From: Beynet, Pierre A
Sent: Mon Apr 26 09:13:41 2010
To: Beynet, Pierre A; Austin, Julian; Cook, Howard H; Owen, Les L
Cc: Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Pattillo, Phillip D; Neilson, Ian
Subject: Where is the choke? Setting priorities
Importance: Normal

All,

There are a lot of assumptions going into an FEA. Redundancy is the best way in reducing uncertainty in hardware and in engineering conclusions.
A lot ride on our estimate of the opening size in the riser kink and where the choke is and how long it will last.

As I say below my copper pipe kink almost seal when I keep a small bending moment on it. Yes , thin copper is different than 1 in steel but it is an indication.

The flexjoint is bottom out indicating a substantial moment in the FJ and most likely in the kink.
By looking at the pictures I conclude that the moment is a a closing moment. Let me know if you agree on that one.

I am asking to raise the priority of :

1) 3 D image processing . I should be able to get the work started this morning with one firm.

2) taking pictures every 30 degrees around the kink.

4) Acoustical leak survey.

5) Stereo still images of the kink - mobilize Welaptega stereo camera - to allow 3D reconstruction ?

An other point. At the choke point there is most likely a very large change in temperature, may be a large drop in temperature. A lot of gas is coming out of solution. I am far from an expert on the subject.
A thermal survey of the BOP, kink and riser may give us an indication of where that pressure drop is or is not and thus providing redundancy to our line of though.

If a large cooling is taking place we may have hydrate formation if water is present. We

need to find out what the fluid composition. If there is no water will injecting water in the drill pipe lead a sealing hydrate plug? Probably not the hydrate crystals will probably be washed away. As I say I am not an expert. I will contact a flow expert today.

I am writing these Emails so that we can all think faster and again to provide redundancy.

Sincerely,

Pierre

From: Beynet, Pierre A
Sent: Sunday, April 25, 2010 7:40 PM
To: Austin, Julian; Cook, Howard H; Owen, Les L
Cc: Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Pattillo, Phillip D; Neilson, Ian
Subject: RE: Info Requests to the IMT

All,

1) Are the plastic FEA large opening results correct? A lot ride on the answer. My copper pipe kink is almost sealing I keep the bending moment on, however when I release the bending moment I have a large leak. I suspect that the riser when it landed overshoot it present position and thus the moment on the kink is partially released.
Would further test with steel pipe with the correct t/D teach us more? It may show a crack on the outer edge of the corners.

2) I question our priorities, they are correct if we think that the kink and the riser are the choke. We do not know. Now that we suspect otherwise I would raise the priority of finding where the choke is. May be can prove that it is not in the riser using acoustical survey for example. We have to be careful, we may have a leak through a capillary or porous medias (junk) and we would not hear it.

3) If we are convinced that the riser or the kink do not choke the flow, then the hose clamp mentioned by Julian is a good idea. We shall try it on land first to make sure that the steel will not start to rip at the two edges starting a traveling tear. By shaping the jaws and adding some sealing material on the edges we should be able to get a seal.

The clamp will need axial anchorage too.

Pierre

From: Austin, Julian
Sent: Sunday, April 25, 2010 5:59 PM
To: Cook, Howard H; Owen, Les L
Cc: Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Beynet, Pierre A; Pattillo, Phillip D; Neilson, Ian
Subject: RE: Info Requests to the IMT

All,

One additional suggestion I would like to make. It may be early days, however, if there is another restriction in the system that may deteriorate or if there are plans to cap the riser, then in my opinion we really should be tackling a design mitigation option to pinch across the kink. As things stand, the minimum cross section is pretty useless at retaining pressure and will likely want to open up under significant internal pressure, thereby applying a strain reversal to material that has already been loaded beyond its ductility in compression. There is a real risk that the material in the internal corner of the kink will tear in this case - Pierre, try to unbend one of your copper pipe bends - there's a good chance it will break. The current flat appearance of the outside of the kink may be an indication that the internal pressure upstream of the kink could be currently less than 7500psi (which would also explain the low leak rate) - I may be able to confirm this using the FEA as we already saw considerable flexure of this surface when applying a 2500psi external pressure. As I said today, I will be surprised to find that the kink would be able to withstand 10ksi internal pressure without mechanical reinforcement.

