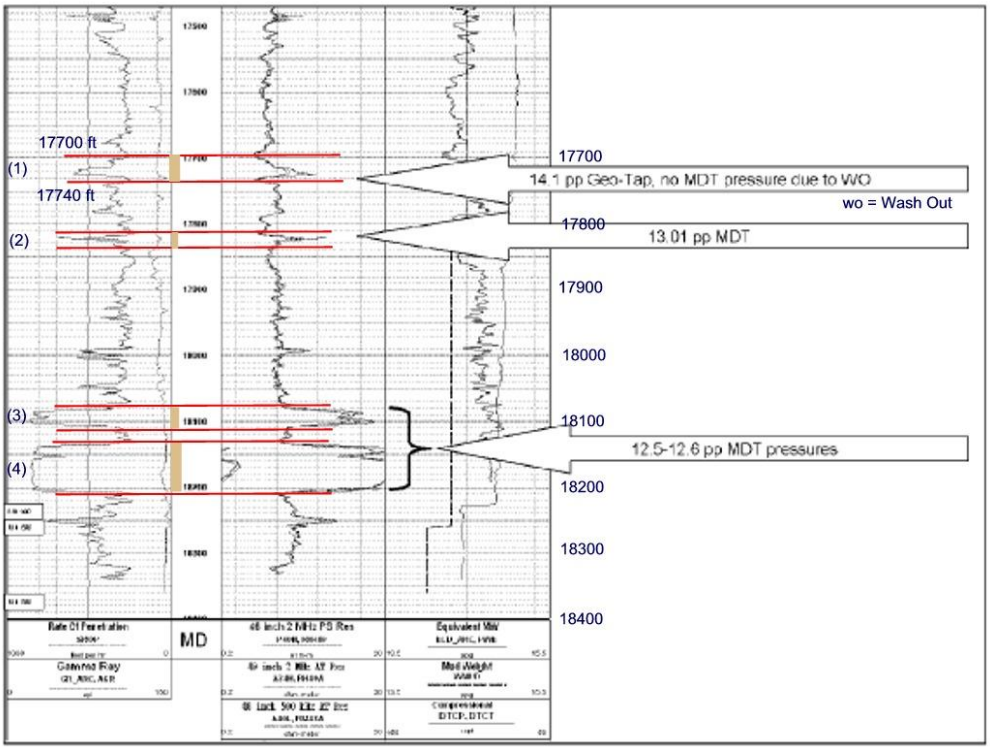
What the Marine Board Investigation is Missing?

The following was developed from examination of two key documents as posted on the House of Representatives – Committee on Energy and Commerce Website as listed in the references. The figure and table were taken from these references.

(1) The Marine Board hasn't gone back enough and discussed the evaluation phase (WL logs, LWD, MDT, Geotap data, mud logs, rig daily log) of the final section.

The team Well Leader, Mr. John Guide, defended the use of the six centralizers as adequate since they would be placed opposite the pay zone, presumably from 18,083 to 18,136 ft. Is this the only HC zone? There is evidence now to support the top of the hydrocarbon zone as high as 17,700 ft.

What did the formation look like before casing was landed in the hole? Could there have been hydrocarbon zones above 18038'? There is a zone from 17,700 to 17,740' that BP indicates has a pressure of 14 ppg, from Geo-tap. Could it be a gas zone?



(BP's figure, BP-HZN-CEC022030, see references, colored lines and writing have been added)

From the logs above, the MDT tool attempted to test 3 zones. According to the log (I assume this is a LWD log, with GR and induction logs), this is in a washed-out zone. While I show four zones, there could be six zones, if one counts the approximately 5 ft zone beginning at 17,995 to 18,000 ft and the zone 18,250 to 18,255 ft. It is just a possibility. All logs and associated records need to be examined.

Also note that the MDT (modular dynamic tester from Schlumberger) collects fluid samples. The gas-to-oil ratios occasionally reported from BP as they produced from the top hat were high, some over 2,000 SCF/STB that might suggest a contributing gas zone. Of course, one would examine all information before making this determination. The Board should request from Schlumberger all of the fluid analyses done on the Macondo well.

The board does itself and the industry a great disservice if they limit the technical scope at this critical juncture. John Guide's testimony should allow the Board to further investigate which zones in the final sections could be hydrocarbon bearing. Formation data from the Macondo well and the relief well may shed light in this area.

(2) Why doesn't the OptiCem report show a more complete set of data on wellbore geometry?

One would expect that the hole diameter to come from the caliper log, and readings would be every ½ foot. I was particular interested in the zone 1, (17,700 to 17,740') where a wash out was reported. In this interval, there is only one hole depth, at 17,719.5' with a hole diameter of 10.801". How does this affect the cement volume calculations? I would also expect the directional surveys to have data every half a foot. It is possible that this has not been included in the print out.

