From: Merrill, Robert C
Sent: Mon Jul 05 22:56:09 2010
To: Baker, Kate H (Swift)
Cc: Mason, Mike C; Yeilding, Cindy
Subject: Depletion Review with James Dupree
Importance: Normal
Attachments: Modelling_Presentation_6July.ZIP
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Kate:

As promised, I enclose a set of slides for tomorrow's discussions. I will be here early (6:30-ish), so if you see anything that needs clarification, let me know and I will do my best to fix it before the meeting.

I assume that the meeting will not be before 8am? The last note didn't give a time.

Bob

Bob Merrill

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Reservoir Engineering Community of Practice
BP EPT, Houston
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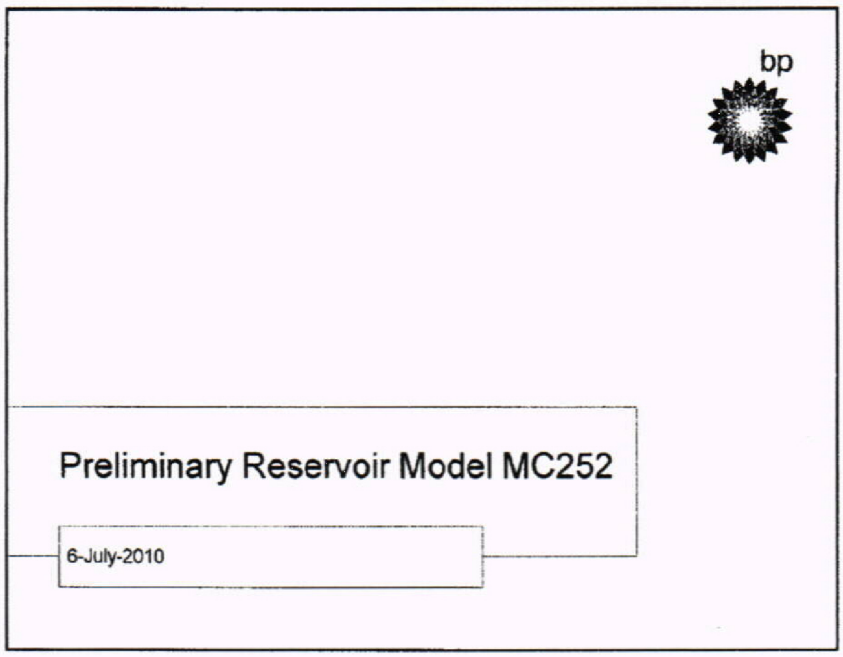
bp
Preliminary Reservoir Model MC252
6-July-2010

Outline

- Modelling approach & purpose
- Input Data & Model
  - Rock & Fluid Properties
  - Layering
  - Aquifer Support
- Results
- Impact on "tubing head pressure
- Conclusions & Future Directions

Model Approach & Purpose

bp

- Model constructed to address impact of crossflow of M57B & M56A gas sands during "top kill"
  - Response of observed pressures
  - GOR variation with time
- Request to investigate whether depletion was consistent with known pressures below BOP
- Requested to avoid making operations regarding likely rates
  - Role of flowrate investigation team

- Approach
  - Simple: tight timing, multiple unknowns
  - Single layer per reservoir (M57B to M56F, with intervening shales)
  - 10 x 12 x 17; no structure

Input Data

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- Data provided by GoMx Reservoir Team
- Rock Properties
  - Developed from MC252 logs
  - Permeability
    - 275 mD in main M56E sand
    - 397 mD in M56A gas/oil sand (only 2.5')
    - 86 – 110 mD in other oi[illegible]s
  - Compressibility:
    - Cr: 6 x10^{-6} psia^{-1}
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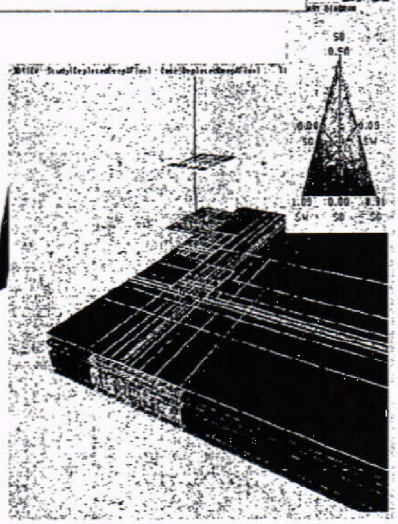
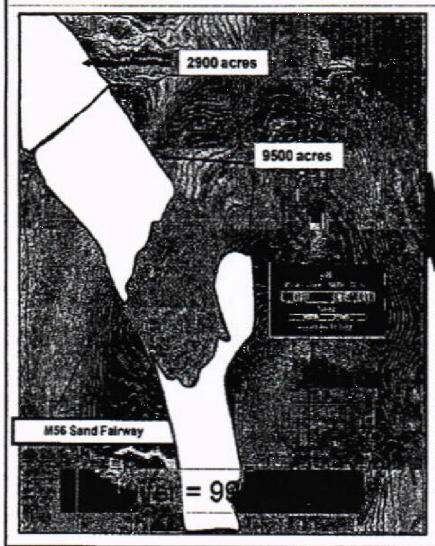
  - Fluid properties generated by EoS; volatile, near critical fluid
- tubing performance matched to GAP / Prosper work of T. Liao, A. Chitale & M Gokdemir

DR



Macondo RF – Aquifer Size

bp



Oil Accumulation
110 mmstb = 258 mmrb

9500 acre Aquifer		
Net Sand Thickness, ft.	Porosity, %	
44	13	
44	17	2.0x
66	17	2.9x