The mechanical advantage at the kink is pretty good from a clamping viewpoint - the nearly flat lobes of the dogbone shape should have little resistance to being clamped, and there may not be much differential pressure present currently if the primary choking element is downhole. The majority of the work may already have been done in forming the kink. We would need a deep beam to be placed across the inside of the kink and a corresponding one outside, joined by tie bolts, whose function is to flatten the dogbone into a metal to metal seal across the full width of the kink, just like a normal hose clamp. As long as we don't apply excessive force and bite through the kink we should be in with a good chance of achieving effective pressure containment.

This option could provide us with a confident means of capping the well, can be designed and substantiated within the existing FEA model, and may well prove to be necessary to permit the kink to resist full wellhead pressure in any case. I think it is worth pursuing such a concept now, in case the pressure conditions change adversely in the near future.

Comments?
Julian

From: Cook, Howard H
Sent: 25 April 2010 22:56
To: Owen, Les L
Cc: Austin, Julian; Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Beynet, Pierre A; Pattillo, Phillip D; Neilson, Ian
Subject: Info Requests to the IMT

Les

You agreed to act as compiler of possible requests from this team to the IMT. Thanks!

Here is a summary of those I've collated from my notes and I heard proposed in our telecalls over the last 2 days. I'd invite others to add to this list.
I think it's useful to categorise them - I have suggested two groupings below.
Prioritisation is also necessary. Some I have already suggested as High/Near term or Low/Longer term - but I think we need a group discussion to agree priorities of those in group 2. Some we may decide to discount after further discussion, or as other results become available.

1. Data to support the analytical work
Either because it provides better input data, or because it helps confirm analysis results.

1.1 Survey data local to the kink (as requested by Julian) - to confirm the local kink geometry and support F-Nash local FEA model.
1.2 Survey data of the whole global riser configuration to support 2H riser model. (Mike Tognarelli can discuss further with 2H and provide further clarity on my suggestins below).

- of riser joint i.d.s to allow comparison with the original stack-up, as input to the global model and hence determine possible buried riser profile
- estimates of riser pipe burial depth for all buried sections, and any associated trench profiles (see 2.4 below)
- estimates of angle of entry/exit to the seabed at points where riser becomes buried
- survey information for the location where the riser appears to cross itself at the location near the plume

1.3 Better estimates of flow rates emanating from the open riser end and open drill pipe end (or max / min estimates) - to support erosion calcs
1.4 Some ROV footage over a several minutes period at the location of the first joints (from BOP) entering the seabed - to confirm that the joints appear completely static and that no sign of dynamic motion (which could be transmitted back to the riser kink)

2. Data or Techniques which could provide further insight on status and integrity (L)
To help support or discount various theories (about restrictions, orfices etc.)

2.1 Multiple photos of the kink from different angles - to allow photogrammetry and 3D reconstruction from single stills
2.2 Stereo still images of the kink - mobilise Welaptega stereo camera - to allow 3D reconstruction
2.3 Acoustic survey over whole length of riser (to listen for restriction/high flow rate locations)

2.4 Side scan sonar or sub-bottom-profiling of the buried riser sections - to determine buried shape and depth
2.5 Subsea digital radiography of the accessible riser sections (to determine locations of any drill pipe within - if we think this is valuable?)
2.6 Direct stress measurement on the riser upstream/downstream of the kink (ACSM probe) to provide information on internal pressure.
2.7 Surface temperature measurement on the riser upstream/downstream of the kink - to provide supporting information on internal flowing conditions.
2.8 ADCP current profile data (for the water column from 1500ft to seabed) - using ADCP profiler from relief-well rig - to provide information to the global riser modelling.

regards
Howard

From: Owen, Les L
Sent: 25 April 2010 20:21
To: Austin, Julian; Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Cook, Howard H; Beynet, Pierre A; Pattillo, Phillip D; Neilson, Ian
Subject: RE: Saturday, April 24 telecon notes

I just had a similar discussion with the source control team from Wild Well Control and this is certainly a credible scenario.

Les Owen
Segment Engineering Technical Authority, Pipelines
bp Exploration & Production Technology
Houston
Office: 281-366-1886
Mobile: [redacted]
owenl@bp.com

From: Austin, Julian
Sent: Sunday, April 25, 2010 2:00 PM
To: Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Cook, Howard H; Beynet, Pierre A; Pattillo, Phillip D; Owen, Les L; Neilson, Ian
Subject: RE: Saturday, April 24 telecon notes

Gents,

It occurs to me that the riser and drill pipe are likely to have separated from the rig at different times. That suggests that the drill pipe which may have been severed by the bop closure could have been pulled some way out of the riser before the drill pipe itself became separated from the rig, which would explain both the naked length of drill pipe and the absence of a visible indication of entrained drill pipe within the kink. The fluid emanating from the drill pipe is then perhaps being pushed through there by a combination of gravity

(chimney effect) and flow resistance in the riser.

