

8.5x9.875" Open Hole Mud Loss Event Summary

Title: Macondo 8.5x9.875" Open Hole Mud Loss Event Summary

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Objective: To summarize and review the third drilling related mud loss event on the Macondo well and use the lessons learned and corrective actions for future wells.

Background: EPT was engaged in the planning phase of Macondo concerning stress cage and also engaged when loss events occurred. During and after the loss events a joint effort was made by EPT, Macondo drilling engineering, operations, subsurface and I to identify the cause of the losses, learn from the event, and apply the learnings as we drill ahead. During the review of the near 18" shoe event I asked for and received permission to share Macondo information with EPT to help in the review of the loss event. The information provided to EPT on the near 18" shoe event was daily mud reports, daily drilling reports, M-I SWACO daily stacked sieve information, daily geological reports, daily PPFG reports, and mud logger captured time based data on depth, rop, rpm, torque, flow in, flow out, riser flow, stand pipe pressure, pump rate and strokes.

Because of the previous weak shoe and mud loss events on Macondo, I decided to try a more proactive method of using EPT expertise by sending them the above mentioned data on a daily basis from the start of the 8.5"x9.875" interval. Mark Alberty and Jianguo Zhang with EPT agreed that this would allow them to be more proactive in their recommendations.

Pre Event: 14.75" x 16.5" OH 13.625" liner -After the Kick and stuck pipe event that occurred in the (14.75" x 16.5") interval below the 16" casing, the well was plugged back to 11,615' and side tracked. We kicked off the cement plug and drilled 14.75" x 16.5" hole to 13,150' MD with 12.3 ppg mwt and raised mud weight to 12.4 ppg before POOH to run the liner. Ran 13.625" liner with no mud losses, circulated with no losses, cemented losing 76 bbls.

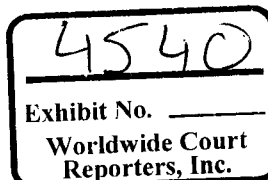
12.25" x 14.5" OH 11.875" liner -The mud weight was increased from 12.4 ppg to 12.5 ppg while drilling 13.625" the liner shoe track. 10' of new formation was drilled and LOT to 14.66 ppg EMW. Raised mud weight to 12.8 ppg and drilled 12.25" x 14.5" hole to 13,554' and weighted up to 13.0 ppg. Drilled to 13,930' and raised mwt to 13.2 ppg due to pore pressure increase. Drilled 14,581' and raised mwt to 13.3 ppg, at 14,754 ECD increased to 13.77 ppg and circulated to reduce to 13.72 ppg. Drilled to TD for interval at 15,113' and pumped 200 bbl high viscosity sweep and weighted up to 13.4 ppg. Sweep brought no increase in cuttings at the shakers. Ran 11.875" liner with no losses, circulated with 79 bbls lost and some evidence of ballooning. Lost 228 bbls while cementing.

10.625" x 12.25" OH 13.625" liner -Drilled shoe track and 10' of new formation with 10.625" x 12.25". Leak off tested the formation to 14.7 ppg EMW and raised mud weight to 13.6 ppg. Drilled ahead and increased mud weight to 13.7 ppg at 15,575', 13.8 ppg at 16,075', 13.9 ppg at 16,341', 14.0 ppg at 16,782', and drilled to interval TD of 17,173' and increased the mud weight to 14.1 ppg before running 9.875" liner. 59 bbls of mud was lost while running liner, 50 bbls circulating and 233 bbls while cementing.

Event Summary - 1st 8.5" x 9.875" interval event: Tripped in the hole with a 8.5" x 9.875" drilling assembly and weighed up to 14.3 ppg before drilling shoe track. 10' of new formation was drilled to 17,183' and FIT to 15.98 ppg EMW. Drilled to 17,634' and increased the mud weight to 14.5 ppg. Drilled to 17,761 MD and noted a 134 bbl loss. Flow check was unable to obtain a no flow and shut well in with 110 psi on choke and incrementally ballooned back to 0 psi over 6.5 hours. Pumped 184 bbl 84 ppb mixed LCM pill and spotted at 17,761' lost 41 bbls putting pill in place. Continued drilling to 17,835' and took GEO-TAP @ 17,723' with 14.15 ppg EMW. Cut the mud weight to 14.3 ppg and pumped a 178 bbl 84 ppb mixed LCM pill. Circulated bottoms up and got 309 units of gas. Flow checked at 17,634' and flowed back 16 bbls in one hour and well went static. Washed down to 17,835' and pumped 100 bbl 84 ppb mixed LCM pill. Drilled ahead to 17,909' with no mud losses noted. Total losses to this point were 233 bbls.

Event Summary - 2nd 8.5" x 9.875" event: Continued drilling to 18,195' and took GEO-TAP at 18,089' with 12.58 ppg EMW. Continued to drill to 18,260' where ROP dropped and a decision was made to increase the mud weight to 14.4 ppg and POOH for bit and reamer. At 9322 strokes of 14.4 ppg pumped complete returns were lost and annular was closed and 23 bbls of base oil was placed in the Kill line. Pumped 171 bbls of 84 ppb mixed LCM with the annular closed, looking for returns on Kill line side. Relieved pressure on annular and allowed mud to fall, pressures back up on the annular and topped off riser with 301 bbls of base oil. Opened the annular and the well was static. The calculated EMW at TD was 13.9 ppg. POOH into casing cutting mud weight on surface to from 14.3 to 14.0 ppg. Closed the annular and displace the riser to 14.0 ppg. Monitored the well on the kill line and the well was static. Pumped 184 bbls of 84 ppb mixed LCM pill with annular closed monitoring for returns from the kill line. No returns and drill pipe was slugged. Total losses to this point for the 2nd interval event were 1902 bbls.

