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ILN Conference Re-Cap: Deepwater Gulf Oil Spill - An Energy Update

On the first morning of our 2010 ILN Regional Meeting of the Americas in Houston, we had a fascinating presentation from Beirne Maynard & Parsons' Brit Brown and Ben Escobar on "Deepwater Gulf Oil Spill - An Energy Update."

A Little Oil History...

Brown started by saying that it used to be incredibly easy to find oil in Texas - it would just bubble up. The first oil well was actually the Drake Oil Well in Pennsylvania and it produced about 400 barrels a day. About the same time, they figured out how to distill oil into kerosene, and that became the cheap alternative to well oil.

The well oil industry started to boom, and the first gusher was Spindletop, which started on January 10, 1901. Brown said that it was a phenomenal gusher by any standards, taking nine days to control. It only went to 1,100 feet, which is a relatively shallow well by today's standards.

Spindletop was outside of Beaumont, Texas and produced, during the gushing stage, about 100,000 barrels of oil a day. To compare, Brown said that the government estimate for the Macondo well was a high of 63,000 barrels a day when it was gushing into the Gulf.

Brown said when that well came through, they started drilling "like it was going out of style," and within a year, they had about 300 producing wells. This started to go down after a time, but in 1927, it hit peak production. The field had a peak production of 21 million barrels a year, which was incredible for this period.

However, things have changed. Brown said that in Texas, the railroad commission used to be like OPEC. Even in the 50's and 60's, the railroad commission controlled all of the oil and gas production in the state of Texas. They acted like OPEC and could actually control price. They started to lose that edge going into the 1970's, when the US hit peak production. Ever since, production has been going down.

Where Are We Now?

Brown said that the greatest oil production (based on barrels of proven reserves) is in the Middle East, followed by South and Central America, Europe and Eurasia. The US proven reserves is right about 28 billion barrels, which is not a lot when you consider that the US consumes about seven billion barrels of oil each year and was once the largest producers of oil in the world.

Brown compared US consumption of oil (7 billion barrels a year) to production, which is about 2.6 billion. He said that oil provides about 90% of our motor fuel, and 40% for total power. He commented that the demand for oil has increased, resulting in the US having to import 75% of its oil and added that at the current rate of consumption, it would take the world 45.7 years, approximately, to exhaust the world's current proven reserves.

Brown said that whether we like it or not, fossil fuel is what fuels our economy. He showed a refinery utilization curve, saying that US refineries have gotten up to 92 or 93% utilization, which is the peak of the entire world. He said that we were importing not only crude, but also refined products, because we don't have any refineries and we can't build them.

He then showed a stat that's contested by a lot of people, saying that the advocates of drilling estimated that deepwater reserves account for:

- Gulf: 72 billion
- Atlantic: 4 billion
- Pacific: 13 billion
- Alaska: 27 billion

Brown said that the advocates are saying that if the US is going to have continued oil exploration and meet even a modest amount of its consumption, we'll have to go offshore. Brown said you could agree or disagree with this, but even if the statistics are inflated, the truth is that oil is offshore.

Brown showed the Louisiana and Mississippi border, pointing out where the Macondo well was. He said that the closest land mass to the well was Louisiana. He showed the platform and pipe systems, with the vast majority being offshore Louisiana, because the Mississippi River is depositing sediment that will eventually become oil.

Brown indicated that natural gas finds in the US have grown enormously, mostly through shale gas. He showed a statistic that looks at the adjusted price, which shows that gas has been undervalued for the last several decades because production, storage or transportation capacity has been limited.

The growth of natural gas has put the US in a competitive advantage for future gas, which will become important going forward. Brown mentioned one thing about shale formations, that their decline curve is different to that of a traditional gas' decline curve.

For a normal reservoir, when you drill a well, the gas comes out quickly and then declines over time because the ground can only migrate so much gas. However, shale formations have a very steep decline curve because more lateral/horizontal drilling is required to get to areas where the gas can come into the pipe. As a result, more wells have to be drilled.