12400 acre Aquifer		
Net Sand Thickness, ft.	Porosity, %	Aquifer Size
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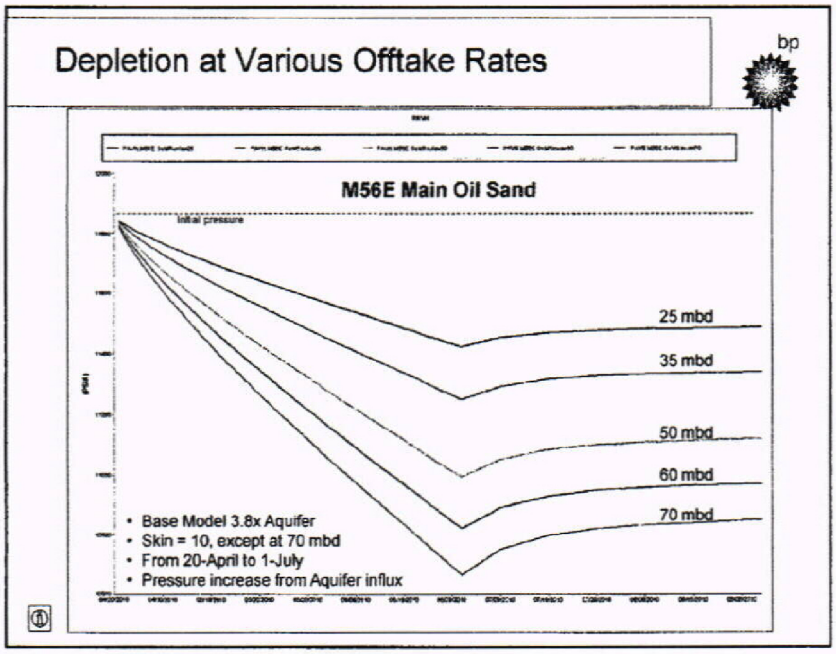
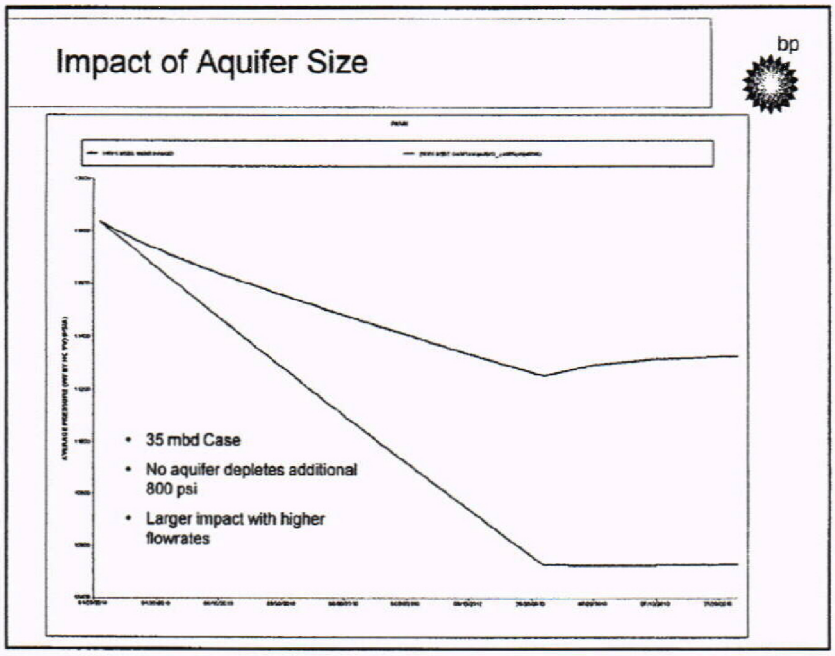
Largest Aquifer Size – used as base case (will minimise depletion)


Depletion at Various Offtake Rates
bp
M56E Main Oil Sand
Initial pressure
25 mbd
35 mbd
50 mbd
60 mbd
70 mbd
• Base Model 3.8x Aquifer
• Skin = 10, except at 70 mbd
• From 20-April to 1-July
• Pressure increase from Aquifer influx

Impact of Aquifer Size



Depletion Response @wellbore

bp

- PIE gives similar results to VIP
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- P_{wf} drops ~8 psi/day (for 35mbd case)
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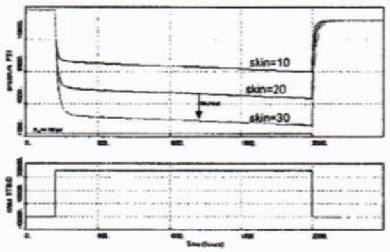
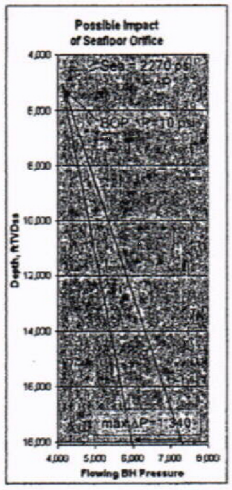
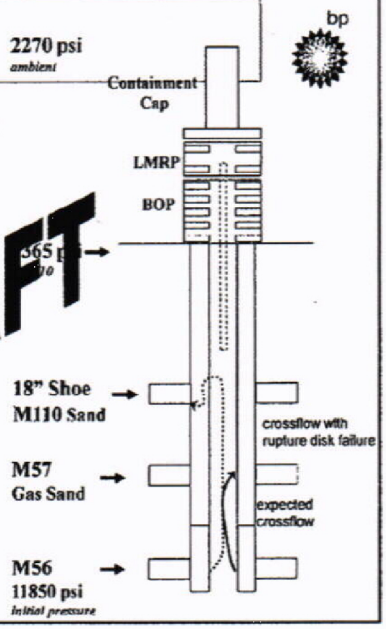