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Stripped out of hole to 14,937' and pumped 80 bbls of Form-a-squeeze followed by 180 bbls of Form-a-set followed by 40 bbls of Form-a-squeeze followed with 14.0 ppg mud at 6 bbls per minute. Displaced out of drill string and squeezed pills at 0.5 bbls per minute building pressure to 132 psi after 78 bbls pumped. Waited 2.5 hours and bled 75 psi off and opened kill valve and monitored well on mini trip tank. Opened the annular and monitored the well on the trip tank. Decided to build another Form-a-squeeze/Form-a-set pill while waiting on 1st pill 3 more hours, opened the annular and observed losses were 12 bbls per hour. Pumped 80 bbls of the Form-a-squeeze pill into the drill pipe at 9.5 bbls per minute and had returns so decision was made to suspend pumping pills and pumped the 80 bbl Form-a-squeeze pill around and out cutting mud weight to 14.0 ppg. Closed annular and displaced choke and kill lines to 14.0 ppg. POOH and changed out bit and reamer (Baker reamer had all cutters broken or missing and blades were worn past cutter pockets).

Ramped up to full recommended stress cage background LCM ((8 ppb Safecarb 500, 7 ppb Safecarb 250, and 4 ppb of G-seal+) (420 micron fracture width)) and TIH breaking circulation regularly, and washed and reamed. While back-reaming the flow rate dropped from 39% to 29%, the pump pressure dropped from 2049 psi to 1924 psi, and the ECD dropped from 14.5 to 14.4 ppg. Monitored on trip tank. Initial losses were 6 BPH and ended the hour at 1.2 BPH with total lost in one hour of 3 bbls. Pumped 172 bbls of 84 ppb mixed LCM with full returns. Continued to wash and ream from 18,234' to 18,260' and drilled to 18,360 losing total of 51 bbls.

E-logged well for 5 days with well staying static. TIH with and cleaned out with no losses, POOH and could not retrieve the wear bushing. POOH, picked up tool, TIH and retrieved wear bushing. Picked up and ran the 7" x 9.875" production casing string and TIH with no mud losses. Circulated and cemented with no mud losses.

The total mud losses for this interval were 3271 bbls bbls.

Post Discussion Points:

- Weeks after the Macondo 20" hole mud loss event, BP experts still differed as to the characterization of the event.
- Current BP process is to determine the character of the losses and apply the appropriate LCM strategy.
- The M-I SWACO "tandem pill" (form-a-squeeze/Form-a-set,) when mixed correctly solved the problem on the 20" open hole mud loss event even though the characterization of the loss event was still unclear.
- The M-I SWACO "tandem pill" also solved the problem in this interval, even though at the time of the application, the characterization of this loss event was still unclear.
- Because of these reasons and the dual nature of the M-I SWACO "tandem pill", the M-I SWACO "tandem pill" has been recommended as the first choice for induced axial fractures on the Macondo relief wells.
- The other mud vendors have similar de-fluidizing and crosslink polymer pills that can be combined and pumped in a "tandem pill" configuration.
- It is important to consider large pills for mud loss situations which call for them.

Stacked Sieve Data:




3/28/2010	4/3/2010	4/4/2010
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			100.0 ml	LBS/BL	100.0 ml	LBS/BL	100.0 ml	LBS/BL
18	1000	1000						
20	841	850						
25	707	710	0.025	0.1	0.025	0.1	0.01	0.0
30	595	600						
35	500	500	0.125	0.5	0.125	0.5	0.15	0.6
40	420	425						
45	354	355						
50	297	300						
60	250	250	0.25	1.0	0.25	1.0	0.25	1.0
70	210	212						
80	177	180						
100	149	150						
120	125	125						
140	105	106	1.75	6.7	1.5	5.8	1.5	5.8
170	88	90						
200	74	75	2	7.7	2.25	8.7	2.5	9.6
This fluid contains LPM (lbs/bbl) Larger than (microns)			16 ppb 75		16 ppb 75		17 ppb 75	

Stacked Sieve Data: (continued) (mud losses caused 4/7/2010 concentration to drop)

		4/7/2010	4/8/2010	4/9/2010
		100.0 ml	100.0 ml	100.0 ml
		LBS/BL	LBS/BL	LBS/BL

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18	1000	1000						
20	841	850						
25	707	710	0					
30	595	600						
35	500	500	0.15	0.6	2	7.7	2.1	8.1
40	420	425						
45	354	355						
50	297	300						
60	250	250	0.25	1.0	1.75	6.7	1.75	6.7
70	210	212						
80	177	180						
100	149	150						
120	125	125						
140	105	106	1	3.9	0.75	2.9	0.5	1.9
170	88	90						
200	74	75	1.75	6.7	0.75	2.9	0.75	2.9
This fluid contains LPM (lbs/bbl) Larger than (microns)			12 ppb 75		20 ppb 75		20 ppb 75	

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