

From: Bodek, Robert
Sent: Thu Mar 18 16:11:47 2010
To: Bellow, Jonathan M; Lacy, Stuart C (QO Inc.); 'Gord Bennett'; 'John Brannen'; Brannen, John (QO Inc.); Paine, Kate (QuaDril Energy LT); 'katepaine@aol.com'; Deepwater Horizon, Sperry Sun; Deepwater Horizon, MWD Directional; Guide, John; Hafle, Mark E; Morel, Brian P; Bondurant, Charles H
Cc: Johnston, Paul J (Houston); Vinson, Graham (Pinky); Albertin, Martin L.; Wagner, Bruce E
Subject: Lesson learned - Plan forward: Macondo
Importance: High
Attachments: Lessons learned_plan forward Macondo SS NPT.doc

Macondo Team,
I've collated the responses to Jon's original email below. Additionally, we on the TIGER team have had several discussions over the past few days regarding lessons learnt from previous hole-section, and a way forward, for not only the remainder of Macondo, but future exploration wells. Please browse the attached lessons learnt/plan forward document and provide feedback should you feel obliged.
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Thank you,
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From: Bellow, Jonathan M
Sent: Friday, March 12, 2010 7:14 AM
To: Lacy, Stuart C (QO Inc.); Gord Bennett; John Brannen; Brannen, John (QO Inc.); Paine, Kate (QuaDril Energy LT); katepaine@aol.com; Deepwater Horizon, Sperry Sun; Deepwater Horizon, MWD Directional; Guide, John; Hafle, Mark E; Morel, Brian P; Bondurant, Charles H
Cc: Bodek, Robert; Johnston, Paul J (Houston); Vinson, Graham (Pinky); Sims, David C; Albertin, Martin L.; Wagner, Bruce E
Subject: Some Thoughts and Help Requested, PP detection, Macondo

All: As we have some time while we recover from the Macondo stuck pipe and kick event, I want to spend some time re-evaluating how we manage real time pore pressure detection for Macondo type wells. By Macondo type wells, I mean those wells without thick salt sections that usually have narrow drilling windows for a large part of the well. I believe that we can learn from Macondo to allow these kind of wells to be successfully drilled without subsurface NPT events. To that end several conversations will take place over the next couple of weeks to assist us in making better pore pressure detections decisions as we drill the remaining hole sections at Macondo. In writing this note, I want to make sure that no one feels that we made poor decisions with these events. We have been spoiled in exploration on the Deepwater Horizon with having wells like Tiber, Freedom, Kodiak, Big Kahuna, Kaskida that have had salt sections thick enough to allow us a luxury of a wider drilling margin. We are very very good at salt exit now. We have not drilled a huge number of these "no salt narrow drilling window" wells. The purpose of this note is three fold. First I want to raise the issue, second, I want to provide some initial thoughts that we have come up with to assist with improved performance with pore pressure, and third, and most important, we are also asking for your help. This team has a huge amount of experience and we want to hear all of your inputs and suggestions. I am confident, that once we have these discussions and put refined procedures in place, we will be successful as we always are. Please regard these discussions as a huge learning opportunity. As for our initial thoughts, in looking at the kick events there were signs of pore pressure with all events. They were in some cases subtle and again, considering the type wells we usually drill, we get away with having some



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connection gas or sonic showing a PP increase. With these tighter margin wells, I want to get to a place where we are considering the all data suggesting PP change much more carefully in Macando type wells. We need to have larger conversations on all signs of PP change with these wells and as soon as the change is observed. We need to be prepared to use dummy connections, D exponent, sonic and any other indicator with more rigor. We can perhaps afford wait longer to raise the flag and watch for a PP trend we were confident in thick salt wells. However, in these narrow window wells, we believe we need to have PP conversations as soon as ANY indicator shows a change in PP. We also need to be prepared to have some false alarms and not be afraid of it. We need to have the entire team more aware and focused on ALL PP indicators with the mentality that a couple of dummy connections and a circulation time costs far less then three kick events.