Macondo M1 Shut-In

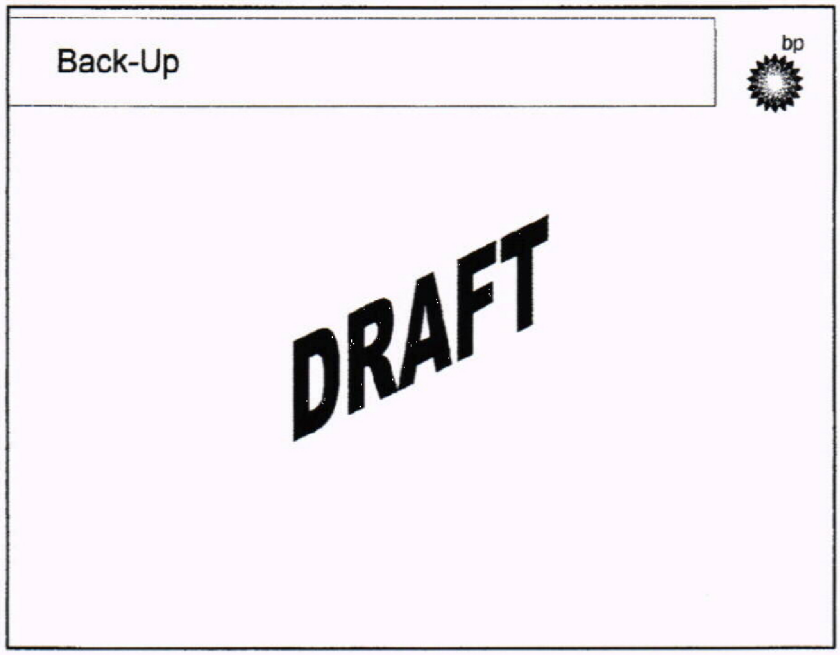


Conclusions

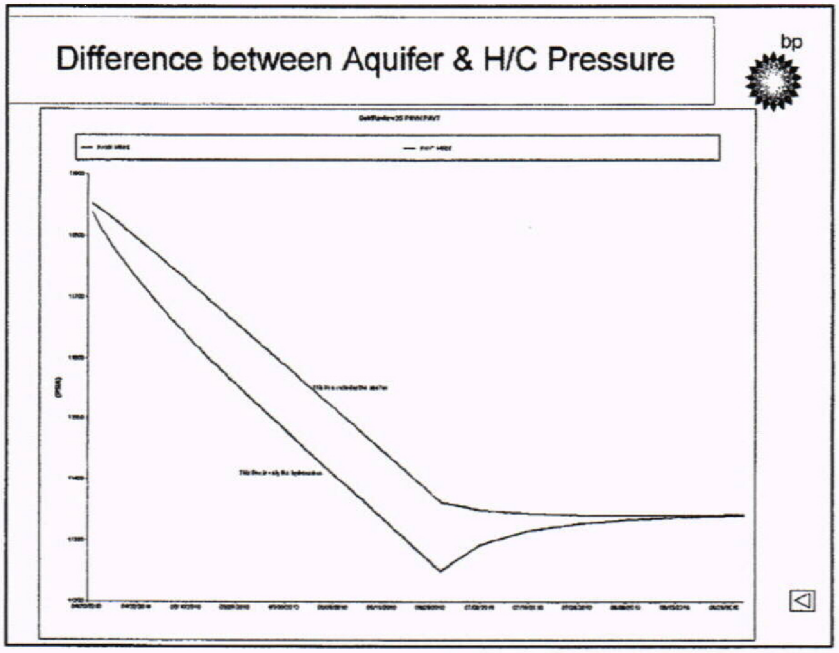
- Actual reservoir depletion dependent on:
  - Flowrate
  - Oil column size
  - Aquifer
- Limited depletion observed in [illegible] could be controlled by [illegible] mechanisms
  - Large orifice
  - Flowpath / choke between BOP & reservoir
  - Broken gauge
  - Crossflow
- Largest uncertainties: flowrate and pressure drop



Back-Up



Difference between Aquifer & H/C Pressure



Match to "Tubing Performance"

bp

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- Various cases considered:
  - Annular flow
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- VIP wellbore modelling [illegible] limited in comparison w Prosper / Gap
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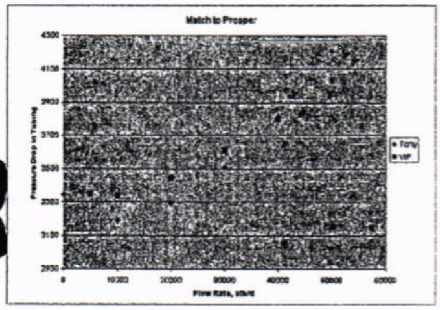

DR

Influences on Observable Shut-In Pressure

bp

At Shut-In

High Wellhead Pressure

- Limited crossflow
- Well integrity above 18" shoe
  - small leak into small zone
- Large aquifer
- Lower production (higher skin)

Low Wellhead Pressure

- Integrity failure (crossflow into M110)
- Smaller aquifer
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Rising THP

- Fluid Segregation
  - Only if P_{thp} < 6,650psia
  - Increase would begin at low rates or at flow cessation
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MBal Results for Various Aquifers

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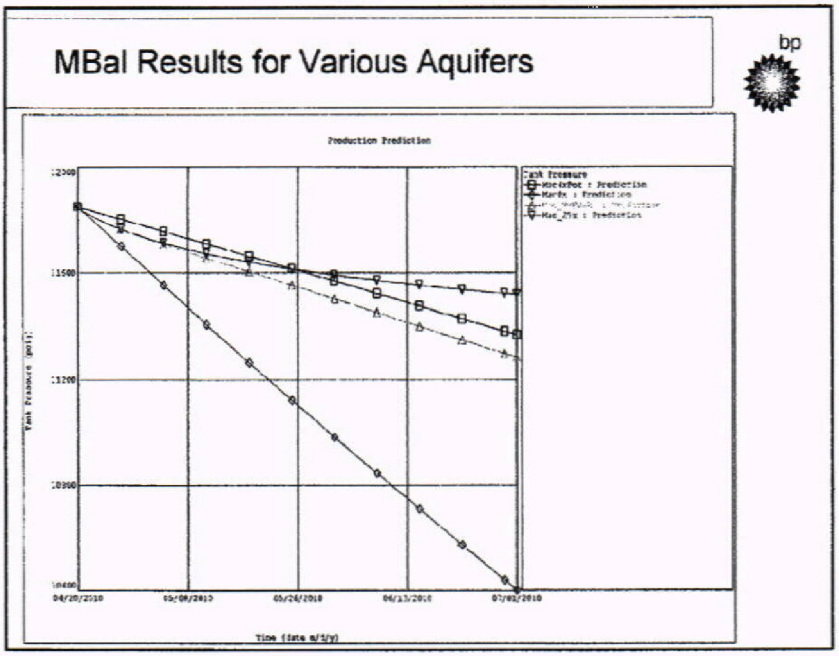

