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Oil Pressure Stopping Short of Target … Does that Mean the Well Integrity Test Is Failing?

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Theme: Environment
In-depth Report: THE BP OIL SLICK

The well integrity test is arguably failing, as the pressures are not reaching the 8,000 psi minimum target.

CBS News notes:

> The federal pointman for the BP oil spill says results are short of ideal in the new cap but the oil will stay shut in for another 6 hours at least.
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> Retired Coast Guard Adm. Thad Allen said on a Friday afternoon conference that pressure readings from the cap have not reached the level that would show there are no other leaks in the well.
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> He said the test will go ahead for another 6-hour period before being reassessed to see if BP needs to reopen the cap and let oil spill out again.

MSNBC writes:

> Allen said two possible reasons were being debated by scientists: The reservoir that is the source of the oil could be running lower than expected three months into the spill. Or there could be an undiscovered leak somewhere down in the well.

The New York Times reports:

> Thad W. Allen, the retired Coast Guard admiral who is overseeing the response to the gulf oil spill, said that while there were indications from the test that the well was in good shape, it was not yet possible to rule out damage that could complicate efforts to halt the leak permanently.
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> “We want to be careful not to do any harm or create a situation that could not be reversed,” he said in a conference call with reporters Friday afternoon.
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> Admiral Allen said the test would continue in six-hour increments and that any new data would be reviewed by scientists and engineers from the government, BP and other companies. He said there would be “enhanced monitoring” of the seabed, including acoustic tests that could detect tiny bubbles of methane gas coming from the bed, which would be evidence of damage to the well.

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> Admiral Allen said that such a pressure buildup suggested that the well was not damaged. But he said that the pressure level reached — about 6,700 pounds per square inch, or more than 450 times atmospheric pressure — was below that expected for an intact well.
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> One explanation for the ambiguity, he said, is that the reservoir of oil 13,000 feet below the seabed could have been depleted by the well as it galloped out of control for nearly three months. But another possibility is that the well is breached, with oil and gas escaping into the rock or, worse, into the gulf through the sea floor.

BP states that the pressure in the well is only rising 2 pounds per square inch each hour.

I will post a transcript of Allen's report when it becomes available (here is an unofficial, rough transcript). In the meantime, blogger Wang – who attended the press conference by telephone – added details from Allen's press conference (I simply edited for clarity of reading; I will update with corrected and expanded transcript as I receive it):

> Uncertainty about the meaning of the pressure. Could be lower because of well integrity, or the reservoir has become somewhat depleted and so is lower in pressure than expected.
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> The initial curve of pressure build up was normal but stopped short of our target which is the concern.
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> Don't want to create harm or an irreversible situation.
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> Was the reservoir depleted or is there an ongoing way for the oil to leave the well bore? We do not know the condition of the well bore. There's a good chance it could be depletion. Checking out the well bore. Checking for leaks. We have no indication of a seafloor breach so it could be reservoir depletion.
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> Additional seismic surveys are required.
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> This kind of formation can maybe heal itself if we do damage it, the quickest way to reduce pressure is opening the kill and choke line.If there is a problem we will vent the oil.
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> Reservoir depletion can be measured by determining if there was an aquifer beneath the reservoir but there is not one. If the seismic and acoustic show no sign of leakage we will continue with the testing.
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> NOAA boat looking for methane from the sea floor with acoustic device. There is some concern about methane. We want to make sure there is no methane. If we were to detect methane we would lower the pressure by venting or ramp up Helix Producer.
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> We will reevaluate in 6 hours and have a series of meetings (with the committee) everything moving forward is condition based. We should have results in the next 6 hours. The 6 hour period starts now.

(BP's Kent Wells gave a similar, follow-up briefing.)