Upstream, Downstream, Midstream

Brown also spent a few minutes discussing upstream, downstream and midstream, saying that some companies like EMP, refining and marketing groups don't always distinguish it in the same way. A lot of companies will incorporate midstream into upstream or downstream:

- Upstream: Exploration and extraction - go out and look for oil by seismic and other means. Dig for it, drill for it, and bring it out of the earth.
- Midstream: Pipelines, well truck and tanker transportation and storage.
- Downstream: Refineries, gas distribution, oil product wholesalers, service stations, and petrochemical companies.

Brown said that at Beirne Maynard & Parsons, their energy practice is separated into these three areas, and they have attorneys who are very knowledgeable in each of the three areas.

Alternative Energy

Brown then invited Ben Escobar to talk about alternative energies to supplement what Brown said about the oil and gas industry. He started by saying that the US will need 226,000 megawatts of new capacity by 2030, which would be the equivalent of 450 new power plants. To fill this void, there has been talk of nuclear power, wind power, and coal, but there are uncertainties surrounding greenhouse gases and how that will affect future growth.

Before the plant being constructed now, the last nuclear power plant was constructed in the 1970's. Nuclear power plants are old. Escobar asked whether nuclear power can even hold on to it's 20% share, because a lot of these plants are heading towards retirement. He quoted a few hurdles for nuclear power as an alternative source of energy, including cost (the capital cost is anywhere from two to three times the cost of alternatives), competing technologies & their effect on economics, and the cost imposed on emitting carbon.

Escobar commented that right now, nuclear power really isn't going anywhere, particularly with only one plant slated for development. He then moved on to talk about wind energy, which saw 39% growth in 2009, though it hasn't had a huge impact yet.

The challenges for wind energy include intermittent levels of energy-producing wind (which makes it tough to use on baseload capacity), the electrical grid, and local "NIMBY," (Not In My Back Yard) such as the Cape Wind Project. Escobar said that no one wants wind power in their backyard. As a final point, he said a lot of what is done in alternative energy will be influenced by government policy.

The Deepwater Horizon Spill

Escobar then turned the podium back over to Brown to talk about the Deepwater Horizon Oil Spill, who started with some basic issues before going into the national commission's report. There are several reports that have come out, including the BP report, which he feels does a fair job of being critical of themselves and being objective. There is also the Chevron report, which came out in October - they were doing an independent study of the cement used by Halliburton.

Brown showed a graphic about the BOP (Blowout Preventer). Every oil well that's under pressure will have one - the oil rigs and the offshore rigs. They have various components, such as different kinds of "rams" which close off the flow of oil. Once these are activated, they should close off the oil to topside. In the Deepwater Horizon spill, the idea was that once the rams were activated, they should have closed off the flow of oil, but the BOP failed, and there's all kinds of theories for why it didn't work.

Brown said that the commission report is silent on that because the BOP was lifted and they're going to do some studies on it and report on that at a later date. There's been speculation with various experts saying what they think happened, and Brown said a few things had to happen for that BOP to fail.

He showed a graphic of the BOP stack, saying that it's about 57 feet from the well head to where the risers are. Brown said there's a lot of talk about the "mud line," which was 5,000 feet down and is the bottom of the ocean. A deep well is about 18,500 feet to the bottom. The well was drilling into the reservoir which was estimated to be about 50 million barrels of oil.

From the mud line to the bottom is about 18,360 feet - it's a fairly deep well, though by no means a record. Brown pointed out that the yellow pipe from the mud line to the rig is called the "riser." The "riser" is the pipe with a thick diameter, which creates an artificial hole for the drills to work and fluids can travel up and down without getting into the ocean.

In the Deepwater Horizon spill, Brown said there were several theories right off the bat about what caused the spill. Although they were all speculation, he said that they all turned out to be relatively true.

Failure of Primary and Secondary Cement

One of the theories that was looked into early on was the failure of the primary and secondary cement. Brown showed some animation to help the audience understand this. He showed a drill pipe, and said that there isn't cement holding a drill pipe. But if you have a pipe, on both sides of the pipe, the space between the pipe and the earth is called the "annulus."