Kind regards,
Julian

From: Birrell, Gordon Y
Sent: 25 April 2010 18:19
To: Birrell, Gordon Y; Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Austin, Julian; Cook, Howard H; Beynet, Pierre A; Pattillo, Phillip D; Owen, Les L; Neilson, Ian
Subject: RE: Saturday, April 24 telecon notes
Further diagram.

GYB

From: Birrell, Gordon Y
Sent: Saturday, April 24, 2010 9:42 PM
To: Petruska, David J; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Austin, Julian; Cook, Howard H; Beynet, Pierre A; Pattillo, Phillip D; Owen, Les L; Neilson, Ian
Subject: RE: Saturday, April 24 telecon notes

Team,

Today the response was intensely focused on preparing to close the Variable Bore Rams on the BOP. We didn't get much else done.

We didn't actually close the VBRs for reasons that I will update you on when we talk Sunday.

Rgds

Gordon

From: Petruska, David J
Sent: Saturday, April 24, 2010 3:45 PM
To: Birrell, Gordon Y; Tognarelli, Michael A; Tooms, Paul J; Evans, Geoff; Nichols, Mark; Austin, Julian; Cook, Howard H; Beynet, Pierre A; Pattillo, Phillip D; Owen, Les L; Neilson, Ian
Subject: Saturday, April 24 telecon notes

All,
Notes and action items from meeting today:
Gordon provided a status update. The ROV followed the riser out and found it suspended to about 1500' above the seafloor and then came back down. It was then followed on the seafloor until they found the end which is lying in a crater and found flow. Also have flow from drill pipe but still not sure

on the connection of that back to the riser. The rig was also found not to far from the end of the riser. This team is to focus on 1) analyzing the riser at the bend and evaluating erosion at the bend and 2) what can be done to restrict/stop flow through the riser lying on the seafloor. Some other ideas where discussed although this team would not be the best to work them.

Concern around erosion of the drilling riser in particular around the bending crimp where the riser bent over just above the flexjoint to rest on the seafloor. It was agreed that we need to generate some erosion data and do some analysis. Julian Austin to be SPA but pull in John Martins as erosion expert. Pierre noted problem should be bound as some of the variable we will not be able to get good data on (flow rate, pressures, etc.). This way we can understand where we may have erosion problems and where we are ok looking at 3-6 month time frame.

Based on data Pierre obtained from the drillers, the sea floor shut in pressure of the well is 7800 psi with a crude gradient and 10346 psi with a gas gradient. The bubble point is 10,000 psi and the GOR at 14 psi is 3000. Hydrostatic head is about 2250 psi.

Crimping the pipe to reduce/stop flow - Julian to continue working with Frazer Nash on FEA modeling to look at burst pressure of pipe in the condition it is in. Gordon to get with Harold Reeves to get a copy of the ROV inspection that Phil developed so we get measurements around the main tube kink and send around.

In particular, Julian to see if he would need more data for his FEA work. David noted that per API RP 1111, X70 pipe with 21" OD and 7/8" wt has burst pressure of about 6000 psi so noted we need to understand the pipe burst capacity before we attempt crimping or other means to stop flow via the riser (note, someone stated the wt was 1" so expected burst pressure to 1111 would be 6950 psi). It was also discussed that we may want to do multiple bending kinks as a single kink is not expected to stop the flow.

Howard noted we should get the ROV to survey the riser and note location of joint numbers as found and compare with riser tally from when it was ran.

Need to get pipeline folks involved to look at plugging type solutions or options they may have in their tool kit. Mark Nichols to get with Les Owens who is returning to Houston on Sunday.

It was raised if the flexjoint or wellhead could be a weak link. Howard Cook noted that the flexjoint is bent over resting on the stops so should be ok and group agreed with that. Mike Tognerelli to get data on the H4 wellhead. (note, wellhead is not usually a weak link as you do not want that failing so you can not get back on the well).

If Gordon needs help, for example if the request for collecting data gets to be to much, he will get Houston based employees of the team to come in and help.

REDACTED

A shared site is being set up so everyone can work from the same known data (Gordon to provide details).

Next telecon Sunday, April 25 at 8:00 CST, 2:00 London time.