MD DP = 123'
18,066' MD → 18,190' MD WLM = 124'
12.6 PPG Pore Pressure
Pre-read pack pg4. mud will go to well through Choke/kill Manifold
Pg6: Do not exceed 8000 psi at the capping stack.
"Loss of Yellow Pad" — SHUT Down —
What is yellow pad?

8335 − 7535 = 800

7535 − 4955 = 2580

Injectivity data results.

Q, P.

740 BBLS - casing, 1100 bbls - annulus. 1840BBLS Csg + Ann.

13.2 ppg., 2bpm, IS=5, Frac gradient 13.5 ppg.

Water 8.33 lb/gal at 60°F

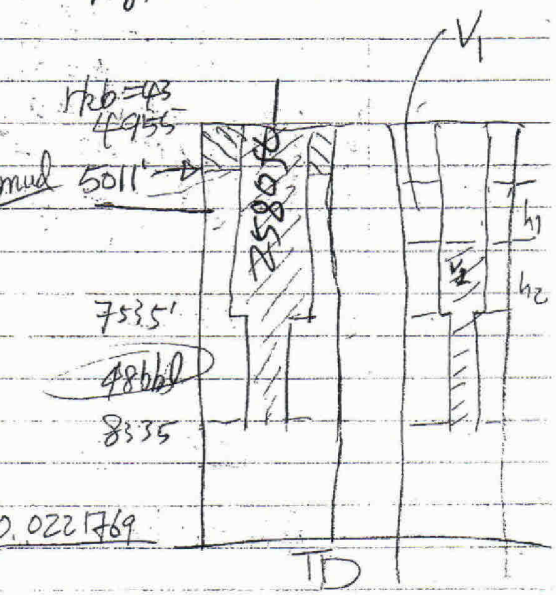
⇒ HC in drill pipe

rkb = 43

5011' Pump

Now Pwh = 7000 #

What P is expected once we start to pump in mud.



7535 − 4955 = 2580

2480 × 4.37 = 10838.8

Displacement:

left side.

$V_2 = V_{3\frac{1}{2}} + h_2 \times$ [bbl/ft in $5\frac{1}{2}$ dp] 0.0221769

$V_1 = h_1 *$ [bbl/ft in $9\frac{7}{8} \times 5\frac{1}{2}$" ann]

$h_1 + h_2 = 7535 - 5011 = 2524$ ok

static pressure

$\Delta p = [0.052 * 4.37 (TD - 4955)]$ ← HC

$= 0.052 \times [13.2 (TD - 7535 + h_2)] + 4.37 (h_1)]$ → HC + Mud

$h_1 \times \frac{0.0428192}{0.0221769} - \frac{6\ (bbls)}{0.0221769} = 2524 - h_1 = 2524 + 270$

$h_1 \times 1.93 = 270$

$h_1 = \frac{2524 + 270}{2.93} = 953'$ ($V_1 = 40$ bbl)

$\frac{6}{0.0221769} = 270'$

$\frac{0.0428192}{0.0221769} = 1.93$ not 2.93

0.02218 BBL/ft $5\frac{1}{2}$" dp

What do we do when the pressure is not as modelled,

(1) Static oil = 10355 psi

(2) Mud + oil + gas = 10355 psi.

$P_{mud} = h_m \times (0.433 \times \frac{13.2}{8.33}) = 0.686\, h_m$

$P_{oil} = h_{oil} * 0.25$

$P_{gas} \cong$ oil gradient

$\cong 7000 + 0.25 * (1800 - 1000)$

$0.686\, h_m + 0.25\, h_{oil} = 10355$ psi.

$9\frac{5}{8}$" → 0.0428 BBL/ft

mud 40 bbls:

$h_1 + h_2 = 2524$

Before mud reaches bottom, for 40 BBl mud,

When well is dead, (killed by mud).

h mud ⇒ at 13.2 x 0.052 x hm = 10355 psi

hm = 10355 / 0.6864 = 15086 ft

18300 − 15086 = 3214?

1. Backside of DP = 0 psi.
2. 8335 X 0.052 X 13.2 = 5721 mud at 8335 ft
   8335 X 0.25 = 2084 oil at 8335 ft
   Diff = 3637 psi

Mud: (8335 − 4955) X 0.052 X 13.2 = 2320
Oil side (8335 − 4955) X 0.25 = 845
Diff = 1475

1. Pump mud.
   at 8335 ft, DP side: oil + mud = mud + gas
   outside: gas + hc + mud (DP + casing)

$P_g h + P_o h_o + P_m h_m = P_m$

At 3637 psi, fluid flows to annulus in DP & Casing.