The annulus around the pipe is cemented in to protect the formation and the pipe. That's called the primary cement job, that which goes around the pipe between the pipe and the earth. The cement on the bottom of the well is called the secondary cement, kind of like a plug at the bottom. Brown said there are speculations that either the primary or secondary cement failed, but the commission report focuses on the primary cement, saying that that did fail.

Ram Failure

Brown's next slide showed a better idea of how the BOP operates - the BOP stack on top of the well head has different rams, such as the blind ram which chokes off space around the pipe. It also has a shear ram, which cuts the pipe. If that works properly, it cuts off all communication between the reservoir and topside. But on the Macondo well, this didn't work.

Brown said that various theories about this have been discussed with respect to rams and shears. One theory was that the shear ram that slices through this pipe, and is very powerful. If it's not powerful enough to go through a tool joint, which is where the pipes are connected, a thicker area where the threads are connected. If the thread happens to be at the same location as the shear, it might have prevented it from cutting.

The next slide showed an image of a riser joint, which are literally connected together from the vessel to the well head. Brown said that risers are a phenomenal piece of engineering, and have flotation devices that can affect the buoyancy of the riser string, so it's not one heavy piece of metal going from the ship to the well head. They can affect buoyancy and actually neutralize buoyancy.

He mentioned that he had a case where there was a lost string on a drill ship in 7,000 feet of water. They lost the BOP, lost risers, and after the incident, they had a lot of risers floating to the top or just below the surface of the ocean.

Brown used another slide to show how the BOP stack is connected to the top of the rig by the riser. He said that the riser only goes to the flex joints on the BOP - that's where the riser string stops, and the BOP starts. The well head is below that.

Brown showed animation on how to run a riser, and said that casing is run the same way. On the fifth and sixth generations of these vessels, it's all automated to lower the riser one joint at a time until it connects to the well head.

Casing Failure

Brown said that there had been speculation about casing failure as well, and showed a simple graphic to illustrate the idea of the casing - he likened it to a reverse telescope, saying that the deeper you go, the smaller the casing becomes.

Brown said that in addition to the cement between the pipe and the earth, there is cement between different layers of pipe. He added that certain areas won't have cement in order to save time and money. If you misjudge where the primary cement is located or the job isn't done well, that's when you can have gas leak out through the annulus - this is what they believe happened in the Deepwater Horizon spill.

He showed a diagram of the Macondo well, and said that it had a single string tapered pipe, which tapered from nine and seven eighths to a seven inch line. The alleged problem was that there was a single communication path up to the top, because there wasn't a series of packers isolating this zone.

So if the primary cement failed, and gas got into the annulus, or in this case, the space between the pipe and another pipe, it had a straight shot to topside. Brown showed some animation for the spudding and laying of conductor pipe, as well as how the cement is placed.

Brown said that for the Macondo well, several concerns have been raised, including how the casing was centered within the hole. He said that if it was leaning against one side of the well board, there wouldn't be an equal distribution of cement around the pipe. Another concern was the type of cement used - it was a nitrogen-laced cement, which was a lighter weight to protect the well board. There were some concerns that it wasn't stable, and so wouldn't have solidified around the well board.

Drilling Mud

Brown added that there has been some discussion about the drilling mud also, on how it was displaced. He said that they mix a thick milkshake of chemical mud (this goes back to early drilling days when they actually used mud). But this is a chemical compound, which makes it possible to adjust how heavy it is, by pounds per gallon, to counterbalance the underwater pressure.

The heavier the mud is, the more pressure you can keep down at the bottom of the well. Brown said that the mud pits mix the mud, then it goes through mud pumps, down the drill pipe and comes back up on the outside, equalizing the pressure of the down hold reservoir. It also brings up the cuttings and pulls up the drill bit.

Mud weights can vary, and Brown said that the mud that was used at the time of the incident was 14.5 pounds per gallon. You may have heard it come up in the report that they were displacing drilling mud with seawater, which is 7.5 or 8.5 pounds per gallon. It's much lighter than drilling mud. When they replaced the mud with seawater, they decreased the amount of weight and pressure that was being pushed down against the formation, and that was one of the reasons that they eventually had a blowout.

Brown said there are things called "kicks" and "blowouts" - he said generally you have mud coming down the inside of the drill pipe, when you're in drilling mode. It comes back up the outside and with it comes all the cuttings. Additionally, it cools the bits and maintains the pressure.