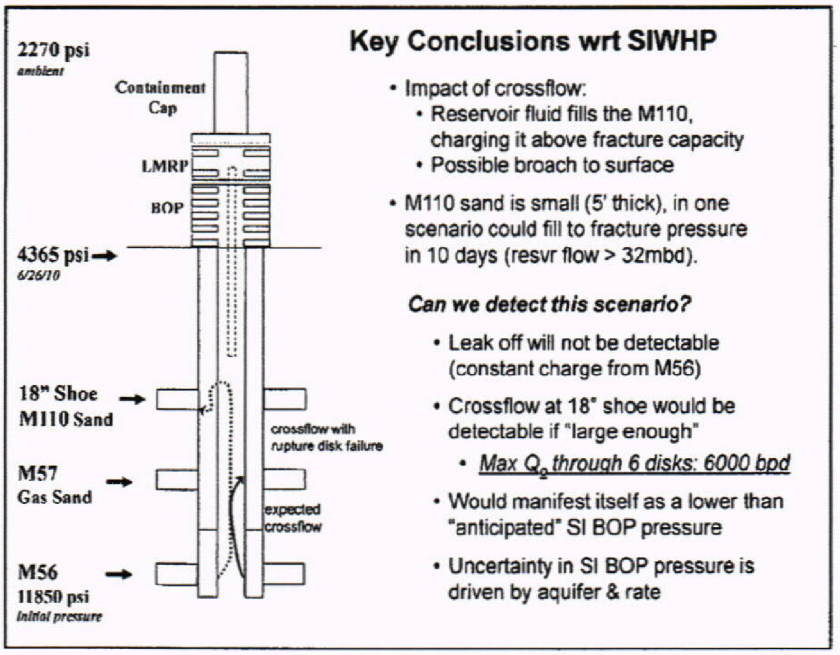

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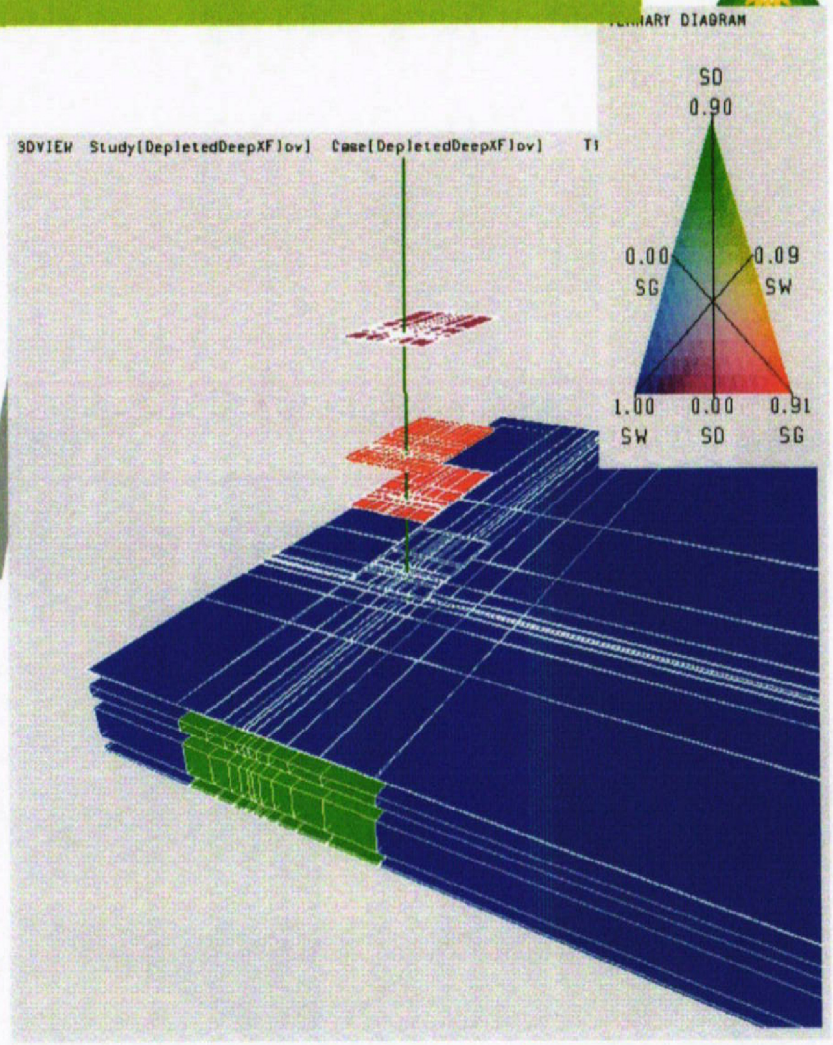

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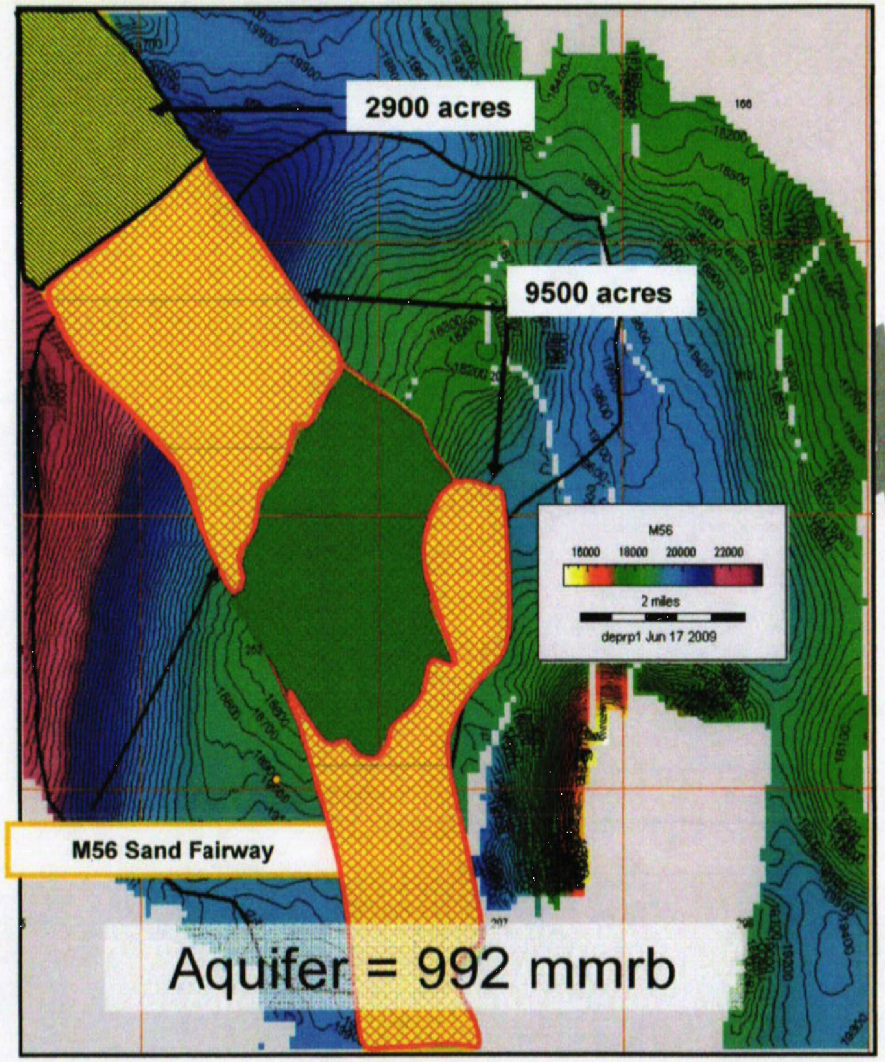