There are actually at least four potential explanations for the low pressure readings:

(1) There are substantial leaks in the well;

(2) There is leakage in the sands deep under the seafloor. Oil industry professionals posting at the Oil Drum hypothesize:

> What this could indicate is that there is a possibility of crossflow at the bottom of the well. What this means that the oil and gas that are flowing out of the reservoir into the bottom of the well, are, under the pressure in the well, now flowing into a higher reservoir of rock, now that they can't get out of the well. Depending on where that re-injection flow is, this may, or may not, suggest that the casing has lost integrity. This is a topic that has been covered in the comments at The Oil Drum, where fdoleza – "a petroleum engineering consultant retired from a major multi-national oil company" – has noted:
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> > … I believe the flow will be coming out of the bottom sand and going into the upper sand. It would not be a leak, but it would tell them why their pressure data ain't a classical surface buildup. And I sure hope they're modeling temperatures and so on, because this is a very interesting case. They don't have downhole gauges, so they'll have to take the way the oil cools down as it sits to get a better idea of the way things are moving down below.
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> If there are questions whether there is still flow in the formation or from the original formation into surrounding rock, then it is possible that the relief well (RW) is close enough to the original well (WW) that putting a set of very sensitive microphones down the RW might allow some triangulation to estimate where such a flow might be occurring. It might make it easier that the well hasn't been finally cased yet. But the test has 2 days to run, and will be evaluated every 6 hours. With time some of these questions may be answered as the test continues. (If there is no flow anywhere, after a while all the readings should become quite stable).

(3) A hypothesis proposed by Roger N. Anderson – professor of marine geology and geophysics at Columbia University – that the pressure could be rising slowly not because of a leak, but because of some kind of blockage in the well: "If it's rising slowly, that means the pipe's integrity's still there. It's just getting around obstacles"

or

(4) The reservoir has been depleted more than engineers anticipated (although many experts have said that the reservoir is much bigger than BP has forecast; in any event, there are factors other than size which determine pressure. For example, blowouts can reduce pressure pretty quickly in some reservoirs)

While many oil industry experts are betting on damage to the well bore or communication between layers of sand, Don Van Nieuwenhuise – Director of the Professional Geoscience Programs at the University of Houston – thinks reservoir pressure has simply "deflated", and that 6,700 psi isn't unexpected:

> The 6,700 pound- per-square inch pressure reading logged inside the blown-out Macondo well this morning may suggest that the well has lost power over the almost three-month-long period it has flowed into the Gulf of Mexico and not that the well is leaking somewhere beneath the sea floor, a geologist who has been following the gusher said.
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> The reservoir could have "deflated" since it began leaking April 20, reducing the amount of pressure it is capable of producing, said [Van Nieuwenhuise].
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> But Van Nieuwenhuise said this morning's 6,700 pounds per square inch reading should not cause worry.
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> "I don't think it's a cause for immediate concern, because it could reflect a natural loss of oil in the reservoir," Van Nieuwenhuise said. "It's amazing that it has held its strength for as long as it has."
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> When they first said this, I said if they can get to 7,000 (pounds per square inch) that would be good," Van Nieuwenhuise said. "The 8,000 to 9,000 estimate reflects its initial pressure, but since it's been bleeding so much, I'm not surprised it's at 7,000."

Note 1: Because pressures are still rising (if only 2 lbs per hour), it probably means that the well integrity test hasn't caused any new leaks so far.

Note 2: Oil industry expert Robert Cavner notes that seismic testing isn't as straightforward as it sounds:

> Seismic puts sound into the sea floor, and measures the time it takes for those sound waves to return. Different kinds of rocks reflect sound waves at certain velocities, or speeds. By measuring the time it takes for the sound to return from a certain depth of rock, geo-scientists can draw maps of the subsurface. Often you can get an idea of the fluid within the pore space of rocks by the way it returns sound waves. They ran a baseline survey a couple of days ago, and will compare that data to the data that they'll get today to see if anything has changed around the well to indicate fluid movement. But, as one of my geologist friends of mine likes to say, reading seismic for precise conclusions is often like trying to observe airplanes flying overhead while lying on the bottom of a swimming pool. It's difficult to draw definite conclusions, even using high frequency seismic, but it will be another data point.