P at 8335 psi = 5721 psi, $P_m h_m + P$

260
92
168

0.022 18 X 2580 = 57.22

57 / 52 ✓
113 / 85 ✓
7 ✓
39.5 / 85 ✓

1. 3½" Tubing 0.0087 BL/ft (X800 = 7 BBL) ✓
9⅞" casing 9⅞"
9⅞" Using 9⅝" casing + 3½" OD = 0.0494 bbl/ft (X800 = 39.5 BBLS)
(Casing ID = 8.681 Vs 8.605 very close).
9⅞" casing + 5½" Tubing Vol: = 0.0438 bbl/ft (X2580) = 113 BBLS)
5½" DP = 0.02258 (0.02218 X 2580 = 57 ✓

0.0732648
0.0119
0746
in
(629.4)
= bbl/ft
D3
1029.4

Total = mud = 113
40
153

HC = 57 + 7 = 64 BL

218
47
171

153
- 47
106

113
57
180

106/180 = 159 ft
106 ft

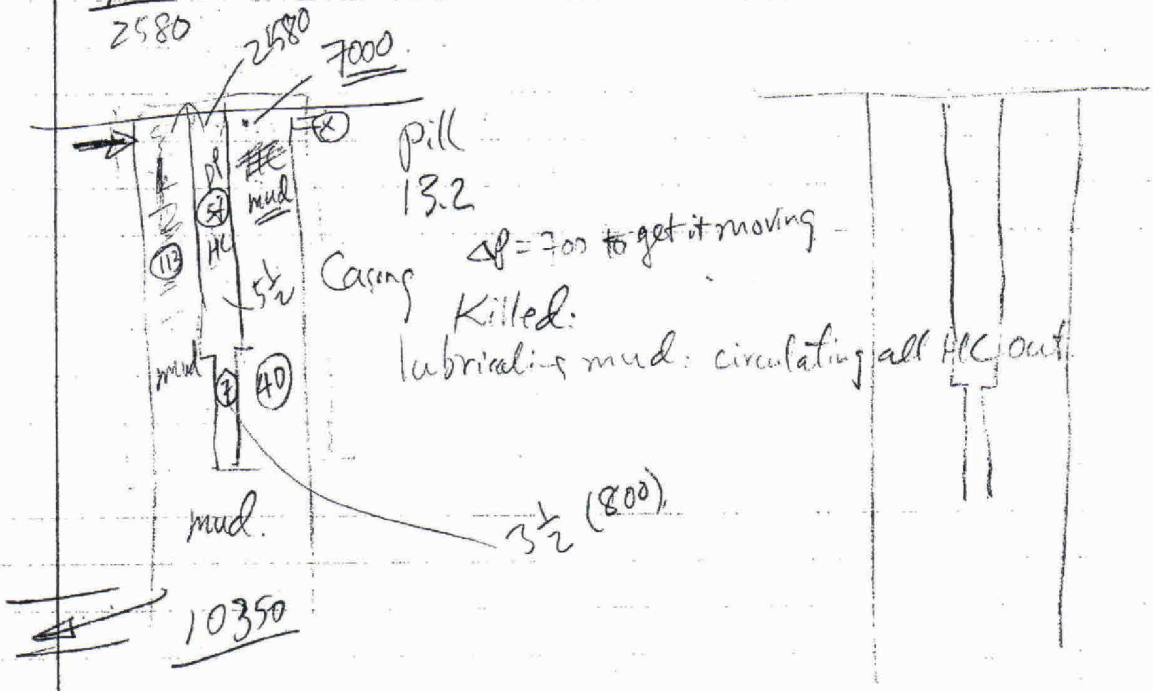
4789
1061
6050

Oil

1061 X 0.052 X 13.2 = 728
389
339

Pressure at

1061 X 113 =
2580



Δp = 700 to get it moving

Killed:
lubricating mud: circulating all HC out

Warming

Rodrigo Murillo

$3\frac{1}{2}$" (OD) → 0.0119 BBL/L-ft.
$9\frac{7}{8}$" (ID = 8.605) → 0.0798
$5\frac{1}{2}$" (OD) $\frac{5.52}{1029.4}$ = 0.02939.

Annulus = 0.06003 BBL/ft

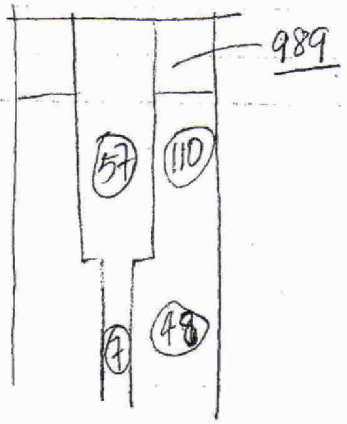
Annulus = 0.04254

X2580 = 110 BBLS

X800 = 48 BBLs

0.15 psi/ft for wet gas
0.1 psi/ft for dry gas

0.0634 psi/ft
$9\frac{7}{8}$" 628 #/ft — ID =
7" 32 #/ft



At Kill

HC = 57 + 7 = 64 BBLS
Mud = 110 + 48 = 158 BBLs.

After kill

$3\frac{1}{2}$" DP @ Annulus outside = 7 + 48 = 55 BBLs mud.
Rest mud = 158 − 55 = 103 BBLs.

$\frac{103}{(110+57)} = \frac{103}{167} = 0.616766 \times 2580 = 1591$ ft. mud in $5\frac{1}{2}$" DP @ Annulus Outside

2580
−1591
989 ft HC.

4989
· 989
5978

@ 5978 ft = 361 psi.

$P_{@5978}^{gal} = 989 \times 0.1 = 99$ psi.

989 ft of drilling mud = 0.052 X 13.2 X 989 = 679 PSI.

For oil: 679 − 361 = 318 psi.
For gas 679 − 99 = 580 psi

989 X 0.04254 = 42