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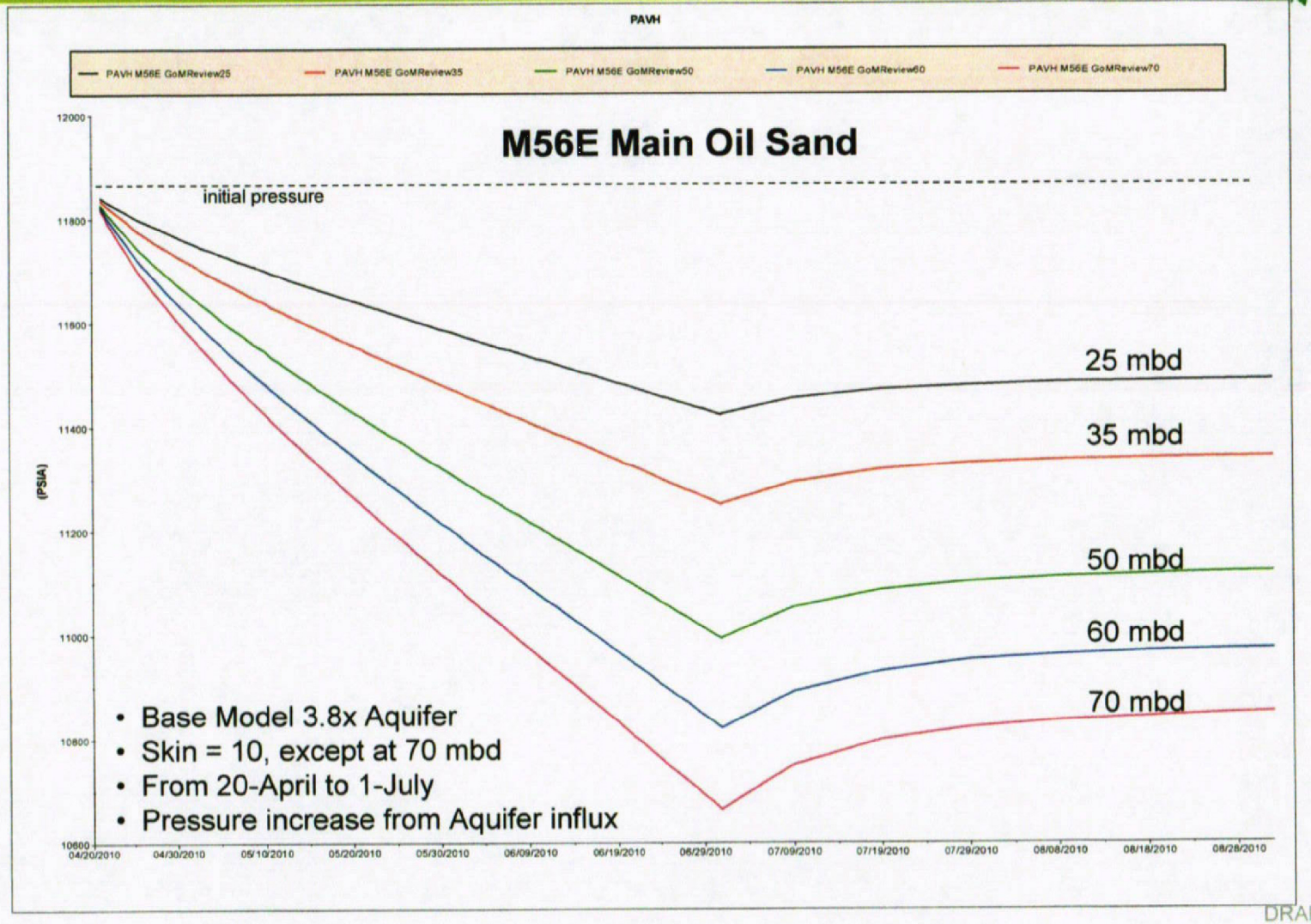

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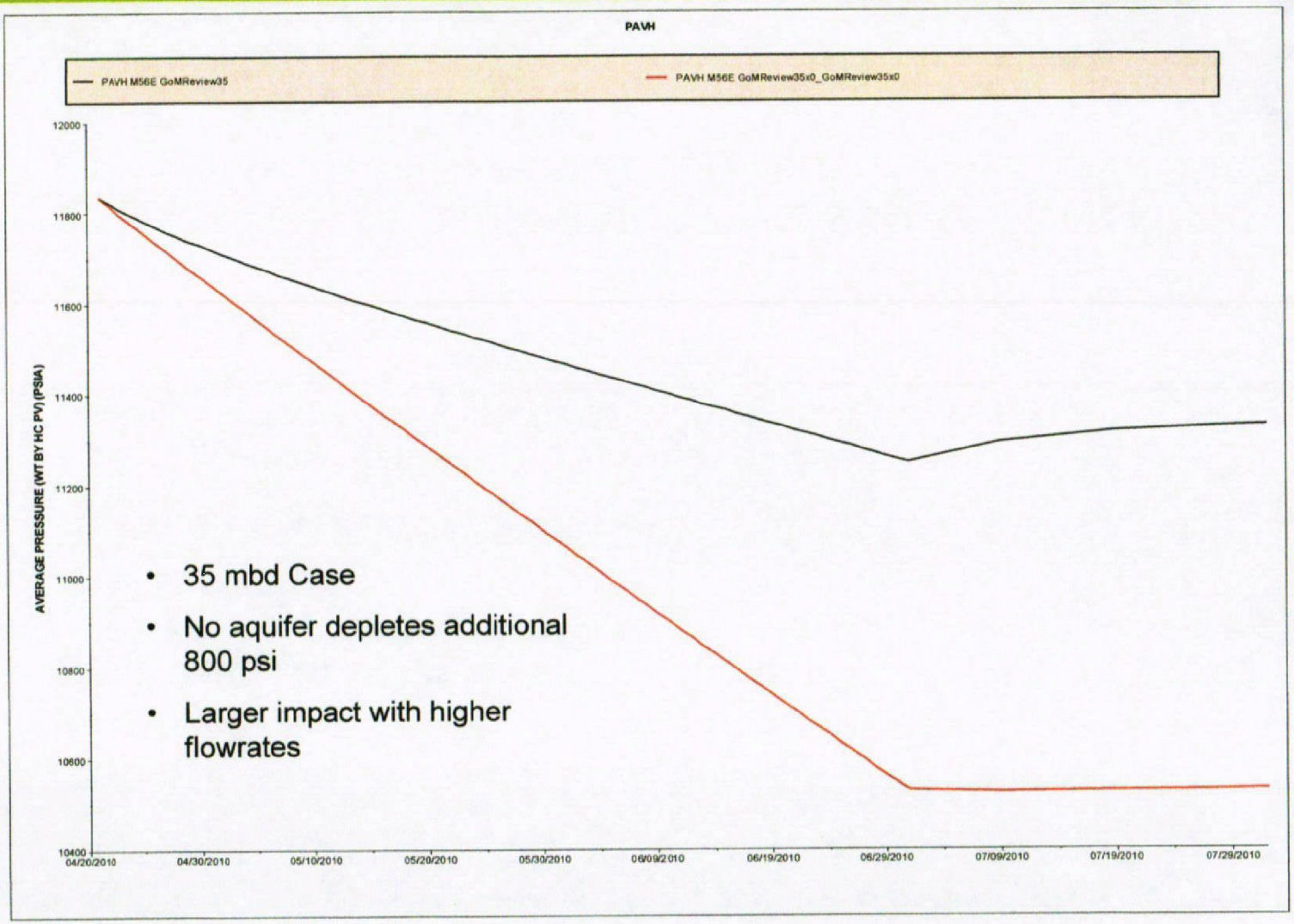
MDM945-000316