However, when you drill into a gas pocket, or you drill into a zone with vary pressures, if the mud weights are not correctly calculated, you can have the pressure "kick" up the well board. If you don't control it before it gets out the BOP, it's called a blowout.

Brown showed a video of people running around and drilling mud coming out topside, which he said in west Texas is called an "Oh sh*t moment." He said first you see drilling mud, then oil and the associated gas. Brown said all you need is an ignition point, and it's a place to have a bonfire. It didn't take long for that to happen.

Commission Report

He went on to talk about the recently issued commission report, which studies several things about the plan, including the use of the single string with the communication path that goes all the way to to the top, the cement plan, and how the casing was set.

Brown said that there are things called "hangers," which literally support the weight of the down hold assembly by hanging on to the prior string. If the hangers aren't properly aligned, there can be a bending effect on the casing or even cause them to tear or break.

The report targeted a number of companies that had been involved in the Macondo well, including BP, Transocean, Halliburton, MI Swaco, Schlumberger, Dril-Quip, Cameron, Oceaneering, and Weatherford.

Brown said that BP was the EMP company controlling the well. Transocean had the rig and the crew, and Halliburton did the cementing and some of the "logging" or testing on the well. Cameron had the BOP and MI Swaco was in charge of the drilling mud. Schlumberger had various things out there, but they also had a crew out to do a cement bond log to test the cement to see if it was bonding to the pipe. Brown said they were sent back on shore about seven hours before the explosion and hadn't done the test, because they were asked not to.

Brown showed a slide of the Deepwater Horizon vessel, which was self-positioning and a very sophisticated piece of equipment, going for about $500,000 per day. Peter Altieri asked about the size of the drilling platform, and Brown answered that it was 267 by 200 feet and the derrick height was 395 feet. It generally can drill in about 10,000 feet of water, and it can go 30,000 feet below that.

Brown said that one of the issues you'll see is how deep you can be during drilling mode. One of the things they're looking at now is whether it was properly ballasted and supported. The deeper it sits, the more stable it is. A lot of these rigs are tethered and have cables that go to the bottom of the ocean, but this one didn't. Instead, it has a sophisticated dynamic positioning system.

Thrusters keep the rig in place, and they have a circle of operation where they have to keep the rig. They can only deviate from that circle so much before they have to pick up and detach from the sea bed. So not only does the equipment have to be very good, but the operators have to be very proficient as well.

Brown showed a graphic from the commission's report of how the primary and secondary cement should look, and said that the report is focusing on the failure of the primary cement. Another graphic illustrated that as you go deeper, the pressure increases, so it's necessary to increase the weight of the mud to avoid a blowout and keep it in the earth.

Brown said that the fractured gradient is something that they're always looking at because that's the amount of pressure that it takes to fracture and break open the rock. Brown said you want to look at all three things, because if the weight of the mud is too much, it's going to keep the gases down, but it also can fracture the rock and push the mud into the reservoir. This injures the ability to produce the well later on and can damage the well.

The Macondo well had all kinds of problems from the start. Deepwater Horizon had replaced the Marianas rig, which was damaged in Hurricane Ida in November of 2009. The rig had various problems, including a kick through the pressure that meant the crew had to "sidetrack," or pull up and start drilling another hole through the well board to get around the problem.

The well was "snake bit" the entire time, according to Brown, who said that there were documents showing that BP and Transocean considered it to be a problem well. He said that crew members were glad to go home and get off the rig.

He showed another graphic that illustrated the liner versus the long string - with the long string, there is a straight communication path to the top, while with the liner, there could be packers and other safety barriers to prevent the gas from getting to the top.

Another problem that they had on the Macondo well, which was documented, was that the mud was too heavy. It was 14.5 towards the bottom of the well, which they need to have mud at that weight because part of the reservoir was sufficiently strong enough to push in if the mud was not that strong. But the producing sands, where the oil was going to be coming from, was at 12.6pounds per gallon. So the mud was pushing out into the formation.