Specifically to the Macando data, all three events are preceded by gas events. There are indications of a PP increase in the normalized gas values prior to the kicks. The first two kicks have elevated gas levels and occurrences of C2 and C3 levels prior to the kick event. This last event was preceded by two connections gas peaks. In this last event there was a significant event with the D exponent from the normal trend at least 150 feet below the kick. There were also cavings that although not PP related, gave us an indication of other issues that would require more mud weight. The sonic data also showed an upward trend in PP. All of these signs were present but at 85 feet per hour, occur quickly in "real time". We just need to refine our process to allow quicker conversations to occur and ensure that we are monitoring all relevant PP trend data.

Once we recover from this event, Bobby Bodek is planning to be on the rig to asset with implementing the improvements thought of in this conversation. I would ask that all of you think of the last events and offer suggestions and improvements to our process. WE will capture these comments and suggestions and use these to create a better proceeds to allow us to drill Macando and future similar wells with the same low NPT that we drilled Tiber. Thanks for all of you help folks. This effort will not be successful without your help and input. We appreciate your help in starting this conversation.

Jon

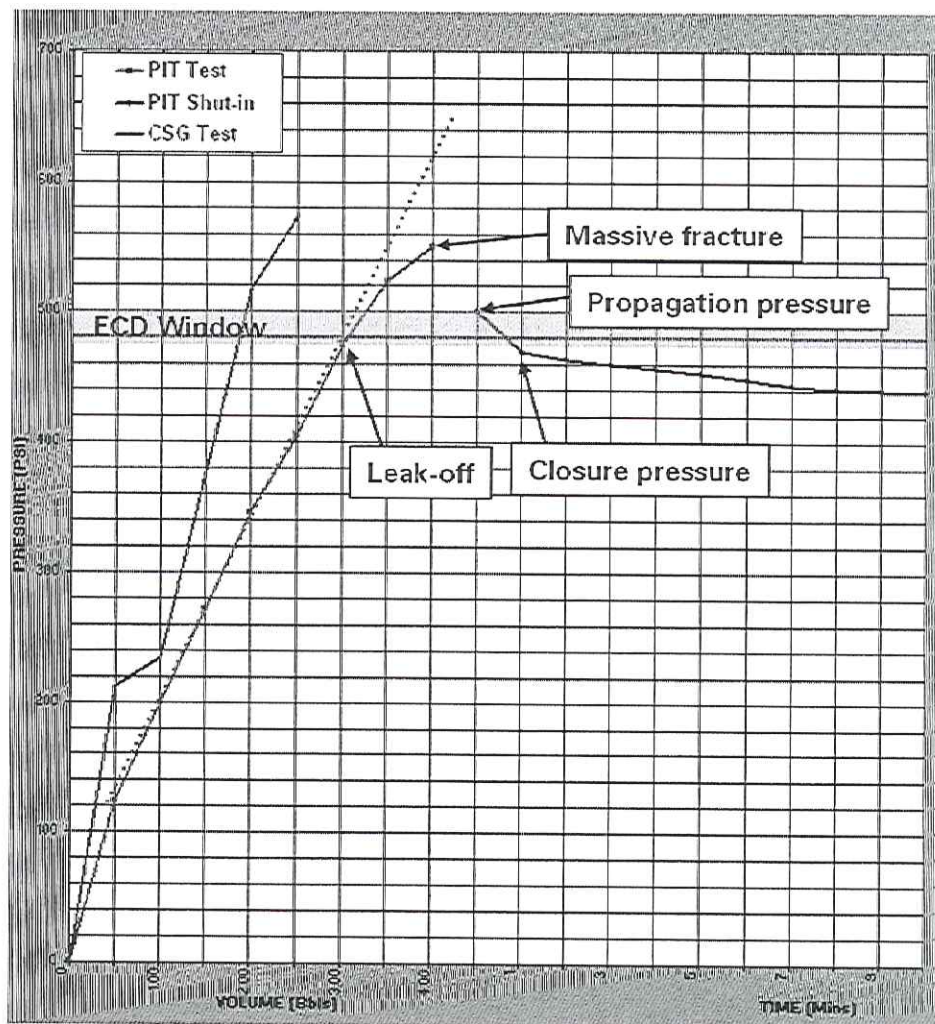
Jonathan M. Bellow

Operations Coordinator

Lessons learned and path forward: Macondo subsurface NPT events

1. When interpreting graphical leak-off test results, understanding the significance of the leak-off, fracture propagation, and fracture pressures is imperative. The value that is reported to the MMS is the surface fracture pressure. It is at this downhole equivalent pressure that a large fracture(s) has/have been formed. ECD values should be maintained between the fracture initiation pressure (leak-off), and fracture propagation pressure. Once the ECD values approach the downhole equivalent of the MMS reported surface fracture pressure, fracture failure and corresponding fluid losses are imminent.