TREX 010839.0022

Impact of Aquifer Size



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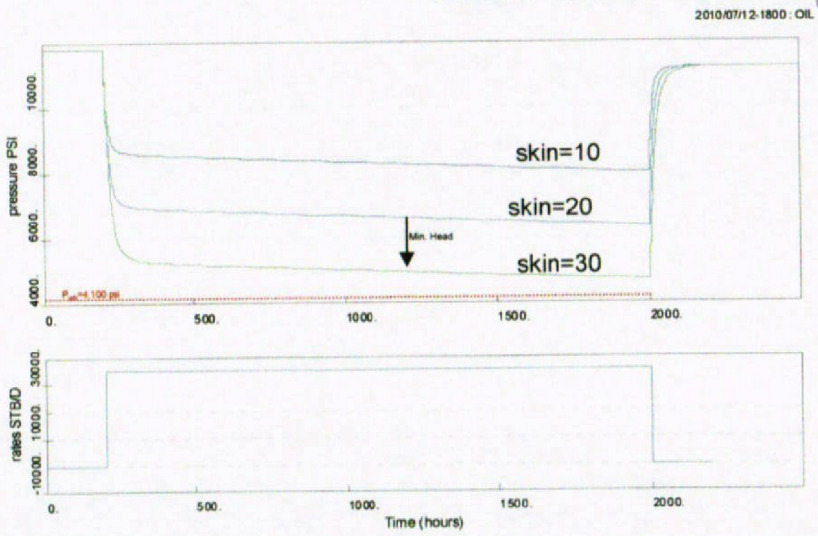
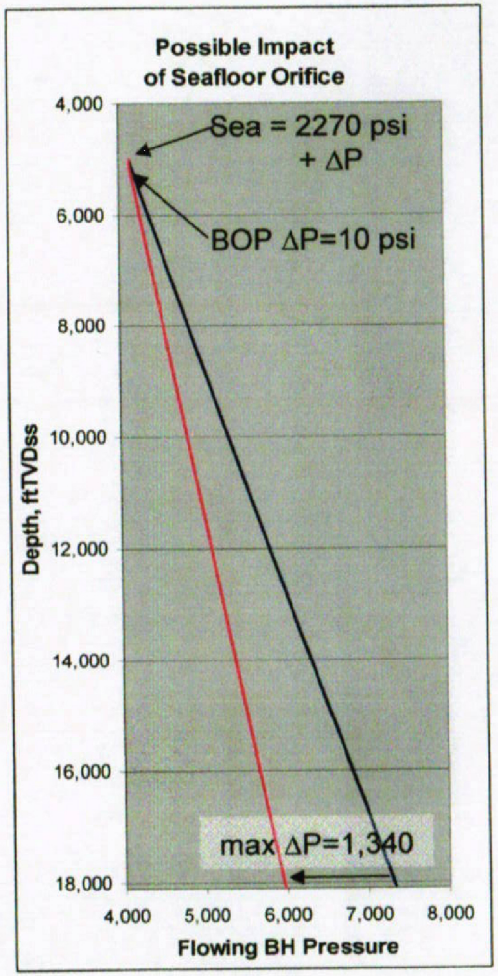


Macondo M1 Shut-In



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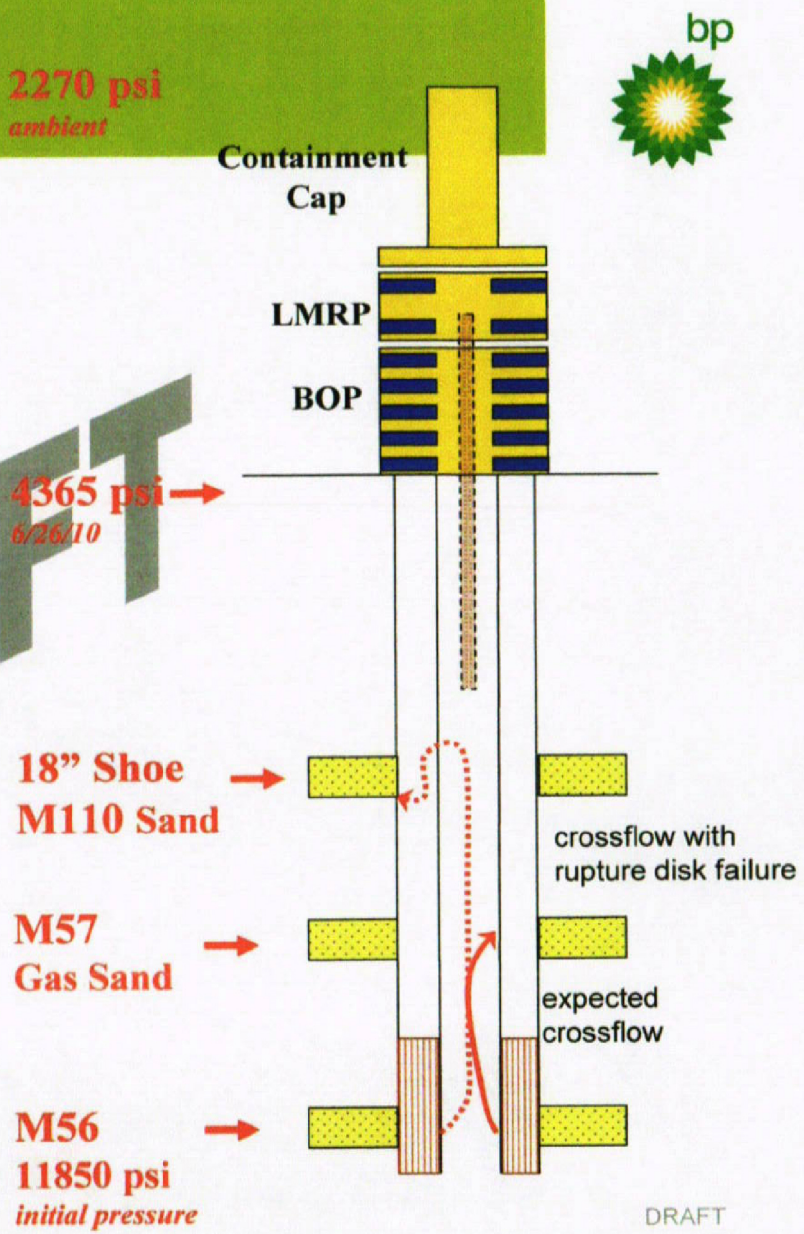