This caused "lost returns" or "lost circulation." "Lost returns" means that the mud is going into formation, damaging the ability to produce this well.

There was a lot of testimony in a case outside of the discovery of the courts in the Coast Guard hearings, where they realized that they had a safety problem. They had a sand that was taking 12.6 pounds per gallon and mud at 14.15 pounds per gallon. So the mud is heavier than the formation can withstand and it was damages - they had to make some decisions because of that.

Brown said that there was also an alleged problem with the "centralizers" - centralizers are a device that you put around the casing as you put the casing into the well board to keep the pipe dead center, and allow the cement to be equally distributed.

Some thought that this was a red herring, but the commission report talks about it. When the cement gets pumped down on both sides of the pipe, they can have a feature called channeling. Channeling allows it to push up against the pipe on one side, but not necessarily on the other side, or not equally distributing it. That's a bad cement job. With a bad cement job, there's communication where gas can go up one side and up to topside. It's something the commission report does examine.

They knew there was a potential problem with the cement, but decided that it wasn't sufficient to keep from proceeding - Brown showed copies of a few emails that were used as evidence.

The results of the Chevron report, which came out in October, focuses on the cement that's used on the rig. The base cement was 16.7 pounds, which is very heavy and can push into the formation. So they have nitrogen-laced cement, which lightens the cement, to allow it to move at a better pace and prevent it from hurting the formation.

The problem with it was that when Chevron did it's test, it was unstable on every test. Meaning that the cement could not uniformly solidify under the right pressure and the right time. Halliburton did some tests as well and when you look at their tests, only one of their results of instability was given to BP. There was only one result that was stable, but the commission does not believe that they had the results of that test before they decided to pump the cement. The way the test results were done weren't compatible with how Chevron did the tests, and their tests were run at the request of the commission.

Brown showed a piece of the commission report, which said that they "strongly suggest that foam cement used at Macondo was unstable and this may have contributed to the blowout."

On the day of the spill, at 9:08, there was a pressure anomaly that should have showed the people in the rig that there was pressure pushing up. BP now agrees that this reading, if it had been accurately interpreted, would have told the people in the rig that they had pressure on the bottom of the well that was pushing up, that the prior tests that were done on the cement had been read inaccurately.

There were three tests done on the well - a seal assembly, positive pressure test and a negative pressure test. The one that's focused on the most in the report is the negative pressure test. Brown said there are two tests, one of which clearly failed, and a second which the experts looking at the documentation now say failed. But BP and Transocean believe that it succeeded at the time.

Brown said that the idea of the negative pressure test was to close the valves and see if any pressure builds from the underground reservoir. It needs to hold for a certain period of time with no increase in pressure. In this case, the pressure did increase, which should have given some indication that they had a problem with the mechanics down below.

Brown showed a timeline of that last two hours before the blowout. There was a negative pressure test that failed, which was recorded to have succeeded at 8:00. The well was under-balanced at roughtly 9:00, which means there was more pressure on the bottom than was holding it on the bottom, so it could produce a kick.

There was anomalies drill pipe pressure, a subtle increase, and then an increase while the pumps were off. BP calculated hydrocarbons in the risers at 9:38 and at 9:40, drilling mud began to overflow on the rig floor.

Brown said what was really ironic was at this time, BP and Transocean both had some dignitaries on the rig celebrating its safety record. They had been secreted to the control rooms beyond the rig floor because they knew they had a problem.

At 9:41, the annular preventer was activated.

At 9:42, a nearby ship was told to move. They knew they had a problem and they were panicking. Brown said that the men you never hear about on CNN, the nine Transocean men and two MI Swaco guys on the rig that were trying to do something about the problems, were all killed.

At 9:46, gas emerges onto the drill floor, and at 9:49, the first explosion happens. Brown said that the rest is on videotape.

Conclusions

Brown said that there were several conclusions the report reached.