Reference: HAL-0010593, see references.

1.5 Wellbore Geometry

MD	Hole Ex.	Hole Dia.	Casing OD	Casing ID	Casing Weight
ft	%	in	in	in	lb/ft
5067.0	0.00	19.500	6.625	5.426	32.000
5069.0	0.00	14.920	14.300	8.625	62.800
11185.0	0.00	14.920	9.875	8.625	62.800
12600.0	0.00	12.375	9.875	8.625	62.800
12800.0	0.00	12.375	7.000	6.094	32.000
14803.0	0.00	10.711	7.000	6.094	32.000
17168.0	0.00	8.625	7.000	6.094	32.000
17284.5	0.00	9.700	7.000	6.094	32.000
17352.0	0.00	10.139	7.000	6.094	32.000
17579.5	0.00	10.176	7.000	6.094	32.000
17619.5	0.00	10.555	7.000	6.094	32.000
17639.0	0.00	10.660	7.000	6.094	32.000
17680.5	0.00	10.901	7.000	6.094	32.000
17686.0	0.00	11.578	7.000	6.094	32.000
17719.5	0.00	10.601	7.000	6.094	32.000
17774.0	0.00	10.417	7.000	6.094	32.000
17787.0	0.00	11.140	7.000	6.094	32.000
17803.5	0.00	11.180	7.000	6.094	32.000
17810.5	0.00	10.167	7.000	6.094	32.000
17829.5	0.00	11.469	7.000	6.094	32.000
17848.5	0.00	11.474	7.000	6.094	32.000
17864.0	0.00	10.642	7.000	6.094	32.000
17890.5	0.00	10.740	7.000	6.094	32.000
17910.5	0.00	10.601	7.000	6.094	32.000
17935.0	0.00	10.688	7.000	6.094	32.000
18061.0	0.00	10.550	7.000	6.094	32.000
18105.0	0.00	9.502	7.000	6.094	32.000
18107.5	0.00	11.215	7.000	6.094	32.000
18191.5	0.00	8.755	7.000	6.094	32.000
18300.0	0.00	8.998	7.000	6.094	32.000

I would like to know which caliper log they used. There would normally be a number of caliper logs run, each a bit different. For example, a caliper log run with a density log might show a larger hole because the density tool is a pad tool, with a plow shape in front designed to scrape off the mud cake. A four or six arm caliper, if run, gives a full picture of the wellbore geometry. It would also seem, if there were differences in caliper runs, the highest caliper (or hole size) should be used, to be conservative of cement volumes.

(3) Circulating Bottom Hole temperature used in OptiCem appears under estimated. I would like more details.

The static bottom hole temperature at a bottom hole depth of 18,300 ft is 262 ^{o}F as stated on the completion diagram, supplied by BP. In the Halliburton Production Casing Design Report, (Reference 3), the circulating annulus and casing temperature at 18,300 ft is given as 135 ^{o}F, page 9. Circulating temperatures should be lower than static temperatures, but these differences seemed large.

Articles on HTHP cementing highlight the circulating temperature as an important parameter. In IADC/ SPE 74483 (Optimizing HTHP Cementing Operations, 2002), states:

> "The following formula has proven to be the most accurate for use in determining Bottom Hole Circulating Temperatures (BHCT) in comparison with down hole circulating probes and computer simulation temperature software:
>
> Circulating Temperature for Casing or line cement jobs (not squeezes)
>
> $$BHCT = 80.0 + \frac{0.66(BHPTPC - 80) - 8.5}{1 - 0.0000111D}$$
>
> where BHCT = Bottom Hole Circulating Temperature, ^{o}F, BHTPC = Bottom Hole temperature prior to circulation, ^{o}F, = maximum log temperature and D = depth in ft."

The paper is authored by John Shaughnessey, BP America and John Helweg, Schlumberger Dowell.

Using the above formula, BHCT is 220 ^{o}F for a BHST = 262 ^{o}F at a depth of 18,300 ft. I do not know how this would affect the calculated results.

References

1. British Petroleum, "TD Forward Plan Review, Production Casing and TA Options, BP-HZN-CEC022030, as posted to the House of Representatives- Committee on Energy and Commerce website.

2. Halliburton, "9-7/8 x 7" Production Casing Design Report", HAL-0010592 (cover page), HAL-0010596 (Table showing hole diameters), HAL-0010598 (BHCT = 135 deg F)

3. Shaughnessy, J. and Helweg, J. Optimized HTHP Cementing Operations, IADC/ SPE 74483, as presented at the IADC/SPE Drilling Conference held in Dallas, TX 26-28, February.