pressure-based flow calcs

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Wereley, Steven T. to: pdy@clarkson.edu, pmbommer@mail.utexas.edu, Victor F Labson, George.Guthrie@NETL.DOE.GOV, Donald.Maclay@mms.gov, wsr@lanl.gov, Catherine_Cesnik@ios.doi.gov, Lori_Caramanian@ios.doi.gov 06/05/2010 09:55 PM

Cc: "Franklin.Shaffer@NETL.DOE.GOV", "ira.leifer@bubbleology.com", "mark_sogge@usgs.gov", "Chris.Barker@noaa.gov", "Kathryn_Moran@ostp.eop.gov", "mark_sogge@usgs.gov", "vhines@usgs.gov"

Hi all. I received the attached email--along with 4 million others... This guy does some calculations of flow rate using well geometry and so forth. I think this is Paul Bommer's area. I'm not sure it adds anything new to Paul's work, but it might be worth a quick look.

Best,

Steve Wereley, Professor of Mechanical Engineering
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----- Message from "Bray, Alan" <Alan.Bray@can.apachecorp.com> on Fri, 4 Jun 2010 00:30:05 -0400 -----

To: "Wereley, Steven T." <wereley@purdue.edu>

Subject: FW: Deep water Horizon estimated oil rate

Steve,

FYI: I approached the oil rate calculation in a different manner by calculating the flow potential based on the ability of the reservoir to deliver fluid to and up the wellbore. In petroleum engineering, this is called nodal analysis. I based the nodal analysis (attaqched) on the information I could piece together from news reports, senate committee testimony and my knowledge of GoM reservoirs. I assumed annular flow behind the 7" & 9-7/8" production casing (a copy of the wellbore schematic is attached as presented by Haliburton to the Senate committee). I suspect that the bent riser pipe was providing a significant restriction to flow and that prior to cutting the riser pipe the flow could have been between 12,000 to

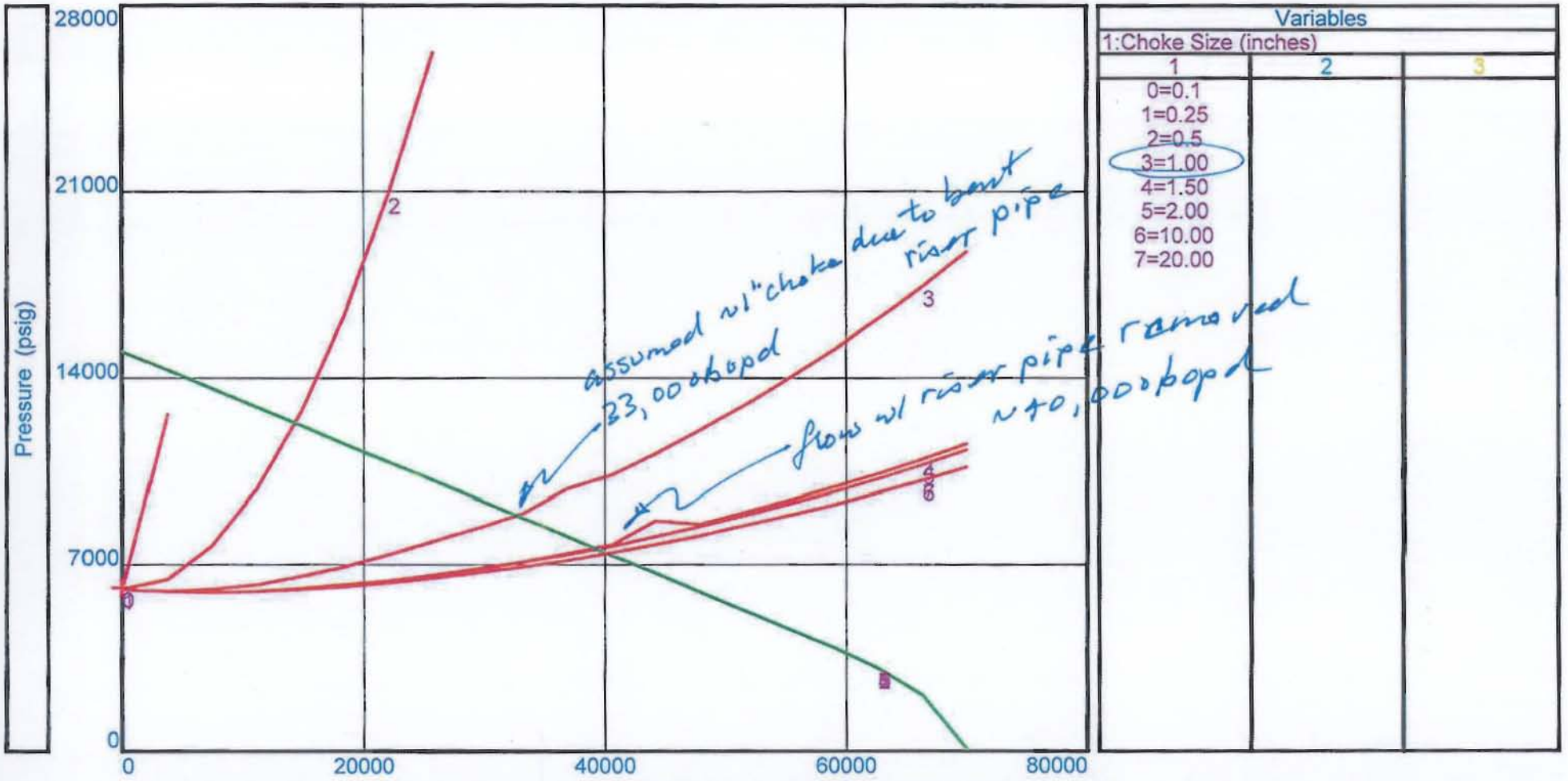
25,000bopd as you have estimated. Now that the riser pipe is removed the flow rate has likely increased dramatically and is probably more like about 40,000bopd. If I had a copy of the well logs or more information about the reservoir properties I would be able to do a better estimate. Any petroleum engineer is able to do these calculations.