It should also be noted that weaker lithologies (i.e. – sand or marl) can be present in shallow reaches of the hole-section that may behave more brittle than the lithology exposed at the shoe during the leak-off test. As a good practice, the ECD value should be maintained more towards the leak-off value to mitigate the chances of losses into a weaker lithology.



2. The entire breadth of pore-pressure indicators need to be evaluated under higher scrutiny. A systematic approach of integrating sonic/resistivity modeling, cutting/caving description, d-exponent, background gas, flowback fingerprinting, normalized gas curves, and gas ratio analysis need to be implemented. Thus far on this well, it has been shown that one or more pore-pressure indicators have provided ambiguous or even contradictory data. A more robust analysis of all indicators would allow us to better discern systemic pore-pressure changes from localized anomalies.
3. The application of some traditional exploration drilling practices needs to be considered. In wells with narrow drilling margins, drilling techniques such as drilling at reduced ROP, only having one connection in the hole at one time, simulating connections, performing flow-checks when a sand interval is cut, and circulating to manage ECD should be employed.
4. Better lines of communication, both amongst the rig subsurface and drilling personnel, and with Houston office needs to be reestablished. Preceding each well control event, subtle indicators of pore pressure increase were either not recognized, or not discussed amongst the greater group. It is the responsibility of the mudloggers and wellsite PP/FG personnel to openly communicate with the wellsite geologist. The wellsite geologist is the subsurface single point of contact on the wellsite. The wellsite geologist communicates to both the operations geologist and wellsite leader. Discussion points such as those outlined in the previous bullet point #3, for example, can be initiated by a wellsite geologist – wellsite leader conversation.

In retrospect, after compiling the above list of observations from various individuals, it seems that the accelerated rate of penetration and the resulting 'onslaught' of drilling indicators exceeded the ability of all team members to effectively recognize, properly communicate, and decisively act upon available data.

I would like to propose the following for the remainder of the Macondo well:

1. Rig-based subsurface personnel, including, but not limited to, the wellsite geologist, wellsite PP/FG detection analyst, and the mud logger(s), will meet at least twice/day, preferably at tour change, to discuss the data acquired over the past 12 hours, and plan forward. Consensus regarding the interpretation of the data will be achieved and communicated to the operation geologist. This communication will be delivered prior to 0730hrs morning call.
2. Subsurface personnel need to evaluate the entire suite of drilling parameters that may be indicative of a shift in pore-pressure.
 - a. Resistivity and sonic are to be modeled real-time at the wellsite during the evening tour, and by the office-based PP/FG SPA during the workday hours.
 - b. Cutting and cavings are monitored, described, and analyzed for tell-tale pressure indicators as they are lagged-up.

- c. Background gas and d-exponent are displayed on the real-time displays on the rig, in the operations room, and in a standard template in INSITE anywhere.
 - d. Sperry drilling services provides flowback fingerprints, and gas ratio analysis on each lagged connection, and a normalized gas curve
- 3. Rate of penetration is such that all the aforementioned indicators can be adequately evaluated in 'real-time'. Practices such as having only one connection in the hole at one time while drilling in tight drilling margins (less than 0.5ppg), stopping and circulating during times of uncertainty, simulating connections at half-stands, and performing flow-checks when a sand is cut while drilling in a tight drilling window (less than 0.5ppg) will be employed.
- 4. All indicators, no matter how subtle, will be discussed by the rig-based subsurface personnel and communicated to the rig foreman and operations geologist. Issues requiring a more in-depth discussion will be brought to the greater group. In the spirit of heightened sensitivity, and increased conversation, please be prepared for some "false alarm" discussions.