Back-Up

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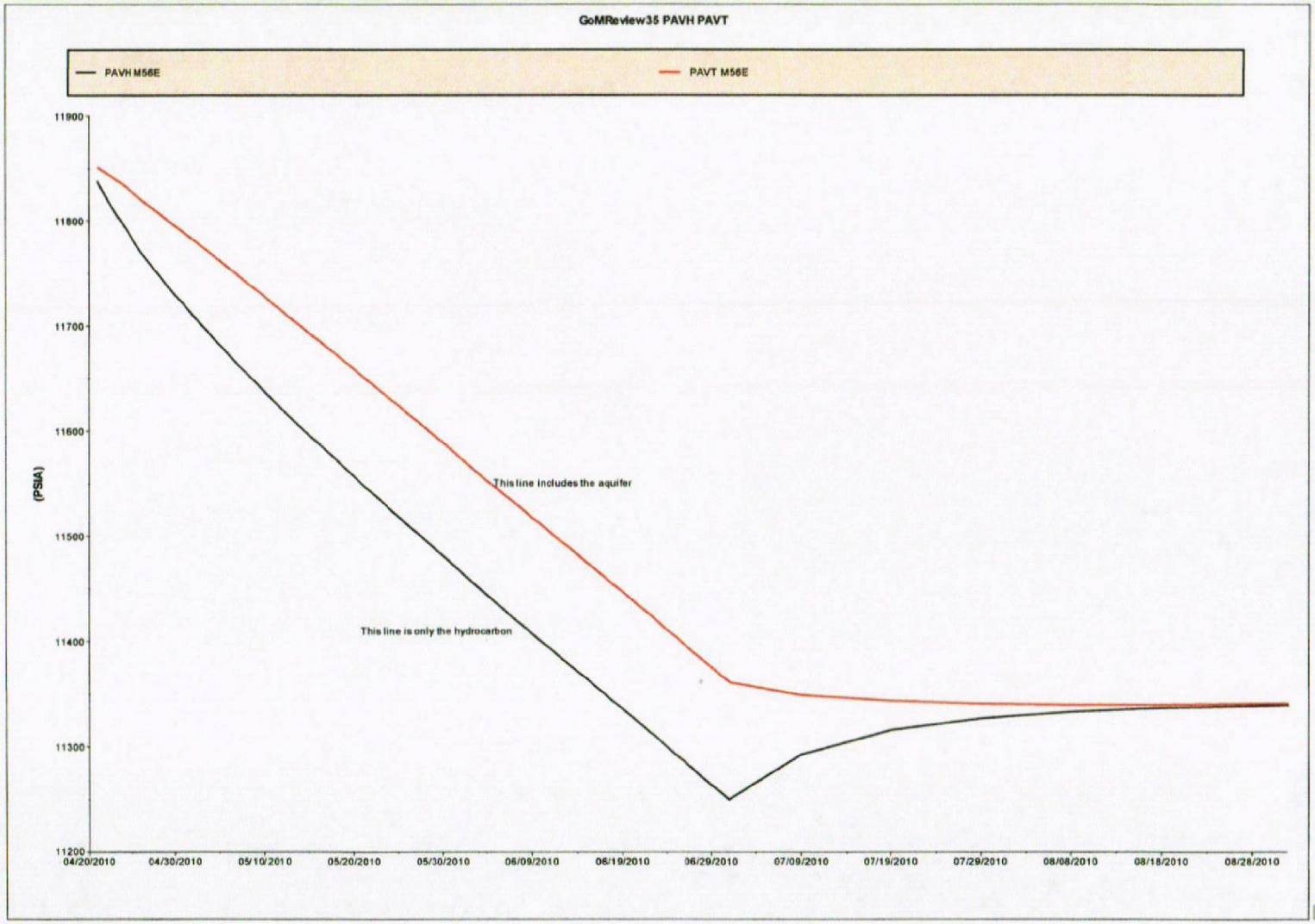

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MDM945-000321

TREX 010839.0027

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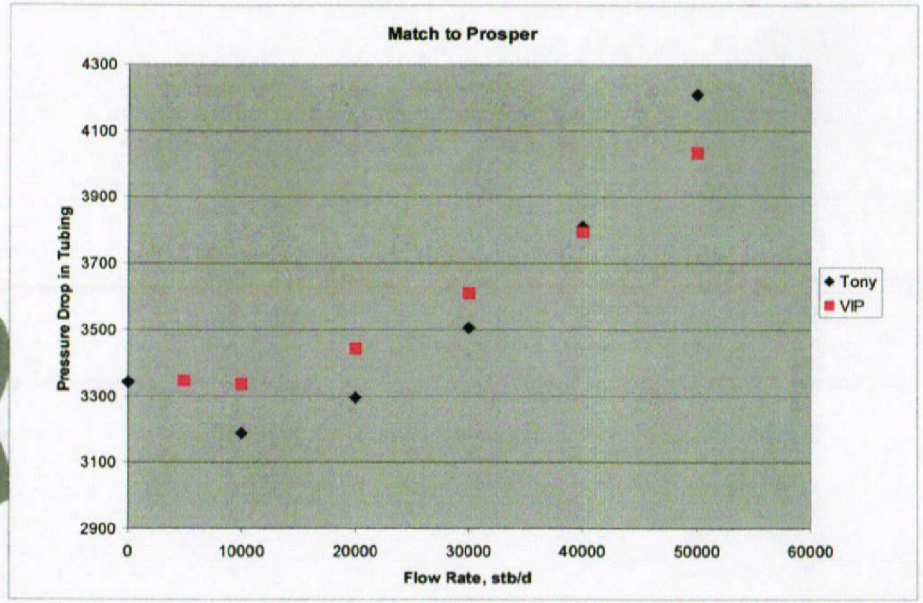