Regards,

Alan Bray
Calgary, Alberta


20100603160825274.pdf oil-halliburton-cement-052010jpg-e618a2271a66c847.jpg

Inflow (IPR) v Outflow (VLP) Curves (06/01/10 09:13:09)



Variables		
1:Choke Size (inches)		
1	2	3
0=0.1		
1=0.25		
2=0.5		
3=1.00		
4=1.50		
5=2.00		
6=10.00		
7=20.00		

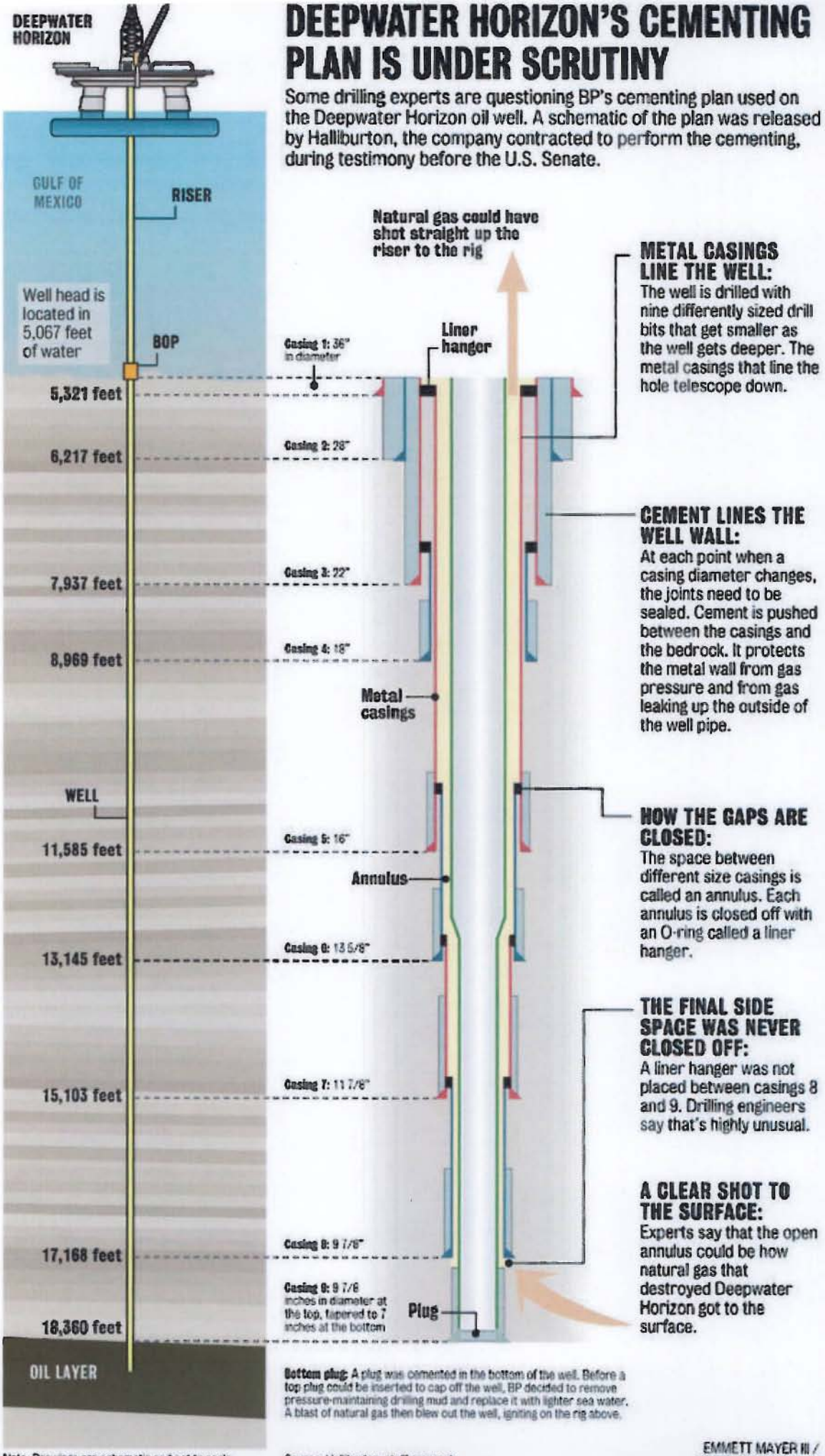
PVT Method	Black Oil
Fluid	Oil
Flow Type	Annular
Well Type	Producer
Artificial Lift	None
Lift Type	
Predicting	Pressure and Temperature
Temperature Model	Rough Approximation
Company	
Field	
Location	

Top Node Pressure	2165.00 (psig)
Water Cut	0 (percent)
Bottom Measured Depth	13349.0 (feet)
Bottom True Vertical Depth	13349.0 (feet)
Surface Equipment Correlation	Beggs and Brill
Vertical Lift Correlation	Petroleum Experts
Solution Node	Bottom Node
Left-Hand Intersection	DisAllow

Inflow Type	Single Branch
Completion	Cased Hole
Gravel Pack	No
Gas Coning	No
Reservoir Model	Darcy
M&G Skin Model	Enter Skin By Hand
Relative Permeability	No
Formation PI	11.80 (STB/day/
Absolute Open Flow (AOF)	0 (STB/day)

DEEPWATER HORIZON'S CEMENTING PLAN IS UNDER SCRUTINY

Some drilling experts are questioning BP's cementing plan used on the Deepwater Horizon oil well. A schematic of the plan was released by Halliburton, the company contracted to perform the cementing, during testimony before the U.S. Senate.



METAL CASINGS LINE THE WELL: The well is drilled with nine differently sized drill bits that get smaller as the well gets deeper. The metal casings that line the hole telescope down.

CEMENT LINES THE WELL WALL: At each point when a casing diameter changes, the joints need to be sealed. Cement is pushed between the casings and the bedrock. It protects the metal wall from gas pressure and from gas leaking up the outside of the well pipe.

HOW THE GAPS ARE CLOSED: The space between different size casings is called an annulus. Each annulus is closed off with an O-ring called a liner hanger.

THE FINAL SIDE SPACE WAS NEVER CLOSED OFF: A liner hanger was not placed between casings 8 and 9. Drilling engineers say that's highly unusual.

A CLEAR SHOT TO THE SURFACE: Experts say that the open annulus could be how natural gas that destroyed Deepwater Horizon got to the surface.

Bottom plug: A plug was cemented in the bottom of the well. Before a top plug could be inserted to cap off the well, BP decided to remove pressure-maintaining drilling mud and replace it with lighter sea water. A blast of natural gas then blew out the well, igniting on the rig above.

Note: Drawings are schematic and not to scale.

Source: Halliburton, staff research

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