- Flow path was through the casing.
- The cement was contaminated and maybe displaced; didn't have equal distribution.
- Pre-job laboratory data on the foam cement should have given the recommendation to re-design the cement.
- Negative pressure test: Commissioners noted that a drilling crew would not ordinarily do tests like a cement bond log at that time; they would rely on the negative pressure test. If they thought this was good and solid, they might go without the bond log, which Schlumberger was out there to do. But in reality the negative pressure test was bad and it should have required additional diagnostic testing at that point.
- The last point was critically important to BP - they said there was no evidence at this time to suggest that there was a conscious decision to sacrifice safety to save money. Brown said this isn't the definition of gross negligence, but it certainly goes in that direction.

This is an important distinction, because if there is no gross negligence, all the partners share in the liability based on their percentage interest. One of the partners involved is currently in arbitration with BP to avoid this because for them, it's a company maker or breaker, saying that BP was grossly negligent. If they're grossly negligent, under the joint operating agreement they have with BP, they get to escape and avoid liability.

Brown spent a couple of minutes on how the legal community is reacting to the Deepwater Horizon spill. There's a lot of litigation that's now centered in Louisiana, even though BP wanted it in Houston. There are hundreds of lawsuits, including survivors of the victims, companies, restaurant owners, and those affected. Additionally, there are a lot of legislative discussions going on.

The moratorium, which was an NTL, or Notice to lessees, was supposed to only affect the floating types of vessels out in deep water. But in reality, it has affected all drilling activity in the Gulf. Brown said that the permits that used to be issued on a fairly regular basis with limited red tape have just stopped.

It's affecting companies who have hired these rigs, sometimes for many years, such as Shell, who's had rigs with Mobil for 40 years. It's affecting helicopter services, support vessels and many more. Brown said they're working with a case right now where it's costing $1.8 million a day just to hold the services. They're seeing either claims of maritime frustration of purpose or force majeure claims.

Brown said it's a very sad situation, with a lot of companies, investors and workers suffering tremendously, and there's no bad guy. He said that no matter what happens, someone will get hurt - these companies have expensive rigs sitting idle. Workers can't go out, and companies are relocating their talent to other places. Drilling companies have leases on various prospects offshore that they may not be able to hold on to. He finished by saying that it's an unfortunate situation for all involved, particularly for the families of the men killed in the explosion.

Brown then turned the floor back over to Escobar, who talked about litigation in the legal industry. He said he had mentioned shale earlier, which could lead to some litigation in the future. When they develop the shale, it's not just a vertical well; they have to go horizontally. Once they get past the water table, they curve and go horizontal. What they next do is perforate the casing to reach the formation.

When they perforate the casing, they're doing it all across that horizontal leg. Then they "frac" the formation - they're trying to fracture the formation using high pressure fluids that contact water, for the most part, and a variety of chemicals (I happened to know exactly what this meant thanks to watching CSI the week before - the episode will only be available for a short while, but I highly recommend watching it if you'd like to know more - it should be available On Demand).. They try to project those fluids as much as 1,000-2,000 feet beyond the casing or well board. Escobar said that the problem that can happen in this process is that they might hit ground water or move into other people's properties.

He mentioned a frac-ing case in Pennsylvania that has just been removed to federal court, where the allegation is that when the well was frac-ed, it moved into the water table and contaminated it. The homeowners are saying they've lost property value and there will be issues as to whether they can even use their groundwater anymore.

Escobar said that Texas recently addressed a frac-ing case, but it wasn't about the horizontal frac-ing. When the formation was fractured, it extended beyond the leasehold properties and into adjacent properties, and it did drain reservoirs. The claim was that there was economic damage because one of the landowners lost his minerals.

However, in Texas, they have the rule of capture, so there was no liability. It's a very narrow holding in this type of case and basically, it says if the only damage you're claiming as a result of the frac-ing operation is that you've lost your minerals, that's not going to be recognized in Texas. They haven't had a case yet about what happens if they hit the groundwater and start contaminating it.

Escobar said that there are also all kind of royalty disputes, citing the recent Shell Oil Co. v. Ross, 2010 case. This is a suit the royalty owner has against Shell for underpayment. The issue was the calculation of royalty on "weighted average price" versus actual price, meaning one of the lessees was getting a slightly lower price than Shell, and Shell used that to push down their price.

Another example of a royalty dispute would be the matter of Moose Oil, where the question was can a lessor recover royalties by claiming 3rd party beneficiary status.

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