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MDM945-000322

TREX 010839.0028

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bp

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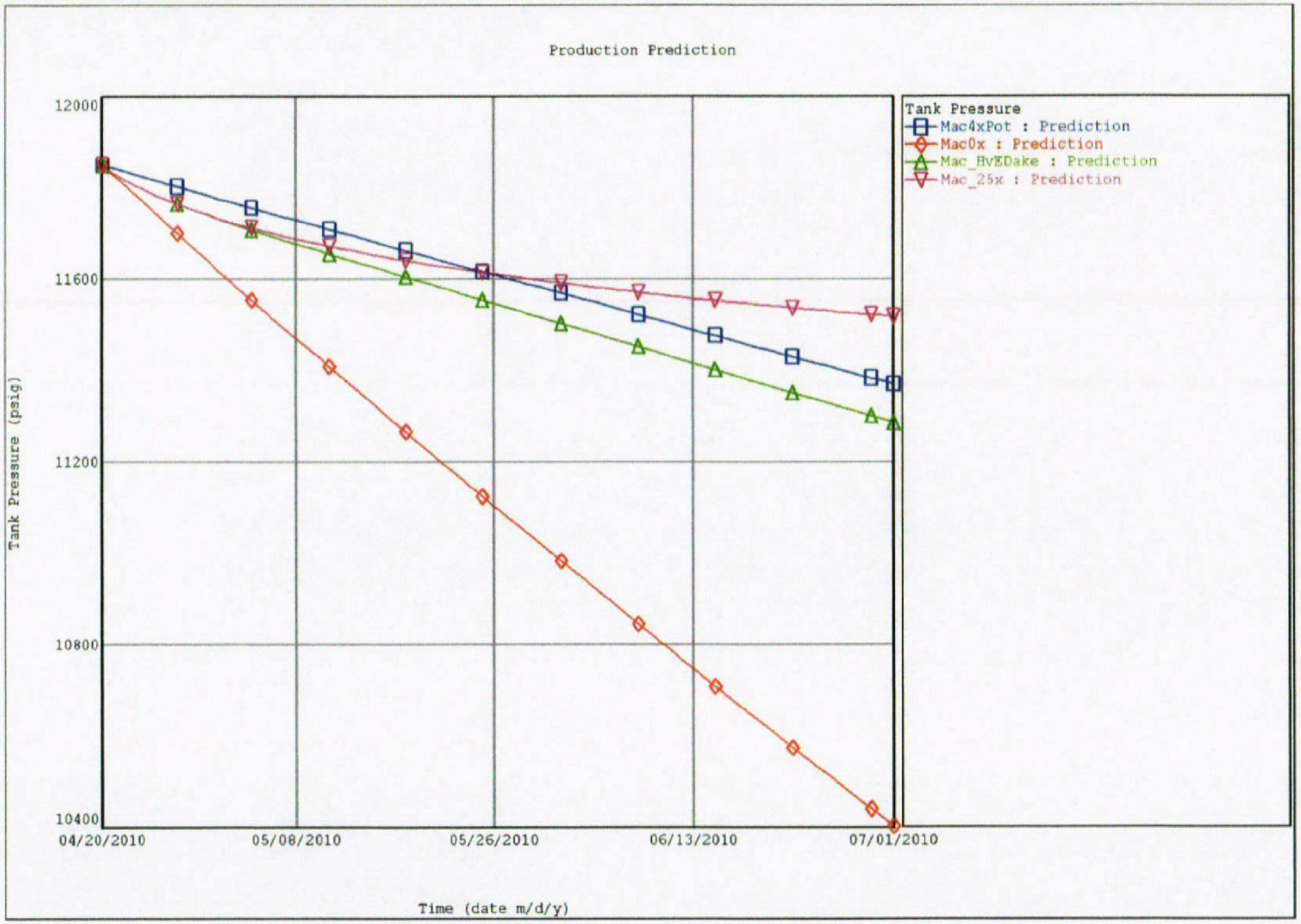

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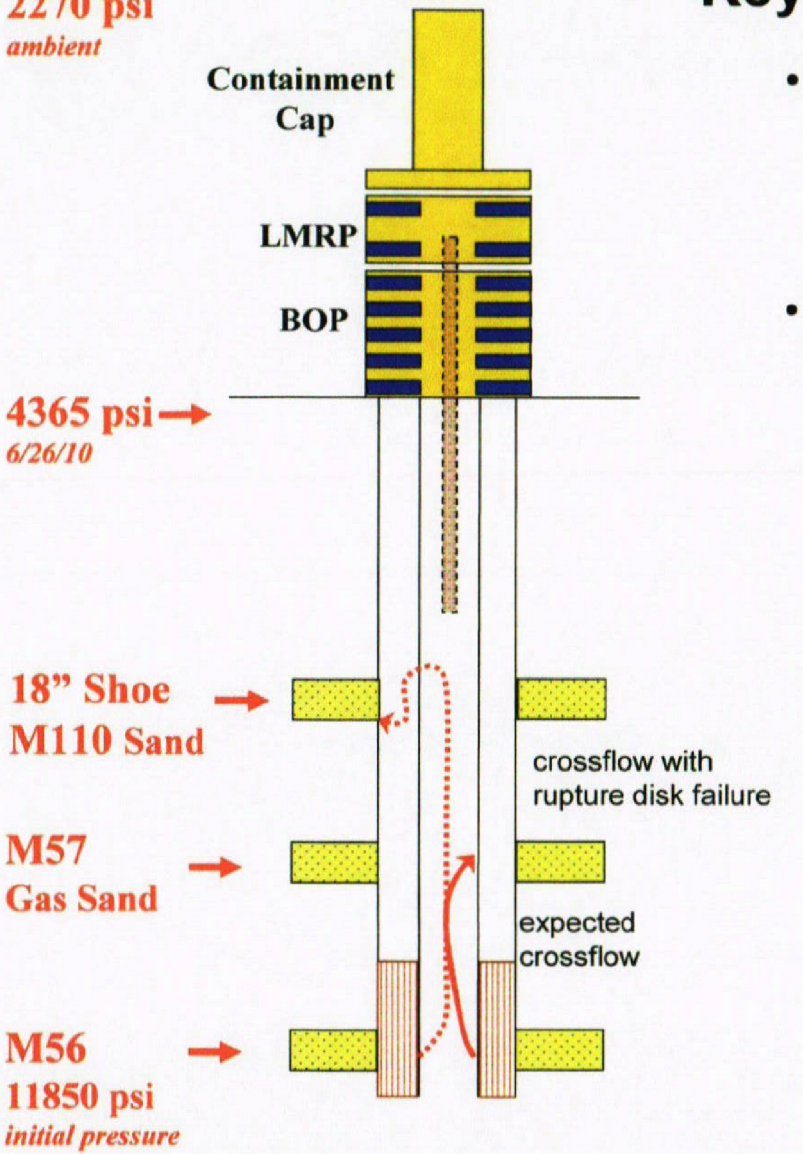

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MDM945-000325

TREX 010839.0031